AMERICAN LUNG ASSOCIATION®

State of the Air: 2008

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The State of the Air in

Kentucky

Acknowledgments

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The American Lung Association assumes sole responsibility for the content of the *American Lung Association State of the Air 2008*.

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Executive Summary

Air pollution continued to challenge the nation in 2004, 2005, and 2006. Some cities—notably Los Angeles and Houston—managed to steadily cut ozone and particle pollution. Progress stalled in many other cities, slowing or eroding gains recorded earlier in the decade. For the first time, a city outside of California—Pittsburgh—topped one of the lists of the most polluted city—and stands on the verge of topping a second.

The adoption of a new ozone standard on March 12th will require redoubled efforts to reduce the nation's most common air pollutant. The history of battling ozone shows that aggressive measures can cut emissions, leading to much cleaner air. However, the trends shown in this report warn that progress can stall without putting more measures in place to reduce ozone. Unfortunately, some have proposed changes that would weaken the Clean Air Act and set back the progress toward healthier air.

Looking at the nation as a whole, the ***American Lung Association State of the Air 2008*** finds:

- **Two of every five people—42 percent—in the U.S. live in counties that have unhealthful levels of either ozone or particle pollution.**
  Almost 125 million Americans live in 216 counties where they are exposed to unhealthful levels of air pollution in the form of either ozone or short-term or year-round levels of particles.

- **Nearly one-third of the U.S. population—31 percent—live in areas with unhealthful levels of ozone.**
  Counties that were graded F for ozone levels have a combined population of over 92.5 million. One in three Americans live in counties where the monitored air quality places them at risk for decreased lung function, respiratory infection, lung inflammation and aggravation of respiratory illness.

- **Over one quarter of the people in the United States live in an area with unhealthful short-term levels of particle pollution.**
  Over 81.4 million Americans live in areas where there are too many days of unhealthy spikes in particle pollution. Short-term spikes in particle pollution can last from hours to several days and can increase the risk of heart attacks, strokes and emergency-room visits for asthma and cardiovascular disease, and most importantly, can increase the risk of early death.

- **One in six people in the United States lives in an area with unhealthful year-round levels of particle pollution.**
  Nearly 50 million Americans suffer from chronic exposure to particle pollution. Even when levels are fairly low, exposure to particles over time can increase risk of hospitalization for asthma, damage to the lungs and, significantly, increase the risk of premature death.

- **About 30.4 million Americans—roughly one in 10 people—live in 18 counties with unhealthful levels of all three: ozone and short-term and year-round particle pollution.**

With the risks from airborne pollution so great, the American Lung Association seeks to inform people who may be in danger. Many people are at greater risk because of their age or because they have asthma or other chronic lung or cardiovascular diseases or diabetes. Here are the numbers of people in each at-risk group.

- **People with Asthma—**Approximately 2.2 million children and over 5.5 million adults with asthma live in parts of the United States with very high levels of ozone. Nearly 5 million adults and over 1.9 million children with asthma live in areas with high levels of short-term particle pollution. Nearly 3 million adults and over 1.2 million children with asthma live in counties with unhealthful levels of year-round particle pollution.

- **Older and Younger—**Over 10.2 million adults age 65 and over and nearly 24 million children age 18 and under live in counties with unhealthful ozone levels. Over 9.4 million seniors and 20.6 million children live in counties with unhealthful short-term levels of particle pollution. Over 5.5 million seniors and 13 million children live in counties with unhealthful levels of year-round particle pollution.

- **Chronic Bronchitis and Emphysema—**Nearly 2.9 million people with chronic bronchitis and over 1.2 million with emphysema live in counties with unhealthful ozone levels. Nearly 2.6 million people with chronic bronchitis and 1.1 million with emphysema live in counties with unhealthful levels of short-term particle pollution. Over 1.5 million people with chronic bronchitis and over 644,000 people with emphysema live in counties with unhealthful year-round levels of particle pollution.

- **Cardiovascular Diseases—**Nearly 20.1 million people with cardiovascular diseases live in areas with unhealthful levels of short-term particle pollution; nearly 12 million people live in counties with unhealthful levels of year-round particle pollution. Cardiovascular disease includes coronary heart disease, heart attacks, strokes, hypertension and angina pectoris.

- **Diabetes**—Over 4.6 million people with diabetes live in areas with unhealthful levels of short-term particle pollution; over 2.7 million people live in counties with unhealthful levels of year-round particle pollution.

Research indicates that diabetics face increased risk due to the damage particle pollution can cause to their cardiovascular systems.

The American Lung Association also calls for these key steps needed to improve the air we all breathe.

- **Ensure every county is protected from ozone.** The U.S. Environmental Protection Agency (EPA) has just adopted a new, tighter national standard for ozone, an important step that drives the measures to clean up the sources of ozone pollution all across the nation. Now the EPA must determine which counties to protect and which counties to leave out of the clean up requirements. The American Lung Association urges the EPA to include every county in planning and protection in every metropolitan area that has monitored unhealthy levels of ozone. The Lung Association opposes leaving counties left out of the planning for protection from this dangerous pollutant.

- **Protect the Clean Air Act.** Since 1970, the Clean Air Act has proven to be one of the nation's leading public health laws. Thanks to clean-up measures put in place under the Act, emissions from all pollutants have dropped in half since 1980. However, in March the EPA proposed substantial changes to the Act, changes that would weaken decades-old protections to the public. The American Lung Association will oppose any changes that weaken the Clean Air Act.

- **Clean up dirty power plants.** Old, coal-fired power plants are among the biggest industrial contributors to unhealthful air, especially particle pollution in the eastern United States. The toll of death, disease and environmental destruction caused by coal-fired power plant pollution continues to mount. The EPA issued rules in 2005 that give states the tools to clean up these plants. However, the EPA has issued other rules that give the electric power plants huge loopholes in complying with the Clean Air Act. The American Lung Association and our partners will continue to take steps to ensure that loopholes are removed.

  Several Northeastern states are considering adopting even more stringent requirements for their power plants. The American Lung Association repeatedly urged the EPA to use this opportunity to clean up even more pollution, faster. The American Lung Association supports efforts in Congress to strengthen the Clean Air Act to further clean up these heavy polluters.

- **Clean up existing diesel equipment.** New diesel buses, trucks, and heavy equipment are cleaner than ever, thanks to clean up requirements EPA has put in place in the last decade. Diesel fuels are also much cleaner. However, old diesel engines last a long time. Diesel engines in school buses, highway trucks, and other equipment continue to operate for hundreds of thousands of miles, threatening the health of millions—especially those on or near highways—with dangerous exposure to diesel exhaust. Each community should move rapidly to retrofit and replace old diesel school buses and other equipment in the public diesel fleet. Communities should require contractors to clean up trucks and construction equipment. These and other steps can reduce the burden of pollution from old, dirty, diesel equipment and vehicles.

- **Require all ships calling on U.S. ports to use cleaner marine fuels and engines.** Although international shipping is essential to the global economy, it also produces large amounts of air pollution. Emissions from these engines seriously worsen national ozone, carbon monoxide, sulfur oxide, and particle pollution levels, especially in communities near commercial ports such as Seattle, Oakland, Chicago, Los Angeles, New Orleans, and New York. Both foreign-flagged as well as U S ships must be required to use much cleaner fuels and engines.

Individual citizens can do a great deal to help reduce air pollution outdoors as well. Simple, but effective ways include:

- **Drive less.** Combine trips, walk, bike, carpool or vanpool, and use buses, subways or other alternatives to driving. Vehicle emissions are a major source of air pollution. Support community plans that provide ways to get around that don't require a car, such as more sidewalks, bike trails and transit systems.

- **Don't burn wood or trash**. Burning firewood and trash are among the largest sources of particles in many parts of the country. If you must use a fireplace or stove for heat, convert your woodstoves to natural gas, which has far fewer polluting emissions. Compost and recycle as much as possible and dispose of other waste properly; don't burn it. Support efforts in your community to ban outdoor burning of construction and yard wastes. Avoid the use of outdoor hydronic heaters, also called outdoor wood boilers, which are often much more polluting than woodstoves.

- **Get involved.** Participate in your community's review of its air pollution plans and support state and local efforts to clean up air pollution.

- **Use less electricity.** Turn out the lights and use energy-efficient appliances. Generating electricity is one of the biggest sources of pollution, particularly in the eastern United States.

- **Send a message to decision makers.** Send an email or fax to urge Congress to oppose measures that weaken the Clean Air Act. Log on at www.lungusa.org to see how easy that can be.

The State of the Air in 2004–2006

Air pollution continued to challenge the nation in 2004, 2005, and 2006. Some cities—notably Los Angeles and Houston—managed to steadily cut ozone and particle pollution. Progress stalled in many other cities, however, slowing or eroding gains recorded earlier in the decade. For the first time, a city outside of California—Pittsburgh—topped one of the lists of the most polluted cities—and stands on the verge of topping a second. Over 124.7 million people live in places where air pollution levels for ozone or fine particle pollution place human health at risk.

Many cities have multiple problems. Eight metropolitan areas ranked as the nation's most polluted cities by every measure. Five of the eight are from California—Los Angeles, Bakersfield, Fresno, Visalia-Porterfield, and Hanford-Corcoran—with Washington, DC-Baltimore, St. Louis, and Birmingham rounding out the list. Seven metropolitan areas landed on two of the three lists, including Pittsburgh, Atlanta, New York City, Detroit, Chicago, Louisville, and Merced, California.

Two cities ranked at the top of the cleanest cities in the United States: Fargo, North Dakota, and Salinas, California. These metropolitan areas recorded no unhealthy ozone or particle pollution days and ranked as having some of the lowest annual levels of particle pollution. Three cities scored the best for ozone and annual levels of particle pollution: Albuquerque, New Mexico; Duluth, Minnesota; and Honolulu, Hawaii.

Policy changes

On March 12, the U.S. Environmental Protection Agency (EPA) adopted a tighter national air quality standard for ozone based on the new research that shows serious harm at much lower levels of exposure. Meeting that standard will require redoubled efforts to reduce the nation's most common air pollutant. The history of battling ozone shows that aggressive measures can cut emissions, leading to much cleaner air. However, the trends shown in this report warn that progress can stall without putting more measures in place to reduce ozone.

Unfortunately, that same day, the EPA announced recommendations for changes that would dismantle the core principles that are embodied in the Clean Air Act. The EPA Administrator offered to allow the state and local governments to determine which pollutants to ignore and which to clean up. The Clean Air Act recognized these pollutants as the national priority because they were the most widespread and dangerous. The EPA has the responsibility to protect the health of all of the public from these pollutants, not just some, and required the states and local governments to reduce the burden of all these pollutants, not just some.

On March 14, the EPA announced the long-awaited requirements for much cleaner diesel locomotive and marine equipment. Trains and ships contribute tons of diesel particle pollution and tons of nitrogen oxides that lead to ozone problems. This step will help reduce pollution from ports, rivers and industrial areas across the nation. This action will require the clean-up of diesel locomotives, barges, tugs, and boats beginning in 2008.

Particle pollution

For the first time, a city not in California—Pittsburgh—moved to the top of a most polluted list. Pittsburgh edged out Los Angeles, despite having slightly fewer days in this report than last year. In addition, Pittsburgh's annual level of particle pollution just missed tying Los Angeles in this year's report, and may overtake it next year. Aggressive emissions controls in the Los Angeles basin dropped the year-round particle levels by just under one-third during this decade. By contrast, the ranking for Pittsburgh remains only marginally better than in the 2007 report and tied with its level in the 2006 report. Los Angeles remains at the top of the list of cities most polluted year-round by particle pollution.

Several cities that also reduced year-round particle pollution dropped off the "25 most polluted" list this year, including New York City, Chicago, Philadelphia and Indianapolis. Several cities saw increased particle pollution, including Atlanta, Birmingham, Hanford-Corcoran (California), and Macon (Georgia).

By contrast, most cities curtailed the number of days with dangerous levels of short-term particle pollution. On the list of the cities most polluted by these spikes in particles, cities shifted rankings based more on how they compared with other cities than on their own improvements. Several metro areas had markedly fewer days of high particle pollution, including Washington, DC-Baltimore-Northern Virginia, Eugene (OR), Harrisburg (PA), San Diego and Weirton-Steubenville (WV-OH). Sacramento and Modesto, California reported more days with high particle pollution spikes.

In a report published in January, 2008, the EPA analyzed trends in particle pollution, along with ozone and four other pollutants. The analysis of particle pollution shows a clear drop from 2000 to 2006, but most of that drop occurred between 2000 and 2002. Adjusted for weather, the three-year average particle pollution levels declined during 2004-2006 compared to 2003-2005. However, the adjustment shows a general stalling in particle levels between 2002 and 2006.

Nationwide particle pollution trends, 2000-2006

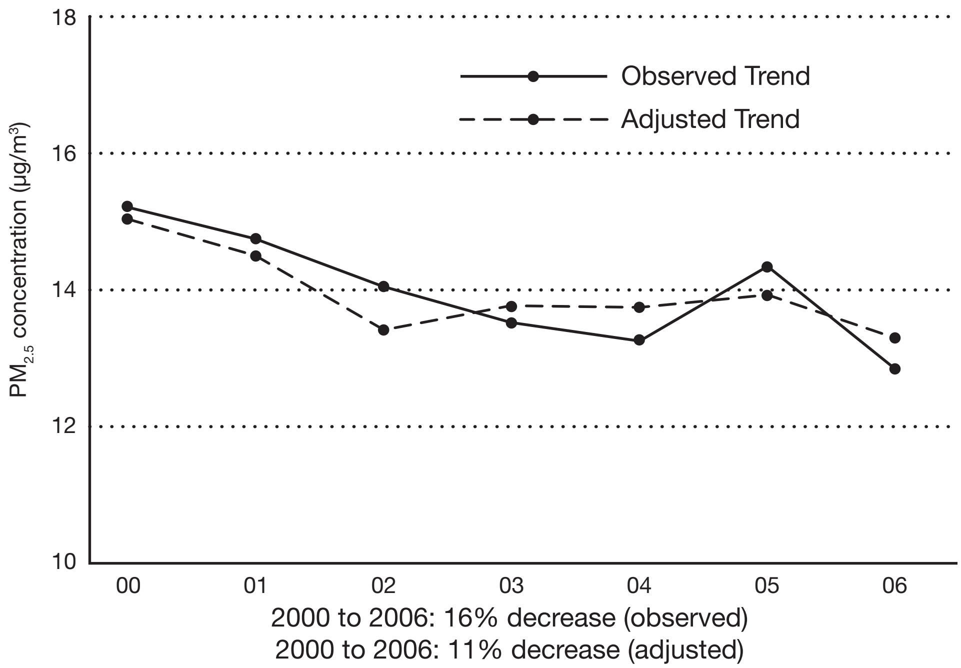

Fig. 1. Chart showing changes in particle pollution concentrations nationwide in monitored data (observed trend) and in particle pollution concentrations adjusted for meteorology (adjusted trend). From U.S. Environmental Protection Agency, *Latest Findings on National Air Quality: Status and Trends through 2006.* January 2008.

Rankings for the year-round particle pollution list also changed despite improved levels in some cities because other cities made even greater improvements. For example, Louisville saw its rankings worsen, moving to 18th most polluted from 22nd, despite a slight improvement in year-round levels because other cities made much greater progress.

A few other cities also improved their air quality, despite continuing to rank in the list of cities most polluted by year-round levels of particle pollution. Detroit and Cleveland both dropped their annual levels. Improvements tapered off in other cities.

Ozone

The five worst cities for ozone all saw good improvement in their ozone levels during 2004-2006, including Los Angeles and Houston—two cities with most infamous smog problems. In particular, Fresno (CA) marked a remarkable decline in high ozone days since a peak in 2001-2003, showing a drop of two-thirds in that metro area's weighted average. Most cities on the list of the most polluted had fewer high ozone days in the 2004–2006 period, compared to last year's report, including Dallas, New York City, and Philadelphia. Several cities on the most ozone-polluted list fared worse in 2004–2006 over the previous report—Sacramento, San Diego, Washington, DC-Baltimore, Atlanta and Charlotte. New to the list of most polluted cities for ozone is Birmingham.

Table 4: **(continued)** *Counties with the Worst Particle Pollution ($PM_{2.5}$ 24-Hour and Annual Averages) in Each State*

			24-HOUR		ANNUAL	
County	**ST[1]**	**Metropolitan Statistical Area**	WGT. AVG.[2]	GRADE[3]	DESIGN VALUE[4]	PASS/FAIL[5]
LANE	OR	Eugene-Springfield, OR	16.0	F	12.0	PASS
ALLEGHENY	PA	Pittsburgh-New Castle, PA	62.0	F	20.4	FAIL
PROVIDENCE	RI	Boston-Worcester-Manchester, MA-RI-NH	2.3	D	12.0	PASS
GREENVILLE	SC	Greenville-Spartanburg-Anderson, SC	5.0	F	15.9	FAIL
KNOX	TN	Knoxville-Sevierville-La Follette, TN	4.3	F	15.6	FAIL
SHELBY	TN	Memphis, TN-MS-AR	6.3	F	13.6	PASS
HARRIS	TX	Houston-Baytown-Huntsville, TX	2.3	D	15.4	FAIL
EL PASO	TX	El Paso, TX	3.0	D		INC
CACHE	UT	Logan, UT-ID	31.0	F	12.2	PASS
FAIRFAX	VA	Washington-Baltimore-Northern Virginia, DC-MD-VA-WV	6.7	F	13.9	PASS
ROANOKE CITY	VA	Roanoke, VA	1.3	C	14.3	PASS
RUTLAND	VT	Rutland, VT	1.3	C	11.1	PASS
CHITTENDEN	VT	Burlington-South Burlington, VT	1.7	C	9.2	PASS
PIERCE	WA	Seattle-Tacoma-Olympia, WA	4.8	F	10.6	PASS
WAUKESHA	WI	Milwaukee-Racine-Waukesha, WI	4.3	F	13.9	PASS
MILWAUKEE	WI	Milwaukee-Racine-Waukesha, WI	5.3	F	13.5	PASS
BROOKE	WV	Weirton-Steubenville, WV-OH	8.0	F	16.4	FAIL
KANAWHA	WV	Charleston, WV	6.0	F	16.4	FAIL
SHERIDAN	WY	Sheridan, WY	2.0	C	9.7	PASS

Notes:

(1) States were not included if all monitored counties got a grade of B or better for the 24-hour standard and a Passing grade for the annual standard.

(2) The **Weighted Average** was derived by counting the number of days in each unhealthful range (orange, red, purple, maroon) in each year (2004-2006), multiplying the total in each range by the assigned standard weights (i.e., 1 for orange, 1.5 for red, 2.0 for purple, 2.5 for maroon), and calculating the average.

(3) **Grades** are assigned by weighted average as follows: A=0.0, B=0.3-0.9, C=1.0-2.0, D=2.1-3.2, F=3.3+.

(4) The **Design Value** is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by EPA to determine whether the air quality in a county meets the standard. The source for the Design Values is EPA, communication from the Office of Air Quality Planning & Standards, Mark Schmidt, October 31, 2007.

(5) Grades are based on EPA's determination of meeting or failure to meet the NAAQS for annual $PM_{2.5}$ levels during 2004-2006. Counties meeting the NAAQS received grades of Pass; counties not meeting received grades of Fail. "INC" indicates incomplete monitoring of data.

Table 4a: *Counties with the Worst Ozone Air Pollution in Each State*

County	ST[1]	Metropolitan Statistical Area	OZONE WGT. AVG.[2]	OZONE GRADE[3]
JEFFERSON	AL	Birmingham-Hoover-Cullman, AL	7.5	F
CRITTENDEN	AR	Memphis, TN-MS-AR	4.2	F
MARICOPA	AZ	Phoenix-Mesa-Scottsdale, AZ	8.0	F
SAN BERNARDINO	CA	Los Angeles-Long Beach-Riverside, CA	90.3	F
JEFFERSON	CO	Denver-Aurora-Boulder, CO	2.7	D
FAIRFIELD	CT	New York-Newark-Bridgeport, NY-NJ-CT-PA	12.2	F
DISTRICT OFLUMBIA	DC	Washington-Baltimore-Northern Virginia, DC-MD-VA-WV	6.0	F
NEW CASTLE	DE	Philadelphia-Camden-Vineland, PA-NJ-DE-MD	4.5	F
SUSSEX	DE	Seaford, DE	4.5	F
ESCAMBIA	FL	Pensacola-Ferry Pass-Brent, FL	2.3	D
HILLSBOROUGH	FL	Tampa-St. Petersburg-Clearwater, FL	2.3	D
FULTON	GA	Atlanta-Sandy Springs-Gainesville, GA-AL	9.0	F
COOK	IL	Chicago-Naperville-Michigan City, IL-IN-WI	5.0	F
LAKE	IN	Chicago-Naperville-Michigan City, IL-IN-WI	3.0	D
WYANDOTTE	KS	Kansas City-Overland Park-Kansas City, MO-KS	1.5	C
CAMPBELL	KY	Cincinnati-Middletown-Wilmington, OH-KY-IN	3.2	D
EAST BATON ROUGE PARISH	LA	Baton Rouge-Pierre Part, LA	10.8	F
HAMPSHIRE	MA	Springfield, MA	5.2	F
HARFORD	MD	Washington-Baltimore-Northern Virginia, DC-MD-VA-WV	11.2	F
HANCOCK	ME		1.7	C
ALLEGAN	MI	Grand Rapids-Muskegon-Holland, MI	5.8	F
ST CHARLES	MO	St. Louis-St. Charles-Farmington, MO-IL	8.7	F
DESOTO	MS	Memphis, TN-MS-AR	2.7	D
HARRISON	MS	Gulfport-Biloxi-Pascagoula, MS	2.7	D
ROWAN	NC	Charlotte-Gastonia-Salisbury, NC-SC	9.0	F
HILLSBOROUGH	NH	Boston-Worcester-Manchester, MA-RI-NH	3.0	D
OCEAN	NJ	New York-Newark-Bridgeport, NY-NJ-CT-PA	10.2	F
CLARK	NV	Las Vegas-Paradise-Pahrump, NV	6.8	F
RICHMOND	NY	New York-Newark-Bridgeport, NY-NJ-CT-PA	6.3	F
LAKE	OH	Cleveland-Akron-Elyria, OH	5.2	F
OKLAHOMA	OK	Oklahoma City-Shawnee, OK	4.3	F
TULSA	OK	Tulsa-Bartlesville, OK	4.3	F
PHILADELPHIA	PA	Philadelphia-Camden-Vineland, PA-NJ-DE-MD	6.3	F
WASHINGTON	RI	Boston-Worcester-Manchester, MA-RI-NH	4.5	F
RICHLAND	SC	Columbia-Newberry, SC	4.3	F
BLOUNT	TN	Knoxville-Sevierville-La Follette, TN	5.0	F
HARRIS	TX	Houston-Baytown-Huntsville, TX	36.0	F
DAVIS	UT	Salt Lake City-Ogden-Clearfield, UT	3.5	F
FAIRFAX	VA	Washington-Baltimore-Northern Virginia, DC-MD-VA-WV	10.8	F
KING	WA	Seattle-Tacoma-Olympia, WA	2.0	C
OZAUKEE	WI	Milwaukee-Waukesha-West Allis, WI	6.0	F
KENOSHA	WI	Chicago-Naperville-Michigan City, IL-IN-WI	6.0	F
OHIO	WV	Wheeling, WV-OH	2.3	D

Notes:

(1) States were not included if all monitored counties got a grade of B or higher.

(2) The **Weighted Average** was derived by counting the number of days in each unhealthful range (orange, red, purple) in each year (2004-2006), multiplying the total in each range by the assigned standard weights (i.e., 1 for orange, 1.5 for red, 2.0 for purple), and calculating the average.

(3) **Grade** is assigned by weighted average as follows: A=0.0, B=0.3-0.9, C=1.0-2.0, D=2.1-3.2, F=3.3+.

Table 5: *Cleanest U.S. Cities for Short-term Particle Pollution (24-hour $PM_{2.5}$)*[1]

Metropolitan Statistical Area	Population
Alexandria, LA	150,080
Amarillo, TX	241,515
Bismarck, ND	101,138
Brownsville-Harlingen-Raymondville, TX	408,362
Cheyenne, WY	85,384
Colorado Springs, CO	599,127
Corpus Christi-Kingsville, TX	446,565
Fargo-Wahpeton, ND-MN	210,523
Farmington, NM	126,473
Flagstaff, AZ	124,953
Fort Collins-Loveland, CO	276,253
Great Falls, MT	79,385
Longview-Marshall, TX	267,186
Midland-Odessa, TX	251,842
Pueblo, CO	152,912
Redding, CA	179,951
Salinas, CA	410,206
San Luis Obispo-Paso Robles, CA	257,005
Santa Barbara-Santa Maria-Goleta, CA	400,335
Santa Fe-Espanola, NM	183,356
Sioux Falls, SD	212,911
Tucson, AZ	946,362
Valdosta, GA	126,305

Note:
(1) This list represents cities with the lowest levels of short-term $PM_{2.5}$ air pollution. Monitors in these cities reported no days with unhealthful $PM_{2.5}$ levels.

Table 5a: *Top 25 Cleanest U.S. Cities for Long-term Particle Pollution (Annual $PM_{2.5}$)*[1]

Rank[2]	Design Value[3]	Metropolitan Statistical Area	Population
1	4.5	Cheyenne, WY	85,384
2	4.7	Santa Fe-Espanola, NM	183,356
3	4.9	Honolulu, HI	909,863
4	5.3	Great Falls, MT	79,385
5	5.9	Farmington, NM	126,473
6	6.0	Tucson, AZ	946,362
7	6.5	Bismarck, ND	101,138
7	6.5	Flagstaff, AZ	124,953
9	6.7	Anchorage, AK	359,180
10	6.9	Salinas, CA	410,206
11	7.3	Fort Collins-Loveland, CO	276,253
12	7.4	Duluth, MN-WI	274,244
13	7.5	Pueblo, CO	152,912
14	7.6	Midland-Odessa, TX	251,842
15	7.7	Pocatello, ID	86,357
15	7.7	Redding, CA	179,951
17	7.8	Fargo-Wahpeton, ND-MN	210,523
17	7.8	Albuquerque, NM	816,811
19	8.0	San Luis Obispo-Paso Robles, CA	257,005
20	8.1	Reno-Sparks-Fernley, NV	451,791
20	8.1	Colorado Springs, CO	599,127
22	8.3	Las Vegas-Paradise-Pahrump, NV	1,820,232
23	8.4	Cape Coral-Fort Myers, FL	571,344
24	8.6	Boise City-Nampa, ID	567,640
24	8.6	Palm Bay-Melbourne-Titusville, FL	534,359

Notes:

(1) This list represents cities with the lowest levels of annual $PM_{2.5}$ air pollution.

(2) Cities are ranked by using the highest Design Value for any county within that metropolitan area.

(3) The **Design Value** is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by EPA to determine whether the air quality in a county meets the standard. The source for the Design Values is EPA, communication from the Office of Air Quality Planning & Standards, Mark Schmidt, October 31, 2007.

Table 5b: *Cleanest U.S. Cities for Ozone Air Pollution*[1]

Metropolitan Statistical Area	Population	Metropolitan Statistical Area	Population
Albuquerque, NM	816,811	Lafayette-Frankfort, IN	219,962
Ames-Boone, IA	106,729	Laredo, TX	231,470
Appleton-Oshkosh-Neenah, WI	377,906	Lexington-Fayette--Frankfort--Richmond, KY	645,006
Austin-Round Rock, TX	1,513,565	Lincoln, NE	283,970
Bangor, ME	147,180	Logan, UT-ID	111,156
Bellingham, WA	185,953	Medford, OR	197,071
Bloomington, IN	178,714	Montgomery-Alexander City, AL	413,802
Bloomington-Normal, IL	161,202	Naples-Marco Island, FL	314,649
Bowling Green, KY	113,320	Ocala, FL	316,183
Brunswick, GA	100,613	Omaha-Council Bluffs-Fremont, NE-IA	858,720
Burlington-South Burlington, VT	206,007	Peoria-Canton, IL	407,572
Cape Coral-Fort Myers, FL	571,344	Port St. Lucie-Sebastian-Vero Beach, FL	522,217
Carson City, NV	55,289	Rapid City, SD	118,763
Cedar Rapids, IA	249,320	Reno-Sparks-Fernley, NV	451,791
Champaign-Urbana, IL	216,581	Roanoke, VA	295,050
Davenport-Moline-Rock Island, IA-IL	377,291	Rochester, MN	179,573
Decatur, IL	109,309	Rochester-Batavia-Seneca Falls, NY	1,128,989
Des Moines-Newton-Pella, IA	604,626	Rockford-Freeport-Rochelle, IL	450,466
Duluth, MN-WI	274,244	Salinas, CA	410,206
Elmira, NY	88,641	Savannah-Hinesville-Fort Stewart, GA	394,036
Eugene-Springfield, OR	337,870	Sioux Falls, SD	212,911
Fargo-Wahpeton, ND-MN	210,523	Spokane, WA	446,706
Florence-Muscle Shoals, AL	142,657	Springfield, IL	206,112
Gadsden, AL	103,362	Utica-Rome, NY	297,286
Gainesville, FL	243,985	Waterloo-Cedar Falls, IA	162,263
Hickory-Lenoir-Morganton, NC	359,856	Wilmington, NC	326,166
Honolulu, HI	909,863	Yuma, AZ	187,555

Note:

(1) This list represents cities with no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on the 1997 National Ambient Air Quality Standard of 0.08 ppm..

Table 6: *Cleanest Counties for Short-term Particle Pollution (24-Hour $PM_{2.5}$)[1]*

County	ST	MSAs and Respective CMSA[2]
BALDWIN	AL	Mobile-Daphne-Fairhope, AL
POLK	AR	
COCHISE	AZ	Sierra Vista-Douglas, AZ
COCONINO	AZ	Flagstaff, AZ
GILA	AZ	Payson, AZ
PIMA	AZ	Tucson, AZ
PINAL	AZ	Phoenix-Mesa-Scottsdale, AZ
CALAVERAS	CA	
HUMBOLDT	CA	Eureka-Arcata-Fortuna, CA
LAKE	CA	Clearlake, CA
MENDOCINO	CA	Ukiah, CA
MONTEREY	CA	Salinas, CA
NEVADA	CA	Sacramento-Arden-Arcade-Yuba City, CA-NV
SAN LUIS OBISPO	CA	San Luis Obispo-Paso Robles, CA
SANTA BARBARA	CA	Santa Barbara-Santa Maria-Goleta, CA
SANTA CRUZ	CA	San Jose-San Francisco-Oakland, CA
SHASTA	CA	Redding, CA
ARCHULETA	CO	
BOULDER	CO	Denver-Aurora-Boulder, CO
DELTA	CO	
EL PASO	CO	Colorado Springs, CO
ELBERT	CO	Denver-Aurora-Boulder, CO
GUNNISON	CO	
LARIMER	CO	Fort Collins-Loveland, CO
PUEBLO	CO	Pueblo, CO
SAN MIGUEL	CO	
BROWARD	FL	Miami-Fort Lauderdale-Pompano Beach, FL
PALM BEACH	FL	Miami-Fort Lauderdale-Pompano Beach, FL
HOUSTON	GA	Macon-Warner Robins-Fort Valley, GA
LOWNDES	GA	Valdosta, GA
MAUI	HI	Kahului-Wailuku, HI
RANDOLPH	IL	
JOHNSON	KS	Kansas City-Overland Park-Kansas City, MO-KS
LINN	KS	Kansas City-Overland Park-Kansas City, MO-KS
BELL	KY	Middlesborough, KY
EDMONSON	KY	Bowling Green, KY
PERRY	KY	
CONCORDIA PARISH	LA	Natchez, MS-LA
RAPIDES PARISH	LA	Alexandria, LA
CUMBERLAND	ME	Portland-Lewiston-South Portland, ME
HANCOCK	ME	
KENNEBEC	ME	Augusta-Waterville, ME
MISSAUKEE	MI	Cadillac, MI
CASS	MN	Brainerd, MN
CASS	MO	Kansas City-Overland Park-Kansas City, MO-KS
CEDAR	MO	
CASCADE	MT	Great Falls, MT
SANDERS	MT	
CHATHAM	NC	Raleigh-Durham-Cary, NC
DUPLIN	NC	
HAYWOOD	NC	Asheville-Brevard, NC
JACKSON	NC	
MITCHELL	NC	
SWAIN	NC	
BILLINGS	ND	Dickinson, ND
BURLEIGH	ND	Bismarck, ND
CASS	ND	Fargo-Wahpeton, ND-MN
MC KENZIE	ND	
MERCER	ND	
HALL	NE	Grand Island, NE
SCOTTS BLUFF	NE	Scottsbluff, NE
CHESHIRE	NH	Keene, NH
GRAFTON	NH	Claremont-Lebanon, NH-VT
CHAVES	NM	Roswell, NM
GRANT	NM	Silver City, NM
LEA	NM	Hobbs, NM
SAN JUAN	NM	Farmington, NM
SANTA FE	NM	Santa Fe-Espanola, NM
OKLAHOMA	OK	Oklahoma City-Shawnee, OK
JOSEPHINE	OR	Grants Pass, OR
BROOKINGS	SD	Brookings, SD
BROWN	SD	Aberdeen, SD
JACKSON	SD	
MINNEHAHA	SD	Sioux Falls, SD
ROANE	TN	Knoxville-Sevierville-La Follette, TN
BREWSTER	TX	
CAMERON	TX	Brownsville-Harlingen-Raymondville, TX
ECTOR	TX	Midland-Odessa, TX
HARRISON	TX	Longview-Marshall, TX
NUECES	TX	Corpus Christi-Kingsville, TX
POTTER	TX	Amarillo, TX
ASHLAND	WI	
FOREST	WI	
TAYLOR	WI	
VILAS	WI	
CAMPBELL	WY	Gillette, WY
CONVERSE	WY	
LARAMIE	WY	Cheyenne, WY

Note:

(1) This list represents counties with the lowest levels of short term $PM_{2.5}$ air pollution. Monitors in these counties reported no days with unhealthful $PM_{2.5}$ levels

(2) MSA and CSA are terms used by the U.S. Office of Management and Budget for statistical purposes. MSA stands for Metropolitan Statistical Area. CSA stands for Combined Statistical Area, which may include multiple metropolitan statistical areas and individual counties.

Table 6a: *Top 25 Cleanest Counties for Long-term Particle Pollution (Annual $PM_{2.5}$)*[1]

2008 Rank[2]	County	ST	Design Value[3]
1	CONVERSE	WY	3.5
2	GALLATIN	MT	4.2
3	ELBERT	CO	4.3
4	SAN MIGUEL	CO	4.5
4	BILLINGS	ND	4.5
4	LARAMIE	WY	4.5
7	MAUI	HI	4.6
8	SANTA FE	NM	4.7
9	LAKE	CA	4.8
10	HONOLULU	HI	4.9
10	MC KENZIE	ND	4.9
12	CAMPBELL	WY	5.2
13	INYO	CA	5.3
13	CASCADE	MT	5.3
13	JACKSON	SD	5.3
16	HANCOCK	ME	5.6
17	CASS	MN	5.8
17	MERCER	ND	5.8
19	SAN JUAN	NM	5.9
20	PIMA	AZ	6.0
20	ESSEX	NY	6.0
20	ASHLAND	WI	6.0
23	MILLE LACS	MN	6.4
24	COCONINO	AZ	6.5
24	BURLEIGH	ND	6.5
24	CHAVES	NM	6.5

Notes:

(1) This list represents counties with the lowest levels of monitored long-term $PM_{2.5}$ air pollution.

(2) Counties are ranked by Design Value.

(3) The **Design Value** is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by EPA to determine whether the air quality in a county meets the standard. The source for the Design Values is EPA, communication from the Office of Air Quality Planning & Standards, Mark Schmidt, October 31, 2007.

Table 6b: *Cleanest Counties for Ozone Air Pollution*[1]

County	ST	Metropolitan Statistical Area
YUKON-KOYUKUK BOROUGH	AK	
CLAY	AL	
COLBERT	AL	Florence-Muscle Shoals, AL
ELMORE	AL	Montgomery-Alexander City, AL
ETOWAH	AL	Gadsden, AL
LAWRENCE	AL	Huntsville-Decatur, AL
MONTGOMERY	AL	Montgomery-Alexander City, AL
MORGAN	AL	Huntsville-Decatur, AL
SUMTER	AL	
NEWTON	AR	Harrison, AR
POLK	AR	
COCHISE	AZ	Sierra Vista-Douglas, AZ
YUMA	AZ	Yuma, AZ
COLUSA	CA	
GLENN	CA	
LAKE	CA	Clearlake, CA
MARIN	CA	San Jose-San Francisco-Oakland, CA
MENDOCINO	CA	Ukiah, CA
MONTEREY	CA	Salinas, CA
NAPA	CA	San Jose-San Francisco-Oakland, CA
PLUMAS	CA	
SAN FRANCISCO	CA	San Jose-San Francisco-Oakland, CA
SAN MATEO	CA	San Jose-San Francisco-Oakland, CA
SANTA CRUZ	CA	San Jose-San Francisco-Oakland, CA
SISKIYOU	CA	
SONOMA	CA	San Jose-San Francisco-Oakland, CA
ADAMS	CO	Denver-Aurora-Boulder, CO
LA PLATA	CO	Durango, CO
MONTEZUMA	CO	
ALACHUA	FL	Gainesville, FL
BAKER	FL	Jacksonville, FL
COLLIER	FL	Naples-Marco Island, FL
COLUMBIA	FL	Lake City, FL
HIGHLANDS	FL	Sebring, FL
LEE	FL	Cape Coral-Fort Myers, FL
MARION	FL	Ocala, FL
OSCEOLA	FL	Orlando-Deltona-Daytona Beach, FL
PALM BEACH	FL	Miami-Fort Lauderdale-Pompano Beach, FL
ST. LUCIE	FL	Port St. Lucie-Sebastian-Vero Beach, FL
VOLUSIA	FL	Orlando-Deltona-Daytona Beach, FL
WAKULLA	FL	Tallahassee, FL
CHATHAM	GA	Savannah-Hinesville-Fort Stewart, GA
GLYNN	GA	Brunswick, GA
HONOLULU	HI	Honolulu, HI
BREMER	IA	Waterloo-Cedar Falls, IA
HARRISON	IA	Omaha-Council Bluffs-Fremont, NE-IA
LINN	IA	Cedar Rapids, IA
MONTGOMERY	IA	
PALO ALTO	IA	
POLK	IA	Des Moines-Newton-Pella, IA
SCOTT	IA	Davenport-Moline-Rock Island, IA-IL
STORY	IA	Ames-Boone, IA
VAN BUREN	IA	
WARREN	IA	Des Moines-Newton-Pella, IA
BUTTE	ID	
CANYON	ID	Boise City-Nampa, ID
ADAMS	IL	Quincy, IL-MO
CHAMPAIGN	IL	Champaign-Urbana, IL
CLARK	IL	
EFFINGHAM	IL	Effingham, IL
HAMILTON	IL	Mount Vernon, IL
MACON	IL	Decatur, IL
MCLEAN	IL	Bloomington-Normal, IL
PEORIA	IL	Peoria-Canton, IL
RANDOLPH	IL	
ROCK ISLAND	IL	Davenport-Moline-Rock Island, IA-IL
SANGAMON	IL	Springfield, IL
WILL	IL	Chicago-Naperville-Michigan City, IL-IN-WI
WINNEBAGO	IL	Rockford-Freeport-Rochelle, IL
CARROLL	IN	Lafayette-Frankfort, IN
GREENE	IN	Bloomington, IN
HUNTINGTON	IN	Fort Wayne-Huntington-Auburn, IN
MORGAN	IN	Indianapolis-Anderson-Columbus, IN
SHELBY	IN	Indianapolis-Anderson-Columbus, IN

Note:
(1) This list represents counties no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on the 1997 National Ambient Air Quality Standard of 0.08 ppm. .

Table 6b: (continued) *Cleanest Counties for Ozone Air Pollution*[1]

County	ST	Metropolitan Statistical Area
LINN	KS	Kansas City-Overland Park-Kansas City, MO-KS
SEDGWICK	KS	Wichita-Winfield, KS
TREGO	KS	
BELL	KY	Middlesborough, KY
BOONE	KY	Cincinnati-Middletown-Wilmington, OH-KY-IN
EDMONSON	KY	Bowling Green, KY
FAYETTE	KY	Lexington-Fayette--Frankfort--Richmond, KY
HARDIN	KY	Louisville-Jefferson County-Elizabethtown-Scottsburg, KY-IN
HENDERSON	KY	Evansville, IN-KY
JESSAMINE	KY	Lexington-Fayette--Frankfort--Richmond, KY
MCCRACKEN	KY	Paducah-Mayfield, KY-IL
PERRY	KY	
PIKE	KY	
PULASKI	KY	Somerset, KY
TRIGG	KY	Clarksville, TN-KY
WARREN	KY	Bowling Green, KY
CUMBERLAND	ME	Portland-Lewiston-South Portland, ME
KENNEBEC	ME	Augusta-Waterville, ME
OXFORD	ME	
PENOBSCOT	ME	Bangor, ME
CLINTON	MI	Lansing-East Lansing-Owosso, MI
OAKLAND	MI	Detroit-Warren-Flint, MI
ANOKA	MN	Minneapolis-St. Paul-St. Cloud, MN-WI
CARLTON	MN	Duluth, MN-WI
CROW WING	MN	Brainerd, MN
GOODHUE	MN	Minneapolis-St. Paul-St. Cloud, MN-WI
LAKE	MN	
OLMSTED	MN	Rochester, MN
ST LOUIS	MN	Duluth, MN-WI
STEARNS	MN	Minneapolis-St. Paul-St. Cloud, MN-WI
WASHINGTON	MN	Minneapolis-St. Paul-St. Cloud, MN-WI
ADAMS	MS	Natchez, MS-LA
BOLIVAR	MS	Cleveland, MS
LEE	MS	Tupelo, MS
FLATHEAD	MT	Kalispell, MT
ALEXANDER	NC	Hickory-Lenoir-Morganton, NC
AVERY	NC	
CALDWELL	NC	Hickory-Lenoir-Morganton, NC
CASWELL	NC	
CHATHAM	NC	Raleigh-Durham-Cary, NC
NEW HANOVER	NC	Wilmington, NC
SWAIN	NC	
BILLINGS	ND	Dickinson, ND
BURKE	ND	
CASS	ND	Fargo-Wahpeton, ND-MN
DUNN	ND	
MC KENZIE	ND	
MERCER	ND	
OLIVER	ND	
DOUGLAS	NE	Omaha-Council Bluffs-Fremont, NE-IA
LANCASTER	NE	Lincoln, NE
BELKNAP	NH	Boston-Worcester-Manchester, MA-RI-NH
CHESHIRE	NH	Keene, NH
GRAFTON	NH	Claremont-Lebanon, NH-VT
BERNALILLO	NM	Albuquerque, NM
EDDY	NM	Carlsbad-Artesia, NM
LEA	NM	Hobbs, NM
SANDOVAL	NM	Albuquerque, NM
CARSON CITY	NV	Carson City, NV
WASHOE	NV	Reno-Sparks-Fernley, NV
WHITE PINE	NV	
CHEMUNG	NY	Elmira, NY
HERKIMER	NY	Utica-Rome, NY
MADISON	NY	Syracuse-Auburn, NY
MONROE	NY	Rochester-Batavia-Seneca Falls, NY
ONEIDA	NY	Utica-Rome, NY
SCHENECTADY	NY	Albany-Schenectady-Amsterdam, NY
ULSTER	NY	New York-Newark-Bridgeport, NY-NJ-CT-PA
WAYNE	NY	Rochester-Batavia-Seneca Falls, NY
CLEVELAND	OK	Oklahoma City-Shawnee, OK
PITTSBURG	OK	McAlester, OK
COLUMBIA	OR	Portland-Vancouver-Beaverton, OR-WA
JACKSON	OR	Medford, OR
LANE	OR	Eugene-Springfield, OR

Note:

(1) This list represents counties no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on the 1997 National Ambient Air Quality Standard of 0.08 ppm. .

Table 6b: (continued) *Cleanest Counties for Ozone Air Pollution*[1]

County	ST	Metropolitan Statistical Area
MULTNOMAH	OR	Portland-Vancouver-Beaverton, OR-WA
FRANKLIN	PA	Chambersburg, PA
TIOGA	PA	
AIKEN	SC	Augusta-Richmond County, GA-SC
ANDERSON	SC	Greenville-Spartanburg-Anderson, SC
BARNWELL	SC	
BERKELEY	SC	Charleston-North Charleston, SC
COLLETON	SC	Walterboro, SC
WILLIAMSBURG	SC	
JACKSON	SD	
MINNEHAHA	SD	Sioux Falls, SD
PENNINGTON	SD	Rapid City, SD
BREWSTER	TX	
HAYS	TX	Austin-Round Rock, TX
WEBB	TX	Laredo, TX
CACHE	UT	Logan, UT-ID
SAN JUAN	UT	
PAGE	VA	
ROANOKE	VA	Roanoke, VA
ROCKBRIDGE	VA	
WYTHE	VA	

County	ST	Metropolitan Statistical Area
CHITTENDEN	VT	Burlington-South Burlington, VT
CLALLAM	WA	Port Angeles, WA
CLARK	WA	Portland-Vancouver-Beaverton, OR-WA
KLICKITAT	WA	
SKAGIT	WA	Seattle-Tacoma-Olympia, WA
SPOKANE	WA	Spokane, WA
THURSTON	WA	Seattle-Tacoma-Olympia, WA
WHATCOM	WA	Bellingham, WA
ASHLAND	WI	
DANE	WI	Madison-Baraboo, WI
FLORENCE	WI	Iron Mountain, MI-WI
FOREST	WI	
ONEIDA	WI	
OUTAGAMIE	WI	Appleton-Oshkosh-Neenah, WI
SAUK	WI	Madison-Baraboo, WI
VILAS	WI	
WASHINGTON	WI	Milwaukee-Racine-Waukesha, WI
GREENBRIER	WV	
CAMPBELL	WY	Gillette, WY
TETON	WY	Jackson, WY-ID

Note:
(1) This list represents counties no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on the 1997 National Ambient Air Quality Standard of 0.08 ppm. .

Health Effects of Ozone and Particle Pollution

Ozone and particle pollution are the most widespread air pollutants—and among the most dangerous. Recent research has revealed new insights into how they can harm the body—including taking the lives of infants and altering the lungs of children. All in all, the evidence shows that the risks are greater than we once thought.

Two types of air pollution dominate the problem in the U.S.: ozone and particle pollution.

What Is Ozone?

Ozone (O_3) is an extremely reactive gas molecule composed of three oxygen atoms. It is the primary ingredient of smog air pollution and is very harmful to breathe. Ozone attacks lung tissue by reacting with it chemically.

News about ozone can be confusing. Some days you hear that ozone levels are too high and other days that we need to prevent ozone depletion. Basically, the ozone layer found high in the upper atmosphere (the stratosphere) is beneficial because it shields us from much of the sun's ultraviolet radiation. However, ozone air pollution at ground level where we can breathe it (in the troposphere) is harmful. It causes serious health problems.

Where Does Ozone Come From?

What you see coming out of the tailpipe on a car or a truck isn't ozone, but the raw ingredients for making ozone. Ozone is formed by chemical reactions in the atmosphere from two raw gases that do come out of tailpipes, smokestacks and many other sources. These essential raw ingredients for ozone are nitrogen oxides (NO_x) and hydrocarbons, also called volatile organic compounds (VOCs). They are produced primarily when fossil fuels like gasoline, oil or coal are burned or when some chemicals, like paints, evaporate. When NOx and VOCs come in contact with both heat and sunlight, they combine and form ozone smog. NO_x is emitted from power plants, motor vehicles and other sources of high-heat combustion. VOCs are emitted from motor vehicles, chemical plants, refineries, factories, gas stations, paint and other sources. The formula for ozone is simple, and like any formula, the ingredients must all be present and in the right proportions to make the final product:

$$NO_x + VOC + Heat + Sunlight = Ozone$$

You may have wondered why "ozone action day" warnings are sometimes followed by recommendations to avoid activities such as mowing your lawn or refilling your gas tank during daylight hours. Lawn mower exhaust and gasoline vapors are VOCs that could turn into ozone in the heat and sun. Take away the sunlight and ozone doesn't form, so refilling your gas tank after dark is better on high ozone days. Since we can't control sunlight and heat, we must reduce the chemical raw ingredients if we want to reduce ozone.

Who is at Risk from Breathing Ozone?

Five groups of people are especially vulnerable to the effects of breathing ozone:

- children and teens
- anyone 65 and older
- people who work or exercise outdoors
- people with existing lung diseases, such as asthma and chronic obstructive pulmonary disease (also known as COPD, which includes emphysema and chronic bronchitis)
- "responders" who are otherwise healthy but for some reason react more strongly to ozone.

The impact on your health can depend on many factors, however, not just whether you are part of one of these groups. For example, the risks would be greater if ozone levels are higher, if you are breathing faster because you're working outdoors or if you spend more time outdoors.

How Ozone Pollution Harms Your Health

Scientists have studied the effects of ozone on health for decades. Hundreds of research studies have confirmed that ozone harms people at levels currently found in the United States. In the last few years, we've learned that it can also be deadly.

Breathing ozone may shorten your life. Strong evidence arrived late in 2004, when two large multi-city investigations documented that short-term exposure to ozone can shorten lives, building on numerous earlier studies. One of them looked at 95 cities across the United States over a 14-year period. That study compared the impact of ozone on death patterns during several days after the ozone measurements. Even on days when ozone levels were low, the researchers found that the risk of premature death increased with higher levels of ozone. They estimated that over 3,700 deaths annually could be attributed to a 10-parts-per-billion increase in ozone levels.[1] Another study, published the same week, looked at 23 European cities and found similar effects on mortality from short-term exposure to ozone.[2]

Confirmation came in the summer of 2005. Three groups of researchers working independently reviewed and analyzed the research around deaths associated with short-term exposures to ozone. The three teams—at Harvard, Johns Hopkins and New York University—used different approaches but all came to similar conclusions. All three studies report a small, but robust association between daily ozone levels and increased deaths.[3] Writing a commentary on these reviews, David Bates, MD, explained how these premature deaths could occur:

> *"Ozone is capable of causing inflammation in the lung at lower concentrations than any other gas. Such an effect would be a hazard to anyone with heart failure and pulmonary congestion, and would worsen the function of anyone with advanced lung disease."*[4]

Other immediate risks from breathing high levels of ozone. Many areas in the United States produce enough ground-level ozone during the summer months to cause health problems that can be felt right away. Immediate problems—in addition to increased risk of premature death—include:

- shortness of breath;
- chest pain when inhaling;
- wheezing and coughing;
- asthma attacks;
- increased susceptibility to respiratory infections;
- pulmonary inflammation; and
- increased need for people with lung diseases, like asthma or chronic obstructive pulmonary disease (COPD), to receive medical treatment and to go to the hospital.[5]

Breathing ozone for longer periods can alter the lungs' ability to function. Two studies published in 2005 explored ozone's ability to reduce the lung's ability to work efficiently, a term called "lung function." Each study looked at otherwise healthy groups who were exposed to ozone for long periods: outdoor postal workers in Taiwan and college freshmen who were lifelong residents of Los Angeles or the San Francisco Bay area. Both studies found that the long exposure to elevated ozone levels had decreased their lung function.[6]

Other effects of long-term exposure to ozone. Short-term exposure to ozone also appears to worsen COPD.[7] Repeated inflammation due to exposure to ozone over a period of years can lead to a chronic "stiffening" of the lungs.

Inhaling ozone may affect the heart as well as the lungs. One new study linked exposures to high ozone levels for as little as one hour to a particular type of cardiac arrhythmia that itself increases the risk of premature death and stroke.[8] A French study found that exposure to elevated ozone levels for one to two days increased the risk of heart attacks for middle-aged adults without heart disease.[9]

Breathing other pollutants in the air may make your lungs more responsive to ozone—and breathing ozone may increase your body's response to other pollutants. For example, research warns that breathing sulfur dioxide and nitrogen oxide—two pollutants common in the eastern United States—can make the lungs react more strongly than to just breathing ozone alone. Breathing ozone may also increase the response to allergens in people with allergies.[10]

Particle Pollution

Ever look at dirty truck exhaust?

The dirty, smoky part of that stream of exhaust is made of particle pollution. More new evidence shows that the particle pollution—like that coming from the exhaust smoke—can lead to shorter lives, heart disease, lung cancer and asthma attacks and can interfere with the growth and work of the lungs.

What Is Particle Pollution?

Particle pollution refers to a mix of very tiny solid and liquid particles that are in the air we breathe. But nothing about particle pollution is simple. First of all, the particles themselves are different sizes. Some are one-tenth the diameter of a strand of hair. Many are even tinier; some are so small they can only be seen with an electron microscope. Because of their size, you can't see the individual particles. You can only see the haze that forms when millions of particles blur the spread of sunlight. You may not be able to tell when you're breathing particle pollution. Yet it is so dangerous it can shorten your life.

The differences in size make a big difference in how they affect us. Our natural defenses help us to cough or sneeze larger particles out of our bodies. But those defenses don't keep out smaller particles, those that are smaller than 10 microns (or micrometers) in diameter, or about one-seventh the diameter of a single human hair. These particles get trapped in the lungs, while the smallest are so minute that they can pass through the lungs into the blood stream, just like the essential oxygen molecules we need to survive.

Researchers categorize particles according to size, grouping them as coarse, fine and ultrafine. Coarse particles fall between 2.5 microns and 10 microns in diameter and are called $PM_{10-2.5}$. Fine particles are 2.5 microns in diameter or smaller and are called $PM_{2.5}$. Ultrafine particles are smaller than 0.1 micron in diameter[11] and are small enough to pass through the lung tissue into the blood stream, circulating like the oxygen molecules themselves. No matter what the size, particles can be harmful to your health.

Because particles are formed in so many different ways, they also can be composed of many different compounds. Although we often think of particles as solids, not all are. Some are completely liquid; some are solids suspended in liquids. As the U.S. Environmental Protection Agency puts it, particles are really "a mixture of mixtures." [12] The mixtures differ between the eastern and western United States. For example, the eastern states have more sulfate particles than the west, largely due to the high levels of sulfur dioxide emitted by large, coal-fired power plants. By contrast, in Southern California, nitrate particles from motor vehicle exhaust form a larger proportion of the unhealthful mix.[13]

Where Does Particle Pollution Come From?

Particle pollution is produced through two separate processes—mechanical and chemical.

Mechanical processes break down bigger bits into smaller bits with the material remaining essentially the same, only becoming smaller. Mechanical processes primarily create coarse particles.[14] Dust storms, construction and demolition, mining operations, agriculture, and coal and oil combustion are among the activities that produce coarse particles.

By contrast, chemical processes in the atmosphere create most of the tiniest fine and ultrafine particles. Combustion sources burn fuels and emit gases. These gases can vaporize and then condense to become a particle of the same chemical compound. Or, they can react with other gases or particles in the atmosphere to form a particle of a different chemical compound. Particles formed by this latter process come from the reaction of elemental carbon (soot), heavy metals, sulfur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds with water and other compounds in the atmosphere.[15] Burning fossil fuels in factories, power plants, steel mills, smelters, diesel- and gasoline-powered motor vehicles (cars and trucks) and equipment generate a large part of the raw materials for fine particles. So does burning wood in residential fireplaces and wood stoves or burning agricultural fields or forests.

What Can Particles Do to Your Health?

Studies showing the dangers of particle pollution are pouring in by the thousands. The new studies validate earlier research showing a strong relationship between particle pollution and illness, hospitalization and premature death.[16]

Researchers these days are exploring possible differences in health effects of the three sizes of particles and particles from different sources, such as diesel particles from trucks and buses or sulfates from coal-fired power plants. So far, the evidence remains clear that all particles from all sources are dangerous.[17]

Particle pollution can damage the body in ways similar to cigarette smoking. A recent review of the research on how particles cause harm found that the body responds to particles in similar ways to its response to cigarette smoke. These findings help explain why particle pollution can cause heart attacks and strokes.[18]

Short-term Exposure Can Be Deadly

First and foremost, short-term exposure to particle pollution can kill. Deaths can occur on the very day that particle levels are high, or within one to two months afterward. Particle pollution does not just make people die a few days earlier than they might otherwise—these are deaths that would not have occurred if the air were cleaner.[19] Particle pollution also diminishes lung function, causes greater use of asthma medications and increased rates of school absenteeism, emergency room visits and hospital admissions. Other adverse effects can be coughing, wheezing, cardiac arrhythmias and heart attacks. According to the findings from some of the latest studies, short-term increases in particle pollution have been linked to:

- death from respiratory and cardiovascular causes, including strokes;[20,21,22,23]
- increased mortality in infants and young children;[24]
- increased numbers of heart attacks, especially among the elderly and in people with heart conditions;[25]
- inflammation of lung tissue in young, healthy adults;[26]
- increased hospitalization for cardiovascular disease, including strokes and congestive heart failure;[27,28,29]
- increased emergency room visits for patients suffering from acute respiratory ailments;[30]
- increased hospitalization for asthma among children; and[31,32,33]
- increased severity of asthma attacks in children.[34]

Year-Round Exposure

Breathing high levels of particle pollution day in and day out also can be deadly, as landmark studies in the 1990s showed conclusively.[35] Chronic exposure to particle pollution can shorten life by one to three years.[36] Other impacts range from premature births to serious respiratory disorders, even when the particle levels are very low.

Year-round exposure to particle pollution has also been linked to:

- increased hospitalization for asthma attacks for children living near roads with heavy truck or trailer traffic;[37,38]
- slowed lung function growth in children and teenagers; [39,40]
- significant damage to the small airways of the lungs;[41]
- increased risk of dying from lung cancer; and[42]
- increased risk of death from cardiovascular disease.[43]

Alarmingly, the risks may be even greater than previously thought. Earlier studies of the long-term health risks of air pollution relied on estimates of the average exposure to people in the community. New evidence from studies published since 2005 suggests that those estimates may be far too low. Tracking 23,000 residents of Los Angeles and looking at data from monitors nearest to them, researchers found that the risk of premature death from fine particle pollution may be *three times higher* than previously reported.[44] New research into risks to the health of 65,000 women over age 50 found that those who lived in areas with higher levels of particle pollution faced a much greater risk of dying from heart disease than had been previously estimated. Even women who lived within the same city faced differing risks depending on the annual levels of pollution in their neighborhood.[45]

Who Is at Risk?

Anyone living in an area with a high level of particle pollution is at risk (you can take a look at levels in your state in this report). People at the greatest risk from particle pollution exposure include those with lung disease such as asthma and chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema; people with sensitive airways, where exposure to particle pollution can cause wheezing, coughing and respiratory irritation; the elderly; people with heart disease; and children. New research points to ever-larger groups at higher risk, including diabetics, and most recently, women over 50.[46]

Focusing on Children's Health

Children may look like miniature adults, but they're not. Air pollution is especially dangerous to them because their lungs are growing and because they are so active.

Just like the arms and legs, the largest portion of a child's lungs will grow long after he or she is born. Eighty percent of their tiny air sacs develop after birth. Those sacs, called the alveoli, are where the life-sustaining transfer of oxygen to the blood takes place. The lungs and their alveoli aren't fully grown until children become adults.[47] In addition, the body's defenses that help adults fight off infections are still developing in young bodies.[48] Children have more respiratory infections than adults, which also seems to increase their susceptibility to air pollution.[49]

Furthermore, children don't behave like adults, which also affects their vulnerability. They are outside for longer periods and are usually more active when outdoors. Consequently, they inhale more polluted outdoor air than adults typically do.[50]

Major Reviews Confirm Harm to Children

Two major analyses recently concluded that air pollution is especially harmful to children. They found that air pollution is so dangerous that it can even threaten children's lives.

The World Health Organization (WHO) published an in-depth look at the research on children's health and air pollution. Most importantly, the scientists concluded that particle pollution caused infant deaths. In addition, they found that air pollution caused a host of harmful effects on children, including:

- short-term and long-term decreased lung function rates and lower lung function levels, critical measures of how well the child will breathe throughout his or her life (due primarily to exposure to particle pollution and traffic-related pollution);
- worsening of asthma (from exposure to particle as well as ozone pollution);
- increased prevalence and incidence of cough and bronchitis (primarily from particle pollution); and
- increased risk of upper and lower respiratory infections.[51]

The American Academy of Pediatrics issued a statement on the dangers of outdoor air pollution on children's health, pointing out the special differences for children.[52] The Academy reported many of the health effects cited by the WHO study, but also focused on the sources common to many children. Both the WHO monograph and the Academy statement highlighted recent studies showing how children living near highly traveled highways appear to be particularly harmed by traffic-related pollution. The Academy statement highlighted the specific concern over diesel school buses, citing a pilot study that showed children riding inside a school bus may be exposed to four times more diesel exhaust than if they were riding in a car.[53]

Research on Prenatal Exposure to Air Pollution

Several studies published in 2005 found prenatal exposure to air pollution can harm children. A study of pregnant women in four Pennsylvania counties found an increased risk of preterm births linked to chronic exposure to high levels of air pollution during the last six weeks of pregnancy.[54] A study of three low-income neighborhoods in New York City found that infants born to nonsmoking mothers faced a possible increased risk of cancer from living in areas with elevated urban area air pollutants.[55] A third study in the Czech Republic found evidence that the mother's exposure to air pollution may even alter the immune systems of the fetus.[56]

Air Pollution Linked to Increased Risk to Newborns and Infants

As the World Health Organization concluded, evidence shows that air pollution, especially particle pollution, increases the risk of infant death. Earlier this year researchers published a study looking at the infant deaths in the U.S. from 1999 to 2002. They confirmed the risk from particle pollution and found evidence that ozone may also increase the risk of sudden infant death syndrome, or SIDS.[57]

Researchers from Yale University looked at the records of over 350,000 babies born in Connecticut and Massachusetts with low birth weights to see if they could identify any relationships with outdoor air pollutants. The researchers concluded that air pollution may increase the risk of babies being born with low birth weight, even though almost all the air pollutants were at levels that were officially listed as safe by the U.S. Environmental Protection Agency.[58]

Air Pollution Linked to Asthma Attacks, New Onset of Asthma

A 2003 study followed children with asthma by having their mothers track their symptoms on a daily basis. The study found that children with asthma were particularly vulnerable to ozone even at levels then officially considered safe.[59] An accompanying editorial warned, "Air pollution is one of the most under-appreciated contributors to asthma exacerbation."[60]

A recent study suggests that year-round exposure to ozone may be associated with an increased risk of the development of asthma. While more research is needed to confirm this finding, researchers tracking 3,500 students in Southern California found an increased onset of asthma in children who were taking part in three or more outdoor activities in communities with high levels of ozone.[61]

Air Pollution Increases Risk of Underdeveloped Lungs

Another finding from the Southern California Children's Health study looked at the long-term effects of particle pollution on teenagers. Tracking 1,759 children between ages 10 and 18, researchers found that those who grew up in more polluted areas face the increased risk of having underdeveloped lungs, which may never recover to their full capacity. The average drop in lung function was 20 percent below what was expected for the child's age, similar to the impact of growing up in a home with parents who smoked.[62]

Community health studies are pointing to less obvious, but serious effects from year-round exposure to ozone, especially for children. Scientists followed 500 Yale University students and determined that living just four years in a region with high levels of ozone and related co-pollutants was associated with diminished lung function and frequent reports of respiratory symptoms.[63] A much larger study of 3,300 school children in Southern California found reduced lung function in girls with asthma and boys who spent more time outdoors in areas with high levels of ozone.[64]

Cleaning Up Pollution Can Reduce Risk to Children

There is also real-world evidence that reducing air pollution can help protect children. Two new studies published in 2005 added more weight to the argument.

Changes in air pollution from the reunification of Germany proved a real-life laboratory. Both East and West Germany had different levels and sources of particles. Outdoor particle levels were much higher in East Germany, where they came from factories and homes. West Germany had higher concentrations of traffic-generated particles. After reunification, emissions from the factories and homes dropped, but traffic increased. A German study explored the impact on the lungs of six-year olds from both East and West Germany. Total lung capacity improved with the lower particle levels. However, for those children living near busy roads, the increased pollution from the increased traffic kept them from benefiting from the overall cleaner air.[65]

In Switzerland, particle pollution dropped during a period in the 1990s. Researchers there tracked 9,000 children over a nine-year period, following their respiratory symptoms. After taking other factors such as family characteristics and indoor air pollution into account, the researchers noted that during the years with less pollution, the children had fewer episodes of chronic cough, bronchitis, common cold, and conjunctivitis symptoms.[66]

In this country, the 1996 Olympics in Atlanta, Georgia remains one of the most interesting cases. Atlanta is a prime example of an urban area with a history of serious ozone problems. The determined efforts of the city to reduce traffic during the Olympics succeeded in not just reducing congestion, but in improving the health of children with asthma. Concerned with an expected traffic nightmare, the city brought in more buses, more subway cars, and encouraged ridesharing and telecommuting during the Summer Olympic Games. These measures created a prolonged period of low ozone pollution that resulted in significantly lower rates of childhood asthma events for children aged 1 to 16. The number of asthma acute care events (e.g., treatment and hospitalization) decreased 42 percent in the Georgia Medicaid claims files. Pediatric emergency departments also saw significant reductions, as did the Georgia Hospital Discharge Database and a health maintenance organization database. It is important to note researchers determined that weather was not the determining factor in the reduced ozone levels.[67]

Living Near Highways May Be Especially Dangerous

Being in heavy traffic, or living near a road may be even more dangerous than being in other places in a community. Several studies have found that the vehicle emissions coming directly from those highways may be higher than in the community as a whole, increasing the risk of harm to people who live or work near busy roads.

Children and teenagers are among the most vulnerable—though not the only ones at risk. A new European study found infants and young children exposed to air pollution from traffic faced a greater risk of wheezing.[68] In Southern California, a 2007 study found that air pollution can limit the capacity of the lungs in 10- to 18-year-olds who live within about one-third of a mile of a freeway. Changes such as that can reduce their capacity to breathe for the rest of their lives and increase their risk of serious lung diseases. Other recent research found that children who live near freeways had higher risk of being diagnosed with asthma.[69,70] However, children are certainly not the only ones at risk. Studies have found increased risk of premature death from living near a major highway or an urban road.[71] Another study found an increase in risk of heart attacks from being in traffic, whether driving or taking public transportation.[72]

How to Protect Yourself from Ozone and Particle Pollution

To minimize your exposure to ozone and particle pollution:

- Pay attention to forecasts for high air pollution days to know when to take precautions;
- Avoid exercising near high-traffic areas;
- Avoid exercising outdoors when pollution levels are high, or substitute an activity that requires less exertion;
- Eliminate indoor smoking; and
- Reduce the use of fireplaces and wood-burning stoves.

Bottom line: Help yourself and everyone else breathe easier. Support national, state and local efforts to clean up sources of pollution. Your life and the life of someone you love may depend on it.

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Description of Methodology

Statistical Methodology: The Air Quality Data

Data Sources

The data on air quality throughout the United States were obtained from the U.S. Environmental Protection Agency's Air Quality System (AQS), formerly called Aerometric Information Retrieval System (AIRS) database. The American Lung Association contracted with Dr. Allen S. Lefohn, A.S.L. & Associates, Helena, Montana, to characterize the hourly averaged ozone concentration information and the 24-hour averaged $PM_{2.5}$ concentration information for the 3-year period for 2004-2006 for each monitoring site.

Design values for the annual $PM_{2.5}$ concentrations by county were collected from data previously summarized by the U.S. Environmental Protection Agency (EPA) and were used as received from the EPA on October 31, 2007 in personal correspondence from Mr. Mark Schmidt, EPA.

Ozone Data Analysis

The 2004, 2005, and 2006 AQS hourly ozone data were used to calculate the daily 8-hour maximum concentration for each ozone-monitoring site. The data were considered for a 3-year period for the same reason that the EPA uses 3 years of data to determine compliance with the ozone: to prevent a situation in any single year, where anomalies of weather or other factors create air pollution levels, which inaccurately reflect the normal conditions. The highest 8-hour daily maximum concentration in each county for 2004, 2005, and 2006, based on the EPA-defined ozone season, was identified.

Using these results, A.S.L. & Associates prepared a table by county that summarized, for each of the 3 years, the number of days the ozone level was within the ranges identified by the EPA based on the EPA Air Quality Index. The Air Quality Index then in place used the 1997 National Ambient Air Quality Standard set at 0.084 ppm. Those ranges are:

0.000 – 0.064 ppm	Good (Green)
0.065 – 0.084 ppm	Moderate (Yellow)
0.085 – 0.104 ppm	Unhealthy for Sensitive Groups (Orange)
0.105 – 0.124 ppm	Unhealthy (Red)
0.125 – 0.374 ppm	Very Unhealthy (Purple)

No data capture criteria were used to eliminate monitoring sites. All data within the ozone season were used in the analysis because it was the goal to identify the number of days that 8-hour daily maximum concentrations occurred within the defined ranges.

Following receipt of the above information, the American Lung Association identified the number of days each county, with at least one ozone monitor, experienced air quality designated as orange, red, or purple.

Short-term Particle Pollution Data Analysis

A.S.L. & Associates identified the maximum daily 24-hour AQS $PM_{2.5}$ concentration for each county in 2004, 2005, and 2006 with monitoring information. Using these results, A.S.L. & Associates prepared a table by county that summarized, for each of the 3 years, the number of days the maximum of the ***daily*** $PM_{2.5}$ concentration was within the ranges identified by EPA based on the EPA Air Quality Index, adjusted by the American Lung Association as discussed below:

from 0.0 $\mu g/m^3$ to 15.4 $\mu g/m^3$	Good (Green)
from 15.5 $\mu g/m^3$ to 35.0 $\mu g/m^3$	Moderate (Yellow)
from 35.1 $\mu g/m^3$ to 65.4 $\mu g/m^3$	Unhealthy for Sensitive Groups (Orange)
from 65.5 $\mu g/m^3$ to 150.4 $\mu g/m^3$	Unhealthy (Red)
from 150.5 $\mu g/m^3$ to 250.4 $\mu g/m^3$	Very Unhealthy (Purple)
greater than or equal to 250.5 $\mu g/m^3$	Hazardous (Maroon)

On September 21, 2006, the EPA announced a revised 24-hour National Ambient Air Quality standard for $PM_{2.5}$, changing the standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. The EPA has not yet announced changes to the Air Quality Index based on the new standard. However, the Lung Association adjusted the level of the category "Unhealthy for Sensitive Groups" to include the new standard, making that category range from 35.1 $\mu g/m^3$ to 65.4 $\mu g/m^3$.

No data capture criteria were used to eliminate monitoring sites. All data were used in the analysis because it was the goal to identify the number of days that the maximum in each county of the daily AIRS $PM_{2.5}$ concentration occurred within the defined ranges. Only 24-h averaged PM data were used. Included in the analysis are data collected using only FRM and FEM methods, which reported 24-h averaged data. As instructed by the Lung Association, A.S.L. & Associates included the exceptional and natural events that were identified in the database and identified for the Lung Association the dates and monitoring sites that experienced such events.

Following receipt of the above information, the American Lung Association identified the number of days each county, with at least one $PM_{2.5}$ monitor, experienced air quality designated as orange, red, purple or maroon.

Description of County Grading System

Ozone and Short-term Particle Pollution (24-hour $PM_{2.5}$)

The grades for ozone and short-term particle pollution (24-hour $PM_{2.5}$) were based on a weighted average for each county calculated using the Air Quality Index as noted above. The number of orange days experienced by each county was assigned a factor of 1, red days a factor of 1.5, purple days a factor of 2 and maroon days a factor of 2.5. By multiplying the total number of days within each category by their assigned factor, a total was determined. Because the monitoring data were collected over a three-year period, the total was divided by three to determine the weighted average. Each county's grade was determined using the weighted average. Counties were ranked by weighted average. Metropolitan areas were ranked by the highest weighted average among the counties in the defined Metropolitan Statistical Area. In 2006, the White House Office of Management and Budget published revised definitions for the nation's Metropolitan Statistical Areas. Therefore, comparisons between MSAs of the *State of the Air 2008* report and earlier *State of the Air* reports should be made with caution.

All counties with a weighted average of zero (corresponding to no exceedances of the 8-hour standard over the three year period) were given a grade of "A." Counties with a weighted average of 0.3 to 0.9 (corresponding to 1 to 2 orange days) received a "B." Counties receiving a "C" had only 3 to 6 days over the standard, including at most one red day, and scored a weighted average of 1.0 to 2.0. Counties received a "D" if they had a weighted average of 2.1 to 3.2, which meant they had 7 to 9 days over the standard. Counties with weighted averages of 3.3 or higher (corresponding to approximately the 8-hour standard) received an "F." These counties generally had at least 10 orange days or 9 days over the standard with at least one or more days in the red or purple or maroon category. The number of days for an "F" grade was set to roughly correlate with the number of days that would place a county in nonattainment for the ozone standard. For short-term particle pollution, the number of days required for an F would roughly approximate a 99th percentile form of the $PM_{2.5}$, a form the American Lung Association supports.

Grading System

Grade	Weighted Average	Approximate Number of Allowable Orange/Red/Purple/Maroon days
A	0.0	None
B	0.3 to 0.9	1 to 2 orange days with no red
C	1.0 to 2.0	3 to 6 days over the standard: 3 to 5 orange with no more than 1 red OR 6 orange with no red
D	2.1 to 3.2	7 to 9 days over the standard: 7 total (including up to 2 red) to 9 orange with no red
F	3.3 or higher	9 days or more over the standard: 10 orange days or 9 total including at least 1 or more red or purple

Weighted averages allow comparisons to be drawn based on severity of air pollution. For example, if one county had 9 orange days and 0 red days, it would earn a weighted average of 3.0 and a D grade. However, another county which had only 8 orange days, but also had 2 red days, which signify days with more serious air pollution, would receive an F. That second county would have a weighted average of 3.7.

Note that this system differs significantly from the methodology the EPA uses to determine violations of both the ozone standard and the 24-hour $PM_{2.5}$. the EPA determines whether a county violates the standard based on the 4^{th} maximum daily 8-hour ozone reading each year averaged over three years. Multiple days of unhealthy air beyond the highest four in each year are not considered. By contrast, the system used in this report recognizes when a community's air quality repeatedly results in unhealthy air throughout the three years. Consequently, some counties will receive grades of "F" in this report showing repeated instances of unhealthy air, while still meeting the EPA's 1997 ozone standard or the 1-hour ozone standard set in 1979. The EPA adopted a new ozone standard on March 12, 2008. This grading system has not been adjusted to reflect the new standard.

Year-round particle pollution (Annual $PM_{2.5}$)

Since no comparable Air Quality Index exists for year-round particle pollution (annual $PM_{2.5}$), the grading was based on the EPA's determination of violations of the national ambient air quality standard for annual $PM_{2.5}$ of 15 µg/m^3, as reported October 31, 2007 in personal correspondence from Mark Schmidt, EPA. Counties that the EPA listed as being in attainment of the standard were given grades of "Pass." Counties that the EPA listed as being in nonattainment were given grades of "Fail." Where insufficient data existed for the EPA to determine attainment or nonattainment, those counties received a grade of "Incomplete." Counties were ranked by design value. Metropolitan areas were ranked by the design value among the counties in the Metropolitan Statistical Area as of 2006 as defined by the White House Office of Management and Budget. The design value is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by the EPA to determine whether or not the air quality in a county meets the standard.

The Lung Association received critical assistance from members of the National Association of Clean Air Administrators, formerly known as the State and Territorial Air Pollution Control Administrators and the Association of Local Air Pollution Control Administrators. With their assistance, all state and local agencies were provided the opportunity to review and comment on the data in draft tabular form. The Lung Association reviewed all discrepancies with the agencies and, if needed, with Dr. Lefohn at A.S.L. and Associates. Questions about the annual PM design values were referred to Mr. Schmidt of the EPA, who reviewed and had final decision on those determinations. The American Lung Association wishes to express its continued appreciation to the state and local air directors and to Mr. Schmidt of the EPA for their willingness to assist in ensuring that the characterized data used in this report are correct.

Calculations of Populations-at-Risk

Presently county-specific measurements of the number of persons with chronic lung disease and other chronic conditions are not generally available. (The primary exception to this is asthma, as state-specific estimates for adult asthma are available through one national survey discussed below.) In order to assess the magnitude of lung disease and other chronic conditions at the state and county levels, we have employed a synthetic estimation technique originally developed by the U.S. Bureau of the Census. This method uses age-specific national estimates of self-reported lung disease and other conditions to project the prevalence of disease by county.

Population Estimates

The U.S. Census Bureau estimated data on the total population of each county in the United States for 2006. The Census Bureau also estimated the age-specific breakdown of the population by county.

Prevalence Estimates

Chronic Bronchitis, Emphysema, Pediatric Asthma and Cardiovascular Disease. In 2006, the National Health Interview Survey (NHIS) estimated the nationwide annual prevalence of diagnosed chronic bronchitis at 9.5 million; the nationwide lifetime prevalence of emphysema was estimated at 4.1 million. The NHIS estimates the prevalence of diagnosed pediatric asthma to be over 6.8 million under age 18. The NHIS estimates the prevalence of cardiovascular disease (CV) at 74.6 million among adults age 18 years and over, which includes coronary heart disease, hypertension, stroke, angina pectoris and heart attack.

Due to the revision of the Health Interview Survey questionnaire, prevalence estimates from the *American Lung Association State of the Air 2000* cannot be compared to later publications. Estimates for chronic bronchitis and emphysema can be compared to the *State of the Air* reports for 2001 through 2008. Furthermore, estimates for chronic bronchitis and emphysema cannot be summed since they represent different types of prevalence estimates.

Pediatric asthma prevalence estimates from this year's report can only be compared to those in the *State of the Air* reports since 2004 and not the *State of the Air* reports from 2000 through 2003 due to a change to the National Health Interview Survey.

Local area prevalence of chronic bronchitis, emphysema, pediatric asthma and CV disease are estimated by applying age-specific national prevalence rates from the 2006 NHIS to age-specific county-level resident populations obtained from the U.S. Bureaus of the Census web site. Prevalence estimates for chronic bronchitis, emphysema and CV disease are calculated for those 18 to 44, 45 to 64 and 65+. The prevalence estimate for pediatric asthma is calculated for those under age 18.

Adult Asthma. In 2006, the Behavioral Risk Factor Surveillance System (BRFSS) survey indicated that approximately 8.5% of adults residing in the United States reported currently having asthma. The information on adult asthma obtained from the Behavioral Risk Factor Surveillance System survey cannot be compared with pediatric asthma estimates that are derived from the National Health Interview Survey.

The prevalence estimate for adult asthma is calculated for those 18 to 44, 45 to 64 and 65+. Local area prevalence of adult asthma is estimated by applying age-specific state prevalence rates from the 2006 BRFSS to age-specific county-level resident populations obtained from the U.S. Bureaus of the Census web site.

Diabetes Estimates. In 2006, the National Health Interview Survey estimated the nationwide lifetime prevalence of diabetes at 17.1 million. Local area prevalence of diabetes is estimated by applying age-specific national prevalence rates from the 2006 NHIS to age-specific county-level resident populations obtained from the U.S. Bureaus of the Census web site. Prevalence estimates for diabetes are calculated for those 18 to 44, 45 to 64 and 65+.

Limitations of Estimates. Since the statistics presented by the NHIS and the BRFSS are based on a sample, they will differ (due to random sampling variability) from figures that would be derived from a complete census, or case registry of people in the United States with these diseases. The results are also subject to reporting, non-response and processing errors. These types of errors are kept to a minimum by methods built into the survey.

Additionally, a major limitation of both surveys is that the information collected represents self-reports of medically diagnosed conditions, which may underestimate disease prevalence since not all individuals with these conditions have been properly diagnosed. However, the NHIS is the best available source that depicts the magnitude of chronic disease on the national level and the BRFSS is the best available source for state-specific adult asthma information. The conditions covered in the survey may vary considerably in the accuracy and completeness with which they are reported.

Local estimates of chronic diseases are scaled in direct proportion to the base population of the county and its age distribution. No adjustments are made for other factors that may affect local prevalence (e.g. local prevalence of cigarette smokers or occupational exposures) since the health surveys that obtain such data are rarely conducted on the county level. Because the estimates do not account for geographic differences in the prevalence of chronic and acute diseases, the sum of the estimates for each of the counties in the United States may not exactly reflect the national estimate derived by the NHIS or state estimates derived by the BRFSS.

REFERENCES

Irwin, R. Guide to Local Area Populations U.S. Bureau of the Census Technical Paper Number 39 (1972).

National Center for Health Statistics. Raw Data from the National Health Interview Survey, United States, 2006. Calculations by the American Lung Association Research and Program Services Division using SPSS and SUDAAN software.

Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System, 2006.

Population Estimates Branch, U.S. Bureau of the Census. County Resident Population Estimates, by Age, Sex, and Race: July 1, 2006.

Office of Management and Budget. Update of Statistical Areas Definitions and Guidance on Their Uses. OMB Bulletin 07-01 December 18, 2006.

Notes for State Data Table

1. **Total Population** is based on 2006 US Census and represents the at-risk populations in counties with ozone or $PM_{2.5}$ pollution monitors; it does not represent the entire state's sensitive populations.
2. Those **18 & under** and **65 & over** are vulnerable to ozone and $PM_{2.5}$. They should not be used as population denominators for disease estimates.
3. **Pediatric asthma** estimates are for those under 18 years of age and represent the estimated number of people who had asthma in 2006 based on national rates (NHIS) applied to county population estimates (US Census).
4. **Adult asthma** estimates are for those 18 years and older and represent the estimated number of people who had asthma during 2006 based on state rates (BRFSS) applied to county population estimates (US Census).
5. **Chronic bronchitis** estimates are for adults 18 and over who had been diagnosed within 2006 based on national rates (NHIS) applied to county population estimates (US Census).
6. **Emphysema** estimates are for adults 18 and over who have been diagnosed within their lifetime based on national rates (NHIS) applied to county population estimates (US Census).
7. **CV disease** estimates are for adults 18 and over who had been diagnosed within 2006 based on national rates (NHIS) applied to county population estimates (US Census). CV disease includes coronary heart disease, hypertension, stroke, angina pectoris and heart attack.
8. **Diabetes** estimates are for adults 18 and over who have been diagnosed within their lifetime based on national rates (NHIS) applied to county population estimates (US Census).
9. Adding across rows does not produce valid estimates. For example, because of differences in the surveys used to gather the information, adding pediatric and adult asthma does not produce an accurate estimate of total population with asthma. Adding emphysema and chronic bronchitis will double count people with both diseases.
10. Changes to the county grades and monitoring from those found in the 2007 report are noted on the last page of each state's section.

AT-RISK GROUPS

County	Total Population	Under 18	65 & Over	Lung Diseases: Pediatric Asthma	Lung Diseases: Adult Asthma	Lung Diseases: Chronic Bronchitis	Lung Diseases: Emphysema	CV Disease	Diabetes
BELL CO	29,544	6,745	4,214	626	1,869	1,000	452	8,128	1,861
BOONE CO	110,080	29,549	9,339	2,742	6,481	3,318	1,270	24,354	5,618
BOYD CO	49,371	10,504	7,650	975	3,212	1,736	809	14,392	3,295
BULLITT CO	72,851	17,443	6,763	1,619	4,501	2,325	917	17,377	4,010
CAMPBELL CO	86,866	21,290	11,147	1,976	5,367	2,849	1,252	22,750	5,218
CARTER CO	27,365	6,484	3,597	602	1,700	900	394	7,176	1,644
CHRISTIAN CO	66,989	21,627	7,208	2,007	3,619	1,881	780	14,498	3,317
DAVIESS CO	93,613	23,225	13,348	2,155	5,788	3,109	1,424	25,485	5,835
EDMONSON CO	12,054	2,597	1,775	241	776	416	189	3,391	776
FAYETTE CO	270,789	59,718	28,538	5,542	16,956	8,752	3,487	65,826	15,133
FRANKLIN CO	48,183	10,635	6,149	987	3,094	1,644	720	13,106	3,012
GRAVES CO	37,872	9,034	6,007	838	2,369	1,283	606	10,723	2,449
GREENUP CO	37,374	8,127	6,056	754	2,424	1,319	627	11,075	2,533
HANCOCK CO	8,636	2,266	1,027	210	525	278	121	2,212	509
HARDIN CO	97,087	25,587	10,841	2,374	5,829	3,061	1,291	23,834	5,478

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HIGH OZONE DAYS 2004-2006 / PARTICLE POLLUTION DAYS 2004-2006

	High Ozone Days					Particle Pollution 24-Hour					Annual	
County	Orange	Red	Purple	Wgt. Avg	Grade	Orange	Red	Purple	Wgt. Avg	Grade	Design Value	Pass/ Fail
BELL CO	0	0	0	0.0	A	0	0	0	0.0	A	14	PASS
BOONE CO	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC
BOYD CO	2	0	0	0.7	B	5	0	0	1.7	C	14.4	PASS
BULLITT CO	1	0	0	0.3	B	5	0	0	1.7	C	14.7	PASS
CAMPBELL CO	8	1	0	3.2	D	5	0	0	1.7	C	*	INC
CARTER CO	1	0	0	0.3	B	5	0	0	1.7	C	12	PASS
CHRISTIAN CO	1	0	0	0.3	B	3	0	0	1.0	C	12.8	PASS
DAVIESS CO	3	0	0	1.0	C	7	0	0	2.3	D	*	INC
EDMONSON CO	0	0	0	0.0	A	0	0	0	0.0	A	*	INC
FAYETTE CO	0	0	0	0.0	A	6	0	0	2.0	C	14.7	PASS
FRANKLIN CO	DNC	DNC	DNC	DNC	DNC	5	0	0	1.7	C	13.2	PASS
GRAVES CO	*	*	*	*	*	DNC	DNC	DNC	DNC	DNC	DNC	DNC
GREENUP CO	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC
HANCOCK CO	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC
HARDIN CO	0	0	0	0.0	A	4	0	0	1.3	C	13.3	PASS

Notes:
(1) The weighted average was derived by adding the three years of individual level data (2004-2006), multiplying the sums of each level by the assigned standard weights, i.e. 1=orange, 1.5=red, 2.0=purple and calculating the average. (2) Asterisk (*) indicates incomplete monitoring data for all three years. Therefore, those counties are excluded from the grade analysis or received an Incomplete. (3) DNC indicates that data on that particular pollutant is not collected in that county. (4) Grades are as follows: A=0.0, B=0.3-0.9, C=1.0-2.0, D=2.1-3.2, F=3.3+.
(2) The Design Value is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by EPA to determine whether the air quality in a county meets the standard. The source for the Design Values is EPA, communication from the Office of Air Quality Planning & Standards, Mark Schmidt, October 31, 2007.

AT-RISK GROUPS

County	Total Population	Under 18	65 & Over	Lung Diseases: Pediatric Asthma	Adult Asthma	Chronic Bronchitis	Emphysema	CV Disease	Diabetes
HENDERSON CO	45,666	10,774	6,150	1,000	2,876	1,538	690	12,441	2,854
JEFFERSON CO	701,500	170,460	94,048	15,819	43,706	23,355	10,468	188,862	43,318
JESSAMINE CO	44,790	11,079	4,529	1,028	2,715	1,403	560	10,564	2,430
KENTON CO	154,911	40,432	16,689	3,752	9,360	4,910	2,056	38,053	8,758
LAUREL CO	56,979	13,792	6,818	1,280	3,518	1,851	790	14,514	3,332
LIVINGSTON CO	9,797	1,985	1,572	184	648	352	166	2,940	673
MADISON CO	79,015	17,355	8,163	1,611	4,893	2,502	971	18,522	4,251
MCCRACKEN CO	64,950	14,820	10,299	1,375	4,170	2,271	1,081	19,080	4,367
MCLEAN CO	9,844	2,251	1,498	209	626	338	157	2,798	640
OHIO CO	23,844	5,571	3,443	517	1,498	803	365	6,554	1,500
OLDHAM CO	55,285	13,072	4,294	1,213	3,471	1,789	688	13,170	3,055
PERRY CO	29,753	6,979	3,625	648	1,872	991	429	7,845	1,804
PIKE CO	66,860	14,786	8,551	1,372	4,297	2,286	1,004	18,256	4,196
PULASKI CO	59,749	13,432	9,643	1,246	3,800	2,056	969	17,168	3,920
SCOTT CO	41,605	10,672	3,536	990	2,464	1,252	468	9,071	2,090
SIMPSON CO	17,180	4,282	2,266	397	1,053	560	248	4,495	1,030
TRIGG CO	13,399	2,927	2,355	272	864	473	230	4,032	920
WARREN CO	101,266	23,076	10,997	2,141	6,269	3,240	1,302	24,496	5,625
TOTALS	**2,625,067**	**632,576**	**322,135**	**58,703**	**162,610**	**85,841**	**36,983**	**677,190**	**155,453**

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	HIGH OZONE DAYS 2004-2006					PARTICLE POLLUTION DAYS 2004-2006						
						24-Hour					Annual	
County	Orange	Red	Purple	Wgt. Avg	Grade	Orange	Red	Purple	Wgt. Avg	Grade	Design Value	Pass/ Fail
HENDERSON CO	0	0	0	0.0	A	5	0	0	1.7	C	13.6	PASS
JEFFERSON CO	6	0	0	2.0	C	30	0	0	10.0	F	15.4	FAIL
JESSAMINE CO	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC
KENTON CO	3	0	0	1.0	C	8	0	0	2.7	D	14.2	PASS
LAUREL CO	DNC	DNC	DNC	DNC	DNC	1	0	0	0.3	B	*	INC
LIVINGSTON CO	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC
MADISON CO	DNC	DNC	DNC	DNC	DNC	2	0	0	0.7	B	13.5	PASS
MCCRACKEN CO	0	0	0	0.0	A	7	0	0	2.3	D	13.1	PASS
MCLEAN CO	*	*	*	*	*	DNC	DNC	DNC	DNC	DNC	DNC	DNC
OHIO CO	*	*	*	*	*	*	*	*	*	*	*	INC
OLDHAM CO	7	0	0	2.3	D	DNC	DNC	DNC	DNC	DNC	DNC	DNC
PERRY CO	0	0	0	0.0	A	0	0	0	0.0	A	12.7	PASS
PIKE CO	0	0	0	0.0	A	2	0	0	0.7	B	13.3	PASS
PULASKI CO	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC
SCOTT CO	*	*	*	*	*	DNC	DNC	DNC	DNC	DNC	DNC	DNC
SIMPSON CO	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC
TRIGG CO	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC
WARREN CO	0	0	0	0.0	A	3	0	0	1.0	C	13.9	PASS

Ozone
- Boone County, Edmondson County, Fayette County, Jessamine County and McCracken County improved their grades from a B to an A.
- Boyd County's grade improved from a D to a B.
- Campbell County's grade improved from an F to a D.
- Christian County's grade improved from a C to B.
- Daviess County's grade dropped from a B to a C.
- McLean County no longer has sufficient data to receive a grade.
- Oldham County's grade dropped from a C to a D.

PM
- Bell County's and Perry County's grade improved from a B to an A.
- Edmonson County now has sufficient data to receive a grade.
- McCracken County's grade dropped from a C to a D.
- Pike County's grade improved from a C to a B.
- Campbell County and Laurel County no longer have sufficient data to receive a grade for their annual levels.
- Fayette County's grade improved from failing to passing for their annual levels.
- Henderson County now has sufficient data to receive a grade for their annual levels.

Notes:
(1) The weighted average was derived by adding the three years of individual level data (2004-2006), multiplying the sums of each level by the assigned standard weights, i.e. 1=orange, 1.5=red, 2.0=purple and calculating the average. (2) Asterisk (*) indicates incomplete monitoring data for all three years. Therefore, those counties are excluded from the grade analysis or received an Incomplete. (3) DNC indicates that data on that particular pollutant is not collected in that county. (4) Grades are as follows: A=0.0, B=0.3-0.9, C=1.0-2.0, D=2.1-3.2, F=3.3+.
(2) The Design Value is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard, and is used by EPA to determine whether the air quality in a county meets the standard. The source for the Design Values is EPA, communication from the Office of Air Quality Planning & Standards, Mark Schmidt, October 31, 2007.

Beginning our second century, the American Lung Association works to prevent lung disease and promote lung health. Asthma is the leading serious chronic childhood illness. Lung diseases and breathing problems are the primary causes of infant deaths in the United States today. Smoking remains the nation's number one preventable cause of chronic illness. Lung disease death rates continue to increase while other major causes of death have declined.

The American Lung Association has long funded vital research to discover the causes and seek improved treatments for those suffering with lung disease. We are the foremost defender of the Clean Air Act and laws that protect citizens from secondhand smoke. The Lung Association teaches children the dangers of tobacco use and helps teenage and adult smokers overcome addiction. We help children and adults living with lung disease to improve their quality of life. With your generous support, the American Lung Association is "Improving life, one breath at a time."

For more information about the American Lung Association
or to support the work we do, call
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