

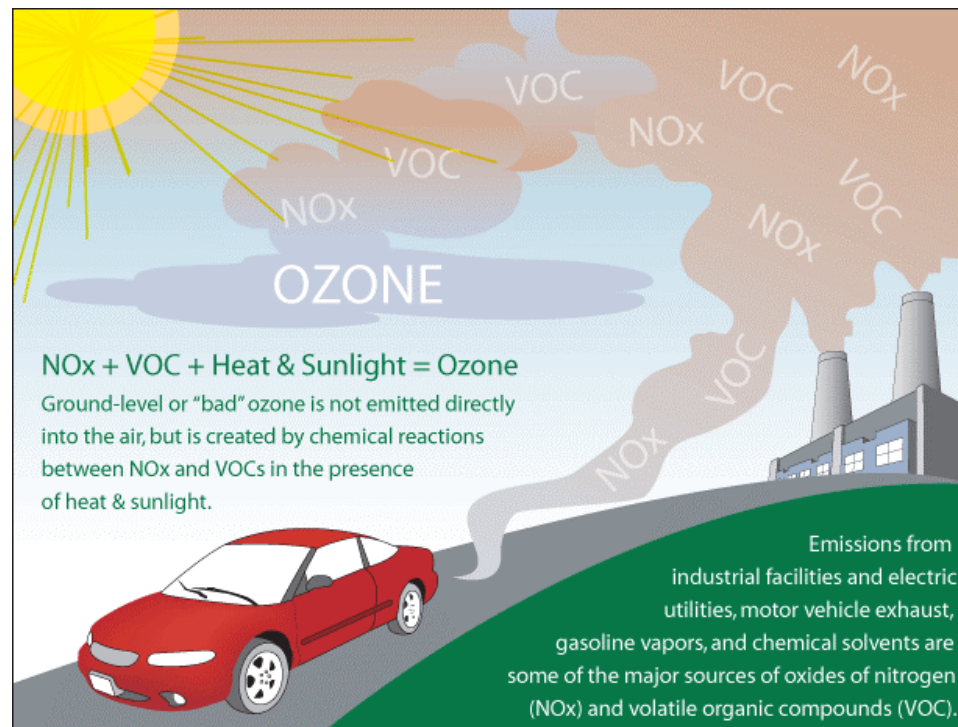
Sierra Ozone Summit

Homework Reading

Ozone

Ozone is a gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere and at ground level. Ozone can be good or bad, depending on where it is found:

- **Good Ozone.** Ozone occurs naturally in the Earth's upper atmosphere - 6 to 30 miles above the Earth's surface - where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. Manmade chemicals are known to destroy this beneficial ozone. An area where the protective "ozone layer" has been significantly depleted-for example, over the North or South pole-is sometimes called "the ozone hole." The United States, along with over 180 other countries, recognized the threats posed by ozone depletion and in 1987 adopted a treaty called the Montreal Protocol to phase out the production and use of ozone-depleting substances. EPA has established regulations to phase out ozone-depleting chemicals in the United States. [Learn more](#)
- **Bad Ozone.** In the Earth's lower atmosphere, near ground level, ozone is formed when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. Ozone at ground level is a harmful air pollutant.



from http://airnow.gov/index.cfm?action=jump.jump_ozone

Air Quality 101

Introduction

All kinds of activities contribute to polluting the air we breathe. In addition to industrial causes of pollution, day-to-day activities such as driving, filling your car with gas, dry cleaning, and using household paint can release gases and particles to the air. In high enough concentrations, these pollutants can harm our environment and us.

The average adult breathes over 3,000 gallons of air every day. Children breathe even more air per pound of body weight and are more susceptible to air pollution. The elderly are also more sensitive to air pollution because they often have heart or lung disease.

People exposed to high enough levels of certain air pollutants may experience burning in their eyes, an irritated throat, or breathing difficulties. Long-term exposure to air pollution can cause cancer and long-term damage to the immune, neurological, reproductive, and respiratory systems. In extreme cases, it can even cause death.

What is the Air Quality Index?

Like the weather, air quality can change from day to day or even hour to hour. The U.S. Environmental Protection Agency (EPA) and others are working to make information about outdoor air quality as available to the public as information about the weather. A key tool in this effort is the Air Quality Index, or AQI.

The AQI is an index for forecasting daily air quality. It tells you how clean or polluted your air is, and what associated health concerns you should be aware of. The AQI focuses on health effects that can happen within a few hours or days after breathing polluted air.

EPA uses the AQI for five major air pollutants regulated by the Clean Air Act: [ground-level ozone](#), [particulate matter](#), [carbon monoxide](#), [sulfur dioxide](#) and [nitrogen dioxide](#). For each of these pollutants, EPA has established national air quality standards to protect against harmful health effects.

[You can select a regional Air Quality Forecast on The Weather Channels Air Quality welcome page.](#), or by going to your local air quality management district site. For Northern Sierra Air Quality Management District: www.myairdistrict.com

What do the color codes mean?

EPA has assigned a specific color to each AQI category to make it easier for people to understand quickly the significance of forecasted air pollution levels in their communities. For example, the color orange means that conditions are "unhealthy for sensitive groups"; the color red means that conditions may be "unhealthy" for everyone, and so on. [See the Air Quality Legend for details.](#)

How is the Air Quality Index calculated?

To measure air quality, networks of monitors record the concentrations of the major pollutants at more than a thousand locations across the U.S. each day. These raw measurements are then converted into AQI values using standard formulas developed by EPA. An AQI value is calculated for each of the individual pollutants in an area (ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide).

The pollutant with the highest AQI is used as the overall AQI reading for that day and is listed as the principal pollutant.

Ozone (O₃)

Ground-level ozone is an air pollutant that causes human health problems even at very low levels. It also damages crops and other vegetation. It is a key ingredient of urban smog.

"Good ozone" occurs naturally in the Earth's upper atmosphere -- 10 to 30 miles above the Earth's surface -- where it shields us from the sun's harmful ultraviolet rays.

"Bad ozone" is formed in the Earth's lower atmosphere, near ground level, when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. Ozone pollution is a concern during the summer months when the weather conditions needed to form ground-level ozone -- lots of sun, hot temperatures -- normally occur.

The length of the ozone season varies from one area of the United States to another. Southern and Southwestern states may have an ozone season that lasts nearly the entire year.

What are the health effects?

- Ozone can irritate lung airways and cause inflammation much like a sunburn. Other symptoms include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people who are active outdoors can be affected when ozone levels are high.
- Repeated exposure to ozone pollution for several months may cause permanent lung damage. Anyone who spends time outdoors in the summer is at risk, particularly children and other people who are active outdoors.
- Even at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.
- Ozone damage can occur without any noticeable signs. People who live in areas where ozone levels are frequently high may find that their initial symptoms go away over time -- particularly when exposure to high ozone levels continues for several days. Ozone continues to cause lung damage even when the symptoms have disappeared.

Who is at risk?

Several groups of people are particularly sensitive to ozone -- especially when they are active outdoors -- because physical activity causes people to breathe faster and more deeply.

- Active children are the group at highest risk from ozone exposure because they often spend a large part of the summer playing outdoors. Children are also more likely to have asthma, which may be aggravated by ozone exposure.

- Active adults of all ages who exercise or work vigorously outdoors have a higher level of exposure to ozone than people who are less active.
- People with asthma or other respiratory diseases that make the lungs more vulnerable to the effects of ozone will generally experience health effects earlier and at lower ozone levels than less sensitive individuals.
- People with unusual susceptibility to ozone. Scientists don't yet know why, but some healthy people may experience health effects at more moderate levels of outdoor exertion or at lower ozone levels than the average person.

In general, as concentrations of ground-level ozone increase, more and more people experience health effects, the effects become more serious, and more people are admitted to the hospital for respiratory problems. When ozone levels are very high, everyone should be concerned about ozone exposure. [Find out what you can do to help reduce pollution on high-ozone days.](#)

Avoiding unhealthy exposure to ground-level ozone

Your chances of being affected by ozone increase the longer you are active outdoors and the more strenuous the activity you engage in. If you're involved in an activity that requires heavy exertion, you can reduce the time you spend on this activity or substitute another activity that requires more moderate exertion (e.g., go for a walk rather than a jog).

In addition, you can plan outdoor activities when ozone levels are lower, usually in the morning or evening.

Examples of activities that involve moderate exertion include climbing stairs, playing tennis or baseball, simple garden or construction work, and light jogging, cycling, or hiking.

Activities that involve heavy exertion include playing basketball or soccer, chopping wood, heavy manual labor, and vigorous running, cycling, or hiking.

Because fitness levels vary widely among individuals, what is moderate exertion for one person may be heavy exertion for another. No matter how fit you are, cutting back on the level or duration of exertion when ozone levels are high will help protect you from ozone's harmful effects.

What are the environmental effects?

- Ground-level ozone interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather.
- Ozone damages the leaves of trees and other plants, diminishing the attractiveness of cities, national parks, and recreation areas.
- Ozone reduces crop and forest yields and increases plant vulnerability to disease, pests, and harsh weather.

Air Quality Advisory

Your State or local air quality agency may call an "Air Quality Advisory" when ozone levels are forecast to reach unhealthy levels. These programs, often partnerships with local businesses, encourage voluntary actions to reduce emissions of pollutants that contribute to ground level ozone information.

On high-ozone days, take these special steps to help reduce pollution:

- Choose a cleaner commute -- share a ride to work or use public transportation.
- Combine errands and reduce trips. Walk to errands when possible.
- Avoid excessive idling of your automobile.
- Refuel your car in the evening when it's cooler.
- Conserve electricity and set air conditioners no lower than 78 degrees.
- Use household, workshop and garden chemicals in ways that minimize evaporation, or try to delay using them when ozone levels are high.
- Defer lawn and gardening chores that use gasoline-powered equipment, or wait until evening.

Follow these tips every day to reduce pollution:

- Conserve energy -- at home, at work, everywhere.
- Follow gasoline refueling instructions for efficient vapor recovery, being careful not to spill fuel and always tightening your gas cap securely.
- Keep car, boat and other engines tuned-up according to manufacturer's specifications.
- Be sure your tires are properly inflated.
- Carpool, use public transportation, bike, or walk whenever possible.
- Use environmentally safe paints and cleaning products whenever possible.
- What you can do: [Get more tips on reducing pollution](#)

Particulate Matter (PM10 and PM2.5)

Particulate matter, or PM, is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. These particles can cause coughing and painful breathing and can aggravate asthma.

The particle mix in most U.S. cities is dominated by fine particles known as **PM2.5** (less than 2.5 micrometers in diameter), with smaller amounts of coarse dust known as **PM10** (between 2.5 and 10 micrometers in diameter). These two categories of particles pose a health concern because they are small enough that they can be inhaled into -- and accumulate in -- the respiratory system.

Sources of fine particles include all types of combustion (motor vehicles, power plants, wood burning, etc.) and some industrial processes. Sources of coarse particles include crushing or grinding operations and dust from paved or unpaved roads.

What are the health effects and who is most at risk?

Both fine and coarse particles can accumulate in the respiratory system and are associated with numerous health effects. Coarse particles can aggravate respiratory conditions such as asthma. Exposure to fine particles is associated with several serious health effects, including premature death. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more).

- When exposed to PM, people with existing heart or lung diseases -- such as asthma, chronic obstructive pulmonary disease, congestive heart disease, or ischemic heart disease -- are at increased risk of premature death or admission to hospitals or emergency rooms
- The elderly also are sensitive to PM exposure. They are at increased risk of admission to hospitals or emergency rooms and premature death from heart or lung diseases.
- When exposed to PM, children and people with existing lung disease may not be able to breathe as deeply or vigorously as they normally would, and they may experience symptoms such as coughing and shortness of breath.
- PM can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases, such as asthma and chronic bronchitis, causing more use of medication and more doctor visits.

What are the environmental effects?

Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include:

- Making lakes and streams acidic
- Changing the nutrient balance in coastal waters and large river basins
- Depleting the nutrients in soil
- Damaging sensitive forests and farm crops
- Affecting the diversity of ecosystems

Other effects:

- PM is the major cause of reduced visibility (haze) in parts of the United States, including many national parks.
- Soot, a type of PM, stains and damages stone and other materials, including culturally important objects such as monuments and statues.

Sulfur Dioxide (SO₂)

Sulfur dioxide contributes to respiratory illness, particularly in children and the elderly, and aggravates asthma and existing heart and lung diseases. Because it dissolves easily in water, sulfur dioxide also contributes to the formation of acid rain.

Sulfur dioxide, or SO₂, belongs to the family of sulfur oxide gases. Sulfur oxide gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore.

Over 65 percent of SO₂ released to the air, or more than 13 million tons per year, comes from electric utilities, especially those that burn coal. Other sources of SO₂ are industrial facilities that derive their products from raw materials like metallic ore, coal and crude oil, or that burn coal or oil to produce process heat. Examples are petroleum refineries, cement manufacturing, and metal processing facilities. Locomotives, large ships, and some diesel equipment currently burn high sulfur fuel and release SO₂ emissions to the air in large quantities.

What are the health effects and who is most at risk?

- Children and adults with asthma who are active outdoors are most vulnerable to the health effects of sulfur dioxide. The primary effect they experience, even with brief exposure, is a narrowing of the airways (called bronchoconstriction), which may cause symptoms such as wheezing, chest tightness, and shortness of breath. Symptoms increase as sulfur dioxide concentrations and/or breathing rates increase. When exposure ceases, lung function typically returns to normal within an hour.
- At very high levels, sulfur dioxide may cause wheezing, chest tightness, and shortness of breath in people who do not have asthma.
- Long-term exposure to both sulfur dioxide and fine particles can cause respiratory illness, alter the lung's defense mechanisms, and aggravate existing cardiovascular disease. People who may be most susceptible to these effects include individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly.

What are the environmental effects?

- Visibility impairment: Haze occurs when light is scattered or absorbed by particles and gases in the air. Sulfate particles are the major cause of reduced visibility in many parts of the U.S., including national parks.
- Acid rain: SO₂ and nitrogen oxides react with other substances in the air to form acids, which fall to earth as rain, fog, snow or dry particles. Some may be carried by the wind for hundreds of miles.
- Plant and water damage: Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure over a long time changes the natural variety of plants and animals in an ecosystem.
- Aesthetic damage: SO₂ accelerates the decay of building materials and paints, including irreplaceable monuments, statues and sculptures.

Nitrogen Dioxide (NO₂)

Nitrogen dioxide belongs to a family of highly reactive gases called nitrogen oxides. These gases form when fuel is burned at high temperatures, and come principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers.

A suffocating, brownish gas, nitrogen dioxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates. It also plays a major role in the atmospheric reactions that produce [ground-level ozone](#) (or smog).

What are the health effects and who is most at risk?

- In children and adults with respiratory disease, such as asthma, nitrogen dioxide can cause respiratory symptoms such as coughing, wheezing, and shortness of breath. Even short exposures to nitrogen dioxide affect lung function.
- In children, short-term exposure can increase the risk of respiratory illness.
- Animal studies suggest that long-term exposure to nitrogen dioxide may increase susceptibility to respiratory infection and may cause permanent structural changes in the lungs.

What are the environmental effects?

Nitrogen oxides contribute to ozone formation and can have adverse effects on both terrestrial and aquatic ecosystems. Nitrogen oxides in the air can significantly contribute to a number of environmental effects such as acid rain and eutrophication in coastal waters like the Chesapeake Bay. (Eutrophication occurs when a body of water suffers an increase in nutrients that leads to a reduction in the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life.)

Carbon Monoxide (CO)

Carbon monoxide, or CO, is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Carbon monoxide is a health concern because, at high levels, it is poisonous even to healthy people. It also can affect people with heart disease.

Sources of carbon monoxide include:

- Motor vehicle exhaust, which contributes about 56 percent of all CO emissions in the United States.
- Other non-road engines and vehicles (such as construction equipment and boats), which contribute about 22 percent of all CO emissions nationwide.
- Other sources of CO emissions include industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires.
- Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are sources of CO indoors.

The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. The air pollution becomes trapped near the ground beneath a layer of warm air.

What are the health effects and who is most at risk?

Carbon monoxide can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.

- **Cardiovascular Effects:** The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects.
- **Central Nervous System Effects:** Even healthy people can be affected by high levels of CO. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death.

What are the environmental effects?

CO contributes to the formation of [ground-level ozone](#), which can trigger serious respiratory problems.

What You Can Do to Reduce Air Pollution

Although much of the pollution in our air comes from power plants, industrial sources and motor vehicles, the choices you, as an individual, make every day can increase or decrease air pollution and can protect or threaten your health. You have the power to change your home, transportation, and consumer habits to help reduce air pollution.

At home

Here is what you can do to pollute less and save some money:

- Use compact florescent lights with energy-efficiency lighting and other energy-efficient appliances. To learn more about energy-efficient appliances visit the [Energy Star](#) Web site.
- Turn off appliances and lights when you leave the room.
- Use the microwave to cook small meals. (It uses less power than an oven.)
- Plant deciduous trees in locations around your home to provide shade in the summer, but to allow light in the winter.
- Recycle paper, plastic, glass bottles, cardboard and aluminum cans. (This conserves energy and reduces production emissions.)
- Reuse materials like paper bags and boxes when you can.
- Properly dispose of household paints, solvents and pesticides. Store these materials in airtight containers. For information on handling solid waste visit the [EPA's solid waste](#) page. For questions about solid waste management call 1-800-424-9346.
- Paint with a brush, not a sprayer.
- Keep woodstoves and fireplaces well maintained.
- Purchase "Green Power" for you home's electricity. (Contact your power supplier to see where and if it is available.)
- Have leaky air conditioning and refrigeration systems repaired.
- Cut back on air conditioning and heating use if you can.
- Turn thermostat down in the winter and up in the summer.
- Insulate your home, water heater and pipes.

- Have air conditioning systems checked in the Spring and heating systems checked in the Fall.
- Follow professional advice on how to check filters monthly. These tips can save money from more serious repairs down the road as well as insure cleaner air.

Buy smart

Everything you buy has an effect on the environment. When you buy products that consume less energy and last longer than others, you not only pollute the air less, you send a message to industry that you want them to produce environmentally responsible products. Here's what you can do when it's time to shop:

- Buy ENERGY STAR products, including cars and houses. They are environmentally friendly products approved by EPA. For more information visit the ENERGY STAR website at <http://www.energystar.gov/> or call 1-888-STAR-YES.
- Choose efficient, low-polluting models of vehicles. For more information visit the Vehicle Emissions Guide at <http://www.epa.gov/autoemissions/>
- Choose recycled products.
- Choose products that have less packaging and are reusable.

Drive wise

Transportation consumes about 25-percent of the total energy used in the United States. When people drive they are responsible for releasing harmful chemicals into the air. When, where, how, why and what you drive all play an important role in affecting air pollution. Here are some suggestions on how to be more environmentally friendly when you need to get somewhere:

- Drive less, especially during peak traffic periods or hot days.
- Use public transportation, walk or ride a bike.
- Shop by phone, mail or Internet.
- Telecommute.
- Combine your errands into one trip.
- Avoid revving or idling engine over 30 seconds.
- Avoid waiting in long drive-through lines. Turn off your car and go in.
- Accelerate gradually, maintain speed limit and use cruise control on the highway.
- Follow your owner's manual on recommendations for maximum economic efficiency.
- Use an energy-conserving (E.C.) grade of motor oil.
- Minimize use of air conditioning if you can.
- Get regular engine tune ups and car maintenance checks (especially for the spark plugs).
- Use EPA-certified facilities for air conditioner repair. (Call facilities to find out before going.)
- Find out if materials are recycled when you change your tires, "throw away" your car or change car fluids.
- Ask before your car is serviced and consider going to someone who is environmentally friendly.
- Replace your car's air filter and oil regularly.

- Keep your tires properly inflated and aligned.
- Repair all vehicle leaks.
- Fill gas tank during cooler evening hours to cut down on evaporation.
- Avoid spilling gas and don't "top off" the tank. Replace gas tank cap tightly.
- Look for the most efficient, lowest-polluting model of vehicle. For more information visit the [Green Vehicles Guide Web page](#).
- Don't ignore the "check engine" or "service engine soon" light if it comes on. Make an appointment with your repair technician for diagnosis soon. For more information, read the [EPA's FAQ](#) page for fixing your car's emissions system.

Be informed

Knowledge is power. Share what you know with your family and friends. You can also contact your state or local air pollution agency about how to become involved in local air pollution control issues.

Source: U.S. Environmental Protection Agency (EPA)

from <http://www.weather.com/activities/health/airquality/airquality101/index.html>