Competitive Exams: Air Pollution

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort thumans or other living organisms, or damages the natural environment, intthe atmosphere.

The atmosphere is a complex, dynamic natural gaseous system that is essential tsupport life on planet Earth. Stratospheric ozone depletion due tair pollution has long been recognized as a threat thuman health as well as tthe Earth's ecosystems.

Before flue gas desulfurization was installed, the emissions from this power plant in New Mexiccontained excessive amounts of sulfur dioxide.

An air pollutant is known as a substance in the air that can cause harm thumans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone. One of the many secondary pollutants that make up photochemical smog.

Note that some pollutants may be both primary and secondary: That is, they are both emitted directly and formed from other primary pollutants.

About 4 percent of deaths in the United States can be attributed tair pollution, according tthe Environmental Science Engineering Program at the Harvard School of Public Health.

Major Pollutants

Major Pollutants

Major primary pollutants produced by human activity include:

- Sulfur oxides (SO_x) -especially sulfur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.

- Nitrogen oxides (NOx) -especially nitrogen dioxide are emitted from high temperature combustion. Can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO_2 is one of the most prominent air pollutants.

- Carbon monoxide-is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.

- Carbon dioxide (CO_2) -a greenhouse gas emitted from combustion but is alsa gas vital tliving organisms. It is a natural gas in the atmosphere.

- Volatile organic compounds-VOCs are an important outdoor air pollutant. In this field they are often divided intthe separate categories of methane (CH_4) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes tenhanced global warming. Other hydrocarbon VOCs are alssignificant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead tleukemia through prolonged exposure. 1, 3-butadiene is another dangerous compound which is often associated with industrial uses.

- Particulate matter-Particulates, alternatively referred tas particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers tparticles and the gas together. Sources of particulate matter can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes alsgenerate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols those made by human activities currently account for about 10 percent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked thealth hazards such as heart disease, altered lung function and lung cancer.

- Persistent free radicals connected tairborne fine particles could cause cardiopulmonary disease.

- Toxic metals, such as lead, cadmium and copper.

- Chlorofluorocarbons (CFCs) -harmful tthe ozone layer emitted from products currently banned from use.

- Ammonia (NH_3) -emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly tthe nutritional needs of terrestrial organisms by serving as a precursor tfoodstuffs and fertilizers. Ammonia, either directly or indirectly, is alsa building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.

- Odors such as from garbage, sewage, and industrial processes
- Radioactive pollutants-produced by nuclear explosions, war explosives, and natural processes such as the radioactive decay of radon.

Secondary Pollutants

Secondary pollutants include:

- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by sunlight tform secondary pollutants that alscombine with the primary emissions tform photochemical smog.
- Ground level ozone (O_3) formed from NOx and VOCs. Ozone (O_3) is a key constituent of the troposphere (it is alsan important constituent of certain regions of the stratosphere commonly known as the Ozone layer). Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant, and a constituent of smog.
- Peroxyacetyl nitrate (PAN) -similarly formed from NOx and VOCs.

Minor Air Pollutants

- A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive.
- A variety of persistent organic pollutants, which can attach tparticulate matter. Persistent organic pollutants (POPs) are organic compounds that are resistant tenvironmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed tpersist in the environment, tbe capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and thave potential significant impacts on human health and the environment. Controlled burning of a field outside of Statesboro, Georgia in preparation for spring planting

Sources of Air Pollution

Sources of air pollution refer tthe various locations, activities or factors which are responsible for the releasing of pollutants in the atmosphere. These sources can be classified into major categories which are:

Anthropogenic Sources

These human activity mostly related tburning different kinds of fuel

- "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices
- "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
- Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents
- Waste deposition in landfills, which generate methane. Methane is not toxic; however, it is highly flammable and may form explosive mixtures with air. Methane is alsan asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced tbelow 19.5% by displacement
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry

Natural Sources

- Dust from natural sources, usually large areas of land with little or nvegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered tbe a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and carbon monoxide from wildfires.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

Emission Factors

Air pollutant emission factors are representative values that attempt trelate the quantity of a pollutant released tthe ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e. g. kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed tbe representative of long-term averages.

The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a multitude of industrial sources. The United Kingdom, Australia, Canada and many other countries have published similar compilations, as well as the European Environment Agency.

Indoor Air Quality (IAQ)

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate intdust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates intthe air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors. Chronic carbon monoxide poisoning can result even from poorly adjusted pilot lights. Traps are built intall domestic plumbing tkeep sewer gas, hydrogen sulfide, out of interiors. Clothing emits tetrachloroethylene, or other dry cleaning fluids, for days after dry cleaning.

Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure tasbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea (shortness of breath) and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken tdistinguish between several forms of relevant diseases. According tthe World Health Organisation (WHO), these may defined as; asbestosis, lung cancer, and mesothelioma (generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure tasbestos).

Biological sources of air pollution are alsfound indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micrometre-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires'disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants taccumulate more than they would otherwise occur in nature.

Health Effects

The World Health Organization states that 2.4 million people die each year from causes directly attributable tair pollution, with 1.5 million of these deaths attributable tindoor air pollution. "Epidemiological studies suggest that more than 500, 000 Americans die each year from cardiopulmonary disease linked tbreathing fine particle air pollution…" A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and air pollution from motor vehicles. Worldwide more deaths per year are linked tair pollution than tautomobile accidents. Published in 2005 suggests that 310, 000 Europeans die from air pollution annually. Direct causes of air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases, and respiratory allergies. The US EPA estimates that a proposed set of changes in diesel engine technology (Tier 2) could result in 12, 000 fewer premature mortalities, 15, 000 fewer heart attacks, 6, 000 fewer emergency room visits by children with asthma, and 8, 900 fewer respiratory-related hospital admissions each year in the United States.

The worst short term civilian pollution crisis in India was the 1984 Bhopal Disaster. Leaked industrial vapors from the Union Carbide factory, belonging tUnion Carbide, Inc. USA. killed more than 2, 000 people outright and injured anywhere from 150, 000 t600, 000 others, some 6, 000 of whom would later die from their injuries. The United Kingdom suffered its worst air pollution event when the December 4 Great Smog of 1952 formed over London. In six days more than 4, 000 died, and 8, 000 more died within the following months. An accidental leak of anthrax spores from a biological warfare laboratory in the former USSR in 1979 near Sverdlovsk is believed thave been the cause of hundreds of civilian deaths. The worst single incident of air pollution toccur in the United States of America occurred in Donora, Pennsylvania in late October, 1948, when 20 people died and over 7, 000 were injured.

The health effects caused by air pollutants may range from subtle biochemical and physiological changes tdifficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions tair pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.

A new economic study of the health impacts and associated costs of air pollution in the Los Angeles Basin and San Joaquin Valley of Southern California shows that more than 3800 people die prematurely (approximately 14 years earlier than normal) each year because air pollution levels violate federal standards. The number of annual premature deaths is considerably higher than the fatalities related tautcollisions in the same area, which average fewer than 2, 000 per year.

Diesel exhaust (DE) is a major contributor tcombustion derived particulate matter air pollution. In several human experimental studies, using a well validated exposure chamber setup, DE has been linked tacute vascular dysfunction and increased thrombus formation. This serves as a plausible mechanistic link between the previously described association between particulate matter air pollution and increased cardiovascular morbidity and mortality.

Effects on Cystic Fibrosis

A study from 1999 t2000 by the University of Washington showed that patients near and around particulate matter air pollution had an increased risk of pulmonary exacerbations and decrease in lung function. Patients were examined before the study for amounts of specific pollutants like Pseudomonas aeruginosa or Burkholderia cenocepacia as well as their socioeconomic standing. Participants involved in the study were located in the United States in close proximity tan Environmental Protection Agency. [clarification needed] During the time of the study 117 deaths were associated with air pollution. A trend was noticed that patients living closer or in large metropolitan areas tbe close tmedical help alshad higher level of pollutants found in their system because of more emissions in larger cities. With cystic fibrosis patients already being born with decreased lung function everyday pollutants such as smoke emissions from automobiles, tobaccsmoke and improper use of indoor heating devices could add tthe disintegration of lung function.

Effects on COPD

Chronic obstructive pulmonary disease (COPD) include diseases such as chronic bronchitis, emphysema, and some forms of asthma.

A study conducted in 1960 – 1961 in the wake of the Great Smog of 1952 compared 293 London residents with 477 residents of Gloucester, Peterborough, and Norwich, three towns with low reported death rates from chronic bronchitis. All subjects were male postal truck drivers aged 40 t59. Compared tthe subjects from the outlying towns, the London subjects exhibited more severe respiratory symptoms (including cough, phlegm, and dyspnea), reduced lung function (FEV1 and peak flow rate), and increased sputum production and purulence. The differences were more pronounced for subjects aged 50 t59. The study controlled for age and smoking habits, sconcluded that air pollution was the most likely cause of the observed differences.

It is believed that much like cystic fibrosis, by living in a more urban environment serious health hazards become more apparent. Studies have shown that in urban areas patients suffer mucus hypersecretion, lower levels of lung function, and more self diagnosis of chronic bronchitis and emphysema. [23]

The Great Smog of 1952 in London

Early in December 1952, a cold fog descended upon London. Because of the cold, Londoners began tburn more coal than usual. The resulting air pollution was trapped by the inversion layer formed by the dense mass of cold air. Concentrations of pollutants, coal smoke in particular, built up dramatically. The problem was made worse by use of low-quality, high-sulphur coal for home heating in London in order tpermit export of higher-quality coal, because of the country's tenuous postwar economic situation. The “fog” or smog, was sthick that driving became difficult or impossible. The extreme reduction in visibility was accompanied by an increase in criminal activity as well as transportation delays and a virtual shut down of the city. During the 4 day period of fog, at least 4, 000 people died as a direct result of the weather.

Effects on Children

Cities around the world with high exposure tair pollutants have the possibility of children living within them tdevelop asthma, pneumonia and other lower respiratory infections as well as a low initial birth rate. Protective measures tensure the youths'health are being taken in cities such as New Delhi, India where buses now use compressed natural gas thelp eliminate the pea-soup smog. Research by the World Health Organization shows there is the greatest concentration of particulate matter particles in countries with low economic world power and high poverty and population rates. Examples of these countries include Egypt, Sudan, Mongolia, and Indonesia. The Clean Air Act was passed in 1970, however in 2002 at least 146 million Americans were living in areas that did not meet at least one of the criteria pollutants laid out in the 1997 National Ambient Air Quality Standards. Those pollutants included: Ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. Because children are outdoors more and have higher minute ventilation they are more susceptible tthe dangers of air pollution.

Health Effects in Relatively “Clean” Areas

Even in areas with relatively low levels of air pollution, public health effects can be substantial and costly. This is because effects can occur at very low levels and a large number of people can potentially breathe in such pollutants. A 2005 scientific study for the British Columbia Lung Association showed that a 1% improvement in ambient PM2.5 and ozone concentrations will produce a $29 million in annual savings in the region in 2010. This finding is based on health valuation of lethal (mortality) and sub-lethal (morbidity) effects.

Reduction Efforts

There are various air pollution control technologies and land use planning strategies available treduce air pollution. At its most basic level land use planning is likely tinvolve zoning and transport infrastructure planning. In most developed countries, land use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population as well as tprotect the environment.

Efforts treduce pollution from mobile sources includes primary regulation (many developing countries have permissive regulations), expanding regulation tnew sources (such as cruise and transport ships, farm equipment, and small gas-powered equipment such as lawn trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid vehicles), conversion tcleaner fuels (such as bioethanol, biodiesel, or conversion telectric vehicles).

Control Devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted intthe atmosphere.

- Particulate control Mechanical collectors (dust cyclones, multicyclones), Electrostatic precipitators An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream. Baghouses Designed thandle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters tremove the dust).
- Particulate scrubbers Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought intcontact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, to remove the pollutants.
- Dioxin and furan control
- Scrubbers

Types of Scrubbers

1. Baffle spray scrubber
2. Cyclonic spray scrubber
3. Ejector venturi scrubber
4. Mechanically aided scrubber
5. Spray tower
6. Wet scrubber

NOx Control

1. Low NOx burners
2. Selective catalytic reduction (SCR)
3. Selective non-catalytic reduction (SNCR)
4. NOx scrubbers
5. Exhaust gas recirculation

6. Catalytic converter (alsfor VOC control)

VOC Abatement

1. Adsorption systems, such as activated carbon
2. Flares
3. Thermal oxidizers
4. Catalytic oxidizers
5. Biofilters
6. Absorption (scrubbing)
7. Cryogenic condensers
8. Vapor recovery systems

Acid Gas/SO2 Control

1. Wet scrubbers
2. Dry scrubbers
3. Flue gas desulfurization

Mercury Control

1. Sorbent Injection Technology
2. Electro-Catalytic Oxidation (ECO)
3. K-Fuel

Miscellaneous Associated Equipment

1. Source capturing systems
2. Continuous emissions monitoring systems (CEMS)

Legal Regulations

The examples and perspective in this article may not represent a worldwide view of the subject. Please improve this article and discuss the issue on the talk page.

Smog in Cairo

In general, there are twtypes of air quality standards. The first class of standards (such as the US National Ambient Air Quality Standards) set maximum atmospheric concentrations for specific pollutants. Environmental agencies enact regulations which are intended tresult in attainment of these target levels. The second class (such as the North American Air Quality Index) take the form of a scale with various thresholds, which is used tcommunicate tthe public the relative risk of outdoor activity. The scale may or may not distinguish between different pollutants.

Canada

In Canada, air quality is typically evaluated against standards set by the Canadian Council of Ministers of the Environment (CCME), an inter-governmental body of federal, provincial and territorial Ministers responsible for the environment. The CCME has set Canada Wide Standards (CWS). These are:

Note that there is nconsequence in Canada tnot achieving these standards. In addition, these only apply tjurisdictions with populations greater than 100, 000. Further, provinces and territories may set more stringent standards than those set by the CCME.

- CWS for PM2.5 = 30 µg/m3 (24 hour averaging time, by year 2010, based on 98th percentile ambient measurement annually, averaged over 3 consecutive years).
- CWS for ozone = 65 ppb (8-hour averaging time, by year 2010, achievement is based on the 4th highest measurement annually, averaged over 3 consecutive years).

European Union

A report from the European Environment Agency shows that road transport remains Europe's single largest air polluter.

National Emission Ceilings (NEC) for certain atmospheric pollutants are regulated by NECD Directive 2001/81/EC (NECD). As part of the preparatory work associated with the revision of the NECD, the European Commission is assisted by the NECPI working group (National Emission Ceilings Policy Instruments).

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (the new Air Quality Directive) has entried intforce 2008 – 06 – 11.

Individual citizens can force their local councils ttackle air pollution, following an important ruling in July 2009 from the European Court of Justice (ECJ). The EU's court was asked tjudge the case of a resident of Munich, Dieter Janecek, whsaid that under the 1996 EU Air Quality Directive (Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management) the Munich authorities were obliged ttake action tstop pollution exceeding specified targets. Janecek then took his case tthe ECJ, whose judges said European citizens are entitled tdemand air quality action plans from local authorities in situations where there is a risk that EU limits will be overshot.

United Kingdom

Air quality targets set by the UK's Department for Environment, Food and Rural Affairs (DEFRA) are mostly aimed at local government representatives responsible for the management of air quality in cities, where air quality management is the most urgent. The UK has established an air quality network where levels of the key air pollutants are published by monitoring centers. Air quality in Oxford, Bath and London is particularly poor. One controversial study performed by the Calor Gas company and published in the Guardian newspaper compared walking in Oxford on an average day tsmoking over sixty light cigarettes.

More precise comparisons can be collected from the UK Air Quality Archive which allows the user tcompare a cities management of pollutants against the national air quality objectives set by DEFRA in 2000.

DEFRA acknowledges that air pollution has a significant effect on health and has produced a simple banding index system is used tcreate a daily warning system that is issued by the BBC Weather Service tindicate air pollution levels. DEFRA has published guidelines for people suffering from respiratory and heart diseases.

Localized peak values are often cited, but average values are alsimportant thuman health. The UK National Air Quality Information Archive offers almost real-time monitoring of “current maximum” air pollution measurements for many UK towns and cities. This source offers a wide range of constantly updated data, including:

- Hourly Mean Ozone ($\mu g/m^3$)
- Hourly Mean Nitrogen dioxide ($\mu g/m^3$)
- Maximum 15-Minute Mean Sulphur dioxide ($\mu g/m^3$)
- 8-Hour Mean Carbon monoxide (mg/m^3)
- 24-Hour Mean PM10 ($\mu g/m^3$ Grav Equiv)

United States

In the 1960s, 70s, and 90s, the United States Congress enacted a series of Clean Air Acts which significantly strengthened regulation of air pollution. Individual US states, some European nations and eventually the European Union followed these initiatives. The Clean Air Act sets numerical limits on the concentrations of a basic group of air pollutants and provide reporting and enforcement mechanisms.

In an October 2006 letter to EPA, the agency's independent scientific advisors warned that the ozone smog standard needs tbe substantially reduced and that there is nscientific justification for retaining the current, weaker standard. The scientists unanimously recommended a smog threshold of 60 t70 ppb after they conducted an extensive review of the evidence.

The EPA has proposed, in June 2007, a new threshold of 75 ppb. This is less strict than the scientific recommendation, but is more strict than the current standard.

Some industries are lobbying tkeep the current standards in place. Environmentalists and public health advocates are mobilizing tsupport the scientific recommendations.

The National Ambient Air Quality Standards are pollution thresholds which trigger mandatory remediation plans by state and local governments, subject tenforcement by the EPA.

An outpouring of dust layered with man-made sulfates, smog, industrial fumes, carbon grit, and nitrates is crossing the Pacific Ocean on prevailing winds from booming Asian economies in plumes svast they alter the climate. Almost a third of the air over Los Angeles and San Francisccan be traced directly tAsia. With it comes up tthree-quarters of the black carbon particulate pollution that reaches the West Coast.

Libertarians typically suggest proletarian methods of stopping pollution. They advocate strict liability which would hold accountable anyone whcauses polluted air temanate intsomeone else's airspace. This offense would be considered aggression, and damages could be sought in court under the common law, possibly through class action suits. Since in a libertarian society, highways would be privatized under a system of free market roads, the highway owners would alsbe held liable for pollution emanating from vehicles traveling along their property. This would give them a financial incentive tkeep the worst polluters off of their roads. In 1999, the United States EPA replaced the Pollution Standards Index (PSI) with the Air Quality Index (AQI) tincorporate new PM2.5 and Ozone standards.

The effects of these laws have been very positive. In the United States between 1970 and 2006, citizens enjoyed the following reductions in annual pollution emissions:

- carbon monoxide emissions fell from 197 million tons t89 million tons
- nitrogen oxide emissions fell from 27 million tons t19 million tons
- sulfur dioxide emissions fell from 31 million tons t15 million tons
- particulate emissions fell by 80%
- lead emissions fell by more than 98%