AIR POLLUTION INDICES

The indirect methods of expressing pollutant concentrations or levels are known as Air Pollution Indices. An Air Pollution Index can be defined as a scheme that transforms the values of individual air pollution related parameters into set of numbers.

Uses

- It helps in informing the public about air pollution levels in a particular area.
- It helps in comparing air pollution levels in different cities.
- It may be used for development of a system for avoidance or management of a severe episode of air pollution.

Types of indices

Air quality indices can be broadly classified into two groups.

1. Short term indices
2. Long term indices

Short term indices are usually intended to inform the public about daily changes in the air pollution levels. These indices are used by the local and state air pollution control agencies.

Long term indices are intended to evaluate changes in air quality over periods of several years. These indices are helpful for the purpose of assessing the effectiveness of enforcement policies with regard to pollution control measures in improving air quality.

Air pollution parameters for calculating index

The parameters are suspended particulate matter (SPM), sulphur dioxide (SO2), carbon monoxide, nitrogen dioxide, ozone and hydrocarbons.

Criteria for a standardized index

A standardized index should satisfy the following criteria:

- Easily understood by the public
- Include major pollutants
- Calculated in a simple manner
- Rest on a reasonable scientific basis
- Consistent with perceived air pollution levels
- Spatially meaningful
- Exhibit day- to- day variation
- Ralate to ambient air quality standards

Determination of index

In the first method, the existing pollution levels of various pollutants is related to their ambient air quality standards with the standard being assumed as the reference base line for each pollutant and then converting the concentration of pollutants into a percentage of the standard. The air pollution index is then obtained by adding the percentages for the several pollutants considered.

If there are six pollutants, then the equation for calculating the index will be:

$$I = 1/6 \sum Ai;\ Ai = Ci/Si * 100$$

Where Ci = concentration of pollutant i

Si = air quality standard for pollutant i

I = air pollution index

In the second method, the average of the sum of the ratios of three major pollutant concentrations to their respective air quality standards is obtained. The average is multiplied by 100 to get the index.

If three major pollutants in a city atmosphere are particulate matter, sulphur dioxide and carbon monoxide then

$$API = 1/3 ((PM)/(Spm)+(SO2)/(Sso2)+(CO)/(Sco)) *100$$

Where Spm, Sso2, Sco represent the ambient air quality standards for particulate matter, sulphur dioxide and carbon monoxide respectively.

In the third method, air pollution index is calculated from five sub indices. Each sub-index is obtained by assigning sub-index values for particular ranges of pollutant concentrations.

The index is calculated as $I = \sum Ai$ where Ai is the sub-index determined.

RATING SCALE FOR INDICES

Index value	Remarks
0-25	clean air
26-50	light air pollution
51-75	moderate air pollution
76-100	heavy air pollution
>100	severe air pollution

AIR POLLUTION CONTROL EFFORTS

TOWN PLANNING

The role of urban planning is to manage the spatial organization of cities for efficient allocation of urban use. Depending on how it is applied, urban planning can improve air quality in the long run by strategic location of infrastructure and land polluting sources and

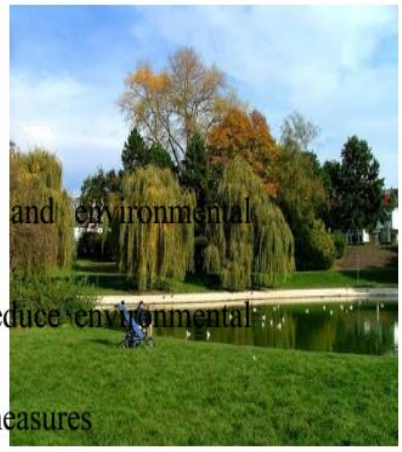
exposed population, and encouraging a city structure that would minimize pollution emissions and build-up.

- Housing, including energy efficiency, social housing, building standards
- Urban planning and development, including compact, smart cities, ageing in cities , disaster risk reduction

- Land administration, including e-governance, institutional aspects, capacity building and informal settlements

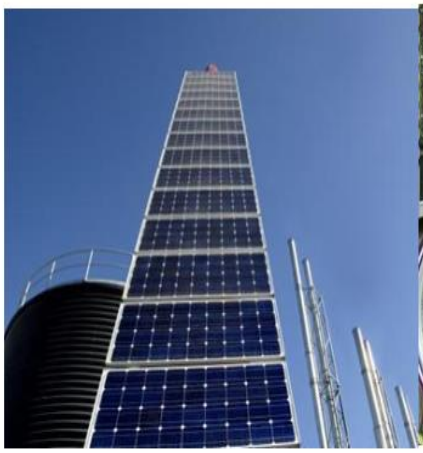
Challenges of urbanization

- Urban sprawl
- High energy consumption
- Environmental degradation
- Overpopulation and critical living conditions
- Conversion of land and green spaces into constructions and buildings
- Mobility problems and lack of infrastructures and services
- Housing issues



What are Smart Cities?

- Cities, which are ready to meet their economic, social and environmental challenges
- Cities, which strive to increase energy efficiency and to reduce environmental pollution
- Cities which plan and implement climate change mitigation measures



Smart city programme

Stakeholders

- National governments
- Local authorities and city councils of the ten pilot cities
- City planners/managers, urban architects
- Private sector/industrial players from the relevant fields
- Academia and other research institutions
- NGOs

Partners

- Housing and Land Management Unit (UNECE)
- Organization for international Economic Cooperation (OiER)
- Real Estate Institute
- Environmental Agency

Activities

- A set of indicators developed
- City profiles for 10 pilot cities
- Networking events, capacity building in transition countries

ZONING

The amount of air pollution generated by urban transport depends on the length, speed and number of motorized trips and the type of vehicles. For a given urban population, the length and number of daily trips are closely correlated with the average population density in built- up areas, and the spatial distribution of trip destinations and origins

Separating residential and industrial areas

In the interest of environmental improvement, there is a drive to earmark zones for all industry away from metropolitan areas. While strict enforcement of such zoning would improve air quality, such a policy points to conflicts between different sector objectives.

- Banning new industries in metropolitan areas exacerbates the phenomenon of increasing number of under- or unemployed workers forced into the informal sector.
- Urban-based workers have to be transported to and from their homes to far-flung industrial sites.
- Small and medium-size industries, which need urban locations to maintain profitability, are forced to operate illegally, making it more difficult to control them for labor, safety and environmental standards.

The process of establishing zoning should incorporate city-wide consultations with all the affected stakeholders. Unilateral decisions based solely on well-intentioned environmental concerns are most likely to have serious adverse social and economic impacts.

REGULATION FOR NEW INDUSTRIES, LEGISLATION AND ENFORCEMENT

Air quality laws govern the emission of air pollutants into the atmosphere. A specialized subset of air quality laws regulate the quality of air inside buildings. Air quality laws are often designed specifically to protect human health by limiting or eliminating airborne pollutant concentrations. Other initiatives are designed to address broader ecological problems, such as limitations on chemicals that affect the ozone layer, and emissions trading programs to address acid rain or climate change. Regulatory efforts include identifying and categorizing air pollutants, setting limits on acceptable emissions levels, and dictating necessary or appropriate mitigation technologies.

Regulation of industrial air pollution

Companies emitting significant levels of air pollutants are regulated by means of environmental approvals or injunctions.

Permits and inspection

The municipalities are responsible for granting permits and inspection of most companies subject to authorisation. The most polluting industries are governed by the Environmental Protection Agency's decentralised units with regard to approvals and inspection.

A company's environmental permit states the pollutant limit values for that specific company. Limit values as stipulated in permits are based on Statutory Orders issued by the Environmental Protection Agency, BAT reference documents (best available techniques), as well as air pollution and B-value guidelines.

Statutory Orders

The Environmental Protection Agency has issued various Statutory Orders over the years, which regulate air pollution from specific types of industries and plants, including branch-related Statutory Orders.

See overview of Statutory Orders and guidelines

Large combustion plants with a rated thermal input greater than 50MW

Large power/heat producing plants must comply with EU requirements for emissions of the air pollutants dust, SO2 og NOx.

Waste co-incineration plants

All facilities must comply with EU requirements for emissions of several air pollutants. Plants are obliged to measure regularly and document their compliance with emission limits for dust, total organic carbon (TOC), SO_2, NO_x and CO. In addition, they must use performance measurements to demonstrate that HCl, HF, heavy metal, as well as dioxin and furan limits are observed.

General guidelines

The Environmental Protection Agency has issued various Statutory Orders over the years. These regulate permitted levels of air pollution from a company or plant, for instance, branch-related Statutory Orders. In addition, several guidance documents have been produced by the Environmental Protection Agency for it's decentralised units, municipalities and companies that require environmental approvals.

See overview of Statutory Orders and guidelines

Air pollution and B-value guidelines

The air pollution guidelines explain how regulations limit emissions and monitor industrial pollution. They also explain the use of B-values and the OML-model (air dispersion calculations) to assess the extent of pollution by harmful substances.

Odour

Several types of industry can constitute a nuisance for their surroundings because of odours. Food and feed manufacturers, waste incineration plants and industries that use organic solvents are in particular to blame for odour problems experienced by people living nearby.

The Environmental Protection Agency's guidelines on odour set limits for odours produced by companies. Municipalities can lay down conditions for limiting odours from local industries. This is particularly relevant in areas where industry is located close to residential areas.

Branch annexes

The Environmental Protection Agency is currently drawing up branch annexes with standard conditions for several branches of industry. The standard conditions concern the equipment and operation of companies, emission limit values for significant air pollution and conditions for in-house monitoring.

Air Enforcement

EPA enforcement efforts focus on reducing flaring from industrial activities reducing pollutant emissions including volatile organic compounds and soot.

EPA regulates emissions of air pollution from mobile and stationary sources under the Clean Air Act (CAA)

Stationary Sources

Stationary sources include facilities such as factories and chemical plants, which must install pollution control equipment and meet specific emission limits under the CAA.

New Source Review (NSR) and Prevention of Significant Deterioration (PSD). These requirements require certain large industrial facilities to install state-of-the-art air pollution controls when they build new facilities or make modifications to existing facilities. Failure to install controls results in emission of pollutants that can degrade air quality and harm public health. Learn more aboutNew Source Review.

Reducing air pollution from the largest source of emissions is one of EPA's national enforcement initiatives. EPA is taking action to eliminate or minimize emissions from coal-fired power, acid, glass and cement plants and petroleum refineries.

- Coal-fired power plants. There are approximately 1,100 coal-fired electric utility units in the United States with an overall capacity of 340,000 megawatts. This sector emits approximately two-thirds of the nation's emissions inventory of sulfur dioxide (SO_2) and approximately one-third of the nitrogen oxides (NO_x). Investigations of this sector have identified a high rate of noncompliance with NSR/PSD when old plants are renovated or upgraded. Learn more about Sulfur Dioxide and Nitrogen Dioxide.
- Plants that manufacture sulfuric and nitric acid, which are used in fertilizer, chemical and explosive production. Acid production plants emit many thousands of tons of nitrogen oxides, sulfur dioxide, and sulfuric acid mist each year. EPA investigations have found a high rate of non-compliance with NSR/PSD in connection with plant expansions and process changes.
- **Glass manufacturing plants**. There are approximately 125 large glass plants operating in the United States. These plants emit approximately 200,000 tons per year of NO_x, SO_2 and particulate matter (PM). Investigation of this sector has shown that there have been a significant number of plant expansions but few applications for the installation of pollution controls required under NSR/PSD.
- Cement manufacturing plants. Cement manufacturing plants are the third largest industrial source of air pollution, emitting more than 500,000 tons per year of SO_2, NO_x and carbon monoxide. EPA determined that many cement manufacturers made changes to existing facilities without applying for and obtaining pre-construction permits. The pollution can contribute to respiratory illness and heart disease, the formation of acid rain, reduced visibility, and can be transported over long distances before falling on land or water.
- Petroleum refineries. Since 2000, EPA has engaged in an enforcement initiative specifically focused on addressing air emissions from petroleum refineries and has reached innovative, multi-issue, multi-facility settlement negotiations with major petroleum refining companies. These

settlements have resulted in significant emission reductions of NO_x, SO_2, benzene, volatile organic compounds and PM.

Air Toxics. National Emission Standard for Hazardous Air Pollutants (NESHAP). Leaks, flares, and excess emissions from refineries, chemical plants and other industries can contain hazardous air pollutants (HAPs) that are known or suspected to cause cancer, birth defects, and seriously impact the environment. Leaking equipment is the largest source of HAP emissions from petroleum refineries and chemical manufacturing facilities. Cutting emissions of air toxics EPA's National Enforcement Initiatives.

New Source Performance Standards (NSPS). Newly constructed sources or those that are modified or reconstructed must follow these standards to control excess emissions of NO_x, SO_2, and particulate matter.

Mobile sources

Motor vehicle engines and off-road vehicles and engines must meet CAA emissions standards. These standards apply to cars, trucks, buses, recreational vehicles and engines, generators, farm and construction machines, lawn and garden equipment, marine engines and locomotives. In addition, the composition of fuels used to operate mobile sources, including gasoline, diesel, ethanol, biodiesel and blends of these fuels, are also regulated under the CAA. Learn more about transportation and air quality.

New vehicles and engines must have an EPA-issued certificate of conformity before import or entry into the United States demonstrating that the engine or vehicle conforms to all applicable emissions requirements. The CAA also requires emissions labels for certified vehicles and engines. See examples of cases and settlements related to vehicles and engines.

- **Illegal imports**. Since 2008, there has been a steady flow of illegally imported uncertified motorcycles, equipment containing small gasoline-powered engines (e.g., generators, mowers, chainsaws, etc.), and recreational vehicles. Uncertified vehicles and engines can emit harmful air pollutants at 30% or more above allowable standards. EPA is working with U.S. Customs to stop illegal vehicles and engines at the ports and requiring exportation. Learn more about importing vehicles and engines.
- **Defeat devices.** It is a violation of the CAA to manufacture, sell, or install a part for a motor vehicle that bypasses, defeats, or renders inoperative any emission control device. For example, computer software that alters diesel fuel injection timing is a defeat device. Defeat devices, which are often sold to enhance engine performance, work by disabling a vehicle's emission controls, causing air pollution. As a result of EPA enforcement, some of the largest manufacturers of defeat devices have agreed to pay penalties and stop the sale of defeat devices.

- **Tampering.** The CAA prohibits anyone from tampering with an emission control device on a motor vehicle by removing it or making it inoperable prior to or after the sale or delivery to the buyer. A vehicle's emission control system is designed to limit emissions of harmful pollutants from vehicles or engines. EPA works with manufacturers to ensure that they design their components with tamper-proofing, addresses trade groups to educate mechanics about the importance of maintaining the emission control systems, and prosecutes cases where significant or imminent harm is occurring.

  Fuels. The CAA regulates fuel used in motor vehicles and non-road equipment. Clean fuels help reduce harmful emissions from a wide variety of motor vehicles, engines, and equipment.
- Standards. EPA regulations require that all fuel and fuel additives produced, imported and sold in the United States meet certain standards. EPA conducts targeted and random inspections to evaluate compliance with these standards, and brings enforcement actions against parties that violate these standards to reduce harmful emissions caused by fuel that does not meet the applicable standards. See diesel and gasoline fuels enforcement actions.
- **Renewable Fuels.** Transportation fuel sold in the U.S. must contain a minimum volume of renewable fuel to reduce greenhouse gas emissions and the use of petroleum fuels. Renewable fuel producers and importers generate renewable identification number (RINs) for each gallon of renewable fuel. Refiners and importers must acquire RINs to show compliance with the standard. EPA investigates and pursues enforcement actions against anyone generating, transferring and using invalid RINs. Learn more about renewable fuels. See Renewable Fuels Standards enforcement actions.
- Fuel Waivers. EPA, with the concurrence of the U.S. Department of Energy (DOE), has the authority to temporarily waive fuel or fuel additive requirements in emergency situations when the fuel supply suffers major disruptions. This helps ensure that an adequate supply of fuel is available, particularly for emergency vehicle needs. In such circumstances EPA works closely with state and other federal agencies to determine an appropriate response.

Ocean-Going Vessels and Large Ships. The CAA regulates new and in-use U.S. flagged compression-ignition marine engines (also called marine diesel engines), vessels containing such engines, emissions from such engines, as well as the sulfur content of marine fuel. EPA's strategy to address emissions from all ships that affect U.S. air quality includes enforcement of CAA standards, as well as implementation and enforcement of the international standards for marine engines and their fuels contained in Annex VI to the International Convention on the Prevention of Pollution from Ships (a treaty called MARPOL) under the authority of the Act to Prevent Pollution from Ships (APPS).

- **Enforcement of MARPOL Annex VI.** The EPA and the U.S. Coast Guard (USCG) agreed to jointly enforce U.S. and International air pollution requirements for vessels operating in U.S. waters. Learn more about MARPOL Annex VI.
- **Engine and Fuel Standards**. EPA regulates air pollution from various marine diesel engines. EPA has adopted standards that apply to Category 3 (C3) engines installed on U.S. vessels, such as large ships and ocean vessels, and to marine diesel fuels produced and distributed in the United States. Learn more about other marine diesel engines.

Compliance Monitoring and Assistance

EPA works with its federal, state and tribal regulatory partners through a comprehensive Clean Air Act compliance monitoring program. Compliance monitoring ensures that the regulated community obeys environmental laws/regulations through on-site inspections and record reviews that can lead to enforcement when necessary. The CAA compliance assistance program provides businesses, federal facilities, local governments and tribes with tools to help meet environmental regulatory requirements.