



- **Selecting Appropriate Multimeters for HVAC Checks**
Selecting Appropriate Multimeters for HVAC Checks Maintaining HVAC Gauges for Accurate Readings Choosing Coil Cleaners Suited to Household Needs Comparing Protective Gloves for Different Tasks Identifying Goggles Designed for Refrigerant Handling Using Screwdriver Sets for Precise Adjustments Organizing Toolkits for Efficient Site Visits Calibrating Equipment for Reliable Measurements Handling Harmful Chemicals with Proper Ventilation Safely Storing Extra HVAC Parts and Supplies Dressing for Extreme Temperatures during Repairs Assessing Essential Items for Emergency Calls
- **Examining Pollutants Affecting Air Circulation**
Examining Pollutants Affecting Air Circulation Improving Vent Placement for Even Distribution Managing Excess Humidity with Simple Techniques Using UV Lights to Minimize Microbial Growth Testing Indoor Air Quality with Basic Tools Filtering Particulates through Electrostatic Options Checking Fan Speed for Consistent Comfort Controlling Airflow Patterns across Different Rooms Maintaining Clear Ducts for Cleaner Breathing Spaces Exploring Optional Dehumidifiers for Damp Areas Balancing Comfort and Efficiency in Vent Adjustments Assessing Long Term Effects of Poor Air Quality
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When it comes to maintaining and troubleshooting mobile home HVAC systems, the importance of selecting the appropriate multimeter cannot be overstated. As a versatile tool used in diagnosing electrical issues, a multimeter is essential for ensuring that heating, ventilation, and air conditioning systems operate efficiently and safely. Selecting the right multimeter for this specific application involves considering several key factors, each contributing to precise diagnostics and effective repairs.

First and foremost, safety is paramount when dealing with HVAC systems. Mobile homes often have compact spaces where HVAC units are installed, and these confined environments can present unique challenges. A good multimeter should have adequate safety ratings such as CAT III or CAT IV, which indicate its capability to handle high voltage circuits typically found in HVAC systems without risking user safety or damaging the equipment.

Proper drainage prevents moisture buildup near HVAC units in mobile homes **hvac mobile home** pump.

Accuracy is another crucial aspect of multimeter selection. For HVAC technicians working on mobile home systems, the ability to precisely measure voltage, current, resistance, capacitance, and temperature is vital. Inaccurate readings can lead to misdiagnoses that may exacerbate existing problems or create new ones. Therefore, selecting a multimeter with high accuracy specifications ensures that measurements are reliable and repairs are done correctly.

The functionality of a multimeter also plays a significant role in its suitability for HVAC checks. While basic models provide essential measurements like voltage and resistance, advanced models offer additional features such as temperature probes and capacitance measurement capabilities-features crucial for evaluating components like thermostats or capacitors within an HVAC system. Having a multimeter with these functionalities allows technicians to perform comprehensive diagnostics without needing multiple tools.

Durability should not be overlooked either. Mobile home environments can be harsh due to fluctuating temperatures and humidity levels that might affect sensitive equipment. A robust multimeter designed to withstand such conditions ensures longevity and consistent performance over time.

Ease of use can greatly influence the efficiency of an HVAC checkup as well. Technicians need tools that provide quick readings with intuitive interfaces so they can focus more on

problem-solving than on navigating complex menus or deciphering unclear displays. Backlit screens for visibility in low-light situations commonly found in mobile homes further enhance usability.

In conclusion, choosing the right multimeter for mobile home HVAC systems is integral to achieving accurate diagnostics and facilitating efficient maintenance or repair work. With considerations ranging from safety standards to functional capabilities tailored specifically for HVAC tasks-such as measuring temperature alongside electrical properties-a well-selected multimeter becomes an indispensable asset in any technician's toolkit. Ensuring these factors align with the demands of mobile home environments ultimately contributes not only to better system performance but also enhances overall tenant comfort by maintaining optimal indoor climates year-round.

When selecting a multimeter for HVAC applications, it is crucial to identify specific features that will enhance the efficiency and accuracy of your work. The complexity of HVAC systems demands reliable tools that can tackle various tasks, from diagnosing electrical issues to ensuring optimal system performance. Therefore, choosing the right multimeter involves understanding the key features that cater specifically to the needs of HVAC professionals.

First and foremost, safety should be a top priority when working with electrical systems. A multimeter designed for HVAC use must comply with appropriate safety standards, such as CAT III or CAT IV ratings, which ensure protection against high voltages typically encountered in these environments. This feature safeguards not only your equipment but also your personal safety as you perform critical diagnostic tasks.

Accuracy and precision are equally important when it comes to selecting a multimeter for HVAC applications. Look for devices that offer True RMS (Root Mean Square) measurements, which provide more accurate readings of AC voltage and current in complex waveforms commonly found in HVAC systems. This capability ensures that you get reliable data for effective troubleshooting and maintenance.

Versatility in measurement functions is another crucial aspect to consider. An ideal multimeter should be able to measure a wide range of parameters including voltage, current, resistance, capacitance, frequency, and temperature. Temperature measurement is especially vital in HVAC applications since maintaining proper thermal conditions is essential for system efficiency. Having all these capabilities integrated into one device simplifies your toolkit and enhances productivity by allowing you to perform multiple checks without needing additional instruments.

The durability of the multimeter is also an important factor given the demanding environments in which HVAC technicians operate. Choose a model with rugged construction that can withstand physical impacts and harsh conditions often encountered on job sites. Features such as a robust casing and shock-absorbent materials contribute significantly to the longevity and reliability of your tool.

User-friendliness should not be overlooked either. A well-designed interface with clear display readouts helps prevent errors during data collection. Backlit displays improve visibility in poorly lit areas while intuitive controls streamline operation even for less experienced users. Some advanced models come equipped with wireless connectivity options or mobile app integrations allowing seamless data transfer and analysis on-the-go.

Lastly, consider additional functionalities like auto-ranging capabilities or low input impedance modes which enable more efficient diagnostics by simplifying measurements or avoiding ghost voltages respectively.

In conclusion, selecting an appropriate multimeter for HVAC applications requires careful consideration of several key features: safety compliance; accuracy through True RMS; versatile measurement functions including temperature; durable construction; user-friendly design; along with beneficial extra features tailored towards enhancing diagnostic efficiency-ensuring you have a reliable partner in maintaining optimal performance across diverse heating ventilation air conditioning systems effectively satisfying both professional requirements plus ensuring peace-of-mind during everyday operations within this technical field!

More About Us

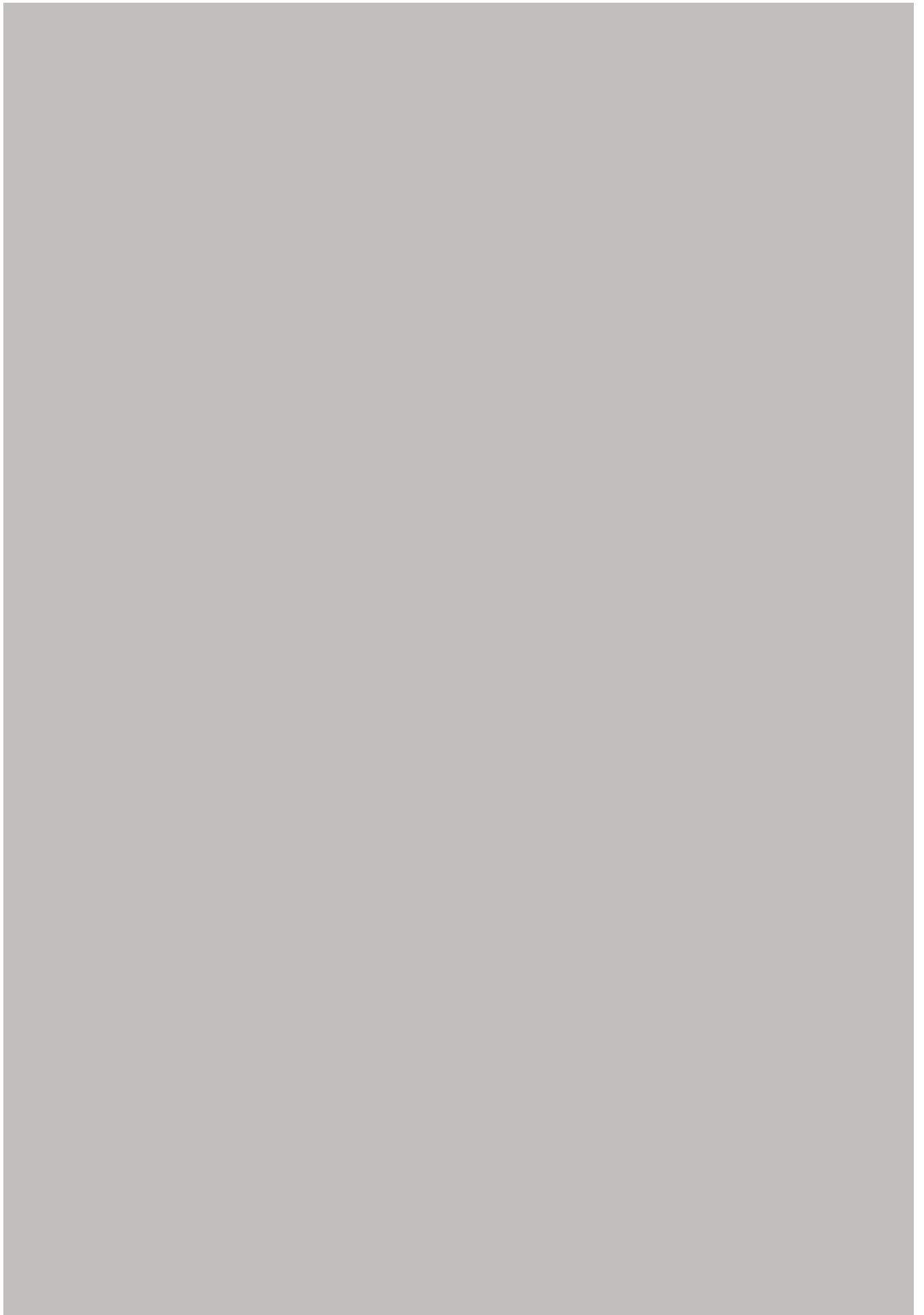
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Types of Measurements Required in Mobile Home HVAC Checks

When it comes to maintaining the efficiency and functionality of mobile home HVAC systems, conducting regular checks is essential. These checks are crucial for ensuring optimal performance and preventing potential issues that could lead to costly repairs. A vital component of these checks is the use of appropriate multimeters, which are indispensable tools for measuring various parameters within the system. Understanding the types of measurements required can significantly aid in selecting the right multimeter for HVAC checks.

Firstly, voltage measurement is a fundamental aspect of any HVAC inspection. Mobile home HVAC systems operate on specific voltage levels, and ensuring that these levels are maintained is critical for system efficiency and safety. When selecting a multimeter, it's important to choose one capable of accurately measuring both AC and DC voltage since different components may require different types of voltage readings.

Next, current measurement is another crucial parameter that needs attention during HVAC inspections. Measuring current helps determine whether the electrical flow within the system's circuits is within acceptable limits. An overly high or low current can indicate potential problems such as faulty wiring or failing components. Hence, a multimeter with precise amperage measurement capabilities becomes an indispensable tool in diagnosing such issues effectively.

Resistance measurement plays a significant role in assessing the condition of various electrical components like capacitors and coils within an HVAC system. By measuring resistance, technicians can identify signs of wear or damage that might not be immediately apparent through visual inspection alone. Therefore, selecting a multimeter with robust resistance measurement features allows for thorough evaluation of component health.

Furthermore, temperature measurement cannot be overlooked when performing mobile home HVAC checks. Temperature readings provide insights into how well different parts of the system are functioning under operational stress. Some advanced multimeters come equipped with thermocouple inputs to facilitate accurate temperature measurements at key points within an HVAC unit.

Lastly, continuity testing is another valuable function offered by many modern multimeters which helps ensure proper connection throughout the entire electrical circuit network present in an HVAC system. This feature can quickly identify breaks or shorts in wiring pathways-issues that could otherwise lead to malfunctions if left unchecked.

In conclusion, choosing an appropriate multimeter for mobile home HVAC checks requires careful consideration based on specific measurement needs: voltage accuracy across AC/DC settings; reliable current readings; comprehensive resistance analysis; thermal assessment capabilities via integrated thermocouples; plus efficient continuity testing functions all contribute towards effective diagnostics during routine maintenance procedures-ultimately safeguarding against unexpected breakdowns while optimizing energy consumption levels across household climates year-round!



Comparing Digital vs Analog Multimeters for HVAC Use

When it comes to selecting the appropriate multimeter for HVAC checks, professionals in the heating, ventilation, and air conditioning industry face the pivotal decision between digital and analog models. Both types of multimeters have their unique advantages and limitations, making this choice crucial for ensuring accurate diagnostics and efficient maintenance.

Digital multimeters have become increasingly popular in recent years due to their precision, ease of use, and versatility. These devices offer clear numerical readouts on an LCD screen, providing exact measurements that are easy to interpret. This precision can be particularly beneficial in the HVAC field where even a slight deviation from standard values can indicate significant issues within a system. Furthermore, digital multimeters often come equipped with additional features such as auto-ranging capabilities, data storage options, and even Bluetooth connectivity for advanced data analysis. These features allow HVAC technicians to perform comprehensive system diagnostics with greater efficiency.

On the other hand, analog multimeters still hold their ground due to their reliability and simplicity. An analog meter provides a visual representation of readings through a needle on a scale which some experienced technicians find easier to interpret when monitoring fluctuations or trends over time. This can be particularly useful when measuring rapidly changing signals or detecting transient events which might not be as apparent on a digital display. Additionally, analog meters tend to be more robust in harsh environments; they are less prone to damage from electrical surges or drops compared to their digital counterparts.

Cost is another factor influencing the choice between digital and analog multimeters for HVAC applications. Digital models generally come at a higher price point due to their advanced features and technology integration. However, this cost can often be justified by their enhanced accuracy and additional functionalities that streamline complex diagnostic processes. Conversely, analog meters provide an economical option without compromising on essential functions needed for basic HVAC tasks.

In terms of training and skill level required for operation, digital meters typically have a gentler learning curve thanks to intuitive interfaces that guide users through various measurement settings automatically. Analog meters may require more experience or familiarity with interpreting scale readings accurately—a skill that seasoned technicians often possess but newcomers might need time to develop.

Ultimately, selecting between digital versus analog multimeters boils down to individual preference aligned with specific job requirements within HVAC contexts. For those seeking high precision coupled with modern convenience features like logging capabilities or wireless communication options—digital is likely the way forward. However if one values durability under extreme conditions along with straightforward results interpretation—analog remains steadfastly reliable.

Both tools serve an integral role in maintaining optimal functionality across diverse HVAC systems; hence understanding each type's strengths enables informed decisions tailored

towards effective troubleshooting solutions while also accommodating personal proficiency levels among industry practitioners.

Safety Considerations When Using Multimeters in Mobile Homes

When working with HVAC systems in mobile homes, selecting the appropriate multimeter is crucial for ensuring safety and efficiency. Mobile homes present unique challenges due to their compact and often densely packed electrical systems. As such, using a multimeter that is specifically suited for these environments not only facilitates accurate diagnostics but also minimizes potential hazards.

First and foremost, it is essential to choose a multimeter with robust safety features. Look for devices that meet the CAT III or CAT IV safety ratings, as they are designed to handle higher voltage environments typical in HVAC systems. These ratings ensure that the multimeter can withstand surges and spikes that may occur when testing live circuits, thereby protecting both the user and the device from electrical accidents.

Additionally, consider a multimeter with non-contact voltage detection capabilities. This feature allows technicians to identify live wires without making direct contact, reducing the risk of electric shock-especially important in confined spaces like those found in mobile homes. The compact layouts mean there's less room to maneuver safely around wiring, so having an added layer of protection can be invaluable.

Another critical feature is auto-ranging functionality. Given the complexity of HVAC systems, which may involve varying voltages and currents across different components, an auto-ranging multimeter simplifies the testing process by automatically adjusting its settings to match the input signal's range. This not only makes measurements quicker but reduces human error

associated with manual range selection.

Durability and ease-of-use are also significant considerations when selecting a multimeter for mobile home HVAC checks. Mobile homes often have limited workspace and challenging access points; therefore, a lightweight yet rugged device can help avoid accidental drops or mishandling during tests. Ergonomic design elements like clear display screens and intuitive interface layouts enhance usability under potentially dim or awkward conditions.

Furthermore, investing in a multimeter with data logging capabilities can be advantageous for tracking performance over time. This feature allows technicians to record readings during maintenance checks systematically, facilitating trend analysis that can preemptively identify issues before they become severe problems.

Finally, training on proper usage cannot be overstated as part of safety considerations when using any tool within mobile home environments. Technicians should be well-versed not only in handling their chosen multimeters but also in understanding specific risks associated with mobile home electrical systems-such as unique grounding configurations or potential insulation weaknesses-that might impact readings or require special precautions during tests.

In conclusion, selecting an appropriate multimeter for HVAC checks in mobile homes revolves around prioritizing safety through comprehensive features tailored to these unique settings' requirements. By choosing devices equipped with advanced protective measures like high CAT ratings and non-contact voltage detection alongside practical functionalities such as auto-ranging and data logging capabilities-technicians can ensure safer operations while maintaining precise control over their diagnostic processes.



Recommended Brands and Models for HVAC Multimeters

Selecting the right multimeter for HVAC checks is crucial for ensuring accurate diagnostics and efficient system performance. HVAC professionals rely on these devices to measure voltage, current, resistance, and sometimes other parameters like temperature or capacitance. With a variety of brands and models available in the market, choosing the most suitable one can be daunting. This essay will explore some recommended brands and models that have gained popularity among HVAC technicians for their reliability, functionality, and ease of use.

Fluke is often the go-to brand for many professionals in various fields, including HVAC. Known for their durability and precision, Fluke multimeters are designed to withstand harsh conditions while providing accurate readings. Among their offerings, the Fluke 116 model stands out as an ideal choice for HVAC applications. It features a built-in thermometer specifically tailored for temperature measurements essential in HVAC work. Additionally, its microamp function allows for testing flame sensors without any hassle.

Another noteworthy brand is Fieldpiece, which has carved a niche in the HVAC industry by offering tools specifically designed with HVAC technicians in mind. The Fieldpiece HS33 multimeter is popular due to its versatility and user-friendly interface. It includes alligator clips and leads that make it easy to get into tight spaces—a common challenge when working with HVAC systems. Moreover, its modular design enables users to attach different accessories tailored to specific tasks like measuring refrigerant pressure or airflow.

Klein Tools also deserves mention when discussing reliable multimeters for HVAC purposes. The Klein Tools MM600 Multimeter is renowned for its ruggedness and accuracy at an affordable price point. Its auto-ranging feature simplifies the process of measuring various electrical parameters without needing constant manual adjustments—an advantageous trait when dealing with complex systems.

While selecting a suitable multimeter depends largely on individual needs and preferences, considering these recommended brands can provide a solid starting point. Reliability should always be a top priority; thus investing in reputable brands ensures longevity and consistent performance.

In conclusion, having an appropriate multimeter is indispensable for any professional involved in maintaining or repairing HVAC systems. Whether opting for the proven dependability of Fluke's models or exploring specialized options from Fieldpiece or Klein Tools—each offers unique advantages catering specifically towards enhancing efficiency during inspections or repairs within this vital industry sector. By opting wisely based on informed recommendations such as those outlined here today—the task becomes not only manageable but decidedly more productive too!

Tips for Maintaining and Calibrating Your Multimeter

Maintaining and calibrating your multimeter is essential for ensuring accurate measurements, particularly when selecting the appropriate tools for HVAC checks. A multimeter is a versatile instrument that can measure voltage, current, and resistance, making it indispensable for diagnosing and troubleshooting HVAC systems. However, to maximize its utility and reliability, proper maintenance and calibration are key.

First and foremost, choosing the right multimeter for HVAC tasks requires understanding the specific needs of HVAC systems. Look for features such as True RMS capability for accurate readings in complex electrical environments, a wide temperature range to handle varied conditions, and specialized functions like capacitance measurement to test capacitors efficiently. Once you have selected an appropriate multimeter, maintaining it becomes crucial to preserve its functionality.

Regular maintenance begins with cleanliness. Dust and debris can accumulate over time, affecting the accuracy of your readings. Use a soft cloth or brush to remove any dirt from the exterior surfaces regularly. Avoid using harsh chemicals or solvents as they may damage the device's casing or internal components.

Equally important is battery care. Ensure that your multimeter's batteries are in good condition by checking them periodically. Replace weak or leaking batteries promptly to prevent corrosion damage. It's also wise to remove batteries if you plan on storing the device for extended periods.

Calibration is another critical aspect of maintaining your multimeter's accuracy. Over time, even high-quality instruments can drift from their original calibration due to regular use or environmental factors such as temperature fluctuations. For precision work in HVAC applications, it's advisable to calibrate your multimeter at least once a year or according to the manufacturer's recommendations.

To calibrate a multimeter effectively, follow these steps: first, gather reference standards-known values that you can use as benchmarks-and set up your workspace in a stable environment free from electrical noise or interference. Next, compare readings from your multimeter against these standards across various settings (voltage, current, resistance) to identify any discrepancies.

If you find significant deviations during this process-or if you're unsure about performing calibration yourself-consider sending your multimeter to a professional calibration service provider who has access to certified equipment and expertise needed for precise adjustments.

In addition to annual calibration routines conducted by professionals when necessary; keep an eye out during everyday usage too - watch how consistent results appear between tests done under similar conditions which may indicate potential issues needing attention sooner rather than later!

Finally yet importantly: always store safely after each use! Keep away from moisture-rich areas like bathrooms where condensation might form inside damaging sensitive circuits within plus avoid extreme temperatures altogether whether hot/cold zones alike since both extremes could impact overall performance negatively long term wise thereby compromising future measurements taken thereafter thus defeating purpose entirely altogether!

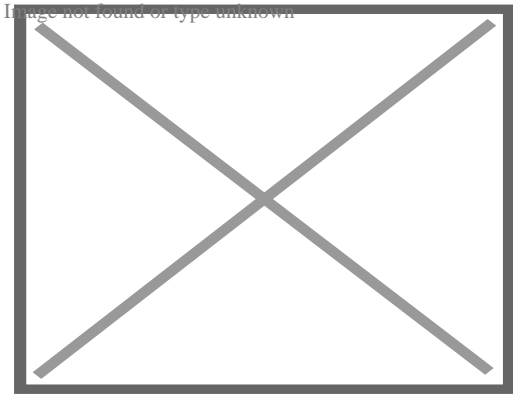
By following these tips diligently while integrating them into routine practice alongside adopting correct handling techniques initially discussed earlier herein above mentioned sections already covered previously throughout essay comprehensively outlining importance behind selecting suitable models specifically designed catered towards meeting demands placed upon those tasked carrying out duties related directly/indirectly involving heating ventilation air conditioning checks respectively ultimately resulting better outcomes achieved across board generally speaking overall without exception whatsoever regardless situation encountered along way ahead moving forward progressively onward into foreseeable future timescales anticipated beyond horizon envisioned currently present day contextually considered holistically viewed perspective-wise objectively assessed independently evaluated critically analyzed thoroughly examined systematically reviewed rigorously scrutinized meticulously inspected carefully checked consistently monitored closely observed attentively watched

vigilantly guarded cautiously protected safeguarded reliably secured dutifully maintained conscientiously managed responsibly handled properly cared looked after diligently attended faithfully serviced regularly updated frequently upgraded promptly repaired swiftly rectified immediately

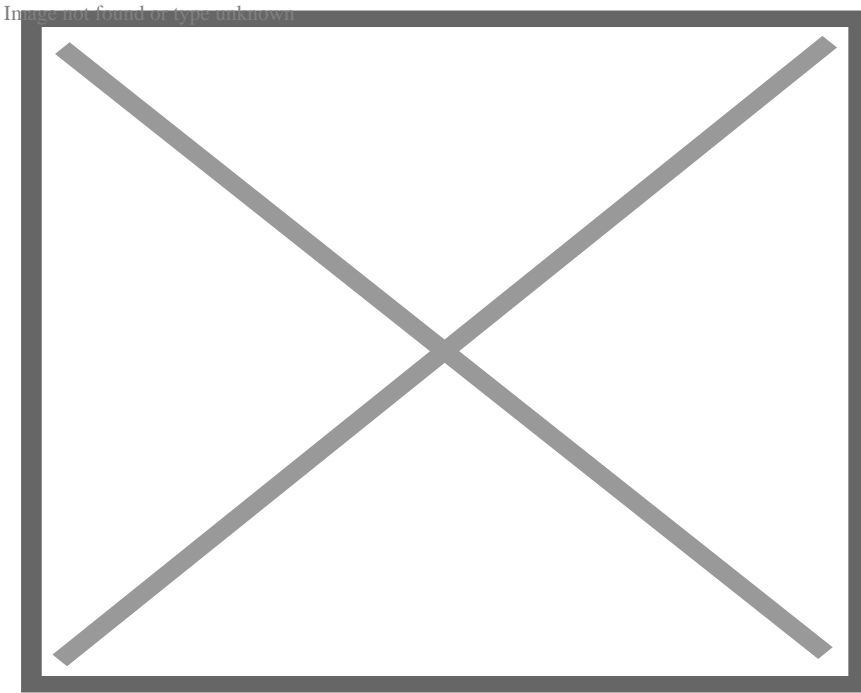


About Air pollution

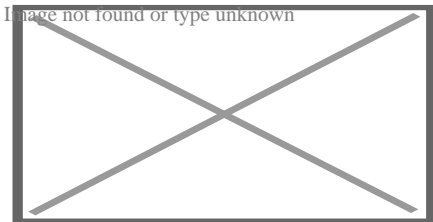
"Bad air quality" and "Air quality" redirect here. For the obsolete medical theory, see Miasma theory. For the measurement of air pollution, see Air quality index. For the qualities of air, see Atmosphere of Earth.



Air pollution from a coking oven



2016 Environmental Performance Index – darker colors indicate lower concentrations of fine particulate matter and nitrogen dioxide, as well as better indoor air quality.

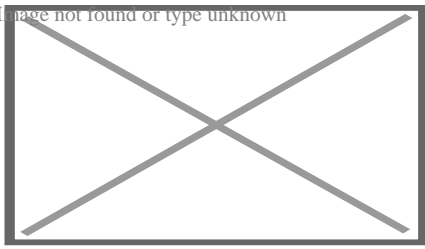


Deaths from air pollution per 100,000 inhabitants (IHME, 2019)

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Part of a series on

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Air pollution from a factory

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
- Exhaust gas
- Haze
- Global dimming
- Global distillation
- Indoor air quality
- Non-exhaust emissions
- Ozone depletion
- Particulates
- Persistent organic pollutant
- Smog
- Soot
- Volatile organic compound

Biological

- Biological hazard
- Genetic
- Illegal logging
- Introduced species
 - Invasive species

Digital

- Information

Electromagnetic

- Light
 - Ecological
 - Overillumination
- Radio spectrum

Natural

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- Radium and radon in the environment
- Volcanic ash
- Wildfire

Noise

- Transportation
- Health effects from noise
- Marine mammals and sonar
- Noise barrier
- Noise control
- Soundproofing

Radiation

- Actinides
- Bioremediation
- Depleted uranium
- Nuclear fission
- Nuclear fallout
- Plutonium
- Poisoning
- Radioactivity
- Uranium
- Radioactive waste

Soil

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- Bioremediation
- Defecation
- Electrical resistance heating
- Illegal mining
- Soil guideline values
- Phytoremediation

Solid waste

- Advertising mail
- Biodegradable waste
- Brown waste
- Electronic waste
- Foam food container
- Food waste
- Green waste
- Hazardous waste
- Industrial waste
- Litter
- Mining
- Municipal solid waste
- Nanomaterials
- Plastic
- Packaging waste
- Post-consumer waste
- Waste management

Space

- Space debris

Thermal

- Urban heat island

Visual

- Air travel
- Advertising clutter
- Overhead power lines
- Traffic signs
- Urban blight
- Vandalism

War

- Chemical warfare
- Herbicidal warfare
 - Agent Orange
- Nuclear holocaust
 - Nuclear fallout
 - Nuclear famine
 - Nuclear winter
- Scorched earth
- Unexploded ordnance
- War and environmental law

Water

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- Firewater
- Freshwater
- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
- Monitoring
- Nonpoint source
- Nutrient
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- Stagnation
- Sulfur water
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- Turbidity
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- Wastewater

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 - Heavy metals
 - Paint

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- Brain health and pollution
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- Dust
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- Midden
- Point source
- Waste
 - Toxic

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- Law by country
- Most polluted cities
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- Treaties
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Part of a series on

Weather

Temperate and polar seasons

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- Spring
- Summer
- Autumn

Tropical seasons

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 - Harmattan
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 - Thundersnow
 - Dry thunderstorm
- Mesocyclone
 - Supercell
- Tornado
 - Anticyclonic tornado
 - Landspout
 - Waterspout
- Dust devil
- Fire whirl
- Anticyclone
- Cyclone
- Polar low
- Extratropical cyclone
 - European windstorm
 - Nor'easter
- Subtropical cyclone
- Tropical cyclone
 - Atlantic hurricane
 - Typhoon
- Storm surge
- Dust storm
 - Simoom
 - Haboob
- Monsoon
 - Amihan
- Gale
- Sirocco
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- Winter storm
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Precipitation

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 - Megacryometeor
- Ice pellets
- Diamond dust
- Rain
 - Freezing
- Cloudburst
- Snow
 - Rain and snow mixed
 - Snow grains
 - Snow roller
 - Slush

Topics

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- Cloud
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 - Mist
 - Season
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- Heat wave
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Glossaries

- Meteorology
- Climate change
- Tornado terms
- Tropical cyclone terms

 Weather portal

Air pollution is the contamination of air due to the presence of substances called pollutants in the atmosphere that are harmful to the health of humans and other living beings, or cause damage to the climate or to materials.^[1] It is also the contamination of the indoor or outdoor environment either by chemical, physical, or biological agents that alters the natural features of the atmosphere.^[1] There are many different types of air pollutants, such as gases (including ammonia, carbon monoxide, sulfur dioxide, nitrous oxides, methane and chlorofluorocarbons), particulates (both organic and inorganic) and biological molecules. Air pollution can cause diseases, allergies, and even death to humans; it can also cause harm to other living organisms such as animals and crops, and may damage the natural environment (for example, climate change, ozone depletion or habitat degradation) or built environment (for example, acid rain).^[2] Air pollution can be caused by both human activities^[3] and natural phenomena.^[4]

Air quality is closely related to the Earth's climate and ecosystems globally. Many of the contributors of air pollution are also sources of greenhouse emission i.e., burning of fossil fuel.^[1]

Air pollution is a significant risk factor for a number of pollution-related diseases, including respiratory infections, heart disease, chronic obstructive pulmonary disease (COPD), stroke, and lung cancer.^[5] Growing evidence suggests that air pollution exposure may be associated with reduced IQ scores, impaired cognition,^[6] increased risk for psychiatric disorders such as depression^[7] and detrimental perinatal health.^[8] The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system.^[9]^[10] Individual reactions to air pollutants depend on the type of pollutant a person is exposed to,^[11]^[12] the degree of exposure, and the individual's health status and genetics.^[13]

Air pollution is the largest environmental risk factor for disease and premature death^[5] ^[14] and the fourth largest risk factor overall for human health.^[15] Air pollution causes the premature deaths of around 7 million people worldwide each year,^[5] or a global mean loss of life expectancy (LLE) of 2.9 years,^[16] and there has been no significant change in the number of deaths caused by all forms of pollution since at least 2015.^[14]^[17]^[18] Outdoor air pollution attributable to fossil fuel use alone causes ~3.61

million deaths annually,^[19] making it one of the top contributors to human death.^[5] Anthropogenic ozone causes around 470,000 premature deaths a year and fine particulate (PM_{2.5}) pollution around another 2.1 million.^[20] The scope of the air pollution crisis is large: In 2018, WHO estimated that "9 out of 10 people breathe air containing high levels of pollutants."^[21] Although the health consequences are extensive, the way the problem is handled is considered largely haphazard^[22]^[21]^[23] or neglected.^[14]

The World Bank has estimated that welfare losses (premature deaths) and productivity losses (lost labour) caused by air pollution cost the world economy \$5 trillion per year.^[24]^[25]^[26] The costs of air pollution are generally an externality to the contemporary economic system and most human activity, although they are sometimes recovered through monitoring, legislation, and regulation.^[27]^[28]

Many different technologies and strategies are available for reducing air pollution.^[29] Although a majority of countries have air pollution laws, according to UNEP, 43 percent of countries lack a legal definition of air pollution, 31 percent lack outdoor air quality standards, 49 percent restrict their definition to outdoor pollution only, and just 31 percent have laws for tackling pollution originating from outside their borders.^[30] National air quality laws have often been highly effective, notably the 1956 Clean Air Act in Britain and the US Clean Air Act, introduced in 1963.^[31]^[32] Some of these efforts have been successful at the international level, such as the Montreal Protocol,^[33] which reduced the release of harmful ozone depleting chemicals, and the 1985 Helsinki Protocol,^[34] which reduced sulfur emissions,^[35] while others, such as international action on climate change,^[36]^[37]^[38] have been less successful.

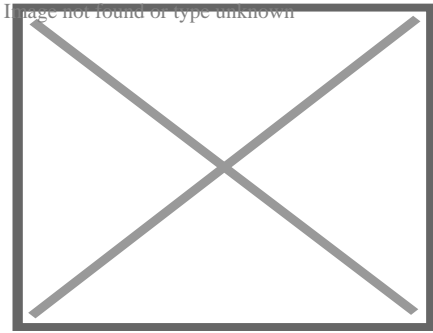
Sources of air pollution

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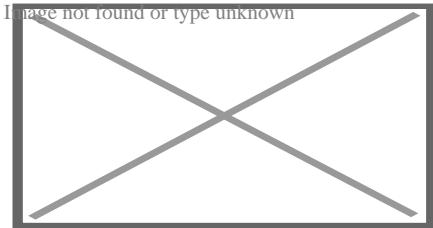
There are many different sources of air pollution. Some air pollutants (such as nitrogen oxides) originate mainly from human activities,^[39] while some (notably radon gas) come mostly from natural sources.^[40] However, many air pollutants (including dust and sulfur dioxide) come from a mixture of natural and human sources.^[41]

Anthropogenic (human-made) sources

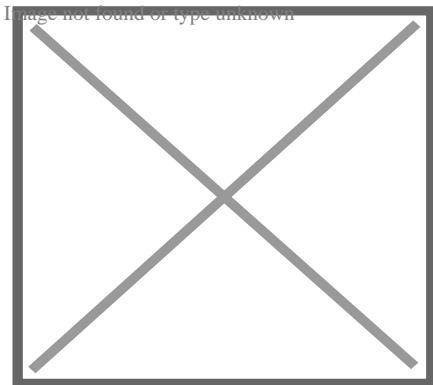
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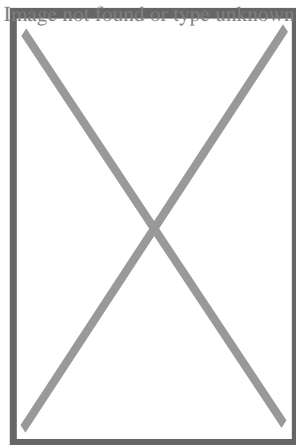
Demolition of the cooling towers of a power station, Athlone, Cape Town, South Africa, 2010



Controlled burning of a field outside of Statesboro, Georgia, US, in preparation for spring planting



Smoking of fish over an open fire in Ghana, 2018



Burning of joss paper in a Chinese temple in Hong Kong

- Stationary sources include:
 - fossil-fuel power plants and biomass power plants both have smoke stacks (see for example environmental impact of the coal industry)^[42]
 - Oil and gas sites that have methane leaks^{[43][44][45][46]}
 - burning of traditional biomass such as wood, crop waste and dung. (In developing and poor countries,^[47] traditional biomass burning is the major source of air pollutants.^{[48][49]} It is also the main source of particulate pollution in many developed areas including the UK & New South Wales.^{[50][51]} Its pollutants include PAHs.^[52])
 - manufacturing facilities (factories)^[53]
 - a 2014 study found that in China equipment-, machinery-, and devices-manufacturing and construction sectors contributed more than 50% of air pollutant emissions.^[54]^[better source needed] This high emission is due to high emission intensity and high emission factors in its industrial structure.^[55]
 - construction^{[56][57]}
 - renovation^[58]
 - waste incineration (incinerators as well as open and uncontrolled fires of mismanaged waste, making up about a fourth of municipal solid terrestrial waste)^{[59][60]}
 - furnaces and other types of fuel-burning heating devices^[61]
 - Mobile sources include motor vehicles, trains (particularly diesel locomotives and DMUs), marine vessels and aircraft^[62] as well as rockets and re-entry of components and debris.^[63] The air pollution externality of cars enters the air from the exhaust gas and car tires (including microplastics^[64]). Road vehicles make a significant amount of all air pollution (typically, for example, around a third to a half of all nitrogen dioxide emissions)^{[65][66][67]} and are a major driver of climate change.^{[68][69]}
 - Agriculture and forest management strategies using controlled burns. Practices like slash-and-burn in forests like the Amazon cause large air pollution with the deforestation.^[70] Controlled or prescribed burning is a practice used in forest management, agriculture, prairie restoration, and greenhouse gas reduction.^[71] Foresters can use controlled fire as a tool because fire is a natural feature of both forest and grassland ecology.^{[72][73]} Controlled burning encourages the sprouting of some desirable forest trees, resulting in a forest renewal.^[74]

There are also sources from processes other than combustion:

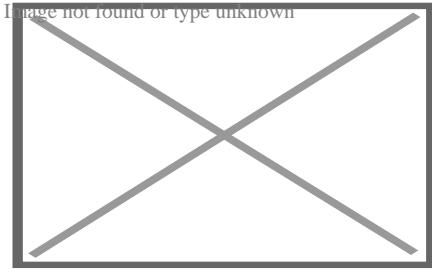
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents. These can be substantial; emissions from these sources was estimated to account for almost half of pollution from volatile organic compounds in the Los Angeles basin in the 2010s.^[75]

- Waste deposition in landfills produces methane^[76] and open burning of waste releases harmful substances.^[77]
 - Nuclear weapons, toxic gases, germ warfare, and rocketry are examples of military resources.^[78]
 - Agricultural emissions and emissions from meat production or livestock contribute substantially to air pollution^{[79][80]}
 - Fertilized farmland may be a major source of nitrogen oxides.^[81]
- Mean acidifying emissions (air pollution) of different foods per 100g of protein^[82]

Food Types	Acidifying Emissions (g SO₂eq per 100g protein)
Beef	343.6
Cheese	165.5
Pork	142.7
Lamb and mutton	139.0
Farmed crustaceans	133.1
Poultry	102.4
Farmed fish	65.9
Eggs	53.7
Groundnuts	22.6
Peas	8.5
Tofu	6.7

Natural sources

[edit]



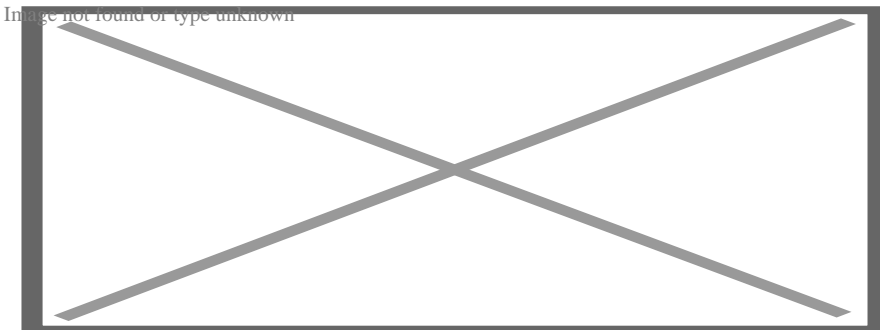
Dust storm approaching Stratford, Texas, in 1935

- Dust from natural sources, usually large areas of land with little or no vegetation.
- 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 to be 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. During periods of active wildfires, smoke from uncontrolled biomass combustion can make up almost 75% of all air pollution by concentration.^[83]
- Vegetation, in some regions, emits environmentally significant amounts of volatile organic compounds (VOCs) on warmer days. These VOCs react with primary anthropogenic pollutants – specifically, NO_x , SO_2 , and anthropogenic organic carbon compounds – to produce a seasonal haze of secondary pollutants.^[84] Black gum, poplar, oak and willow are some examples of vegetation that can produce abundant VOCs. The VOC production from these species result in ozone levels up to eight times higher than the low-impact tree species.^[85]
- Volcanic activity, which produces sulfur, chlorine, and ash particulates.^[86]

Emission factors

[edit]

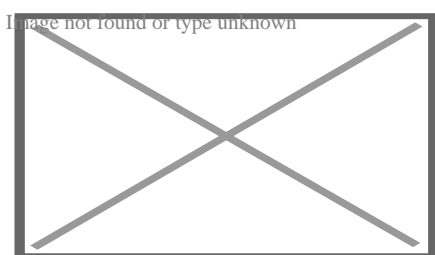
Main article: AP 42 Compilation of Air Pollutant Emission Factors



Beijing air in 2005 after rain (left) and a smoggy day (right)

Air pollutant emission factors are reported representative values that aim to link the quantity of a pollutant released into the ambient air to an activity connected with that pollutant's release.^{[2][87][88][89]} The weight of the pollutant divided by a unit weight, volume, distance, or time of the activity generating the pollutant is how these factors are commonly stated (e.g., kilograms of particulate emitted per tonne of coal burned). These criteria make estimating emissions from diverse sources of pollution easier. Most of the time, these components are just averages of all available data of acceptable quality, and they are thought to be typical of long-term averages.

The Stockholm Convention on Persistent Organic Pollutants identified pesticides and other persistent organic pollutants of concern. These include dioxins and furans which are unintentionally created by combustion of organics, like open burning of plastics, and are endocrine disruptors and mutagens.



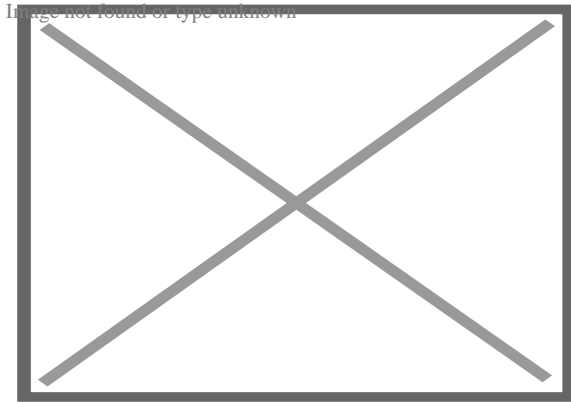
E-waste processing in Agbogbloshie, Ghana, using open-burning of electronics to access valuable metals like copper. Open burning of plastics is common in many parts of the world without the capacity for processing. Especially without proper protections, heavy metals and other contaminants can seep into the soil, and create water pollution and air pollution.

The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a wide range of industrial sources.^[90] The United Kingdom, Australia, Canada, and many other countries have published similar compilations, as well as the European Environment Agency.^{[91][92][93][94]}

Pollutants

[edit]

Main articles: Pollutant and Greenhouse gas emissions



Schematic drawing, causes and effects of air pollution: (1) greenhouse effect, (2) particulate contamination, (3) increased UV radiation, (4) acid rain, (5) increased ground-level ozone concentration, (6) increased levels of nitrogen oxides

An air pollutant is a material in the air that can have many effects on humans and the ecosystem.^[95] The substance can be solid particles, liquid droplets, or gases, and often takes the form of an aerosol (solid particles or liquid droplets dispersed and carried by a gas).^[96] A pollutant can be of natural origin or man-made. Pollutants are classified as primary or secondary. Primary pollutants are usually produced by processes such as ash from a volcanic eruption.

Other examples include carbon monoxide gas from motor vehicle exhausts or sulfur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. Ground level ozone is a prominent example of a secondary pollutant. Some pollutants may be both primary and secondary: they are both emitted directly and formed from other primary pollutants.

Primary pollutants

[edit]



This section is in list format but may read better as prose. You can help by converting this section, if appropriate. Editing help is available. *(April 2023)*

Pollutants emitted into the atmosphere by human activity include:

- Ammonia: Emitted mainly by agricultural waste. Ammonia is a compound with the formula NH_3 . It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers.

Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.^[97] In the atmosphere, ammonia reacts with oxides of nitrogen and sulfur to form secondary particles.^[98]

- Carbon dioxide (CO₂): Carbon dioxide is a natural component of the atmosphere, essential for plant life and given off by the human respiratory system.^[99] It is potentially lethal at very high concentrations (typically 100 times "normal" atmospheric levels).^{[100][101]} Although the World Health Organization recognizes CO₂ as a climate pollutant, it does not include the gas in its *Air Quality Guidelines* or set recommended targets for it.^[102] Because of its role as a greenhouse gas, CO₂ has been described as "the worst climate pollutant".^[103] Statements such as this refer to its long-term atmospheric effects rather than shorter-term effects on such things as human health, food crops, and buildings. This question of terminology has practical consequences, for example, in determining whether the U.S. Clean Air Act (which is designed to improve air quality) is deemed to regulate CO₂ emissions.^[104] That issue was resolved in the United States by the Inflation Reduction Act of 2022, which specifically amended the Clean Air Act "to define the carbon dioxide produced by the burning of fossil fuels as an 'air pollutant.'"^[105] CO₂ currently forms about 410 parts per million (ppm) of Earth's atmosphere, compared to about 280 ppm in pre-industrial times,^[106] and billions of metric tons of CO₂ are emitted annually by burning of fossil fuels.^[107] CO₂ increase in Earth's atmosphere has been accelerating.^[108] CO₂ is an asphyxiant gas and not classified as toxic or harmful in general.^[109] Workplace exposure limits exist in places like UK (5,000 ppm for long-term exposure and 15,000 ppm for short-term exposure).^[101] Natural disasters like the limnic eruption at Lake Nyos can result in a sudden release of huge amount of CO₂ as well.^[110]
- Carbon monoxide (CO): CO is a colorless, odorless, toxic gas.^[111] It is a product of combustion of fuel such as natural gas, coal or wood. Vehicular exhaust contributes to the majority of carbon monoxide let into the atmosphere. It creates a smog type formation in the air that has been linked to many lung diseases and disruptions to the natural environment and animals.
- Chlorofluorocarbons (CFCs): Emitted from goods that are now prohibited from use; harmful to the ozone layer. These are gases emitted by air conditioners, freezers, aerosol sprays, and other similar devices. CFCs reach the stratosphere after being released into the atmosphere.^[112] They interact with other gases here, causing harm to the ozone layer. UV rays are able to reach the Earth's surface as a result of this. This can result in skin cancer, eye problems, and even plant damage.^[113]
- Nitrogen oxides (NO_x): Nitrogen oxides, particularly nitrogen dioxide, are expelled from high temperature combustion, and are also produced during thunderstorms by electric discharge. They can be seen as a brown haze dome above or a plume downwind of cities. Nitrogen dioxide is a chemical compound

with the formula NO_2 . It is one of several nitrogen oxides. One of the most prominent air pollutants, this reddish-brown toxic gas has a characteristic sharp, biting odor.

- Odors: Such as from garbage, sewage, and industrial processes.
- Particulate matter/particles (PM), also known as particulates, atmospheric particulate matter (APM), or fine particles, are microscopic solid or liquid particles suspended in a gas.^[114] Aerosol is a mixture of particles and gas. Volcanoes, dust storms, forest and grassland fires, living plants, and sea spray are all sources of particles. Aerosols are produced by human activities such as the combustion of fossil fuels in automobiles, power plants, and numerous industrial processes.^[115] Averaged worldwide, anthropogenic aerosols – those made by human activities – currently account for approximately 10% of the atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease,^[116] altered lung function and lung cancer. Particulates are related to respiratory infections and can be particularly harmful to those with conditions like asthma.^[117]
- Persistent organic pollutants, which can attach to particulates. Persistent organic pollutants are organic compounds that are resistant to environmental degradation due to chemical, biological, or photolytic processes (POPs). As a result, they've been discovered to survive in the environment, be capable of long-range transmission, bioaccumulate in human and animal tissue, biomagnify in food chains, and pose a major threat to human health and the ecosystem.^[118]
- Persistent free radicals connected to airborne fine particles are linked to cardiopulmonary disease.^{[119][120]}
- Polycyclic Aromatic Hydrocarbons (PAHs): a group of aromatic compounds formed from the incomplete combustion of organic compounds including coal and oil and tobacco.^[121]
- Radioactive pollutants: Produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.
- Sulfur oxides (SO_x): particularly sulfur dioxide, a chemical compound with the formula SO_2 . SO_2 is produced by volcanoes and in various industrial processes. Coal and petroleum often contain sulfur compounds, and 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 is formed. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.
- Toxic metals, such as lead and mercury, especially their compounds.
- Volatile organic compounds (VOC): VOCs are both indoor and outdoor air pollutants.^[122] They are categorized as either methane (CH_4) or non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases because of their role in creating ozone and prolonging the life of methane in the atmosphere. This effect varies depending on local air quality.

The aromatic NMVOCs benzene, toluene and xylene are suspected carcinogens and may lead to leukemia with prolonged exposure. 1,3-butadiene is another dangerous compound often associated with industrial use.

Secondary pollutants

[edit]

Secondary pollutants include:

- Ground level ozone (O_3): Ozone is created when NO_x and VOCs mix. It is a significant part of the troposphere.^[123] It's also an important part of the ozone layer, which can be found in different sections of the stratosphere. Photochemical and chemical reactions involving it fuel many of the chemical activities that occur in the atmosphere during the day and night. It is a pollutant and a component of smog that is produced in large quantities as a result of human activities (mostly the combustion of fossil fuels).^[124] O_3 is largely produced by chemical reactions involving NO_x gases (nitrogen oxides, especially from combustion) and volatile organic compounds in the presence of sunlight. Due to the influence of temperature and sunlight on this reaction, high ozone levels are most common on hot summer afternoons.^[125]
- Peroxyacetyl nitrate ($C_2H_3NO_5$): similarly formed from NO_x and VOCs.
- Photochemical smog: particles are formed from gaseous primary contaminants and chemicals.^[126] Smog is a type of pollution that occurs in the atmosphere. Smog is caused by a huge volume of coal being burned in a certain region, resulting in a mixture of smoke and sulfur dioxide.^[127] Modern smog is usually caused by automotive and industrial emissions, which are acted on in the atmosphere by UV light from the sun to produce secondary pollutants, which then combine with the primary emissions to generate photochemical smog.

Other pollutants

[edit]

There are many other chemicals classed as hazardous air pollutants. Some of these are regulated in the USA under the Clean Air Act and in Europe under numerous directives (including the Air "Framework" Directive, 96/62/EC, on ambient air quality assessment and management, Directive 98/24/EC, on risks related to chemical agents at work, and Directive 2004/107/EC covering heavy metals and polycyclic aromatic

hydrocarbons in ambient air).^{[128][129]}

To display all pages, subcategories and images click on the

"[Air Pollution](#)":

Hazardous air pollutants (4 C, 68 P)

Before flue-gas desulfurization was installed, the emissions from this power plant in New

○

Image not found or type unknown

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

Thermal oxidisers are air pollution abatement options for hazardous air pollutants (HAPs)

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Thermal oxidisers are air pollution abatement options for hazardous air pollutants (HAPs), volatile organic compounds (VOCs), and odorous emissions.

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This video provides an overview of a NASA study on the human fingerprint on global air quality.

Exposure

[edit]

The risk of air pollution is determined by the pollutant's hazard and the amount of exposure to that pollutant. Air pollution exposure can be measured for a person, a group, such as a neighborhood or a country's children, or an entire population. For example, one would want to determine a geographic area's exposure to a dangerous air pollution, taking into account the various microenvironments and age groups. This can be calculated^[130] as an inhalation exposure. This would account for daily exposure in various settings, e.g. different indoor micro-environments and outdoor locations. The exposure needs to include different ages and other demographic groups, especially infants, children, pregnant women, and other sensitive subpopulations.^[130]

For each specific time that the subgroup is in the setting and engaged in particular activities, the exposure to an air pollutant must integrate the concentrations of the air pollutant with regard to the time spent in each setting and the respective inhalation rates for each subgroup, playing, cooking, reading, working, spending time in traffic, etc. A little child's inhaling rate, for example, will be lower than that of an adult. A young person engaging in strenuous exercise will have a faster rate of breathing than a child engaged in sedentary activity. The daily exposure must therefore include the amount of time spent in each micro-environmental setting as well as the kind of activities performed there. The air pollutant concentration in each microactivity/microenvironmental setting is summed to indicate the exposure.^[130]

For some pollutants such as black carbon, traffic related exposures may dominate total exposure despite short exposure times since high concentrations coincide with proximity to major roads or participation in (motorized) traffic.^[131] A large portion of

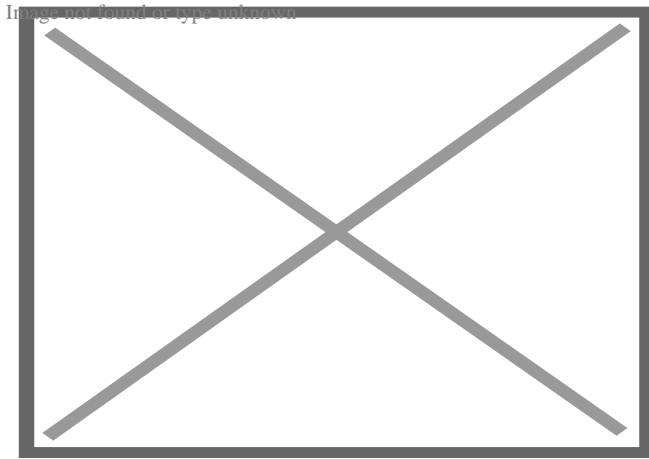
total daily exposure occurs as short peaks of high concentrations, but it remains unclear how to define peaks and determine their frequency and health impact.[¹³²]

In 2021, the WHO halved its recommended guideline limit for tiny particles from burning fossil fuels. The new limit for nitrogen dioxide (NO₂) is 75% lower.[¹³³]
Growing evidence that air pollution—even when experienced at very low levels—hurts human health, led the WHO to revise its guideline (from 10 µg/m³ to 5 µg/m³) for what it considers a safe level of exposure of particulate pollution, bringing most of the world—97.3 percent of the global population—into the unsafe zone.[¹³⁴]

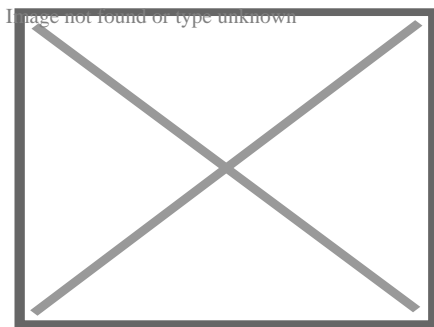
Indoor air quality

[edit]

Main articles: Indoor air quality and Indoor air pollution in developing countries



The share of total deaths from indoor air pollution, 2017



Air quality monitoring, New Delhi, India

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Indoor air pollution can pose a significant health risk. According to EPA reports, the concentrations of many air pollutants can be two to five times higher in indoor air than in outdoor air. Indoor air pollutants can be up to 100 times higher in some cases than they are inside. People can spend up to 90% of their time

indoors, according to the American Lung Association; the US Consumer Product Safety Commission (CPSC) 2012; and the US Environmental Protection Agency 2012a.[¹³⁵]

Indoor contaminants that can cause pollution include asbestos, biologic agents, building materials, radon, tobacco smoke, and wood stoves, gas ranges, or other heating systems.[¹³⁵]

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-CHO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled.[¹³⁶][¹³⁷]

Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in cook stoves and fireplaces can add significant amounts of harmful smoke particulates into the air, inside and out.[¹³⁶][¹³⁷] Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation. Also the kitchen in a modern produce harmful particles and gases, with equipment like toasters being one of the worst sources.[¹³⁸]

Carbon monoxide poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors or in a confined space, such as a tent. [¹³⁹] Chronic carbon monoxide poisoning can result even from poorly-adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas and 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 to asbestos from asbestos-containing materials in structures. Those with asbestosis 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 to distinguish between several forms of relevant diseases. According to the World Health Organization,[¹⁴⁰] these may be defined as asbestosis, lung cancer, and peritoneal mesothelioma (generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure to asbestos).

Biological sources of air pollution are also found 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 on 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 to accumulate more than they would otherwise occur in nature.

Health effects

[edit]

Air pollution has both acute and chronic effects on human health, affecting a number of different systems and organs but principally affect the body's respiratory system and the cardiovascular system. Afflictions include minor to chronic upper respiratory irritation such as difficulty in breathing, wheezing, coughing, asthma^[141] and heart disease, lung cancer, stroke, acute respiratory infections in children and chronic bronchitis in adults, aggravating pre-existing heart and lung disease, or asthmatic attacks.

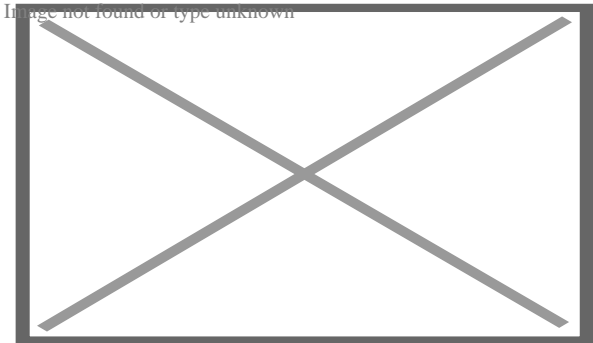
Short and long term exposures have been linked with premature mortality and reduced life expectancy^[142] and can result in increased medication use, increased doctor or emergency department visits, more hospital admissions and premature death.^[130]^[*better source needed*] Diseases that develop from persistent exposure to air pollution are environmental health diseases, which develop when a health environment is not maintained.^[143]

Even at levels lower than those considered safe by United States regulators, exposure to three components of air pollution, fine particulate matter, nitrogen dioxide and ozone, correlates with cardiac and respiratory illness.^[144] Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, and the individual's health status and genetics.^[130] The most common sources of air pollution include particulates and ozone (often from burning fossil fuels),^[145] nitrogen dioxide, and sulfur dioxide. Children aged less than five years who live in developing countries are the most vulnerable population to death attributable to indoor and outdoor air pollution.^[146]

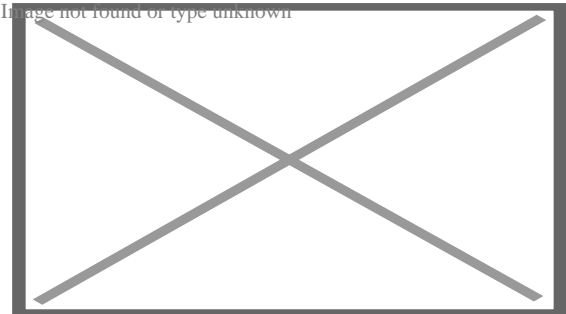
Under the Clean Air Act, U.S. EPA sets limits on certain air pollutants, including setting limits on how much can be in the air anywhere in the United States.^[147] Mixed exposure to both carbon black and ozone could result in significantly greater health affects.^[148]

Mortality

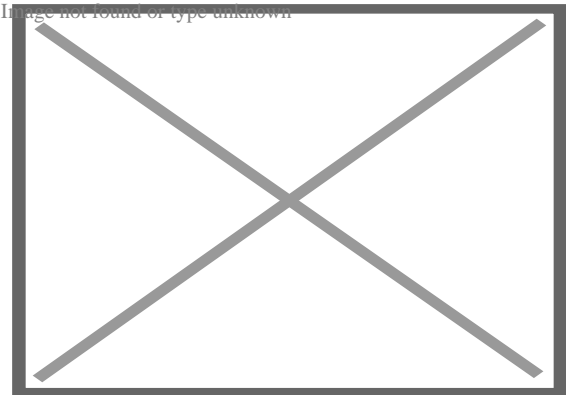
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Estimates of the death toll from air pollution vary across publications.



Deaths caused by accidents and air pollution from fossil fuel use in power plants exceed those caused by production of renewable energy.^[149]



Estimated annual number of deaths attributed to air pollution in 2019. This includes three categories of air pollution: indoor household, outdoor particulate matter and ozone.

Estimates of deaths toll due to air pollution vary.^[150] In 2014 the World Health Organization estimated that every year air pollution causes the premature death of 7 million people worldwide,^[5] 1 in 8 deaths worldwide.^[151] A study published in 2019 indicated that in 2015 the number may be closer to 8.8 million, with 5.5 million of these premature deaths due to air pollution from anthropogenic sources.^{[152][153]} A 2022 review concluded that in 2019 air pollution was responsible for approximately 9 million premature deaths. It concluded that since 2015 little real progress against pollution has been made.^{[14][154]} Causes of deaths include strokes, heart disease, COPD, lung cancer, and lung infections.^[5] Children are particularly at risk.^[155]

In 2021, the WHO reported that outdoor air pollution was estimated to cause 4.2 million premature deaths worldwide in 2019.^[156]

The global mean loss of life expectancy (LLE; similar to YPLL) from air pollution in 2015 was 2.9 years, substantially more than, for example, 0.3 years from all forms of direct violence.^[16] Communities with persons that live beyond 85 years have low ambient air pollution, suggesting a link between air pollution levels and longevity.^[157]

Primary mechanisms

[edit]

The WHO estimates that in 2016, ~58% of outdoor air pollution-related premature deaths were due to ischaemic heart disease and stroke.^[156] The mechanisms linking air pollution to increased cardiovascular mortality are uncertain, but probably include pulmonary and systemic inflammation.^[158]

By region

[edit]

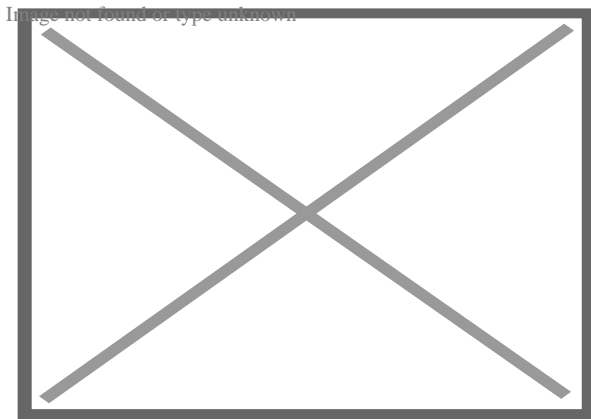
India and China have the highest death rate due to air pollution.^{[159][160]} India also has more deaths from asthma than any other nation according to the World Health Organization. In 2019, 1.6 million deaths in India were caused by air pollution.^[161] In 2013, air pollution was estimated to kill 500,000 people in China each year.^[162] In 2012, 2.48% of China's total air pollution emissions were caused by exports due to US demand, causing an additional 27,963 deaths across 30 provinces.^[163]

Annual premature European deaths caused by air pollution are estimated at 430,000^[164] to 800,000.^[153] An important cause of these deaths is nitrogen dioxide and other nitrogen oxides (NOx) emitted by road vehicles.^[164] Across the European

Union, air pollution is estimated to reduce life expectancy by almost nine months.[¹⁶⁵] In a 2015 consultation document the UK government disclosed that nitrogen dioxide is responsible for 23,500 premature UK deaths per annum.[¹⁶⁶] There is a positive correlation between pneumonia-related deaths and air pollution from motor vehicle emissions in England.[¹⁶⁷]

Eliminating energy-related fossil fuel emissions in the United States would prevent 46,900–59,400 premature deaths each year and provide \$537–\$678 billion in benefits from avoided PM_{2.5}-related illness and death.[¹⁶⁸]

A study published in 2023 in *Science* focused on sulfur dioxide emissions by coal power plants (coal PM_{2.5}) and concluded that "exposure to coal PM_{2.5} was associated with 2.1 times greater mortality risk than exposure to PM_{2.5} from all sources."^[169] From 1999 to 2020, a total of 460,000 deaths in the US were attributed to coal PM_{2.5}.^[169]

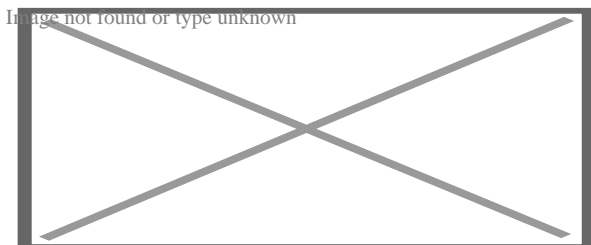


Air pollution deaths by nation due to fossil fuels

Major causes

[edit]

Further information: § Sources



A comparison of footprint-based and transboundary pollution-based relationships among G20 nations for the number of PM_{2.5}-related premature deaths^[170]

The largest cause of air pollution is fossil fuel combustion^[171] – mostly the production and use of cars, electricity production, and heating.^[172] There are estimated 4.5 million annual premature deaths worldwide due to pollutants released by high-emission power stations and vehicle exhausts.^[173]

Diesel exhaust (DE) is a major contributor to combustion-derived particulate matter air pollution. In several human experimental studies, using a well-validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation.^{[174][175]}

A study concluded that PM_{2.5} air pollution induced by the contemporary free trade and consumption by the 19 G20 nations causes two million premature deaths annually, suggesting that the average lifetime consumption of about ~28 people in these countries causes at least one premature death (average age ~67) while developing countries "cannot be expected" to implement or be able to implement countermeasures without external support or internationally coordinated efforts.^{[176][170]}

Guidelines

[edit]

Main article: Air quality guideline

The US EPA has estimated that limiting ground-level ozone concentration to 65 parts per billion (ppb), would avert 1,700 to 5,100 premature deaths nationwide in 2020 compared with the 75 ppb standard. The agency projected the more protective standard would also prevent an additional 26,000 cases of aggravated asthma, and more than a million cases of missed work or school.^{[177][178]} Following this assessment, the EPA acted to protect public health by lowering the National Ambient Air Quality Standards (NAAQS) for ground-level ozone to 70 ppb.^[179]

A 2008 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 3,800 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 to auto collisions in the same area, which average fewer than 2,000 per year.^{[180][181][182]} A 2021 study found that outdoor air pollution is associated with substantially increased mortality "even at low pollution levels below the current European and North American standards and WHO guideline values" shortly before the WHO adjusted its guidelines.^{[183][184]}

Cardiovascular disease

[edit]

According to the Global Burden of Disease Study, air pollution is responsible for 19% of all cardiovascular deaths.^{[185][186]} There is strong evidence linking both short- and long-term exposure to air pollution with cardiovascular disease mortality and morbidity, stroke, blood pressure, and ischemic heart diseases (IHD).^[186]

Air pollution is a leading risk factor for stroke, particularly in developing countries where pollutant levels are highest.^[187] A systematic analysis of 17 different risk factors in 188 countries found air pollution is associated with nearly one in three strokes (29%) worldwide (33.7% of strokes in developing countries versus 10.2% in developed countries).^{[187][188]} In women, air pollution is not associated with hemorrhagic but with ischemic stroke.^[189] Air pollution was found to be associated with increased incidence and mortality from coronary stroke.^[190] Associations are believed to be causal and effects may be mediated by vasoconstriction, low-grade inflammation and atherosclerosis.^[191] Other mechanisms such as autonomic nervous system imbalance have also been suggested.^{[192][193]}

Lung disease

[edit]

Research has demonstrated increased risk of developing asthma^[194] and chronic obstructive pulmonary disease (COPD)^[195] from increased exposure to traffic-related air pollution. Air pollution has been associated with increased hospitalization and mortality from asthma and COPD.^{[196][197]}

COPD comprises a spectrum of clinical disorders that include emphysema, bronchiectasis, and chronic bronchitis.^[198] COPD risk factors are both genetic and environmental. Elevated particle pollution contributes to the exacerbation of this disease and likely its pathogenesis.^[199]

The risk of lung disease from air pollution is greatest for infants and young children, whose normal breathing is faster than that of older children and adults; the elderly; those who work outside or spend a lot of time outside; and those who have heart or lung disease comorbidities.^[200]

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 to 59. Compared to the 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 to 59. The study controlled for age and smoking habits, so concluded that air pollution was the most likely cause of the observed differences.^[201] More studies have shown that air pollution exposure from traffic reduces lung function development in children^[202] and lung function may be compromised by air pollution even at low concentrations.^[203]

It is believed that, much like cystic fibrosis, serious health hazards become more apparent when living in a more urban environment. Studies have shown that in urban areas people experience mucus hypersecretion, lower levels of lung function, and more self-diagnosis of chronic bronchitis and emphysema.^[204]

Cancer

[edit]

Dark factory clouds obscure the Clark Avenue Bridge in Cleveland, Ohio, July 1973.

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Dark factory-emitted clouds obscuring the Clark Avenue Bridge in Cleveland, Ohio in July 1973

Around 300,000 lung cancer deaths were attributed globally in 2019 to exposure to fine particulate matter, PM_{2.5}, suspended in the air.^[205] PM_{2.5} exposure, such as from car exhausts, activates dormant mutations in lung cells, causing them to become

cancerous.^{[206][205]} Unprotected exposure to PM_{2.5} air pollution can be equivalent to smoking multiple cigarettes per day,^[207]^[*dead link*] potentially increasing the risk of cancer, which is mainly the result of environmental factors.^[208]

Long-term exposure to PM_{2.5} (fine particulates) increases the overall risk of non-accidental mortality by 6% per 10 µg/m³ increase. Exposure to PM_{2.5} is also associated with an increased risk of mortality from lung cancer (range: 15–21% per 10 µg/m³ increase) and total cardiovascular mortality (range: 12–14% per 10 µg/m³ increase).^[209]

The review further noted that living close to busy traffic appears to be associated with elevated risks of these three outcomes – increase in lung cancer deaths, cardiovascular deaths, and overall non-accidental deaths. The reviewers also found suggestive evidence that exposure to PM_{2.5} is positively associated with mortality from coronary heart diseases and exposure to SO₂ increases mortality from lung cancer, but the data was insufficient to provide solid conclusions.^[209] Another investigation showed that higher activity level increases deposition fraction of aerosol particles in human lung and recommended avoiding heavy activities like running in outdoor space at polluted areas.^[210]

In 2011, a large Danish epidemiological study found an increased risk of lung cancer for people who lived in areas with high nitrogen oxide concentrations.^[211] Another Danish study, likewise noted evidence of possible associations between air pollution and other forms of cancer, including cervical cancer and brain cancer.^[212]

Kidney disease

[edit]

A study of 163,197 Taiwanese residents over the period of 2001–2016 estimated that every 5 µg/m³ decrease (from an approximate peak of 30µg/m³) in the ambient concentration of PM_{2.5} was associated with a 25% reduced risk of chronic kidney disease development.^[213] According to a cohort study involving 10,997 atherosclerosis patients, higher PM 2.5 exposure is associated with increased albuminuria.^[214]

Fertility

[edit]

Nitrogen dioxide (NO₂)

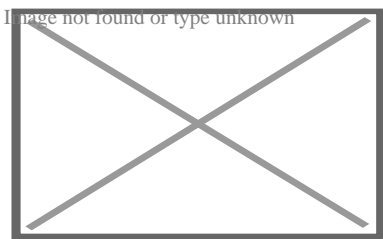
[edit]

An increase in NO₂ is significantly associated with a lower live birth rate in women undergoing IVF treatment.^[215] In the general population, there is a significant increase in miscarriage rate in women exposed to NO₂ compared to those not exposed.^[215]

Carbon monoxide (CO)

[edit]

CO exposure is significantly associated with stillbirth in the second and third trimester.^[215]



Standard line-angle structure of benzo-a-pyrene (BaP)

Polycyclic aromatic hydrocarbons

[edit]

Polycyclic aromatic hydrocarbons (PAHs) have been associated with reduced fertility. Benzo(a)pyrene (BaP) is a well-known PAH and carcinogen which is often found in exhaust fumes and cigarette smoke.^[216] PAHs have been reported to administer their toxic effects through oxidative stress by increasing the production of Reactive Oxygen Species (ROS) which can result in inflammation and cell death. More long-term exposure to PAHs can result in DNA damage and reduced repair.^[217]

Exposure to BaP has been reported to reduce sperm motility and increasing the exposure worsens this effect. Research has demonstrated that more BaPs were found in men with reported fertility issues compared to men without.^[218]

Studies have shown that BaPs can affect folliculogenesis and ovarian development by reducing the number of ovarian germ cells via triggering cell death pathways and inducing inflammation which can lead to ovarian damage.[²¹⁹]

Particulate matter

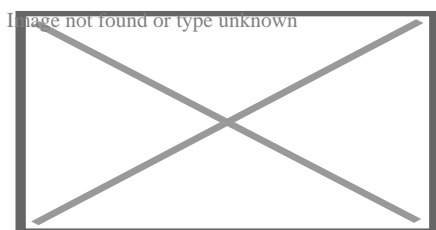
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Particulate matter (PM) refers to the collection of solids and liquids suspended in the air. These can be harmful to humans, and more research has shown that these effects may be more extensive than first thought; particularly on male fertility. PM can be different sizes, such as PM_{2.5} which are tiny particles of 2.5 microns in width or smaller, compared with PM₁₀ which are classified as 10 microns in diameter or less.

A study in California found that increased exposure to PM_{2.5} led to decreased sperm motility and increased abnormal morphology. Similarly, in Poland exposure to PM_{2.5} and PM₁₀ led to an increase in the percentage of cells with immature chromatin (DNA that has not fully developed or has developed abnormally).[²²⁰]

In Turkey, a study examined the fertility of men who work as toll collectors and are therefore exposed to high levels of traffic pollutants daily. Traffic pollution often has high levels of PM₁₀ alongside carbon monoxide and nitrogen oxides.[²²⁰] There were significant differences in sperm count and motility in this study group compared to a control group with limited air pollution exposure.

In women, while overall effects on fertility do not appear significant there is an association between increased exposure to PM₁₀ and early miscarriage. Exposure to smaller particulate matter, PM_{2.5}, appears to have an effect on conception rates in women undergoing IVF but does not affect live birth rates.[²¹⁵]



Ozone structure showing three oxygen atoms

Ground-level ozone pollution

[edit]

Ground-level ozone (O_3), when in high concentrations, is regarded as an air pollutant and is often found in smog in industrial areas.

There is limited research about the effect that ozone pollution has on fertility.^[215] At present, there is no evidence to suggest that ozone exposure poses a deleterious effect on spontaneous fertility in either females or males. However, there have been studies which suggest that high levels of ozone pollution, often a problem in the summer months, exert an effect on in vitro fertilisation (IVF) outcomes. Within an IVF population, NO_x and ozone pollutants were linked with reduced rates of live birth.^[215]

While most research on this topic is focused on the direct human exposure of air pollution, other studies have analysed the impact of air pollution on gametes and embryos within IVF laboratories. Multiple studies have reported a marked improvement in embryo quality, implantation and pregnancy rates after IVF laboratories have implemented air filters in a concerted effort to reduce levels of air pollution.^[221] Therefore, ozone pollution is considered to have a negative impact on the success of assisted reproductive technologies (ART) when occurring at high levels.

Ozone is thought to act in a biphasic manner where a positive effect on live birth is observed when ozone exposure is limited to before IVF embryo implantation. Conversely, a negative effect is demonstrated upon exposure to ozone after embryo implantation. However, after adjusting for NO_2 , the association between O_3 and IVF live birth rate was no longer significant.^{[222][223]}

In terms of male fertility, ozone is reported to cause a significant decrease in the concentration and count of sperm in semen after exposure.^[224] Similarly, sperm vitality, the proportion of live spermatozoa in a sample, was demonstrated to be diminished as a result of exposure to air pollution.^[223] However, findings on the effect of ozone exposure on male fertility are somewhat discordant, highlighting the need for further research.^[223]

Children

[edit]

Children and infants are among the most vulnerable to air pollution. Polluted air leads to the poisoning of millions of children under the age of 15, resulting in the death of some 600,000 children annually (543,000 under 5 years of age and 52,000 aged 5-15 years).^[225] Children in low or middle income countries are exposed to higher levels of fine particulate matter than those in high income countries.^[225]

Health effects of air pollution on children include asthma, pneumonia and lower respiratory tract infections and low birth weight.^[226] A study in Europe found that exposure to ultrafine particles can increase blood pressure in children.^[227]

Prenatal exposure

[edit]

Prenatal exposure to polluted air has been linked to a variety of neurodevelopmental disorders in children. For example, exposure to polycyclic aromatic hydrocarbons (PAH) was associated with reduced IQ scores and symptoms of anxiety and depression.^[228] They can also lead to detrimental perinatal health outcomes that are often fatal in developing countries.^[8] A 2014 study found that PAHs might play a role in the development of childhood attention deficit hyperactivity disorder (ADHD).^[229]

Researchers have found a correlation between air pollution and risk of autism spectrum disorder (ASD) diagnosis, although definitive causality has not yet been established. In Los Angeles, children living in areas with high levels of traffic-related air pollution were more likely to be diagnosed with autism between three–five years of age.^[230] A cohort study in Southern California linked in-utero exposure to near-roadway air pollution to an increased risk of ASD diagnosis^[231] and a study in Sweden concluded that exposure to PM_{2.5} during pregnancy was associated with ASD.^[232] A Danish study linked exposure to air pollution during infancy, but not during pregnancy, to an increased risk of ASD diagnosis.^[233]

The connection between air pollution and neurodevelopmental disorders in children is thought to be related to epigenetic dysregulation of the primordial germ cells, embryo, and fetus during a critical period. Some PAHs are considered endocrine disruptors and are lipid soluble. When they build up in adipose tissue they can be transferred across the placenta can exert a genotoxic effect, causing DNA damage and mutations.^[234] Air pollution has been associated with the prevalence of preterm births.^[235]

Infants

[edit]

Ambient levels of air pollution have been associated with preterm birth and low birth weight. A 2014 WHO worldwide survey on maternal and perinatal health found a statistically significant association between low birth weights (LBW) and increased levels of exposure to PM_{2.5}. Women in regions with greater than average PM_{2.5}

levels had statistically significant higher odds of pregnancy resulting in a low-birth weight infant even when adjusted for country-related variables.^[236] The effect is thought to be from stimulating inflammation and increasing oxidative stress.

A study found that in 2010 exposure to PM_{2.5} was strongly associated with 18% of preterm births globally, which was approximately 2.7 million premature births. The countries with the highest air pollution associated preterm births were in South and East Asia, the Middle East, North Africa, and West sub-Saharan Africa.^[237] In 2019, ambient particulate matter pollution in Africa resulted in at least 383,000 early deaths, according to new estimates of the cost of air pollution in the continent. This increased from 3.6% in 1990 to around 7.4% of all premature deaths in the area.^{[238][239][240]}

The source of PM_{2.5} differs greatly by region. In South and East Asia, pregnant women are frequently exposed to indoor air pollution because of wood and other biomass fuels being used for cooking, which are responsible for more than 80% of regional pollution. In the Middle East, North Africa and West sub-Saharan Africa, fine PM comes from natural sources, such as dust storms.^[237] The United States had an estimated 50,000 preterm births associated with exposure to PM_{2.5} in 2010.^[237]

A study between 1988 and 1991 found a correlation between sulfur dioxide (SO₂) and total suspended particulates (TSP) and preterm births and low birth weights in Beijing. A group of 74,671 pregnant women, in four separate regions of Beijing, were monitored from early pregnancy to delivery along with daily air pollution levels of SO₂ and TSP (along with other particulates). The estimated reduction in birth weight was 7.3 g for every 100 µg/m³ increase in SO₂ and 6.9 g for each 100 µg/m³ increase in TSP. These associations were statistically significant in both summer and winter, although summer was greater. The proportion of low birth weight attributable to air pollution, was 13%. This is the largest attributable risk ever reported for the known risk factors of low birth weight.^[241] Coal stoves, which are in 97% of homes, are a major source of air pollution in this area.

Brauer et al. studied the relationship between air pollution and proximity to a highway with pregnancy outcomes in a Vancouver cohort of pregnant women using addresses to estimate exposure during pregnancy. Exposure to NO, NO₂, CO, PM₁₀ and PM_{2.5} were associated with infants born small for gestational age (SGA). Women living less than 50 meters away from an expressway or highway were 26% more likely to give birth to a SGA infant.^[242]

Central nervous system

[edit]

See also: Brain health and pollution and neuroplastic effects of pollution

Data is accumulating that air pollution exposure also affects the central nervous system.^[243]

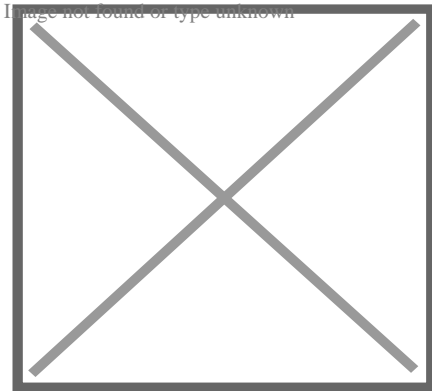
Air pollution increases the risk of dementia in people over 50 years old.^[244] Indoor air pollution exposure during childhood may negatively affect cognitive function and neurodevelopment.^{[245][246]} Prenatal exposure may also affect neurodevelopment.^{[247][248]} Studies show that air pollution is associated with a variety of developmental disabilities, oxidative stress, and neuro-inflammation and that it may contribute to Alzheimer's disease and Parkinson's disease.^[246]

Researchers found that early exposure to air pollution causes the same changes in the brain as autism and schizophrenia in mice. It also showed that air pollution also affected short-term memory, learning ability, and impulsivity. In this study, air pollution had a larger negative impact on male mice than on females.^{[249][250]} Lead researcher on the study, Deborah Cory-Slechta, said that:^[251]

When we looked closely at the ventricles, we could see that the white matter that normally surrounds them hadn't fully developed. It appears that inflammation had damaged those brain cells and prevented that region of the brain from developing, and the ventricles simply expanded to fill the space. Our findings add to the growing body of evidence that air pollution may play a role in autism, as well as in other neurodevelopmental disorders.

Exposure to fine particulate matter can increase levels of cytokines - neurotransmitters produced in response to infection and inflammation that are also associated with depression and suicide. Pollution has been associated with inflammation of the brain, which may disrupt mood regulation. Heightened PM_{2.5} levels are linked to more self-reported depressive symptoms, and increases in daily suicide rates.^{[252][253]}

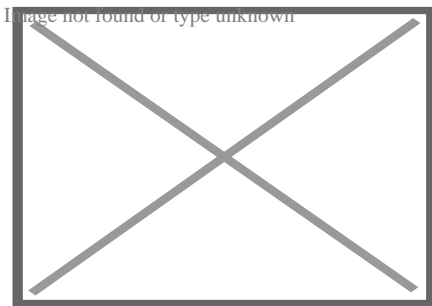
In 2015, experimental studies reported the detection of significant episodic (situational) cognitive impairment from impurities in indoor air breathed by test subjects who were not informed about changes in the air quality. Significant deficits were observed in the performance scores achieved in increasing concentrations of either volatile organic compounds (VOCs) or carbon dioxide, while keeping other factors constant. The highest impurity levels reached are not uncommon in some classroom or office environments.^{[254][255]} Higher PM_{2.5} and CO₂ concentrations were shown to be associated with slower response times and reduced accuracy in tests.^[256]



PM2.5 Levels Across the World's 5 Most Populated Nations in 2019

"Clean" areas

[edit]



Share of the population exposed to air pollution levels above WHO guidelines, 2017

Even in areas with relatively low levels of air pollution, public health effects can be significant and costly, since a large number of people breathe in such pollutants. A study found that even in areas of the U.S. where ozone and PM_{2.5} meet federal standards, Medicare recipients who are exposed to more air pollution have higher mortality rates.^[257]

Rural populations in India, like those in urban areas, are also exposed to high levels of air pollution.^[258] In 2020, scientists found that the boundary layer air over the Southern Ocean around Antarctica is 'unpolluted' by humans.^[259]

Agricultural effects

[edit]

Various studies have estimated the impacts of air pollution on agriculture, especially ozone. A 2020 study showed that ozone pollution in California may reduce yields of certain perennial crops such as table grapes by as much as 22% per year, translating into economic damages of more than \$1 billion per year.^[260] After air pollutants enter the agricultural environment, they not only directly affect agricultural production and quality, but also enter agricultural waters and soil.^[261] The COVID-19 induced lockdown served as a natural experiment to expose the close links between air quality and surface greenness. In India, the lockdown induced improvement in air quality, enhanced surface greenness and photosynthetic activity, with the positive response of vegetation to reduce air pollution was dominant in croplands.^[262] On the other hand, agriculture in its traditional form is one of the primary contributors to the emission of trace gases like atmospheric ammonia.^[263]

Economic effects

[edit]

Air pollution costs the world economy \$5 trillion per year as a result of productivity losses and degraded quality of life.^{[24][25][26]} These productivity losses are caused by deaths due to diseases caused by air pollution. One out of ten deaths in 2013 was caused by diseases associated with air pollution and the problem is getting worse.

A small improvement in air quality (1% reduction of ambient PM_{2.5} and ozone concentrations) would produce \$29 million in annual savings in the lower Fraser Valley region in 2010.^[264] This finding is based on health valuation of lethal (death) and sub-lethal (illness) affects.

The problem is even more acute in the developing world. "Children under age 5 in lower-income countries are more than 60 times as likely to die from exposure to air pollution as children in high-income countries."^{[24][25]} The report states that additional economic losses caused by air pollution, including health costs^[265] and the adverse effect on agricultural and other productivity were not calculated in the report, and thus the actual costs to the world economy are far higher than \$5 trillion.

A study published in 2022 found "a strong and significant connection between air pollution and construction site accidents" and that "a 10-ppb increase in NO₂ levels increases the likelihood of an accident by as much as 25%".^[266]

Other effects

[edit]

Artificial air pollution may be detectable on Earth from distant vantage points such as other planetary systems via atmospheric SETI – including NO₂ pollution levels and with telescopic technology close to today. It may also be possible to detect extraterrestrial civilizations this way.^{[267][268][269]}

Historical disasters

[edit]

The world's worst short-term civilian pollution crisis was the 1984 Bhopal Disaster in India.^[270] Leaked industrial vapours from the Union Carbide factory, belonging to Union Carbide, Inc., U.S.A. (later bought by Dow Chemical Company), killed at least 3787 people and injured from 150,000 to 600,000. The United Kingdom suffered its worst air pollution event when the 4 December Great Smog of 1952 formed over London. In six days more than 4,000 died and more recent estimates put the figure at nearer 12,000.^[271]

An accidental leak of anthrax spores from a biological warfare laboratory in the former USSR in 1979 near Yekaterinburg (formerly Sverdlovsk) is believed to have caused at least 64 deaths.^[272] The worst single incident of air pollution to occur in the US occurred in Donora, Pennsylvania, in late October 1948, when 20 people died and over 7,000 were injured.^[273]

Reduction and regulation

[edit]

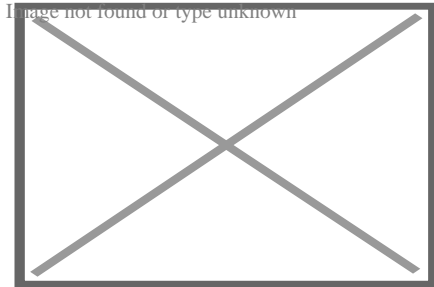
Global depletion of the surrounding air pollution will require valiant leadership, a surplus of combined resources from the international community, and extensive societal changes.^[274] Pollution prevention seeks to prevent pollution such as air pollution and could include adjustments to industrial and business activities such as designing sustainable manufacturing processes (and the products' designs)^[275] and related legal regulations as well as efforts towards renewable energy transitions.^{[276][277]}

Efforts to reduce particulate matter in the air may result in better health.^[278]

The 9-Euro-Ticket scheme in Germany which allowed people to buy a monthly pass allowing use on all local and regional transport (trains, trams and busses) for 9 euro (€) for one month of unlimited travel saved 1.8 million tons of CO₂ emissions during its three-month implementation from June to August 2022.^[279]

Pollution control

[edit]



Burning of items polluting Jamestown environment in Accra, Ghana

Various pollution control technologies and strategies are available to reduce air pollution.^[280]^[281] At its most basic level, land-use planning is likely to involve 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 to protect the environment.^[282] Stringent environmental regulations, effective control technologies and shift towards the renewable source of energy also helping countries like China and India to reduce their sulfur dioxide pollution.^[283]

Titanium dioxide has been researched for its ability to reduce air pollution. Ultraviolet light will release free electrons from material, thereby creating free radicals, which break up VOCs and

NO_x gases. One form is superhydrophilic.^[284]

Pollution-eating nanoparticles placed near a busy road were shown to absorb toxic emission from around 20 cars each day.^[285]

Energy transition

[edit]

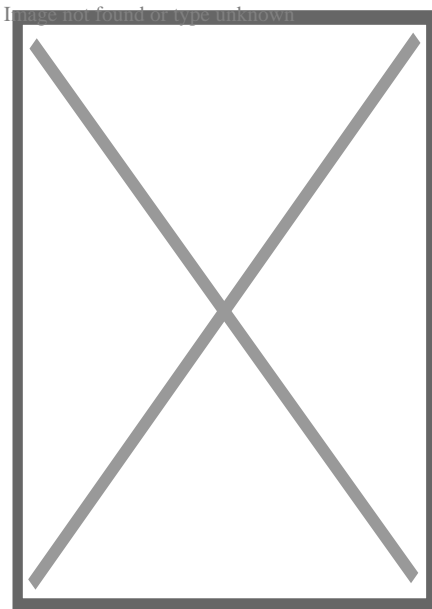
Since a large share of air pollution is caused by combustion of fossil fuels such as coal and oil, the reduction of these fuels can reduce air pollution drastically. Most effective

is the switch to clean power sources such as wind power, solar power, hydro power which do not cause air pollution.^[286] Efforts to reduce pollution from mobile sources includes expanding regulation to new sources (such as cruise and transport ships, farm equipment, and small gas-powered equipment such as string trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid vehicles), conversion to cleaner fuels, and conversion to electric vehicles. For example, buses in New Delhi, India, have run on compressed natural gas since 2000, to help eliminate the city's "pea-soup" smog.^{[226][287]}

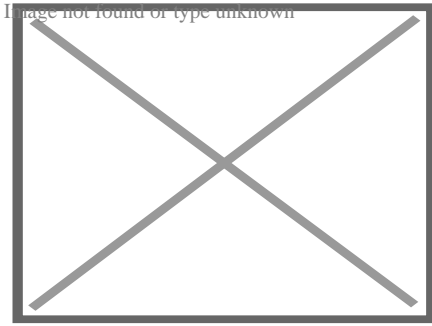
A very effective means to reduce air pollution is the transition to renewable energy. According to a study published in Energy and Environmental Science in 2015 the switch to 100% renewable energy in the United States would eliminate about 62,000 premature mortalities per year and about 42,000 in 2050, if no biomass were used. This would save about \$600 billion in health costs a year due to reduced air pollution in 2050, or about 3.6% of the 2014 U.S. gross domestic product.^[286] Air quality improvement is a near-term benefit among the many societal benefits from climate change mitigation.

Alternatives to pollution

[edit]



Support for a ban on high-emission vehicles in city centres in Europe, China and the US from respondents to the European Investment Bank Climate Survey



Support, use and infrastructure-expansion of forms of public transport that do not cause air pollution may be a critical key alternative to pollution.

There are now practical alternatives to the principal causes of air pollution:

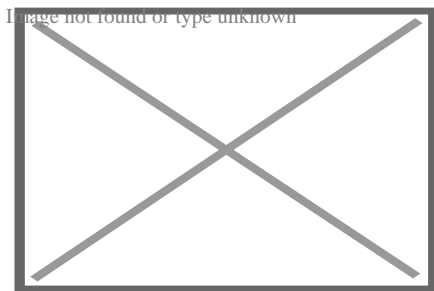
- Strategic substitution of air pollution sources in transport with lower-emission or, during the lifecycle, emission-free forms of public transport^{[288][289]} and bicycle use and infrastructure (as well as with remote work, reductions of work, relocations, and localizations)
 - Phase-out of fossil fuel vehicles is a critical component of a shift to sustainable transport; however, similar infrastructure and design decisions like electric vehicles may be associated with similar pollution for production as well as mining and resource exploitation for large numbers of needed batteries as well as the energy for their recharging^{[290][291]}
- Areas downwind (over 20 miles) of major airports have more than double *total particulate emissions in air* than other areas, even when factoring in areas with frequent ship calls, and heavy freeway and city traffic like Los Angeles.^[292] Aviation biofuel mixed in with jetfuel at a 50/50 ratio can reduce jet derived cruise altitude particulate emissions by 50–70%, according to a NASA led 2017 study (however, this should imply ground level benefits to urban air pollution as well).^[293]
- Ship propulsion and idling can be switched to much cleaner fuels like natural gas. (Ideally a renewable source but not practical yet)
- Combustion of fossil fuels for space heating can be replaced by using ground source heat pumps and seasonal thermal energy storage.^[294]
- Electricity generated from the combustion of fossil fuels can be replaced by nuclear and renewable energy. Heating and home stoves, which contribute significantly to regional air pollution, can be replaced with a much cleaner fossil fuel, such as natural gas, or, preferably, renewables, in poor countries.^{[295][296]}
- Motor vehicles driven by fossil fuels, a key factor in urban air pollution, can be replaced by electric vehicles. Though lithium supply and cost is a limitation, there are alternatives. Herding more people into clean public transit such as electric trains can also help. Nevertheless, even in emission-free electric vehicles, rubber tires produce significant amounts of air pollution themselves, ranking as 13th worst pollutant in Los Angeles.^[297]

- Reducing travel in vehicles can curb pollution. After Stockholm reduced vehicle traffic in the central city with a congestion tax, nitrogen dioxide and PM₁₀ pollution declined, as did acute pediatric asthma attacks.^[298]
- Biodigesters can be utilized in poor nations where slash and burn is prevalent, turning a useless commodity into a source of income. The plants can be gathered and sold to a central authority that will break them down in a large modern biodigester, producing much needed energy to use.^[299]
- Induced humidity and ventilation both can greatly dampen air pollution in enclosed spaces, which was found to be relatively high inside subway lines due to braking and friction and relatively less ironically inside transit buses than lower sitting passenger automobiles or subways.^[300]

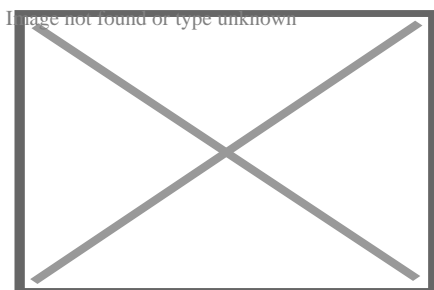
Further information: § Sources

Control devices

[edit]



Tarps and netting are often used to reduce the amount of dust released from construction sites.



Air pollution from a car

The following items are commonly used as pollution control devices in industry and transportation. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the 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 particulates such as dust and smoke from the air stream.
- Baghouses: Designed to handle 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 to remove the dust).
- Particulate scrubbers: A 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 into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.
- **Scrubbers**
 - Baffle spray scrubber
 - Cyclonic spray scrubber
 - Ejector venturi scrubber
 - Mechanically aided scrubber
 - Spray tower
 - Wet scrubber
- **NO_x control**
 - LO-NO_x burners
 - Selective catalytic reduction (SCR)
 - Selective non-catalytic reduction (SNCR)
 - NO_x scrubbers
 - Exhaust gas recirculation
 - Catalytic converter (also for VOC control)
- **VOC abatement**
 - Adsorption systems, using activated carbon, such as Fluidized Bed Concentrator
 - Flares
 - Thermal oxidizers
 - Catalytic converters
 - Biofilters
 - Absorption (scrubbing)
 - Cryogenic condensers
 - Vapor recovery systems
- **Acid gas/SO₂ control**
 - Wet scrubbers

- Dry scrubbers
- Flue-gas desulfurization
- **Mercury control**
 - Sorbent injection technology
 - Electro-catalytic oxidation (ECO)
 - K-Fuel
- **Dioxin and furan control**
- **Miscellaneous associated equipment**
 - Source capturing systems
 - Continuous emissions monitoring systems (CEMS)

Monitoring

[edit]

See also: Smart city

Further information: Air pollution measurement and Environmental monitoring

Spatiotemporal monitoring of air quality may be necessary for improving air quality, and thereby the health and safety of the public, and assessing impacts of interventions.^[301] Such monitoring is done to different extents with different regulatory requirements with discrepant regional coverage by a variety of organizations and governance entities such as using a variety of technologies for use of the data and sensing such mobile IoT sensors,^{[302][303]} satellites,^{[304][305][306]} and monitoring stations.^{[307][308]} Some websites attempt to map air pollution levels using available data.^{[309][310][311]}

Air quality modeling

[edit]

Main article: Air quality modeling

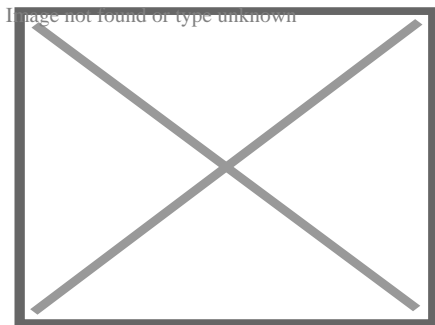
Numerical models either on a global scale using tools such as GCMs (general circulation models coupled with a pollution module) or CTMs (Chemical transport model) can be used to simulate the levels of different pollutants in the atmosphere. These tools can have several types (Atmospheric model) and different uses. These models can be used in forecast mode which can help policy makers to decide on appropriate actions when an air pollution episode is detected. They can also be used for climate modeling including evolution of air quality in the future, for example the

IPCC (Intergovernmental Panel on Climate Change) provides climate simulations including air quality assessments in their reports (latest report accessible through their site).

Regulations

[edit]

Main article: Air quality law



Smog in Cairo

In general, there are two types of air quality standards. The first class of standards (such as the U.S. National Ambient Air Quality Standards and E.U. Air Quality Directive^[312]) set maximum atmospheric concentrations for specific pollutants. Environmental agencies enact regulations which are intended to result 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 to communicate to the public the relative risk of outdoor activity. The scale may or may not distinguish between different pollutants.

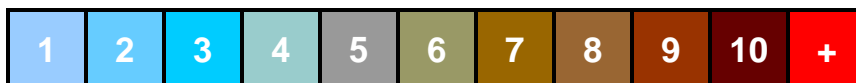
Canada

[edit]

In Canada, air pollution and associated health risks are measured with the Air Quality Health Index (AQHI).^[313] It is a health protection tool used to make decisions to reduce short-term exposure to air pollution by adjusting activity levels during increased levels of air pollution.

The AQHI is a federal program jointly coordinated by Health Canada and Environment Canada. However, the AQHI program would not be possible without the commitment and support of the provinces, municipalities and NGOs. From air quality monitoring to

health risk communication and community engagement, local partners are responsible for the vast majority of work related to AQHI implementation. The AQHI provides a number from 1 to 10+ to indicate the level of health risk associated with local air quality. Occasionally, when the amount of air pollution is abnormally high, the number may exceed 10. The AQHI provides a local air quality current value as well as a local air quality maximums forecast for today, tonight and tomorrow and provides associated health advice.



Risk: Low (1–3) Moderate (4–6) High (7–10) Very high (above 10)

As it is now known that even low levels of air pollution can trigger discomfort for the sensitive population, the index has been developed as a continuum: The higher the number, the greater the health risk and need to take precautions. The index describes the level of health risk associated with this number as 'low', 'moderate', 'high' or 'very high', and suggests steps that can be taken to reduce exposure.^[314]

Health risk	Air Quality Health Index	Health messages ^[315]	
		At risk population	General population
Low	1–3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities
Moderate	4–6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	7–10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very high	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion and should stay indoors.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

The measurement is based on the observed relationship of nitrogen dioxide (NO₂), ground-level ozone (O₃) and particulates (PM_{2.5}) with mortality, from an analysis of

several Canadian cities. Significantly, all three of these pollutants can pose health risks, even at low levels of exposure, especially among those with pre-existing health problems.

When developing the AQHI, Health Canada's original analysis of health effects included five major air pollutants: particulates, ozone, and nitrogen dioxide (NO₂), as well as sulfur dioxide (SO₂), and carbon monoxide (CO). The latter two pollutants provided little information in predicting health effects and were removed from the AQHI formulation.

The AQHI does not measure the effects of odour, pollen, dust, heat or humidity.

Germany

[edit]

TA Luft is the German air quality regulation.^[316]

Governing urban air pollution

[edit]

Further information: Phase-out of fossil fuel vehicles § Cities and territories

In Europe, Council Directive 96/62/EC on ambient air quality assessment and management provides a common strategy against which member states can "set objectives for ambient air quality in order to avoid, prevent or reduce harmful effects on human health and the environment ... and improve air quality where it is unsatisfactory".^[317]

In July 2008, in the case *Dieter Janecek v. Freistaat Bayern*, the European Court of Justice ruled that under this directive^[317] citizens have the right to require national authorities to implement a short term action plan that aims to maintain or achieve compliance to air quality limit values.^{[318][319]}

This important case law appears to confirm the role of the EC as centralised regulator to European nation-states as regards air pollution control. It places a supranational legal obligation on the UK to protect its citizens from dangerous levels of air pollution, furthermore superseding national interests with those of the citizen.

In 2010, the European Commission (EC) threatened the UK with legal action against the successive breaching of PM₁₀ limit values.^[320] The UK government has identified that if fines are imposed, they could cost the nation upwards of £300 million per year.^[321]

In March 2011, the Greater London Built-up Area remained the only UK region in breach of the EC's limit values, and was given three months to implement an emergency action plan aimed at meeting the EU Air Quality Directive.^[322] The City of London has dangerous levels of PM₁₀ concentrations, estimated to cause 3000 deaths per year within the city.^[323] As well as the threat of EU fines, in 2010 it was threatened with legal action for scrapping the western congestion charge zone, which is claimed to have led to an increase in air pollution levels.^[324]

In response to these charges, mayor of London Boris Johnson has criticised the current need for European cities to communicate with Europe through their nation state's central government, arguing that in future "A great city like London" should be permitted to bypass its government and deal directly with the European Commission regarding its air quality action plan.^[322]

This can be interpreted as recognition that cities can transcend the traditional national government organisational hierarchy and develop solutions to air pollution using global governance networks, for example through transnational relations. Transnational relations include but are not exclusive to national governments and intergovernmental organisations,^[325] allowing sub-national actors including cities and regions to partake in air pollution control as independent actors.

Global city partnerships can be built into networks, for example the C40 Cities Climate Leadership Group, of which London is a member. The C40 is a public 'non-state' network of the world's leading cities that aims to curb their greenhouse emissions.^[326]] The C40 has been identified as 'governance from the middle' and is an alternative to intergovernmental policy.^[327] It has the potential to improve urban air quality as participating cities "exchange information, learn from best practices and consequently mitigate carbon dioxide emissions independently from national government decisions".^[326] A criticism of the C40 network is that its exclusive nature limits influence to participating cities and risks drawing resources away from less powerful city and regional actors.

Indigenous people

[edit]

Because Indigenous people^[328] frequently experience a disproportionate share of the effects of environmental degradation and climate change, even while they have made very little contribution to the processes causing these changes, environmental justice is especially important to them. Indigenous peoples have been marginalized and their lands and resources have been exploited as a result of historical and continuing colonization, institutional injustices, and inequality.

Indigenous groups frequently lack the political and financial clout to influence policy decisions that impact their lands and means of subsistence or to lessen the effects of climate change. This makes the already-existing inequalities in these communities' social, economic, and health conditions worse. Furthermore, traditional ecological knowledge and Indigenous knowledge systems provide insightful information about sustainable resource management and climate change adaptation techniques. To promote persistence and environmental justice, Indigenous viewpoints must be acknowledged and integrated into efforts to mitigate the effects of climate change and adapt to them.

Combating climate change necessitates an all-encompassing strategy that recognizes the interdependence of social, economic, and environmental elements. This entails defending treaty rights, advancing Indigenous sovereignty and self-determination, and aiding Indigenous-led projects for sustainable development and environmental preservation.

Hotspots

[edit]

Main article: Toxic hotspot

See also: Cancer alley and Superfund

Air pollution hotspots are areas where air pollution emissions expose individuals to increased negative health effects.^[329] They are particularly common in highly populated, urban areas, where there may be a combination of stationary sources (e.g. industrial facilities) and mobile sources (e.g. cars and trucks) of pollution. Emissions from these sources can cause respiratory disease, childhood asthma,^[141] cancer, and other health problems. Fine particulate matter such as diesel soot, which contributes to more than 3.2 million premature deaths around the world each year, is a significant problem. It is very small and can lodge itself within the lungs and enter the bloodstream. Diesel soot is concentrated in densely populated areas, and one in six people in the U.S. live near a diesel pollution hot spot.^[330]

External videos

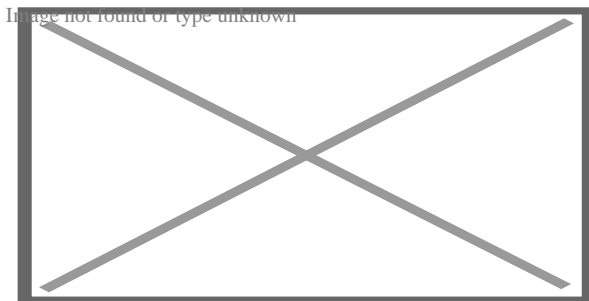
While air pollution hotspots affect a variety of populations, some groups are more likely to be located in hotspots. Previous studies have shown disparities in exposure to pollution by race and/or income. Hazardous land uses (toxic storage and disposal facilities, manufacturing facilities, major roadways) tend to be located where property values and income levels are low. Low socioeconomic status can be a proxy for other kinds of social vulnerability, including race, a lack of ability to influence regulation and a lack of ability to move to neighborhoods with less environmental pollution. These communities bear a disproportionate burden of environmental pollution and are more likely to face health risks such as cancer or asthma.^[332]

Studies show that patterns in race and income disparities not only indicate a higher exposure to pollution but also higher risk of adverse health outcomes.^[333] Communities characterized by low socioeconomic status and racial minorities can be more vulnerable to cumulative adverse health impacts resulting from elevated exposure to pollutants than more privileged communities.^[333] Blacks and Latinos generally face more pollution than Whites and Asians, and low-income communities bear a higher burden of risk than affluent ones.^[332] Racial discrepancies are particularly distinct in suburban areas of the Southern United States and metropolitan areas of the Midwestern and Western United States.^[334] Residents in public housing, who are generally low-income and cannot move to healthier neighborhoods, are highly affected by nearby refineries and chemical plants.^[335]

Cities

[edit]

See also: List of most polluted cities in the world by particulate matter concentration
Further information: List of least polluted cities by particulate matter concentration



Nitrogen dioxide concentrations as measured from satellite 2002–2004

Air pollution is usually concentrated in densely populated metropolitan areas, especially in developing countries where cities are experiencing rapid growth and

environmental regulations are relatively lax or nonexistent. Urbanization leads to a rapid rise in premature mortality due to anthropogenic air pollution in fast-growing tropical cities.^[336] However, even populated areas in developed countries attain unhealthy levels of pollution, with Los Angeles and Rome being two examples.^[337] Between 2002 and 2011 the incidence of lung cancer in Beijing near doubled. While smoking remains the leading cause of lung cancer in China, the number of smokers is falling while lung cancer rates are rising .^[338]

^[339]

World's Most Polluted Cities 2020 2020 Average 2019 Average

Hotan, China	110.2	110.1
Ghaziabad, India	106.6	110.2
Bulandshahr, India	98.4	89.4
Bisrakh Jalalpur, India	96.0	-
Bhiwadi, India	95.5	83.4

Tehran was declared the most polluted city in the world on May 24, 2022.^[340]

Projections




[edit]

In a 2019 projection, by 2030 half of the world's pollution emissions could be generated by Africa.^[341] Potential contributors to such an outcome include increased burning activities (such as the burning of open waste), traffic, agri-food and chemical industries, sand dust from the Sahara, and overall population growth.

In a 2012 study, by 2050 outdoor air pollution (particulate matter and ground-level ozone) is projected to become the top cause of environmentally related deaths worldwide.^[342]

See also

[edit]

-  [Global warming portal](#)
-  [Plants portal](#)
-  [Trees portal](#)

Source

- [Beehive burner](#)

- Bottom ash
- Concrete#Concrete – health and safety
- Diwali-related air pollution
- Flue-gas emissions from fossil-fuel combustion
- Health impacts of sawdust
- Joss paper
- Metal working
- Mining
- Non-exhaust emissions
- Power tool
- Rubber pollution
- Slag
- Smelting
- Tire fire
- Welding
- Wood ash

Measurement

- Air pollutant concentrations
- Air pollution measurement
- Organic molecular tracers
- Intake fraction
- Particulate matter sampler

Others

- Air stagnation
- ASEAN Agreement on Transboundary Haze Pollution
- Asian brown cloud
- Atmospheric chemistry
- BenMAP
- Best Available Control Technology
- Critical load
- Emission standard
- Emissions & Generation Resource Integrated Database
- Environmental agreement
- Environmental racism
- Exposome
- Global Atmosphere Watch
- Global dimming
- Great Smog of London
- Haze
- Health Effects Institute (HEI)

- Indicator value
- International Agency for Research on Cancer
- International Day of Clean Air for Blue Skies
- Kyoto Protocol
- Light water reactor sustainability
- List of smogs by death toll
- Lowest Achievable Emissions Rate
- NASA Clean Air Study
- NIEHS
- Phytoremediation
- Polluter pays principle
- Regulation of greenhouse gases under the Clean Air Act
- Silicosis#Prevention

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Further reading

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Library resources about

Air pollution

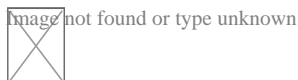
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- Resources in other libraries
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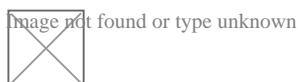
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External links

[edit]



Wikimedia Commons has media related to ***Air pollution***.



Wikivoyage has travel information for ***Air pollution***.

- WHO fact sheet on outdoor air pollution

- Air Pollution: Everything You Need to Know Guide by the Natural Resources Defense Council (NRDC)
- Global real-time air quality index map
- Air Quality Index (AQI) Basics
- AQI Calculator AQI to Concentration and Concentration to AQI for five pollutants
- UNEP Urban environmental planning
- European Commission > Environment > Air > Air Quality
- Database: outdoor air pollution in cities from the World Health Organization
- The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom, UK Committee on the Medical Effects of Air Pollution, 2010.
- Hazardous air pollutants | What are hazardous pollutants at EPA.gov

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Pollution

History

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
 - Biofuel
 - Biomass
 - Joss paper
 - Open burning of waste
- Construction
 - Renovation
- Demolition
- Exhaust gas
 - Diesel exhaust
- Haze
 - Smoke
- Indoor air quality
- Internal combustion engine
- Global dimming
- Global distillation
- Mining
- Ozone depletion
- Particulates
 - Asbestos
 - Metal working
 - Oil refining
 - Wood dust
 - Welding
- Persistent organic pollutant
- Smelting
- Smog
- Soot
 - Black carbon
- Volatile organic compound
- Waste
- Biological hazard
- Genetic pollution
- Introduced species
 - Invasive species
- Information pollution

Biological

Digital

Electromagnetic

Natural

Noise

Radiation

Soil

- Light
 - Ecological light pollution
 - Overillumination
- Radio spectrum pollution
- Ozone
- Radium and radon in the environment
- Volcanic ash
- Wildfire
- Transportation
 - Land
 - Water
 - Air
 - Rail
 - Sustainable transport
- Urban
- Sonar
 - Marine mammals and sonar
- Industrial
- Military
- Abstract
- Noise control
- Actinides
- Bioremediation
- Nuclear fission
- Nuclear fallout
- Plutonium
- Poisoning
- Radioactivity
- Uranium
- Electromagnetic radiation and health
- Radioactive waste
- Agricultural pollution
 - Herbicides
 - Manure waste
 - Pesticides
- Land degradation
- Bioremediation
- Open defecation
- Electrical resistance heating
- Soil guideline values
- Phytoremediation

Solid waste

- Advertising mail
- Biodegradable waste
- Brown waste
- Electronic waste
 - Battery recycling
- Foam food container
- Food waste
- Green waste
- Hazardous waste
 - Biomedical waste
 - Chemical waste
 - Construction waste
 - Lead poisoning
 - Mercury poisoning
 - Toxic waste
- Industrial waste
 - Lead smelting
- Litter
- Mining
 - Coal mining
 - Gold mining
 - Surface mining
 - Deep sea mining
 - Mining waste
 - Uranium mining
- Municipal solid waste
 - Garbage
- Nanomaterials
- Plastic pollution
 - Microplastics
- Packaging waste
- Post-consumer waste
- Waste management
 - Landfill
 - Thermal treatment

Space

- Satellite
- Air travel
- Clutter (advertising)
- Traffic signs
- Overhead power lines
- Vandalism

Visual

War

- Chemical warfare
- Herbicidal warfare (Agent Orange)
- Nuclear holocaust (Nuclear fallout - nuclear famine - nuclear winter)
- Scorched earth
- Unexploded ordnance
- War and environmental law
- Agricultural wastewater
- Biological pollution
- Diseases
- Eutrophication
- Firewater
- Freshwater
- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
 - debris
- Monitoring

Water

- Nonpoint source pollution
- Nutrient pollution
- Ocean acidification
- Oil exploitation
- Oil exploration
- Oil spill
- Pharmaceuticals
- Sewage
 - Septic tanks
 - Pit latrine
- Shipping
- Stagnation
- Sulfur water
- Surface runoff
- Thermal
- Turbidity
- Urban runoff
- Water quality
- Pollutants
 - Heavy metals
 - Paint
- Brain health and pollution







Topics

Misc

- Area source
- Debris
- Dust
- Garbology
- Legacy pollution
- Midden
- Point source
- Waste
- Cleaner production
- Industrial ecology
- Pollution haven hypothesis
- Pollutant release and transfer register
- Polluter pays principle
- Pollution control
- Waste minimisation
- Zero waste
- Diseases
- Law by country
- Most polluted cities
- Least polluted cities by PM_{2.5}
- Most polluted countries
- Most polluted rivers
- Treaties

Responses

Lists

 [Categories \(by country\)](#)  [Commons](#)  [WikiProject Environment](#)  [WikiProject Ecology](#)  [Environment portal](#)  [Ecology portal](#)

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Asia pollution topics

	Dust storm	<ul style="list-style-type: none"> ○ 2010 China dust storms ○ 1997 SEA haze ○ 1997 Indonesian forest fires ○ 2005 Malaysian haze ○ 2006 SEA haze ○ 2009 SEA haze ○ 2010 SEA haze
Notable incidents	Forest fires and haze	<ul style="list-style-type: none"> ○ 2013 SEA haze ○ 2015 SEA haze ○ 2016 Malaysian haze ○ 2016 SEA haze ○ 2017 SEA haze ○ 2019 SEA haze ○ 2019 Vietnam forest fires ○ 2024 Indo-Pakistani smog
Air pollution	Air radioactive contamination	<ul style="list-style-type: none"> ○ 1982 Bukit Merah radioactive pollution
	By countries	<ul style="list-style-type: none"> ○ China ○ Hong Kong ○ India ○ Macau ○ Malaysia ○ Taiwan
	Recurrent issues	<ul style="list-style-type: none"> ○ Asian brown cloud ○ Asian Dust ○ Shamal ○ Southeast Asian haze ○ ASEAN Agreement on Transboundary Haze Pollution
	Counter-measures	<ul style="list-style-type: none"> ○ Operation Haze ○ Pollutant Standards Index ○ Great Green Wall (China)

**Water
pollution**

**Water
radioactive
contamination
Notable
incidents**

**Marine
pollution**

- 2011 Fukushima Daiichi nuclear disaster
- 2016 Vietnam marine life disaster
- 2019 Kim Kim River toxic pollution
- Pollution of the Pasig River

**By
countries**

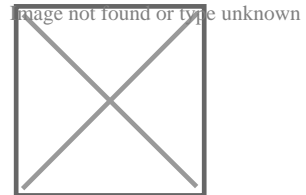
- China
 - Water crisis
- India
- Japan
- Philippines
- Vietnam

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Environmental science

Main fields

- Atmospheric science
- Biogeochemistry
- Ecology
- Environmental chemistry
- Geosciences
- Hydrology
- Limnology
- Oceanography
- Soil science



- Biology
- Chemistry
 - green
- Ecological economics
- Environmental design
- Environmental economics
- Environmental engineering
- Environmental health
 - epidemiology
- Environmental studies
- Environmental humanities
- Environmental statistics
- Environmental toxicology
- Geodesy
- Physics
- Radioecology
- Sustainability science
- Systems ecology
- Urban ecology
- Energy conservation
- Environmental technology
- Natural resource management
- Pollution control
- Public transport encouragement
- Recycling
- Remediation
- Renewable energy
- Road ecology
- Sewage treatment
- Urban metabolism
- Water purification
- Waste management
- Degrees
- Journals
- Research institutes
- Glossary
- Environment by year
- Human impact on the environment
- Sustainability
- Technogaianism

Related fields

Applications

Lists

See also

-  **Category**
 - scientists
-  **Commons**
-  **Environment portal**
-  **WikiProject**

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Public health

General

- Auxology
- Biological hazard
- Chief Medical Officer
- Cultural competence
- Deviance
- Environmental health
- Eugenics
 - History of
 - Liberal
- Euthenics
- Genomics
- Globalization and disease
- Harm reduction
- Health economics
- Health literacy
- Health policy
 - Health system
 - Health care reform
- Housing First
- Human right to water and sanitation
- Management of depression
 - Public health law
 - National public health institute
- Health politics
- Labor rights
- Maternal health
- Medical anthropology
- Medical sociology
- Mental health (Ministers)
- Occupational safety and health
- Pharmaceutical policy
- Pollution
 - Air
 - Water
 - Soil
 - Radiation
 - Light
- Prisoners' rights
- Public health intervention
- Public health laboratory
- Right to food
- Right to health
- Right to housing
- Right to rest and leisure
- Right to sit
- Security of person
- Sexual and reproductive health

**Preventive
healthcare**

- Behavior change
 - Theories
- Family planning
- Health promotion
- Human nutrition
 - Healthy diet
 - Preventive nutrition
- Hygiene
 - Food safety
 - Hand washing
 - Infection control
 - Oral hygiene
- Occupational safety and health
 - Human factors and ergonomics
 - Hygiene
 - Controlled Drugs
 - Injury prevention
 - Medicine
 - Nursing
- Patient safety
 - Organization
- Pharmacovigilance
- Safe sex
- Sanitation
 - Emergency
 - Fecal–oral transmission
 - Open defecation
 - Sanitary sewer
 - Waterborne diseases
 - Worker
- School hygiene
- Smoking cessation
- Vaccination
- Vector control

Population health

- Biostatistics
- Child mortality
- Community health
- Epidemiology
- Global health
- Health impact assessment
- Health system
- Infant mortality
- Open-source healthcare software
- Multimorbidity
- Public health informatics
- Social determinants of health
 - Commercial determinants of health
 - Health equity
 - Race and health
- Social medicine
- Case-control study
- Randomized controlled trial
- Relative risk

Biological and epidemiological statistics

- Statistical hypothesis testing
 - Analysis of variance (ANOVA)
 - Regression analysis
 - ROC curve
 - Student's *t*-test
 - Z-test
- Statistical software
- Asymptomatic carrier
- Epidemics
 - List

Infectious and epidemic disease prevention

- Notifiable diseases
 - List
- Public health surveillance
 - Disease surveillance
- Quarantine
- Sexually transmitted infection
- Social distancing
- Tropical disease
- Vaccine trial
- WASH

**Food hygiene
and
safety
management**

- Food
 - Additive
 - Chemistry
 - Engineering
 - Microbiology
 - Processing
 - Safety
 - Safety scandals
- Good agricultural practice
- Good manufacturing practice
 - HACCP
 - ISO 22000
- Diffusion of innovations
- Health belief model
- Health communication
- Health psychology
- Positive deviance
- PRECEDE–PROCEED model
- Social cognitive theory
- Social norms approach
- Theory of planned behavior
- Transtheoretical model

**Health
behavioral
sciences**

**Organizations,
education
and history**

Organizations

- Caribbean
 - Caribbean Public Health Agency
- China
 - Center for Disease Control and Prevention
- Europe
 - Centre for Disease Prevention and Control
 - Committee on the Environment, Public Health and Food Safety
- India
 - Ministry of Health and Family Welfare
- Canada
 - Health Canada
 - Public Health Agency
- U.S.
 - Centers for Disease Control and Prevention
 - Health departments in the United States
 - Council on Education for Public Health
 - Public Health Service
- World Health Organization
- World Toilet Organization
- (Full list)
- Health education
- Higher education

Education

- Bachelor of Science in Public Health
- Doctor of Public Health
- Professional degrees of public health
- Schools of public health

History

- Sara Josephine Baker
- Samuel Jay Crumbine
- Carl Rogers Darnall
- Joseph Lister
- Margaret Sanger
- John Snow
- Typhoid Mary
- Radium Girls
- Germ theory of disease
- Social hygiene movement

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-  **Commons** image not found or type unknown
-  **WikiProject** image not found or type unknown

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Natural resources

Air

Pollution / quality

- Ambient standards (US)
- Index
- Indoor
- Law
 - Clean Air Act (US)
- Ozone depletion
- Airshed
- Trading
- Deforestation (REDD)

Emissions

Energy

- Bio
- Law
- Resources
- Fossil fuels (gas, peak coal, peak gas, peak oil)
- Geothermal
- Hydro
- Nuclear
- Solar
 - sunlight
 - shade
- Wind

Land

- Agricultural
 - arable
 - peak farmland
- Degradation
- Field
- Landscape
 - cityscape
 - seascape
 - soundscape
 - viewshed
- Law
 - property
- Management
 - habitat conservation
- Minerals
 - gemstone
 - industrial
 - ore
 - metal
 - mining
 - law
 - sand
 - peak
 - copper
 - phosphorus
 - rights
- Soil
 - conservation
 - fertility
 - health
 - resilience
- Use
 - planning
 - reserve

Life

- Biodiversity
- Bioprospecting
 - biopiracy
- Biosphere
- Bushfood
- Bushmeat
- Fisheries
 - climate change
 - law
 - management
- Forests
 - genetic resources
 - law
 - management
 - non-timber products
- Game
 - law
- Marine conservation
- Meadow
- Pasture
- Plants
 - FAO Plant Treaty
 - food
 - genetic resources
 - gene banks
 - herbal medicines
 - UPOV Convention
 - wood
- Rangeland
- Seed bank
- Wildlife
 - conservation
 - management

Water

Types / location

- Aquifer
 - storage and recovery
- Drinking
- Fresh
- Groundwater
 - pollution
 - recharge
 - remediation
- Hydrosphere
- Ice
 - bergs
 - glacial
 - polar
- Irrigation
 - *huerta*
- Marine
- Rain
 - harvesting
- Stormwater
- Surface water
- Sewage
 - reclaimed water
- Watershed
- Desalination
- Floods
- Law
- Leaching
- Sanitation
 - improved
- Scarcity
- Security
- Supply
- Efficiency
- Conflict
- Conservation
- Peak water
- Pollution
- Privatization
- Quality
- Right
- Resources
 - improved
 - policy

Aspects

- Commons
 - enclosure
 - global
 - land
 - tragedy of
- Economics
 - ecological
 - land
- Ecosystem services
- Exploitation
 - overexploitation
 - Earth Overshoot Day
- Management
 - adaptive
- Natural capital
 - accounting
 - good
- Natural heritage
- Nature reserve
 - remnant natural area
- Systems ecology
- Urban ecology
- Wilderness

Related

- Resource
 - Common-pool
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 - Oil war
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About Royal Supply South

Things To Do in Arapahoe County

Photo

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Big Blue Bear

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Photo

Wings Over the Rockies Air & Space Museum

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Molly Brown House Museum

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Colorado Freedom Memorial

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Morrison Nature Center

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Four Mile Historic Park

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Driving Directions in Arapahoe County

Driving Directions From St. Nicks Christmas and Collectibles to Royal Supply South

Driving Directions From U.S. Bank ATM to Royal Supply South

Driving Directions From Littleton to Royal Supply South

[Mobile Home Hvac Service](#)

[Mobile home supply store](#)

[Air conditioning repair service](#)

[Air conditioning store](#)

Driving Directions From History Colorado Center to Royal Supply South

Driving Directions From Plains Conservation Center (Visitor Center) to Royal Supply South

Driving Directions From The Aurora Highlands North Sculpture to Royal Supply South

Driving Directions From Colorado Freedom Memorial to Royal Supply South

Driving Directions From Molly Brown House Museum to Royal Supply South

Driving Directions From The Aurora Highlands North Sculpture to Royal Supply South

Mobile Home Furnace Installation

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Reviews for Royal Supply South

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