

3. MODULE

AIR

EcoTournament -Planet depends on us

The resulting teaching material was created for the Eco- Tournament platform and includes basic information about the environment and ways to fight against climate change. The knowledge contained in the publication will allow tournament participants to acquire the knowledge to correctly answer the Eco- Tournament tasks. Good luck!



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Introduction

Definition of air

Air is the invisible mixture of gasses that surrounds Earth. Air contains important substances, such as oxygen and nitrogen, that most species need to survive.

Air isn't just gas:

While air is mostly gas, it also holds lots of tiny particles. These particles in the air are called aerosols. Some aerosols like dust and pollen are picked up naturally when the wind blows. But the air can also carry soot, smoke, and other particles from car exhaust and power plants. While air is mostly gas, it also holds lots of tiny particles. These particles in the air are called aerosols. Some aerosols like dust and pollen are picked up naturally when the wind blows. But the air can also carry soot, smoke, and other particles from car exhaust and power plants. The air is different as you move higher and higher into the atmosphere. The air gets "thinner" as elevation climbs because there are fewer air molecules up there. Properties of air: Air takes up space. Air has volume and, if enclosed in a container, will expand to fill the container.

Air has mass:

Air doesn't have as much mass per unit volume compared to say, gold, but it does weigh something.

Air exerts pressure:

Atmospheric air pressure is a very important concept in meteorology - it refers to the weight of air in a column above a particular point. Atmospheric air pressure is higher at sea level than at the top of Mt. Everest because there is a bigger pile of air above a point at sea level than at a point on the top of Mt. Everest. We don't notice air pressure much in our day-to-day lives, except perhaps when our ears pop when we gain or lose a lot of altitude in a plane or car.

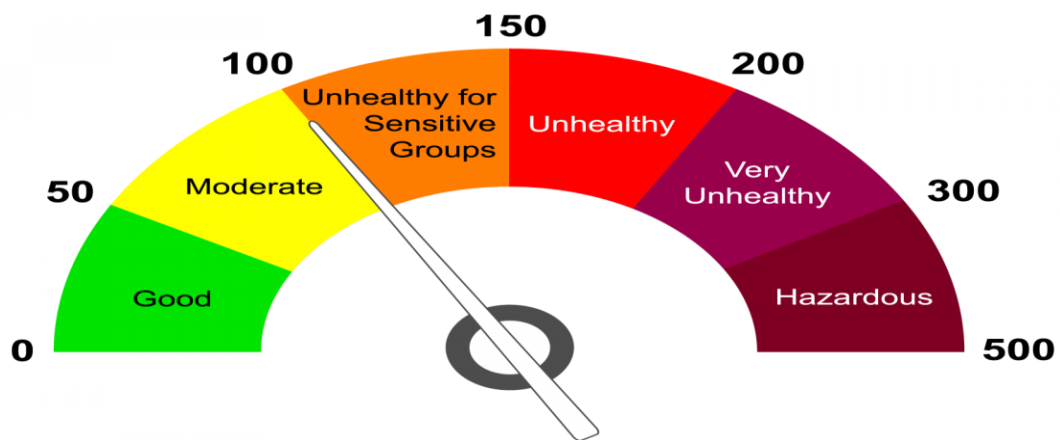
Air is a natural virtue on earth which sustains life:

It exists in the atmosphere and it basically contains a mixture of numerous gasses like oxygen, nitrogen and carbon dioxide in higher proportions and much smaller levels of argon, water vapor, and other gasses. Air also contains bacteria, suspended dust, and spores.

To measure the quality of the air, we use Air quality index: runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.



Example:



Air components

Water vapor: We know that water present in oceans and rivers evaporates during summer and escapes into the air.

Thus, water vapor is one of the components of the air. It occupies a very less percentage of the earth's atmosphere.

Oxygen: Air contains some matter which supports combustion. This substance is oxygen. Oxygen is one of the major components of air around us. Air comprises almost 21% oxygen.

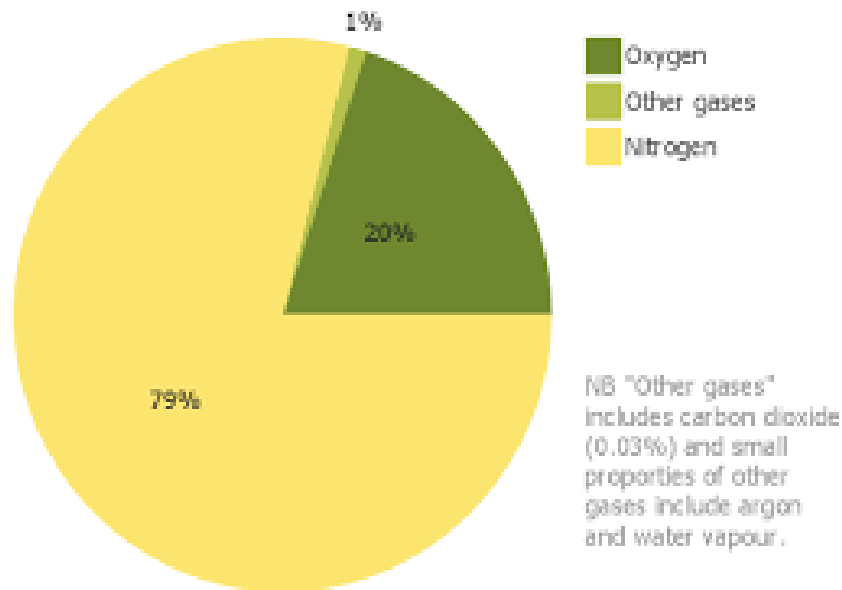
Nitrogen: When you blow over a burning candle you notice that it extinguishes. This means air contains incombustible gasses (gasses that don't support combustion) too. This is majorly due to the presence of nitrogen. Nitrogen occupies nearly 78% of the earth's atmosphere and is the most abundant gas on our planet.

Carbon dioxide: Carbon dioxide is mainly produced due to respiration by plants and animals or the burning of fuel. It occupies 0.038% of the earth's atmosphere. Its occupancy keeps on changing from one place to another in our atmosphere. Smoke and dust particles: Smoke is present in our atmosphere due to the burning of fuels. Its occupancy varies from place to place. It is a mixture of gasses and is often harmful.

Apart from these, dust particles are also present in our atmosphere which we observe when we see a ray of light in a dark room. Smoke and dust particles occupy less than 1% of the earth's atmosphere.



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Learning outcomes

As a result of engaging with the material in this module, youth workers and volunteers are intended to achieve the following learning outcomes:

Knowledge

Learn about the composition of the air, its basic use ; Learn about the causes of air pollution and ways to counteract it ; Learn what sustainable development goals are related to air.

Skills

- What steps to take to avoid air pollution;
- Awareness of the need to combat climate change;
- Ability to engage effectively;
- Critical thinking;
- Self-motivation to effect change.

Attitude

- Competence includes an attitude of critical appreciation and curiosity, a concern for ethical issues and support for both safety and environmental sustainability,
- Take responsibility for the environment,
- Pro-activity, being forward-looking.



Main use of Air

Air is important for living things. People need to breathe, and so do lots of other animals—and plants! Breathing is part of a process called respiration. During respiration, a living thing takes in oxygen from the air and gives out carbon dioxide. This process gives animals and plants the energy to eat, grow, and live life! Carbon dioxide in the air can be good. When humans and animals breathe, we give off an odorless gas called carbon dioxide, or CO₂. Plants use this gas, along with sunlight, to make food—and oxygen too! This process is called photosynthesis. Air also holds water. When it's a hot, muggy summer day, you've probably heard the word "humid." But what does that mean, exactly? The relative humidity is the amount of water that the air can hold before it rains. Humidity is usually measured in percentages, so the highest level of relative humidity—right before it rains—is 100 percent.

Air changes as you go up, up, up.

Air seems light, but there is a lot of it pushing down on Earth's surface. This is called air pressure. You experience high air pressure at sea level because the whole atmosphere is pushing down on you.

The air pressure is low on top of a mountain because there is less atmosphere pushing down on you.

That difference in air pressure can cause your ears to pop when you're taking off in an airplane or driving up a hill.

Air is a protective cushion.

On Earth, we're pretty lucky to have an atmosphere filled with air. The air in our atmosphere acts as insulation, keeping the Earth from getting too cold or too hot. Ozone, another type of gas in the air, also protects us from too much sunlight.

Air in the atmosphere can also protect us from meteoroids. When meteoroids contact our atmosphere, they rub against the air and oftentimes are burned into small pieces before reaching Earth. :

There is life in the air

Lots of living things make their homes in soil and water. But did you know that living organisms can also be found hanging out in the air?

These tiny microbial organisms are called bioaerosols.

Although these microbes can't fly, they can travel long distances through the air—via wind, rain, or even a sneeze!

Air can move fast and far.

Even on a very still day, the air around us is always moving.



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But when a big wind comes, that air can really go! The fastest gust of wind ever recorded on Earth was 253 miles per hour.

Air pollution

Air pollution is the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Household combustion devices, motor vehicles, industrial facilities, and forest fires are common sources of air pollution. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide.

Around 2.4 billion people cook and heat their homes with polluting fuels.

Ambient and household air pollution can come from similar processes such as incomplete combustion of fuels or chemical reactions between gasses.

However, the specific source of the combustion process can vary.

For example, household activities such as cooking and heating with dirty technologies, and lighting with kerosene, emit a range of health harmful pollutants indoors, while activities such as high-temperature combustion in vehicles, industries, and power-generating facilities contribute to ambient air pollution.

Activities such as boiling water for bathing or cooking animal fodder can also add to household air pollution exposures.

Air pollution can ruin your outdoor plans:

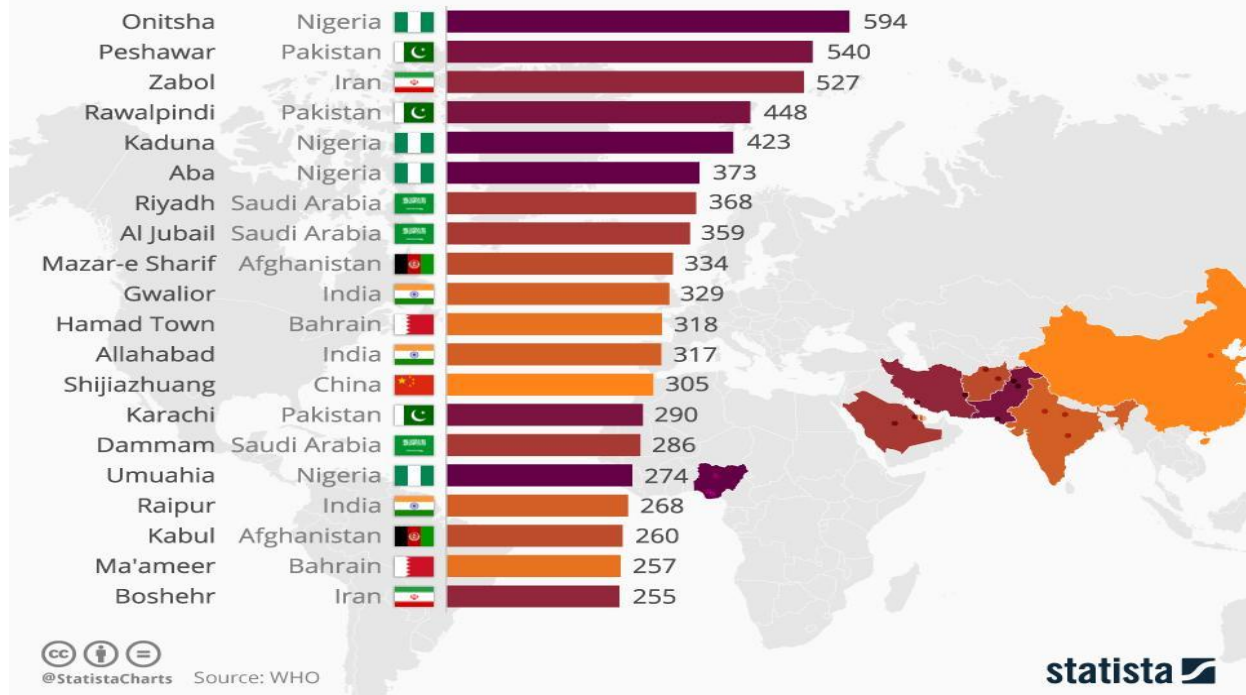
Air pollution is measured with the Air Quality Index or AQI. The lower the AQI, the cleaner the air is.

However, if you are outside when the AQI is over 100, it's about the same as breathing in exhaust from a car all day! Things that cause poor air quality are forest fires and cities with lots of car traffic. If the AQI is higher than 100 you shouldn't spend too much time outside.



The 20 Worst Cities Worldwide For Air Pollution

Annual mean micrograms per cubic metre of PM10 in cities worldwide



Causes of pollution

The Burning of Fossil Fuels

Most of the air pollution takes place due to the incomplete burning of fossil fuels. These include coal, oil, and gasoline to produce energy for electricity or transportation. The release of CO₂ at a high level indicates how much fossil fuel is burned. This also emits other toxic pollutants like nitrogen oxides into the air. Inhaling air induced with pollutants due to the burning of natural gas and fossil fuel reduces the heart's ability to pump enough oxygen. Hence causing one to suffer from various respiratory and heart illnesses.

Furthermore, nitrogen oxides are responsible for acid rain and the formation of smog. When fossil fuels are burned, they emit more than just CO₂. Coal-fired power stations alone account for 35% of harmful mercury emissions in the US. Two-thirds of SO₂ emissions cause acid rain. The great majority of dust (particle pollution) is released in our air due to fossil fuel burning.

A new study has shown that the demand for fossil fuels will peak by 2025 if countries meet their climate pledges, according to the latest World Energy Outlook 2021 from the International Energy Agency (IEA).



Industrial Emission

Industrial activities emit several pollutants into the air that affect the air quality more than we can even imagine. Particulate matter 2.5 and 10, NO₂, SO₂, and CO are key pollutants that are emitted from industries that use coal and wood as their primary energy source for the production of their goods. Industrial pollution effects associated with your health can range from Irritation in your eyes and throat.

Breathing issues

At times can even lead to chronic illness VOCs and other emissions from industries can aggregate respiratory disorders like asthma and bronchitis. O₃ is also released from industries that can increase asthma attacks. Huge amounts of organic chemicals like CO₂, hydrocarbons, etc. are released by the industries including other toxicants. They furthermore affect the climate as CO₂ causes a greenhouse effect. Hence, causing the heat to be trapped within the earth's atmosphere. Therefore, the temperature and humidity increase. More and more industries are being built as the demand grows. And as a result the emissions also increase day by day.

As many as 90% of wildfires are caused by anthropogenic reasons, a small spark can turn acres of forest area into ashes. The soot and dust particles, and smoke (that contains several toxic chemicals) can stay suspended in the air for days. The average temperature is increasing day by day due to the greenhouse effect. As a result, the rise in temperature affects the rate of wildfires. More the temperature, the more the cases of wildfires and forest fires. Wildlife, plants, and animals are all impacted by wildfires.

Microbial Decaying Process

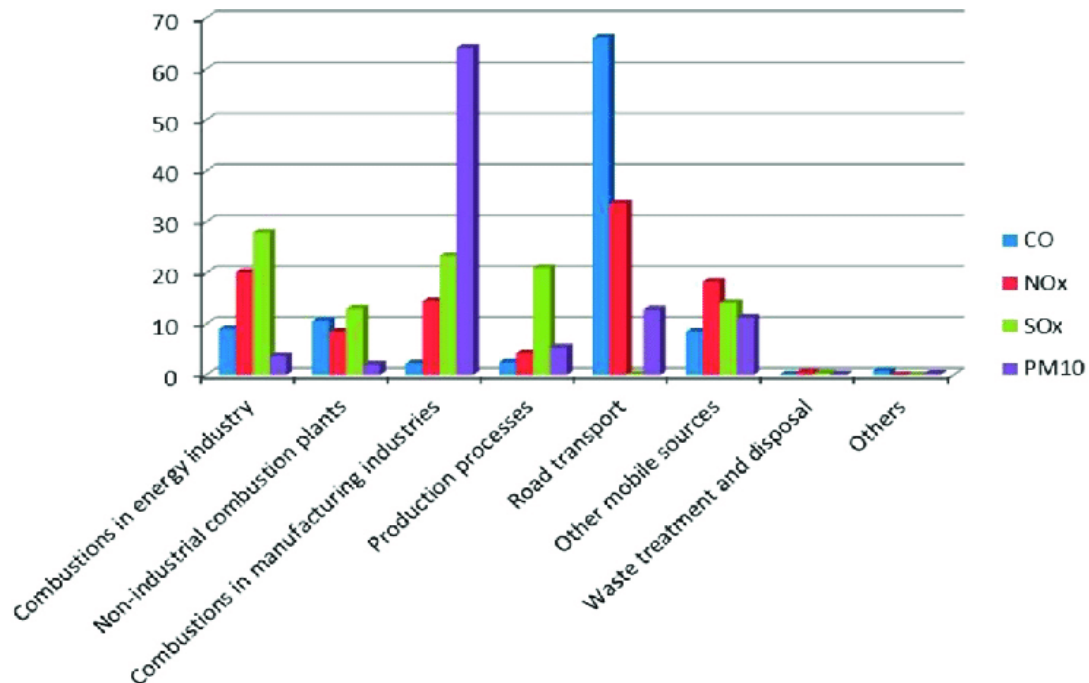
Manufacturing, chemical, and textiles industries release a large number of CO, hydrocarbons, chemicals, and organic compounds which contaminate our environment. Bacteria and fungi play a fundamental role in the biogeochemical cycles in nature. They are the key indicators of abnormal environmental conditions. Decaying of these microorganisms present in the surroundings releases methane gas which is highly toxic.

Transportation

Cars on the roads are increasing day by day. There is no denying that vehicle pollution is the major contributor to air pollution, especially in urban cities, where car ownership rates are more as compared to rural areas. When the car burns gasoline, it emits pollutants in the air which is as harmful as smoking 10 cigarettes a day. Your vehicle emits Carbon monoxide, Hydrocarbons, Nitrogen oxide, and Particulate matter (PM_{2.5} and PM₁₀). When vehicle pollution is high in the atmosphere, it creates a hole in the ozone layer contributing to smog and causing various health issues. Large numbers of cars and other vehicles on the roads



contribute to traffic congestion on the roads, affecting the air quality of that particular area to a great extent.



Open Burning of Garbage Waste

Open burning of garbage is much more harmful to your health and the environment than one may think. As per Engage EPW, Delhi Air Pollution is choking public health. Delhi generates a whopping 9500 tons of waste every day, which makes it India's second waste dumping city.

Construction and Demolition:

With the rise of population in the city, construction and demolition is a part of the ever-going development phase of the national capital. Several construction sites and raw materials such as bricks and concrete cause haze and foul air which is hazardous for people especially, children and the elderly.

Agricultural Activities:

To begin with, pesticides and fertilizers are the main sources that contaminate the surrounding air. Nowadays, pesticides and fertilizers are mixed with new invasive species which are not found in nature, for quick growth of crops and vegetation. Once they are sprayed over, the



smell and the effect of the pesticides are left in the air. According to the FAO (Food and Agriculture Organization), “About 40% of world emissions come from livestock, 16% from mineral fertilizers, 17% from burning biomass, and 8% come from agricultural wastes.” Agricultural activities include 4 activities that generate toxins that are released into the air. These are fertilizers and pesticides, animal husbandry, agricultural waste, and salts from applied irrigation water. Agricultural solids and waste are burnt in order to clear out the area for next cultivation, but this causes the release of soot, PM, and other toxins into the air.

Consequences of air pollution

The climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1,000 years after emissions stop. Following cessation of emissions, removal of atmospheric carbon dioxide decreases radiative forcing, but is largely compensated by slower loss of heat to the ocean, that atmospheric temperatures do not drop significantly for at least 1,000 years.

It is not generally appreciated that the atmospheric temperature increases caused by rising carbon dioxide concentrations are not expected to decrease significantly even if carbon emissions were to completely cease (5-7). Future carbon dioxide emissions in the 21st century will hence lead to adverse climate changes on both short and long timescales that would be essentially irreversible (where irreversible is defined here as a timescale exceeding the end of the millennium in year 3000; note that we do not consider geo-engineering measures that might be able to remove gasses already in the atmosphere or to introduce active cooling to counteract warming). For the same reason, the physical climate changes that are due to anthropogenic carbon dioxide already in the atmosphere today are expected to be largely irreversible.

Such climate changes will lead to a range of damaging impacts in different regions and sectors, some of which occur promptly in association with warming, while others build up under sustained warming because of the time lags of the processes involved.

These aspects are among the reasons for concern but are not comprehensive; other possible climate impacts include Arctic sea ice retreat, increases in heavy rainfall and flooding, permafrost melt, loss of glaciers and snowpack with attendant changes in water supply, increased intensity of hurricanes, etc. Many air pollutant sources also emit carbon dioxide (CO₂), the dominant anthropogenic greenhouse gas (GHG). The two main contributors to



ambient air quality standards, ozone (O₃) and particulate matter (PM), interact with radiation, forcing climate change. PM warms by absorbing sunlight (e.g., black carbon) or cools by scattering sunlight (e.g., sulfates) and interacts with clouds; these radiative and microphysical interactions can induce changes in precipitation and regional circulation patterns.

Climate change is expected to degrade air quality in many polluted regions by changing air pollution meteorology (ventilation and dilution), precipitation, and other removal processes, and by triggering some amplifying responses in atmospheric chemistry and in anthropogenic and natural sources.

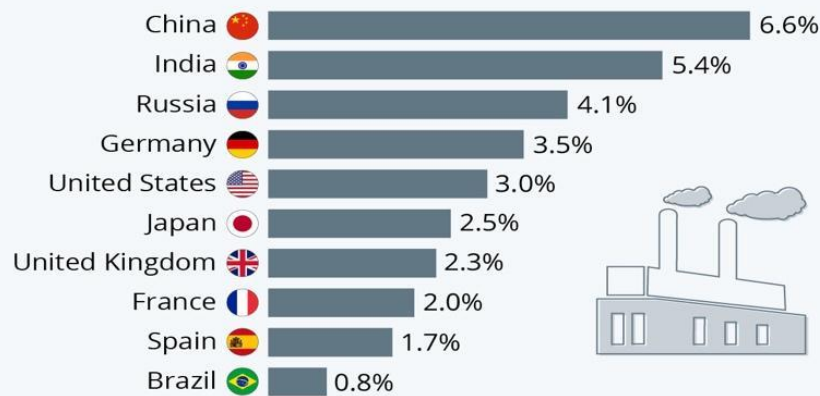
Air pollution kills an estimated seven million people worldwide every year, according to the World Health Organization (WHO), which says such deaths occur largely as a result of increased mortality from stroke, heart disease, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections.

WHO data shows that nine out of 10 people breathe air that exceeds guideline limits on high levels of pollutants. Air pollution leads to various diseases, and exposure to particulate matter for a long time can lead to respiratory and cardiovascular diseases such as asthma, bronchitis, COPD, lung cancer, and heart attack. The economic burden of air pollution: Burning gas, coal and oil results in three times as many deaths as road traffic accidents worldwide and it is estimated that air pollution has a \$2.9 trillion economic cost, equating to 3.3 percent of the world's GDP. In 2018, the report estimates that it was linked to 4.5 million deaths with PM_{2.5} pollution also responsible for 1.8 billion days of work absence, 4 million new cases of child asthma and 2 million preterm births. It can have an impact on the economy in many forms such as higher rates of asthma, diabetes or chronic respiratory diseases leading to reduced ability to work and lower participation rates in the labor force.



The Economic Burden Of Air Pollution

Economic costs of air pollution from fossil fuels
as a share of GDP in 2018



Sources: Greenpeace, Center for Research on Energy and Clean Air



statista

Children susceptible to asthma attacks also miss school days, impacting their learning while healthcare requirements can result in their guardians also taking extra time off work. According to the report, disability from chronic diseases cost the world's economy \$200 billion in 2018, with sick leave and preterm births costing \$100 billion and \$90 billion respectively.

Air pollution consequences in big cities

According to the IQAir World Air Quality Report, Bangladesh and Pakistan had the poorest air quality in Asia and the world. Both countries were labeled as having unhealthy levels of air pollution even for the general population. Among the 106 countries and regional economies where sufficient data exists, eleven more received the designation of having unhealthy air for sensitive groups. Out of these, six were located in Asia. On the other hand, Japan and Singapore received the designation of good air quality and the Philippines only missed this label by 0.8 percentage points.

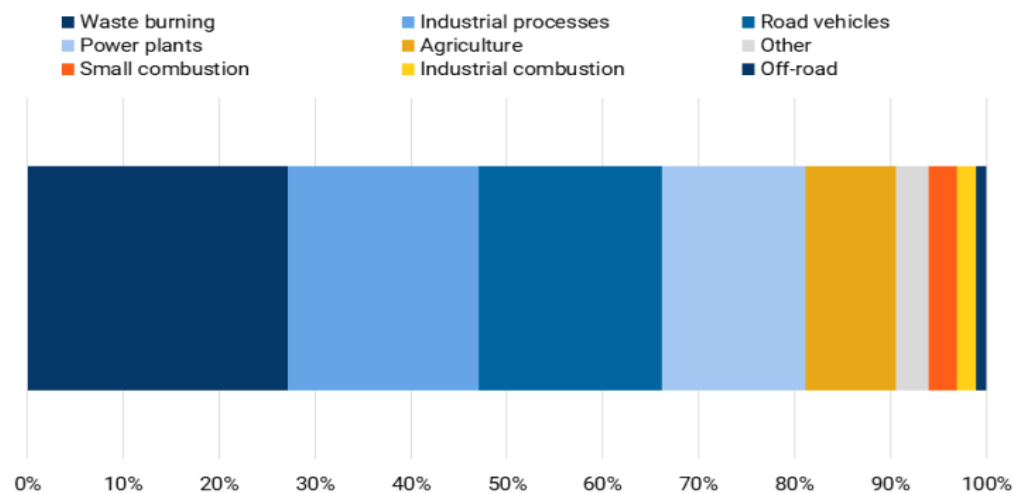
While in America, the number of Americans exposed to unhealthy spikes in air pollution has been constantly rising, taking a jump up in the latest observation period of 2018 to 2020. The data shows that most recently, 63.2 million Americans lived in counties where average air quality did not necessarily fail the ALA's standards, but extreme fluctuations in the quality of the ambient air nevertheless took place. The number of Americans exposed to these spikes



rose from 49.6 million in four years, while the number of Americans exposed to unhealthy ozone pollution sank and the number of those suffering from year-round unhealthy air stagnated.

Figure 1. Main sources of ambient air pollution in MENA

Contribution of national sources to population-weighted exposure of PM_{2.5} concentrations



Source: Adapted from Wagner et al. (2021) using the GAINS model.
Note: Transboundary sources are not considered.

BROOKINGS

Mena region

MENA's heavy subsidization of fossil fuels, whether that is at the point of consumption or at the point of intermediary inputs in power generation and manufacturing, makes price reforms essential. Aside from incorporating negative externalities better, lifting subsidies also reduces pressure on fiscal budgets, with freed-up fiscal space being available to cushion the impact for low-income households.

Underdevelopment of public transport, low fuel quality, and low emissions standards drive high levels of emissions from the transport sector. In MENA, the modal share is often heavily skewed toward the use of private cars; when public transportation is available, it has a low utilization rate in international comparison.

Weak solid waste management (SWM) is a major issue in MENA. Although the collection of municipal waste has room for improvement in many countries, it is mainly the disposal stage of SWM where the leakage occurs. Too often waste ends up in open dumps or informal



landfills, where it ignites. Furthermore, processing capabilities are often limited, and equipment outdated, at least for the lower- and middle-income countries of the region. All of this leads to an alarming air pollution rate in the Mena region.

There is a growing realization that the risks and economic costs of climate change have been underestimated. If unchecked, climate change could displace hundreds of millions of people, mostly in the developing world, increasing the potential for conflict. Likewise, carbon-intensive economies depend on jobs that may be eliminated in the future to reduce pollution and avert catastrophic climate change. Jobs and incomes will be lost, driving many into poverty, and the longer decarbonization is delayed, the more disorderly future shocks will be.

Thanks to technological advances, the cost of renewable energy is declining, making it increasingly competitive with fossil fuels. Moreover, there is mounting evidence that decarbonization does not hamper growth, development, and jobs but instead offers a path to more inclusive, resilient, and sustainable growth; indeed it can “unlock the inclusive growth story of the 21st century.” Increased spending on sustainable infrastructure has strong multiplier effects. In the short term, it can help the world economy recover from the effects of the COVID-19 pandemic by creating jobs and investment opportunities. In the medium term, it can spur innovation, create new sources of growth, and reduce poverty and inequality while delivering cleaner air and water. Over the long term, stabilizing climate change is the only path to a viable future.

To enable the shift away from carbon, governments must work with stakeholders to encourage clean energy and transportation systems, smart development, sustainable land use, wise water management, and a circular industrial economy. Major investment is needed to replace aging and polluting infrastructure, address infrastructure deficits and structural change in emerging markets and developing economies, and protect and restore natural capital. Policymakers must set expectations and provide a clear sense of direction on how to achieve the net zero emissions target. To that end, the International Monetary Fund (IMF), the World Bank, and a growing number of academic, public, and private sector voices have called for elimination of fossil fuel subsidies and putting a price on carbon. A credible carbon price would send a critical signal to direct investment and innovation toward clean technologies and encourage energy efficiency.

Along with carbon pricing, the transition to climate-resilient growth will require many different and mutually supportive policies given major market failures, the availability of other powerful and effective policy instruments, and political economic impediments. As outlined in a recent



paper, governments and the private sector must: Reinforce carbon pricing with sector-specific policies—regulations, energy efficiency standards, feebates—and phase out coal. Boost public investment in sustainable and resilient infrastructure, including nature-based solutions—restoration of degraded lands and conservation of existing ecosystems—while mitigating the impact on the poor.

Promote sustainable use of natural resources with policy measures such as payments for ecosystem services, regulations, reform of agricultural and water subsidies, and incentives for a circular economy to decouple economic growth from use of material resources. Deploy industrial and other policies to spur climate-friendly innovation, including in digitalization, new materials, life sciences, and production processes, with a focus on the coordination of policy areas and on long-term policies and policy planning.

Provide information and promote public discussion on social norms and behavior to reduce energy demand and carbon intensity of consumption and business activity; educate the public about climate change risks and on early warning systems and evacuation plans in case of natural disasters. Align finance with climate objectives—manage financial stability risks posed by climate change; align social and private returns with green investment; mobilize resources for investment, including a major boost to international climate finance; and make monetary and supervisory policies consistent with net-zero-emissions objectives.

Develop insurance instruments and social safety nets to mitigate the immediate impact of climate shocks. Foster a just transition with investment in and support for the shift to a low-carbon economy for affected workers, businesses, and regions—rapid change will involve dislocation in both production and consumption. Integrate sustainability considerations into public financial management and corporate governance; use better models and look beyond gross domestic product when deciding policy priorities and measuring well-being and sustainability.

Mobilizing climate finance

Progress on global climate action will require commensurate ambition on climate finance. There are abundant pools of long-term savings, and interest rates are exceptionally low worldwide, but many emerging markets and most developing economies find it difficult to access long-term financing on the necessary scale, and the cost of capital is a major impediment to sustainable investment. New technologies that contribute to emissions' reductions are constantly being developed. Setting emission limit values for air pollutants, as done under the different Protocols of the Convention, have proven to be an effective tool in stimulating investment in clean technologies. Benefits of improved technology to reduce air pollution have been quantified in many cases. Economic models show that with the introduction



of additional measures some sectors will lose jobs (e.g. the fossil fuel sector); but that other sectors will gain jobs (e.g. the building and equipment sectors). In the long run environmental policy will favor the economy as it stimulates more efficient use of resources, and the health benefits would increase GDP by up to 10%. A larger market for clean technologies will reduce the costs of producing the required equipment and thus the abatement measures. Countries that move first expand their possibilities for a growing clean tech industry. Reducing emissions is a wise long term investment that contributes to several development goals and ultimately will yield substantial benefits.

The convention between UNECE and Sustainable Development Goals

This Convention sets emission limit values for air pollutants and these have proven to be an effective tool in stimulating investment in clean technologies, including in the energy sector, and will thus also promote sustainable industrialization. Concretely, the Task Force on Techno-Economic Issues under the Convention develops a techno-economic database of information on control technologies for air pollution abatement and their costs. The information may be used both in the formulation of draft revisions of technical annexes to existing Protocols to the Convention, as well as for input data to integrated assessment modeling. The information assists countries in identifying technologies, including for industry and in the energy sector that helps reduce air pollution. The Convention thus helps countries in achieving targets under Sustainable Development Goal 7 on affordable and clean energy and Sustainable Development Goal 9 on industry, innovation and infrastructure.

A common framework for transboundary cooperation on air pollution

When scientists in the 1960s investigated the causes of the “acid rain” that was destroying forests, causing fish loss in lakes and putting entire ecosystems at risks in the Northern Hemisphere, they found that air pollutants, a significant part of which were emitted thousands of kilometers away, were the culprit.

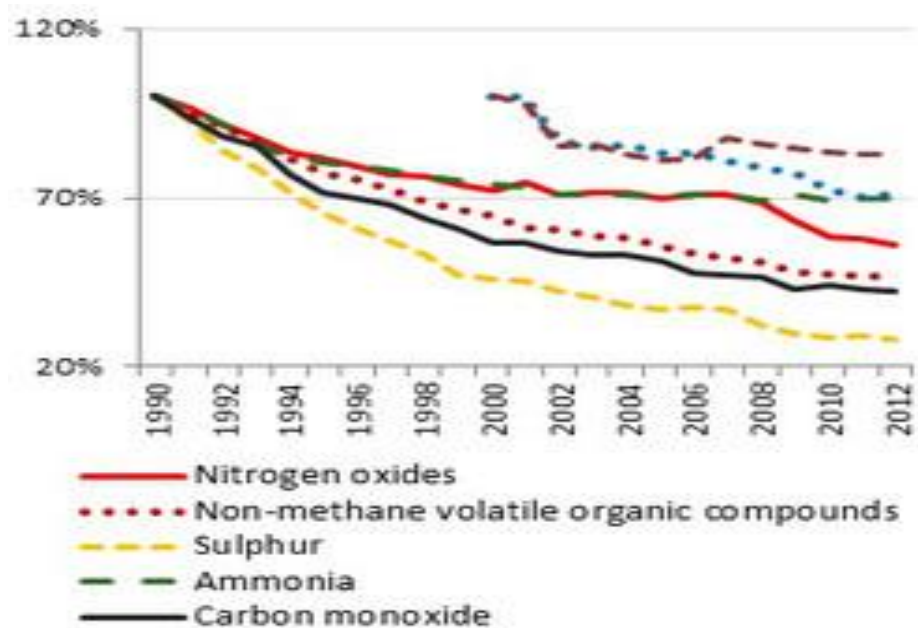
In order to solve this problem, 32 countries in the pan-European region decided to cooperate to reduce air pollution. In 1979, they signed the UNECE Convention on Long-range Transboundary Air Pollution, creating the first international treaty to deal with air pollution on a broad regional basis. The Convention entered into force in 1983, laying down the general principles of international cooperation for air pollution abatement and setting up an institutional framework which has since brought together research and policy. Over the years, the number of substances covered by the Convention and its protocols has been gradually extended, notably to ground-level ozone, persistent organic pollutants, heavy metals and particulate matter. The Convention has substantially contributed to the development of international



environmental law and has created the essential framework for controlling and reducing the damage to human health and the environment caused by transboundary air pollution. It is a successful example of what can be achieved through intergovernmental cooperation.

Emission reductions

The result of this collective effort has been remarkable: emissions of a series of harmful substances have been reduced by 40 to 80% since 1990 in Europe. In particular, the decrease in sulfur emissions has led to healthier and forest soils. The drop in emissions has reduced the deposition of acidifying compounds to levels below critical loads of acidity in large parts of Europe. Nitrogen emissions have also been reduced, although to a lesser extent than sulfur emissions. Hence, in areas in Europe where acidification of forest soils is still a problem, these exceedances are mainly due to deposition of nitrogen compounds. The efforts to reduce nitrogen oxides emissions led to a decrease in lead pollution. Lead pollution levels in the UNECE countries were reduced by almost 80% between 1990 and 2012. The highest reduction rates took place in the beginning of the period, reaching 15-18% per year in a number of countries (e.g., Finland, Denmark, Germany, Spain, Norway etc.).



Air pollution emissions in the ECE-region between 1990 and 2012 (excluding Canada and the United States of America). Sulphur has the steepest decline (Source: EMEP-Centre for Emission Inventories and Projections). Important for the success of the Convention in air pollution abatement was its solid scientific underpinning. This was established through the development of a common knowledge base including a scientific infrastructure aimed at joint



monitoring and modeling programmes, including an extensive international network of scientists of various disciplines. In addition, the Convention has provided a platform for scientists and policymakers to exchange information which has led to innovative approaches creating mutual trust and learning. Neatherless to say , Air pollutants know no borders, which is why international coordination of air pollution policy remains indispensable.

Ratification and implementation of the Convention and its protocols will, for many Parties, reduce health and environmental impacts in a more cost-effective way than with unilateral action. It will also create economic benefits as harmonized legislation and standards across borders will introduce a level playing field for industry across countries and prevent Parties from competing with each other at the expense of environment and health. One of the priorities for the Convention in recent years has been the strengthened implementation of the Convention and its protocols, targeting more specifically Parties from Eastern, South-Eastern Europe, the Caucasus and Central Asia. In this regard, an assistance programme is being undertaken to raise the political profile of the Convention in the region and to encourage ratification of the Convention's protocols. Recent amendments to the Convention's key protocols offer flexibility to facilitate accession by new Parties. Air pollution affects all of us: it harms human health, affects food security, hinders economic development, contributes to climate change and degrades the environment upon which our very livelihoods depend. The Convention provides a platform to discuss these interconnections and take actions to prevent negative impacts.

Air Pollution, ecosystems and biodiversity

Increased ground-level ozone causes damage to cell membranes on plants inhibiting key processes required for their growth and development. The loss of plant cover affects us all. Trees and other vegetation absorb pollutants such as excessive nitrogen dioxide, ozone and particulate matter, through their leaves and needles and thereby help to improve air quality. Less plant cover thus means less filtering capacity to clean our air.

Eutrophication: the process of accumulation of nutrients including nitrogen, in water bodies, often results from air pollution. Nutrient overloads in aquatic ecosystems can cause algae blooms and ultimately a loss of oxygen, and of life. As ecosystems are impacted, so is the biological diversity. Even worse, ultimately human populations are also affected. Harmful concentrations of pollutants may directly enter our drinking water, notably through ground water seepage. Equally, water quality may be deteriorated as air pollution negatively affects vegetation which helps to naturally filter our water systems. Affected vegetation also has negative consequences on another important ecosystem service: that of capturing carbon and



thereby reducing the impacts of climate change.

Sustainable Development Goals related to air pollution

The UN sustainable development goals (SDG) have a strong focus on reducing environmental pollution (un, 2015). Specifically, SDG 3.9 seeks to “substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination” by 2030. Many of the other goals are also related to pollution, including SDG 2.4 on improving soil quality, SDG 7 on clean energy, SDG 9.4 on clean technologies and industrial processes, SDG 11 on sustainable cities and communities, SDG 12 on responsible consumption and production, and SDG14 and 15 on conservation of water and land.

All these Sustainable Development goals are related on a deep level on the sustainability of the Ecosystem and air pollution:

- SDG goal N3: Good Health and Well being
- SDG goal N7: Affordable and clean energy
- SDG goal N11: Sustainable cities and communities
- SDG goal N13: Climate action
- SDG goal N14: Life below water
- SDG goal N15: life on Land

the breakdown of these goals is the following:

- Goal 1: Reducing air pollution can help families become healthier, save on medical expenses, and improve productivity.
- Goal 2: Air pollution can cause crop damage and affect food quality and security
- Goal 3: Air pollution poses a major threat to human health. It is linked to respiratory infections and cardiovascular diseases. It causes increases in population morbidity and mortality.
- Goal 6: Pollutants such as sulfur dioxide (SO₂) and nitrogen oxides (NO₂) from open sores and the combustion of fossil fuels mix with precipitation causing harmful acid rain that can compromise water quality.
- Goal 7: Electricity from renewable energy rather than fossil fuels offers significant public health benefits through a reduction in air pollution.



- Goal 8: Air pollution impacts on health, crop and forest yields, ecosystems, the climate and the built environment, with consequences for productivity and economic growth. Ambient and indoor air pollution also has negative effects on the working environment and its safety.
- Goal 9: Power generation, industry and transportation are large contributions to air pollution. A new focus on decreasing energy consumption and on improving sustainable and public transportation could progressively reduce pollution.
- Goal 11: Urban areas significantly contribute to air pollution. Making cities sustainable could progressively improve the air quality.
- Goal 12: Chemicals released into the air increase air pollution and contribute to harmful effects on human health. Responsible production and consumption could help to reduce these harmful chemicals.
- Goal 13: Combustion of fossil fuels plays a key role in the process of climate change, which places food, air and water supplies at risk, and poses a major threat to human health.
- Goal 14: Deposition of air pollutants on water negatively affects its quality and life under water. It can lead to eutrophication of freshwater bodies, and accumulation of toxic metals and Persistent organic pollutants (POPs) in fresh and marine waters.
- Goals 15: Emission from combustion of fossil fuels mixed with precipitation causes acid rains that pose a major threat to forests and ecosystems.

Solutions

1. Renewable fuel and clean energy production

The most basic solution for air pollution is to move away from fossil fuels, replacing them with alternative energies like solar, wind and geothermal.

2. Energy conservation and efficiency

Producing clean energy is crucial. But equally important is to reduce our consumption of energy



by adopting responsible habits and using more efficient devices.

3. Eco-friendly transportation

Shifting to electric vehicles and hydrogen vehicles, and promoting shared mobility (i.e. carpooling, and public transports) could reduce air pollution.

4. Green building

From planning to demolition, green building aims to create environmentally responsible and resource-efficient structures to reduce their carbon footprint.

On the road

1. Walk or ride a bike when possible.
2. Take public transportation.
3. Organize and condense errands into one trip.
4. When driving, accelerate gradually and obey the speed limit.
5. Drive less, particularly on days with unhealthy air.
6. Maintain your vehicle and keep your tires properly inflated.
7. Support the Smog Check Program.
8. Report smoking vehicles to 1-800-END-SMOG.
9. Travel lightly and remove any unnecessary items that may weigh down your vehicle.
10. Limit idling your vehicle to no more than 30 seconds.
11. When in the market for a new car, look for the most efficient, lowest-polluting vehicle or even a zero-emission electric car.

At home

12. There are many ways air quality can be improved in the home. By reducing energy consumption, choosing sustainable products and eliminating your exposure to chemicals, we can all contribute to a cleaner California.
13. Reducing energy consumption helps reduce air pollution. If less gasoline, natural gas and electricity (power plants burn fossil fuels to generate electricity) are used, not only do your bills decrease but less pollutants are emitted.
14. There are also many products in the home, garden and garage that emit smog forming chemicals that pollute the air when used. Volatile organic compounds (VOCs) and particulate matter (PM) contained in these products penetrate deep into the lungs and can trigger asthma attacks or worsen respiratory illnesses. The suggestions below will help reduce exposure in your home.
15. Turn the lights off when you leave a room.
16. Replace energy-hungry incandescent lights with compact fluorescent light bulbs.
17. Ask your energy supplier for a home audit and inquire about alternative energy solutions



like solar or wind.

18. Opt for a fan instead of air conditioning.
19. Use a programmable thermostat and set it to 78°F in the summer and 68°F in the winter.
20. Install low-flow shower heads.
21. Recycle paper, plastic, metals and organic materials.
22. Use an EPA-approved wood burning stove or replace insert.
23. Don't use your wood stove or replace it on days with unhealthy air.
24. Don't heat your home with a gas stove.
25. Use a surge protector for multiple appliances and turn it off when products are not in use.
26. Add insulation to your home.
27. Wash laundry in cold water and line dry.
28. When ready to replace, look for energy star appliances.
29. Use a propane or natural gas barbecue rather than a charcoal one.
30. Microwave or use a toaster oven for small meals.
31. Have your gas appliances and heater regularly inspected and maintained.
32. Use washable dishes, utensils and fabric napkins rather than disposable dinnerware.
33. Choose products that use recycled materials.
34. Eat locally, shop at farmers markets and buy organic products.
35. Buy products from sustainable sources such as bamboo and hemp.
36. Use durable reusable grocery bags and keep them in your car so you're never caught off guard.
37. Paint with a brush instead of a sprayer.
38. Store all solvents in airtight containers.
39. Use an electric or push lawn mower.
40. Use a rake or broom instead of a leaf blower.
41. Use water-based cleaning products that are labeled 'zero VOC'.
42. Insulate your water heater and any accessible hot water pipes.
43. Eliminate use of toxic chemicals at home; opt for natural substitutes.
44. Plant a tree! They filter the air and provide shade.
45. Let your elected representatives know you support action for cleaner air.

At Work

46. There are multiple ways of reducing consumption at the workplace.
47. Considering we spend a good portion of every week at the office, use the suggestions below to keep your workplace environmentally friendly:
48. Carpool.



49. Telecommute.
50. Start a recycling program.
51. Print and photocopy on both sides of paper.
52. Bring your lunch to work to avoid mid-day outings.
53. Turn off office equipment, computers, printers, and fax machines, after hours.
54. Harness the power of the sun: open the blinds and turn off the lights.
55. Dress for the weather and adjust layers before adjusting the thermostat.

Economical solution for air pollution

Members of the Alliance for Clean Air pledge to:

- Establish air pollution footprints on nitrogen oxides, sulfur oxides and particulate matter within 12 months.
- Pinpoint where they are being emitted to track human exposure.
- Set ambitious targets to reduce the air pollution emissions with a clear action plan.
- Use their assets innovatively to accelerate clean air solutions.

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