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| ISSUE: | Measures to Diminish Air Pollution and Restore |
| | Air Quality in Urban Regions |
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Introduction

Even as technology today continues to make revolutionary advancements in all of life's facets including health, transportation, communication, or manufacturing, air pollution has never been such a threat. Air pollution refers to the presence of pollutants in the air that are detrimental to health, most of which is anthropogenic. It has been a consequence of an unprecedented surge of human activity since the 18th century, and naturalists warn



Urban pollution in Beijing, China

that the current levels of carbon dioxide in the atmosphere have not been matched in millions of years. Air pollution is most common in urban areas, where tall buildings tend to prevent air from diffusing. Having in mind the compact, dense nature of cities, it is crucial, then, to abate air pollution in cities and to ensure the safety of the population.

Background

Air pollution was making its presence felt by the mid-20th century, and environmental movements arose across the world to prevent the flow of toxic chemicals and compounds. Nonetheless, according to the World Health Organization (WHO), global urban air pollution from 2008 to 2013 rose by 8% despite recoveries in few specific regions. Among the reasons for the difficulty in restoring air quality is its highly diversified nature. While 98% of cities in low to middle-income countries do not meet WHO air quality limits, 56% of cities in high-income do not. Similarly, a study from the EU Science Hub underscored the notable variations between main sources of air pollution in urban regions around the world. The study attributes traffic (25%), domestic fuel burning (20%), natural dust and salt (18%), and industrial activities (15%) as the main causes. Another study conducted in London revealed that 70% of



particulate matter (PM) in cities is associated with the built environment, such as heating, construction, and relevant traffic, while 15% of PM is correlated with personal transport. Air pollution is an intricate task produced by these various yet important sources. Resolving this issue will save 4.2 million people from deaths and recover blue skies in 91% of places where air quality levels exceed WHO limits.

Problems Raised

Health

Air pollution is difficult to avoid; every breath draws in undesirable, microscopic pollutants, which penetrate respiratory and circulatory systems. In urban regions, two types of air pollutants are most common: ground-level ozone and soot. Ground-level ozone, often referred to as smog, is produced when volatile organic compounds (VOCs) and nitrogen oxides (NO_x) interact in the presence of sunlight. Smog irritates the eyes and throat and damages the lungs, particularly those of the children, elderly, and citizens who work outside. The smog further endangers people with asthma or diseases, worsening bronchitis, causing heart attacks, and even hastening death. Indeed, mortality rates were higher in areas with less smog and soot. Soot is fine particulate matter, tiny particles or droplets in the air usually generated by combustion. When levels of soot are high, visibility is diminished and toxic particles harm the body along with smog. Exposure to these air types risks stroke, heart disease, and lung cancer, as well as respiratory diseases. As mentioned previously, ambient air pollution accounts for 7 million deaths and three million premature deaths around the world per year.

Climate Change

Air pollution is deeply interconnected with climate change. Fossil fuel combustion, a major source of pollutants, is also the main contributor to climate change. In 2018, carbon dioxide (CO₂), a by-product of fossil fuel combustion, accounted for 81% of total greenhouse gas emissions, which trap heat in the

earth's atmosphere. In turn, climate change raises the global temperature and severely impacts agriculture, water resources, forests, wildlife, and coastal areas. For example, scientists have calculated that the global sea level rises at a rate of 0.04 to 0.1 inches per year due to climate change, and the increased frequency of floods in the European Region affected more than 3.4 million people from 2000 to 2011.



Global warming's impact on food production



International Actions

Montreal Protocol

The Montreal Protocol on Substances That Deplete the Ozone Layer is an international treaty validated in 1987 intended to moderate the production and use of ozone depleting substances that harm the ozone shield over Antarctica. Major targets were assigned and eliminated by 1996: halons, chlorofluorocarbons (CFCs), hydrobromofluorocarbons (HBFCs), carbon tetrachloride (CCl4) and methyl chloroform (CH₃CCl₃). Others are scheduled to be completely phased out in future years, such as hydrochlorofluorocarbons (HCFCs) by 2030. Originally signed by forty-six countries, the Montreal Protocol reached universal ratification in 2012. It holds annual meetings to update scientific information and determine further actions. Since 1987, the successful protocol has been enhanced through six amendments and is estimated to have saved 443 million cases of skin cancer, 2.7 million skin cancer deaths, and 63 million cataracts.

Paris Agreement

The Paris Agreement Under the United Nations Framework Convention on Climate Change is an international treaty adopted in 2015 that effectively replaces the earlier Kyoto Protocol and endeavors to reduce gas emissions that contribute to global warming. It aims to limit global warming to below 2 °C with the contribution of all countries, including those both developed and non-developed. 190 countries support one another for finance, technology, and capacity-building actions while reporting transparently of their actions and progress. Developments vary across nations: China met its 2020 targets by 2017, Sweden reached 77% of its commitments by 2018, and France achieved 65% of its commitments by 2018. Governments convene every five years to assess the cumulative progress and makes further decisions such as to reduce at least 55% of emissions by 2030 compared to 1990.

Global Efforts to Convert Energy Sources

Fossil fuel is not only a major nonrenewable energy source but also a major contributor to air pollution, thus converting energy sources from fossil fuel is a practical step towards reducing air pollution. China, well-known for its high levels of air pollution, has shut down 103 coal-powered plants, 27 coal mines, and suspended 553 car models that did not meet fuel economy standards. Instead, the country put a quota on



Closed coal-power plants in Beijing

the number of new license plates, introduced all-electric buses, and increased the portion of renewable sources to a quarter of total energy generated in China. In 2015, Sweden committed itself towards a goal to become the world's first fossil fuel-free welfare state by 2045 for an equal society without greenhouse gas emissions. The Swedish Parliament implemented a framework that includes various acts and targets such as banning fossil fuel transportation and sharpening of biofuel blending in diesel and gasoline.

Global Efforts to Promote Cleaner Transport



16,000 electric buses in Shenzhen

Air emissions from road vehicles are directly influential on the air quality of cities. As a result, countries have set regulations on certain transportation methods while encouraging others. The United States Environmental Protection Agency (EPA) published Tier 3, a set of fuel and vehicle standards, and a strict gasoline sulfur standard. The European Commission also developed frameworks for types of vehicles and limited emissions for monitored

pollutants like nitrogen oxides. Furthermore, several Asian countries have promoted public transportation as a means of lowering emissions, decreasing congestion, and raising air quality. Shenzhen, a city in southeast China, became the world's first to fully electrify its bus fleet of more than 16,000, which emits 48% less CO₂ than fuel-powered buses do. Philippines' Department of Transportation and Communications (DOTC) introduced the express bus and point-to-point buses that travel uninterrupted in the busy Philippine traffic, which save 30 minutes of normal travel time and appeals to private car owners.

Key Players

China

As a result of rapid industrialization and urbanization over the last few decades, China suffered a severe decline in air quality and became one of the most polluted countries in the world, with an air quality average three times above the WHO standards. Each year due to air pollution, approximately 1.1 million deaths occur and an estimated 267 billion yuan, US\$38 billion, is paid for early deaths and lost food production. As a response, China's government has enforced strict regulations to reduce emissions

and has successfully cut down fossil fuel emissions and advanced renewable energy sources.

Accordingly, a study indicates that PM_{2.5} and SO₂ concentrations sunk prominently at 53% and 59% of more than 1,000 stations constructed by China's Ministry of Ecology and Environment (MEE).

World Health Organization (WHO)

A United Nations agency primarily functioning to promote world health, the World Health Organization is deeply concerned with resolving air pollution around the



Solar panels installed in Jiangsu Province of China

world and its negative effects on health. WHO provides accurate global pollution data, maps, and tools such as AirQ+ that inform the community of air pollution in various features such as outdoor air pollution or household air pollution. The BreatheLife is a joint campaign led by WHO and the Climate & Clean Air Coalition (CCAC) to provide a platform that connects cities, increase monitoring that informs citizens, accelerate solutions that help effective implementations, and build public awareness that gathers support for actions.

Possible Solutions

Promoting Clean Transportation

Although emissions caused by transportation directly impact urban air quality, it is outside the control of individuals or cities and difficult to implement without proper investment. Each charging station for electric buses in Shenzhen costs £57,000 (US\$78,000), economically burdening for individual cities or poorer countries. Overcoming the cost of electric buses or pursuing other types of cleaner vehicles, such as solar or electric powered jeepneys, hybrid vehicles, or clean diesel vehicles, could be possible solutions for quality air in distinct countries. Meanwhile, the government not only can advertise the use of public transportation but also establish benefits to it. For example, redesigning bussing routes or providing accurate bussing schedules on stations can satisfy citizens with a fast and convenient way of transportation more appealing than personal cars.



Improving Infrastructure

Energizing buildings by heating and cooling in cities consume a considerable amount of energy – 43% of total energy use in the U.S.A. – and can contribute to much of greenhouse gases. Improving the

energy efficiency of buildings by renovation is a solution to decrease the demand for non-renewable energy. Encouraging or requiring the transition to utilize reused or recycled materials for construction will reduce emissions from constructing buildings. For example, fired bricks are one of the strongest and enduring building materials that can drop emissions by 90%. On the other hand, toxic materials such as asbestos could be prohibited from construction. Moreover, citizens could be alerted to select



Air pollution caused by construction

furnishings with low volatile organic compounds (VOCs), which negatively impacts their health.

Glossary

Greenhouse Gas

Greenhouse gases are gases that trap heat in the Earth's atmosphere. Main gases include carbon dioxide (CO₂), Methane (CH₄), and Nitrous oxide (N₂O). Each type of gas remains in the atmosphere for varying lengths of time and effects climate change in different magnitudes. Increasing concentrations of greenhouse gases act as a blanket, warming the Earth and leading to climate change.

Ozone

Ozone (O3) is a molecule containing three atoms of oxygen that mostly resides in the stratosphere and troposphere. Ozone in the stratosphere protects Earth's surface from ultraviolet radiation and prevents skin cancer, cataracts, and impaired immune systems. On the other hand, ozone near the Earth's surface is a dangerous pollutant that can cause lung tissue and plant damage. Currently, scientists believe ozone in the stratosphere is decreasing while ozone in the troposphere is increasing.

Particulate Matter (PM)

Particulate matter is a mixture of solid particles and liquid droplets in the air, many of which are dangerous. It is conventionally split into two groups: PM₁₀ and PM_{2.5}, PM₁₀ are particles that are between



2.5 and 10 micrometers in diameter. They can get into respiratory systems and bloodstreams, causing coughing, wheezing, heart attacks, etc. $PM_{2.5}$ are particles with diameters of 2.5 micrometers and smaller. They pose the greatest threat to health as well as cause haze.

Volatile Organic Compounds (VOCs)

Volatile organic compounds are compounds with high vapor pressure and low water solubility. Most commonly found in house construction products, these chemicals are emitted indoors; thus, inhabitants can be exposed to high levels of these pollutants for long periods of time.



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