Forum: Special Conference on Climate Change

Issue: Evaluating sustainable measures to improve global urban air quality

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Introduction

Around 56% of the world's population (4.4 billion inhabitants) currently live in urban areas, most of which have outdoor air quality that fails to meet World Health Organization guidelines for healthy living. This is now the leading environmental cause of mortality worldwide, causing approximately 3 million premature deaths a year, twice the number due to road traffic accidents (World Health Organization 2016). The most abundant components of urban air pollution in urban areas with high levels of vehicle traffic are airborne particulate matter, nitrogen dioxide, and ozone. In addition, the earth's temperature is increasing, mainly as a result of anthropogenic factors (e.g. fossil fuel combustion and greenhouse gas emissions from energy supply, transport, industry, and more) and climate change. This alters the concentration and distribution of air pollutants and interferes with the seasonal presence of allergenic pollen in the atmosphere by prolonging these periods.

Particulate Matter (PM) is inextricably linked with genotoxicity and mutations. In September 2021, the World Health Organization (WHO) released a timely and ambitious update to its global air quality guidelines, 15 years after the last update released in 2006. Acknowledging the significant impact of air pollution on global health, the WHO cut the recommended annual PM 2.5 concentration by half, which initially had devastating impacts on human health such as reduced lung function, development of chronic bronchitis, and even premature death. Thus preventing millions of deaths by having meaningful health gains.

Ahead of the upcoming 2019 Climate Action Summit, the United Nations, the WHO, the United Nations Environment Programme (UNEP) and Climate and Clean Air Coalition announced the "Clean Air Initiative", calling on governments at all levels to commit to achieving air quality that is safe for citizens, and to align climate change and air pollution policies by 2030. Meeting the Paris Agreement on climate change, however, could save over 1 million lives a year by 2050 and yield health benefits worth an estimated US$54.1 trillion – about twice the costs of mitigation – through reduced air pollution alone. While reducing pollutant emissions is always the most direct way to improve urban air quality, authorities worldwide have, with few exceptions, struggled to provide adequate air quality improvements through emission control strategies alone. Thus, policymakers are increasingly turning to complementary methods of reducing human exposure to air pollutants as cities expand.

Definition of Key Terms

PM 2.5

According to the global AQI, PM2.5 is defined as the mass concentration of particles in the air less than 2.5 microns in diameter, capable of penetrating the deepest parts of the lungs and causing health concerns such as throat and lung irritation, coughing, runny nose and shortness of breath.

PM 10

The mass concentration of particles is less than 10 microns in diameter. PM10 is generally used as an indicator for suspended particulate matter and is routinely measured at many locations throughout the world.

GHGs

Greenhouse gasses, or GHGs, are compound gasses that trap heat or radiation in the atmosphere. Their presence in the atmosphere makes the Earth's surface warmer. Sunlight or shortwave radiation easily passes through these gasses and the atmosphere.

Heatwave

A heatwave is a period of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. A heatwave is usually measured relative to the usual climate in the area and relative to normal temperatures for the season.

Anthropogenic Activities

Anthropogenic effects, processes, objects, or materials are those that are derived from human activities, as opposed to those occurring in natural environments without human influences. For example, mining, the release of industrial waste, smelting of ore, incineration of fossil fuel, particularly coal, utilization of loaded water for irrigation, and use of pesticides, herbicides, and fertilizers.

Energy System

The term “energy systems” usually describes the set of production, transformation, transport and distribution processes of energy sources.

Atmospheric Lifetime

The atmospheric lifetime is the time required to restore equilibrium in the atmosphere following a sudden increase or decrease in the concentration of its gasses.

Key Issues

Mix of Emissions

The particular mix of pollutants during emissions determines the effect of air quality on climate change. Air pollutants and GHGs are emitted from the same sources as a mixture. For example, any source involving combustion will emit not only carbon dioxide, but air pollutants such as nitrogen oxides, carbon monoxide, and particulate matter. The impact of urban emissions over different scales depends on the dilution and chemical transformation of the urban plumes which are governed by the local and regional-scale meteorological conditions. These are influenced by the presence of urbanized land surface via the so-called Urban Canopy Meteorological Forcing (UCMF). About 40% to 60% and 20% to 40% of urban concentrations of NO2 and PM2.5 respectively are caused by local emissions in that particular region. Therefore, any source emitting a GHG will correspondingly emit toxic co pollutants, thus deteriorating air quality and causing an increase in PM concentration.

Cities, as a result of urbanization, emit larger quantities of different pollutants with various chemical characteristics. Urban canopies are covered by artificial materials and objects in a specific geometric layout (buildings and streets) resulting in a range of effects on the meteorological conditions. Due to enhanced roughness, the city-scale wind speed is decreased, whereas a strong increase is seen for turbulence (especially the vertical eddy diffusivity) and temperature. Moreover, due to high population density and concentrated human activities and energy demand, cities represent an intense source of both greenhouse and short-lived pollutants.

According to the Intergovernmental Panel on Climate Change (IPCC), if greenhouse gas emissions remain high (such that global temperatures rise by 3° C from pre-industrial levels by the second half of the 21st century), surface ozone levels are expected to increase across heavily polluted areas, particularly in Asia. Fossil fuel emissions result in the depletion of the ozone layer that most likely triggers heatwaves,

which in turn amplify air pollution. Thus explaining why the heatwaves (that are becoming increasingly common due to climate change), are likely to continue degrading air quality through increased emissions of ozone gas.

Atmospheric Lifetime

The atmospheric lifetime is the time required to restore equilibrium in the atmosphere following a sudden increase or decrease in the concentration of its gasses. Due to a drastic increase in anthropogenic activities nowadays, - such as industrialization, combustion and power generation - the concentration of toxic gasses in the atmosphere has proportionally increased by 47% ever since the beginning of the industrial age. The time duration for the atmosphere to balance these gasses on its own has become extremely short due to the increasing amount of emissions caused by anthropogenic activities. For example, Nitrous oxide - a highly destructible gas - has an atmospheric lifetime of about 150 years and an estimated one-third to one-half of the nitrous oxide released into the atmosphere today is a result of human activities. Since the industrial revolution, the atmospheric concentrations of nitrous oxide have increased by 27%, being 300 times more potent than carbon dioxide and resulting in the depletion of the ozone layer. About 40% of nitrous oxide emissions come from human activities, mainly agriculture. When farmers add nitrogen fertilizer to their soil to help stimulate plant growth, only about half gets taken up by the plant, the rest is washed away in groundwater, or off-gassed as nitrous oxide or other gasses. Its potency and relatively long life are what make N2O such a dangerous contributor to the environment.

Increased emissions of nitrous oxide along with other gasses like CO2 and methane has contributed to the ozone layer depletion and global warming of the Earth. With such high concentration of these gasses alone, it'll take ages for the atmosphere to restore equilibrium in the atmosphere on its own without affecting other environmental characteristics.

Climate Change

Due to an increase in anthropogenic activities, an anticipated rise in the frequency, intensity and duration of heatwaves; and the associated increase in wildfires is likely to worsen air quality, harming human health and ecosystems. As the globe warms, wildfires and associated air pollution are expected to increase (even under a low carbon emissions scenario). In addition to human health impacts, this will also affect ecosystems as air pollutants settle from the atmosphere to Earth's surface. The Sixth Assessment Report (AR6) of The IPCC provides future scenarios on the evolution of air quality, as temperatures increase in the 21st century. It has been assessed that the probability of catastrophic wildfire events –like those observed over central Chile in 2017, Australia in 2019 or the western United States in 2020 and 2021– is likely to increase by 40-60% by the end of this century under a high emission scenario, and by 30-50% under a low emission scenario.

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Major Parties Involved and their views

Bangladesh

Air pollution in Bangladesh is the worst in the world, contributing to a reduction of nearly seven years in the average life expectancy. Air pollution levels here exceed both national and global standards and have gotten worse over the past two and a half decades. In the regions of Dhaka and Khulna Division, which include the country's biggest and third-biggest cities, the pollution level is more than eight times the WHO limit. In 2019, Dhaka came in with a PM2.5 reading of 83.3 microns as the yearly average, putting it in the 'unhealthy' bracket of air quality, which is considered to be between 55.5 to 150.4 microns. From 2017-2020, Bangladesh's Ministry of Fisheries and Livestock, the Food

and The Agriculture Organization of the United Nations (FAO) and the Climate and Clean Air Coalition (CCAC) designed the “Livestock Development-based Dairy Revolution and Meat Production Project" (LDDP) to reduce methane emissions in the livestock sector. The project worked to improve the national emissions inventory by coordinating a household survey on livestock production practices and analyzing the findings. Further impacts created by the implementation of this project include:

- Improved Climate Smart Production Practices
- Critical and Climate Resilient Public Infrastructure
- Consumer Awareness and Nutrition
- Livestock Risk mitigation

Chad

By the WHO's guidelines, the air quality in Chad is considered unsafe. The most recent data indicates the country's annual mean concentration of PM2.5 is 66 microns which exceeds the recommended maximum of 10 microns. Contributors to the poor air quality in Chad include the oil, textile, and meatpacking industries, vehicle emissions, and incineration of waste.

The Ministry of Environment, Water and Fishing of Chad is working with the Supporting National Planning (SNAP) Initiative to develop an integrated emission inventory of greenhouse gasses, short-lived climate pollutants and air pollutants. This will enhance the ability of the country to address issues related to the mitigation of short-lived climate pollutants and pave the way for informed emission reduction strategies that will deliver in-country benefits for health and economic growth.

Pakistan

Pakistan is today the world's fourth most polluted country. Air pollution shortens the average Pakistani's life expectancy by 4.3 years, relative to what it would have been if the WHO guideline was met. Some areas of Pakistan fare much worse than average, with air pollution shortening lives by almost 7 years in the most polluted areas. Looking at Pakistan as a whole, in 2018 the country came in with a PM2.5 reading of 74.27 microns. In 2019 its yearly average was 65.81 microns, a considerable improvement however still not enough to take its world ranking down, coming in as 2nd most polluted country in the world and still in the unhealthy group bracket. One major reason being an increase in the emissions of black carbon. Fine particulate matter such as black carbon is released in high quantities, its creation taking place as a result of the incomplete combustion of fossil fuels or organic matter. As such it can also be found coming from the burning of wood or coal, but most prominently from vehicle fumes.

Pakistan joined the US and EU-led Global Methane Pledge on October 11th, 2021, committing to the collective goal of reducing global methane emissions by at least 30% from 2020 levels by 2030. The country aims to act on methane mitigation by moving towards using the best available inventory methodologies to reduce methane emissions, with a particular focus on their high-emission sources.

Puerto Rico

The Caribbean island of Puerto Rico has the world's cleanest air according to the latest World Air Quality Report by IQAir. The current concentration of PM 2.5 in Puerto Rico is 4 microns. The WHO recommends 15 microns as the threshold concentration of PM2.5 for 24 hours. From being a country hit with disaster hurricanes in 2017 to now having the cleanest air in the world; Puerto Rico has improved its policies and guidelines towards addressing air pollution very impressively. The violations addressed in the country include failure to use good air pollution control practices at the petroleum storage tanks; failure to follow regulatory requirements after the liquid was found on an internal

floating roof within one petroleum storage tank; and violations related to the vapor recovery system at the site's truck loading racks, which resulted in excess emissions of hazardous air pollutants. This was partially possible due to the funds provided by the United States Environmental Protection Agency (U.S. EPA) to improve Puerto Rico's urban air quality.

Finland

Air quality in Finland is the best in the world according to data released by the WHO. The level of airborne particles in Finland is on average 6 micrograms per cubic meter – the lowest level for any individual country. It has such clean air because of strong environmental regulations. The government invests in renewable energy, protects forests and lakes, and promotes the usage of electric vehicles. The country is also well on its way to reaching the goals it set under the Paris Climate Agreement. In general, Finland's air pollution control policies aim to maintain high air quality to preserve healthy and pleasant residential environments and viable natural ecosystems. Many of the national policies and activities strive to reduce emissions of air pollutants and thus indirectly affect air quality. For example, Finland's National Climate and Energy Strategy consists of new climate and energy policy measures aiming to stop or limit the increase in final energy consumption and electricity consumption which is closely connected to climate change mitigation.

Norway

Norway is among the countries in Europe that have the lowest risk of premature deaths as a result of local air pollution. In 2019, Oslo achieved the WHO target figure of 10 microns for clean air for 10 months of the year. For the remaining two months, the air was classified as"Good" with figures between 10 and 12 microns.

Oslo is one of 42 cities that take part in Breathe Life, a campaign led by the World Health Organization, UN Environment and the Climate & Clean Air Coalition that inspires cities and individuals to protect our health and planet from the effects of air

pollution. Zero-emission vehicles play a key part in the city's strategy to reduce C02 equivalents by 95% in 2030, and city officials are encouraging people to make the transition to electric vehicles. International cooperation is key for Oslo to work towards a zero-emission, resilient and green future. In addition, the city supports various initiatives including C40 Cities Climate Leadership Group, the Carbon Neutral Cities Alliance, ICLEI - Local Governments for Sustainability and Eurocities.

Development of Issue/Timeline

Year	Event	Outcome
1820-1840	The Industrial Revolution	The rise of the mechanized factory system to replace hand production methods. Chemical manufacturing, iron production, and an increase in the use of steam and water power implicated the need for more natural resources such as coal and iron.
1952	The Great Smog of London	UK's Capital is covered in thick lethal smog, due to airborne pollutants arising mostly from coal combustion accumulated in the air. Premature deaths of estimated 12,000 people.
1956	The Clean Air Act is passed	This led to significant reductions in emissions in urban areas as well as to the closure of many urban power stations and other polluting industrial infrastructure.
The 1960s	Acid Rain	Acid rain was first identified in North

		America at Hubbard Brook in the mid-1960s. A direct consequence of air pollution that affected the environment, corroding surfaces, increasing the acidification of freshwaters, and contributing to the overall loss of biodiversity – mainly aquatic animal species
1979	Convention on Long-range Transboundary Air Pollution (LRTAP)	Extensive monitoring of emissions as well as a plan for interpretation of the data and concrete action.
The 1980s	Burning of coal, gasoline, and oil in vehicles, homes, industries, and power plants	Abnormal changes in botanical species composition of heathlands. Eutrophication - reduction in the richness of grasslands due to high concentrations of phosphorus and nitrogen in bodies of water
2nd half of the 20th Century	Ground-Level-Ozone	Quickly associated with premature mortality and a range of health issues and diseases of the respiratory tract and sensitive effects on vegetation and ecosystems including forests.

Previous Attempts to Solve the Issue

The WHO Global Air Quality Guidelines

Since 1987, WHO has periodically issued health-based air quality guidelines to assist governments and civil society to reduce human exposure to air pollution and its adverse effects. In various ways, these guidelines have stimulated authorities and civil society alike to increase efforts to control and take action on harmful air pollution exposures. The overall objective of the updated global guidelines is to offer quantitative health-based recommendations for air quality management, expressed as long- or short-term concentrations for several key air pollutants. Exceedance of the air quality guideline (AQG) levels is associated with important risks to public health. Implementation of the guidelines requires the existence and operation of air pollution monitoring systems; public access to air quality data; legally binding, globally harmonized air quality standards; and air quality management systems. Policy decisions to set priorities for action will profit from the health risk assessment of air pollution.

As a result, the 5 concentration limit was tightened by 100% (10 microns in 2005 and only 5 microns in 2021). At the same time, the 24-hours average PM2. 5 threshold value was decreased from 25 microns in 2005 to 15 microns in 2021. Moreover, the WHO highlighted the importance of nitrogen dioxide pollution.

Greener Cities Partnership (UN-Habitat and UN Environment)

To advocate and promote environmental sustainability in urban development, and to mainstream environmental considerations into urban policy-making, the United Nations Environment Programme and the United Nations Human Settlement Programme have jointly developed the Greener Cities Partnership. UN-Habitat's 2016 World Cities Report states that urban environmental issues have implications on various spatial scales, and therefore should be tackled on all levels of governance: municipal, metropolitan, national, sub-regional, regional or international levels, overcoming many institutional boundaries.

Thus, the objective of the Greener Cities Partnership is to mainstream environmental considerations into local, national and global urban policy-making, as well as highlight local-global linkages of environmental issues. Current priorities include resource flows, efficiency and resilience; waste and wastewater management; transport and mobility; and the monitoring and reporting on urban environmental SDG indicators through:

- Sustainable Transport
- Climate Change
- Waste and wastewater management
- Monitoring and reporting on urban environmental indicators
- Resilient and resource-efficient cities and air quality

The Greener Cities Partnership Project set up the Community-based Urban Garden Project in Queen Rania Al Abdullah Park. It addressed the framework of the project “Inclusive, safe, resilient and sustainable development in urban areas". Forterra and the City of Seattle recognized this opportunity to drive change and increase community benefit by working together to restore and maintain Seattle’s 2,500 acres of forested parkland.

Possible Solutions

Renewable fuel and clean energy production

The adoption of renewable energy would provide a significant and noticeable change by immediately reducing particulate matter produced by fossil fuel-burning power plants. Particle pollutants don’t just directly impact air quality. Over time, they contribute to climate change, leading to hotter summers that can make air quality even worse. Slowing climate change with renewables could help prevent some of these stagnation events by reducing the potential impact of ozone and other pollutants already in the

atmosphere. Moreover, it could result in more frequent fog and rain that would cool down the environment and help counter global warming.

Eco-friendly transportation

Every vehicle on the road releases an average of one pound of CO2 per mile driven. Compared with driving, taking public transportation reduces CO2 emissions by 45%, decreasing pollutants in the atmosphere and improving air quality. Shifting to battery-powered or electric modes of transportation would help urban air quality through a reduction in emissions of harmful gasses; eventually resulting in healthier communities and clearer skies. Sustainable public transportation would give way to the growth of the environment and animal habitats which are often destroyed to make space for constructing roads and commercial buildings.

Energy conservation and efficiency

The energy system contributes vitally to economic and social progress around the world, but the associated emissions and negative side effects are costly. Scaling up the use of energy-efficient appliances and lighting reduces the demand for electricity generation, and therefore reduces air pollution. Mandatory building standards and retrofits that reduce the energy consumption within buildings can also greatly reduce the need for power generation. Similarly, improvements in the efficiency of industrial sites can lead to fuel-based cancer based on emissions from fossil fuel-based power generation (including at the level of industrial facilities).

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