



# CLEAN AIR

**A DOSSIER ON AIR POLLUTION  
FOR HEALTH PROFESSIONALS  
IN THE LATIN AMERICAN  
AND THE CARIBBEAN REGION**



**SEPTEMBER 2022**

This dossier brings together crucial material regarding Air Pollution and Health from various scientific sources in an easy to read format for health professionals.



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Air pollution occurs when gasses, dust particles, fumes, or smoke (or odor) enter the indoor and outdoor environment in a way that makes it harmful to humans, animals, or plants. Examples of pollutants of major public health concern include oxides of nitrogen and sulfur, carbon monoxide, ozone, methane, hydrocarbons, sand or dust particles, and volatile organic compounds that can evaporate and enter the environment.

Household combustion devices, motor vehicles, waste burning, industrial facilities, refineries, coal power plants, and forest fires are common sources of air pollution. According to data from the World Health Organization (WHO), almost all of the global population (99%) breathe air that exceeds [WHO guideline limits](#) and contains high levels of [pollutants](#), with low- and middle-income countries suffering from the highest exposures.

Some of the same pollution that compromises respiratory health also drives climate change. For example, the burning of fossil fuels (coal, oil, and gas) for electricity, heat, or transportation is a major driver of climate change and the main source of air pollution. Recent [research](#) from Harvard University, in collaboration with the University of Birmingham, the University of Leicester, and University College London, found that “more than 8 million people died in 2018 from fossil fuel pollution, significantly higher than previous research suggested—meaning that air pollution from burning fossil fuels like coal and diesel was responsible for about 1 in 5 deaths worldwide.”

It is not only the deaths from air pollution that is a concern. Air pollution causes daily disruptions in people’s lives from allergies, cold, cough, irritation of the eyes, nose, and throat, headaches, dizziness, fatigue, drive absenteeism from work and school, impaired productivity, and lead to mental health issues.

# AIR POLLUTION

## A PUBLIC HEALTH CONCERN IN THE LATIN AMERICAN COUNTRIES



Air pollution is the largest environmental risk for public health in the Americas. [According to the WHO](#), more than 150 million people in Latin America and the Caribbean (LAC) live in cities with levels of air pollution exceeding WHO air quality guidelines of 2005.

According to an expert [report](#) by the Natural Resources Defense Council (NRDC), “between January to May 2019, Mexico suffered terrible air pollution from raging wildfires throughout the country. These [wildfires](#) burned almost 849,000 acres in 32 different jurisdictions. As a result, the air quality in Mexico reached [toxic levels](#) in various states, and the government closed schools and recommended that people stay inside. Around the same time, Chile was preparing for winter, the time of year when air pollution is at its worst due to the widespread use of wood for heating and cooking in homes and other buildings. Because of this, cities in central and southern Chile typically have air quality levels that are among the worst in the Western Hemisphere. [Ten million Chileans live in areas categorized as ‘saturated’](#) due to the high levels of fine particulate matter in the air.” Those living in Chile’s heavily industrialized regions, also known as “sacrifice zones” are particularly vulnerable to the adverse effects of environmental contamination including air pollution. According to [reports](#), the health risks of sacrifice zones in Chile were highlighted in mid-2018 when hundreds of people were hospitalized in the Quintero-Puchuncavi area for symptoms that health authorities said were caused by toxic gas leaks.

The NRDC report also states that, “[most countries and cities](#) in the LAC region do not have standards for fuel efficiency, vehicle emissions, or fuel quality, which are generally considered to be the basic standards for creating a cleaner transportation sector. This means that the majority of light- and heavy-duty vehicles in the region emit high levels of carbon dioxide and particulate matter, worsening air pollution—and at a rate that is growing due to the [increasing number of vehicles in the region](#).” In addition, household air pollution (HAP) is associated with the inefficient combustion of solid fuels and kerosene, and is one of the leading environmental risk factors for death and disability in the world.

**Household  
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the LAC region.

# OIL & GAS FACILITIES

Major sources of air pollution in the Latin American region

South Pacific Ocean

North Atlantic Ocean

South Atlantic Ocean



Petroleum dominant



Gas dominant

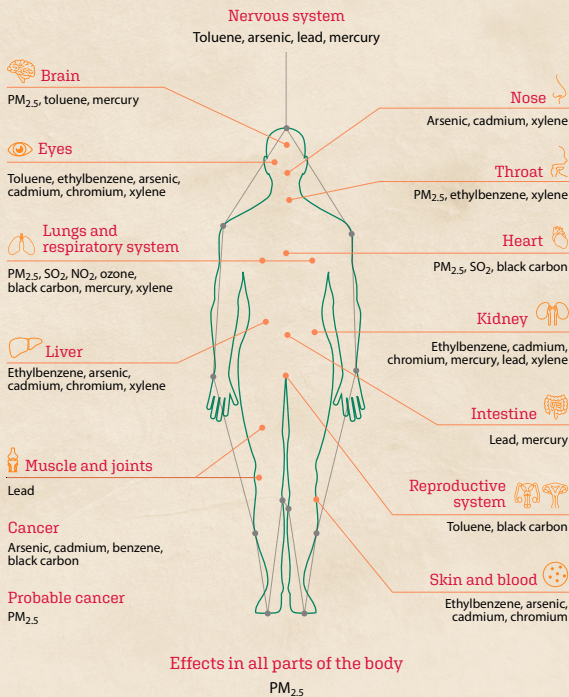


Source: [https://es.m.wikipedia.org/wiki/Archivo:Petroleum\\_regions\\_-\\_south\\_america\\_map-fr.svg](https://es.m.wikipedia.org/wiki/Archivo:Petroleum_regions_-_south_america_map-fr.svg)

Petroleum refineries are a **major source** of commonly found air pollutants: Particulate matter (PM), Nitrogen oxides ( $\text{NO}_x$ ), Carbon monoxide (CO), Hydrogen sulfide ( $\text{H}_2\text{S}$ ), Sulfur dioxide ( $\text{SO}_2$ ), and hazardous and toxic air pollutants, as well as Volatile Organic Compounds such as BTEX compounds (benzene, toluene, ethylbenzene, and xylene). The combination of volatile organic compounds and oxides of nitrogen also contributes to ground-level ozone formation. These gasses can wreak havoc on communities that live near the production, transmission, and storage of fossil fuels. Some of the chemicals released are known or suspected cancer-causing agents, responsible for developmental and reproductive problems. They may also aggravate certain respiratory conditions such as childhood asthma.

Stack or vent emissions are often identified as the most significant sources of emissions in a refinery. However, fugitive emissions from storage tanks, cooling tanks, pipe connectors, valves, equipment leaks, flanges, pumps, compressors, pressure release devices, transfer of raw materials, etc. can violate the ambient air quality standards and even exceed the stack emissions. Pollution control agencies often do not monitor fugitive emissions.

# HEALTH IMPACTS OF AIR POLLUTION





## PARTICULATE MATTER 2.5 (PM<sub>2.5</sub>)

There is a robust association between several adverse health effects and ambient air particulate matter levels. Very small (fine) particles exert disproportionately more adverse health effects than larger particles.

According to the [United States Environmental Protection Agency](#):

*"Particles less than 10 micrometers in diameter (PM<sub>10</sub>) pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter (PM<sub>2.5</sub>) are referred to as 'fine' particles and are believed to pose the largest health risks. Because of their small size [less than one-seventh the average width of a human hair], fine particles can lodge deeply into the lungs.*

*"Health studies have shown a significant association between exposure to fine particles and premature mortality. Other important effects include aggravation of respiratory and cardiovascular disease [as indicated by increased hospital admissions, emergency room visits, absence from school or work, and restricted activity days], lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children."*

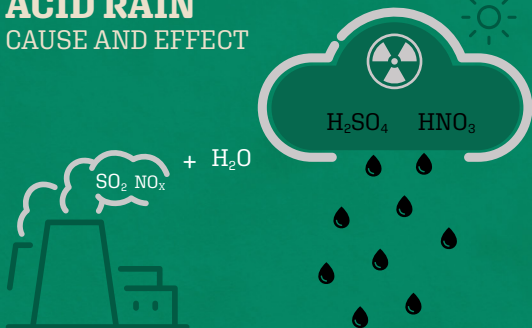


## SULFUR DIOXIDE

Sulfur dioxide is produced when oil and coal containing sulfur burns. It can cause health issues, especially in people with existing heart or lung conditions. Sulfur dioxide irritates the respiratory tract and increases the risk of tract infections. It causes coughing and mucus secretion and aggravates conditions such as asthma and chronic bronchitis. Sulfur dioxide mixes with water to produce sulfuric acid (known as acid rain) which can impact urban infrastructure, forests, waterbodies, and aquatic life.

# ACID RAIN

## CAUSE AND EFFECT



**Acid Rain is caused by emissions of Sulfur dioxide ( $\text{SO}_2$ ) and Nitrogen oxide ( $\text{NO}_x$ ), which react with water molecules in the atmosphere, producing Sulphuric acid ( $\text{H}_2\text{SO}_4$ ) and Nitric acid ( $\text{HNO}_3$ ).**

**Lowers pH level in waterways, killing marine organisms**

**Acid deposition** has many harmful ecological effects when the pH of most aquatic systems falls below 6 and especially below 5



**Damages** to man-made structures like buildings and statues is evident with signs of corrosion and erosion



**Forests** have been impacted by acid rain. It makes trees vulnerable to diseases, extreme weather conditions and insects





### 3 NITROGEN DIOXIDE

Nitrogen dioxide ( $\text{NO}_2$ ) is one of a group of highly reactive gasses known as oxides of nitrogen or nitrogen oxides ( $\text{NO}_x$ ). Other nitrogen oxides include nitrous acid and nitric acid.  $\text{NO}_2$  is used as the indicator for the larger group of nitrogen oxides.  $\text{NO}_2$  primarily gets in the air from the burning of fuel.  $\text{NO}_2$  forms from emissions from cars, trucks and buses, power plants, and off-road equipment.

Breathing air with a high concentration of  $\text{NO}_2$  can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing, or difficulty breathing), hospital admissions, and visits to emergency rooms. Longer exposures to elevated concentrations of  $\text{NO}_2$  may contribute to the development of asthma and potentially increase susceptibility to respiratory infections.

Nitrogen dioxide along with other  $\text{NO}_x$  reacts with other chemicals in the air to form both particulate matter and ozone. Both are also harmful when inhaled due to their effects on the respiratory system.

### 4 VOLATILE ORGANIC COMPOUNDS

Volatile organic compounds (VOCs) are chemicals that contain carbon and can quickly turn into vapors or gasses. These VOCs can be released by several products or items in everyday life. The simplest way to determine the presence of VOCs in the air is through their distinct odors.

#### Some common VOCs emitted from oil & gas facilities and their health impacts:

##### • Benzene

Benzene is a known carcinogen [cancer-causing chemical] and it is particularly known to cause leukemia. The main effect of benzene from long-term exposure is on the blood. It causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance of infection. Prolonged exposure may result in blood disorders like leukemia, reproductive and developmental disorders, and other cancers.

##### • Toluene

Low to moderate levels can cause headaches, dizziness, tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure stops. Toluene may affect the nervous system. Long-term daily exposure to toluene in the workplace may cause some hearing and color vision loss. Repeatedly breathing toluene from glue or paint thinners may permanently damage the brain. Exposure to high levels of toluene during pregnancy, such as those associated with solvent abuse, may lead to developmental effects, such as reduced mental abilities and growth in children.



## ▪ Ethylbenzene

Exposure to high levels of ethylbenzene in the air for short periods can cause eye and throat irritation. Exposure to higher levels can result in dizziness. Animal studies have reported effects on the blood, liver, and kidneys from chronic inhalation exposure to ethylbenzene.

## ▪ Xylene

High levels of exposure for short or long periods can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

## 5 TROPOSPHERIC OZONE

Ozone can be "good" or "bad" for health and the environment depending on where it is found in the atmosphere. Stratospheric ozone (found 32 kms above ground) is "good" because it protects living things from ultraviolet radiation from the sun. Ground-level ozone, also known as tropospheric ozone, is "bad" because it is a greenhouse gas and air pollutant, which is harmful to human and ecosystem health. It can trigger a variety of health problems, particularly for children, the older adults, and people who have lung diseases such as asthma. It is also a major component of urban smog.

Ground level ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen ( $\text{NO}_x$ ) and volatile organic compounds (VOCs). This happens when pollutants emitted by cars, power plants, industrial boilers, oil and gas refineries, chemical plants, and other sources chemically react in the presence of sunlight.

### SEASONAL AVERAGE POPULATION-WEIGHTED OZONE CONCENTRATIONS IN 2015

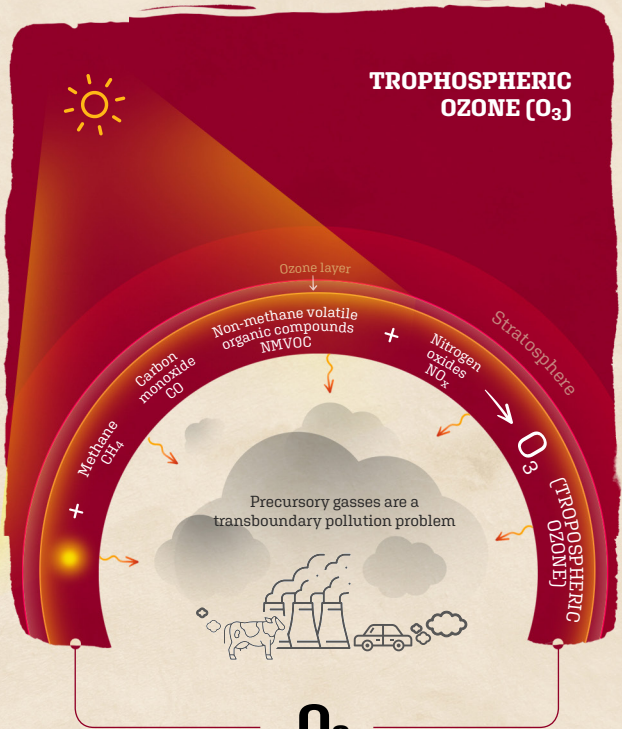
#### TROPOSPHERIC OZONE

(PARTS PER BILLION)



Source: Health Effects Institute, 2017

## TROPOSPHERIC OZONE (O<sub>3</sub>)



O<sub>3</sub>

is known as a 'secondary' pollutant because **it is not emitted directly**, but instead forms when precursor gases react in the presence of sunlight



Warms the atmosphere



Damages plants and affects cultural production by reducing:

- health and productivity of crops
- plants ability to sequester carbon
- photosynthesis



O<sub>3</sub> pollution causes **over 150000 premature deaths every year, and millions more chronic diseases**, particularly in children and older adult

Source: Climate & Clean Air Coalition

## 6 METHANE AND HEALTH

Methane is a colorless, odorless, and highly flammable gas, which is the primary component of natural gas, biogas, and marsh gas. Depending on its origin it may be referred to as either of these. It is a powerful greenhouse gas emitted by human activities such as oil and gas production, waste landfills, and the raising of livestock, as well as by natural sources such as wetlands and volcanoes.

Methane is used for domestic cooking and heating, in energy generation, and in industry to refine petrochemicals and to produce plastics, fertilizers, anti-freeze, and fabrics.

Methane is present in the atmosphere (and its [levels are increasing](#)); therefore, the public may be exposed to very low levels when breathing in the air. Low-level exposure to methane can also occur from the use of natural gas products or gas appliances in the home. Low-level exposure would not be expected to cause adverse health effects.

Occupational exposure to methane may occur in the workplace where it is extracted, produced, or used. Exposure to high levels of methane can reduce the amount of oxygen breathed from the air. This can result in mood changes, slurred speech, vision problems, memory loss, nausea, vomiting, facial flushing, and headache. In severe cases, there may be changes in breathing and heart rate, balance problems, numbness, and unconsciousness. If exposure to methane is large or continues for a longer period, it can result in death.

Methane is a [key precursor gas](#) of the harmful air pollutant, tropospheric ozone. Globally, increased methane emissions are responsible for half of the observed [rise in tropospheric ozone levels](#). While low-level methane does not cause direct harm to human health or crop production, ozone is responsible for about [1 million premature respiratory deaths](#) globally. Methane is responsible for about half of these deaths.



*Methane has a global warming potential at least 84 times greater than CO<sub>2</sub>. Reducing its emissions is not only necessary to limit global temperature rise to 1.5 C, but it is also essential for the prevention of its numerous effects on human health. The Climate and Clean Air Coalition (CCAC) estimates that for each reduction of one million tons of methane, approximately 1,430 premature deaths globally could be prevented, as well as 4,000 incidents and visits to the hospital and 90 annual hospitalizations caused by asthma. It is possible to reduce 30% of global methane emissions by 2030. Emissions from the fossil fuel sector in particular can be reduced with existing low- or no-cost solutions that can be implemented now. It is imperative to act now to reduce methane in the fossil fuel, waste, and agricultural sectors and thus improve people's health.*

Paula García

Latin America Policy Manager, Clean Air Task Force



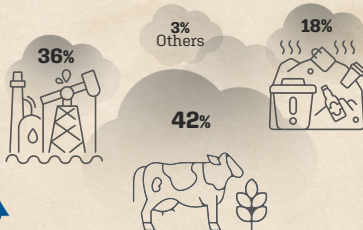


## METHANE ( $\text{CH}_4$ )

Lifetime in atmosphere:  
12 years

Precursory gasses create greenhouse effect,  
trap the heat from the sun

Atmosphere



Atmosphere

### Methane emissions

caused by human activities are one of the most significant drivers of climate change.

Methane is also the main precursor of tropospheric ozone, a powerful greenhouse gas and pollutant.



Responsible for 40% of warming since the industrial revolution

86x

times more powerful than  $\text{CO}_2$  over a 20-year period

Causes roughly **50% of the 1+ millions deaths** due to ozone air pollution



- Respiratory diseases
- Heart disease
- Damaged airways and lung tissues



**Upto 15% annual yield losses** of wheat, rice and maize

## 7 BLACK CARBON

**Black carbon** is the sooty black material emitted from gas and diesel engines, coal-fired power plants, and other sources that burn fossil fuel. It comprises a significant portion of particulate matter or PM, which is an air pollutant. Black carbon is a global environmental problem that has negative implications for both human health and our climate. Inhalation of black carbon is associated with health problems including respiratory and cardiovascular disease, cancer, and even birth defects. And because of its ability to absorb light as heat, it also contributes to climate change. For example, as black carbon warms the air, rapid changes in patterns of rain and clouds can occur.

# WHO IS MOST AT RISK

While air pollution is a problem that affects everyone, some groups of people are more vulnerable than others. These groups are multiple and may be overlapping; they include **children, pregnant women and other pregnant people, fetus, older adults, economically disadvantaged people, people with respiratory ailments (asthma and chronic bronchitis), and people with cardiovascular disease or diabetes**

When ambient air quality standards are set, special attention needs to be paid to ensure that the levels established are stringent enough to protect these vulnerable populations and not only those who are fully grown and in good health.



# HOW CAN HEALTH CARE PROFESSIONALS ADVOCATE FOR CLEAN AIR?

Health professionals are usually the most trusted voices in their communities. Country leadership looks to them for advice, families confide in them, and citizens want to adhere to what the country's leading medical professionals have to say about their health. When doctors, nurses, hospitals, and health systems take public stances on air pollution and climate change, it can reframe these issues as questions of public health and help move public opinion and policy. The voices of health workers are critical in promoting actions that address air pollution and its impacts on health. Health care professionals can make a big difference — with their patients, in their practices, and in their health care institutions.



## ON THE ISSUE OF AIR POLLUTION, HEALTH PROFESSIONALS CAN

1. Highlight the health impacts of pollution and humanize the issue in the media, with the public and policymakers or with other colleagues and within professional medical associations.
2. Generate local health evidence from their clinics and communities on the health impacts of air pollution.
3. Provide health advisories for protecting their patients and the vulnerable population from the dangers of air pollution.
4. Highlight the health co-benefits of clean air and advocate for actions that promote clean air to their patients, communities, and policymakers.
5. Advocate for robust health adaptation and mitigation plans to combat the adverse health impacts of poor air quality, especially on the economically disadvantaged and marginalized populations.
6. Advocate for a just transition from dependence on fossil fuels to an economy that values health and is based on clean, renewable, healthy energy.





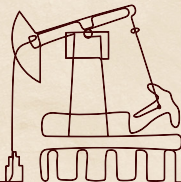
## A GLOBAL CALL FOR HEALTH CARE PROFESSIONALS ON THE FOSSIL FUEL NON-PROLIFERATION TREATY

The [Healthy Climate Prescription](#) letter that health professionals signed in the lead-up to COP26 called on nations to deliver a rapid and just transition away from fossil fuels. Now, there is an opportunity to get involved in an important initiative that supports that goal - an international treaty among governments committing to stop the expansion of fossil fuel projects and to phase out existing projects.

A global effort is underway to establish a Fossil Fuel Non-Proliferation Treaty, and the health community is ready to add their support to this call. Health organizations are joining academics, scientists, Nobel laureates, cities, faith leaders, and young people in endorsing the call for a treaty to stop fossil fuels with a new letter of support specifically from the health community.

Like the Framework Convention on Tobacco Control, the proposed Fossil Fuel Non-Proliferation Treaty would aim to be an evidence-based international agreement to control a category of substances well-known to be harmful to human health, in order to ensure the right of all people to the highest standard of health.

The letter for endorsement can be found at:  
<https://fossilfueltreaty.org/health-letter>



*More than 90% of the global population lives in areas where concentrations of the most pervasive air pollutants exceed WHO recommendations, and more than 7 million premature deaths are caused each year because of air pollution. This international day is an opportunity to raise awareness about this silent killer and demand decisive action to combat it. It is literally about standing up for the air we breathe.*

*Andrea Hurtado Epstein*  
Health Care Without Harm





## **AIR POLLUTION: A REGIONAL PROBLEM THAT NEEDS REGIONAL SOLUTIONS**

Air pollution knows no borders. Management of air pollution sources, particularly those which affect territories over thousands of kilometers, require high levels of coordination and cooperation among several institutions across states and countries. In other words, we need to evolve a new framework that focuses on reducing air pollution in an 'airshed'; i.e., the entire area over which the pollutants disperse due to meteorological and geographical factors. The concept is very similar to a 'watershed', an area of land that drains all the streams and rainfall into a common outlet like a river.

In an airshed approach, institutions in different jurisdictions would need to coordinate reductions in air emissions from all sources including industry, energy, vehicular, and residential sources. Formal coordination mechanisms through working groups and advisory committees between local, regional, state, and central authorities can provide pathways to effective regulatory and scientific cooperation across jurisdictions and sectors. The key is also to build trust and dialogue to achieve compliance with regulations and respond to political demands.



## WHAT SHOULD THE GOVERNMENTS OF LATIN AMERICAN COUNTRIES DO?

### National level:

- ✓ Invest in increasing air quality monitoring capacity and disclosing data to the public about the health impacts of the air quality in the form of health advisories.
- ✓ Urgently revise their existing air quality standards and align them with the WHO guidelines of 2021, putting public health at the center of the standard setting process.
- ✓ Invest in policies and mechanisms to ensure enforcement of its air quality standards.
- ✓ Set stringent emission standards for refineries, industries, transportation, etc.
- ✓ Have robust health adaptation and mitigation plans to combat the adverse health impacts of poor air quality.
- ✓ Commit to phasing out of fossil fuels and invest in low carbon and healthy sources of energy options.

### Regional level:

- ✓ Recognize that air pollution knows no boundaries and that there is a need for urgent cross border collaboration.
- ✓ Set up mechanisms to ensure regional collaboration, exchange of information, data, policies, and action to strategically tackle the air pollution and health crisis.
- ✓ Commit to phasing out of fossil fuels and invest in low carbon and healthy sources of energy options.



*On this international day of clean air for blue skies, and in the context of the global climate crisis, we must commit to closing fossil fuel-based power generation plants (such as thermoelectric power stations) and replacing them with renewable energy sources as soon as possible. This will produce a dual benefit, environmental and social: it will reduce the emissions of black carbon, which impact the so-called sacrifice zones and severely affect the health of people, crops and the local flora and fauna; and it will reduce the emission of greenhouse gasses that accelerate the disruption of the global climate.*

*Dr. Mauricio Ilabaca Marileo*

*President of the Environment Department of the  
Chilean Medical College (COLMED)*





**Health Care Without Harm (HCWH) works to transform health care worldwide so that it reduces its environmental footprint, becomes a community anchor for sustainability and a leader in the global movement for environmental health and justice.**

The Health Care Without Harm Global Network is composed of regional offices in Europe, South East Asia, and the United States; a Latin America regional team and a global secretariat. Strategic partner organizations represent us in Australia, Brazil, China, India, Nepal and South Africa.

Health Care Without Harm and its partners also lead Global Green and Healthy Hospitals, a worldwide network of hospitals and health systems with more than 1,500 members in 75 countries, representing the interests of over 60,000 hospitals and health centers.

We also work in partnership with international organizations, including the World Health Organization (WHO), United Nations Development Program (UNDP), International Federation of Medical Students Associations (IFMSA), Global Climate and Health Alliance (GCHA), and World Federation of Public Health Associations (WFPHA).