The Effects of Air Pollution

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Air pollution is an existential threat and must be at once dealt with in a serious manner. This is because air pollutants both damage the environment and human health. More specifically, certain pollutants, such as ozone, are rapidly deteriorating Earth's atmosphere as we emit them in enormous quantities. Even some of the same air pollutants that ruin our atmosphere can damage our lungs as well, or even make living more difficult. Humans handle the emission of various air pollutants since we partake in activities that release air pollutants such as transportation, agriculture, and electricity production. Not only do our activities lead to the emission of emit ozone, but they also emit nitrous oxides, sulfur dioxide, carbon dioxide, chlorinated hydrocarbons (CHCs) (EPA 2020e). So, it is our duty to completely prevent any further pollution.

Considering air pollutants environmentally, there is a strong correlation between carbon dioxide and rising temperatures all over the earth. If emissions are not cut soon, atmospheric carbon dioxide gas concentrations will continue to increase, which will cause earth's average temperature to rise. We need to reach net-zero emissions ASAP to prevent intense climate change.

The US' role in climate change began in the Industrial Revolution where coal was burned, and our emissive contributions have generally increased since then. In order combat emissions and climate change in the US, the US passed the Clean Air Act in 1970. According to the journal *An Introduction to Air Pollution – Definitions, Classifications, and History* by Aaron Daly and Paolo Zannetti (2007), Daly and Zannetti clarify that, "1970 Clean Air Act in the US, air pollution has been regulated all over the world through a series of laws and regulations." This was one of the biggest steps in regulating air pollution, but not by completely preventing it.

Carbon dioxide is an overwhelming contributor to global warming. According to the PowerPoint titled, "Part 1 – Air, Climate, and Ozone" (2020) by Doctor Guang Jin, Director of the ISU (Illinois State University) Environmental Health Department, it states that, "CO2 is the leading greenhouse gas, contributing to about 80% of global warming." The evidence plainly and appropriately explains carbon dioxide's role in global warming, and that humanity handles reducing carbon dioxide emissions. According to the EU Science Hub (2018), in 2005, the US used to emit the most carbon dioxide from burning fossil fuels compared to other countries. The EU Science Hub further recorded that in 2017, China surpassed in US in terms of MT CO2e in emissions.

Doctor Jin's PowerPoint also mentions that, "the US produces more CO2 per capita than China." All these facts point to the US being a large contributor to carbon dioxide. What makes the US' emissions more problematic, currently, is that it has a smaller population and is smaller than China, but it produces more carbon dioxide emissions per capita. It almost seems embarrassing that the US emits so much more carbon dioxide than it should. The US needs to take more initiative to reduce and prevent carbon dioxide emissions because of how dangerous emissions can be.

Taking sulfur dioxides and nitrous oxides into consideration, they too play a role in global warming, ecology, and human health. Sulfur dioxide and nitrous oxides are emitted after burning fossil fuels and are contributors to acid rain. The creation of acid rain is described the webpage by the EPA (2020d) titled "Ground-level Ozone Basics", when it states, "Acid rain

results when sulfur dioxide (SO_2) and nitrogen oxides (NOx) are emitted into the atmosphere and transported by wind and air currents." Acid rain can decrease biodiversity and lower the yield of crops. This is because acid rain can leach nutrients from the soil, killing plants, thus killing off animals, which humans depend on both for materials and provisions. Biodiversity is necessary to perpetuate ecosystems that help support other forms of life, more importantly, human life. Also, according to another webpage by the EPA (2019b) "Current and Future Challenges", specific pollutants such as NO2, SO2 and ozone aggravate asthma.

Speaking of ozone, it is an air pollutant a direct, major threat to human health when it is at ground level. According to the webpage "Ground-level Ozone Basics" by the EPA (2020d), it explains how ground-level ozone is created when it says, "Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). This happens when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight." This clarifies that ozone is likelier to be ground level rather than directly emitted into the atmosphere. Since we live in the troposphere, we are likely to inhale ozone. It can be assumed that populations that live near vehicle-dense locations, plants, boilers, refineries have a higher exposure to ground-level ozone.

Individuals who are highly exposed to ozone are also at a high-level risk of lung damage since ozone can go as far as to "reduce lung function and harm lung tissue," and, ". . . cause permanent damage to lungs through long-term exposure," (EPA 2020d). Ozone should be feared, reduced, and avoided as much as possible since breathing is detrimental to one's survival. The EPA (2020d) also says that, "Elevated ozone levels are linked to increases in hospitalizations, emergency room visits and premature death." This statement lists the worst-case scenarios for ozone exposure cases. Hospitalization and emergency room visits can become unfortunately expensive, which places financial stress on individuals. Ozone can even take away one of the most important things: a life.

When considering the impact that air pollutants have on ecosystems and climate change, there will be undesirable ecological effects. According to Doctor Jin's (2020) PowerPoint titled "Ecosystems", increasing average temperatures above the optimum range will place stress on all forms of life, which includes humans, by pushing them into a zone of stress or, in an extreme case, a zone of intolerance. This means that rising temperatures decrease biodiversity and crop yield. Climate change is rapidly occurring, which means that plant and animal species that are easily affected by temperature cannot adapt fast enough. As a result, all species will be pushed into a zone of stress or a zone of intolerance in the worst-case scenario. The zone of intolerance could mean death or extinction upon these species, which will have a cascading effect upon various ecosystems as they lose species necessary to sustain them. We rely on plants, animals, and their ecosystems for our survival, so it would be a major loss to humanity's survival if we lost these resources. Flooding will also occur as glacial melting occurs, which is also bad.

To combat and regulate pollutants such as carbon dioxide, nitrous oxides, sulfur dioxide, and ozone, the US has implemented federal level air quality-related laws. The EPA is an independent executive agency of the United States federal government tasked with environmental protection matters, such as outdoor air pollution. Government passed the Clean Air Act (CAA) in 1970 and the EPA established the U.S. National Ambient Air Quality

Standards (NAAQS). The US still enforces the regulations established by the CAA and NAAQS to control air pollutant emission.

The need to enforce the CAA and NAAQS implies big emitters such as the top 3 economic sectors: transportation, electricity production, and industry need restrictions on the quantities of air pollutants they emit (EPA 2020b). It can be further implied that major human activities that play a role in transportation, electricity production, and industry would freely emit air pollutants such as carbon dioxide, sulfur dioxide, nitrous oxides, and ozone, which would become more concentrated in the atmosphere. Freely emitting air pollutants without restriction would deteriorate the earth's atmosphere *even more* rapidly compared to the rapid rate at which it is *already* deteriorating due to increased atmospheric air pollutant concentrations. Freer emissions would also affect asthmatics and even non-asthmatics, overall worsening lung health and increasing hospital/ ER visits as previously described.

There has been further research done on the effects of pollution, climate change, and human health. The effects of climate change can be confirmed by the 2014 National Climate Assessment according to the EPA when it states, "The U.S. government's May 2014 National Climate Assessment concluded that climate change impacts are already manifesting themselves and imposing losses and costs. The report documents increase in extreme weather and climate events in recent decades, with resulting damage and disruption to human well-being, infrastructure, ecosystems, and agriculture, and projects continued increases in impacts across a wide range of communities, sectors, and ecosystems," (EPA 2020b). The report from the National Climate Assessment affirms that climate change is upon humanity. The report also lists the other disastrous effects that climate change brings. Not only does climate change make the earth less habitable, but it also imposes losses and costs, and disrupts human well-being. It can be assumed that the losses and costs include valuables such as infrastructure, agriculture, ecosystems, which humanity relies on. The loss of these valuable may be infringing on human well-being because some parts of the world may be facing hunger from corrupted agricultural land, a lack of housing from damaged homes from extreme natural events, and anxiety towards the degradation of the earth. Humanity cannot afford to lose its necessities, but it also cannot afford to lose the world to climate change.

To confirm the existence of more extreme weather induced by climate change, the EPA (2020b) further discusses that, "Scientists warn that carbon pollution and resulting climate change are expected to lead to more intense hurricanes and storms, heavier and more frequent flooding, increased drought, and more severe wildfires - events that can cause deaths, injuries, and billions of dollars of damage to property and the nation's infrastructure." There is a strong link between extreme weather/ natural disasters, climate change, and loss. The losses here are lives, money, and infrastructure. As the effects of climate change increase, extreme weather increases, costing lives, human well-being, homes, hospitals, other property, and money. It would be the ideal for climate change to be reversed by taking preventive measures so that priceless and valuable things are not lost.

Another study regarding human health and air pollution states, "Newer scientific studies have shown that some pollutants can harm public health and welfare even at very low levels. EPA in recent years revised standards for five of the six common pollutants subject to national air quality standards. EPA made the standards more protective because new, peer-reviewed scientific studies showed that existing standards were not adequate to protect public health and

the environment," (EPA 2020b). The report and analysis prove that pollutants (specifically air pollutants in the context of the website) can be harmful even at low levels, which may be more applicable to ozone as it harms the lungs. It can be implied from the evidence that there is more room to tighten EPA standards as the EPA standards needed to be tightened in the first place. Ideally and foremost, there should be zero emissions of carbon dioxide, sulfur dioxide, nitrous oxides, and ozone out of respect for human health.

Fortunately, there are multiple methods to solving the issue of air pollution and its effects. Though there are multiple solutions, every part of society in the US, must take responsibility. Thankfully, there are careers such as environmental sciences, environmental law, and environmental health (EH) that step in to help protect the environment. Focusing on EH, the EH field includes practitioners who enforce environmental and human safety on a smaller scale than that of environmental lawyers. An EH practitioner may keep paperwork/ records, conduct in-field research, and communicate environmental concerns. More specifically, EH practitioners in the environmental protection field anticipate, recognize, evaluate, control/ prevent, and sometimes monitor environment and human health-related hazards and risks.

EH practitioners in the environmental protection field may anticipate by predicting the impact of natural disasters or the public's response to changes to changes in terms of air pollution concentration in different living environments. EH practitioners may also have to anticipate the impacts of newly implemented regulations or technology meant to restrict air pollution. Overall EH practitioners must be able to anticipate responses of the public, industry, and ecosystems when there is environmental change such as the implementation of regulation, modern technology, and increase/ decrease of air pollutants and how these factors affect each other.

EH practitioners must also recognize both environmental and public health hazards such as air pollutants via investigation. Practitioners may collect data from devices that detect pollutants such as carbon dioxide, nitrous oxides, sulfur dioxide, and ozone. Practitioners would also recognize the number and frequency of extreme weather incidents. It is also imperative that EH practitioners investigate in places that are considered marginalized so that everyone is rightly served and protected if it is applicable since polluted air can be swept across large areas of land. Investigating everywhere is a means of avoiding environmental injustice. As investigation is taking place, data must also be recorded so it can be later evaluated.

EH practitioners must evaluate collected data. At this point, practitioners must decide whether if the collected data holds any concerns that are worth fixing. The quality of air is determined during evaluation. Practitioners must consider if an issue holds any elevated levels of risk. Air quality data will be evaluated in respect to the pollution limits set by the NAAQS. Practitioners will evaluate the level of risk associated with ground level of ozone based on how many hospitalizations or asthma attacks occur because of ozone. Practitioners will even evaluate the level of danger of recent extreme weather events.

EH practitioners create plans of actions when they control and prevent hazards. EH practitioners in environmental protection will creates plans for the protecting environment and the public. In this step, practitioners will set air pollution restrictions as needed, recommend technology that is meant to reduce air pollution emissions, teach the public industries about good environmental hygiene and environmental stewardship, teach industries about good

environmental hygiene and environmental stewardship, and make sure that the public is informed when air quality is low.

If possible, an EH practitioner will monitor by determining whether the controls that were implemented are working by using scientific approaches if there is money or time to reevaluate. A practitioner would reevaluate the conditions of the outdoor world to see if any progress were made after the controls were implemented.

The hierarchy of controls also plays a role in controlling air pollution. The best course of action starts with engineering controls. With engineering controls, technology such as catalytic converters are used to lower air pollutant emissions, specifically nitrous oxide emissions. Engineering controls also involves phasing out the use of emissive technologies or at least substituting highly emissive tech for less emissive tech. The second-best course of action involves administrative controls. Administrative control may be applied by planning residential areas to be placed far away from emissive sites. Administrative controls also involve informing companies on what they can do to be less emissive. Administrative controls may even involve teaching the public about air pollution, climate change, solutions, what individuals can do to prevent climate change, and environmental stewardship. The least effective method is the use of PPE. PPE such as masks and respirators are likely to be used in places with low air quality.

There are still more solutions to air pollution than the solutions previously mentioned. Some other approaches to fight air pollution involve forcing companies to design products that are reusable and durable, consuming less goods, making renewable energy more accessible and mainstream (preferably less combustive), abolishing, or reducing incinerators across the US as a means of waste processing, and creating more energy-effective technology.

The most preventive solutions listed are reducing consumption, creating more energy-effective technology, and product reusability/ durability. Reducing consumption means less energy used and less waste is made. If less goods are produced, less waste is made, so that there will be less waste to process, which processing waste usually leads to air pollution emissions. Also, if there are less goods consumed, there should be less goods needed to be produced, which would conserve resources used for making goods. Harvesting resources requires a lot of energy, which leads to the emission of air pollutants since harvesting requires the burning fossil fuels.

Making more energy-efficient tech means less energy is needed to power the tech. The production of energy is a pollutive activity, so it is important that energy is conserved. Product reusability and durability also helps with creating less goods, conserving resources, reducing energy needed to harvest materials, thus reducing emissions. As a real-world example, iPhones require metals to produce them, so machinery is needed to dig up the metals necessary. The machinery requires diesel most of the time, which also emits CO2. So, it would be ideal if iPhone generations were not quickly replaced by new ones and made to last long.

There is technology in the world that fight against air pollution. There are catalytic converters, rechargeable/ more durable batteries, RETIGO (EPA 2018a, pg. 6), real time geospatial data viewers. There is also non-combustive or less combustive renewable energy technology such as solar panels, wind turbines, geothermal power plants, and heat pumps.

To sum up the situation, air pollution emissions must be reduced for the sake of earth's climate, but most importantly, for the sake of perpetuating humanity and maintaining human

health. What should be done to address the situation now is preventing and controlling the emission of air pollutants such as carbon dioxide, nitrous oxides, sulfur dioxide, and ozone by setting stricter regulations, being stricter on highly emissive bodies, conserving energy, and consuming less.

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