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The Sides of Climate Change

Climate change has been in the limelight for many decades in the United States. It is a pervasive issue that is defined as changes in weather, temperatures, and ecosystems that are long-lasting. The climate crisis has been subject to acceptance, leading to more action being taken to mitigate this crisis, but also objection. Yet, science has proved time and time again that climate change is real and progressing in a poor direction. This change negatively affects the environment and communities, causing enormous damage. Climate change remains a significant issue and can be traced to the emission of greenhouse gases, fossil fuel burning, and extraction of fossil fuels, contributing to rising sea levels and the endangerment of ecosystems; solutions, such as carbon offsets, carbon capture, and renewable energy sources, lack effectiveness in solving the climate crisis.

First of all, greenhouse gases are classified as air pollutants, emitted substances in an airborne state that have harmful effects on the environment and people. These gases cloak the Earth, allowing heat given off by the sun to become more concentrated, and, in turn, lead to an increase in the Earth's temperatures. When the global temperature increases, it alters the climate, which can ultimately be classified as climate change. Greenhouse gases come in several forms, notably carbon dioxide, methane, nitrous oxide, and fluorinated gases. Fluorinated gases can be further divided into hydrofluorocarbons, nitrogen trifluoride, perfluorocarbons, and sulfur hexafluoride ("Overview of Greenhouse Gases"). Carbon dioxide, the main greenhouse gas, is released from several sources, some innate (due to the planet's natural carbon cycle and changes occurring in the solar cycle), but mostly from mankind's actions ("What Is Climate Change?"; "Overview of Greenhouse Gases"). This includes burning different kinds of fossil fuels to

generate energy to power numerous industries, primarily coal, natural gas, and oil. Additionally, carbon dioxide is emitted when any biological matter is burned, such as waste. A large portion of methane is generated from factory farming, constituting "37%" of all released methane ("11 Facts About Factory Farms and the Environment"). Also, methane is released from moving fossil fuels from one place to another, using land, and landfills containing decomposed biodegradable waste. Nitrous oxide is released because of fossil fuel burning and active factories. Lastly, fluorinated gases end up in the atmosphere due to active factories ("Overview of Greenhouse Gases"). Given these facts, these emitted greenhouse gases only serve to damage the Earth and its communities.

Unfortunately, the major contributor to climate change is the actions of mankind, such as relying on fossil fuels as a form of energy. Burning fossil fuels made up "74%" of emitted greenhouse gases in 2019 ("Energy and the Environment Explained"). Other contributors to climate change include the operation of gas-powered vehicles, the widespread presence of landfills, deforestation, etc. To go more in-depth, gas-powered vehicles release carbon dioxide (a greenhouse gas) when in use, landfills produce methane due to biodegradable waste decomposition, and deforestation removes trees, resulting in fewer structures that absorb carbon dioxide from the air ("Overview of Greenhouse Gases"). Subsequently, greenhouse gases are released into the atmosphere due to humans' usage of fossil fuels for energy, causing the world to face a rise in temperatures ("What is Climate Change?"). In brief, climate change is largely accelerated due to human activities, mainly from the combustion of fossil fuels as a source of energy.

Furthermore, the extraction process of fossil fuels is detrimental to the health of coal miners and communities. Fossil fuels are extracted from the Earth by either mining (to retrieve

fossil fuels in a solid state) or drilling (to retrieve fossil fuels in a liquid or gaseous state). Mine settings can contain many safety hazards which can harm or kill workers. Also, negligence of safety precautions within coal mines can lead to disasters. For example, the Upper Big Branch coal mine in the southeastern U.S. experienced an explosion eleven years ago, causing the death of 29 coal miners ("The Hidden Costs of Fossil Fuels"). Coal miners are frequently exposed to and inhale coal dust, which can lead to numerous health illnesses. For example, constant exposure to coal dust can lead to some coal miners having pneumoconiosis, making the lungs have a black appearance ("The Hidden Costs of Fossil Fuels"). Surface mining has the possibility of causing an increase in natural hazards, which can disrupt the safety of nearby communities. Accordingly, harmful elements released from surface mining for coal can interlace with communities' sources of water, leading to health problems. For instance, a community's water source can be contaminated with metal, like iron, creating a health hazard ("The Hidden Costs of Fossil Fuels"). Removal of fossil fuels in a liquid or gaseous state can bring contaminated water near these fossil fuels to rise to the surface, creating a health hazard for local communities ("The Hidden Costs of Fossil Fuels"). To summarize, extracting fossil fuels increases the risk of causing health problems for coal miners and nearby communities due to coal and chemical exposure.

Equally important, extracting fossil fuels from the ground endangers the environment. Coal mines can face instability and cave-in, disturbing nearby structures of nature ("The Hidden Costs of Fossil Fuels"). Incorrect handling of coal mines can make them conducive for combustion ("The Hidden Costs of Fossil Fuels"). Also, negligence toward coal mines can make them susceptible to containing water, which mixes with toxic elements, creating a risk of this coming into contact with wildlife ("The Hidden Costs of Fossil Fuels"). Environments are

ruined through surface mining as layers of land separating coal from humans need to be mined away ("The Hidden Costs of Fossil Fuels"). These destroyed environments can interfere with organisms' way of life. Even more, the matter from the destroyed landscapes is deposited into nearby bodies of water, shifting the flow and biology of its ecosystems ("The Hidden Costs of Fossil Fuels"). Soil remaining from surface mining often lacks nutrients and is unable to nourish native plants ("The Hidden Costs of Fossil Fuels"). Overall, extracting fossil fuels damages the environment as leftover matter intertwines with nature.

Consequently, having too many greenhouse gases pollute the atmosphere can lead to more amounts of confined radiation on the Earth, and therefore heat. When an overflow of greenhouse gases pollutes the atmosphere, it acts as a cover holding in the Earth's heat, eventually raising the planet's temperatures. This process is known as global warming. To explain, the Earth is largely exposed mainly to light that can be seen by humans, ultraviolet rays, and infrared rays, all of which are types of radiation. The majority of radiation (70%) the Earth receives goes into oceans, land, and the atmosphere, which is then converted into infrared "thermal radiation" to be sent back into space through the atmosphere (Means and Lallanilla). This process allows for a balance of temperatures on the Earth (since much of the heat from the sun leaves the atmosphere) that makes it a livable place for humans. Greenhouse gases are capable of absorbing radiation, so having a balanced amount will balance the Earth's temperatures (Means and Lallanilla). For example, global warming interrupts organisms' natural cycle, which can force them to adapt to new conditions; berry-eating birds can experience a prolonged waiting period for certain berries to be in season, changing their eating pattern. To illustrate, global warming causes glaciers to melt, leading to this melted water accumulating in oceans and, therefore, higher sea levels. Higher sea levels put communities near seasides at risk

since storms can push water closer to land. To put this into context, the Earth has been rising in temperature by "0.32℉" every 10 years for the last 41 years (Lindsey and Dahlman). All in all, the increased rate and confined greenhouse gases in the atmosphere have contributed to a considerable amount of damage to society and the environment.

In addition to climate change causing rising temperatures comes the issue of rising sea levels. Higher sea levels pose a problem because they can weaken and interfere with infrastructure; they can also contribute to increased and more severe flooding and wearing away of coastlines in locations near sea waters. For example, storms that become present on the ocean, like hurricanes, can cause more damage due to them having more contact with land (Lindsey). Water being pushed further into land can inflict more damage to buildings and houses, as well as pose a threat to people nearby. A deeper look into this phenomenon reveals that globally, glaciers and sheets of ice are slowly melting because of the Earth's rising temperatures. In turn, the water from these melted ice structures goes into the seas, elevating its levels. Moreover, increased sea levels are also attributed to oceans experiencing growing volumes due to rising temperatures heating the oceans. For example, based on the World Glacier Monitoring Service reference network, 33 inches of water has melted from glaciers between 2010 and 2018 (Lindsey). These 33 inches of melted water add to the height of seas, making land bordering oceans more endangered. Hence, climate change affects the Earth's seas significantly, leading to exacerbated natural disasters (Lindsey).

Climate change's harmful effects also reach nature, specifically ecosystems. The increased temperatures the Earth is enduring are causing a shift in organisms' habitats. This intrudes on their adaptations to their environments. For example, plants can be in season at different times than before, confusing animals' consumption patterns (which can affect their

function). Bees, for instance, can be forced to pollinate from flowers outside their usual network due to a change in their normal flowers' season pattern. Also, some environments perfectly support species as they are and changes occurring as a result of climate change can disrupt this equilibrium. By the same token, growing temperatures can lead to one species performing better than other species, which can cause a boom in their population and other species to fall short ("Wildlife and Climate Change"). Ultimately, this will break any balances in the ecosystem that previously existed. The increasing occurrences of floods can harm organisms' habitats as it threatens landscapes and all that it contains. For example, a flood can devastate a forest, leading to a scarcity of wood in an area that can affect an animal's way of life, such as beavers who use wood to create dams ("Wildlife and Climate Change"). Thus, climate change negatively impacts nature by shifting environmental patterns and threatening landscapes.

To combat the negative effects of greenhouse gases, a growing "supposed" solution to climate change has been rising in popularity: carbon offsets; however, this method can be prone to avoidance, lack effectiveness, and stability. Carbon offsets serve as a way people can cancel out any greenhouse gases they emit by purchasing actions to remove greenhouse gases in other places. For example, a factory that releases carbon dioxide into the atmosphere can purchase carbon offsets that plant trees, which in turn, absorb carbon dioxide, lessening the factory's contribution to the climate crisis. Another example can involve a company funding a solar farm to produce renewable energy for others to use, reducing the energy users' carbon footprint. However, carbon offsets are not a perfect solution to climate change and contain many flaws. Some programs that provide carbon offsets are unable to show the exact effectiveness of their carbon offsets. Additionally, trees withdrawing carbon dioxide can lack stability in this process, as it has the possibility of releasing the carbon dioxide it stores if it is killed. A multitude of

scenarios can occur that lead to this, such as if trees are afire, infected with a disease, chopped down, become victim to sinkholes, etc. Furthermore, in certain areas, limits are set in place that restricts the amount of greenhouse gases a company can release into the atmosphere. This can cause companies to circumvent these laws by moving their facilities elsewhere to avoid possibly needing to purchase carbon offsets (Irfan). This represents the term carbon leakage, involving companies contributing to climate change further by avoiding areas with strict greenhouse gas laws and settling into areas with more permissive greenhouse gas laws ("What is Carbon Leakage?"). To conclude, carbon offsets are not the perfect solution to climate change as they can be a cause for avoidance (of strict climate laws) and require more effectiveness and stability.

In addition to the many flaws carbon offsets contain, they are not subject to any federal compliance laws in the United States. The federal government has not established a compliance carbon offset market, therefore making companies less inclined to purchase carbon offsets (of their own accord) in order to cancel out greenhouse gas emissions. However, despite no governmental requirements surrounding offsets, companies can turn to the voluntary carbon offset market within the U.S. to negate some or most of their greenhouse gas emissions. The U.S. voluntary carbon offset market has risen significantly within the span of several years, with the "supply of offsets" standing at approximately "6.2 million tons in 2004" rising to around "10.2 million tons in 2007" ("GAO-08-1048 Highlights, Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants."). Moreover, there are more than "600 organizations" that create, "market, or sell offsets" in the U.S., with ranging factors including "participants, prices, transaction types, and projects" ("GAO-08-1048 Highlights, Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants."). So, even though a compliance offset

market does not exist, companies are still able to turn to the voluntary market to offset their carbon emissions.

In addition, carbon capture and storage (CCS) is another solution with ideal intent but not as much feasibility since it is energy and cost-intensive. CCS, as the name suggests, is a method that captures carbon dioxide from the air and stores it (Moseman). Chemicals are used to allow the targeted carbon to attach itself to it, preventing the carbon from being further emitted. For instance, the chemicals can take on as "potassium hydroxide," which is suitable for connecting carbon to it. Afterward, the chemical duo undergoes removal to remove the carbon dioxide and purification. The carbon dioxide can then go underground as it originated there in the first place. For example, carbon dioxide can be put into magnesium-rich rocks that can contain it well. Though, this procedure has downsides as it is energy and cost-intensive. The actual carbon capture and purification process uses a large amount of heat. Not only that, capturing a single ton of carbon dioxide can be priced at around "$600." It is also important to take into account the price of transporting the captured carbon dioxide into the ground, as this increases the overall costs of CCS (Nogrady). In sum, CCS is another imperfect solution to climate change because it requires large amounts of heat as well as money to capture the carbon dioxide and transport it underground.

A popular and more reliable solution to climate change is the utilization of renewable energy, as it holds a large amount of potential for reducing greenhouse gas emissions. To start, renewable energy is energy that originates from renewable or replenishable sources and is bounded by the quantity of energy available. More so, renewable energy appears in many different forms, including biomass, hydropower, geothermal, wind, and solar. According to the EIA, in 2020, renewable energy in the U.S. accounted for 12% of the total energy consumption

("Renewable Energy Explained."). In essence, renewable energy is effective in combating climate change because it can be used to substitute energy generated from fossil fuels, and in turn, lessen the amount of greenhouse gas emissions ("Renewable Energy Explained.").

Solar thermal energy is a form of renewable energy that has several advantages and disadvantages. Solar energy utilizes solar radiation from the sun and solar photovoltaic devices (also known as solar cells) in order to transform the radiation into electricity ("Solar Explained."). On a small scale, this generated electricity can be used to warm up water "for use in homes, buildings, or swimming pools" and the interior of "homes, greenhouses, and other buildings" ("Solar Explained."). On a larger scale, solar energy can be used to warm liquids "to high temperatures in solar thermal power plants" ("Solar Explained."). With this, solar energy has many upsides, such as not generating greenhouse gases throughout its collection and consumption and having a trivial environmental impact. On the contrary, solar energy does have downsides, such as inconsistency with the quantity of sunlight reaching the earth; the quantity of sunlight relying on "location, time of day, [the] season of the year, and weather conditions,"; and solar energy requiring a sizable surface area to gather an adequate quantity of energy ("Solar Explained."). To put it briefly, solar energy is a good solution to fighting climate change but contains downsides that make it a solution that cannot stand by itself.

Like solar energy, wind energy is a rapidly growing renewable energy source that presents many advantages and limitations. Wind energy involves the usage of wind turbines in order to produce electricity through the conversion of the "kinetic energy of wind into mechanical or electrical energy" (Selin). Wind energy is most gainful in areas with high "wind power [densities]," which makes it ideal for the placement of wind farms (Selin). In 2016, wind-produced electricity accounted for "4 percent" of total global electricity (Selin). Wind

energy has a multitude of advantages. First, wind energy is inexpensive, totaling "1-2 cents per kilowatt-hour" (post "production tax credit") ("Advantages and Challenges of Wind Energy."). Moreover, the wind power industry generates jobs (over 100,000) and has a high potential for increasing its job count six times its current amount by 2050. Most importantly, wind power does not emit greenhouse gases, a significant contributor to climate change. Along with these advantages, there are limitations that hinder wind power's absolute potential. Wind power has undergone many improvements, such as price reductions, but still faces competition from traditional sources of electricity generation (as they are cheaper). Additionally, areas in which wind farms are situated can experience a lack of wind, making it difficult for wind energy to rival other energy sources in terms of efficiency. In addition, wind farms are frequently placed in rural areas, making cities (that need the most electricity) harder to reach in order to transport electricity to them (requiring many transmission lines). Another disadvantage of wind power is its capability of harming animals. Wind turbines' blades can injure or kill birds and even bats, as they sometimes fly toward active wind turbines. Thus, wind energy is more reliable than other solutions to climate change but does contain flaws that stray it away from being close to a perfect solution ("Advantages and Challenges of Wind Energy.").

Human activities have enormously sped up the progression of climate change. More action needs to be taken as communities and the Earth are enduring the negative consequences of the climate crisis. Climate change persists as a major issue and results from the emission of greenhouse gases, fossil fuel burning, and extraction of fossil fuels, leading to rising sea levels and the endangerment of ecosystems; solutions, such as carbon offsets, carbon capture, and renewable energy sources, lack effectiveness in solving the climate crisis. Industries and sectors that largely contribute to climate change need to adopt cleaner and more sustainable sources of

energy in order to reduce their carbon footprint.

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