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Climate Change, Pollution, and Green Energy

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Climate Change, Pollution, and Green Energy

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BIS 437 – Integrated Studies Research

Abstract

Two of the largest issues humanity faces today are climate change and pollution. What needs to be sought out for is why climate change is happening at an accelerated rate and what can be done to either slow it down or completely stop it. Pollution is another problem that is causing detrimental damage to the planet. Future generations are at risk if people today do not change and look for cleaner solutions. The intent of this project is to give clear information on climate change, pollution, the scientific research it is currently undergoing, and green technology. Having a complete understanding of the issue is the first step to solving it. There is a multitude of green energy being utilized today to replace the old fuels that are known to enhance climate change. Greenpower is being proven in effectiveness to not only provide enough electricity but also reduction in damage to the planet. We are going to look at various information concerning what climate change and pollution is and take the first steps into a more greener change to possibly make a healthier Earth.

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Climate Change, Pollution, and Green Energy

What is Climate Change?

Humanity lives within the confines of a unique planet. Here they have prospered and built an entire civilization for centuries. However, these actions have not proceeded without consequences. As humanity continued to make technological advancements, these devices and machines needed a reliable source to perform efficiently. Two of the most widely forms of energy come from oil and natural gas. Oil is derived from animal remnants that have been heated and pressed for millions of years (Eia, 2020). Similarly, Natural gas goes through the same process but the end results in what is known as thermogenic methane. Both are then harvested from the ground and used to produce electricity and heat for commercial, industrial, transportation, and residential needs. Within the many years of oil and natural gas use, weather patterns have changed considerably.

Temperatures, extreme weather, and melting of ice are all directed into human activity with these conventional energies. When the weather changes in a region drastically and what is not discerned as normal is a direct sign of climate change. Climate change has been occurring throughout history and has been attributed to small orbital changes of the earth that affect how much solar energy hits the planet (NASA, 2021). This is a natural occurrence; however, humans have ramped up the process making the transition of weather and temperature more dramatic.

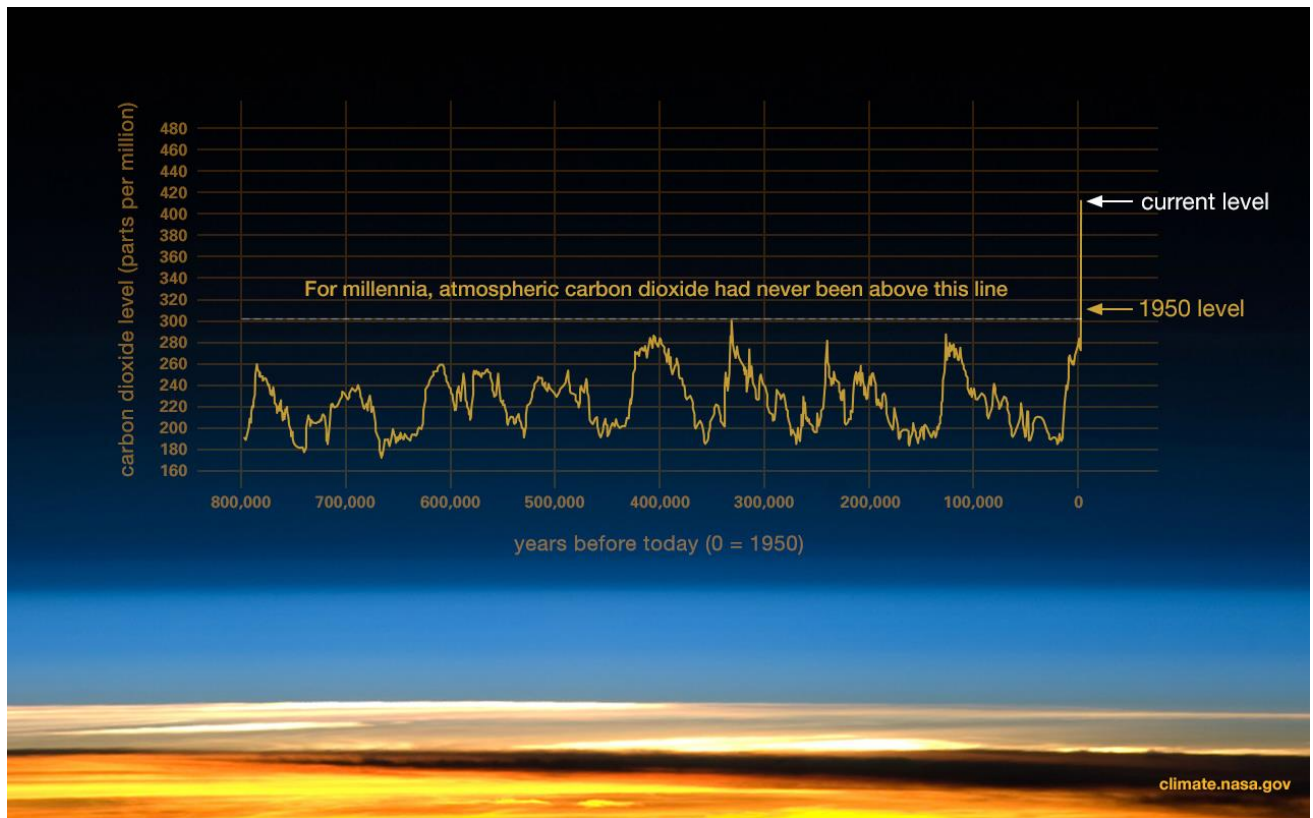
So, why is this happening? What effects does the use oil and natural gas have on our planet? And what can be done to mitigate climate change for future generation? So much research has been done regarding learning about climate change. Scientist have conducted work to discover what is happening to our planet. Climate change is happening, and human activity is

accelerating the process. There is evidence and research show global warming is real if people are willing to listen.

Scientific Research and proof on Climate Change

Just by saying climate change exists is not enough when it comes to getting across the severity of the issue. Physical evidence must be presented to prove any hypothesis. If no research is conducted, then there is no way to validate that climate change is occurring at a concerning rate. The international Panel on Climate Change or IPCC conducted a survey with thousands of scientists who specialize in climate science drew the conclusion that global warming is happening (IPCC, 2019). Sadly, the IPCC does remain uncertain on the events of climate change such as how fast and much will temperatures rise. Multiple scientists think that it will be a slow increase while others say it will be instantaneous. IPCC believes if nothing is done then the risk is raised higher. That is why it is important to move forward with science today to figure out a better outcome for Earth.

NASA is another leader in the research of climate change research. Their scientists can use satellites to gain information about the planet. The data they have collected over the years shows signs of climate change (NASA, 2021). Instruments from NASA have found that these gasses can affect the transfer of infrared energy within the atmosphere. Burning of coal and oil has increased the concentration of carbon dioxide in the atmosphere. Carbon dioxide and other gasses cause heat to be trapped within the atmosphere. These other gasses consist of Methane, Nitrous oxide, fluorinated gases. These gasses can stay in the atmosphere for a few years to a thousand years depending on which type (EPA, 2020). This is highly disturbing because these gasses cannot be removed from the atmosphere once released. Emissions from the past are still apparent and will be around for a long time.



This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO₂ has increased since the Industrial Revolution. (Credit: Luthi, D., et al. 2008; Etheridge, D.M., et al. 2010; Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO₂ record.) [Find out more about ice cores](#) (external site).

Not only is the atmosphere but also glaciers. NASA drew ice cores from various glaciers around earth. What they found is these glaciers are showing signs that current warming is occurring ten times faster than it did in ice-age-recovery warming (NASA, 2021). Since the late nineteenth, the Earth's surface has risen to 2.12 degrees Fahrenheit. The cause for this is due to the increase of carbon dioxide emission and other human activities. Within the past forty years, warming has occurred and within the past seven years being the warmest. Across the planet NASA has found that the temperatures in the ocean have increased. Around ninety percent of extra energy is stored in the ocean. Not only is the ocean heating up, but it is also expanding as ice sheets and glaciers melt. The ocean has rose to eight inches in the last century (NASA, 2021).

The ocean has also absorbed carbon dioxide around twenty to thirty percent causing ocean acidification due to human emissions.

The effects of climate change

The effects of climate change have reached noticeable levels. As mentioned before glaciers and ice sheets are melting, sea levels are rising, and the temperature is increasing. There is a plethora of issues caused by climate change that should be of more concern than it already is. Severe Weather has increased in intensity through floods and droughts. Agriculture is being threatened and researchers have found that crops are starting suffering. The frequency of intense heat, changes in the atmosphere, and carbon dioxide can play adverse impacts on crop yields (Shipman, M., 2020). Corn crops are becoming sensitive to drought through research conducted by Matt Shipman. He states that even though average corn yields are increasing during droughts the long-term effects are causing smaller yields of corn currently. Soybeans are also affected but not as severely. If our food system goes down without finding proper agricultural technologies to reduce the risk climate change on crops, people will starve, and death rates will rise.

Climate change also affects human health. The CDC has found that climate change influences human health and diseases. Pre-existing health issues will increase while new health issues develop. Respiratory diseases, cardiovascular diseases, injuries, and premature death are involved in extreme weather events. Wide-range health impacts such as air pollution are affecting lung function, worsen asthma, and causing premature death for humans. Allergens will be more prevalent due to warmer seasons. Pollen season will increase triggering allergic sensitization, asthma episodes, and reduce production of work and school time (Luber, C., 2019). Climate change has caused wildfires to become more frequent due to dryer conditions. The smoke from the fires contains carbon monoxide and nitrogen oxides. Exposure to smoke causes

lung illnesses such as bronchitis, chest pains, and chronic obstructive pulmonary disease. The longest threatening issue of climate change is temperature extremes. Cities, such as Philadelphia, Chicago, St. Louis, have been dealing with heat waves in recent years. Death rates increased as people suffered from heat stroke and other adverse health problems.

Humans are not the only ones affected by climate change. Animal species across the world are being negatively impacted by extreme changes of weather. The Earth's oceans have revealed serious damage to the marine ecosystems. With warming temperatures, coral bleaching, changes in fish migration patterns, and alteration in oceans currents are disrupting marine life (Massa, J., 2019). Sea turtles are being debilitated by weather systems in which colder temperatures, high tides, and strong winds have killed them as they try to migrate to lay their eggs. Polar bears have lost majority of arctic ice where they normally hunt for food. They are so desperate that they have been found on a small island north of Moscow, Russia. It only took two days of a heat wave to kill twenty-three thousand speckled flying foxes in Queensland Australia. Climate change and human driven habitat loss could cause around forty percent of the worlds insect species to go extinct. If this happens animals that rely on insects would lose their food source. Losing insects that pollinate would lead to crop and soil degradation. Humans would struggle to provide sufficient food for the growing population.

Food connected to climate change

When it comes to climate change, even the food we eat has an impact. It is important to ask certain question when planning meals, shopping, and ordering at a restaurant. An example of this question could be how far away did this food travel to get to the store? It is often overlooked on where food comes from and the resources used to grow it. Livestock production is another issue as it takes over large amounts of land and is responsible for eighteen percent of greenhouse

gasses being released. It is also inefficient to produce animals for food as it takes large amounts of grain to produce a one kilogram of beef. Energy is also wasted in water and energy through production, processing, and transportation. When meat consumption increases then does the impact of climate change. Many farms use chemical agriculture for their crops. Pesticides and fertilizers are commonly mad from fossil fuels and the manufacturing and transportation of these items waste more energy and creates greenhouses gases (David Suzuki Foundation, 2020). Chemical farming uses up more energy than organic farming. Nitrous oxide is produced when synthetic nitrogen fertilizers are used in the soil. It is three hundred times more potent than carbon dioxide when it comes to trapping heat within the atmosphere. Organic farms only use manure and compost for fertilizers, and they store more carbon in the soil which stays out of the atmosphere (David Suzuki Foundation, 2020). Food that is also grown closer to home helps reduce pollution as there is less shipment time where vehicles produce carbon dioxide. This also makes food fresher and less likely to spoil than average meals that usually travel around 1,200 kilometers for retail.

People can reduce waste and pollution from food by eating at least one meat free meal a day. This does require some planning ahead and choosing veggie or meatless menu items are a plus. Purchasing organic and local foods means that the food has not been altered genetically. Any animal products are not given antibiotics or growth hormones and are raised naturally. Organically grown foods carry more nutrients, vitamins, and minerals than genetically modified ones. Organic farms also promote biodiversity, less water pollution, less soil damage, fewer poisoning of farm workers, and less harm to wildlife (David Suzuki Foundation, 2020). Try not to waste food as almost half of all the worlds food is thrown out after production. Not only is it a waste of food but also a waste of resources such as the shipment made to deliver the food to the

grocery store. Growing one's own vegetables is another alternative as it can reduce trips to the store. Large backyards to tiny balconies can produce.

Deforestation

Forests are capable of fighting climate change naturally. Since plant life need carbon dioxide to perform photosynthesis and other chemical processes, it releases clean oxygen back into the area. They also provide homes for animals, food, medicine, livelihood for people. Even though forest is essential to the ecological state of the planet, they are threatened. Large portions of forest are still being cut down even though they provide a free service to earth. Forty-six to fifty-eight square miles of forest are cut within a minute (Lauren, 2017). The cause in deforestation has many factors. Agriculture is the largest reason for deforestation. Technique such as slash-and-burn can cause a loss of fifty acres every hour globally.

The problem is when the fire spread out of control. This can destroy the forest canopy allowing for sunlight to intensify the fire. Smoke from the fire will suppress water making it almost impossible to extinguish. The amazon rainforest is continuously burned down as since the soil is infertile. Burned wood turns into biomass the replenishes the nutrients on the soil. Sadly, it only lasts around two years. Farmers will then leave their lands to burn more forest. These fires also have a destructive effect on biodiversity. Animals that have not escaped are killed in the fires. Endangered or extinct animals' numbers have grown due to this practice.

Cattle ranching is another damaging force to forest. Land is cleared to make room for the cattle. Large scale corporations such as Burger King, Wal-Mart, McDonalds, and Pizza Hut have contributed heavily to this. These companies promise to be environmentally sound but make no action to stop practicing this agriculture. Logging is one of the first issues people bring up when they think about deforestation. Clear cutting is the most harmful form of logging as It leaves

nothing alive afterwards. Areas have been used for remediation but that does not solve the problem. Only one species of tree is replanted, called mono-cropping, and leaves out any biodiversity. An example would be if there were hundreds of oak trees planted. Animals that rely on the oak tree for food or shelter would be fine but other species of animals need other types of trees to flourish. This clearly shows that mono-cropping does not fix clear cut lands. Urban sprawl housing is a deforestation issue as it means overpopulation of people take up more space in the area. Trying to solve overpopulation is difficult due to it being a short-term solution. Numerous designs have arisen to create housing that takes up small amount of land with large amount of people. Compact cities, tiny cities, or sustainable cities utilize smaller areas of land while accommodating numerous amounts of people. Everything would be walking distance as buildings are built tall to create section for living, groceries, hospitals, and more. Biomass is a renewable energy source, however, in large operations, around ninety percent of fires are caused by humans. These fires also produce carbon dioxide that is a well-known greenhouse gas to cause changes in the atmosphere. This kind of burning of biomass carries long and short-term consequences. Carbon dioxide is stored within a plant through photosynthesis. Once burned, the gas escapes causing years' worth of carbon dioxide to be released into the atmosphere. This is another example of contributions towards climate change. The continuation of deforestation in the future will cause around fifty-five percent of the amazon rainforest to be lost in 2030 (Bennett, 2017). So much damage already done is visible in space. Not only is there a loss of trees but a significant loss of everything that relies on these trees to survive.

Climate change in the United States

In recent years, climate change has caused several problems in the U.S. and weather patterns have become more extreme and temperatures are still rising. A prime example is the

snowstorm caused by the polar vortex during February of 2021. The arctic polar vortex is a band of extremely cold and strong westerly winds that form in the stratosphere between ten to thirty miles above the north pole every winter (Lindsey, 2021). In late February, the southern plains, and Gulf of Mexico were hit with strong winter weather with the potential of it being linked to global warming. What caused this polar vortex to stretch out into the south was due to atmospheric disruptions where the stratosphere became warm. This disruption allowed for polar jet stream to become wavier for weeks alongside other weather conditions causing the cold air outbreak in the United States. The link between the polar vortex and global change can be found when the waves are changed by surface temperature and pressure from loss of sea ice which could influence the vortex. Between the 1980's and 2000's sea ice in the Arctic Barents and Kara Sea was below average for February. During the polar vortex Siberia and Central Eurasia was hit by a colder unaverage winter.

The winter season for Canada, Greenland, and arctic areas were warmer than average from the disrupted polar vortex. States such as Texas were devastated by the frigid temperatures and snow. This led to a high demand of electrical energy to keep homes and businesses warm. This preceded to a surge of about seventy-one gigawatts, but power plants were only able to keep up around fifty-one gigawatts causing millions to lose power. Even in places where temperatures are not normally extreme, having the right equipment to endure would have had less dire consequences.

Not long after the snowstorms, Kentucky faced flooding as heavy rainfall fell in early March. Roads covered in high water, mudslides, and flash floods caused Kentucky to declare a state of emergency. Business and homes in low lying areas were completely submerged. This quick transition from ice and snow to torrential rains is a clear indicator of climate change at its

worst. Scientists predict these trends to intensify as these weather patterns are becoming more apparent. However, cold records are becoming rare as the earth's temperature increase. They are intense now but will diminish over time.

With colder weather become less, wildfires have started running rampant across the United States. Almost a million acres of land is burned up every year. Trends have shown that wildfire are worsening each year. Every year, for the United States, around one hundred wildfires break out. With the year after that, the number doubles. Fire seasons now burn hotter, longer, and intensely. More acres are lost as these wildfires continue to grow out of control. Not only are wildfires dangerous but also destructive. Ninety deaths were recorded during the Camp Fire of 2018 and 18,000 structures were destroyed (Union of Concerned Scientists, 2020). Rebuilding from a wildfire disaster is also expensive. Around 2.4 billion dollars are used to fight wildfires every year. Carbon dioxide is also released into the atmosphere due to tree and plant matter being burnt up. This is just another aspect in worsening climate change due to the trapping capabilities of CO₂.

The correlation between global warming and wildfires is indisputable. When temperatures are warming snow melts faster, rain patterns change, soil and forest dry up and become kindling. It only takes on spark to set the whole area ablaze. Manage areas that are known to catch fire easily is important. In the west, low-intensity fires are used to remove underbrush, debris, and fallen timber for years (UOCS, 2020). This helps trees grow larger and reduces the number of wildfires from occurring. The problem is when these fires are suppressed, and plant life becomes dense. This also for more fuel tot the fire and creates dangerously large wildfires. Development in areas that are prone to wildfires is another concern as it increases fire risks and makes fighting the fire costly. Some government agencies have been trying to small

scale burnings but struggle due to the sheer mass of certain areas. The southeast has frequented prescribed burns. These have risk as air quality is affected and the fires can grow out of control if managed improperly. The benefits of these small burnings, however, can help the forest ecology and diminish the risk of wildfire. The best tool of action in fighting wildfires is slowing the growth of emissions that cause climate change. If nothing is done, the planet will continue to get hotter, and the threat of wildfires will increase drastically.

Hurricanes, tropical storms, and rotating storms are all considered to be categorized into cyclones. These storms are most common around June through November. There are two types of cyclones: tropical and extratropical (EPA, 2021). Extratropical cyclones develop outside tropical areas. To gain energy, tropical cyclones rely on warm tropical oceans. Extratropical cyclones rely on jet streams with cold dry air in high altitudes and warm moist air masses from lower altitudes. These cyclones are a danger to ships out at sea. The damage these storms cause on land can erode soil, damage property, floods, and potentially kill. Tropical cyclones have been found to be intensifying over the course of the 21st century. Many states along the Gulf of Mexico are at risk of these cyclones and many have suffered more frequencies with these storms. Six to seven hurricanes have formed yearly in the north Atlantic since 1878 and around two have made landfall with the United States every year (EPA, 2021).

Droughts are another common occurrence in the United States. Droughts are defined as prolonged periods without precipitation. This creates shortages of water in the area. Droughts are also explained as imbalances of precipitation and evaporation. Climate change has sped up the water cycle making the rate of evaporation faster. Though there is more moisture in the air, some areas suffer drying and less moisture in the soil. Some regions in the world have experienced less precipitation and increased risk of drought, especially Southern Europe, and East Africa (EPA,

2021). This also leads to flooding as the soil is too dry to absorb the moisture back. Agriculture, water supply, energy production is heavily impacted by drought conditions. Drought threatens indigenous people, medicinal and cultural plants, animals and increases the risk for wildfires. Between 2000 and 2015, 20 to 70 percent of the United States land has experienced abnormally dry conditions. During 2012, U.S. land was covered in a moderate to severe drought and for several states, 2012 was recorded as the driest year on record (EPA, 2021).

The Future and Possible Tipping Points for Climate Change

Climate scientists are expecting certain changes with the decade to hundreds of years. There are possible rapid changes and slower changes to be expected. For rapid changes glacial ice would retreat or vanish, year-round sea ice will disappear, and the polar tundra would become conifer forests. Slower changes would occur over thousands of years where melt patterns would change in Greenland ice sheets. Ice streams will increase in flow as they melt. The ocean will experience thermal expansions. Ice sheets in West Antarctica will be gone completely. The oceans will acidify and contain less oxygen levels. Tipping points are instances of abrupt changes that cannot be stopped at that moment. They are considered situations that are impossible to predict. Some tipping points that can occur with the planet are Greenland and Antarctica's sudden melting of their ice sheets. Currently these ice sheets are melting but a sudden loss of the sheets could cause sea levels to rise drastically while ocean circulation is affected. When these ocean circulations are changed, there can be a change in heat transfer and that can cause the climate system to be altered. Methane gases are known to be trapped within Arctic permafrost. A sudden release of these gases would increase the rate of warming. A feedback loop would be created as the released methane would further drive methane emission. It has been suspected that methane jumps have caused major extinctions in the past. The ocean is known for absorbing CO₂

but at some point, will not be able to store anymore. Any excess of CO₂ will be left in the atmosphere increasing greenhouse gasses. At this point the ocean have become acidified and marine life is killed off. Though none of these tipping points are likely to occur, they still run the risk of transpiring is still possible. When they do happen, there will be no way of retreat as the consequences are instantaneously. It is important to keep them in mind especially with the risks involving climate change (National Center for Atmospheric Research, 2021).

Green Energy

Green energy or clean energy is renewable energy that provides beneficial aspect to the environment. Green energy is defined as the production of electricity through solar, wind, hydro, tidal, geothermal, and biomass energy. This type of energy is sought out for by producing zero emissions and reducing carbon footprints. Renewable energy are sources that need fuel for only a small amount of time and do not diminish (EPA, 2019). Certain renewable energy can impact the environment such as hydroelectric dams causing issues for fisheries and land use. Conventional energy, which is coal, natural gas, and oil, is one of the main sources of air pollution and greenhouse gas emissions. Using green energy helps develop renewable energy directly or indirectly. It helps reduce carbon footprints from purchased electricity. It also reduces the cost of electricity prices for the future.

Solar Energy

Solar energy is energy derived from the sun. It is created by nuclear fission within the sun. Solar energy can easily be harvested directly for use in homes, businesses, schools, and hospitals. Solar energy technology includes photovoltaic cells and panels, concentrated solar energy, and solar architecture (National Geographic Society, 2012). There are various ways on capturing solar radiation and two methods use are active solar anergy and passive solar energy.

Active solar technology actively converts solar energy into other forms of energy such as heat or electricity. Passive solar energy does not have any external devices but takes advantage of the climate to heat structures in winter and reflect heat in the summer.

Concentrated solar energy is a type of active solar technology that uses lenses or mirrors to concentrate sunlight from a large to small area. This radiation then heats up fluid to generate electricity or fuels. Another example of concentrated solar power is solar furnaces, and they use the same method to absorb and convert energy. Solar power towers are mirrors arranged around a collector tower and reflect sunlight into the focal point of the tower. They also turn to the direction the sun is located.

There are pros and cons when it comes to solar energy. The advantages are that solar energy is a renewable resource and has a steady, limitless supply of sunlight for the next five billion years (National Geographic Society, 2012). Within one hour, the Earth receives so much sunlight that it can power the electrical need of every human for a year. This energy is clean and there is no fuel necessary for it to work once installed. It does not release greenhouse gases or toxic chemicals and reduces the impact humans have on the environment. Areas with little to no cloud cover can benefit greatly since they can harness the sun's energy. Solar cookers are an alternative to wood-fire stoves in cooking while providing a cleaner and safer way to sanitize food and water (National Geographic Society, 2012). Solar energy can be used with other renewable energy such as solar and hydroelectric. Installation of successful solar panels can produce excess electricity. This in turn allows the user to sell energy back to the electric provider making their bill cheaper or eliminating it.

The disadvantages of solar energy are the cost. Solar equipment through purchasing and installing can cost the consumer tens of thousands of dollars. Even with the benefit of not having

to pay electric bills, the cost gives people cold feet. Solar energy is heavy and building roofs must be strong, large, and facing the sun (National Geographic Society, 2012). Solar technology is factor dependent and is uncontrollable when it comes to climate and cloud cover. Studies must be made to identify is and area would be effective for solar power. For solar energy to be an efficient choice, sunlight must be plentiful and reliable which means the variability of sunlight makes it problematic to use as an only source of energy.

However, there are advancements that have created the Si-panel. This panel cost has declined to around thirty percent less than traditionally installed solar panels (Lewis, N., 2016). Research is also being done to find ways to make the Si-panel lightweight, flexible, and efficient. By do this, the cost of the panel would drop even more. Engineers are also looking into new types of batteries to store unused solar energy. This will be incredibly useful for cloudy days.

Solar energy carries only a small percentage towards the total supply of global energy. Technologists, regulators, politicians, and environmentalist groups remain optimistic in the solar energy system. This technology has some issues to still work out such as size, cost, and outside forces but the enthusiasm to create better panels may make solar energy more reliable in the future.

Wind Energy

Wind is a powerful force and full of kinetic energy. Wind power is made using a wind turbine which channels the wind to create electricity. Once the blades are hit by wind, they begin to spin. Attached to the blades is a rotor that rotates with the blades to produce electricity. There are two types of wind turbines: horizontal-axis wind turbine and vertical-axis wind turbine (National Geographic society, 2019). Horizontal- axis wind turbines are more commonly used than the vertical-axis wind turbines. They have two or three blades that resemble a propeller.

The turbine is placed in the direction of where the wind is blowing. Vertical-axis wind turbines are shorter and have wider curved blades that resemble electric mixer beaters. Small wind turbines produce one hundred kilowatts of energy which is enough to power a home. Slightly larger wind turbines can generate one point eight megawatts of power. The largest turbine can generate four point eight to nine point five megawatts of power. This generated electricity is then used to power electrical grids or to be stored for the future. There are improvements being made by the United States Department of Energy and National laboratories to create batteries that can store excess wind energy.

Wind power is cost effective and is the lowest priced energy source today. The cost is only around one to two cent per kilowatt-hours (EERE, 2019). Wind energy also creates jobs and has the potential to support six hundred thousand jobs in the manufacturing, installation, maintenance, and support around (EERE,2019). U.S. industries are growing allowing for competitiveness in the clean energy economy due to wind. Unlike power plants that combust coal or natural gas, wind energy does not produce pollution. It also does not affect the atmosphere in the sense of causing acid rain or smog. Wind power is inexhaustible meaning it will never deplete and has grown around in capacity at fifteen percent. That makes it the largest source of renewable energy in the U.S. Wind energy is linked to solar energy as it relies on heat from the sun to create turbulence. Wind turbines benefit farmlands and ranches as wind power plant owners will pay rent to farmers for use of the land which in turn allows the farmer to make more income.

Wind power still faces challenges, however. It still is in competition with conventional sources in affordability. Areas where wind is plentiful can be remote locations. This possesses the challenges of creating transmission lines that reach from the wind farm all the way to the city.

Competition for land development puts wind farms at risk as alternative uses may be more valued than production of electricity. Birds and bats have been victims of the wind turbine blades as they accidentally hit them or get hit. Resolutions to fix this issue have resulted in setting the blades in a position that will not hurt the local wildlife. Wind projects may alter the area they are developed in and can alter the sustainability of habitats for species (EERE, 2019). Wind turbines that are used in coastal areas are negatively impacted by the salt. This causes them to need constant maintenance due to the salt eroding the machinery.

Hydro Energy

One of the oldest sources of energy still used today, hydropower was one of the first used for electrical generation. In 2019, hydroelectricity accounted for six percent of total U.S. utility-scale electricity generations and thirty-eight percent of total utility-scale renewable electricity generation (EIA, 2020). There has been a decrease in the use of hydroelectricity in part by the increase of other electrical generating sources. To understand how hydroelectricity works, the water cycle must be considered first. There are three steps that include solar energy heating up the surface of the water causing evaporation in large bodies of water. Second these water vapors must condense into cloud to produce precipitation. Thirdly, this rainfall enters rivers and streams that turn to oceans and lakes thus the cycle repeats again the amount of water available to producing hydropower is all determined by the amount of precipitation. Variables in precipitation such as drought can negatively affects the availability of hydropower production.

Hydroelectric plants are normally found on or near a water source and with greater water flow, this allows for more electricity for the hydropower plant to produce (EIA, 2020). Electricity is produced when water flows through a pipe and pushes the blades of a turbine to spin. Two types of hydroelectricity facilities are Run-of-the-river system and storage system.

Run-of-the-river systems use the force of river currents to spin a turbine. Storage systems accumulate water into reservoirs created by dams which is released through hydro turbines.

Hydropower is the largest renewable resource in the U.S. and because it can be used indefinitely without it reducing in quantity marks it as a renewable source. there is no fuel required at any part of its process. It does not emit pollutants and is one of the cleanest for renewable energy. The flexibility of hydroelectric energy allows for plants to scale up or down to meet changing energy demands (GreenandGrowing, 2017). Ninety percent of energy captured from hydropower is converted to electrical power making it highly efficient. Due to its low cost, maintenance, and operation, hydropower is the cheapest form of renewable resources. Water collected in the plant reservoirs can be used to irrigate and consume. Unlike nuclear energy, dams have a low failure rate.

Disadvantages to hydropower are the initial cost of constructing the machinery and the dam. It takes time to build dams as the engineers must make sure there are no leaks or unstable structures. On rare situations, if the dam's structure is compromised, water will rush downriver flooding all that is in the area below whether it is towns or ecosystems. The structure of the dam can negatively affect the ecosystem as the area retaining water floods areas upstream. Areas below the dam can be altered as water flow is reduced, leaving marshes and grassland with less water to use. Animals are forced to relocate to other areas where dams have been built as their native ecosystem can no longer sustain them. Fish have the most trouble with dams as certain species swim upstream for breeding purposes. They will push themselves to exhaustion which often leads to their death even when they come across a dam. Luckily, fish ladders have been made to allow them upriver. The greatest issue a dam can face is drought. If there is little to no water flow, hydroelectricity production will cease and people relying on it will lose power.

Tidal Energy

Tidal energy and hydrotherapy are one in the same when it comes to generating electricity from water. However, instead of rivers and streams, tidal energy utilizes the ocean tides. The sun and the moons gravitational pull along with the earth's rotation produces ocean tides. To produce tidal energy, there needs to be at least ten feet of tidal range. The United States does not currently have any tidal energy power plants but does have potential areas where tidal range is high enough. The two areas probable for use are the cook inlet of Alaska and several places in Maine (EIA, 2020).

Tidal energy systems use a structure called a barrage rather than a dam. The barrage is installed across an inlet of ocean bays or lagoons to form a tidal basin (EIA, 2020). There are specialized gates that control the water level and flow which fill tidal basins in the high tides. The water is then emptied through electrical turbines systems. Electricity is produced by both incoming and outgoing tides. Wind is not the only renewable energy that manages turbines. Tidal turbines are placed on the ocean floor where currents are strong. The only difference is tidal turbines need to be heavier and stronger than its windy counter parts. It is also more expensive than wind turbines but can capture more energy with the same sized blades (EIA, 2020).

The natural occurrence of ocean tides and waves makes tidal energy a renewable source of energy and it is eco-friendly due to it not releasing pollutants. Since tidal cycles are easy to predict, it allows for planning on the amount of power required to power an area (Green Coast, 2019). Tidal power is one of the most reliable sources due to tides being present all year around without the concerns of dwindling. Being that water is denser than air, it is easier to generate electricity no matter the speed of water making tidal energy effective compared to other sources. Electricity produced is generally affordable because tidal energy is a constant force. Around the

shores, forty kilowatts can be produced while going deeper into the oceans allows for one hundred kilowatts (Green Coast, 2019). The abundance and availability of tidal power makes it desirable for cities and harbors close to the ocean.

Tidal energy suffers from cost as setting up and operating a plant can be expensive. It is still in early stages of development but is expected to drop over time. Conflicts with tourism and acceptance of local communities has caused restrictions of size and location for construction of plants on the coastline. Being that the machinery is underwater, it makes maintenance a challenge if there is a malfunction. Marine ecosystems are impacted by the large machinery used in tidal power as it disrupts the seafloor and can cause animals to leave for another habitat. Plants are limited in locations since they must be where the ocean is accessible. The inclusion of tidal range is a must as it needs to be ten feet. If that requirement is not met then a plant cannot be constructed in the area.

Geothermal Energy

Heat that is generated by the earth is known as geothermal energy. The word geothermal is derived from the Greek language for earth heat. The earth's core is heated by radioactive isotopes potassium-40 and thorium-232. The core is in a continuous state of decay and temperatures reach about nine thousand degrees Fahrenheit. This heat radiates out and warms surrounding rocks, water, gas, and other geological material (National Geographic Society, 2012). Magma, located in the mantle and lower crust, also heats rocks and underground aquifers. These are prime examples of geothermal energy. Once this heat or steam is captured, it can be used to produce electricity. Buildings, sidewalks, and parking lots can be heated by this source. Pockets of high heat, made by magma that remains in the mantle, can be drilled, and injected with water to create steam. For many parts of the world, there are various ways to access

geothermal energy. Iceland, known for its abundant hot underground water, makes it possible to rely on geothermal energy (National Geographic Society, 2012). This makes it a safe and inexpensive energy source.

There are a couple of ways geothermal energy is harvested. The first is called low-temperature geothermal energy which is obtained from three hundred- and two-degrees heat pockets. These pockets are found closest to the earth's surface. Greenhouses, homes, fisheries, and industrial process benefits from low-temperature energy as it is used for heating purposes. Geothermal energy has been utilized for centuries in engineering, cooking, and healing (National Geographic society, 2012). Stated within its name, co-produced geothermal energy relies on other energy sources. Heated water is a byproduct of oil and gas wells. The water is then used by geothermal energy. Heated water was rejected in early years until becoming recognized to potentially carry more energy than first believed. Advancements in technology have allowed geothermal facilities to be portable. This is beneficial to isolated and poverty-stricken communities.

Geothermal heat pumps utilize earth's heat while being operational anywhere in the world. These pumps are drilled into the earth around ten to thirty feet deep but does not require fracturing bedrock in the process. A pipe, called the slinky loop, is a continuous loop that circles above and below ground (National Geographic Society, 2012). It is connected to the geothermal heat pump and allows for heating of buildings, parking lots, and landscapes. Depending on the season, water and antifreeze liquids work to either keep a building cool or warm. During the winter heat is absorbed into the liquids and brought upwards into the building to be vented out for warmth. During the summertime, the liquid draws the heat from the building and brings it back into the ground for cooling. Geothermal heating has been declared the most energy efficient

and environmentally safe heating and cooling system by the U.S. Environmental Protection Agency (National Geographic Society, 2012). GHP are so effective that at the University of Indiana they were able to replace a coal-fire boiler system while being able to save two million a year for heating.

One of the oldest forms of geothermal energy is called dry steam. This is where plants will locate natural sources of steam underground and place a pipe into it. The steam is then brought back to the plant where it is used to produce electricity. Two known sources of underground steam within the United States are Yellowstone National Park and the California geysers. Due to protection law, Yellowstone is off limits to plants however in California, dry steam provides a fifth of all renewable energy in the state. The most common Geothermal power plants are called flash steam power plants. When hot water is pumped into a low-pressure area some of that water will flash or evaporate into steam rapidly hence the name. The steam is then pushed out to power a turbine. Remaining water is evaporated again to extract more energy.

Geothermal energy is renewable and cannot be used up since the earth is at a constant state of radioactive decay that will continue for billions of more years. This energy can be harvested just about anywhere in the world and is clean since it only releases water vapors. Geothermal power plants last decades if managed properly if there is balance on the renewing heat of rocks. Since geothermal systems can work in all seasons, they are called baseloads and do not depend on the sun or wind. They work to produce electricity and heat twenty-four hours, seven days a week without having to stop for any changing factors. The compact nature of geothermal facilities allows them to take up less space than other power plants.

Challenges still pose issues for geothermal energy. Since the ground is being injected with high pressured steam, it has been the cause of small earthquakes. Subsidence, which is the

slow sinking of the land, is caused by geothermal plants. Underground fractures collapse upon themselves and can damage buildings, roadways, pipelines, and drainage systems (National Geographic Society, 2012). When geothermal systems are not insulated correctly, it can lead to toxic chemical leaching into water that flows in the underground reservoirs. Like other renewable energy technology, geothermal equipment is expensive due to the initial setup. This makes it hard for developing countries to access.

Biomass Fuels

Biomass is organic material derived from plants and animals used to cook and heat buildings. This material was a main source of energy for U.S. energy consumption until the mid-1800s (EIA, 2020). Used in cooking and heating, biomass is highly important to developing countries and gives them a way to avoid carbon dioxide emissions when using transportation or electrical generation. The energy from the sun is stored into renewable chemical energy within biomass. This material can then be burned directly to produce heat and converted to liquids or gaseous fuels.

Biomass contains a plethora of sources for energy from wood and wood processing waste, agricultural crops and waste material, and biogenic materials. Energy created from biomass starts by burning to produce heat. Solid, gaseous, and liquid fuels are produced through thermochemical conversion. This includes pyrolysis and gasification. Pyrolysis heats organic material until there is almost no oxygen to produce charcoal, bio-oil, renewable diesel, and more. Gasification heats organic matter that is then injected with controlled amounts of oxygen or steam to produce a rich gas called syngas or synthesis gas. Research is still being conducted to improve these methods. In the U.S., large biomass consumption is in industrial and transportation sectors.

Nuclear Energy

Energy derived from the core of an atom is called nuclear energy. Nuclear fission is a process where two atoms are split to release the electrical energy inside. Machines called a nuclear reactor control nuclear fission. Uranium pellets are used to fuel nuclear reactors. When uranium atoms are forced apart, it creates particles called fission products. This causes a chain reaction as other uranium atoms break apart. Heat is then created from the chain reaction. This heat then warms up the reactors cooling agent which can be water, liquid metal, or molten salt (National Geographic Society, 2012). Steam is then produced from the cooling agent which turns turbines that create electricity. Specialized rods called nuclear poison are used to adjust of electricity made. These rods allow for slower and controlled reactions when there are multiple present. Stronger chain reactions occur and produce more electricity once these rods are removed. Around fifteen percent of the global electricity is created from nuclear power plants. The United States has one hundred reactors currently but generates more energy from fossil fuels and hydroelectricity. Slovakia, France, and Lithuania use majority of nuclear energy as a source of electricity.

Due to the nature of uranium, nation that are with the Nuclear Non-proliferation Treaty can import it (National Geographic Society, 2012). This Treaty exists due to uranium being used not only for reactors but nuclear weapons. It reduces the spread of weapons along with the consumption of peaceful nuclear fuel. Around two hundred tons of uranium is used every year and some processes allow for the recycle of uranium allowing reduction in mining. The uranium used to make nuclear energy, U-235, is rare meaning any recycled uranium can help reduce costs in mining and electrical pricing.

In Arco, Idaho, the first nuclear reactor was built in 1951. 1954, in Obninsk, Russia, the first community used nuclear power plant was created. It was a turning point for electrical production as this energy is now viable to power commercial and residential buildings. The Nuclear Non-Proliferation Treaty is involved in any nuclear reactor construction due to needing precise building and advanced technology. Developed worlds are more ideal for nuclear power plants in this situation.

Being a clean energy, Nuclear power does not emit greenhouse gasses. They do not cause radioactive alterations to the environment and can be built almost anywhere. Steam used to power the generators is infinitely reprocessed. Once steam is cooled down it returns to water and hence is used again. Any excess steam is returned to the atmosphere. This water vapor is clean and causes no issues like carbon dioxide would. There are still byproducts of nuclear energy. It comes in the form of radioactive material. Unstable atomic nuclei wreak havoc on organism and the environment. It causes burns, cancer, blood disease, bone deterioration, and radiation sickness. Radioactive waste is volatile, and any clothes or tools used by workers in a plant can remain radioactive for decades. Regulations made by the government make sure these items are not disposed improperly which can risk contamination of the surrounding area. The rods and fuels used are also radioactive.

Containers that resemble swimming pools are used to store the uranium pellets. It is to cool the fuel and prevent outside contact with the radiation. The controversy around radiative storage sites is rampant. Governments try to make plans of developing sites where these storage facilities are to be placed. One plan was to place a facility near Yucca Mountain in Nevada. However, environmental groups and locals protest as they are concerned with the radioactive

waste leaking into the water and the environment (National Geographic Society, 2012). Luckily, plans were stopped in 2009 for the nuclear waste facility.

One of the main risks of nuclear plants is when a meltdown occurs. One of the most famous examples of this is Chernobyl, Ukraine, 1986. Fire from a steam explosion produced a large cloud called a plume. This plume was radioactive and rained radioactive particles over the facility and surrounding area. This is known as fallout. When the fallout drifted into the wind, it contaminated the water cycle. The rain had also become radioactive at this point. Scotland, Ireland, and Belarus all had radioactive rain fall on them from Chernobyl. The environmental damage was catastrophic. Nearby pine forest dried up, perished, and turned red giving the Red Forest its name. Pripyat River fish were so radioactive that people could not eat them. Domesticated and livestock died from the poisoning. After the disaster, ten hundred thousand people were repositioned. The death toll for humans was inconclusive as radiation poisoning appears many years later. The future of nuclear energy is uncertain due to its high risk when failure does occur. Engineers are currently looking for ways to create nuclear power plants that can produce energy from nuclear fusion. Instead of splitting atoms apart, atoms are fused together. An example of this can be the sun as it is constantly undergoing nuclear fusion to produce light energy. Power plants are not able to conduct nuclear fusion, but research is being made to make the process possible, safe, and cost effective.

Nuclear energy is not entirely pollution free, however, is one of the safest and environmentally friendly energy sources compared to conventional energy. It is also found to cause less pollution than solar and wind energy through emissions. Even with the startup cost of constructing a plant, once operational the cost is low which allows for electrical energy affordable. On average, a nuclear power plant can last forty to sixty years with proper

maintenance. Weather has no affect in the reliability of nuclear energy due to it not needing specialized sources to create energy. The uranium supply itself can last up to seventy or eighty years (Madsen, 2020). Nuclear energy is so powerful that in 2017 in the U.S., 805 billion Kilowatts was produced enough to power seventy-three million homes.

Nuclear energy is not without its obstacles. Similarly, to other clean energies, the building of a plant is where the cost is high. All pieces and equipment that go into the plant are not cheap which leads to long consideration to start construction. Safety measures, waste disposal, and security are included in the cost. The possible event of a nuclear meltdown is still a concern even if they are rare. The government makes sure to enforce guidelines and rules to keep safe practices. Stated before nuclear waste is toxic. Organic matter that comes into contact can cause serious health issues or even death. Removal of the waste is a burden, and the government must dispatch specialized teams just to remove it safely.

Uranium itself is not renewable which means nuclear energy is not considered to be a renewable energy source. The energy derived from it can last for decades but mining for it means the amount will slowly decline. Developing more power plants on increase the need for uranium which can lead to running out of it. Mining uranium alone is expensive, contaminating, and causes health problems. Due to possible threats from territ groups, security is tight for fear that the nuclear energy can be used as a weapon (Madsen, 2020).

Algae energy

Algae is one of the fastest growing plants and outmatches most other crops. They are a simple microscopic aquatic organism. Algae has increased in popularity due to it being a renewable energy source. Due to it relying on large amounts of carbon dioxide for photosynthesis, algae are environmentally friendly. In turn it releases clean oxygen back into the

air. Alga specializes in cleaning water because it can absorb and remove contamination.

Bioethanol and biodiesel fuels are made from algae to power transportation. Biodiesel fuel is favored more since it causes less air pollution than bioethanol. Fifty percent of algae's weight is oil which makes it a reliable source of energy. Lipids in their biomass are used to make biodiesel for cars, trucks, and airplanes (Morris, 2017). The focus now is to research the best biodiesel due to its minimal impact on the environment. Depending on the species of algae, different types of fuels may be suitable. When algae and micro algae photosynthesis, they convert solar energy into chemical energy. Chemical energy is stored fatty or lipid oils (Morris,2017). Production cost are a concern due to uncertainty in feedstock availability, claims to the land, and regulations based on environmental effects these monocultures could cause. For now, algae are used in biofertilizer, animal feed, and aquaculture feed.

Algae is still a new source of energy and has been estimated to potentially produce around 308,000 liters of oil with current technology. The problems with algae energy are that it requires copious amounts of sunlight. Sunlight is only capable of reaching a few centimeters in the water. Surface area is more important than volume which causes algae farms to take up large amounts of land. Waste from algae can damage the surrounding environment. Due to algae currently having a low energy content, it does produce less engine power and speed which means the fuel has more improvements to be made.

Energy generation "out of thin air"?

As the search for renewable and clean energy continues, researcher at the University of Massachusetts Amherst have made a device that utilizes natural proteins, from the moisture in the air, to produce electrical energy. This only can have a significant impact on climate change, renewable energy, and future medicine. The dives are called the air-gen which is an air power

generator. Nanowires are electrically conductive proteins produced by microbe *Geobacter* (Staff, 2020). When water vapor is present, the air-gen connects electrodes to the nanowires which produces electrical currents. Electrical engineer Jun Yoa states that they are literally creating electricity out of thin air and that the Air-gen generates clean energy twenty-four seven. What Yoa's lab has created is non-polluting, renewable, and low-cost (Staff, 2020). It can even function in areas where low humidity is present. It surpasses both wind and solar energy because it requires no light or wind to work, and it even works indoors. The Air-gen only requires:

A thin film of protein nanowires less than 10 microns thick, the researchers explain. The bottom of the film rests on an electrode, while a smaller electrode that covers only part of the nanowire film sits on top. The film adsorbs water vapor from the atmosphere. A combination of the electrical conductivity and surface chemistry of the protein nanowires, coupled with the fine pores between the nanowires within the film, establishes the conditions that generate an electrical current between the two electrodes. (Staff, 2020)

Currently, Air-gen devices can power small electronics and the researchers hope to bring it to commercial sales. They are currently working in ways to power wearable electronics like fitness monitors to move away from batteries. They also hope to use this for cell phones, so the phones no longer need to recharge. Yoa's goal is to create a large-scale system in which the technology can be added to wall pint which can power a home. Off the grid solutions can be made with standalone air-powered generators (Staff, 2020). It will be only a matter of time before they can industrially scale to create lager systems to help in creating sustainable energy production.

To create a more capable Geobacter, Lovley's lab has created a new strain of microbes that can mass produce protein nanowires. They were able to turn E. coli into factories for nanowires. This will help reduce running out of nanowire supplies when using the Air-gen. The origins of how the Air-gen started happened when Lovley discovered Geobacter in the mud of the Potomac river. This is where he discovered that it had the ability to produce electrically conductive protein nanowires. Once he joined up with Yao, they did extensive research to find out if the protein nanowires could be implemented into electronic devices. For Yao's laboratory, he states that this will be the beginning of protein-based electronic devices.

Pollution

Another issue our planet faces is the crisis of pollution. There are natural and manmade pollutants that affect everyday life. Natural pollutants can come from volcanic ash while manmade is trash and runoff from factories and farms. The quality of air, water, and land is negatively impacted. Majority of what humans use, such as cars, produce pollution. Burning coal for electricity to generation of sewage and trash can leech into the land and water. This is life threatening to all that rely on fresh air and water. Pollution is a world-wide issue. Pollution can be found almost everywhere. Urban areas are what generally come to mind when it comes to a place where trash is just lying around, however, pollution can spread to areas where no one may be present.

Water Pollution

A prime example of water pollution is the Great Pacific Garbage Patch. This patch spans from the west coast of America to Japan (National Geographic Society, 2012). The cause of these patch's formation is due to the North Pacific subtropical convergence zone. Warm water from the South Pacific combines with cold water from the Arctic. The Great Pacific Garbage patch

is caused by the North Pacific Gyre. A gyre is a system of swirling ocean currents that create a form of vortex keeping the patch in place. Due to majority of the debris not being biodegradable, plastic only break down into tinier pieces. The image that comes to mind is an island of floating trash but is an area of cloudy water mixed with larger debris. This cloudy appearance is the accumulation of microplastics. Satellites are still unable to pick up an image due to the microplastic. Underneath the patch is estimated to have a large amount of trash piled up. It has recently been discovered that around 70% of marine debris sinks to the bottom of the ocean (National Geographic Society, 2012). Majority of plastic that ends up in the ocean comes from land while a small percentage comes from boats. Various types of trash do enter the ocean, but plastic makes up majority of the debris. This is imparted by its durability, low cost, and malleability. The processes called photodegradation occurs when the sun breaks down plastic into smaller pieces that can come from plastic bags, bottle caps, plastic water bottles, and Styrofoam.

Marine life is severely threatened by marine debris. Sea turtles may think the plastic bag floating in front of them is a jelly fish and eat it. This can cause them to choke or become severely sick. Many seabird chicks die of starvation or internal damage due to their parents mistaking plastic bits for food. If the animal is not dying from ingesting plastics, they can become entangled in it. Seals and other marine animals can get tangled up in forgotten nets and end up drowning.

The food web is also affected by marine debris. Since microplastics and trash collect at the surface of the water, they can block out essential sunlight. Plankton and algae that rely on this sunlight will die. When this happens animals that rely on them will have less food and their population decreases. Apex predators will struggle as their prey items have reduced in numbers. This can make seafood less available and more expensive to consumers.

Another issue with these patches is the chemicals that leak out of them when they breakdown. Colorants and chemicals like bisphenol A are known to cause damage to the environmental and adverse health effects. These chemicals can easily be ingested into the food chain. A researcher has even found multiple fish sold to have microplastic within their flesh. The clean up the Great Pacific Garbage Patch is a huge undertaking. Since it is so far from coastlines around the world, no one takes responsibility in cleaning it up. There are organizations and individuals who are trying to prevent the growth of the patch. Nets to pick up the trash are out of the question since marine life can be as small as the plastic itself. The size of the ocean also effects cleanup as it would take sixty-seven ship one year to clean up less than one percent of the North Pacific Ocean (National Geographic Society, 2012). The best option in keeping the oceans clean is to limit or element the use of disposable plastic and use more biodegradable resources. The transition can create less toxic to clean and reusable items.

Groundwater is created when rain falls deep within the earth. It fills in the porous spaces called and aquifer. This water is highly important as a natural resource. Almost half of Americans rely on groundwater for drinking. Rural areas especially since it is their only water source. Groundwater becomes polluted when pesticides, fertilizers, and waste leech into it. This causes the water to become unsafe for consumption. The biggest issue with contaminated groundwater is that once it is polluted, it is difficult and costly to clean. This makes aquifers unusable for decades to thousands of years. Groundwater can even contaminated streams, lakes, and oceans as it can seep into them.

As groundwater can transition to surface water, seventy percent of the earth is covered in water. Fresh water from rivers and lakes is used by more than sixty percent of people in the United States. However, the U.S. Environmental Protection Agency has surveyed that one third

of our lakes and half of our rivers and streams are unfit for swimming, fishing, and drinking (Denchak, 2018). One of the culprits for this is nutrient pollution. Nitrates and phosphates are the leading cause of freshwater contamination. Farm waste and fertilizers runoff into surface water sources and damage plants and animals. Industrial and municipal factories are also to blame as they also dump toxins into water. Industries are even found to have purposely dump trash and waste into the waterways. They see it as a way of cutting costs.

There are point sources and nonpoint sources regarding water pollution. Point source pollution occurs when wastewater is legally or illegally dumped by multiple industrial or municipal areas. Contamination can also happen when septic tanks leak, chemical or oil spills, and illegal discarding. Waterway's miles away can be affected due to currents. Nonpoint sources occurs when runoff and debris enter waterways from land. Agricultural and stormwater are examples of how this occurs. Research has found nonpoint sources to be the main cause for water pollution.

Common types of water contamination come from agriculture, sewage, wastewater, oil pollution, and radioactive substances. Agriculture is one of the biggest consumers of freshwater due to it requiring that water for crops and livestock. It is considered the largest cause of water pollution around the world. It has been found to contaminant rivers, streams, wetlands, lakes, and groundwater. Pollutants such as animal waste gets rained on and flow into waterways. This water can carry pathogens, viruses, and bacteria along with nitrogen and phosphorus. When large amounts of nitrogen and phosphorus are present in water, they create toxic algae blooms that can hurt people and wildlife. Water from sinks, showers, and toilets are wastewater. Around 80% of the world's wastewater is placed back into the environment with no treatment (Denchak, 2018).

There are facilities working to remove any pollutants in the water before releasing it back however these sewage treatment plants are struggling to keep up due to overwhelming increase of wastewater while still using older processes. Oil pollution is not only caused by large industries but also consumers. Cars and trucks drip millions of oil and gasoline daily. One million tons of oil spilled into marine habitats does not come from oil tanker spills but from land sources such as factories (Denchak, 2018). Only ten percent is accounted towards tanker spills at sea. Natural release of oil comes from the ocean floor through fractures called seeps. Lastly, radioactive waste occurs from mining uranium, nuclear power plants, testing of military weapons, research, and medicine used in hospitals. Due to the longevity of radiation produced by radioactive waste, disposal is near impossible. This is one of the more severe threats to all sources of water because removal can cost billions and it is not guaranteed to be one hundred percent removed.

The effects of water pollution on human health and the environment are detrimental. In 2015, 1.8 million deaths were caused by polluted waters (Denchak, 2018). Even if it does not kill the individual, it can make the highly ill. Waste from humans and animals contain pathogens such as bacteria and viruses that cause majority of illness. Cholera, giardia, and typhoid are some of the few illnesses spread in contaminated water. In the United States, people are contracting legionnaires' disease which is a severe form of pneumonia. Cases shown it developing in California and Manhattan, New York. A famous example of contaminated water comes from Flint, Michigan. Aged water infrastructure and cost cutting lead to Flint's water to turn foul smelling, discolored, and off-tasting. Water containing high levels of heavy metals, pesticides, and nitrate fertilizers create a plethora of health problems. Cancer, hormone disruption, altered

brain functions, rashes, pinkeye, respiratory infections, and hepatitis infect 3.5 million Americans a year (Denchak, 2018).

The environment fairs no better against water pollution. The web of plants, animals, bacteria, and fungi, if harmed, can cause a chain effect and heavy loss with aquatic environments. Algae blooms in lake or marine environments caused by nutrient pollution, reduces oxygen levels. This is known as eutrophication and it suffocates animals and plants creating a dead zone. This makes areas of an environment completely devoid of life. Algae bloom can even produce neurotoxins that affect both humans and wildlife.

Heavy metals and chemicals from human made wastewater are toxic to aquatic life. It can reduce lifespans and the ability to reproduce. When prey animals are ingested by predators, they can accumulate high levels of toxins in their bodies. Tuna has been known to have mercury and large consumption of canned tuna can make a human sick. Marine debris, as mentioned earlier, threatened marine life as animals are strangled, suffocated, or starved. More than 200 different species have been harmed by discarded fish gear and other trash. Shellfish and coral have been facing ocean acidification making it hard for them to survive. Carbon pollution from burning fossil fuels causes the oceans increased acidity. Shellfish are struggling to build their shells and the nervous system of marine life is being damaged.

Land Pollution

Similarly, to how water can get polluted, the land is also at risk. Mining and farming can leave chemicals, pesticide, and fertilizers that contaminate the ground. Humans, plants, and animals can be harmed as these pollutants can be picked up by the wind. Pesticides used to help fruits and vegetables can enter people's bodies which can cause cancer and other diseases.

Another form of land pollution is trash. If people were asked in any part of the world, they would

say that they would have seen at least one piece of trash on their travels. Cigarette butts, fast food bags, plastic products are just the few examples of land contamination. This makes it hard for plants and procedures to provide nutrients and animals can die from eating plastic due to them mistaking it for food. Oil, chemicals, and ink from garbage can leech into the soil causing harm to every living organism in the area. Other issues that create trash pollution is the inefficient collection of garbage. Dumps and landfills are where the trash is taken to be buried but due to the increasing human population, places to dump the trash is running out. Groundwater is then threatened by the buried garbage as contaminants leak into it. In some areas, trash is just lying on the roadsides due to lack of a garbage collection system. Burning trash to get rid of it still causes problems as heavy metals and chemicals are released causing air pollution. It may help the land pollution problem but just creates problems for the air pollution.

Air Pollution

Air pollution is easily noticed through the exhaust of vehicles or factories. It billows out in a black cloud before dispersing into the atmosphere. Majority of it though is invisible. Both versions of air pollution are dangerous due to causing eye burns and difficulty breathing. Lung cancer is a as it damages the lungs. It even has the potential to kill. In 1984 Bhopal, India, a deadly gas was accidentally released into the air killing 8,000 people while those that survived were severely injured (National Geographic Society, 2012). There are natural air pollutants such as volcanic eruptions that release ash and gases. This ash has the potential to darken the sky making it hard to grow crops and can be carried away by jet streams to other parts of the planet. Sulfur dioxide is some of the gases contained in volcanic eruptions. These gases are highly toxic as they kill people and make the land infertile.

Air pollution is mostly unnatural and created by human activity. Fossil fuels, coal, oil, and natural gas are all linked to air pollution. Carbon dioxide is produced by burning gasoline to power vehicles. Smog is created by nitrogen oxide, sulfur dioxide, and hydrocarbons which reacts with sunlight and is created by cars and factories. An example of fog is found in Linen, China where people barely see the sun. Children and older adults have the most problems breathing in smog. It can get so bad that cities will even place out warnings on extreme smog. Hong Kong, China warns against going outside or any physical activity during heavy smog.

When certain chemicals, nitrogen oxide and sulfur dioxide, mix in the atmosphere, they can create acid rain. This rain destroys forest, lakes, streams, and other waterways. Animal species such as fish have been killed off due to the water acidity level. Acid rain even erodes stone. Many historical buildings, monuments, and gravestones have been worn down and damages. The coloration of the Taj Mahal in India was once white only to be a pale color due to acid rain. There has been some success in Europe and North America in limiting the amount of pollution released into the air but for developing country like Asia, it is still an issue.

Noise pollution

Defined as the constant exposure to sound levels that can damage a humans or other living organism hearing and other health problems. There is a huge list of what causes noise pollution. It is so bad that society does not even notice it anymore. Examples of this include:

- Cars, Buses, pedestrians, ambulances, and more
- Heavy machinery and drilling from construction
- Fireworks, firecrackers, and loudspeaker from events or holidays
- Fans, generators, compressor, and mills in industrial use.
- Majority of household objects such as vacuum cleaners to lawn mowers

- Trains stations
- Constant loud music
- Explosions and gunfire from conflicts

Noise pollution can cause adverse health effects in people. Hypertension, hearing loss, sleep disturbances, cardiovascular dysfunctions, and dementia have occurred from noise pollution. Children are heavily affected by this and can develop hearing impairment, psychological effects, and physical effects. In 2001, playing loud music had caused around 12.5% of children from 6 to 19 years to develop hearing loss in one to both ears (EPC, 2021). Wildlife and marine life are also at risk with noise pollution. For marine life, oil drills, sonars, seismic surveys, human recreations, and ships are affecting their lives. Whales are one of the most impacted due to them relying on their hearing for orienting their location, eating, and communicating. Habits such as feeding, reproduction, and migration are interfered with. Worst cases have found that hemorrhaging and death have occurred.

Light Pollution

This pollution is the harmful effects of artificial light. There are three main types of light pollution called glare, light trespass, and skyglow. Glare occurs when light is scattered across the eyes which causes loss of contrast to even blindness. It is even known to be a public hazard especially when driving. Light trespassing is when unwanted light enters a person property through a bedroom window while a person is trying to sleep. Skyglow happens when light is reflected and in an upward direction making it wasted energy. This can be seen in populated areas. The biggest problem with light pollution is that it affects many animal species. Light and dark help determine when it is time to eat, sleep, migrate, or reproduce.

Biological activities are interfered with. Nocturnal pollination has been reduced in areas which leaves plant to reproduce unsuccessfully. Studies had found that nocturnal pollinators visitation was reduced to 62% when areas were illuminated compared to dark areas (Lee, 2019). Light pollution has made coral reproduction off the clock. Normally Coral Reefs spawn when the moon is full around October or November. When bright lights are present, they mask up the moon's phases and throw off the reproduction of coral. They end up spawning too late or never which reduces their offspring numbers. Lights can disorient birds and affect their migration patterns. Large buildings with bright lights have been known to attract birds which has caused fatal collisions as the bird slams into the building. Baby sea turtles rely on the light of the horizon to find their way to the ocean. Artificial light has been causing them to travel the wrong way where they die of dehydration, predators, and run over by vehicles. Reduction in light near coastal areas could save newly hatched sea turtles from unnecessary death.

Insects are also at risk as when they hang around the light too long, they overheat and die. Non-native bugs have been found as well since their migratory paths have been disrupted by the artificial light. Birds and bats that rely on these insects for food lose them making it difficult to survive. Plant's life cycle is impacted as artificial light can prevent them from growing and reproducing properly. Pollinators that help these plants must go elsewhere as their food source is depleted. It may seem like a small problem but one third of the food humans consume rely on pollination. Amphibians are essential in detecting changes in the environment. Their sensitivity makes them great for studying the health of the ecosystem. Their populations have declined, and light pollution plays a part in their disappearance as they are nocturnal and do most of their foraging and breeding at night.

When zooplankton called daphnia are unable to float for their meals, as they regularly do in darkness, algae blooms run rampant and overtake the life of the lake. Artificial light makes the zooplankton stay in their deep-water homes due to it resembling daytime. Trees are impacted as they have a molecular clock that tells them how long the sun will be out and when to photosynthesis. Artificial light throws that clock off and change how a tree flowers and stores energy for the winter. Humans rely on darkness to sleep. LED, fluorescent, and metal halide suppress melatonin levels while increasing cortisol which make the person stimulated. High levels of cortisol make it hard for a person to sleep which affects the immune system making it hard to fight illness and diseases. In severe cases more dangerous problems can arise if a person does not get a good night rest every night. Some symptoms include:

- High blood pressure
- Diabetes
- Heart attack
- Heart failure
- Stroke
- Obesity
- Depression
- Immunity impairment
- Low sex drive
- Physical appearance

Out of all the other pollutions, light pollution is the easiest to fix. This does not mean living in total darkness but utilizing more efficient and beneficial light sources. Certain areas of land that protect the natural light of the environment are called IDA's or International Dark Sky

Reserve. These lands can be private or public and are distinguished by the quality of the starry nights and nocturnal environment (Lee, 2019). These reservations require a level of sky quality and natural darkness. Government acts have been implemented to stop light pollution and energy waste. During 2014-2016 the US Department of Energy's Outdoor Lighting Accelerator worked with 25 partners that were committed to upgrade 1.3 million streets light that will save the cities around \$48 million a year (Lee, 2019).

Other countries have started to create laws and guidelines to reduce energy use and light pollution. Cities have gone through an undertaking of changing out old light for new ones that do not waste as much energy. For those concerned with more crime occurring if the lights are dimmer, data shows no increase in crime with dimmer lights but have found that brightly lit alleys have increased crime rates. People have even found that less glaring lights makes it easier to see in unlit areas due to their eyes adapting to dark quicker (Lee, 2019).

So how do cities reduce light pollution? Motion sensitive lights are becoming more popular as they only come on when someone approaches and illuminates the surrounding areas. Once there is no noticeable movement, the light will shut off until someone comes by again. This is a huge steppingstone in energy saving as it reduces the waste of energy. Encased above streetlamps are also effective as they ensure light channels downwards rather than unshielded lamps that let the light go everywhere. This type of style is call "cutting off light at the horizontal" to keep the light on the ground and not in the sky (Lee, 2019). Moving away from bluish-white light and using low watt bulbs if a great way to reduce urban light pollution.

Human Overpopulation

Another pressing issue affecting our planet is our own species. Our population has aggravated forces such as global warming, habitat loss, the sixth mass extinction, intensive

farming practices and depletion of non-renewable resources of water and fuels. The Global outlook for water resources in the year 2025 has estimated that around half of the world's population will face water-vulnerability while the demand will account for 70% of all available freshwater and by 2030, nearly half the world's population will be living in acute water shortages (EverythingConnects, 2013).

Currently the planet is going through the stage called the global water crisis and being one of the most important non-renewable resources, humans are still using water ten times faster than what can be replaced. Ecosystems that rely on water are threatened have shown a decrease in fish species to near extinction across the world. Great portions of water ecosystems have been lost and will continue to diminish as dams, pollution, overfishing, and threats continue. Only one percent of freshwater ecosystems cover the earth's surface while having a diverse number of species. The increase of human population will only increase the unavailability of fresh drinking water.

With the growing numbers of the human population, other species are going extinct. Compared to the extinction of dinosaurs, extinction rates today are around 1,000 to 10,000 times faster (EverythingConnects, 2013). Species examined worldwide come up to 63,837 types but 19,817 species are on the brink of extinction. If this problem persists, within a few more years, half of all plants and animal species will die. The resulting issues causing this are:

- Climate change
- Habitat loss
- Pollution
- Acidification of ocean water
- Invasive species

- Overfishing
- Poaching
- Natural resource depletion
- Human overpopulation

There has been domination with human overpopulation with planetary physical, chemical, and biological conditions and limits:

Annual absorption of 42% of the Earth's terrestrial net primary productivity, 30% of its marine net primary productivity, 50% of its fresh water, 40% of its land devoted to human food production, up from 7% in 1700, 50% of its land mass being transformed for human use and atmospheric nitrogen being fixated by humans than all other natural processes combined. (EverythingConnects, 2013)

There is comparable difference between the natural process in which one species per million goes extinct. Now around 30,000 species are being lost a year. In terms three species have gone extinct per hour. Newer species have no time to evolve at this rate.

Natural resources are at a constant state of reduction as the human population continues to grow. Fossil fuels, water, arable land, coral reefs, and forests are all being used up. This has been leading to stress in having basic life sustaining resources while diminishing the quality of life. Research has found that every person requires a third more land supply for their needs than what the planet can sustain. World's leading scientist have discovered that the world's ecosystem structure has rapidly changed within the twentieth century than it has at any other point in time. This has proven that the earth's ecosystems have changed due to human actions.

With the increase of human population and the degradation of the environment, human diseases are now running more rampant. Around 3.7 billion people worldwide suffer malnutrition

and that makes them more susceptible to disease (EverythingConnects, 2013). Within three second, a child dies from and infectious disease and one in five children will make not make it past their fifth birthday. 1.5 billion people each year has died from tuberculosis while eight million others get infected. The poor are the most vulnerable as they deal with overcrowding, pollution, malnutrition, and no healthcare. This leads to them being exposed to diseases.

To keep up with the growing population, intensive farming practices are used to produce more and cheap food. This, however, has been the biggest threat to ecosystems as many have been loss to farmland conversion. New and re-emerging parasites have been found as conditions are being made for their growth due to deforestation. Beneficial plants and animals are being killed off, soil nutrition is being depleted, runoff, clogged water systems, flooding, erosion, biodiversity reduction, and habitat loss are all caused This type of farm practice.

Climate change is a big risk when it comes to increased human population. The more humans, the more greenhouse gasses released into the atmosphere. People are making efforts to address the problem and make cleaner changes but with the constant growth on population, it leads to an overwhelming barrier that negates those efforts for change. It concludes that not only does our carbon footprint need to be smaller but also less feet. This means the human population is only sustainable if there is less. Around 97-98 percent of scientist agree that human activities are increasing climate change. Largely unchecked, climate change is the largest and challenging threat that humanity must face (EverythingConnected, 2013).

Human overpopulation has damaged and destroyed many ecosystems like the arctic or coral reefs. Fourteen percent of the earth's surface was once covered in rainforest but now only six percent remain. It estimated that these rainforests will be gone in the next forty years. With the warming ocean temperature, oceans have become more acidic and polluted. Already thirty

percent of the coral reefs are gone. Caribbean and Philippine's coral reefs account for ninety percent of this loss. By 2050, Australia's Great Barrier Reef will be gone. The Arctic, known for having permanent ice covers, is losing them around 11.5% percent each decade (EverythingConnected, 2013). Within the next thirty years, all the ice will possibly be gone. Wetlands in both the United States and Europe are being lost at a considerable rate. The U.S. only has half of the original wetlands. Fifty-three percent has been lost and in Europe, sixty to seventy percent have been wiped out.

Competition for resources will lead to an increase in crime. Humans need food, water, and shelter to survive. With these necessary resources to maintain a healthy lifestyle, crime will run more rampant to secure them. The scarcity of resources will drive people to steal so they can survive. Observations made in countries that have a balanced population show that crime rates are slow. It is when people do not have the necessities is when the crime rate rises.

Overpopulation Solutions

Majority of environmental trends appear as if nothing can be done to save it. A clear path does exist when it comes to a more sustainable world. It is a balance between humans sharing resources and habitats liberally with other species. One way to do this is to control our own population. As of now, the human population is at 7.9 billion and increasing every second. It is estimated that by 2050, the population will reach 9.7 billion. The earth already is unable to sustain every person and if our population continues to grow, resources will deplete. The action of changing the course of human population has been a growing trend. One the individual level people can:

- Fewer children meaning one or two
- Adopt

- Educate oneself on population issues
- Reduce personal consumption
- Educate young teens about sex and birth control
- Raise awareness with friends, family, and social media on overpopulation
- Support family planning programs like planned parenthood
- Vote for those who are aware of the negative impact's overpopulation has

For actions at the community level, joining environmental groups to find solutions can help address overpopulation issues. Write to the local newspaper, social media to create awareness. Encourage cities and towns to purchase land to create nature preserves. Resolutions from city councils should accept limitation in growth to stabilize national populations. At the national level, it is important to fund family planning program. Create a free market for modern contraceptive so they are available to everyone. To reduce the deaths of children and infants, improve the healthcare system. There are so many ways to help support in reducing the population, but the main aspect is educating people on it. The only way our species is going to survive if people bring awareness to the situation at hand.

Doing Our Part

There are ways even on person can do to help not only mitigate climate change and pollution but also keep our planet healthy. This problem requires everyone to work together as well. The main way is to switch to renewable energy when powering homes if it is feasible. Driving electric cars rather than fuel driven cars can reduce carbon emissions. Electric cars are a double-edged sword as they do rely on coal-sourced electricity. Mass-transit such as trains would reduce the number of cars on the road. Less cars running leads to less carbon being released. Better insulation and sealing drafts of housing will help reduce the amount of energy required to

heat or cool. Replace older appliances for energy- efficient versions. There are ways to drawing in carbon dioxide emissions using planting trees or putting it into storage.

Carbon capture and storage works by capturing carbon dioxide before it escapes a power plant. This prevents it from trapping heat into the atmosphere. The process of storing CO₂ is when the captured CO₂ is pumped underground. Scientists must carefully select where to place the CO₂ to prevent it from leaking out to the surface or in groundwater. The storage needs to be permeable layered rock surrounded by an impermeable layer of rock. The CO₂ is in constant surveillance during and after injection to ensure maximum containment.

The problem with such storage areas is due to the complexity and variation they have. These storage systems were formed millions of years which means humans cannot just create them. The National Energy Technology Laboratories and National Risk Assessment Partnership have worked extensively to produce tools that can evaluate environmental risks of large- scale carbon storage operations (Department of Energy, 2016) With the help of the NRAP tool, Carbon storage is winning. The NRAP tool assesses the safety, viability, and worthwhile of carbon storages while making it easy to estimate the cost of such projects. Supporting local businesses while practicing sustainable and climate change practices can help reduce waste.

Some low budget methods to reduce climate change are available to those who may not be able to afford the more technological advances aspect. Purchasing a reusable bottle can reduce the need for plastic bottles thus reducing the energy needed to make them. Lightbulbs are notorious for being energy wasters if they are not High-quality LED bulbs. Led bulbs provide more efficient energy output while reducing the cost of electricity.

Some practices are as easy as turning off the lights. When a room is not in use, Turning the lights off prevents wasting electricity that could have been used wisely. Walking or biking to

nearby areas instead of driving can help reduce fossil fuel emissions while providing exercise. plant native flora in a garden to help attract pollinators. Unplug any appliances such as computers or coffee makers as even when they are turned off, they still draw electricity. Washing clothes in cool water since warm water requires more energy us just to heat the water up.

Speaking up on the issue lets others know that the individual cares about the planet. Talking to family, friends, and ensuring representatives make good decisions effectively send the message out to start making changes. Water causes carbon pollution since it takes energy to pump and heat. Turning off the water while brushing, taking shorter showers, and purchasing water saving appliances are some ways to prevent water waste. If one out of every one hundred American homes had water-efficient fixtures, one hundred million kilowatts-hour of electricity per year would be saved and would avoid eighty thousand tons of global warming pollution (Denchak, 2021). Driving gas-smart cars may be an alternative to an electric car in affordability. The clean car standards for 2025 it trying to achieve 54.5 miles per gallon for all vehicle types. Maintaining the vehicle can also provide for efficiency in gas usage. Properly inflated tires, tune ups and new air filters can range in an increase in boost per gallon.

Recycling

With the amount of waste, a single person makes, recycling is a must to reduce the amount of trash and waste from pilling up or ending up in the ocean. Humans are responsible for this planet and it is in our interest to protect it for everyone. It helps improve the environment, quality of life, and makes for a brighter future. Recycling has been around for years and during World War 2, 25% of waste was recycled by industries. Again, recycling has come back as garbage levels have negatively affected the environment. For one American per household, seven and a half pounds of garbage is thrown out daily. This trash is then taken to landfills where it is

compressed and buried. Landfills are struggling to keep up with the level of garbage being thrown out and the environment suffers from trash.

If there is more recycling, then there is less trash for landfills and incineration plants. Aluminum, paper, glass, plastics, and other materials all have the capabilities of being recycled. This can save on production and energy cost will reducing the negative impacts extraction and processing of these materials have on the environment (Stanford, 2019). Recycling is an action that requires the person to do so. The more people recycle, new products can be made from that recycled material and it can help boost the economy. Benefits of recycling are reduction of energy use, less pollution in the air, water, and land, and conservation of natural resources. Stanford recycling has been able to reduce 62% of waste while reducing landfill by 35%. In 2016, Stanford recycling saved around 70,481 million BTUs of energy that was capable of power 613 houses for an entire year (Stanford, 2019). Stanford's recycling was so successful in prior years that it reduced greenhouse emissions by 2,447 metric tons of carbon. By recycling, scarce natural resources are saved as recycled material use reduces the use of trees, metal ore, minerals, and oil.

Change for the Future.

Change is a word considered frightening to many people. They see it as a threat to their lives as it takes them out of their comfort zone. Change is required to improve in any aspect it linked to. It is a means to grow. Climate change is a negative change that can be corrected if the world acted and started to take the issue more seriously. Scientist and environmentalist have been trying to reach out to share their findings. They have seen the numbers and problems climate change has caused. There is no denying climate change is not being sped up by human activities. People need to accept the facts and start changing their habits. The old way of doing what is

normal is no longer working for humanity. By trying something new, we can achieve greatness and stop our planet from become unsustainable. There are so many options to choose from when it comes to improving energy efficiency and green technology. they are nowhere near perfect but are a start to a brighter and cleaner future.

We can do this.

With the odds stacked against humanities favor, it may seem like our civilization is heading for disaster. We are only destined for failure if no action is taken. Even the smallest changes can cause huge improvements. Change can be scary but what is more frightening is the uncertainty of earths future if humans continue down the path of using only conventional fuels and polluting the world. We only have one planet, and it is in our best interests to keep it sustainable for everyone. Green energy has given us the ability to let go of old sources such as oil and natural gas. Utilizing them to their fullest will allow us to create a brighter future for the whole world. It will even help these green technologies improve as scientist and engineers can create way to make them more effective in producing electricity and other energy sources. There are many solutions to clean up the waste humanity as created if everyone starts working together as a whole. Recycling has given an option to reduce the amount of trash going to the landfill and even given way to new materials and items. It will take time for these resources to catch up to speed in proficiency, but it is imperative to start now and have a fighting chance. We cannot give up.

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