

# Climate Change Rundown

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## What is Climate Change?

Climate change describes statistical shifts of weather patterns over an extended period of time. The earth is steadily becoming warmer at an alarming rate. Climate change is largely affected by humans through the burning of fossil fuels, which releases carbon dioxide and other greenhouse gases into the atmosphere. These gases then trap heat within the atmosphere. Though certain quantities of these gases are normal, they are currently being released into the atmosphere at an abnormal rate, which leads to climate change.

The “greenhouse effect” is the process that warms the earth. A portion of the Sun’s energy that extends to the Earth’s atmosphere is reflected back into space while the rest is absorbed and re-radiated by greenhouse gases, such as carbon dioxide. The energy that is absorbed warms the earth. This is the process that keeps the earth warm enough for life to inhabit the planet. However, due to human activity, this phenomenon is occurring at an unnatural rate, leading to the many issues created by climate change (Greenhouse Effect, Australian Government).

## Important Facts

- Carbon dioxide has not been as high as it currently is (slightly above 400 parts per million) since the middle of the Pliocene Epoch (3.6 million years ago), and the world was much different at that time.
- The world burns 10 billion pounds of carbon a year.

- Since the Industrial Revolution, humans have increased atmospheric carbon dioxide (CO<sub>2</sub>) concentration by more than one-third.
- The Arctic Ocean is expected to become essentially ice free during the summer before the mid-century.
- Over the last half-century, humans have over-exploited or polluted two-thirds of the earth’s ecological systems.
- As ocean waters warm, they expand, leading to a rise in sea-levels. This occurs as melting glaciers continue to empty freshwater into the oceans.
- The rise in sea level threatens to inundate low-lying areas and islands, displace dense coastal populations, erode shorelines, damage property, and destroy ecosystems such as mangroves and wetlands that protect coasts against storms.
- As the population rises and climate change effects become more severe, viable land utilized for food production will begin to diminish considerably by 2050.
- Geologists have warned that with the current excessive consumption rate of oil, the world only has about 40 to 50 years of world oil supply remaining.
- The Ogallala Aquifer, which is one of the largest aquifers in the world located in the U.S. and a main source of freshwater, is expected to become depleted by 2030.
- If nothing changes, atmospheric CO<sub>2</sub> concentrations will likely be more than 700 parts per million by 2100, and will continue to rise. Over the next century, state-of-the-art climate models suggest that this will result in an increase of about 3.5°F

in global temperatures.

### **Humans' Impact on Climate Change**

The “greenhouse effect” is the primary cause of the rising global temperature and is a direct result of human activity, as many climate scientists have confirmed. One of the main contributors to this is the burning of fossil fuels, such as coal and oil, which increase the concentration of carbon dioxide in the atmosphere.

Due to developments made by humans in modern civilization, the carbon dioxide levels have risen from 280 parts per million to 407 parts per million just in the last 150 years, with much of this rise occurring over the last 50 years. Carbon dioxide, methane, and nitrous oxide are the main gases produced by humans that contribute to climate change (A blanket around the Earth, NASA).

The following is a list of the primary human activities that cause the climate to change:

- Burning fossil fuels: When fossil fuels are burned, they release carbon dioxide and other gases into the atmosphere, which prevent heat from escaping the earth's atmosphere.
- Driving: Cars release smog, which forms when large amounts of air pollutants are released into the air and become trapped in the atmosphere.
- Agriculture: Meat production and other unsustainable agricultural practices result in carbon dioxide and methane emissions, habitat displacement, deforestation and land infertility.

There are many other ways in which humans contribute to climate change, but the presented activities are some of the most prevalent that must be mitigated through sustainable actions to prevent a further crisis from occurring.

### **Meat Consumption and Agriculture**

Livestock production is possibly the human act that has the largest impact on the environment. Over one-third of the world's freshwater is utilized for this industry to continue supplying the demand of meat. Greenhouse gas emissions from dairy and meat production are leading contributors to climate change. Valuable land, such as forests, is lost each day to create space for livestock and other agriculture commodities, which leads to a merit of other environmental issues.

The current rate of meat consumption by most people is unhealthy for the body as well. Excessive meat consumption can lead to cancer, type 2 diabetes, and heart disease (number one cause of death in the U.S.). Reducing meat consumption would not have adverse health effects, but could actually be more nutritious for many people.

Additionally, many agricultural crops are grown unsustainably, which leads to the degradation of land. Topsoil is being lost at a rate 10 times faster than is sustainable and requires hundreds of years to replenish. As the population rises and suitable land to grow crops is depleted, food scarcity will become a plaguing issue. Sustainable agriculture practices, such as crop rotation,

eliminating the use of pesticides, implementation of biodiversity, embracing renewable energy sources, utilizing water conservation techniques and many other ecologically sound methods are essential. Reducing meat consumption and supporting agriculture that apply these sustainable practices are necessary measures for a sustainable future.

### **Current Effects of Climate Change**

**Sea Level Rise:** The global sea level has risen about 8 inches in the last century. This is occurring at a rapid rate with a slight rise every year. Many coastal cities will have to be relocated in the coming years as the sea level rise overtakes them, which in turn will create high population densities in several areas that may not have the capacity to support the migration.

**Temperature:** All three major global surface temperature reconstructions indicate that since 1880, the earth has warmed. Much of this warming occurred in the last 35 years (15 of the 16 warmest years on record occurred since 2001). The temperature rise has changed wildlife habitats as well as where crops and plants grow. If the rate of warming trends continues, experts predict that one-fourth of the species on Earth will be headed for extinction by 2050.

**Ocean:** As the oceans cover much of the planet, they have absorbed an immense amount of increased heat from climate change. The top 700 meters (about 2,300 feet) of ocean has exhibited an increase in warming since 1969.

**Ice Sheets:** Both the Greenland and Antarctic ice sheets have decreased in mass.

Data from NASA's Gravity Recovery and Climate Experiment provides evidence that Greenland lost about 281 billion tons of ice per year between 1993 and 2016. The Antarctic lost an average of 119 billion tons during the same time period. Over the past several decades, the extent and thickness of Arctic sea ice has declined rapidly.

**Glaciers:** Glaciers are retreating in essentially all areas around the world, such as in the Alps, Himalayas, Andes, Rockies, Alaska, and Africa.

**Weather:** There is an increase of record high temperature events in the United States, and the number of record low temperature events has been decreasing since 1950. In the U.S. there has been an increase in numbers of intense rainfall events, and satellite observations show that spring snow cover in the Northern Hemisphere continues to decrease. Snow continues to melt earlier than previously seen.

**Ocean Acidification:** The acidity of the surface ocean waters has increased by 30 percent since the Industrial Revolution. This increase has occurred due to humans emitting more carbon dioxide into the atmosphere, which indicates that increased carbon dioxide is also being absorbed by the ocean. The upper layer of ocean waters are absorbing carbon dioxide at a rate that is increasing by 2 billion tons per year.

(Climate Change: How do we know? NASA)

### **Effects of Climate Change in 100 Years**

#### **Oceans**

**Sea Level Rise:** The estimate of future sea level rise varies for different regions, but

global sea level is expected to rise at a greater rate than that of the past 50 years. Studies suggest that the global sea level will rise by one to four feet by 2100. Melting ice sheets will also contribute to this rise (Future of Climate Change, EPA).

Ocean Acidification: This has adverse effects on various marine species, including plankton, mollusks, shellfish, and coral. Calcium carbonate declines as ocean acidification increases. Calcium carbonate is a main component used to build the shells and skeletons of many marine organisms. If atmospheric carbon dioxide concentration doubles, it is projected to decline coral calcification by more than 30% and slow coral growth by 50% by 2050 (Future of Climate Change, EPA).

Coral Reefs: Coral reefs everywhere are experiencing coral bleaching. As the water warms due to climate change, coral reefs release algae in their tissue, which turns them white. This has already occurred, as 50% of the coral that makes up the Great Barrier Reef were killed off in 2016 and 2017. This is a major issue as coral reefs are home to the highest biodiversity of any ecosystem globally. Reefs provide food, protection from flooding, and sustain fishing and tourism industries. The disappearance of these reefs will have environmental, economic, social, and health consequences.

## **Temperature**

Increases in Average Global Temperature: By 2100, studies show that the average U.S. temperature will increase by about 3°F to 12°F. Temperatures will increase at least twice as much in the next 100 years as it has

during the last 100 years. Weather Events: More frequent and extreme heat events, or heat waves, will occur. The number of days with high temperatures above 90°F is expected to continue to increase throughout the U.S. The climate will shift dramatically throughout different regions across the globe, which will impact all sectors of life. Climate models project that if global emissions of greenhouse gases continue to increase at the current rate, summertime temperatures in the U.S. that were ranked as the hottest 5% from 1950-1979 will occur at least 70% of the time by 2035-2064 (Future of Climate Change, EPA).

## **Storms**

Precipitation: The average precipitation through the end of the century will increase in intensity and amount, although changes in the amount and intensity of precipitation will vary significantly by region. Tropical and high-latitude regions will experience this at a magnified rate. Wind strength and precipitation of tropical storms are likely to increase.

Regions: Northern areas are projected to become wetter, specifically in the winter and spring. Southern areas, the Southwest especially, will become much drier. Heavy precipitation events will likely become more frequent, and heavy downpours that currently transpire once every 20 years will occur between two and five times as frequently by 2100. Along with this, rain will occur more regularly than snow. Atlantic hurricane intensity is likely to increase as the ocean warms. Cold-season

storms are projected to become stronger and more frequent (Future of Climate Change, EPA).

Extreme Weather Events: An overall increased frequency and severity of extreme weather events will occur throughout the globe, such as precipitation, flooding, droughts, and storms, which pose a threat to the health of people during and after these events. Those most at risk include young children, older adults, people with disabilities or medical conditions, and the impoverished. Extreme events can affect human health in a number of ways by:

- Reducing availability of safe food and drinking water.
- Damaging roads and bridges, disrupting access to hospitals, pharmacies, and food.
- Interrupting communication, utility, and healthcare services.
- Contributing to carbon monoxide poisoning from improper use of portable electric generators during and after storms.
- Increasing stomach and intestinal illness, particularly following power outages.
- Creating or worsening mental health impacts such as depression and post-traumatic stress disorder.

(Climate Change Impacts on Human Health, EPA)

## **Ecosystems**

Relocation: For most species, the climate where they live for part of the year influences the main stages of their annual life cycle, such as migration, blooming, and

reproduction. As the seasons continue to shift from the standard, the timing of these events has changed:

- Earlier springs have led to earlier nesting for 28 migratory bird species on the East Coast of the United States.
- Northeastern birds that spend winters in the southern U.S. are returning north in the spring 13 days earlier than they did a century ago.
- In California, 16 out of 23 butterfly species shifted their migration timing and now arrive earlier.
- Species differ in their ability to adjust and asynchronies can develop, increasing species and ecosystem vulnerability. This includes mismatches in the timing of migration, breeding, pest avoidance, and food availability.
- Growth and survival of species are reduced when migrants arrive at a location before or after food sources are present.

(Climate Impacts on Ecosystems, EPA)

Extinction: It is predicted that many animals will begin to go extinct by 2050. Animals are usually able to adapt to the natural cycle of the earth, but climate change is progressing at a rate at which most animals are unable to adapt. Species currently suffering the most include the Adélie penguin, Polar Bears, North Atlantic cod, coral reefs and many species of birds (Dell'Amore, 2014).

## **Human Health**

People at Risk: Climate change poses

significant threats to the health of every country and person. Certain populations, such as children, pregnant women, older adults, and people with low incomes, may face increased risks.

- Increased Heat Stroke/Dehydration: Warmer average temperatures create hotter days and more frequent and longer heat waves, which will lead to an increase in heat-related deaths in the U.S. (as many as thousands to tens of thousands of additional deaths each year during summer months). Other heat related health issues will occur more frequently, such as cardiovascular, respiratory, and cerebrovascular disease.
- Vulnerability: Certain types of populations are more vulnerable than others, such as outdoor workers, student athletes, homeless people, and others, as they are more exposed to extreme heat. Low income households and older adults may not have access to cooling elements, which increases their exposure to extreme heat as well.

(Climate Change Impacts on Human Health, EPA)

Air Quality: Climate change affects the air we breathe both indoors and outdoors. Warmer temperatures and shifting weather patterns will most likely worsen air quality, which can lead to asthma attacks and other respiratory and cardiovascular health effects.

Wildfires: They will continue to rise in number and severity as the climate changes. Wildfires create smoke and other unhealthy air pollutants. The rising carbon dioxide

levels and warmer temperatures affect airborne allergens as well. Wildfire smoke can often be carried a very long distance by the wind, which affects people who live far from the source of this air pollutant. As of 2014, about 57 million Americans lived in counties that did not meet national air quality standards. Climate change will most likely make it more difficult for states to meet these standards in the future, which will expose more people to unhealthy air and adverse effects.

Pollutants: Scientists project that warmer temperatures will increase the frequency of days with unhealthy levels of ground-level ozone, a harmful air pollutant, and a component in smog. Ground-level ozone damages lung tissue, reduces lung function, and causes inflamed airways. This usually aggravates asthma and other lung diseases. Warm, stagnant air intensifies the formation of ozone. Climate change will increase levels of ground-level ozone in areas of the U.S. that are already highly polluted, and will increase the number of days with poor air quality. These higher concentrations of ozone due to climate change could result in tens to thousands of additional ozone-related illnesses and premature deaths per year by 2030 (Climate Change Impacts on Human Health, EPA).

Particulate Matter: This is the term for a category of extremely small particles and liquid droplets suspended in the atmosphere. Some particulate matter such as dust, wildfire smoke, and sea spray occur naturally, while some is formed by human activities such as the burning fossil fuels to produce energy. These particles can be

emitted directly or form in the atmosphere due to chemical reactions of gases such as sulfur dioxide, nitrogen dioxide, and volatile organic compounds. Inhaling fine particles can lead to a broad range of health issues, including lung cancer, chronic obstructive pulmonary disease (COPD), cardiovascular disease, and many other serious health concerns.

Water: It is common for people to become ill if exposed to contaminated drinking or recreational water. Climate change increases the risk of illness from water through increasing temperatures, more frequent heavy rains and runoff, and the effects of storms. This leads to health impacts such as gastrointestinal illness like diarrhea, effects on the body's nervous and respiratory systems, or can cause liver and kidney damage. It also increases exposure to waterborne pathogens (bacteria, viruses, and parasites such as *Cryptosporidium* and *Giardia*), toxins produced by harmful algal and cyanobacterial blooms in the water, and chemicals that end up in water from human activities. The change in water temperatures creates waterborne *Vibrio* bacteria and harmful algal toxins that will be found in water or in seafood at different times of the year, or in places which previously did not pose a threat. Runoff and flooding from extreme precipitation, hurricane rainfall, and storm surge will increasingly contaminate shellfish, water bodies used for recreation (lakes and beaches), and sources of drinking water. Extreme weather events and storm surges can lead to the damage or excess of the capacity of water infrastructure, which increases the risk that people will be

exposed to contaminants (Climate Change Impacts on Human Health, EPA).

Food: Climate change and the impacts of higher concentrations of carbon dioxide in the atmosphere will most likely affect food safety and nutrition. Extreme weather events may disrupt or slow food distribution. Warmer temperatures can increase cases of *Salmonella* and other bacteria-related food illness as bacteria grows more rapidly in warmer conditions. The exposure to a variety of chemical contaminants in food will increase due to climate change. For example, warmer ocean surface water temperatures will lead to higher mercury concentrations in seafood, and an increase in extreme weather events that create stormwater runoff will introduce more contaminants into the food chain. Additionally, many varieties of food crops will have to be grown in new areas as the climate where they are currently growing will no longer be suitable for them, leading to many other issues, such as increased food insecurity (Climate Change Impacts on Human Health, EPA).

### **Soil**

Soil Degradation: Due to past events, even if the rate of emissions is slowed to limit atmospheric concentrations to 550 parts per million (roughly double the pre industrial level), the U.S. will most likely experience temperature increases of 5°F to 10°F, which will lead to an array of diverse issues. The warmer temperatures produced by climate change lead to the soil drying in some regions. During the summer growing season, drying is estimated at 10 percent to 30

percent in the United States. This will also impact food production and availability.

### **Economic Impact**

Industries: The economy is already largely impacted by climate change. Fishing, energy, water utilities, and several other industries will suffer from the long-term impacts of climate change. The warming ocean impacts the fishing industry. Rising temperatures impact energy usage throughout the world. Many industries will have to adapt quickly to these fast occurring changes. The tourist industry will decline in all regions as well. In order for the global economy to not suffer drastically, it will need to adapt, which is already proving very difficult for many. There is currently some governmental pressure, as well as incentive, to operate businesses sustainably. However, large producers of emissions and profits worldwide, such as agriculture, continue to operate in unsustainable manners that put the future of these industries and humanity at risk.

### **The Time to Act is Now**

Climate change is the most severe environmental issue facing the earth and the human population. The issues surrounding climate change are largely human driven, which means that humans are also the solution. We cannot reverse what we have done, but we can significantly reduce what may occur in the future if we act now. There is no more time to wait, action must begin immediately for humans to have a chance at continuing as a species. If nothing is done, humans, along with many other species, will

not be around on earth much longer.

It is up to us, and we can be the difference. Here are some examples of what you can do to help reduce climate change effects:

- Drive only when necessary and look to utilize other methods, such as carpooling, walking, biking, or taking public transportation.
- Limit your meat consumption and consider going meatless for one or more days a week.
- Replace chemical cleaning products with all natural alternatives, or make your own for a cheaper and more sustainable option.
- Reduce waste, such as plastics, by utilizing a reusable water bottle, reusable cups, stainless steel straws, etc.
- Support sustainable agriculture and become more involved with the food system.
- Conserve energy by turning off lights, unplugging electronics when not in use and upgrading to energy efficient appliances.
- Reflect on your daily life and select one or two practices that can be shifted to live more sustainably, and continue to add more with time.
- Become politically involved to support legislation that prioritizes the environment. You can even write a letter to your congressperson.
- Educate yourself about the issues surrounding climate change, and have open conversations with others.

We live in a critical time, and the turning

point is now. The opportunity to change the course of history is slipping through our fingers. If nothing is done, we will have no hope for survival as citizens of Earth. We are all connected, and it will take all of us to be the change. What will you do?

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