



FACT SHEET:

Climate Change

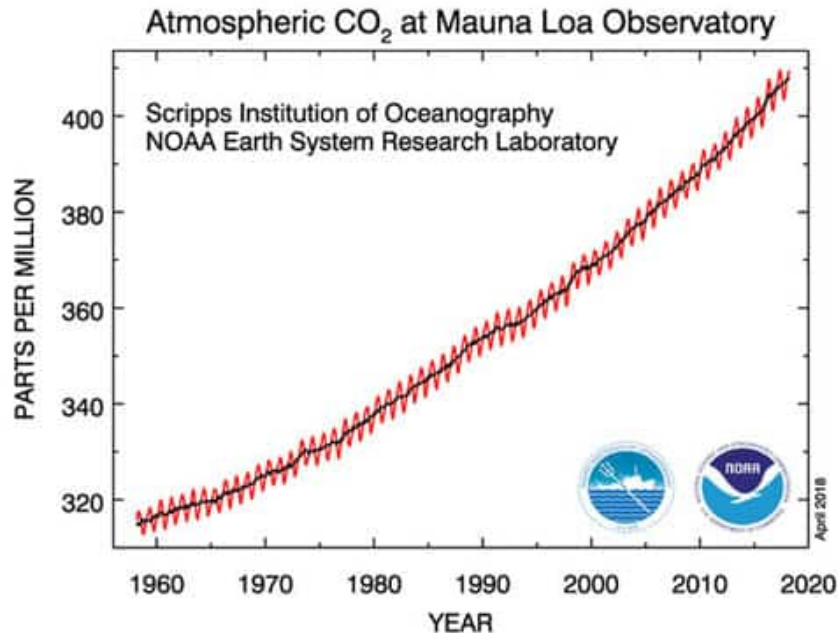
- **What is Climate Change?**

Climate Change encompasses changes in climate, long-term weather events, that occur over several decades. These changes are connected to rising atmospheric temperatures due to the rise in levels of greenhouse gases: **CO₂** (carbon dioxide), **CH₄** (methane), **O₃** (ozone), **N₂O** (nitrous oxide), and **CFCs** (chlorofluorocarbons).

The rise in greenhouse gases is directly attributable to the burning of fossil fuels by humans for heating/cooling, transportation, and industry. The situation is further exacerbated by the removal of vegetation from the land (deforestation) for development projects.

As the world's population increases (currently at 7.7 billion), so does the demand for fuel and land for habitation – both of which exacerbate the problem of climate change.

The **Keeling Curve** (below) illustrates how the levels of CO₂ have steadily risen at the Mauna Loa Observatory (HI) - a very clean oceanic atmosphere - since 1958. Each year has an annual cycle of rising CO₂ in the winter and lowering CO₂ in the summer - to reflect seasonal plant activity, but the overall trend is upwards. A critical level of 400 ppm was reached, and surpassed, in September 2016.



- **What is Global Warming?**

Heat from the sun gets trapped by greenhouse gases close to the surface of the Earth, raising the overall temperature of Earth's atmosphere – this is global warming. Climate change - and its multitude of effects – begins with global warming.

- **What is the Greenhouse Effect?**

Greenhouse gases (CO₂, CH₄, O₃, N₂O, and CFCs) in our atmosphere works to trap heat near the Earth surface – a phenomenon known as the **Greenhouse effect**. It's normal for these gasses to be present, and indeed, are essential to warm our Earth. The problem is when there is an **over-abundance of greenhouse gases** that serve as an extra thick blanket serving to make our planet too warm.

If you've ever walked into a greenhouse on a cool day you have noticed that the air in a greenhouse is warmer and moister than the air outside. The glass walls and ceiling of the greenhouse trap the moisture and heat inside the greenhouse, aiding in the survival and growth of the plants inside. Even though Earth isn't covered by glass, the atmospheric gases act to trap both moisture and heat, just like a greenhouse. The result is not only warmer atmospheric temperatures but also a whole host of cascading events that results from a warmer, moister atmosphere.

There is a large body of scientific evidence for global warming – but the following table is one of the most frequently cited tools that illustrates the increasing

Phrasing:

Global warming, due to the greenhouse effect, results in broad, sweeping effects that in total are grouped under the term “climate change”.

- **What happens when there's an increase in heat energy in the atmosphere?**

Heat is a form of energy – an increase of energy in the atmosphere has many effects:

- Increased atmospheric temperatures = increased transpiration of water from plants = more moisture in the air and less moisture in the plants (see: agricultural effects).
- More moisture and more heat in the air = higher frequency of violent storms with high winds and torrential rain in some areas and a higher frequency of drought and wind in other areas (see: sociological effects).
- A higher rate of transpiration = higher rate of drought/plant death/crop failure (see: agricultural and sociological effects)

- A higher frequency of wildfires – due to unusually dry conditions (see: sociological effects)
- Melting ice – in the Arctic and Antarctic regions, in Greenland, with a subsequent rise in sea levels. Loss of land at the ocean shoreline (see: sociological effects).
- Change in the temperature and the chemical composition of the ocean and resulting effects on oceanic life.
- Thawing of the Arctic permafrost makes a huge store of previously unavailable organic material in the soil now available to bacteria for microbial degradation. This microbial activity results in the release of huge amounts of methane (CH₄) – a very efficient and effective greenhouse gas.
- However – some plants in some areas may respond favorably to the increase of heat, water and CO₂ in the atmosphere and grow very well. It will seem as though these plants are, indeed, inside a greenhouse.

- **In short - what are the results of Climate Change?**

The effects of climate change are **broad and substantial** – impacting weather, agriculture productivity, plant growth and development, wildlife migratory patterns, pollinator behavior, and broad human economic and sociological impacts. Here's a brief list of things to consider as being impacted by climate change:

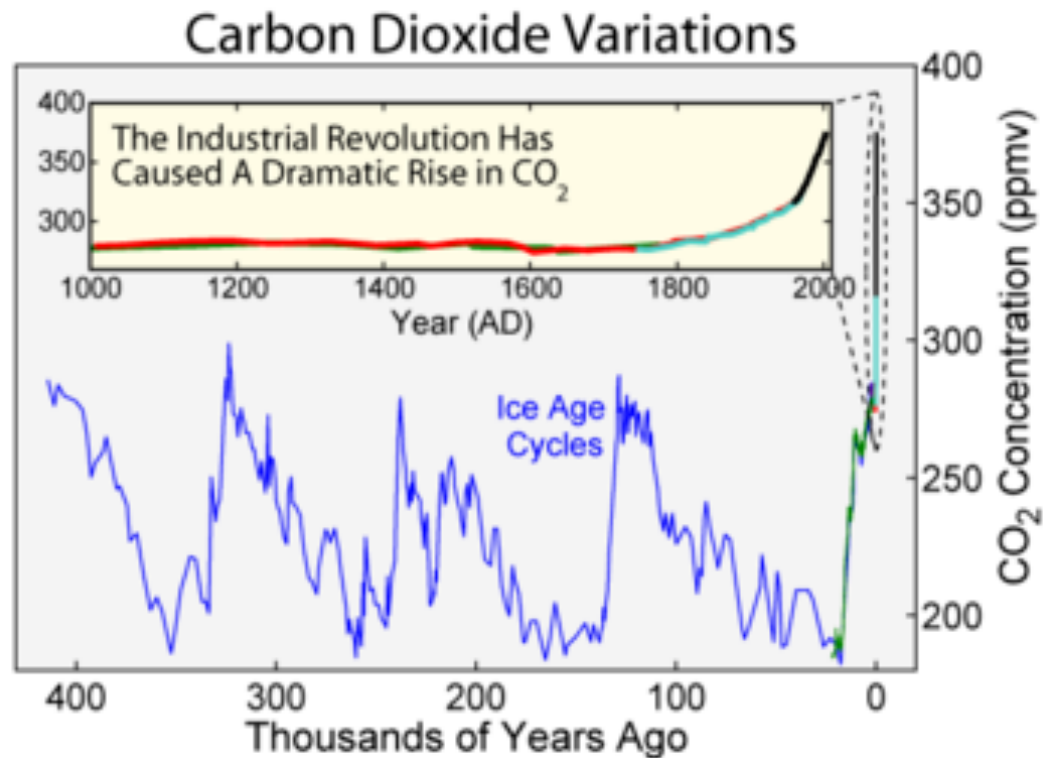
- Agricultural crop production – impacted by drought and flood
- Wildfires – increase in frequency by increased drought
- Disease proliferation – impacted by floods
- Property destruction – floods and fires, land losses due to rising water levels.
- Loss of plant and animal diversity – species lost due to their inability to adapt to these rapid changes.
- Wildlife – behavior changes due to changing environmental cues – migratory and reproductive changes – loss of biodiversity if they can't adapt fast enough.

- **Why are levels of greenhouse gases increasing?**

Greenhouse gases are rising in Earth's atmosphere because humans are burning fossil fuels and because vegetation is being removed for urban development.

- **Fossil fuels** = fuel sources that come from the fossils of prehistoric plants. Examples of fossil fuels are coal, petroleum, kerosene, propane, and natural gas. Burning these fuels results in the mass release of CO₂ into the atmosphere as a byproduct.

- Burning of fossil fuels releases 37.1 billion tons of CO₂/year (2018) – natural processes (photosynthesis) can only absorb about 10.65 billion tons of atmospheric carbon/year - resulting in a net deficit of approximately 26 billion tons of CO₂ being added to the atmosphere.
- The total CO₂ concentrations in the atmosphere hit 411 ppm in 2018 - 45% higher than their preindustrial levels.



- **Sociological/economic effects of climate change**
 - Property loss – flood, fire, rising sea levels
 - Loss of livelihood – fishing, agricultural failures, drought, fire
 - Disease proliferation – from flooding and loss of natural landscape
 - Strengthening of storms – loss of life and property from hurricanes and other strong storms
 - Heat waves become longer and more frequent – loss of life, burning more fuel to run air-conditioning
- **Agricultural effects of climate change**
 - Drought/heat waves
 - Flood
 - Loss of pollinators
 - Increased transpiration = increased plant stress
 - Increases in disease – fungal, bacterial

- **How does the prairie respond to climate change?**
 - Increased transpiration due to higher heat = more water stress in plants. Research shows the prairie becomes more sensitive to drought as it extends multiple years.
 - The prairie ecosystem's ability to recover from extreme events (drought or rainfall extremes) declines under effects of multiple factors involved in climate change.
 - Diversity of species is impacted by climate change.
 - Increase of atmospheric CO₂ may encourage the establishment and growth of woody invaders.
 - Fire, as a tool of prairie management, may have to be more frequent because of the effects of climate change and increased levels of CO₂ in the atmosphere that induce woody plant growth.

- **How to communicate about climate change:**
 - Many people have built their identity on rejecting a certain set of facts – and arguing over those facts is a personal attack and causes them to dig in deeper
 - Talk about why it matters to us – have genuinely shared values. We all care about the future of our children, the safety of our food, conserving and appreciating our green places – parks and natural areas. Connect the dots between their values and the changing climate.
 - One doesn't have to be a liberal environmentalist to care about climate change – all one needs to be is a human living on this planet.
 - No matter where we live climate change is already affecting us. Stronger hurricanes, more frequent wildfires, more frequent/more severe droughts.
 - But, fear isn't a motivator – it makes us run. We need rational hope to fix climate change – knowing what's at stake but having a vision of a better future. With resources available and a better life possible in the future. Attractive solutions. LED light bulbs, plug-in car, solar shingles, lifestyle choices – eating local and eating lower on the food chain, reducing food waste. Innovative technology that automatically turns off electronic appliances when they aren't being used.
 - The fastest growing energy source = solar energy. Consider what you can do to support or use solar energy.
 - The fastest way to impact climate change and to fix it – is to talk about it.

- **Information on the greenhouse gases:**

- Carbon dioxide (**CO₂**). A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Humans have increased atmospheric CO₂ concentration by more than a third since the Industrial Revolution began. This is the most important long-lived "forcing" of climate change.
- Methane (**CH₄**). A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.
- Nitrous oxide (**N₂O**). A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
- Chlorofluorocarbons (**CFCs**). Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases.

- **Additional definitions:**

- **Carbon sequestration** = the process of taking atmospheric carbon and translocating it underground or underwater to mitigate the levels of carbon dioxide in the atmosphere.
 - **Natural carbon sequestration** = This natural process of carbon sequestration involves using photosynthesis in plants and algae, where carbon is stored as cellulose, glucose, and starch. The carbon can remain relatively undisturbed if the plant structures do not decompose. Decomposition or plowing will release the carbon back to the atmosphere. Long-term carbon storage forms of plant-based carbon include oil, gas, and coal.
 - **NOTE:** Prior to when human-induced CO₂ emissions began, nature proceeded with a near balance between the amount of CO₂ released (volcanoes, animal and plant

respiration, burning) and the amount of CO₂ absorbed (photosynthesis) naturally.

- **Deliberate/Human-engineered carbon sequestration** = processes where CO₂ is removed from the atmosphere or diverted from the emission sources and stored in the ocean, terrestrial environments (vegetation, soils, and sediments) and geologic formations. Natural CO₂ uptake mechanisms (CO₂ "sinks") are insufficient to offset the accelerating pace of emission related to human activities, and thus, deliberate carbon sequestration is increasingly viewed as a potential mechanism to deal with climate change.

- **More information:**

- Global emissions interactive maps - by country, by type of emission, by population:
<http://www.globalcarbonatlas.org/en/CO2-emissions>
- Determining your personal carbon footprint:
https://carbonfund.org/calculate-your-footprint/?gclid=EAIaIQobChMIkpSrn6Xh3wIVjp-fCh1gkgV6EAAAYASAAEgJAIfD_BwE

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