Climate and Carbon

Key Takeaways

- Environmental organizations and some scientists contend greenhouse gas emissions from human activities are the principal cause for an increase in average global temperatures.
- Scientists contend carbon dioxide (CO2) is so effective at holding in heat from the sun, and even a small increase in CO2 in the atmosphere can cause Earth to get even warmer.
- CO2 levels in the atmosphere today are higher than at any point in at least the past 800,000 years according to scientists.
- To offset GHG emissions and reduce atmospheric CO2, carbon can be trapped in soils through various carbon sink activities known as carbon sequestration, which agriculture and forestry can play an important role.

Background

Environmental organizations and some scientists contend greenhouse gas (GHG) emissions from human activities (anthropogenic GHGs) are the principal cause for an increase in average global temperatures. These organizations argue unless measures are taken to reduce these emissions, the cumulative effect over coming decades will result in adverse changes in the world's climate and weather. GHGs include carbon dioxide, nitrous oxide, and methane.

Counter arguments to the climate discussion include increased CO2 could actually be beneficial to life, specifically vegetation, as CO2 is a requirement for life. Another argument against human influenced climate change is earth's climate is much more influenced by the sun and human activity has little impact to the climate. **However, this paper is meant to focus on understanding the position some take claiming climate change is being caused primarily by human activities and government action is required to offset those activities.**

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Understanding the CO2 and Climate Change Argument

According to the National Oceanic and Atmospheric Administration (NOAA), carbon dioxide is the most important of Earth's long-lived greenhouse gases. It absorbs less heat per molecule than the GHGs methane or nitrous oxide, but it is more abundant and it stays in the atmosphere much longer. According to the National Aeronautics and Space Administration (NASA), CO2 is a GHG which works to trap heat close to Earth. CO2 helps Earth hold the energy it receives from the sun and not escape into space. **Without CO2 and other GHGs, it is likely Earth would be too cold to be inhabitable. However, scientists contend CO2 is so effective at holding in heat from the Sun, even a small increase in CO2 in the atmosphere can cause Earth to get even warmer.** Throughout Earth's history, whenever the amount of CO2 in the atmosphere has increased, the temperature of Earth has also increased. When the temperature increases then CO2 in the atmosphere goes up even more.

The Carbon Cycle

Carbon flows between the reservoirs of land, atmosphere, and oceans in an exchange called the carbon cycle, which has a slow cycle and a fast cycle. Any change in the cycle which shifts carbon out of one reservoir puts more carbon in the other reservoirs. **Scientists claim changes in the cycle put carbon gases into the atmosphere resulting in warmer temperatures on Earth.** Over the long term, the carbon cycle seems to maintain a balance preventing all of Earth's carbon from entering the atmosphere (as is the case on Venus) or from being stored entirely in rocks. This balance helps keep Earth's temperature relatively stable. The slow carbon cycle takes place through a series of chemical reactions and tectonic activity and takes between 100-200 million years to move between rocks, soil, ocean, and atmosphere. The fast carbon cycle is largely the movement of carbon through life forms on Earth. Four things can happen to move carbon from a plant and return it to the atmosphere, but all involve the same chemical reaction.

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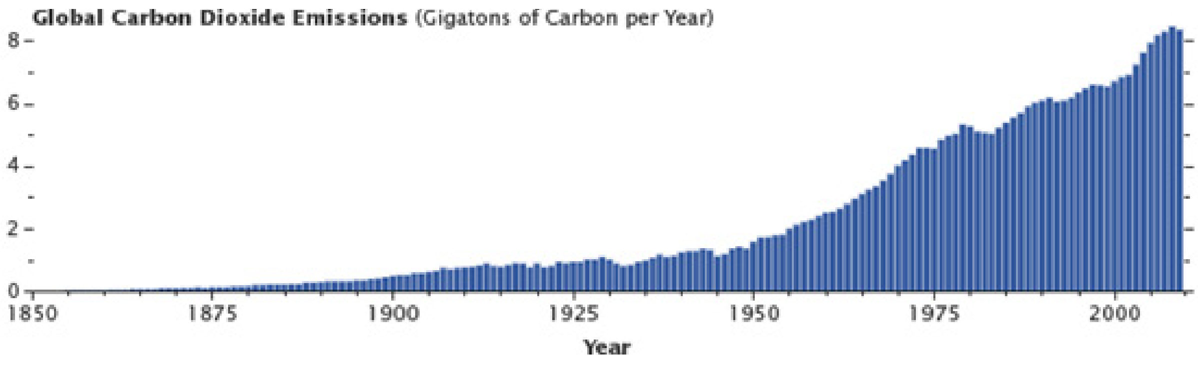
1. Plants break down the sugar to get the energy they need to grow.
2. Animals eat the plants or plankton and break down the plant sugar to get energy.
3. Plants and plankton die and decay (are eaten by bacteria) at the end of the growing season.
4. Fire consumes plants.

In each case, oxygen combines with sugar to release water, carbon dioxide, and energy. In all four processes, the carbon dioxide released in the reaction usually ends up in the atmosphere.

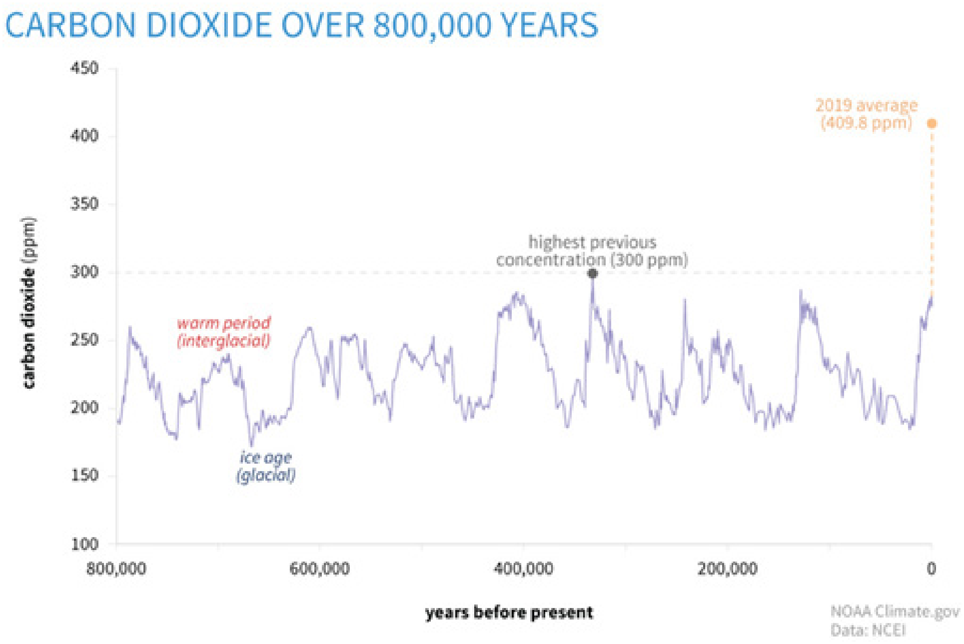
Plants and phytoplankton are the main components of the fast carbon cycle. Phytoplankton (microscopic organisms in the ocean) and plants take carbon dioxide from the atmosphere by absorbing it into their cells. Using energy from the Sun, both plants and plankton combine carbon dioxide (CO2) and water (H2O) to form sugar (CH2O) and oxygen. During photosynthesis, plants absorb carbon dioxide and sunlight to create fuel—glucose and other sugars—for building plant structures. This process forms the foundation of the fast (biological) carbon cycle.

The Carbon Cycle and the Climate

In Earth's past, the carbon cycle has changed in response to climate change. Variations in Earth's orbit alter the amount of energy Earth receives from the Sun and leads to a cycle of ice ages and warm periods like Earth's current climate. **Human activities (anthropogenic GHGs), burning coal, oil, and natural gas, can accelerate the process, releasing vast amounts of carbon into the atmosphere every year.** By doing so, we move the carbon from the slow cycle to the fast cycle.



According to NOAA, the global average atmospheric CO2 in 2019 was 409.8 parts per million (ppm for short), with a range of uncertainty of plus or minus 0.1 ppm. **CO2 levels in the atmosphere today are higher than at any point in at least the past 800,000 years.**



The anthropogenic GHGs must go somewhere. So far, land plants and the ocean have taken up about 55 percent of the extra carbon people have put into the atmosphere while about 45 percent has stayed in the atmosphere. Eventually, the land and oceans will take up most of the extra carbon dioxide, but as much as 20 percent may remain in the atmosphere for many thousands of years, potentially raising global temperatures and changing the climate. Some scientists argue excess carbon in the atmosphere warms the planet, and excess carbon in the ocean makes the water more acidic, putting marine life in danger.

Carbon Sequestration

To offset GHG emissions and reduce atmospheric CO2, carbon can be trapped in soils through various carbon sink activities such as the growth of trees, forestry management reducing forest fires and forest degradation, increasing below-ground plant matter and sequestering carbon in soils through cropland, wetland or grassland management. A variety of carbon-capturing practices are used on agricultural lands, including but not limited to conservation cover crops, no-till or reduced tillage, anaerobic digesters and nutrient management.

Environmental Protection Agency (EPA) data reveals 2018 carbon sequestration efforts resulted of an increase in CO2 stocks, i.e., carbon removed from the atmosphere, of 764 million metric tons. CO2 removals in 2018 represented 12% of the total GHG emissions and resulted in reducing net GHG emissions to 5.7 billion metric tons. Since 1990, the ability to reduce carbon stocks through land and forestry management practices has decreased by approximately 9%, or 80 million metric tons of CO2 equivalent.

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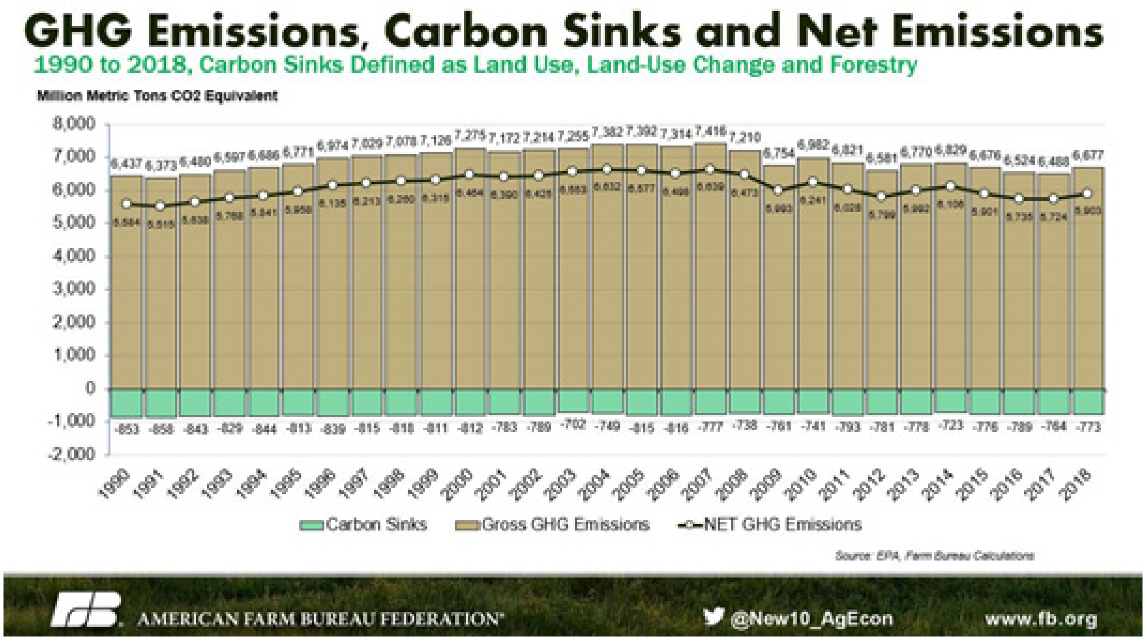

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During 2018, U.S. greenhouse gas emissions totaled 6.7 billion metric tons in CO2 equivalents, up 2%, or 188 million metric tons, from the prior year. When measured using the United Nations Framework Convention on Climate Change, an international standard, agriculture's contribution to greenhouse gas emissions totaled 619 million metric tons, representing 9.3% of total U.S. emissions.

Farmers could play an even larger role in the future to help achieve climate goals by adopting voluntary practices to offset GHG emissions, such as trapping carbon in the soil through increased conservation cover and reduced tillage. For livestock, increasing the number of anaerobic digesters and improved nutrient management and feed efficiency will help to reduce carbon emissions.

Farm Bureau policy supports voluntary and incentive-based tools, including financial and technical support, which can help farmers more rapidly adopt these climate-smart and GHG-mitigating practices on the farm. Moreover, additional efforts are needed to preserve cropland in the United States. Since 1990, total cropland has declined by 31 million acres, representing more than 1 million acres lost per year. This challenge also highlights the importance of investing in agricultural research to develop new technologies and tools to help us achieve our climate goals by capturing more carbon in our soils without jeopardizing the production of the world's food, fiber, and renewable biofuels.