

Chapter One: Climate Change 101

What is Climate Change and Why Should You Care?

Climate change is a change in the typical weather patterns, like precipitation and temperature, over a long period of time. Though these shifts may occur in natural cycles, since the 1800s, human activities, such as burning fossil fuels that produce heat-trapping gasses, have exponentially sped up the rate of the normal cycle ([source](#)), resulting in what many scientists refer to as global warming. Global warming is the long-term heating of Earth's surface since the early 1800s. In 2019, the global mean temperature was estimated to be 1.28 °C above the recorded average temperature recorded from 1850 to 1900 in the late 19th century, which has been widely used as the pre-industrial baseline for global temperature targets. Figure 1 below highlights changes in Earth's surface temperature since about 1850.

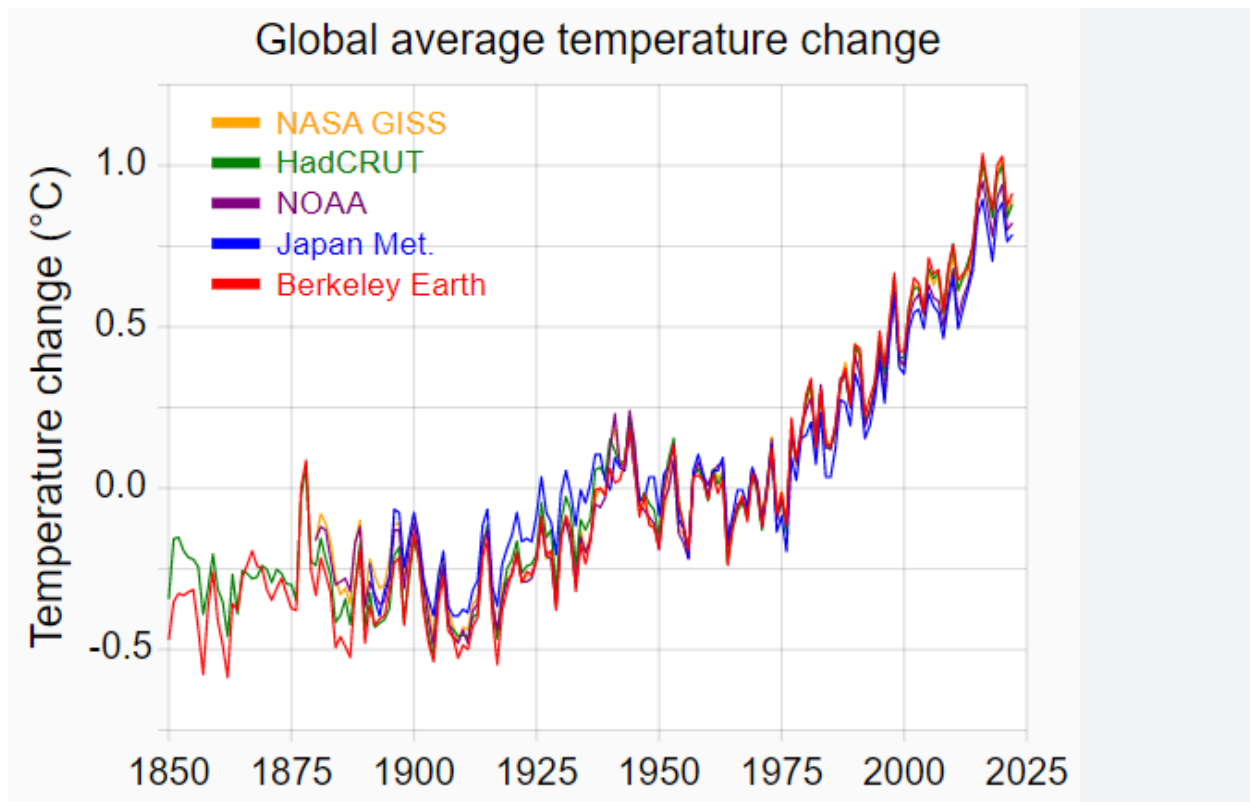


Figure 1: Global annual temperature anomaly

Defining climate vs. weather is often confusing! Recalling that climate change refers to changes in weather patterns over time, weather refers to the day-to-day or season-to-season atmospheric conditions. Weather is often what we experience on any given day, such as it being sunny or raining, while climate change is what we experience over time, such as each summer in the last ten years continuing to break heat records. Take this example of a changing climate from NASA: "After looking at rain gauge data, lake and reservoir levels, and satellite data, scientists can tell if during a summer, an area was drier than average. If it continues to be drier than normal over the course of many summers, then it would likely indicate a change in the climate".

What causes climate change?

Climate change can occur as a totally natural process, such as through solar variations and volcanic eruptions, but since the onset of the industrial revolution in the 1800s climate change has been rapidly accelerated by human activity. The main driver of climate change is greenhouse gasses (GHGs), which act like glass in a greenhouse, trapping the heat from the sun and stopping it from being released into space. In other words, greenhouse gasses act like a large blanket over Earth. This phenomenon where gasses trap heat is known as global warming, which ultimately changes our climate.



Figure 2: Pictorial illustration of greenhouse gasses ([European Institute for General Equality](#))

What causes the release of greenhouse gasses into the atmosphere?

Activities like large-scale agriculture, transportation and electricity production using oil, coal, and gas, release a lot of carbon dioxide, methane, and nitrous oxide - all dangerous greenhouse gasses. However, according to the Intergovernmental Panel on Climate Change (IPCC) the vast majority of greenhouse gas emissions come from the burning of fossil fuels, like coal and oil. In fact, in 2018, 89% of global carbon dioxide emissions came from fossil fuels and fossil-fuel reliant industries. You might be surprised to know that most things we use in our daily lives, such as cars, plastic bags, pillows, paints, rugs, and more all rely on oil too! So, when we look at the main cause of climate change, we don't only point our fingers at fossil fuel energy companies, but all corporations that exploit oil to make products.

The Greenhouse Effect

If you've ever been to a farm or nursery, you may have seen artificial glass structures, known as greenhouses, being used to grow plants and food in controlled environments. Greenhouses work by using glass or plastic panes to form the roof, and often walls of a structure, to trap heat from the sun coming through the panes to make it easy to grow plants throughout different seasons.

Likewise, Earth provides us with a controlled living environment through its "roof" that we know as its atmosphere. The atmosphere acts exactly like the panes of a greenhouse - it lets light in and traps heat to keep us from getting too cold. As opposed to glass panes, the Earth relies on a collection of heat-trapping gasses that act like a blanket around Earth, including nitrogen, methane, carbon dioxide, and water vapor. The process by which gasses trap heat in our atmosphere is known as the Greenhouse Effect.

Scientists have found that carbon dioxide is one of the most important greenhouse gasses for keeping our planet warm. Without it, Earth's surface would be about 33°C (59°F) cooler ([Source](#)). To prevent Earth from being too warm, sunlight is also reflected from nature and lighter surfaces (See Figure 2).

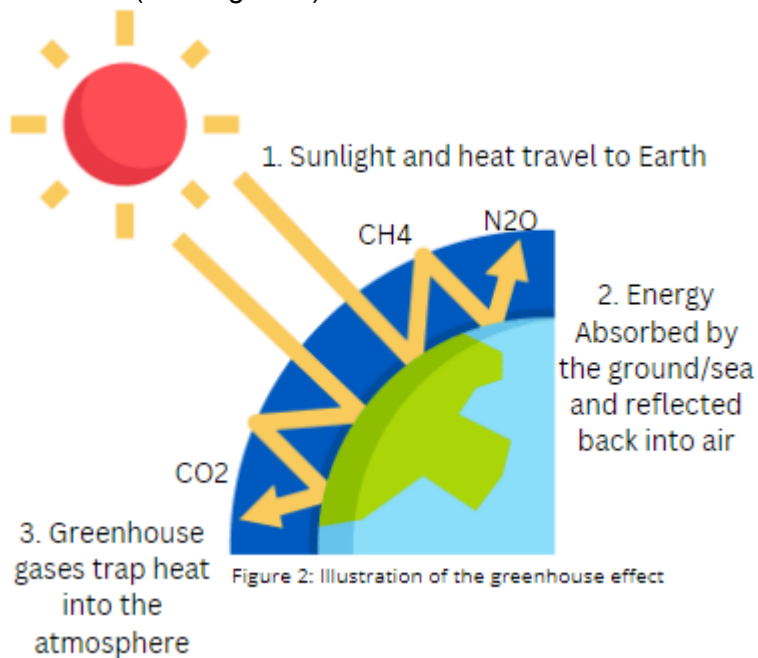


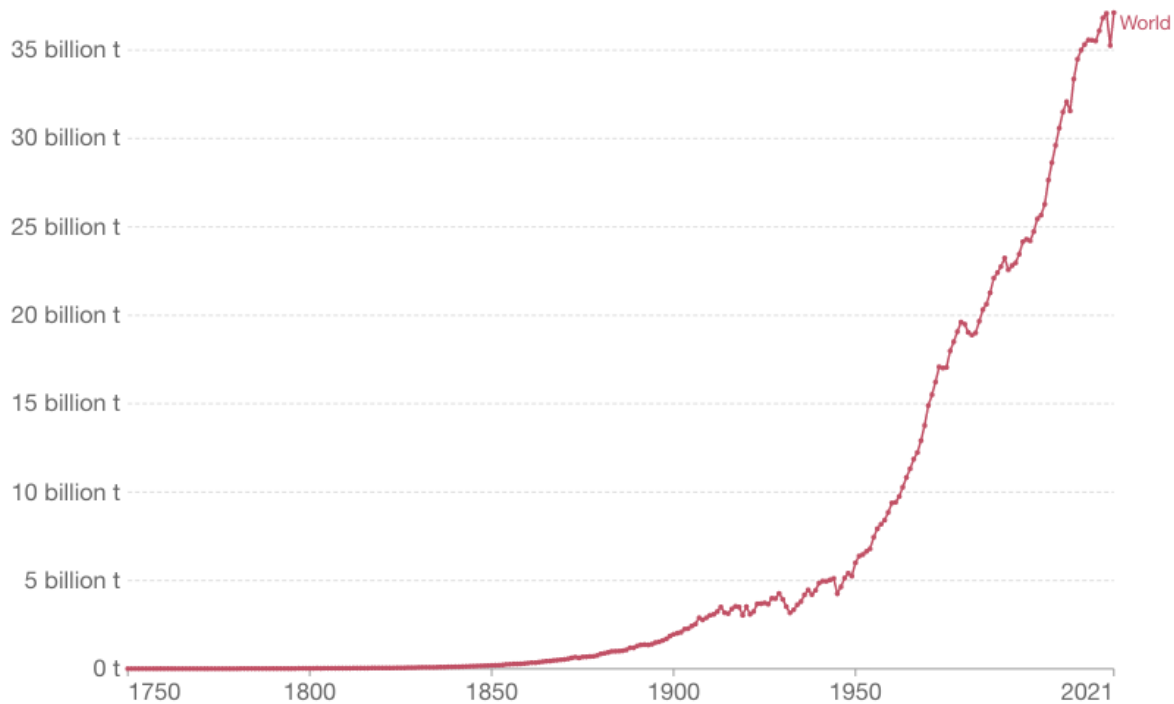
Figure 2: Illustration of the greenhouse effect

Greenhouse gasses occur naturally in our atmosphere; however, in the last century, humans have been interfering with the atmosphere's energy and gas balance, mainly by burning fossil fuels that add extra carbon dioxide and methane to the atmosphere. Collectively, the additional gasses are known as greenhouse gas emissions because they are gasses emitted by human activity that impact the greenhouse effect. The level of carbon dioxide and methane in our atmosphere has been exponentially rising for decades, trapping extra heat that is causing our temperature to rise worldwide as seen in Figure 3. This rise in temperature is known as climate change.

Annual CO₂ emissions

Carbon dioxide (CO₂) emissions from fossil fuels and industry¹. Land use change is not included.

Our World
in Data



Source: Our World in Data based on the Global Carbon Project (2022)

OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

Figure 3: Annual CO₂ emissions

How much is our climate changing and when should we sound the alarm?

The last nine years have been the hottest nine in recorded history. Global temperatures rose approximately 1 degree Celsius (1.8 degrees Fahrenheit) from 1901 to 2020. While the climate of our planet has changed throughout history, the current warming is happening at a rate not seen in the past 10,000 years. In other words, we are experiencing climate change and its effects at an unprecedented rate.

Why does this matter? Every increase in global warming has a drastic effect on our planet, such as rising sea-levels that are wiping islands and coastal communities off the map and unusual heat waves killing more people than any other natural disaster on our planet. To have the best chance at limiting the impacts of climate change and keeping Earth as habitable as possible, scientists and countries around the world have agreed that we must limit warming to a maximum of 1.5 degrees Celsius from pre-industrial levels. This agreement is known as the Paris Agreement, which we will cover in detail in the last chapter.

Who is responsible for climate change?

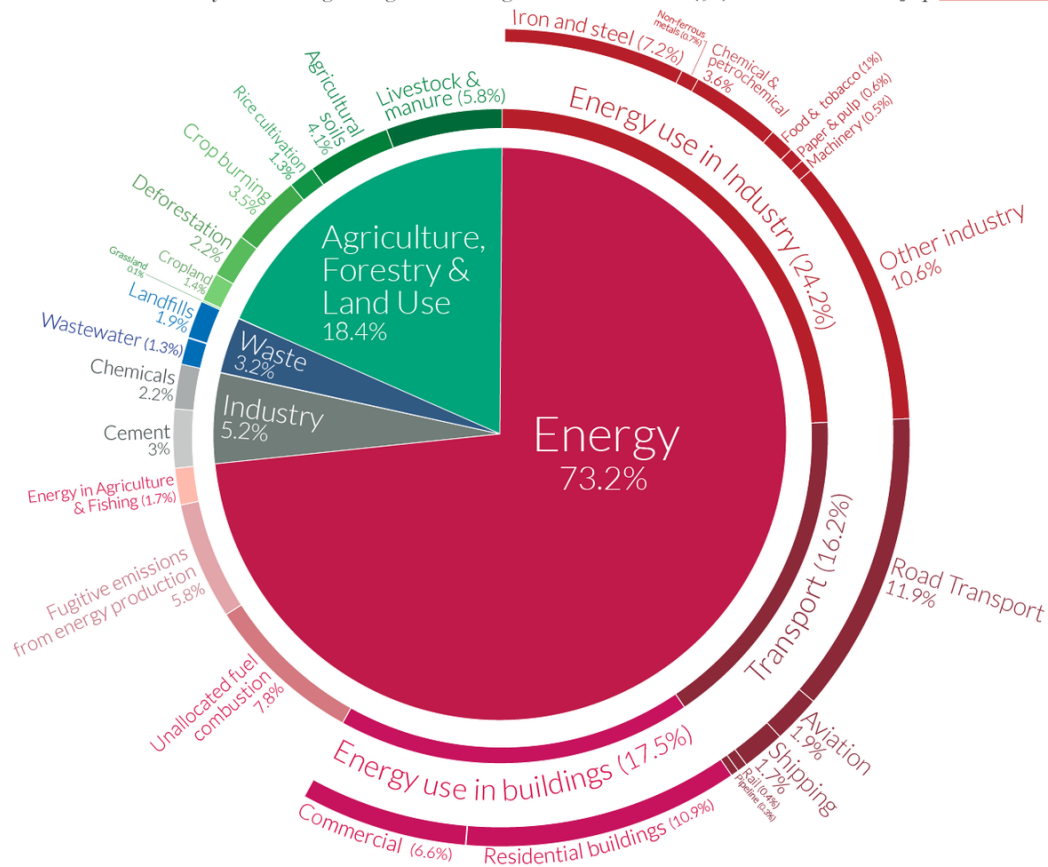
Historically, the majority of greenhouse gas emissions have come from a select few countries that hold a significant amount of global wealth and experienced rapid development with the help

of fossil fuels. The top five highest emitting countries include the United States, China, Russia, Germany, and the United Kingdom ([sources](#)). It's not just countries that contribute to climate change, it's businesses and our global reliance on the products of many of these businesses too! The Carbon Majors Report finds that, since 1988, just 100 companies have been responsible for 71% of global emissions ([source](#)). Some of the worst emitting fossil fuel companies include ExxonMobil, Shell, BP and Chevron, all of which, not surprisingly, are located within the top 5 global emitting countries. In addition to oil and gas companies, fashion and agricultural sectors also play a major role in greenhouse gas emissions as seen in Fig. 4.

Global greenhouse gas emissions by sector

Our World in Data

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.



OurWorldinData.org – Research and data to make progress against the world's largest problems. Source: Climate Watch, the World Resources Institute (2020). Licensed under CC-BY by the author Hannah Ritchie (2020).

Figure 4: Global greenhouse emissions by sector

Each of these high emitting countries and industries are responsible for catastrophic impacts experienced globally as a result of climate change.

How long have we known about the impacts of fossil fuels on our climate?

Katharine Hayhoe, a famous climate scientist and communicator, states that "One of the biggest myths about [climate](#) science—a myth that has been [deliberately fostered](#), for decades—is that we just don't know that much, yet" ([source](#)). For more than 150 years, we've known that mining coal and burning fossil fuels produces carbon dioxide and methane - which, as we learned, are heat trapping gases that can result in climate change, thanks to multiple scientific studies and

climate models stretching back to the 1890s ([source](#)). In fact, even fossil fuel companies' private research forecasted the potential impact of their emissions on climate change. For example, in the 1970s, ExxonMobil's private research predicted that burning fossil fuels would lead to at least 0.2 degrees Celsius of warming per decade ([source](#)), but the company denied any links between global warming and fossil fuels in favor of economic gains. Fossil fuel companies even developed the "carbon footprint" calculator in an effort to shift the blame of climate change entirely on individuals!

Scientists, advocates and community leaders have been sounding the alarm for decades. Many note that climate change is not a problem that may occur in the future; it is a crisis that is occurring now ([NOAA](#), [NASA](#), [NASA](#), [IPCC](#)). In the next Chapter, you will learn about how people and nature are impacted by climate change, especially in marginalized and frontline communities of the world, and, thus, why it's important we all do our part to tackle the climate crisis.