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## Impacts of Climate Change in the United States

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# Thought Paper

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Impacts of Climate Change in the United States

**TITLE**

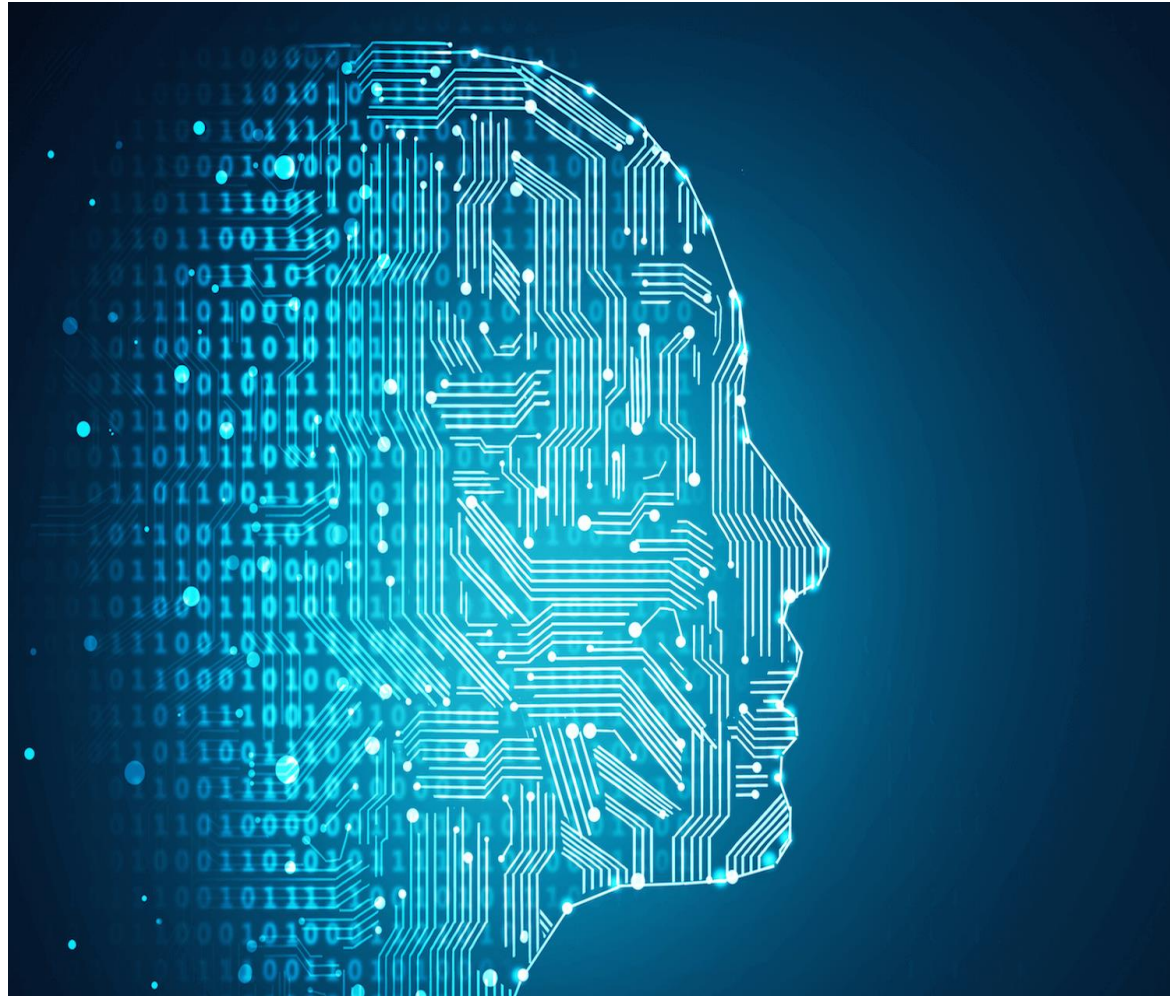
Impacts of Climate Change in the United States

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**TOPICS**

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## Impacts of Climate Change in the United States

By Nathan Thompson, Brigham Young University

## Abstract

Climate change, a shift in long-term climate patterns primarily driven by anthropogenic factors, poses a super wicked problem impacting every sector and region globally, including the United States. This paper explores the scientific basis of climate change, its contributing factors, and the myriad consequences on terrestrial and aquatic systems, as well as mental health. Notably, the emission of greenhouse gases from fossil fuels and agricultural activities is the primary cause, exacerbated by ideological division and psychological distance. The U.S. has seen some progress with a 7% decrease in emissions over the past 30 years and a growing shift toward renewable energy. However, significant challenges remain due to continued reliance on fossil fuels and consumerism.

Terrestrial consequences include desertification and increased wildfire frequency, while aquatic consequences involve flooding, sea level rise, and intensified hurricanes. Socially, climate change contributes to significant mental health challenges such as increasing anxiety and stress among the population. Addressing climate change necessitates electrifying everything, transitioning to renewable energy, and drawing down existing greenhouse gases. Insights from South Australia's transition to renewable energy provide a model for the U.S., though significant policy and behavioral changes are required. Despite progress, the complexity of climate change as a "super wicked problem" underscores the need for immediate, sustained, and coordinated global action to mitigate its effects and ensure environmental justice.

## Introduction

While every country both contributes to and feels the effects of climate change, the United States' heavy influence and high rates of contribution make this problem even more acute domestically. Climate change is primarily driven by human emission of greenhouse gases through the burning of fossil fuels and from mass-scale agriculture. Because climate change can be a polarizing issue, passing legislation to slow the harmful contributing factors has proven difficult. The effects of climate change have worsened in

the past few decades, with increased instances of wildfires and extreme shifts in weather patterns. These negative consequences disproportionately affect vulnerable people groups including ethnic minorities and people with lower levels of income. In order to avoid the detrimental aftereffects of climate change like mental health challenges, floods, and food insecurity, solutions have emerged including shifting the US power dependence to electrical sources rather than fossil fuels; this shift towards electrification has been successful in other countries. This shift of dependence ultimately starts with policy change.

## Context

### Q: What is climate change?

A: To understand the impacts of climate change on people living in the United States and around the world, it is important to differentiate between climate and weather. Climate involves long-term trends in temperature patterns in a general area (May, 2017). Weather, conversely, comprises localized, short-term atmospheric patterns (May, 2017). Climate change is a shift in climate patterns (United Nations, n.d.).

### Q: How is climate change measured?

A: The most basic measurements of climate change are global temperature and greenhouse gas concentration in the atmosphere. Scientists generally measure temperature compared to 1850 because this is when the Industrial Revolution began, and factories started emitting greenhouse gases (Abram et al., 2016). The global average temperature has risen around 1.2°C (~2°F) (Carbon Brief Staff, 2021).

In 1850, CO<sub>2</sub> levels were around 280 ppm (parts per million) (Mulhern, 2020). Today, CO<sub>2</sub> levels in the atmosphere are around 419 ppm (NOAA, n.d.). The rate of change has nearly doubled over the past 50 years, causing the warming that used to take 100 years to only take fifty (NASA, 2007).

### Q: Who is responsible for climate change?

A: Climate change is primarily driven by countries and corporations that consume large quantities of fossil fuels (Hyman, 2020). However, individuals also play a role in contributing to the climate crisis. Each person is responsible for and

impacted by climate change in the United States and worldwide. This brief will look at those who are most impacted and the most responsible industries. In their most recent assessment report, the Intergovernmental Panel on Climate Change (IPCC) ran an analysis comparing all of the possible causes of the increase in temperature. They concluded that human-generated emissions are the reason for this warming (Carbon Brief Staff, 2021). They reported in 2021, "It is unequivocal that human influence has warmed the atmosphere, ocean, and land."

(Intergovernmental Panel on Climate Change, 2021) Humans emit greenhouse gases by burning fossil fuels and from mass-scale agriculture (United Nations, n.d.). Climate change impacts every country, including the United States.

Because the United States is one of the major contributors to global climate change, having produced over 20% of global emissions since 1850 (more than any other country), it is critical to understand how this crisis affects those living there (Evans, 2021).

### **Q: How long have we known about this issue?**

A: Scientists have known about climate change for over 150 years. In 1856, Eunice Foote was the first scientist to demonstrate the warming effect of CO<sub>2</sub> (Foote, 1856). Foote concluded that if there were higher concentrations of these warming gases in the atmosphere—CO<sub>2</sub> being one of the specific gases she worked with—the Earth could experience higher temperatures.

## **Contributing Factors**

### **Greenhouse Gases**

The emission of greenhouse gases is the primary cause of climate change in the United States and worldwide. These gases are produced by fossil fuels, agriculture production, and ecological disturbances such as deforestation and wetland destruction. Over the past 30 years, the United States has seen a decrease in greenhouse gas emissions of around 3% (EPA, 2024). In addition, per capita usage has decreased by 18% (Ritchie, Roser, and Rosado, 2020). This means that, on balance, the United States has been increasing the efficiency of vehicles, buildings, and agriculture while still scaling production to meet a

growing population. While this is a positive change, the consequences of climate change will continue to worsen if more substantial preventative measures are not taken (IPCC, 2023).

Fossil fuels are commonly used across all economic sectors, emitting greenhouse gases that contribute to climate change. Fortunately, the reliance on fossil fuels in the United States is decreasing as renewable energy becomes more prevalent in energy generation (Abbott et al., 2021). In addition to burning fossil fuels, agriculture in the United States accounts for 11% of all greenhouse gases (EPA, 2015). In 2020, 53% of US agriculture's greenhouse gas emissions came from crop cultivation, 40% from livestock, and 6% from fuel combustion (EPA, 2020).

Land-use change is a major problem in the United States, with around half of the land used for agriculture (USDA, 2019). The other major change in land use is urbanization, which has increased by over 11% over the past two decades (Bounoua, et al., 2018). This land-use change, in combination with shifts in rainfall patterns due to climate change (Bartels, Black, and Keim, 2020), has led to a 16% decrease in tree cover since 2000 (Global Forest Watch, n.d.). Since 1990, land-use change and deforestation have contributed around 44% of global carbon emissions since 1850 (Friedlingstein et al., 2022). As humans degrade the land through cutting down trees and poor farming practices—such as over-tilling, failing to rotate crops, and overgrazing—greenhouse gases are released back into the atmosphere. In addition, as vegetation decreases, the quantity of gases being actively sequestered also declines.

### **Social Resistance**

#### ***Ideological Division***

Social resistance to climate change plays a major role in preventing the United States from solving this issue because of ideological division and psychological distance. Especially in the United States, there is a large political divide between those who believe in climate change and those who do not (Kennedy, 2020, Chu and Yang, 2018). Belief in climate change is important because it leads to greater support for policies that would begin to solve the problem (Bergquist et al., 2022). According to a study done by the

Yale Program on Climate Change Communication, nearly three-quarters of Democrats felt that climate change is one of several important issues when deciding how to vote, while less than a quarter of Republicans felt the same way (Leiserowitz et al., 2022). This division exacerbates the climate crisis by making it more difficult to pass effective policies that would begin to resolve the issue (Lazarus, 2009).

### **Psychological Distance and Super Wicked Problems**

The problem of climate change is unique because of a concept known as psychological distance. In the context of climate change, psychological distance suggests that the farther removed an individual is from a climate-related event, the less motivated they will be to act (McDonald, Chai, and Newell, 2015). Psychological distance has four important aspects: spatial, social, temporal, and hypothetical. Spatial deals with distance, temporal distance is related to time, social distance deals with relationships (being in or out of a group), and hypothetical distance is the certainty of an event happening at some point (Kamarck, 2019). Regarding climate change for people in the United States, psychological distance contributes to why individuals, corporations, and governments are often reluctant to reduce their carbon emissions.

Climate change is one of the core “Planetary Boundaries” at the heart of all other environmental issues (Steffen et al., 2015). The planetary boundaries are a framework that defines a safe space for human existence based on nine environmental boundaries. Climate change, specifically relating to global temperature and greenhouse gases, is one of these boundaries and is connected to each of the others. If the climate changes, so will ocean acidification, freshwater use, and so on. With climate change especially, it is difficult to determine the “point of no return”. However, in 2015, these researchers proposed that the zone of uncertainty lies between 350 and 450 parts per million (ppm) of carbon dioxide (Steffen et al., 2015). For perspective, current atmospheric CO<sub>2</sub> levels are around 417 ppm globally and increasing at around 2–3 ppm per year (Lindsey,

2022). At this rate, the CO<sub>2</sub> in the atmosphere will reach its upper limit within 11–16.5 years.

Climate change is difficult to mitigate because it is very challenging to determine jurisdiction and accountability (Kamarck, 2019). It can be hard to comprehend how burning fossil fuels in one country can impact people on the other side of the world, which leads to inaction in solving the problem (Kamarck 2019). Climate change is sometimes considered the largest market failure the world has ever seen (Paavola, 2011). This is caused, in part, by what economists call the “free-rider” problem. The United States has a low Environmental Performance Index score, according to researchers from the Yale Center for Environmental Law and Policy, ranking 20 out of 22 wealthy democracies in the Global West (Wolf et al., 2022). This means that the US has done very little to combat environmental problems such as climate change while contributing more than any other country by a wide margin.

Because of this and other factors, climate change is considered a “super wicked problem” (Lazarus, 2009). Many feedback loops continue to make climate change worse. This means that the longer it takes to address climate change, the harder it will be to fix it. The consequences of climate change compound with each other and worsen the problem exponentially (Lazarus, 2009).

### **Consumerism**

Consumerism has led to climate change because of greater energy use and waste production. Plastic, cement, and concrete contribute to the climate crisis in significant ways (Timperley, 2020, Gregory et al., 2021). Combined, these materials are responsible for around 3% of annual emissions (Nicholson et al., 2021). In addition to these physical materials, food waste is the largest type of waste in the world and contributes an additional 2% to the United States’ annual emissions (Conrad, 2020, Venkat, 2012). Nearly one-third of all food is thrown out, or about 1 pound of food waste daily per American (Conrad, 2020).

## Consequences

### Terrestrial Consequences

#### Desertification

Terrestrial consequences such as deforestation, food insecurity, and fires result from climate change in America because of increased heat and shifts in precipitation patterns. Climate change affects life both on land and in the water. On land, one of the primary changes is desertification (Ostberg et al., 2013). Around the world, over one-third of the land has been impacted by desertification, including much of the agricultural land in the United States (Montgomery, 2022). Nearly 40% of the US is arid or semi-arid and thus highly susceptible to desertification (McClure, 1998). Desertification limits the land that can be effectively farmed and generates dust pollution (Paul and Rashid, 2017). Desertification, along with rising temperatures, harms food security. Warmer temperatures limit the types of plants that can be grown and promotes the spread of invasive species (Easterling et al., 2017). In addition, increased levels of carbon in the atmosphere are limiting the nutritional value of crops grown, further contributing to food insecurity (Ebi and Loladze, 2019). Technology may be able to help offset this loss, but it is expected that crop yields will continue to decline in the coming decades (USDA, n.d., Jägermeyr et al., 2021, Hsiang et al., 2013).

#### Fires

In the western United States, climate change has doubled the number of large fires over the past 30 years (Whener et al., 2017). Additionally, the area burned each year has increased eightfold over that same time (Parks and Abatzoglou, 2020). Fires are increasing in frequency and magnitude for a few primary reasons. First, there is less water later in the year. By 2050, there is expected to be a 25% decrease in precipitation in the western United States, especially snowfall (Siirila-Woodburn et al., 2021). In many parts of the western United States, there is less rain during the summer, meaning that forests and grasslands are drier and more prone to fires (Whener et al., 2017). In addition to less rain in the west, the snow is melting earlier, causing foliage to grow more quickly early in the year. The problem with this is

that by the end of the summer, more tall, dry plant material is available for wildfires (Siirila-Woodburn et al., 2021).

### Aquatic Consequences

#### Flooding

Aquatic consequences such as flooding, sea level rise, and tropical storms are consequences of climate change because warmer air can hold more moisture and therefore makes storms more intense (UCAR Center for Science Education, 2018). Climate change has caused an increase in flooding because of increased precipitation in parts of the United States. There has been a 20% increase in extreme 100-year flooding events throughout the United States (Swain et al., 2020). It is estimated that there has been and will continue to be at least a 7% increase in extreme precipitation per degree C (Wobus et al., 2019). Over the next 80 years, this will result in flood damages up to \$7 billion (Wobus et al., 2017).

#### Sea Level Rising

Sea levels are rising faster along the coast of the contiguous United States than global sea rising rates. By 2100, sea level rise could displace between 4.2-13.1 million up to \$289 billion per year by the year 2100 (Haer et al., 2013). The combination of human migration and GDP loss in the US creates problems for the future. By 2050, the United States coastline could experience a foot of sea level rise (Sweet et al., 2022). Around 39% of the US population lives in coastal counties, meaning that flooding from higher sea levels would result in millions of domestic refugees (Hayhoe, 2018). Around 20% of people impacted by sea-level rise in the United States are among the most socially vulnerable (Martinich et al., 2013). This is an example of distributive environmental justice which explains how inequalities in socio-economic and cultural status generally reflect the distribution of environmental risks (Venn, 2019). Vulnerable populations are more likely to be located in areas impacted by natural disasters related to climate change. It is estimated that 99% of the most socially disadvantaged people in the United States live in areas that will likely be unprotected from climate related disasters (Venn, 2019).

## **Tropical Storms and Hurricanes**

In addition to the sea level rising, hurricanes are a serious environmental hazard directly linked to climate change. Climate change is attributed to increasing the frequency of the most intense categories of hurricanes (Dinan, 2017). In the United States, it is estimated that tropical storms will increase by up to 11% in intensity by the end of the century (Knutson et al., 2010). The reason for this is three-pronged. First, warmer air can hold more moisture resulting in heavier rains as the Earth continues to warm. Second, the warmer water causes wind speeds to increase. Finally, higher sea levels and the destruction of barrier habitats result in more destructive storm surges as the water is pushed up further on the land (UCAR Center for Climate Education, n.d.). Hundreds of people have their lives ended early each year in the US because of hurricanes (Williams et al., 2022). Climate change has already exacerbated previously existing hurricane damages. During the 2017 hurricane season, there were 6 major storms of category 3 or higher. This was double the average number of yearly intense storms from 1979 to 2017 (Gramling, 2018). Distributive environmental justice is also an issue with hurricanes. For example, according to Brodie et al., in the case of Hurricane Katrina, "more than 90% [of the evacuees] were African American, and approximately 6 in 10 had household incomes below \$20,000 in 2004" (2006)

## **Social Consequence**

### **Mental Health**

Climate change also results in major mental health challenges. In the United States, nearly 60% of Americans are concerned by the looming presence of climate change (Goldberg et al., 2020). There is a growing sense of impending doom that is afflicting people across the country, especially among young adults. Nearly half of young adults experience anxiety from climate change that impacts their daily lives (Bethune, 2020). Warmer temperatures from climate change also contribute to adverse mental impacts. Studies have shown that increased heat has a strong positive correlation with increased aggressive behavior such as crime or domestic violence (Anderson, 2001). Increased heat can

also lead to greater psychological stress and possibly suicidal behavior (Padhy et al., 2015).

## **Practices**

### **Electrifying Everything**

To restore the climate to Holocene-like conditions and address the consequences of climate change, two major things must happen. First, greenhouse gas emissions must be cut by implementing a large-scale roll-out of renewable energy and the electrification of appliances, vehicles, and buildings (Griffith, Fraser, and Calisch, 2020). Second, the current greenhouse gases in the atmosphere must be drawn down and sequestered (Project Drawdown, 2020).

Looking at sources of renewable energy, solar, and wind are the cheapest forms of energy in the United States right now (Kennedy, 2021). The price of solar has dropped 91%, and the price of wind energy has dropped 71% since 2009. Transitioning away from fossil fuels is both feasible and critical for mitigating the effects of climate change in America and the world (Abbott et al., 2022).<sup>228</sup> The effort to "electrify everything" will require a tripling in current electricity generation and a better-connected electrical grid system (Griffith, Fraser, Calisch, 2020). This would allow Americans to access renewable energy at any time, rain or shine. Transitioning to renewable energy and decarbonizing America brings with it a plethora of benefits. Most immediately, this change will eliminate all domestic air pollution related to climate change. This could save over 350,000 lives annually in the United States (Vohra et al., 2021). In addition, this will cut down about one-fifth of all emissions output worldwide (Griffith, Fraser, Calisch, 2020).

Fortunately, a few organizations are leading the charge (forgive the pun) in providing a framework for electrifying our grid. The main group is called Electrifying America and they have been pushing boundaries for several years in this field. In 2021, they released a handbook that acts as a guide for the country to move towards full electrification. Their golden rule is that every appliance that is replaced from here on out should be electric (Griffith, Fraser, Calisch, 2020). Something interesting about Rewiring America's proposal is

that it doesn't involve significantly changing our living habits or lowering our standard of living. In fact, it has the potential to improve the quality of life for many people as electricity costs will be cheaper.

While individuals need to participate, this transition can only be accomplished by policy changes. In 2022 the United States passed "the most significant climate legislation in US history" (EPA, n.d.). This act provides funding and tax credits for organizations and individuals to purchase electric appliances and vehicles and to transition to renewable energy. Policies like this are only passed after members of Congress receive pressure from their constituents. Organizations such as the Sierra Club, the Wilderness Society, and The Nature Conservancy often share petitions or letter-writing campaigns to help citizens use their voices to request change from lawmakers (The Wilderness Society, n.d., The Nature Conservancy, n.d., Sierra Club, n.d.). At the center of all of these initiatives is communication. Change starts with people talking about issues that are important to them. Dr. Katharine Hayhoe, the chief scientist for The Nature Conservancy and one of the leading voices on climate change invites everyone to start talking more about the effects of climate change. Most importantly, however, Dr. Hayhoe encourages that these conversations must be focused on hope for a better world (2021). Fear and guilt are not effective motivators for personal action; rather, they will end up pushing people away from acting (Stern, 2012). By focusing on how climate change is personally meaningful in people's lives, the psychological distance that often prevents individuals from caring can be reduced (McDonald, Chai, and Newell, 2015).

### ***Insights from the South Australian Region***

In the United States, there are not any current examples of complete electrification or decarbonization. However, the country of South Australia offers insight into the process and rewards of moving to green energy. In 2020, the country was generating over 60% of its energy from wind and solar sources (Baum and McGreevy, 2021). This came after being completely dependent on fossil fuels less than

two decades ago. Because of this transition, energy prices have dropped to around 3.6c/kWh during the day (Baum and McGreevy, 2021). This drop in prices is especially meaningful for low-income families because electricity now takes up a smaller percentage of their monthly bills. When looking at projections for eliminating fossil fuels over the next 50 years, there are incredible savings in terms of human life and economic gain. It is estimated that limiting warming to 2°C would "prevent roughly 4.5 million premature deaths, about 1.4 million hospitalizations and emergency room visits, ~300 million lost workdays, about 1.7 million incidences of dementia, and about 440 million tons of crop losses in the United States" (Shindell et al., 2021).

### ***Gaps***

Even after eliminating all greenhouse gas emissions, the negative effects of climate change would not immediately be resolved; it takes a very long time for these gases to be drawn back to Earth (Abbott et al., 2022). This is accomplished over time by supporting Earth's natural "sinks," or places that naturally sequester these gases. Sinks include places like forests, freshwater streams and lakes, and the ocean (Project Drawdown, 2020). There are also no countries that have transitioned 100% to green energy sources, making it difficult to determine what the full impact of decarbonizing America would be. Additionally, even when emissions are eliminated in the United States, the issue of climate change will still not disappear. Every other country would need to follow suit in decarbonizing their economy. Fortunately, because the United States is considered a world leader, it is possible that other nations would follow its example (Podesta and Stern, 2020)

Unfortunately, the United States has usually not been the first to take charge of international matters regarding the environment. In 1997, the Kyoto Protocol was presented to members of the United Nations. Representatives from the United States initially signed the agreement but never ratified it and eventually withdrew their signatures (Maizland, 2023). This protocol required participating countries to lower their emissions by 5% of their 1990 levels. The next international



climate treaty came in 2015 with the Paris Agreement. This required participating countries to set their own goals to reduce a certain percentage of emissions and to report on progress made every five years. The goal was to prevent Earth from warming over 2°C above 1850 temperatures. President Donald Trump withdrew the United States from this agreement for a time until President Joe Biden reentered the Paris Agreement during the first few months of his presidency (Maizland, 2023). There are no incentives for countries to keep their commitments which have put most countries lagging behind what they committed to do. One study suggests that even if all countries met their goals, it would only limit warming to 2.9°C which is significantly warmer than what is hoped for (Maizland, 2023).

## Conclusion

While climate change is certainly a global issue, it is critical to understand its impacts in the United States because its high levels of greenhouse gas emissions and global influence. The difficulty in passing climate legislation in the U.S. is compounded by the polarizing nature of the issue, despite the increasingly severe consequences seen in more frequent wildfires, extreme weather patterns, and disproportionate impacts on vulnerable populations. Addressing these challenges requires a focus on reducing fossil fuel dependence, with electrification emerging as a promising solution. Successful examples from other countries show that a shift towards renewable energy is possible, but meaningful progress hinges on decisive policy action. By embracing these changes, the U.S. can take a leadership role in mitigating climate change, protecting its most vulnerable citizens, and fostering a sustainable future.

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