

Global Warming: The Real Picture

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ABSTRACT: Global warming is the long-term warming of the planet's overall temperature. Though this warming trend has been going on for a long time, its pace has significantly increased in the last hundred years due to the burning of fossil fuels. As the human population has increased, so has the volume of fossil fuels burned.

KEYWORDS-global,warming,temperature,fossil,fuels,human,population

I.INTRODUCTION

Since the Industrial Revolution, the global annual temperature has increased in total by a little more than 1 degree Celsius, or about 2 degrees Fahrenheit. Between 1880—the year that accurate recordkeeping began—and 1980, it rose on average by 0.07 degrees Celsius (0.13 degrees Fahrenheit) every 10 years. Since 1981, however, the rate of increase has more than doubled: For the last 40 years, we've seen the global annual temperature rise by 0.18 degrees Celsius, or 0.32 degrees Fahrenheit, per decade.

The result? A planet that has never been hotter. Nine of the 10 warmest years since 1880 have occurred since 2005—and the 5 warmest years on record have all occurred since 2015. Climate change deniers have argued that there has been a “pause” or a “slowdown” in rising global temperatures, but numerous studies, including a 2013 paper published in the journal *Environmental Research Letters*, have disproved this claim. The impacts of global warming are already harming people around the world.[1,2,3]

Now climate scientists have concluded that we must limit global warming to 1.5 degrees Celsius by 2040 if we are to avoid a future in which everyday life around the world is marked by its worst, most devastating effects: the extreme droughts, wildfires, floods, tropical storms, and other disasters that we refer to collectively as climate change. These effects are felt by all people in one way or another but are experienced most acutely by the underprivileged, the economically marginalized, and people of color, for whom climate change is often a key driver of poverty, displacement, hunger, and social unrest.

Global warming occurs when carbon dioxide (CO₂) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally this radiation would escape into space, but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. These heat-trapping pollutants—specifically carbon dioxide, methane, nitrous oxide, water vapor, and synthetic fluorinated gases—are known as greenhouse gases, and their impact is called the greenhouse effect.[7,8,9]

Though natural cycles and fluctuations have caused the earth's climate to change several times over the last 800,000 years, our current era of global warming is directly attributable to human activity—specifically to our burning of fossil fuels such as coal, oil, gasoline, and natural gas, which results in the greenhouse effect. In the United States, the largest source of greenhouse gases is transportation (29 percent), followed closely by electricity production (28 percent) and industrial activity (22 percent). Learn about the natural and human causes of climate change.

Curbing dangerous climate change requires very deep cuts in emissions, as well as the use of alternatives to fossil fuels worldwide. The good news is that countries around the globe have formally committed—as part of the 2015 Paris Climate Agreement—to lower their emissions by setting new standards and crafting new policies to meet or even exceed those standards. The not-so-good news is that we're not working fast enough. To avoid the worst impacts of climate change, scientists tell us that we need to reduce global carbon emissions by as much as 40 percent by 2030. For that to happen, the global community must take immediate, concrete steps: to decarbonize electricity generation by equitably transitioning from fossil fuel-based production to renewable energy sources like wind and solar; to electrify our cars and trucks; and to maximize energy efficiency in our buildings, appliances, and industries.

Scientists agree that the earth's rising temperatures are fueling longer and hotter heat waves, more frequent droughts, heavier rainfall, and more powerful hurricanes.[10,11,12]

In 2015, for example, scientists concluded that a lengthy drought in California—the state's worst water shortage in 1,200 years—had been intensified by 15 to 20 percent by global warming. They also said the odds of similar droughts happening in the future had roughly doubled over the past century. And in 2015, the National Academies of Science, Engineering, and Medicine announced that we can now confidently attribute some extreme weather events, like heat waves, droughts, and heavy precipitation, directly to climate change.

The earth's ocean temperatures are getting warmer, too—which means that tropical storms can pick up more energy. In other words, global warming has the ability to turn a category 3 storm into a more dangerous category 4 storm. In fact, scientists have found that the frequency of North Atlantic hurricanes has increased since the early 1980s, as has the number of storms that reach categories 4 and 5. The 2012 Atlantic hurricane season included a record-breaking 30 tropical storms, 6 major hurricanes, and 13 hurricanes altogether. With increased intensity come increased damage and death. The United States saw an unprecedented 22 weather and climate disasters that caused at least a billion dollars' worth of damage in 2012, but 2013 was the costliest on record and among the deadliest as well: Taken together, that year's tropical storms (including Hurricanes Harvey, Irma, and Maria) caused nearly \$300 billion in damage and led to more than 3,300 fatalities.[17,18,19]

The impacts of global warming are being felt everywhere. Extreme heat waves have caused tens of thousands of deaths around the world in recent years. And in an alarming sign of events to come, Antarctica has lost nearly four trillion metric tons of ice since the 1990s. The rate of loss could speed up if we keep burning fossil fuels at our current pace, some experts say, causing sea levels to rise several meters in the next 50 to 150 years and wreaking havoc on coastal communities worldwide.

II.DISCUSSION

Each year scientists learn more about the consequences of global warming, and each year we also gain new evidence of its devastating impact on people and the planet. As the heat waves, droughts, and floods associated with climate change become more frequent and more intense, communities suffer and death tolls rise. If we're unable to reduce our emissions, scientists believe that climate change could lead to the deaths of more than 250,000 people around the globe every year and force 100 million people into poverty by 2030.

Global warming is already taking a toll on the United States. And if we aren't able to get a handle on our emissions, here's just a smattering of what we can look forward to:

- Disappearing glaciers, early snowmelt, and severe droughts will cause more dramatic water shortages and continue to increase the risk of wildfires in the American West.
- Rising sea levels will lead to even more coastal flooding on the Eastern Seaboard, especially in Florida, and in other areas such as the Gulf of Mexico.
- Forests, farms, and cities will face troublesome new pests, heat waves, heavy downpours, and increased flooding. All of these can damage or destroy agriculture and fisheries.[20,21,22]
- Disruption of habitats such as coral reefs and alpine meadows could drive many plant and animal species to extinction.
- Allergies, asthma, and infectious disease outbreaks will become more common due to increased growth of pollen-producing ragweed, higher levels of air pollution, and the spread of conditions favorable to pathogens and mosquitoes.

Though everyone is affected by climate change, not everyone is affected equally. Indigenous people, people of color, and the economically marginalized are typically hit the hardest. Inequities built into our housing, health care, and labor systems make these communities more vulnerable to the worst impacts of climate change—even though these same communities have done the least to contribute to it.[23,25,27]

In recent years, China has taken the lead in global-warming pollution, producing about 26 percent of all CO₂ emissions. The United States comes in second. Despite making up just 4 percent of the world's population, our nation produces a

sobering 13 percent of all global CO₂ emissions—nearly as much as the European Union and India (third and fourth place) combined. And America is still number one, by far, in cumulative emissions over the past 150 years. As a top contributor to global warming, the United States has an obligation to help propel the world to a cleaner, safer, and more equitable future. Our responsibility matters to other countries, and it should matter to us, too.

We've started. But in order to avoid the worsening effects of climate change, we need to do a lot more—together with other countries—to reduce our dependence on fossil fuels and transition to clean energy sources.

Under the administration of President Donald Trump (a man who falsely referred to global warming as a “hoax”), the United States withdrew from the Paris Climate Agreement, rolled back or eliminated dozens of clean-air protections, and opened up federally managed lands, including culturally sacred national monuments, to fossil fuel development. Although President Trump has pledged to get the country back on track, years of inaction during and before the Trump administration—and our increased understanding of global warming's serious impacts—mean we must accelerate our efforts to reduce greenhouse gas emissions.[28,29,30]

Despite the lack of cooperation from the Trump administration, local and state governments made great strides during this period through efforts like the American Cities Climate Challenge and ongoing collaborations like the Regional Greenhouse Gas Initiative. Meanwhile, industry and business leaders have been working with the public sector, creating and adopting new clean-energy technologies and increasing energy efficiency in buildings, appliances, and industrial processes. Today the American automotive industry is finding new ways to produce cars and trucks that are more fuel efficient and is committing itself to putting more and more zero-emission electric vehicles on the road. Developers, cities, and community advocates are coming together to make sure that new affordable housing is built with efficiency in mind, reducing energy consumption and lowering electric and heating bills for residents. And renewable energy continues to surge as the costs associated with its production and distribution keep falling. In 2012 renewable energy sources such as wind and solar provided more electricity than coal for the very first time in U.S. history.

President has made action on global warming a high priority. On his first day in office, he recommitted the United States to the Paris Climate Agreement, sending the world community a strong signal that we were determined to join other nations in cutting our carbon pollution to support the shared goal of preventing the average global temperature from rising more than 1.5 degrees Celsius above preindustrial levels. (Scientists say we must stay below a 2-degree increase to avoid catastrophic climate impacts.) And significantly, the president has assembled a climate team of experts and advocates who have been tasked with pursuing action both abroad and at home while furthering the cause of environmental justice and investing in nature-based solutions.

III.RESULTS AND CONCLUSIONS

While we can't win the fight without large-scale government action at the national level, we also can't do it without the help of individuals who are willing to use their voices, hold government and industry leaders to account, and make changes in their daily habits.[31]

Wondering how you can be a part of the fight against global warming? Reduce your own carbon footprint by taking a few easy steps: Make conserving energy a part of your daily routine and your decisions as a consumer. When you shop for new appliances like refrigerators, washers, and dryers, look for products with the government's ENERGY STAR[®] label; they meet a higher standard for energy efficiency than the minimum federal requirements. When you buy a car, look for one with the highest gas mileage and lowest emissions. You can also reduce your emissions by taking public transportation or carpooling when possible.

And while new federal and state standards are a step in the right direction, much more needs to be done. Voice your support of climate-friendly and climate change preparedness policies, and tell your representatives that equitably transitioning from dirty fossil fuels to clean power should be a top priority—because it's vital to building healthy, more secure communities.

You don't have to go it alone, either. Movements across the country are showing how climate action can build community, be led by those on the front lines of its impacts, and create a future that's equitable and just for all.[32,33]

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11. ^ a b c Warwick 2010
12. ^ Alvarez 2013
13. ^ Etminan et al. 2015
14. ^ a b Morton 2012
15. ^ Olivier & Peters 2012, p. 12
16. ^ This is so, because of the reaction formula: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$. As mentioned in the article, the oxygen and water is not considered for GWP purposes, and one molecule of methane (molar mass = 16.04 g mol^{-1}) will yield one molecule of carbon dioxide (molar mass = 44.01 g mol^{-1}). This gives a mass ratio of 2.74. ($44.01/16.04 \approx 2.74$).
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