

# **MECH-322 FLUID MECHANICS**

**GLOBAL WARMING AND CLIMATE CHANGE ESSAY:**

**“The Effects of Global Warming on Earth”**

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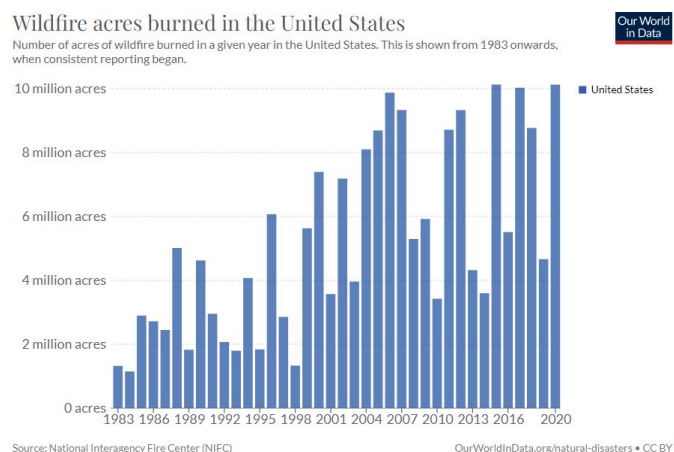
16 years ago, a documentary film titled *An Inconvenient Truth* brought climate change to the forefront of this nation's consciousness for one of the first times since Earth Day was created in 1970. Now, in 2022, we are still facing this battle and it is one that we will continue to face for years to come. But what does climate change mean and what does it mean for us people who call this little blue dot home?

Climate change was first coined in the 1980s to describe warmer surface temperatures but has evolved to cover the bigger issue of global warming. Global warming is caused by the greenhouse effect where the gasses Carbon Dioxide (CO<sub>2</sub>), Nitrous Oxide (N<sub>2</sub>O), Methane (CH<sub>4</sub>), Water Vapor (H<sub>2</sub>O), and Chlorofluorocarbons get trapped in Earth's atmosphere for long periods. The most common of these gasses is CO<sub>2</sub> which primarily comes from tailpipe emissions, production of electricity, and manufacturing/industry emissions. The built-up gasses reduce the amount of heat that can escape from the atmosphere which results in higher global temperatures [8].

With the earth's global temperature rising 0.23 degrees Fahrenheit (0.18 degrees Celsius) every year since 1981 [4], the effects on the climate are significant. The most extreme and obvious examples of these changes are demonstrated during periods of severe weather. Hurricanes gain strength due to warmer sea temperatures and climate change has seen an increase in these surface temperatures. That means the storms we are seeing now have a significantly higher chance of being more intense, longer-lasting, and more damaging [1]. Hurricane Harvey made landfall in Texas in 2017 as a category 4 hurricane before rapidly weakening down to a category 1. However, it took two days to slowly move over Texas, and in that time Harvey poured between 20in and 65in+ of rain down on Texas depending on location.

It was the flooding caused by the torrential downpour that did most of the \$125 billion worth of damage. That number ties Harvey with 2005's Hurricane Katrina as the costliest hurricane in US history. While Harvey and its rapid escalation from a tropical storm to a category 4 hurricane cannot be directly linked to climate change, the sheer amount of precipitation it dropped can be. The Clausius-Clapeyron equation states that as air temperature increases, the amount of water that air can hold also increases. It is this direct relationship and Harvey's slow movement over Texas that led to the destructive flooding witnessed [9]. It is important to note that Hurricane Harvey was an extreme event but not an outlier. The 2020 Atlantic Hurricane Season was the fifth above-average Atlantic Hurricane Season in a

**Figure 1: Graph of acres burned in US wildfires between 1983 & 2020, taken from reference 9.**



row and it also broke the record for most named storms in a single season, with 7 of them being major hurricanes. (Category 3 or above) Hurricanes are the most severe and easily identifiable extreme weather events to be affected by global warming but they are far from the only storms that have increased in severity. Studies have shown that heat waves in Europe are five times more likely and the increase in global heatwaves means that the wildfires may be more frequent and more damaging [3]. In the last 30 years, the amount of acres burned in the US alone has increased from 1.3 million acres in 1983 to 10.1 million acres in 2020 [10].

Global warming has also had vast effects on ecosystems and the inhabitants that reside in them. The easiest place to spot these effects is on Earth's north and south poles. A significant decrease in the total amount of Arctic sea ice has led to a change in polar bear hunting grounds. Now polar bears are spending more time hunting on land as opposed to their preferred sea ice-based hunting grounds. When polar bears hunt on land, they do not have access to their preferred seal pup diet. This change in the diet reduces their nutrition and decreases the total polar bear population to the point that there are only around 900 polar bears remaining in the Arctic Refuge Conservation Area.

Animals in the arctic suffer the most obvious effects but the damage is not limited to the north and south poles [5]. Warmer ocean temperatures mean there is a higher probability of mass oceanic reef destruction. There are some animal species such as the Australian Grey-Headed Robin and the Lemuroid Ringtail Possum that are at risk of extinction should temperatures continue to rise. The water cycle itself is also in jeopardy due to a variety of causes stemming from global warming. As sea levels rise, saltwater pollutes more and more groundwater which reduces its quality and usability. Temperature changes can change precipitation patterns leaving some areas with above-average precipitation and others with below-average. There are even some non-environmental effects that can be traced back to global warming. Higher temperatures mean that energy production efficiency decreases while an increase in oceanic water levels mean that insurance for homes on coastlines also increases. Even outbreaks of violence have their roots in this ecological disaster. A good example is the Arab Spring in 2010 which saw six governments overthrown in four countries, another five countries had elected-leadership change-overs and a total of over 61,000 fatalities. A contributing factor to the protests and revolts was a spike in wheat prices that were caused by a heatwave in Russia which decimated their wheat production [6].

Many agree that humans cannot simply stand idly by as we destroy our world year by year but many disagree on how to fix it. Starting, there are several different solutions to reduce the effects of climate change on both local and national levels. On a local level, households can do simple acts like

recycle more or buy fewer disposable products. Most household appliance manufacturers offer energy-efficient machines which reduce the amount of electricity per household and that in turn means that power plants need to burn less coal. Solutions only get bigger as we go up in scale from local households to national governments. Governments of the world, particularly in the US, have the difficult task of balancing competitive economic growth and increasing power demands with the need for environmental damage mitigation. Our electrical grid is powered primarily by environmentally

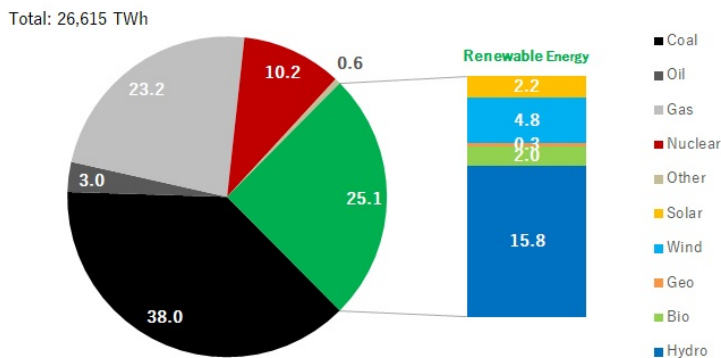


Figure 2: Pie chart of total energy produced (in %) by each energy production method, taken from reference 7.

devastating coal-burning power plants and there are plans to build more alternative energy producers like windmill farms, hydroelectric plants, and solar panel farms. Each of these alternative energy production facilities works best in a specific region. For instance, solar farms work great in Arizona or New Mexico but would not be effective in Delaware or Wisconsin where there is less sun.

The laws of economics can be a surprising asset in the fight for conservation. The government can give companies incentives to offset extra costs incurred by environmental protection steps or incentives can be given to moving the company's facilities to countries with stricter environmental regulations. Regulations can also be passed that limit what materials can be used in production so that companies have to use more recyclable materials. The Environmental Protection Agency (EPA) has been monitoring habitats, air quality, as well as enforcing environmental laws designed to prevent companies from hurting the environment for monetary gain. When companies violate those laws, fines can be levied and jail time can be issued to those responsible [2].

Climate change is a threat that has been around for decades but is just recently being taken seriously even though it is incredibly dangerous for every species on this planet. Changes to the world's weather patterns due to global warming are responsible for debilitating heatwaves, floods, and a noticeable increase in the severity of already severe weather. Endangered animals are at greater risk of extinction as they are unable to adequately adapt to rising temperatures or the loss of their habitats. Luckily, there are still things humans can do to reduce this disaster. We can recycle more and encourage companies to use more recyclable materials. Our government can offer incentives to alternative energy production facilities and to companies that work towards making their end product cleaner. When it comes to tackling the challenges of climate change, it is not a matter of should we do it, it is a matter of how quickly we can do it.

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