

Mech 322: Fluid Mechanics

“Climate Change and Global Warming:
Engineerings Next Major Hurdle”

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Many children have seen images of polar bears walking through tundra and those in Michigan awoke to a mountain of snow on Christmas morning. Well, this may soon be a thing of the past and a fictitious story for the children of the future. The effects of climate change and global warming are being seen more and more worldwide. Not only are temperatures increasing, but an increasing amount of natural disasters occur each year and places that rarely ever see snow have infrastructure that collapses instantaneously. In present times we often hear conversations about what sort of action must be taken to help prevent further decline, but no major action or new developments seem to be occurring. As engineers, it is our responsibility to ensure that we help tackle these issues. Not for profit or fame, but to ensure our children's children can wake up in a world that is not decaying due to the issues we as humans have caused.

To fully understand the issue society presently faces, climate change and global warming must be understood. Climate change is the natural shift in the climate of the earth; much like how the ice age occurred and then global heating occurred that would flood the earth and melt land bridges. It is defined by the United Nations as “...long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle.” Climate change is not independent of human influence and can be accelerated as well as worsened. Global warming is much more dependent on the influence of man. This is the result of an imbalance of greenhouse gases that causes Earth's atmosphere to deteriorate, which increases internal heating. NASA defines global warming as “Global warming is the long-term heating of Earth's surface observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere. This term is not interchangeable with the term "climate change." Hopefully, it is clear the difference and similarities between global warming and climate change.

It is important to understand where our climate started and where it is headed. The Wisconsin Department of Natural Resources accumulated data to analyze this change: “Since 1880, average global temperatures have increased by about 1 degrees Celsius (1.7° degrees Fahrenheit). Global temperature is projected to warm by about 1.5 degrees Celsius (2.7° degrees Fahrenheit) by 2050 and 2-4 degrees Celsius (3.6-7.2 degrees Fahrenheit) by 2100.” Although this may sound like a small increase to some, it will have a massive impact. Wildfires,

drought, and flooding will become more common than ever before. It was found that a decrease in average temperatures of 5 degrees was enough to cover all of the U.S. in snow 20,000 years ago. The rate at which temperatures have increased is only becoming larger.

With temperatures increasing this way engineers and scientists must come to a solution quickly to help before it's too late. There are many ways of attempting to lower temperatures but some are proving more effective than others. Well-known solutions are renewable energies; wind energy, hydro, solar power, and geothermal power. Although it is not a technology many companies are promising to be carbon neutral to help decrease the effects that they have on the climate. A third solution is called cloud seeding which is an act of creating rain clouds and simultaneously pulling CO₂ from the air. The main goal of all these solutions is to decrease CO₂ emissions. Although these methods are a step in the right direction they all have a common issue, efficiency.

Efficiency is one of the major hurdles preventing engineers and scientists from developing a solution to global warming and climate change. Creating “greener” energy is a very important factor in solving climate issues. Energy in the form of electric power contributes nearly 60% of the total global CO₂ emissions. Coal power plants operate at an efficiency of 33% and have an average lifetime of 46 years. The efficiency of solar panels is a maximum of 25%. This means that of all the energy the solar panel can store we can only effectively use 25% of it. Additionally, solar panels have a life span of 30-35 years, this is an important consideration because there must be maintenance for these panels. Wind turbines have an efficiency of 20-40% and a lifespan of 20 years. Lastly, hydroelectric power plants have an efficiency of 90 percent and an average lifespan of 100 years. Based on this information it would be very beneficial to focus on the expansion of hydroelectric power, although it would need to develop to create less impact on the water environment. Although, there are efficiency concerns for all of these energy solutions the carbon footprint is much less that that of fossil fuels.

Now energy solutions are not the only possible solutions, things like cloud seeding and carbon storage are very viable options. Cloud seeding is a “...deliberate introduction into clouds of various substances that act as condensation nuclei or ice nuclei in an attempt to induce precipitation. Although the practice has many advocates, including national, state, and provincial government officials, some meteorologists and atmospheric scientists question its effectiveness.” Cloud seeding seeks to help with droughting and melting, by producing rain or

snow clouds. This technology was used by the United States in Vietnam to worsen conditions for enemies, but it can also be used to ensure water reservoirs are stable and produce snowfall for arctic climates to prosper. Much like the issues of renewable energy the cloud seeding process is seen as highly inefficient. If engineering could solve the efficiency problem of this technology it could very likely be used to humanity's benefit.

Carbon storage/capture is a highly discussed topic and is regarded as a key method for reversing human impact on the environment. Carbon storage/capture is also known as carbon sequestration and is defined as “the long-term storage of carbon in plants, soils, geologic formations, and the ocean.” Although this occurs naturally many methods are being developed to allow for science to increase the amount of carbon storage that occurs. One method that is being investigated is the storage of CO₂ in underground traps. This could be done in man-made structures, or a more natural structure comprised of shale rocks and dense soil. To make sure this method is effective it must be made of porous and permeable material and at a significant depth. A current example of this method at work is the Sleipner Project in Norway, which is an ocean rig that is forcing carbon into the ocean floor that is then filtered through the materials of the ocean floor and consumed by the sea life and continues to store it underground.

After identifying some of the major possibilities in science and technology that could lead to a major impact in the fight against global warming and climate change, it is important to understand that as engineers we are obligated to help advance our society. Unfortunately, we have been forced into a situation where without solving these issues we will not have a society to advance for. It is of the utmost importance that our focus is on creating a stable global environment. It will take the commitment of all people globally. Setting aside issues lesser than global warming and committing our technological minds to a solution capable of creating massive amounts of change. Engineering isn't just a degree, but rather an opportunity to change the world for the better.

References

“Carbon Sequestration.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 8 Mar. 2023, <https://www.britannica.com/technology/carbon-sequestration>.

“Carbon Storage Faqs.” *Netl.doe.gov*,
<https://netl.doe.gov/carbon-management/carbon-storage/faqs/carbon-storage-faqs>.

“Cloud Seeding.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 17 Mar. 2023,
<https://www.britannica.com/science/cloud-seeding>.

“End-of-Life Management for Solar Photovoltaics.” *Energy.gov*,
<https://www.energy.gov/eere/solar/end-life-management-solar-photovoltaics#:~:text=The%20estimated%20operational%20lifespan%20of,in%20the%20next%20few%20decades>.

Lifetime Limits for Coal Power Plants. We Show Lifetimes of Retired ...

https://www.researchgate.net/figure/Lifetime-limits-for-coal-power-plants-We-show-lifetime-s-of-retired-units-a-and-the_fig3_336654082.

“Overview: Weather, Global Warming and Climate Change.” *NASA*, NASA, 7 Feb. 2023,
<https://climate.nasa.gov/global-warming-vs-climate-change/>.

Renewable Energy Fact Sheet: Wind Turbines - US EPA.

https://www.epa.gov/sites/default/files/2019-08/documents/wind_turbines_fact_sheet_p100il8k.pdf.

“Transformative Power Systems.” *Energy.gov*,
<https://www.energy.gov/fecm/transformative-power-systems#:~:text=The%20average%20coal%2Dfired%20power,States%20operates%20near%2033%25%20efficiency>.

“What Is Climate Change?” *United Nations*, United Nations,
<https://www.un.org/en/climatechange/what-is-climate-change>.

“World of Change: Global Temperatures.” *NASA*, NASA,
<https://earthobservatory.nasa.gov/world-of-change/global-temperatures>.