

MECH-322 – Fluid Mechanics

Climate Change and Global Warming

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As of the last few decades, a major topic of discussion and debate has been that of global warming and climate change. Climate change is a term used to describe the long-term change of temperatures and weather due to increased levels of carbon dioxide and greenhouse gasses in the atmosphere. Mankind contributes to through its processes of power generation, manufacturing, deforestation, transportation, and food production. While some argue that climate change is not a real phenomenon, the National Oceanic and Atmospheric Administration (NOAA) reports that since 1880, the earth's average temperature has risen 0.08 °C every decade, which is far above normal. Climate change is a very real and increasingly dangerous threat, and it is our responsibility as engineers to not only communicate the dangers of climate change, but also to assist society in mitigating it. By creating courses of action to minimize the present-day effects of climate change, as well as creating solutions to combat global warming in the future, engineers can contribute to incredible, positive change for society.

Although 0.08 degrees every decade does not seem like a large number, over time it compounds and so too do its effects on the environment and the earth's ecosystems. According to the United States Environmental Protection Agency (EPA), the rate of change in the average sea levels across all the earth's oceans has increased over the past century, and from 1993 to today it has increased at a rate of 0.14 inches per year (maximum). An example of the harm of this effect can be observed in the city of Venice, Italy, which is known for its canals that wind through the city. Because of climate change compounding with groundwater extraction, Venice has been sinking for years and in the worst case scenario is projected to be completely submerged by 2100. This phenomenon is not unique to Venice, as many coastal cities will eventually experience the same effects of ocean water engulfing their cities. However, climate change will not just affect those who live in coastal areas, it will affect everyone. The U.S Fish & Wildlife service has also released a statement about climate change and in which they say, "...some species populations may decline, many will shift their ranges substantially, and still others will face increased risk of extinction." (FWS). As the earth loses species of animals, its ecosystems are thrown out of balance and other animal populations and plant life have the potential to go extinct as well. These are only a few of the ways that climate change will impact our world. How exactly does mankind contribute to temperatures rising? To a degree, climate change can happen naturally due to general cycles of temperatures rising and falling over thousands of years, but the earth has seen over a 200% increase in the rate of rising temperatures since 1980 (NOAA). This rate of growth does not happen organically. Since the discovery of electricity, mankind has been producing energy for consumption by burning a variety of fossil fuels and natural gas, which creates carbon dioxide as a byproduct. When CO₂ gets deposited into the atmosphere, it contributes to the greenhouse effect which traps infrared energy from

the sun and projects some of it towards the surface of the earth. This would be less of a problem, however, if we had more trees to process carbon dioxide into oxygen. Because of deforestation, the earth has lost over a trillion square meters of forest coverage over the surface of the earth from the year 2000 to 2020 (Global Forest Watch, 2020). At the rate temperature increases are compounding over time, climate change is extremely dangerous to the earth and its inhabitants and will change the world as we know it.

As engineers, it is imperative that we collectively contribute to the mitigation and eventual resolution of this phenomenon, which is a looming danger to society. Engineers are directly involved in setting the operations and standards of industrial practices including power generation and manufacturing, which are some of the leading contributors to climate change, so we have the power to enact real change within these industries. In the present day, there are many power generation firms that have this same goal in mind. One of these firms is NextEra Energy Inc, which is a clean energy company in Florida that relies on mostly wind and solar energy to achieve a generation capacity of around 30,000 megawatts of power. NextEra Energy has pledged to reduce their carbon emissions 70% by 2025 and has also pledged to the public that they will achieve zero carbon emissions “...by no later than 2045...” (NextEra Energy Inc., 2022). In addition, scientists and engineers all over the world have been trying for decades to achieve a nuclear fusion reaction. Nuclear fusion as a means of energy production is so important to the mitigation of climate change because there is no carbon emissions and no nuclear waste that results from energy creation. On December fifth of 2022, scientists at the Lawrence Livermore National Laboratory in California were able to generate a fusion reaction that achieved net positive energy. Although decades away from true implementation into actual large-scale energy production, it is a glimpse of hope for annihilation of carbon emissions in the energy sector. With regard to manufacturing there are similar pledges to fight climate change. The Volvo group, a predominantly automotive-focused manufacturer and distributor that is based in Sweden, has publicly pledged to reach the goal of net zero emissions by 2040. They hope to accomplish this by increasing production of electric and fuel-cell electric automobiles and decreasing the manufacturing of internal combustion engine powered cars. Other companies, such as General Motors, have also set a goal to reach carbon neutrality by 2040. Ford Motor Company has also set a goal of reaching net zero carbon emissions by 2050. With such a push to electrify automobiles, however, there are still challenges that must be overcome. One of these challenges is the availability of the necessary infrastructure to make electric vehicles (EV) practical for any consumer to use and depend on. There are many areas in the more rural parts of the United States that have been deemed “charging deserts” because there is a lack

of available public charging stations for an electric vehicle owner to use. In addition, as the market grows for electric vehicles, a major concern for the capacity of the power grid has arisen from states and countries that want to focus on being able to meet the needs of consumers in the EV market. As of 2023, the National Renewable Energy Laboratory (NREL) is investigating the capabilities of the power grid by testing different fast-charging systems on vehicles with a variety of battery compositions, capacity, and thermal designs. By focusing on improving technologies now, scientists and engineers have been able to develop a widely accepted course of action and standard for curbing the rate of climate change on earth.

Looking more towards the future, there are a few technologies that could also help mitigate the effects of climate change on the environment. Because of the rise in temperatures across the globe in recent years, many people have become worried about the long term ramifications on plant life, specifically food sources. The Innovative Genomics Institute, based in California, hopes to combat climate change by genetically engineering plants and soil microbes to capture and store carbon dioxide. As explained in their press release on June 14, 2022, when carbon is removed from the atmosphere by plants, it is quickly released back into the air by soil microbes. If successful in their research, the Innovative Genomics Institute would be able to store carbon in the soil for a long period of time, thus reversing the effect of CO₂ in the atmosphere. The Innovative Genomics Institute is working to tackle the reversal of carbon pollution, but another impending problem for some countries is that of the rising sea level. The Netherlands has a long history of fighting massive flooding across its land, as an eighth of it lies below sea level. After a flood in 1953, which resulted in many casualties, the Dutch started work on a dam that is able to adapt to rising sea levels, up to 40 meters. This solution includes modular gates that allow flow of water, but can quickly block it off in the event of a storm. The design also allows sea life to traverse across the barrier freely, so it causes minimal disruption to the ecosystem. The Dutch have also developed other ways to combat a rising sea level by creating lakes that become reservoirs in the event of a flood. Because of these solutions, the Netherlands have been able to withstand incredible floods and save the lives of many of the Dutch people. In order to resist the ramifications of the sea levels rising, many countries should try to incorporate the lessons that the Dutch have painstakingly learned over many centuries.

Climate change is one of the most looming problems that the world is challenged with combating. It is an unfortunate challenge that has been passed down to us from previous generations, but that does not mean that this generation should pass it onto the next. Engineers, scientists, and activists all over the world should constantly work to resolve this issue. By setting lofty goals in regard to

energy generation and manufacturing, engineers and scientists are able to inspire others to follow their example and join the shared vision of creating zero-carbon emission operations across the globe.

Looking toward the future, researchers focused on reversing the impact of carbon on our environments and mitigating the effects of the rising sea levels create a beacon of hope for the future of society. We as engineers do not just have a responsibility to ourselves, but to improve the conditions and lives of others in the years to come.

References

- Lindsey, Rebecca, and LuAnn Dahlman. "Climate Change: Global Temperature." *NOAA Climate.gov*, National Oceanic and Atmospheric Administration, 18 Jan. 2023, <https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>.
- "Climate Change Indicators: Sea Level." *EPA*, Environmental Protection Agency, <https://www.epa.gov/climate-indicators/climate-change-indicators-sea-level#:~:text=When%20averaged%20over%20all%20of,as%20the%20long%2Dterm%20trend>.
- "Climate Change." *FWS.gov*, U.S Fish & Wildlife Service, <https://www.fws.gov/initiative/climate-change>.
- "Climate." *Climate | Volvo Group*, Volvo Group, <https://www.volvogroup.com/en/sustainable-transportation/responsible-business/climate.html>.
- "Global Deforestation Rates & Statistics by Country: GFW." *Global Forest Watch*, Global Forest Watch, <https://www.globalforestwatch.org/dashboards/global/?category=summary&dashboardPrompts=eyJzaG93UHJvbXB0cyI6dHJ1ZSwicHJvbXB0c1ZpZXdZCI6W10sInNldHRpbmdzIjp7Im9wZW4iOmZhbHNILCJzdGVwSW5kZXgiOjAsInN0ZXBzS2V5Ijoiln0sIm9wZW4iOnRydWUslInN0ZXBzS2V5IjoizG93bmxvYWREYXNoYm9hcmRTdGF0cyJ9&location=WyJnbG9iYWwiXQ%3D%3D&map=eyJjZW50ZXliOnsibGF0IjoyNy42MjQ3MzQ2MjI1Mzg4NzclmXuZyI6MS4xMDg3OTkwMjMyODANjF9LCJkYXRhc2V0cyI6W3siZGF0YXNldCI6InBvbGloaWNhbC1ib3VuZGFyaWVzIiwibGF5ZjZlZjIjImRpc3B1dGVkLXBvbGloaWNhbC1ib3VuZGFyaWVzIiwicG9saXRpY2FsLWJvdW5kYXJpZXMlXSwiYm91bmRhcnciOnRydWUslm9wYWNpdHkiOjEsInZpc2liaWxpdkhkiOnRydWV9LHsiZGF0YXNldCI6Ik5ldC1DaGFuZ2UtU1RBROlORyIsImxheWVycyI6WyJmb3Jlc3QtbnV0LWNoYW5nZSldLCJvcGFjaXR5IjoxLCJ2aXNpYmlsaXR5Ij0cnVILCJwYXJhbXMiOnsidmlzaWJpbGloesi6dHJ1ZSwiYWRtX2xldmVsljoiYWRtMCI9fV19&showMap=true>.
- Magazine, Smithsonian. "Cities around the Globe Are Eagerly Importing a Dutch Speciality-Flood Prevention." *Smithsonian.com*, Smithsonian Institution, 5 Dec. 2019, <https://www.smithsonianmag.com/innovation/cities-around-globe-eagerly-importing-dutch-speciality-flood-prevention-180973679/>.

Meintz, Andrew. "Electric Vehicle Grid Impacts." *NREL.gov*, National Renewable Energy Laboratory, <https://www.nrel.gov/transportation/electric-vehicle-grid-impacts.html>.

"NextEra Energy Sets Industry-Leading Real Zero™ Goal to Eliminate Carbon Emissions from Its Operations, Leverage Low-Cost Renewables to Drive Energy Affordability for Customers." *NextEra Energy Newsroom*, NextEra Energy Inc., 14 June 2022, <https://newsroom.nexteraenergy.com/2022-06-14-NextEra-Energy-sets-industry-leading-Real-Zero-TM-goal-to-eliminate-carbon-emissions-from-its-operations,-leverage-low-cost-renewables-to-drive-energy-affordability-for-customers>.

"Supercharging Plants and Soils to Remove Carbon from the Atmosphere." *Innovative Genomics Institute (IGI)*, Innovative Genomics Institute, 14 June 2022, <https://innovativegenomics.org/news/crispr-carbon-removal/>.