

MECH-322 FLUID MECHANICS

GLOBAL WARMING AND CLIMATE CHANGE ESSAY:

**Climate Change & Engineering
Humanity's Survival**

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TIME FOR TRUTH

Things have changed from being probable to a fact. The Intergovernmental Panel on Climate Change (IPCC), created to provide scientific assessments on climate change, has stroke down the denialism and confirmed that humanity raised temperatures of the atmosphere, the ocean, and the land. Extensive investigations on global warming causes, consequences, as well as possible scenarios related to greenhouse gases emitted in the coming decades have been published as proof of the effects of human actions on the planet, making the denial of this event merely impossible.

Greenhouse gases are generated when creating energy by burning fossil fuels, and these gases are the main responsible for global warming. GHG emissions have not stopped rising since the Industrial Revolution, and they have reached dangerous and unusual levels over the years. The perfect example of this is the concentration of carbon dioxide in the atmosphere, which reached the highest level in the last two million years (Lindsey, 2020). Another example of the consequences of greenhouse gases emissions is the global temperature increase, which is higher with respect to pre-industrial levels.

While talking about climate change and global warming, the best way to explain its effects is by demonstrating the rise in carbon dioxide and global temperature, which are easy factors to explain since showing an increasing graph can do the job. However, these are not the only consequences that humanity's actions have. This temperature rise has consequences that include extreme meteorology events, sea-level rise, extinction of species, food cost increase, etcetera. This investigation will cover the not-commonly heard effects that global warming has had over the years, as well as projected consequences for future decades.

Climate Change and Land

No human life would exist without land, which includes water bodies, since these are the principal providers that sustain life in the world. No evolution would have been possible without the benefits given by the land, such as food, water, ecosystems, and biodiversity. Since land is such a vital part of human life over history, it has been significantly affected over time: around three-quarters of the surface has been affected by humans, including 60-85% of forests and 70-90% of other ecosystems (Jia & Shevliakova , 2016).

The burning of fuels such as coal, petroleum, and gases to generate electricity, heat, and transportation is the principal cause of emissions generated by humankind. The second most important cause is deforestation, which releases carbon dioxide into the atmosphere. It is estimated that logging, fires, and other forms of forest degradation release an average of 8.1 billion metric tons of carbon dioxide per year, representing over

twenty percent of all global emissions (Jia & Shevliakova , 2016). Other activities that generate air pollution include fertilizer use, livestock production, agriculture, and roads construction.

The over-exploitation of land resources has generated an increase of about 1.5°C in the average temperature, compared to data during 1800-1900. The effects of these warmer temperatures reflect in the change of start and end date of seasons, the sea-level rise, reduced freshwater availability, as well as in social and economic challenges related to food supply and consumption. The effects of climate change are often projected as a future scenario, while in reality, society is living these effects day by day. Climate change is not only reflected on our ecosystems but also in our economy. If urgent action to stop over-exploitation is not considered, society will face multiple negative impacts.

Climate Change and Food

Winter and Summer are more similar each time and Fall and Spring can now be considered one season. Climate change is a reality that affects every aspect of our lives, including food production. These temperature and season variations harm fields and orchards around the globe, forcing agriculturists to make drastic and expensive decisions to be able to face increasing temperatures. Global warming alters the development and reproductive cycle of the plants, overtaking flowering and harvesting times and decreasing crop performance. Temperature variations also generate the proliferation and propagation of plagues, making fertilizers a usual tool among agriculturists.

As production, one of the pillars of food security, is increasingly affected by climate change, society faces instability related to food distribution and accessibility, situation that has taken place over the past years. While 821 million people are currently undernourished, 2 billion adults are overweight (Mbow & Rosenzweig, 2016). If no implementation methods towards climate change are considered, society can face an even greater social instability than the one we are facing nowadays.

Climate Change and Poverty

From a poverty standpoint, climate change will slow down the economic growth throughout the globe, making even harder the reduction of poverty and creating new poverty zones, concentrated mainly in urban areas and emerging famine zones. It is also expected that climate change will increase masses' displacement. The populations that lack resources for planned immigration will face more exposure to extreme climate events, particularly developing countries with low income. Climate change can increase the chance of violent conflicts by amplifying the contributing factors that led to these situations, such as poverty and economic crisis, even when done indirectly.

In urban zones, climate change might increase risks to society, affecting the resources, the economy, and the ecosystems. These risks include scenarios such as storms, floods, contamination, water scarcity, sea level rise, etcetera. These risks will amplify if there is a lack of infrastructure, public services such as electricity, water, and sanitation, and even an increase in food production.

Effective decision-making to limit climate change and its effects must assess risks and benefits by using the information provided by a wide range of approaches; these decisions should consider several factors such as politics, ethics, values, equity, and economy. And they must also respect different perspectives and responses to risk and uncertainty. Without additional mitigation efforts to the ones existing nowadays, global warming will result in a high risk of severe, widespread, and irreversible impacts throughout the globe by the end of the twenty-first (XXI) century.

A substantial reduction of greenhouse gases emissions can significantly reduce risks associated with climate change during the upcoming decades. In order to minimize these risks, it is necessary to limit carbon dioxide emissions, which, in turn, would include reducing all emissions of incoming years to zero if possible.

Adaptation can reduce climate change consequences, mainly when focusing on the magnitude and velocity of these risks. Adaptation guidelines implemented for the short-term can contribute to the improvement of our future. Our capacity to respond will improve if current measures are viewed from a long-term standpoint and the perspective of sustainable development.

ENGINEERING OUR SURVIVAL

Energy consumption is a good marker to test welfare and prosperity of a population, however, the concept of energetic crisis appears when our main sources of energy, from which society is supplied, run out. The economic model that we currently live in depends on a continues growth, which means there is an increasing demand on energy. However, energy demand is one of the main reasons why society has numerous environmental issues regarding climate change. If upcoming economic models keep demanding energy consumption, and no environmental measure are taken, this energy demand can bring disastrous consequences.

An alternative to reduce greenhouse effect and protect our planet and our society is the use of clean energies. NCSEA defines clean energy as “Energy derived from renewable, zero-emissions sources, as well as energy saves through energy efficiency measures” (2022). Although several renewable energies have been recently implemented on a daily basis, such as solar and wind energies, as well as hydroelectric power, we have yet one extensive energy source to study and develop in order to ensure good quality living for the future: Nuclear Energy.

Nuclear energy is the second largest source of low-carbon electricity in the world. The U.S. Department of Energy has provided an overview of this process, explaining that it is a zero-emission clean energy that generates power though fission, process of splitting uranium atoms for the energy production. Additionally, the heat released by fission is used to create seam that spins a turbine to generate electricity. Nuclear energy is about 1 million greater than other energy resources, below is a figure provided by the Department of Energy (2021).

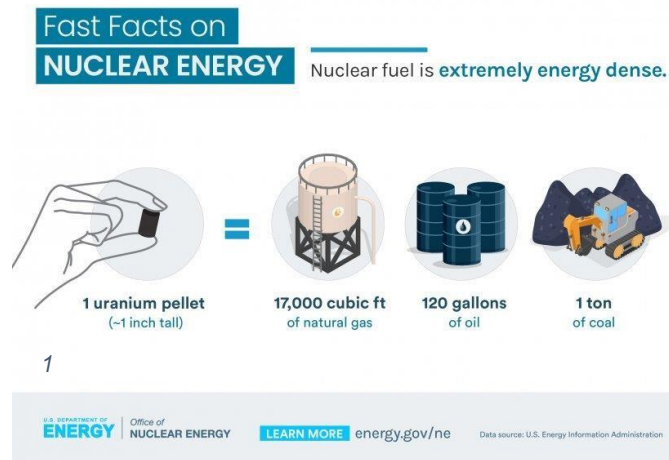


Figure 1. Nuclear Energy Comparison

Although nuclear electricity is considered as the holy grail of clean energy, there is yet a lot to analyze before overcoming technological, engineering, and economic issues related to this process. ITER, one of the most ambitious energy projects in the world, is designing a fusion device that will prove that fusion at a large scale is possible. The ITER Tokamak (*Figure 2*), expected to release in December 2025, will be the first fusion device to produce net energy. If ITER is capable of generating the first fusion device, the commercial production of fusion-based electricity will mark a new era for clean energies (6).

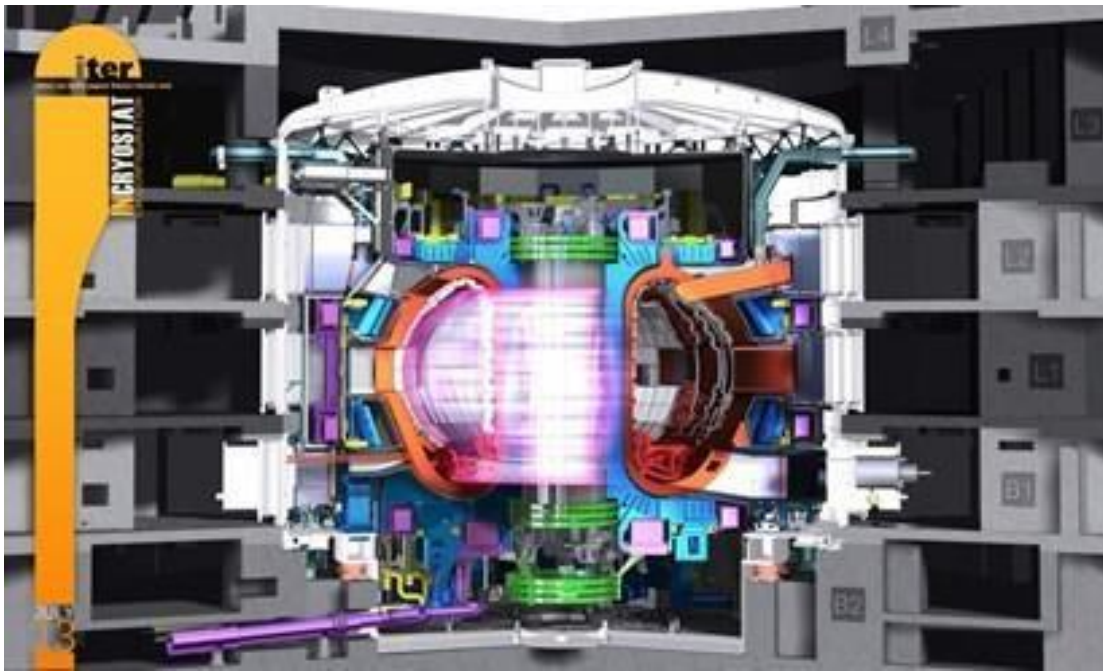


Figure 2. ITER Tokmak, first fusion device engineered.

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