

Global Warming and Climate Change

Introduction

A once natural greenhouse effect that sustained life on Earth ultimately is leading towards the destruction of our planet. Human activities from the past and present have altered this phenomenon and increased the rate of greenhouse gas emission production as a result of increased energy needs. Continued lack of interest for this phenomenon and the effects of it will result in total climate change. As we as a society move towards the future, alternative energy sources such as solar, wind, hydroelectric, bio-energy, geothermal, waves, hydrogen, and nuclear power become just some of the potential solutions to combat this issue. Energy efficient buildings, cities, and vehicles are also options moving towards a more sustainable future. It is clear that action urgently needs to be taken. These solutions listed above are strong technologies to help the progression of an eco-friendly society and there will be more solutions to come.

Climate Change and Global Warming

Climate change is something the world is now heavily combating. With the planet heating up around 1.2°C, society is continuously looking for new improvement methods for the world. The world's projected numbers for the average temperature increase are going to negatively affect our planet. This is illustrated in Fig. (1). Through the continuous burning of fossil fuels, our planet has and will continue to completely change [1]. With this in mind, there are numerous effects of climate change that not only the younger generations have experienced, but their future generations will be exposed and used to in society.

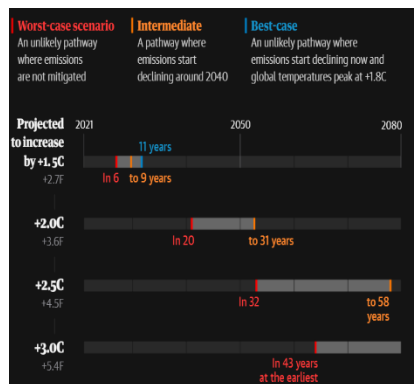


Fig. (1) Guardian graphic. Source: IPCC, 2021: Summary for Policymakers. Note: The IPCC scenarios used for best-case, intermediate and worst-case scenarios are SSP1-2.6, SSP2-4.5 and SSP5-8.5 [1].

The Greenhouse effect is a natural process that warms the Earth's surface. Solar radiation reaches Earth's atmosphere, where about 70% of the radiation permeates the atmosphere, reaching Earth's surface. This heat is absorbed by Earth's atmosphere, oceans, and lands. These gasses also absorb radiation from the Earth's surface and send it towards space. Some heat is trapped within this layer, however [2]. At the heights of 5-10 km upward, where temperature is 30 to 50 C, gasses are colder and emit less radiation, trapping it underneath this layer. This creates a 'blanket layer' where gasses are colder at the top, while keeping Earth's surface warmer at the bottom [3]. Greenhouse gasses are beneficial to keeping the Earth warm enough for

sustaining life, however, human activities have rapidly increased the quantity of greenhouse gasses in the atmosphere. An increase in the amount of greenhouse gasses has led to a rise in Earth's temperature from less solar radiation being sent back into space, trapping the heat between Earth's surface and the 'blanket layer'. The image below (Fig 2) summarizes this effect [4]. A once natural phenomenon has been corrupted from the pollution of the atmosphere.

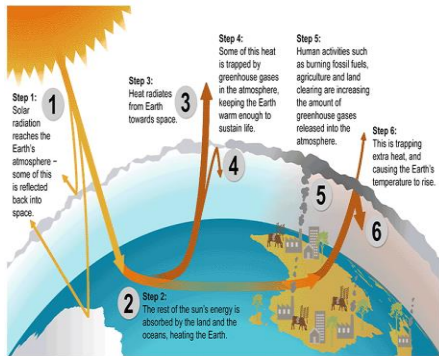


Fig. (2) Greenhouse Effect Infographic [4]

The effects of global warming and climate change are frightening, but the causes are identifiable and, with proper cooperation, can easily be addressed.

Alternative Energy

As global warming continues to develop across the globe alternative energy sources have become a more viable option for the future. These sources include different means of power generation that do not require the use of fossil fuels to operate. In 2018, the majority of energy sources used by Asia & Pacific, North America, Europe/Eurasia, and the Middle East as shown in figure (5) below.

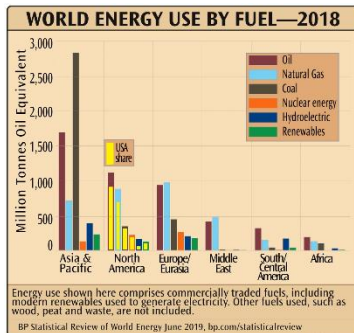


Fig. (3) World Energy Use by Fuel in 2018 [5]

Over time, there has been an increase in the use of renewable sources for energy generation despite the continued growth still in the petroleum and natural gas industries, but there has been a decrease in the amount of coal use which is a step in the sustainable direction [5]. Renewable energy sources include the use of hydropower, wind power, solar PV (photovoltaic)/concentrated solar power, bio-energy, geothermal, ocean, and hydrogen. Hydropower produces electricity from generators driven by turbines. The system converts potential energy of fast-flowing or falling water into mechanical energy that can be used as electricity. Wind power utilizes the air stream present to produce electricity. Solar power converts sunlight to usable energy. Bio-energy utilizes living organisms such as plants, organisms, and waste as renewable energy [7]. Geothermal energy is derived from the earth's natural heat and supplies clean, renewable power around the clock [8]. Ocean energy utilizes the waves and tides to move mechanical

parts. Lastly, hydrogen can be used as an alternative energy source. This resource is a versatile energy carrier that can tackle critical energy challenges as it can be used for almost all energy resources [6]. Today a lot of hydrogen is produced using fossil fuels which creates carbon dioxide emissions. In order to be a better sustainable energy option, it is important to use clean hydrogen that is produced from renewables.

Engineering Challenges

As engineers today, it is important that we focus on sustainable development as a whole so we have a world to be a part of. This includes not only utilizing pre-existing renewable technologies such as those listed above, but creating new technologies while being conscious of the life cycle in product/technology development. It is not longer an option to just create a new method or new apparatus. We as engineers must use our knowledge in all areas to create a solution that is efficient to stop unnecessary usage of fuels and power, analyze and improve the effects the product outputs have such as emissions from vehicles as one example, as well as a variety of other factors. It is the time we as new engineers to the field stop what has been rather consistent in the engineering world of not considering the effects outside of product function and think deeply about how we can make a product sustainable for our world as well as having functionality and improvements from previous products.

Conclusion

As we progress towards the future, it is clear that changes are needed to combat the extent of climate change caused by greenhouse gas emissions. In order to move towards a less carbon-intensive and more sustainable energy pathway, renewables including solar, wind, hydropower, bio-fuels, and others are at the center of this transition [6]. There are many benefits to using alternative energy sources when using renewable resources such as no emissions while operating, providing high efficiency, and being cost effective, but it is key to understand the environmental impacts of each option when creating the infrastructure, their total benefit, and their after-effects.

Globally, the transition to renewables and climate change impacts are talked about widely, but there are improvements that can be made to fix current infrastructure and technology and reach new energy/electricity outputs. As this sector continues to grow and be implemented, the goal would be that the projections of global warming/climate change would be further out in the future and eventually non-existent. However, there is a long way to go as some of the alternative energy sources are yet to be mass produced and used globally.

References

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