Chapter 8

Climate Mitigation in Three Parts: Energy, Land, and Removal

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The implementation of climate policies will need to promote revolutionary social changes in order to achieve emission reductions consistent with 1.5°C warming targets. As part of our efforts to align climate policy with broader societal goals, particularly those related to sustainable development, it is assess the plausible and significant pathways to armed conflict and political violence. It is also identify how climate mitigation policies affect these aspects of socioeconomic development. According to analysis, effects on economic performance, income and livelihoods, food and energy prices, and land tenure are most likely to intensify conflict risks. This is depending on the level of tension in the community and the socioeconomic vulnerability of the community. It may be crucial to mitigate these dangers through different climate policy approaches that promote more desirable societal outcomes like equity and inclusion. To better understand and mitigate conflict risks, it will be necessary to combine research with thorough monitoring and evaluation of the intermediate effects. This will be effects at the beginning of policy implementation. Additionally, by defining future conflict risks under climate policy, it will be possible to make a more detailed

comparison between conflict risks under different mitigation strategies. This is due to the fact that severe climate damage occur.

Keywords: *Climate Mitigation***,** *climate change, economies, United Nations*

INTRODUCTION

It is not possible for a single nation to accomplish the goals of creating a sustainable energy future, combating climate change, and restoring natural values on its own. It is necessary to make responsible decisions as well as to devote time to finding workable solutions to complex social, economic, and environmental problems in order to accomplish this undertaking. Consequently, it is imperative that governments, corporations, organizations, and communities all over the world collaborate towards creating sustainable futures. Thus, the United Nations (UN) has established 17 sustainable development goals, which include mitigation of climate change and the transition to net zero emissions, as well as improving quality of life. Goal 13 (climate action) emphasizes the necessity of taking immediate action in order to address climate change and its consequences in this regard. Essentially, the goal of this initiative is to achieve long-term structural changes in the atmosphere that will alter the trajectory of CO2 concentrations [1]. There is a strong consensus among climate experts that climate change is a phenomenon that is primarily a result of human activity [2,3,4,5]. The fact remains that there is widespread agreement that natural phenomena, such as volcanic eruptions, changes in oceanic currents, variations in solar radiation, and other natural phenomena, contribute to the development of this phenomenon [6, 7]. Furthermore, there is universal agreement that fossil fuels are the primary source of carbon dioxide emissions, one of the key factors contributing to climate change [8, 9, 10]. As a result of other factors and activities, such as deforestation, agriculture, soil degradation, and other directly human-induced impacts on the environment [11, 12], high levels of CO2 emissions can also be released into the atmosphere. This must be kept in mind at all times. The use of fossil resources in a sustainable manner, the introduction of clean and efficient alternative energy sources, and the management of land and water in a practical and meaningful manner can all be considered methods for reducing the increasingly negative environmental impacts of economic and other human activities at substantial levels [14, 15]. While the concept of climate neutrality is currently receiving considerable attention on a global scale, real action geared toward the future is still needed to produce any long-lasting impact [16, 17]. In addition, achieving net-zero economies can only be accomplished through international cooperation since it necessitates a significant shift in the way that the world's energy infrastructure is organized. Additionally, there is a need for greater transparency in the market pertaining to carbon objectives, and targets that have been established as having a net zero carbon footprint need to be converted into carbon-negative targets as soon as possible. Unfortunately, the development of this area is proceeding at a painfully slow pace and encounters resistance.

Human history has demonstrated that several crises on both the humanitarian and economic fronts have had a significant impact on carbon dioxide emissions. There was a significant decrease in CO2 emissions during World Wars I and II, whereas emissions have increased significantly during periods of peace [19, 20].

2. Climate change status

"Climate change" is described as a change in climatic patterns largely caused by greenhouse gas emissions. Global warming is a result of greenhouse gases trapping heat from the earth's surface in the atmosphere. Both natural systems and human actions produce the majority of these emissions. Human activities are largely related to energy production, industrial activities, forestry, land use, and land-use changes [22]. The study of global greenhouse gas emissions from natural systems and anthropogenic activities was conducted by Yue and Gao. Natural systems include forest fires, earthquakes, seas, permafrost, wetlands, mud volcanoes, and volcanoes [21]. According to them, the natural system of the earth is self-balancing, while anthropogenic emissions add additional pressure to the natural system [21].

3. The impact of climate change on wind resources

In addition to altering the geographical distribution of wind resources and their inter- and intra-annual variability, global climate change may also affect the wind energy sector. It has been demonstrated that researchers can derive higher resolution forecasts of climate parameters of interest through the use of downscaling methods that utilize Coupled Atmosphere-Ocean General Circulation Models (AOGCMs, also referred to as Global Climatic Models (GCMs). It is important to distinguish between dynamic downscaling (using regional climate models) and statistical downscaling (utilizing empirical transfer functions between large-scale and local climate variables). A dynamic downscaling process uses restricted area models (RCMs), which are numerical models that are based on the same or similar numerical techniques and parameterizations as GCMs, but are run at a higher resolution over a defined region. As opposed to GCMs, RCMs have spatial resolutions above or near 0.5° (e.g., in the NARCCAP project [16] and the PRUDENCE [17] and ENSEMBLES [18] and [19] projects in Europe). It is theoretically more accurate to downscale using RCMs than empirical downscaling, and it is also possible to do so for any location regardless of measurements of surface variables. There are also parameterizations used in dynamical downscaling to represent unresolved processes (e.g., processes on subgrid scales) in dynamical downscaling. The empirical constants employed in RCM parameterizations are based on data in the domains where the models were developed and may not be entirely transferrable to other climate regimes [20]. Although RCCMs are better at resolving topography and coastline than GCMs, lateral boundary information is obtained from GCMs in which they are nested. In a complex topography, they are able to provide more spatial variability and may be useful when fine-scale dynamical processes, such as mesoscale circulations, are causing high levels of spatial variability.

As a result, it is very difficult to simulate the near-surface wind conditions and energy density with GCMs and RCMs. In future simulations [25], [26], [27], model-to-model variability is equivalent to the climate change signal in future simulations as it does not perfectly capture current wind regimes [21], [22], [23], or historical trends [24]. In order to compensate for subgrid variability and truncations of wind speed probability distributions, a number of RCMs use gust parameterizations [22] and postprocessing to boost wind speeds [23] for post-processing.

It has been demonstrated that the estimates of wind speed and energy density are not significantly affected by climate change scenarios when compared to those derived from the SRES emission scenario [28], but that they are considerably influenced by lateral boundary conditions (e.g., nested GCMs) [27].

It is possible to connect GCM climate characteristics to local variables using statistical downscaling by using transfer functions. Although realistic scenarios and robust transfer functions employ GCM information at scales where it is most accurate [29], they also require strong and steady correlations between predictors and predictands, which may not be possible in a dynamic climate environment. Statistical downscaling does not require surface orographic and roughness maps, but transfer function generation does. Statistical downscaling allows several GCMs to be downscaled because of its cheap processing costs.

For statistical downscaling, underestimating variability has been a fundamental difficulty, which leads to a limited range of applications, such as for wind speeds and energy densities, in which the entire probability distribution is needed. There have been two approaches to addressing this issue: inflation, where the simulated variability is multiplied by a specified factor (or sometimes using techniques that ensure that the resultant variability is correct), and randomization, where noise (often from the synoptic scale) is added to increase variability. There is no need to modify this technique with new techniques [31, 32]. In this approach, the Weibull coefficients A and K are directly downscaled from sea-level pressure and vorticity (i.e., predictors drawn from GCM simulations). In northern Europe, this approach was capable of reproducing independent data (such as mean and 90th percentile wind speed and energy density) very well [33]. As a result of the application of the technique to the output from ten GCM simulations, it has been shown that stochastic influences within individual simulations had a very small impact on wind climate projections, but a major source of uncertainty comes from differences in predictors drawn from different GCMs (i.e., descriptors of the large-scale flow). As a result, the conclusion is consistent with the assessment made using a RCM, which similarly showed the critical importance of using a nested GCM to determine wind regime climate sensitivity.

However, it is possible to generalize downscaling studies on wind speeds and energy density in Europe despite these restrictions. By the end of the 21st century, northern winter energy density is likely to rise [27] and fall in the southeast [34], and wind speeds are also likely to increase. There is a strong correlation between the positive phase of the North Atlantic Oscillation [36], which can be a powerful predictor of wind speeds in northern Europe during the winter months [37] and the displacement of poleward storm tracks [29]. The results from the new probabilistic empirical downscaling method which uses downscaling of the Weibull distribution parameters to stations in northern Europe using a suite of GCMs revealed that, up until the middle of the twenty-first century, there were no significant changes in wind energy density, and that by the end of the century there would be very little change in the mean wind speed and the 90th percentile wind density, both of which would be comparable to the current variability.

4. Climate change and the use of renewable energy

"Climate change" has become a topic of scientific and political concern worldwide. The rapidity of climate change in recent years is concerning, and it may pose a potential threat to the world. During the previous 36 years (1979–

2014), carbon dioxide concentrations grew from 1.4 to 2.0 ppm per year [36] [37]. According to the UN Framework Convention on Climate Change, climate change is caused either directly or indirectly by human activities altering the composition of the global atmosphere. International climate debate has been focused on the issue of limiting global warming by 2 degrees Celsius for more than ten years [39]. As fossil fuel usage has increased, the amount of carbon dioxide emissions has increased significantly as well. In 2010, fossil fuel use accounted for the largest share of anthropogenic greenhouse gas (GHG) emissions worldwide, with concentrations exceeding preindustrial levels by 390 parts per million (39%) [40]. There are many benefits of renewable energy sources, such as being clean, reducing environmental impacts, creating little secondary waste, and being sustainable for current and future economic and social needs. As a result of the replacement of fossil fuels with renewable energy technologies [41], greenhouse gas emissions and global warming may be reduced.

5. An overview of greenhouse gas emissions

It is known that greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), fluorinated gases such as HFCs, PFCs, and SF6 (UNFCCC 2008). Using a 2019 UNEP study [42], total greenhouse gas emissions in 2018 were 55.3 GtCO2e, of which 37.5 GtCO2 originated from fossil energy generation and industry emissions. In 2018, global greenhouse gas and fossil CO2 emissions increased by 2%, compared to 1.5% over the previous decade. It is believed that higher energy demand drives 2018 fossil CO2 emissions growth. Land-use change contributed to 3.5 GtCO2 emitted in 2018. In 2018, fossil fuels and land use accounted for 74% of all global greenhouse gas emissions. In 2018, methane (CH4) emissions increased 1.7% compared to 1.3% annually in the prior decade. The amount of nitrogen oxide (N2O) emissions increased 0.8% compared with a 1% annual growth rate over the previous decade. As for fluorinated gases, they increased 6.1% in 2018 compared to 4.6% during the prior decade [43]. A recent Intergovernmental Panel on Climate Change (IPCC) study has shown that human activities have caused global warming by an estimated 1.0 °C over the pre-industrial level of the planet. It is likely that global warming will reach 1.5 degrees Celsius by 2030-2052 if present emission rates continue [44].

6. Global climate action

In 1979, the first international climate conference was held in Geneva to acknowledge climate change. In response to recent weather events, the International Meteorological Organization established the world climate conference. We aimed to engage technical and scientific specialists in analyzing and predicting future consequences and hazards related to climate change and variability generated by natural and human systems [45]. It was likely the first climate change meeting to be held. In 1988, the World Meteorological Organization and the United Nations Environment Programme (UNEP) created the Intergovernmental Panel on Climate Change (IPCC) in order to offer governments and official entities scientific information and knowledge related to climate issues [46].

As a matter of fact, perhaps the most significant measure was the adoption of the UNFCCC in 1992, which was implemented in 1994. Since then, the UNFCCC has driven global climate action. Its aim is to prevent the occurrence of climate disruption by stabilising the concentrations of greenhouse gases in the atmosphere. In accordance with the treaty, industrialised nations were required to implement national measures aimed at controlling anthropogenic emissions as well as boosting greenhouse gas sinks. This was in order to achieve the goal of reducing greenhouse gas emissions by 2000 by reducing emissions to 1990 levels. It is necessary for developed countries to also help the most vulnerable developing countries to deal with climate change, financially as well as technologically. The convention created the organizational framework, the reporting standards, and the funding methods for global climate policy [47]. 197 nations have signed the convention [48].

As part of the Kyoto protocol, there are four different units of reduction of greenhouse gas emissions, and each of these units can be traded [49]. These units each represent one metric tonne of CO2 equivalent.

1. An Emission Reduction Unit that has been certified by participating in the Clean Development Mechanism as a responsible producer
2. Compliance units for emission reductions, which were acquired through the completion of collaborative project implementation projects.
3. Allocate amount units that have been obtained through participants trading unused assigned emissions to achieve an allocated amount.
4. It would also be appropriate to have a unit for tree removal, acquired through the activities related to trees maintenance and planting.
5. Impacts, risks, and vulnerabilities of climate change

A key to understanding the present climate emergency is to understand the effects of climate change on natural and human systems as well as the risks and vulnerabilities associated with it. Various factors, such as temperature, precipitation, sea-level rise, ocean acidification, and severe weather (UNCCS), have been identified in a recent study by the UN Climate Change Secretariat. Droughts, floods, hurricanes, severe storms, heatwaves, wildfires, cold periods, and landslides [43].

According to CRED, the globe experienced 315 natural catastrophes in 2018, mostly climate-related. There were sixteen droughts in 2018, 26 heat waves, 127 floods, 13 landslides, 95 storms, and 10 wildfires. As a result, 68.5 million people suffered from floods, hurricanes, and droughts in 2018. Of the total losses, 93% came from storms ($700.8B), floods ($19.7B), wildfires ($22.8B) and droughts ($9.7B). A number of statistics provided by CRED show significant increases in yearly averages of catastrophes over the past decade, with wildfires the exception. In 2018, wildfires alone caused economic losses equal to those of the previous decade, which is alarming (CRED 2019). Wildfires directly emit CO2 into the atmosphere. Although wildfires are part of the natural system, human-induced emissions interfere and increase their effect. Numerous natural catastrophes are caused by human-caused climate change. Many countries are increasingly vulnerable to climate change because of factors such as temperature changes, precipitation variability, altering seasonal patterns, disease distribution changes, desertification, ocean-related consequences, soil degradation, and coastal degradation. It is believed that food, water, health, ecology, human habitat, and infrastructure are among the most sensitive sectors to climate change, and Africa is the most vulnerable region in the world [51].

There is also a significant importance to recognizing the interconnection between these areas and their consequences. Global Risks Report 2020, a report published by the World Economic Forum, discusses climate realities and where they are affecting the world. A number of dangers were identified as well, such as health problems, natural disasters, and undue strain on ecosystems, particularly aquatic and marine ones. There is also a threat to food and water security. Climate change, extreme weather, and rising sea levels may contribute to migrations. As governments exploit resources along sea and land borders, geopolitical tensions and confrontations are likely to occur. Additionally, the study examines how rising systematic risks affect capital markets and the impact this has on supply chains and commerce in the long run.

The effects and dangers of global warming of 1.5°C and 2°C were assessed by the IPCC in a special study. As a result of global warming, freshwater supplies, food security, production systems, ecosystems, human health, urbanization, poverty, and community structure were studied as well. A study examined the impact of climate change on tourism, energy, and transportation. Most evaluated consequences had lower risks at 1.5°C than at 2°C. There is a good chance that we will reach 1.5 degrees Celsius within a few decades, and that warming beyond 1.5 degrees will exacerbate risk impacts; for example, water stress will double at 2 degrees Celsius compared to 1.5 degrees Celsius. There would be 70% more people affected by river floods if the temperature rose by 2 °C than under 1.5 °C, especially in the United States, Europe, and Asia. Species extinction rates in terrestrial ecosystems are likely to double or triple if temperatures rise by 2 °C.

CONCLUSION

It is imperative that quick development of methods for mitigating and adapting to climate change is undertaken as a result of the climate emergency. A literature review examined three primary climate change mitigation strategies: conventional mitigation, negative emissions, and geoengineering for radiative forcing. There is no final answer to climate change, and all possible technologies and strategies should be used to address it. Decarbonization activities alone are not sufficient to fulfill the Paris agreement's objectives; therefore, another abatement technique is needed in order to meet the Paris agreement's objectives. In spite of being an intriguing idea for regulating the earth's radiation budget, geoengineering isn't a long-term solution since it doesn't address the root cause of the problem. It will only buy us time until greenhouse gas levels stabilize and fall. In order for the technology to be implemented, it must still be developed, tested, and its negative effects to be addressed. This process can take quite some time. Negative emission technologies assist in the process of decarbonization. Some of the negative emissions solutions discussed in the literature review may still be in development; however, biogenic sequestration approaches can be implemented immediately. It is not difficult to capture CO2 through photosynthesis, but the process must be incorporated into a technical framework in order to work. Carbon pricing for negative emissions is in its infancy, available only via voluntary markets for a limited number of carbon removal techniques, and technologically nonexistent for most of the technologies described. As far as carbon removal is concerned, the price of carbon is insufficient to support carbon removal programs, with the exception of afforestation and reforestation, but as carbon markets develop and provide removal incentives, this may change. In order to actively encourage negative emission initiatives, policymakers and governments must focus on carbon pricing. To encourage carbon removal initiatives, the financial sector should provide financial assistance and access, as well as adopt market-based methods. In the case of biologically based sequestration initiatives, financial resources and policy support can be utilized effectively since many of the technologies linked to this approach can be implemented immediately after conception. In order to achieve this, it will be necessary to set up efficient carbon pricing systems that focus on carbon removal. Research and development funding is also important to ensure the long-term sustainability of such systems.

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