FUNH 5000 Essay 2
What are the solutions to climate change?

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Introduction

Climate change is one of the most pressing challenges facing humanity today. It is primarily driven by human activities that have intensified since the Industrial Revolution, including the burning of fossil fuels, deforestation, and industrial agriculture. These activities release vast amounts of greenhouse gases, such as carbon dioxide (CO_2) and methane (CH_4), into the atmosphere. These gases trap heat, leading to global warming, which in turn triggers a cascade of environmental consequences: rising sea levels threaten coastal communities, more frequent and intense extreme weather events disrupt livelihoods, and ecosystems face unprecedented disruptions. The United Nations has aptly described it as "the defining issue of our time," noting its profound impacts on food production, water security, and the risk of catastrophic flooding worldwide.

In response to this global crisis, governments have taken significant steps to mitigate and adapt to climate change. Internationally, the Paris Agreement [1], adopted in 2015 by 196 parties, sets a goal to limit global warming to well below 2 °C above pre-industrial levels, with an aspirational target of 1.5 °C. Environmental researchers also play an indispensable role in this area, providing the scientific foundation for informed decision-making. Through climate modeling, they predict future scenarios and assess impacts on diverse areas such as human health, biodiversity, and socio-economic systems. Recent studies underscore the urgency of their work: Fang et al. [2] found that climate change contributed to 12.8% of fire-related deaths in 2010, while Carleton et al. [3] demonstrated that climate policies aligned with revenue redistribution can simultaneously reduce inequality and emissions. Research [4] also highlights biodiversity threats, with species distributions shifting rapidly.

Effective climate action depends on vital partnerships between governments and researchers. Policymakers create regulatory frameworks while researchers provide essential data and impact assessments that strengthen these initiatives. Though progress has occurred, significant obstacles persist, including inconsistent policy implementation and unequal research funding across regions. Future success will require translating innovative scientific findings into practical governance solutions and enhancing global collaborative efforts to address climate change and create a sustainable world. In the following sections, I will firstly list three main factors then provide the potential solutions for the corresponding problems.

Main Factors to Climate Change and Potential Solutions

Factor1 : Burning of Fossil Fuels

The use of coal, oil, and natural gas continues to be the biggest driver of our changing climate. When we burn these fossil fuels for electricity, transportation, and manufacturing, they pump carbon dioxide into the air. This CO_2 builds up in the atmosphere, trapping heat like a blanket and warming the planet. Despite growing awareness of this problem, our world still heavily depends on these energy sources, which is why addressing this issue remains such a huge challenge in the fight against climate change. To reduce the use of fossil fuels, more renewable energy sources and nuclear power should be taken into more area of our daily life. For example, we can accelerate the development of new energy vehicles, replacing more internal combustion engine vehicles with electrically-driven automobiles, thereby reducing petroleum consumption. On the other hand, accelerating research on reducing losses in power transmission equipment can assist nations in more efficiently transmitting electrical resources, thus minimizing losses during the transmission process.

Factor 2: Deforestation

The clearing of forests for farming, logging, and urban growth represents another major climate change driver. These forests normally serve as carbon sinks that absorb CO_2 from our atmosphere. When we cut them down, we not only release the carbon they've stored but also reduce Earth's ability to capture future carbon emissions. Research highlights the severity of this issue: the FAO's 2020 report [5] indicates deforestation contributes roughly 10% of global CO2 emissions, while a 2018 Science study found tropical deforestation alone accounts for approximately 20% of emissions from land use changes. To mitigate these impacts, enhanced cooperation and exchange between nations is necessary to implement control measures and interventions addressing deforestation. More importantly, it is essential to promote the development of high-technology agriculture, enhance food production efficiency, and commit to producing greater crop yields on the same land area, thereby reducing the need for deforestation.

Factor 3: Agricultural Practices

Agricultural practices represent a substantial contributor to anthropogenic climate change through complex pathways that extend beyond carbon dioxide emissions. The agricultural sector accounts for approximately one quarter of total global greenhouse gas (GHG) emissions when considering both direct farm activities and associated land-use changes. Livestock production systems generate significant methane through enteric fermentation and manure management, while the widespread application of synthetic fertilizers leads to nitrous oxide emissions via soil microbial processes. To offset these impacts, research on carbon emissions and carbon neutrality needs to be further refined. This would enable effective guidance and constraints for agricultural production processes.

Solutions to Climate Change

To solve the problem, it requires a comprehensive approach targeting the main contributors: fossil fuels, deforestation, and agricultural practices. The renewable energy transition from fossil fuels to sustainable alternatives like solar and wind power represents a cornerstone strategy already gaining momentum worldwide. Complementing this, reforestation efforts such as Africa's Great Green Wall initiative demonstrate how nature-based solutions can simultaneously capture carbon and restore ecosystems. Agricultural transformation through reduced meat consumption, improved farming techniques, and more efficient land management offers another vital pathway to lowering emissions. Underpinning these practical approaches, international frameworks foster essential collaboration among nations, creating accountability and shared commitment to limiting global temperature rise. Together, these science-backed, collaborative strategies provide a realistic roadmap for effectively addressing our climate challenges.

The Imperative for Enhanced New Energy Research

Building upon these integrated strategies, perhaps the most crucial solution lies in the aggressive development of new energy sources, particularly electricity from renewable sources and nuclear power to replace fossil fuels. These alternative energy sources offer significant advantages: they produce electricity with minimal or zero greenhouse gas emissions during operation, can be deployed at various scales from individual buildings to national grids, and many renewable technologies are becoming increasingly cost-competitive with conventional energy sources. The environmental impact of these transitions would be profound, with studies suggesting that a comprehensive shift to new energy could significantly reduce global carbon emissions in the power sector alone. Nuclear energy, despite concerns about waste management, provides reliable base-load power with near-zero emissions, while advances in solar, wind, and hydroelectric technologies continue to improve efficiency and reduce land-use requirements. However, realizing the full potential of these solutions demands more research investment to address remaining challenges such as energy storage capabilities, grid integration of intermittent renewable sources, enhanced safety protocols for nuclear facilities, and the development of next-generation technologies like fusion power. Only through sustained scientific advancement coupled with policy implementation can we fully harness these promising alternatives to create a sustainable energy future.

Statement of AI Usage

When writing the article, I used Grok to gather relevant content for the second section "Main Factors to Climate Change and Potential Solutions." Grok provided me with the main causes of climate change, and then I wrote the other parts based on my own thinking combined with content from class. The search result is shown in the following picture.

The answer from Grok is listed as follow:

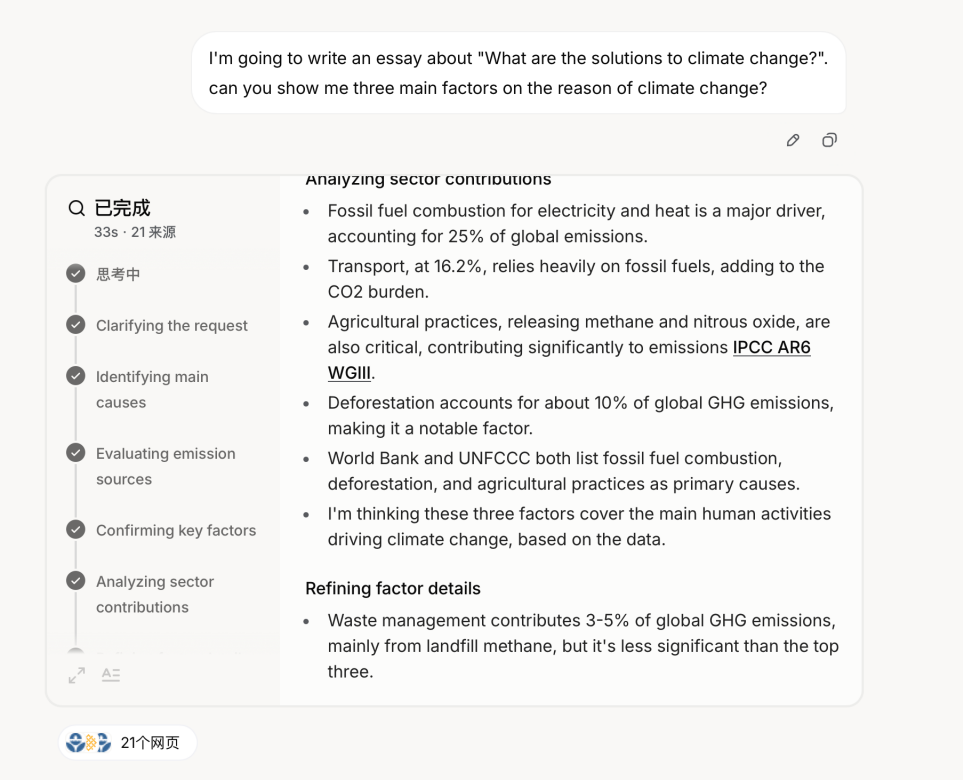

Figure 1: Example of AI usage

Key Points

Research suggests the main factors causing climate change are burning fossil fuels, deforestation, and agricultural practices. It seems likely that these activities significantly increase greenhouse gas emissions, contributing to global warming. The evidence leans toward fossil fuel combustion being the largest contributor, with deforestation and agriculture also playing key roles.

Burning Fossil Fuels

Burning fossil fuels, such as coal, oil, and natural gas, for energy production and transportation releases carbon dioxide (CO2), the primary greenhouse gas driving climate change. This activity is a major source of emissions, accounting for a significant portion of global warming.

Deforestation

Deforestation, often for agriculture or logging, reduces the Earth's ability to absorb CO2 through trees and releases stored carbon into the atmosphere. This process contributes to increased greenhouse gas levels, exacerbating climate change.

Agricultural Practices

Agricultural practices, including livestock farming and fertilizer use, release methane (CH4) and nitrous oxide (N2O), both potent greenhouse gases. Livestock, especially cows and sheep, produce methane through digestion, while fertilizers emit nitrous oxide, adding to the climate impact.

References

[1] P. Agreement, "Paris agreement," in *report of the conference of the parties to the United Nations framework convention on climate change (21st session, 2015: Paris). Retrived December*, vol. 4, no. 2017. HeinOnline, 2015, p. 2.

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[3] R. S. Tol, "The distributional impact of climate change," *Annals of the New York Academy of Sciences*, vol. 1504, no. 1, pp. 63–75, 2021.

[4] J. A. Lawlor, L. Comte, G. Grenouillet, J. Lenoir, J. A. Baecher, R. Bandara, R. Bertrand, I.-C. Chen, S. E. Diamond, L. T. Lancaster *et al.*, "Mechanisms, detection and impacts of species redistributions under climate change," *Nature Reviews Earth & Environment*, vol. 5, no. 5, pp. 351–368, 2024.

[5] M. A. Mekouar, "15. food and agriculture organization of the united nations (fao)," *Yearbook of International Environmental Law*, vol. 31, no. 1, pp. 326–340, 2020.