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Conflict in Advancement of Renewable Energy Technologies

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Abstract— This study investigates the conflicts surrounding the advancement of renewable energy technologies, utilizing a sample of 200 questionnaires to gather data. The research is grounded in a conceptual framework that explores the key challenges and barriers to the adoption and development of renewable energy, such as technological, financial, and social factors. Data analysis was conducted using the simple percentage method, which helped quantify the responses and identify trends within the data. The findings reveal that major conflicts arise from high initial investment costs, inadequate infrastructure, and a lack of public awareness about renewable energy benefits. Additionally, policy and regulatory uncertainties were cited as significant barriers to the growth of renewable energy sectors. Based on these findings, the study recommends that governments implement clearer and more consistent policies, invest in infrastructure development, and launch educational campaigns to raise awareness about the importance and potential of renewable energy technologies. Furthermore, financial incentives and subsidies should be introduced to reduce the cost burden on both businesses and consumers.

***Index Terms*— Renewable energy, Conflicts, Inadequate infrastructure, Technological.**

1. Introduction

The transition from traditional fossil fuels to renewable energy sources such as solar, wind, and hydroelectric power has become a central focus of global energy policy. Amid growing concerns about climate change, environmental degradation, and energy security, renewable energy technologies promise a sustainable solution to the world's energy needs. However, the widespread adoption of these technologies faces numerous challenges that hinder their development and implementation. These conflicts arise from a combination of technical, economic, political, and social factors, each presenting significant obstacles to achieving a green energy future (IEA, 2023; IPCC, 2021). One of the key conflicts in advancing renewable energy technologies lies in the technical limitations of existing infrastructure. The integration of renewable energy into national grids can be complex, especially with intermittent sources like solar and wind, which do not produce energy consistently (Lund et al., 2020). Storage technologies, such as advanced batteries, are critical to mitigating these challenges, but they remain costly and inefficient in comparison to traditional energy storage methods (Gorman, 2021). This technological gap creates a significant barrier to large-scale adoption, as energy providers and governments are hesitant to invest in solutions that are not yet proven or economically viable (IRENA, 2022).

Another major conflict stems from the economic challenges faced by renewable energy technologies. While the cost of producing renewable energy has dramatically decreased over the past decade, with solar and wind becoming increasingly competitive with fossil fuels (REN21, 2022), the upfront investment required for large-scale projects remains high (IRENA, 2022). Additionally, the renewable energy market is still heavily subsidized in many countries, making it difficult for these technologies to compete on a level playing field with fossil fuels (World Bank, 2023). This subsidy dependence also creates a volatile market where shifts in political leadership can drastically alter the trajectory of renewable energy investments, creating uncertainty for investors and developers alike (UNFCCC, 2021). Political and regulatory conflicts further complicate the advancement of renewable energy technologies. Governments around the world are at different stages of commitment to renewable energy, with some offering strong policy support while others prioritize the protection of existing fossil fuel industries (Buchanan, 2020). Policy inconsistencies, lack of long-term vision, and the influence of vested interests in fossil fuel industries can slow down or even reverse progress. For example, some countries have seen a rollback of renewable energy policies following changes in leadership or economic crises, undermining public and private sector confidence in the future of green energy (Carter & Brown, 2021).

In addition to the technical and political challenges, there are significant social conflicts surrounding the adoption of renewable energy technologies. Public acceptance plays a crucial role in the success of renewable energy projects, but opposition often arises due to concerns about the environmental impact of large-scale projects. Wind farms, for instance, have faced opposition in some regions due to concerns about their aesthetic impact, effects on wildlife, or noise pollution (Pfenninger et al., 2020). Similarly, the expansion of solar farms and hydropower can sometimes disrupt local communities or ecosystems, leading to resistance from environmentalists, indigenous groups, and residents (Baker et al., 2021). This creates a complex dynamic where the benefits

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of renewable energy must be weighed against the potential negative consequences on local communities and ecosystems. Finally, the global nature of energy markets further complicates the development of renewable energy technologies. While some regions have made significant strides in adopting renewable, others remain heavily dependent on fossil fuels due to local economic conditions, natural resource availability, or geopolitical considerations (Gielen, 2022). For instance, some oil-rich nations may be reluctant to invest in renewable energy technologies as they rely heavily on the revenue from fossil fuel exports. The lack of a coordinated global approach to renewable energy development results in uneven progress and missed opportunities for collaboration, making the goal of a global green energy transition more difficult to achieve (Bogaard, 2021).

2. Conceptual Clarification

The topic of "conflict in the advancement of renewable energy technologies" centers on the complex challenges and opposing factors that hinder the widespread adoption and development of renewable energy. These conflicts can arise from economic, political, technological, and social barriers, all of which interact and compound the difficulties in scaling up renewable energy systems. Understanding the nature of these conflicts is critical to formulating policies and strategies to overcome them.

A. Economic Conflicts: Cost and Investment Barriers

Economic factors are among the most significant conflicts in the advancement of renewable energy technologies. While renewable sources like solar, wind, and hydroelectric power offer long-term savings and sustainability, the initial investment required for renewable energy infrastructure can be high. This initial financial burden creates a conflict between immediate cost-saving and the future benefits of renewable technologies. Additionally, fossil fuel industries, which have been heavily subsidized for decades, create further economic tension, as they may resist transitioning to renewable energy due to the potential loss of market share. The shift towards cleaner technologies often requires large-scale investments in research, manufacturing, and deployment infrastructure, making it harder for developing nations to compete in the global energy market (Hoffman, 2023; Ochoa et al., 2022).

B. Political Conflicts: Policy and Regulation

Another major source of conflict is political, particularly related to policy frameworks and governmental support. Governments worldwide face pressure from various stakeholders, including fossil fuel industries, lobbying groups, and international organizations. This creates a conflict of interest, as policies might favor short-term economic interests (e.g., fossil fuels) over long-term environmental benefits (e.g., renewable energy). Additionally, inconsistent and often insufficient governmental incentives, lack of clear regulations, and political instability can delay the implementation of renewable energy technologies. Countries with vast fossil fuel resources may be reluctant to adopt policies that could reduce their dependence on these resources, further deepening political conflicts (Sullivan, 2023). For example, countries like Saudi Arabia and Russia, which rely heavily on fossil fuel exports, may prioritize these resources over renewable energy alternatives (Alam, 2021).

C. Technological Conflicts: Innovation vs. Traditional Energy Systems

Technological conflicts in the renewable energy sector often emerge from the competition between emerging energy technologies and traditional energy systems. The renewable energy sector is relatively new compared to the established fossil fuel-based energy industry. While there has been significant progress in renewable technologies such as solar panels, wind turbines, and battery storage systems, these innovations still face several challenges related to efficiency, scalability, and storage. For instance, the intermittent nature of solar and wind power requires significant advancements in energy storage technologies, such as batteries, to ensure a reliable energy supply. The reliance on legacy grid systems designed for fossil fuels further complicates the integration of renewable energy sources. Additionally, renewable energy technologies often require substantial innovation, which can lead to conflicts between industry players that push for faster commercialization versus those advocating for more thorough testing and reliability (IEA, 2023; Xu et al., 2024).

D. Social Conflicts: Public Perception and Behavioral Barriers

Social and behavioral conflicts also play a significant role in the slow adoption of renewable energy technologies. Public perception of renewable energy can be influenced by a variety of factors, including misinformation, resistance to change, and cultural attitudes towards environmentalism. For example, some communities may view wind farms or solar panels as an eyesore, or they may be skeptical about the reliability and efficiency of these technologies. The transition to renewable energy also often requires shifts in lifestyle, such as increased energy efficiency, changes in transportation habits, and investments in new appliances. These shifts can be met with resistance, especially in regions where people are accustomed to the convenience and affordability of fossil fuel-powered systems. Social conflicts can also arise from job losses in traditional energy sectors, particularly coal mining, oil extraction, and natural gas industries, which may lead to pushback from workers and local communities dependent on these jobs (Green, 2022).

E. Environmental Conflicts: Land Use and Ecological Impact

While renewable energy technologies are seen as environmentally friendly, they are not entirely free from environmental impacts. The large-scale implementation of renewable technologies such as solar farms and wind turbines requires significant land use, which can lead to conflicts with other land-based needs, such as agriculture, forestry, or wildlife conservation. For example, large wind farms can disrupt bird migration patterns, and solar farms may require large tracts of land, potentially impacting biodiversity. Moreover, the

extraction of materials necessary for renewable energy technologies, such as rare earth metals for solar panels and batteries, can have significant ecological consequences if not managed sustainably. These environmental conflicts can slow down the acceptance of renewable energy technologies, especially in regions where environmental conservation is a priority (Murray et al., 2023; Reichenberg, 2024).

3. Theoretical Framework

A. Theory 1: The Political Economy Theory

The Political Economy Theory highlights how political, economic, and institutional factors influence technological development and policy decisions. In the case of renewable energy, it suggests that the pace and direction of advancement are often shaped by the interests of powerful stakeholders, including fossil fuel industries, governments, and multinational corporations. These groups, particularly those invested in the fossil fuel sector, can hinder the progress of renewable energy technologies by lobbying against policy changes, downplaying climate change risks, or undermining public support for renewable alternatives. Furthermore, political economy theory emphasizes that government subsidies, tax incentives, and regulatory frameworks play a crucial role in fostering or delaying renewable energy adoption (Meckling et al., 2015). For instance, in many regions, the continued subsidization of fossil fuels directly competes with the profitability and investment in renewable energy, slowing down technological advancements. While some governments are pushing for renewable technologies through legislative measures and international agreements like the Paris Climate Agreement, the pushback from vested fossil fuel interests remains a significant roadblock. Additionally, developing countries often face challenges due to a lack of financial resources or political will to invest in renewable energy infrastructure, further exacerbating the divide between regions embracing renewable technologies and those lagging behind.

B. Theory 2: The Technological Lock-In Theory

The Technological Lock-In Theory refers to the idea that once a particular technology becomes dominant in a market or society, it becomes difficult to transition to alternative technologies, even if they are more efficient or environmentally sustainable. In the case of renewable energy, the widespread global reliance on fossil fuel-based systems such as coal, oil, and natural gas has created a "lock-in" effect that hampers the rapid transition to cleaner, renewable alternatives. The infrastructure, investments, and industries built around fossil fuels create significant barriers to the adoption of renewable energy technologies like solar, wind, or geothermal (Unruh, 2000). The theory explains that as fossil fuel technologies are deeply entrenched in the global economy, they create path dependencies where investments in renewable energy are slow or inconsistent. Additionally, the economic incentives to maintain fossil fuel-based systems, combined with societal norms and consumer behavior patterns, reinforce the status quo. For example, the fossil fuel industry's established supply chains, job markets, and political power make it difficult for renewable energy technologies to penetrate existing markets. Furthermore, renewable energy technologies may not always compete directly in terms of cost or efficiency without large-scale policy shifts, thereby reinforcing the lock-in of fossil fuels in many regions.

4. Literature Review

The global transition towards renewable energy is crucial in addressing climate change, energy security, and sustainable economic development. However, the advancement of renewable energy technologies has been hindered by various conflicts and challenges that stem from both technical and socio-political factors. One primary conflict is the integration of renewable energy into existing energy systems. Traditional power grids, designed around centralized fossil fuel-based generation, face significant technical and operational challenges when attempting to accommodate the intermittent nature of renewable sources like solar and wind power. The intermittency of these sources requires advanced grid management techniques, energy storage systems, and upgraded infrastructure, all of which come at a high cost and require substantial investments. Despite the advancements in smart grid technology and energy storage, such as batteries and pumped hydro storage, the rate of technological adoption remains slow, particularly in developing regions where the cost of transition is perceived as a barrier (Heptonstall et al., 2020).

The economic conflict surrounding the transition to renewable energy is another critical barrier. The initial capital required for the deployment of renewable technologies, particularly solar, wind, and offshore projects, is substantial. Despite the declining cost of renewable technologies over the years, the financial capital needed for their deployment remains a significant obstacle for many countries, especially developing nations. For example, while solar and wind power have become increasingly cost-competitive with fossil fuels in terms of levelized cost of electricity (LCOE), the investment required for initial infrastructure and technological upgrades remains prohibitive for some countries (Lilliestam & Hanger, 2021).

In conclusion, the advancement of renewable energy technologies faces multiple conflicts that hinder their widespread adoption. These conflicts arise from technical, economic, political, social, and environmental factors, each requiring careful consideration and balanced solutions. Overcoming these barriers will require enhanced collaboration between governments, the private sector, and local communities, as well as substantial investment in infrastructure and technological innovation. Policymakers must also ensure that the transition to renewable energy is fair and equitable, taking into account the concerns of all stakeholders while prioritizing the global need for sustainable energy solutions. By addressing these conflicts comprehensively, the path to a renewable energy future may be made clearer and more achievable.

5. Methodology

The population for this study was some few selected persons of the local government. 300 persons were selected as the research population, out of which 300 were randomly selected as the sample size. Questionnaire was used to collect the relevant data for this study. Simple percentage method was used to analyze the retrieved 200 questionnaires from the study area. Below is the date presentation and analysis of the data obtained.

Table 1
Awareness of renewable energy technologies

Response Options	Count	Percentage (%)
Very Aware	45	22.5%
Somewhat Aware	100	50%
Not Aware	55	27.5%

A majority (72.5%) of respondents have some level of awareness about renewable energy technologies, with 22.5% indicating they are very aware. However, 27.5% of respondents have no awareness, suggesting a gap in education and outreach programs.

Table 2
Perceived Barriers to renewable energy adoption

Response Options	Count	Percentage (%)
High Initial Cost	90	45%
Technological Uncertainty	50	25%
Lack of Government Incentives	40	20%
Other (e.g., societal resistance)	20	10%

The biggest perceived barrier to adopting renewable energy technologies is the high initial cost (45%), followed by concerns over technological uncertainty (25%). This suggests that affordability and trust in technology are key hurdles for broader adoption.

Table 3
Government support for renewable energy development

Response Options	Count	Percentage (%)
Strong Support	60	30%
Moderate Support	80	40%
No Support	60	30%

Responses indicate that 70% of participants perceive some form of government support, but 30% believe there is no support. This suggests room for increased government intervention and clear policies to drive renewable energy advancements.

Table 4
Concerns about renewable energy technologies

Response Options	Count	Percentage (%)
Environmental Impact	50	25%
Reliability and Consistency	60	30%
Affordability	40	20%
Aesthetic or Land Use Issues	50	25%

Concerns about reliability and consistency (30%) are the highest, followed by environmental impact and land use issues. This indicates a need for better technology reliability and environmental impact assessments in the development phase.

Table 5
Willingness to adopt renewable energy technologies

Response Options	Count	Percentage (%)
Very Willing	50	25%
Somewhat Willing	100	50%
Not Willing	50	25%

Half of the respondents are somewhat willing to adopt renewable energy technologies, but 25% remain not willing. This suggests that while interest is significant, there are factors, possibly financial or technological, that hinder full acceptance.

Table 6
Perceived role of renewable energy in future energy systems

Response Options	Count	Percentage (%)
Essential for Future Systems	130	65%
Important, but not Essential	50	25%
Not Important	20	10%

A strong majority (65%) believe renewable energy is essential for future energy systems. This indicates a clear understanding of the importance of renewables in addressing future energy needs, though 10% still consider it unimportant.

6. Summary of Findings

The findings of the research are discussed below:

1) A majority of respondents (72.5%) are somewhat or very aware of renewable energy technologies, with 22.5% being highly informed. However, 27.5% of the sample remains unaware, highlighting the need for improved education and outreach programs to bridge this awareness gap.
2) The primary barrier to renewable energy adoption is the high initial cost, cited by 45% of respondents. Technological uncertainty (25%) and lack of government incentives (20%) also contribute to hesitance, suggesting that financial and technological concerns are significant obstacles.
3) Regarding government support, 70% of respondents acknowledge some form of support, but 30% feel there is insufficient government intervention. This indicates a need for clearer policies and stronger government engagement to foster renewable energy development.
4) Concerns about renewable energy technologies are primarily focused on reliability and consistency (30%), followed by environmental impact and land use issues (25% each). These concerns underscore the importance of improving technology reliability and addressing environmental impacts during development.
5) While half of the respondents express a moderate willingness to adopt renewable energy, 25% remain hesitant or unwilling. This suggests that external factors, such as financial constraints or technological trust, may prevent full adoption despite some interest.
6) Most respondents (65%) believe renewable energy is essential for future energy systems, with 25% viewing it as important but not essential. This strong recognition of the importance of renewables reflects growing awareness of their role in addressing future energy

needs.

7. Conclusion

In conclusion, while the advancement of renewable energy technologies holds immense promise for addressing global energy challenges and mitigating climate change, several conflicts hinder their widespread adoption. These conflicts arise from a combination of economic, political, social, and technical factors. The cost of transitioning from fossil fuels, the vested interests of powerful industries, and the inconsistent policies across different regions create significant barriers. Moreover, technological limitations, such as the intermittent nature of renewable energy sources like solar and wind, require substantial investments in storage and grid infrastructure. Public perception and local opposition, often due to concerns over land use and environmental impacts, further complicate progress. Despite these challenges, the growing urgency of climate change and the increasing availability of cost-effective renewable technologies signal a potential turning point. Governments, industries, and communities must work collaboratively to resolve these conflicts, fostering a balanced and sustainable approach to energy production that promotes environmental stewardship, energy security, and economic growth. This multi-faceted approach is essential to overcoming obstacles and realizing the full potential of renewable energy technologies for a sustainable future.

8. Recommendations

Based on the findings of the above research, the following recommendations were made:

1) Governments should prioritize the establishment of clear, long-term policies and regulations that encourage investment in renewable energy technologies. This includes offering tax incentives and subsidies to reduce initial costs for companies and consumers.
2) Financial support should be allocated to research and development, fostering innovation to make renewable energy technologies more efficient and affordable. Public-private partnerships could be key to accelerating this progress.
3) Education and public awareness campaigns should be launched to inform citizens and businesses about the benefits and feasibility of renewable energy. This will help shift public opinion towards greater acceptance of these technologies.
4) Governments should remove bureaucratic barriers and streamline permitting processes for renewable energy projects. Simplifying these procedures will encourage faster deployment and increase the number of projects that can be completed.
5) Stakeholders should foster collaborations between renewable energy developers and traditional energy companies to ensure smooth transitions. This could help with the integration of renewable energy into existing infrastructure and grid systems.
6) Local communities must be actively involved in the decision-making processes regarding renewable energy projects. Ensuring that projects meet local needs and concerns will help prevent opposition and delays.
7) Finally, governments should work on international cooperation to harmonize regulations and share best practices for renewable energy adoption. Global collaboration will ensure that renewable technologies are developed and deployed at scale.

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