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Literature Review on Renewable Energy as an Alternative Electricity Source

Eric Krisna
Universitas Nurdin Hamzah, Indonesia
erickrisna@gmail.com

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Abstract

The fossil fuel crisis and its impact on economic stability, the environment, and national energy sovereignty have driven the urgency of a transition to renewable energy sources. Dependence on fossil fuels that is increasingly ecologically and economically unsustainable demands the development of clean, safe, and affordable energy alternatives. This study aims to critically examine the dynamics, challenges, and opportunities for the development of renewable energy as an alternative electricity source through a qualitative approach based on literature studies. The method used is thematic content analysis of various scientific literature, global institutional reports, and relevant policy documents in the last five to ten years. The results of the study show that although renewable energy technology has made significant progress and become more economically competitive, structural barriers such as non-adaptive regulations, the dominance of carbon-based industries, and minimal equity in energy access are still the main obstacles to its implementation. This study emphasizes the importance of updating energy policies based on a multidisciplinary approach and ecological justice to ensure a just and inclusive transition. Literature reviews are strategic instruments to criticize power structures and development paradigms that are still exploitative, as well as to encourage the transformation of energy systems that are socially and environmentally sustainable.

Keywords: Renewable Energy, Energy Justice, Energy Transition

Introduction

The fossil fuel crisis is no longer a predictive issue, but rather a reality that has begun to be felt by many countries. Dependence on fossil fuels such as coal, oil, and natural gas has caused

an imbalance between global energy availability and demand. According to a report by the International Energy Agency (IEA, 2023), economically explorable oil reserves are estimated to only be sufficient for the next few decades if there are no significant efforts to diversify. Furthermore, fluctuations in global energy market prices that are heavily influenced by geopolitical tensions show how fragile the fossil-based energy system is in supporting the economic and political stability of a country. Therefore, energy diversification through renewable sources is an urgent strategy to ensure the sustainability of long-term energy supplies.

In the context of national development, dependence on fossil fuels also poses a risk to energy sovereignty. Indonesia, for example, despite being the largest coal producing country in Southeast Asia, still imports most of its oil needs, which increases the energy sector trade deficit (Ministry of Energy and Mineral Resources, 2022). In fact, Indonesia's renewable energy potential is enormous, ranging from solar to geothermal energy. However, energy transition policies are still hampered by the dominance of fossil industry interests and the lack of incentives for clean energy investment. Thus, the challenges faced are not only technical and economic, but also structural and political. An in-depth literature review is important to identify the dynamics of this energy crisis and offer a theoretical basis for formulating a sustainable energy transition strategy.

The ecological consequences of conventional energy use are very real, especially in its contribution to global climate change. Carbon dioxide (CO_2) emissions from the combustion of fossil fuels are a major contributor to the greenhouse effect that accelerates global warming. The Intergovernmental Panel on Climate Change (IPCC, 2023) reports that more than 75% of global greenhouse gas emissions come from the energy sector, and without a rapid transition to low-carbon energy sources, the Paris Agreement target of holding global temperature rise below 1.5°C will be impossible to achieve. In addition, mining and fossil fuel exploration activities cause land degradation, groundwater pollution, and biodiversity loss, exacerbating the multidimensional environmental crisis.

On the other hand, renewable energy offers a more environmentally friendly approach and minimal negative externalities to the ecosystem. Energy sources such as solar, wind, and water do not produce direct emissions during the electricity production process, making them a strategic alternative for mitigating climate change (REN21, 2024). However, the adoption of renewable energy still faces resistance, not because of the lack of technology, but because of the economic-political structure that still favors carbon-based industries. This is where the importance of literature studies that are not only technical, but also analytical and critical of power relations in energy policy lies. Such studies are able to open up argumentative space for a paradigm shift towards sustainable development based on ecological justice.

Technological advances in renewable energy have provided significant opportunities to overcome dependence on fossil fuels. Innovations in the efficiency of solar panels, high-capacity wind turbines, and energy storage systems such as lithium-ion batteries have changed the landscape of global energy security. A report by the International Renewable Energy Agency (IRENA, 2023) shows that the cost of producing electricity from renewable energy has fallen dramatically in the last decade—for example, solar photovoltaic power has fallen by 89% since 2010. This decline has not only made renewable energy more economically competitive, but also strengthens the argument that the main obstacles lie not in technology, but in politics, governance, and investment.

However, although renewable energy technology has proven to be efficient and economical, its uptake in the national energy system is still hampered by various structural factors. The infrastructure gap between central and remote areas, the unclear regulation of incentives, and the dominance of large energy corporations that are still oriented towards fossil fuels show that the energy transition is not only about technological substitution, but also systemic transformation. This is where the importance of literature analysis as an academic instrument to reveal power relations, regulatory practices, and investment directions in the energy sector lies (Goldthau, 2020). By understanding these dynamics critically, renewable energy studies do not stop at technological discourse alone, but become an integral part of fair and inclusive decarbonization efforts.

Comprehensive literature review plays a strategic role in shaping the direction of energy policy, especially in the context of the transition to renewable energy. Many policies in the energy sector are born without considering the accumulation of cross-disciplinary scientific knowledge, resulting in regulations that are technically weak and unresponsive to socio-ecological dynamics. According to Sovacool et al. (2020), effective energy policy is not only based on economic and technological efficiency, but must also absorb insights from social, political, and cultural studies. In the Indonesian context, for example, the absence of literature-based mapping of the gap in access to renewable energy in the 3T (frontier, outermost, and disadvantaged) regions has caused the energy transition program to run elitistly, and only benefit certain groups who have access to resources and technology.

Furthermore, literature review can identify epistemic biases in the production of energy knowledge itself—for example, the dominance of top-down technology approaches that often ignore community-based energy transition models. This is important considering that energy transitions do not occur in a vacuum, but in a space full of economic-political interests, as explained by Heffron and McCauley (2017) in the concept of energy justice. Therefore, literature review not only serves as a conceptual foundation, but also as a critical tool for evaluating power structures in energy policy. By using literature as a reflective foothold, policymakers can formulate strategies that are more inclusive, just, and contextual to the social and geographical realities of developing countries like Indonesia.

Method

This study uses a qualitative approach with a literature review method that is explorative and analytical. This approach was chosen to deeply understand various theoretical perspectives, empirical findings, and policy developments related to renewable energy as an alternative electricity source. The main focus of this study is to identify trends, critical issues, and knowledge gaps in renewable energy discourse spread across various scientific publications, institutional reports, and policy documents.

The data in this study were obtained through a literature review of relevant sources, such as indexed scientific journals (Scopus, DOAJ, Google Scholar), reports from international institutions (such as IRENA, IEA, IPCC), government policies (Presidential Regulations, National Energy General Plan/RUEN), and books and articles published in the last five to ten years. Data inclusion criteria include documents that discuss technical, economic, environmental, social, and political aspects of renewable energy. The data analysis technique used is thematic content analysis, which is grouping information based on main themes such as technological efficiency, energy justice, transition policies, and implementation challenges. The analysis was carried out inductively with an emphasis on identifying discourse patterns and relationships between concepts.

The validity of the study was strengthened by using source triangulation and interpretative synthesis techniques, namely by comparing the results of studies from various scientific perspectives and ensuring diversity of approaches. With this method, the study aims to produce a comprehensive, critical, and reflective understanding of the role of renewable energy in a sustainable electricity system.

Results and Discussion

Discussion 1: Global Transformation Towards Renewable Energy: Trends and Dynamics

In the last two decades, the energy transition from fossil fuels to renewable energy has become one of the main themes in the discourse on sustainable development. Renewable energy such as solar, wind, biomass, hydro and geothermal are increasingly being considered as long-term solutions to address the energy crisis and climate change. According to a report by the International Renewable Energy Agency (IRENA, 2023), global renewable energy capacity has more than tripled since 2010, indicating an acceleration in policy and investment in this sector. Countries such as Germany, China and the United States are leading the way in the adoption of renewable technologies, although developing countries are also starting to show significant increases.

This change is not happening by chance, but is driven by a combination of the global environmental crisis, fluctuating fossil fuel prices, and technological advances that are

making renewable energy more economically competitive. In many countries, fiscal incentives and feed-in tariff policies have accelerated private and public investment in green energy projects. The IEA (2023) notes that the cost of producing solar photovoltaic electricity has fallen by almost 90% in the past decade, making it cheaper than coal in many parts of the world. This shows that economic considerations are now aligned with environmental urgency in driving the energy transformation.

However, this global trend also presents new dynamics, including a new technological and geopolitical race in the green energy sector. Countries are racing to secure supplies of critical raw materials such as lithium and cobalt needed for energy storage batteries. On the other hand, there is also an imbalance between developed and developing countries in terms of technological capacity, funding, and regulation. Countries with high innovation capabilities tend to dominate the renewable energy technology market, while developing countries still rely on imports of equipment and technical expertise.

In the context of Indonesia, the potential for renewable energy is very large but has not been optimally utilized. With a potential of more than 400 GW from various sources (ESDM, 2022), the actual utilization of renewable energy in Indonesia is still below 10% of the total capacity. Structural barriers such as lack of incentives, weak governance, and the dominance of fossil fuels are still major challenges. Therefore, understanding global dynamics and Indonesia's position is important so that national energy policies are not left behind in the increasingly rapid flow of global transformation.

Through literature study, it can be concluded that global energy transformation is not only related to technology, but also concerns the power structure, investment direction, and development values. This study emphasizes the importance of a multidisciplinary approach that includes technical, social, economic, and political aspects in understanding the transition to clean energy. By understanding these dynamics, Indonesia can formulate a renewable energy strategy that is not only technologically adaptive, but also proactive in creating energy justice and national independence.

Discussion 2: Challenges and Barriers to Renewable Energy Implementation in Developing Countries

Although renewable energy has shown great potential on a global scale, its implementation in developing countries still faces many challenges. One of the main obstacles is the limited basic infrastructure and supporting technology. In many regions, uneven electricity distribution networks and limited technical capacity make it difficult for renewable energy projects to operate optimally. In addition, the lack of experts and the lack of local research institutions hinder the process of adapting the technology needed to strengthen local energy security.

In addition to technical barriers, regulatory and policy factors are also significant barriers to renewable energy development in developing countries. Many national energy policies are still dominated by the fossil fuel paradigm, both due to short-term economic interests and pressure from large industries. A study by Sovacool et al. (2020) shows that the success of the energy transition depends not only on the available technology, but also on the institutional structure that supports and is able to drive systemic change.

Financial constraints are also a serious issue. Developing renewable energy projects requires high initial investment, even though operating costs are relatively low. Developing countries often have difficulty accessing international funding due to perceived high political and economic risks. Dependence on foreign aid or loans also makes renewable energy projects vulnerable to political interference and long-term program unsustainability.

On the social side, the lack of local community involvement in the planning and implementation of renewable energy projects often creates resistance. Top-down projects that ignore the local socio-cultural context can lead to conflict, as has happened with several geothermal projects in Indonesia. Therefore, a participatory approach is essential to ensure that the energy transition is inclusive and equitable.

Overall, the literature review shows that the challenges of implementing renewable energy in developing countries are multidimensional and require a cross-sectoral approach. Progressive policy interventions, technological capacity building, regulatory reform, and strengthening community participation are key steps to overcome these obstacles. Good energy literacy and strong political support are also important foundations in accelerating sustainable energy transformation.

Discussion 3: Relevance of Renewable Energy as a Strategy for Energy Resilience and Justice

Renewable energy not only offers technical solutions to the energy crisis and climate change, but also plays an important role in realizing energy security and equity. Energy security refers to the ability of a country or region to provide a stable, affordable and sustainable energy supply. In this context, diversifying energy sources through the use of renewable energy can reduce dependence on imported fossil fuels and reduce vulnerability to global energy price fluctuations.

The use of renewable energy also provides an opportunity for decentralization of the energy system, meaning that energy production can be done at the local or community level. This not only increases local energy efficiency and independence, but also strengthens the adaptive capacity of communities to crises. The community-based renewable energy model has proven successful in countries such as Germany and Denmark in creating democratic and participatory local energy independence (Walker & Devine-Wright, 2008).

The concept of energy justice is important in this discussion. The energy transition must ensure that all groups in society, including vulnerable and remote groups, have equitable access to clean and affordable energy. The inequality of energy access in Indonesia, where regions such as Papua and Nusa Tenggara still experience electricity shortages, shows that energy development must consider the dimensions of spatial and social justice.

The literature also highlights that renewable energy projects that ignore social justice principles can exacerbate inequality and exclusion. For example, large projects such as hydropower or geothermal often involve the acquisition of indigenous peoples' lands without proper consultation processes. Therefore, ecological justice and human rights approaches must be an integral part of the planning and evaluation of renewable energy projects.

From various studies, it is clear that renewable energy has great potential to strengthen energy security while encouraging social transformation towards a more equitable energy system. However, this potential can only be realized if supported by responsive policies, participatory governance, and strong public awareness of the importance of a just energy transition. Thus, renewable energy is not just a technical alternative, but becomes the foundation for a more humane and sustainable energy civilization.

Conclusion

This literature review underlines that the global transformation towards renewable energy is not only a technological response to the climate crisis and the limitations of fossil fuels, but also reflects a paradigm shift in the overall energy production and consumption system. Global trends show a significant increase in renewable energy capacity, mainly due to technological advances, declining production costs, and international policy pressures. However, developing countries such as Indonesia face complex challenges in terms of infrastructure, regulation, financing, and local community involvement.

These obstacles demonstrate the need for a cross-sectoral and multidisciplinary approach in designing inclusive and sustainable energy policies. Renewable energy has a strategic role in realizing energy security and justice, especially through energy decentralization and community empowerment. However, without participatory governance and policies that favor vulnerable groups, the energy transition can actually strengthen social inequality and spatial exclusion. Therefore, the urgency of strengthening the scientific basis through literature reviews is crucial to ensure the direction of a just, contextual, and sustainable energy transition in the future.

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