EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 11 | Issue: 10 | November 2023 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2023): 8.322

UTILIZATION OF SUSTAINABLE TECHNOLOGY TO MITIGATE CLIMATE CHANGE AND ITS MAIN CHALLENGES

R. D. Pangestu*
Pasundan University, Bandung, Indonesia

Article DOI: https://doi.org/10.36713/epra14917
DOI No: 10.36713/epra14917

----------ABSTRACT----------
In tackling the increasing adverse effects of climate change, the significance of sustainable technologies cannot be overemphasized. To comprehensively assess the gravity of the climate predicament and appraise the effectiveness of sustainable technological innovations, this study highlights the urgent necessity for joint ventures aimed at surmounting barricades inhibiting the smooth integration of these technologies in diverse sectors. Disturbingly, the findings of this investigation illustrate a notable upsurge in the levels of carbon dioxide (CO2) emissions, which can be attributed to economic undertakings, industrial activities, energy consumption, and policies, all of which compound the global climate crisis. Renewable energy sources are becoming increasingly important in the fight against global warming. Carbonization, which releases greenhouse gases into the atmosphere, is largely to blame for exacerbating the problem. This process has had devastating effects on ecosystems and biodiversity. To combat these effects, we need to transition away from using fossil fuels and towards using renewable energy sources. However, operational challenges in integrating renewable energy into existing electricity networks, coupled with a lack of public awareness and education about renewable energy, pose significant obstacles to widespread adoption.

KEYWORDS: *Climate Change, Sustainable Technologies, Carbonization, Renewable Energy, Integration Challenges*----------

I. INTRODUCTION

The impact of climate change on our world is a growing concern that requires urgent thinking and creative solutions. Sustainable technology is seen as a ray of hope in the fight against this global crisis. Increasing temperatures, extreme weather events and ecological imbalances are just a few of the unique environmental changes caused by anthropogenic climate change and are therefore a viable option reduce greenhouse gas emissions, minimize environmental damage and mitigate the negative impacts of climate change Sustainable technologies have emerged but there are many obstacles and challenges in the way of through which full potential and sustainable technologies are realized on a larger scale [1].

This paper will examine the critical role of sustainable technologies in addressing climate change and examine the key issues that hinder its seamless integration across sectors. By conducting an in-depth analysis of these challenges, this review aims to shed light on the need for single efforts and comprehensive strategies to overcome these obstacles and unleash the power of riding technologies exist permanently in in climate change mitigation implemented fully.

II. OBJECTIVES

The main objectives of this research are as follows.

1. To assess current climate change challenges and analyze sustainable technological solutions.
2. To evaluate environmental impact of greenhouse gas emissions.
3. To identify policy gaps and barriers related to climate change mitigation.
4. To showcase successful case studies and provide recommendations.

III. METHODOLOGY

For this research, literature and case study are selected as the main methodologies. The process of this research is discussed as below.

EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 11 | Issue: 10 | November 2023 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2023): 8.322

1. Identifying Key Issues: The main issues associated with climate change are identified and prioritized. This could include greenhouse gas emissions, deforestation, renewable energy adoption, waste management, water conservation, etc.
2. Data Collection and Analysis: Data is gathered using various methods, such as case studies or scientific experiments, to understand the effectiveness of different sustainable technologies in addressing climate change. The collected data is analyzed to draw conclusions about their impact.
3. Evaluation of Sustainable Technologies: A comprehensive review of existing literature, scholarly articles, and reports related to sustainable technologies aimed at mitigating climate change is conducted. This involves understanding current trends, challenges, and innovations in the field.
4. Policy and Framework Analysis: Existing policies, regulations, and international frameworks related to sustainable technologies and climate change mitigation is being analyzed. Further suggestions will be included in this research.

IV. LITERATURE REVIEW

In recent decades, the world has witnessed an alarming increase in carbon dioxide (CO_2) emissions, contributing significantly to the intensification of climate change [2]. Despite widespread awareness and commitment to reduce emissions greenhouse emissions, many countries continue to take up the challenge of curbing their CO_2 emissions. Increasing speeds and dependence on fuel have led to dramatic increases in CO_2 emissions, further exacerbating the climate crisis.

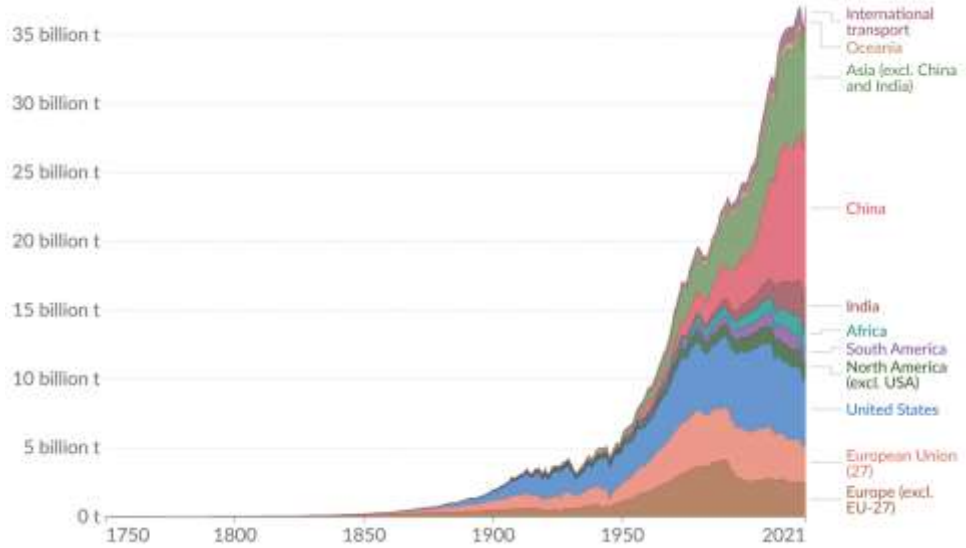

Figure 1. CO_2 Emissions Growth up to 2021 [3]

The accumulation of CO_2 in the atmosphere is a key driver of the greenhouse effect, trapping heat and leading to global warming. This process has resulted in rising average global temperatures, altered weather patterns, accelerated melting of polar ice caps, increased sea levels, and other adverse impacts on ecosystems and biodiversity. As countries continue to develop industrially and technologically, the demand for energy and resources has surged, leading to a corresponding increase in CO_2 emissions, further exacerbating the global climate crisis [4]. The variation in CO_2 emission growth rates among nations is influenced by their economic activities, energy consumption, policies, population size, industrial sectors, and overall commitment to mitigating climate change.

EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 11 | Issue: 10 | November 2023 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2023): 8.322

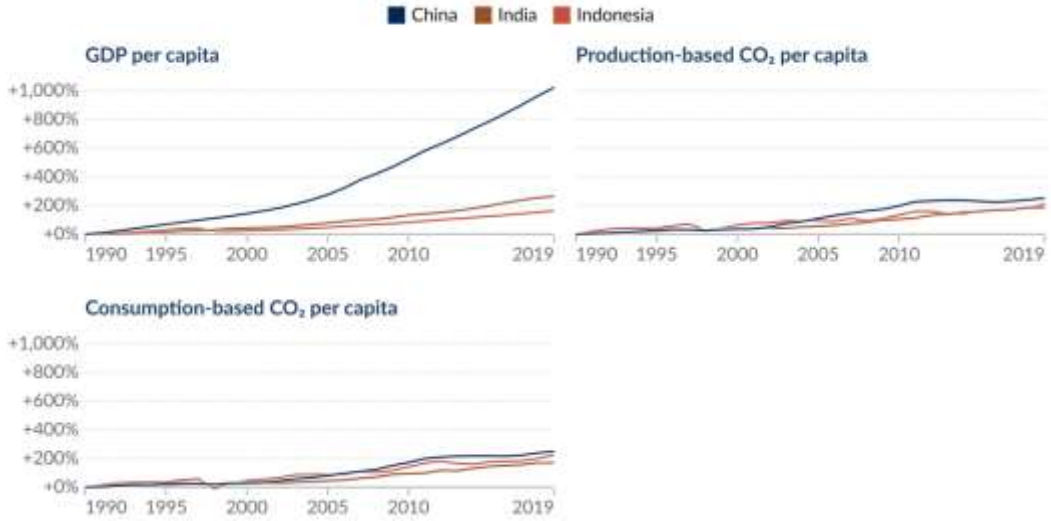

Figure 2. GDP and CO_2 Emission Growth of Three Biggest Emerging Asian Countries [3]

One of the main reasons of climate change is greenhouse gases that is made from carbonization. Carbonization is the process of converting organic materials such as wood, coal, or biomass into carbon or carbon compounds through heating in conditions with minimal oxygen [5]. This process releases greenhouse gases such as carbon monoxide and methane as well as carbon dioxide compounds into the atmosphere. This process is commonly found in coal power plants.

The process itself, carbonization, doesn't directly cause climate change. However, the implications of carbonization contribute to climate change due to the release of greenhouse gases. When organic materials are burned or subjected to incomplete combustion (as in charcoal production), they release carbon dioxide (CO_2), methane (CH_4), and other volatile organic compounds into the atmosphere. These gases trap heat and contribute to the greenhouse effect, exacerbating global warming and climate change. The increased levels of carbon dioxide and other greenhouse gases in the atmosphere act as an insulating layer, trapping heat from the sun and preventing it from escaping back into space. This trapped heat leads to a rise in global temperatures, resulting in various environmental and climatic impacts, such as melting ice caps, rising sea levels, altered weather patterns, and more frequent extreme weather events [6].

V. RESULTS

To tackle carbonization and its effects on the climate and environment, we need to switch to renewable energy. Renewable energies such as solar, wind and water do not produce significant carbon emissions when used to produce electricity or heat energy [7]. By adopting this energy source, we can reduce dependence on fossil fuels and limit the release of carbon dioxide into the atmosphere. In addition, renewable energy also helps reduce the risk of natural disasters such as floods and forest fires because there are no significant greenhouse gas emissions associated with its production and use. Through the transition to renewable energy, we can reduce the negative impact of carbonization on the climate and environment and mitigate the effects of climate change.

The issue of operating distributed generation is a major concern in integrating renewable energy resources into existing electricity networks. This includes a number of problems and aspects, both technical and non-technical, that need to be addressed so that these plants can operate properly, namely as follows.

1. Monitoring and control: Monitoring and control in a distributed energy resource management system can balance demand with supply through communication of metering devices in different geographic locations [8]. For example, when excess energy is injected into the electricity grid due to the large amount of solar energy produced during the day, controls can be exercised to control the batteries in the grid to charge using the excess energy so that at night, the energy in the batteries can be used.
2. System integration: Integration of distributed generation with the grid requires careful planning and possible changes to the grid infrastructure. Various factors such as load estimates, costs, and land availability are important considerations in this aspect [9].
3. Reliability and Maintenance: Distributed generation requires regular maintenance to ensure good performance. In some cases, access to distributed generation sites spread across hard-to-reach areas can be a challenge [9].

EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 11 | Issue: 10 | November 2023 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2023): 8.322

4. Safety and Security: The operation of distributed generation which may be in different locations also raises safety issues. The main safety factor in electricity is the coordination of protection related to it [10].
5. Coordination with the Main Grid: Distributed generation must operate in harmony with the main power grid and applicable regulations. This coordination often involves interaction with network operators, both in terms of electricity systems and regulations [10].

Other than that, there are issues related to renewable energy concerning education for the public. There's often a lack of awareness and knowledge about renewable energy sources among the general public [11]. This gap in understanding can stem from limited educational resources, outdated curriculum, or inadequate training programs in educational institutions. Access to comprehensive and accurate information about renewable energy can be limited in certain regions or communities. This lack of access to educational resources, including internet connectivity, textbooks, or workshops, can impede the dissemination of knowledge about renewable energy.

VI. SUGGESTIONS

The transition to renewable energy can be done through several key steps. First, we can reduce electricity consumption by adopting energy efficiency practices. This can include the use of more efficient household appliances and the use of energy-saving lighting which in total can reduce energy needs by 20-25% from before [12]. In addition, adopting renewable energy technology such as solar panels can help reduce the need for electricity from conventional energy sources.

Second, to reduce carbon emissions from power plants, we can use low-carbon fossil fuel power plants. While not a long-term solution, more efficient and cleaner fossil fuel power plants such as natural gas can help cut carbon emissions as we continue to transition to renewable energy sources. Apart from that, there is also carbon capture technology which ensures that emissions from energy generation are not released directly outside [13].

Furthermore, the development of energy storage technology such as battery systems and the use of hydrogen (H_2) as an energy storage medium is also important in supporting the integration of renewable energy which is not always available all the time [5]. The H_2 storage system is said to be flexible and suitable for all types of generators at a cheaper price than other storage systems [14].

Figure 3. Utilization Example of H_2 Storage [5]

In addition, to encourage this transition, incentives and policies are needed that support renewable energy and reduce fossil fuel subsidies, as well as supporting the development of safer and more advanced nuclear technology [15]. Technologies such as Small Modular Reactors (SMR) have smaller dimensions but can be made faster than conventional reactors [16].

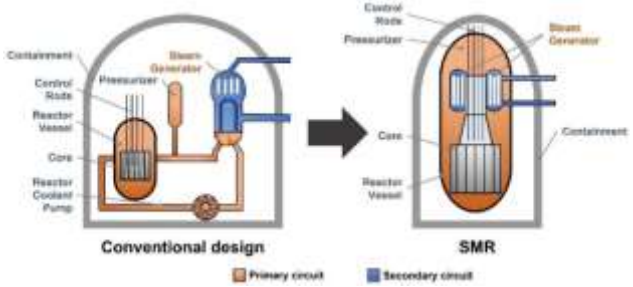

Figure 4. Small Modular Reactors (SMR) Integration [16]

Finally, promoting cross-border energy transfer with neighboring countries can also help optimize the use of renewable energy sources and increase energy security, both in bilateral, multilateral and unified modes. A case example of an energy transfer that has been carried out is the 2 GW power link from Scotland to England due to a surplus of energy generation in Scotland [17]. Apart from that, there are also examples of cases in the Middle East and India-Bangladesh [18].

Methods that can be recommended to ensure the success of the energy transition from the public perspective are as follows. Education to the public about the importance of saving energy through energy efficiency campaigns at the household, industrial and business sector levels [19] would increase efficiency in overall use of electrical energy. Further increase in public awareness about the role of renewable technology in overcoming climate change is also important to strengthen their understanding of the impact of carbonization and the benefits of renewable energy [20].

VII. CONCLUSION

Efforts to address climate change through sustainable technologies require urgent attention and innovative solutions. This study highlights the importance of sustainable technologies in combating the global climate crisis, highlighting their potential to reduce greenhouse gas emissions and minimize the negative impacts of climate emphasize the effects of change. An important role of this research is to examine the barriers that hinder the integration of sustainable technologies across sectors. After a thorough investigation, this study aims to explain the immediate need for efforts and comprehensive strategies to overcome these barriers, to enable the successful development and implementation of sustainable technologies in mitigating climate change.

A concerning surge in carbon dioxide (CO2) emissions over the past few decades, discovered through an analysis of sustainable technological ideas and an evaluation of the present climate change challenge, is contributing greatly to the worsening climate crisis. This increase in emissions not only leads to higher worldwide temperatures and changes in weather patterns but also reigns in polar ice melting, swelling sea levels, and other harmful effects to biodiversity and ecosystems. CO_2 emission grow rates among nations are heavily influenced by economic activity, energy consumption, industrial practices, policies, and their commitments to mitigating climate change. Greenhouse gas emissions that result from carbonization, and particularly the release of CO_2, methane, and other volatile organic compounds into their atmosphere, only exacerbate the greenhouse effect, bringing on further global warming and perpetuating climate change.

Switching to renewable sources of energy, such as wind, solar and hydro, as well as nuclear energy, has become vital to reducing the damage caused by carbonization. Dependence on fossil fuels will be lessened, curbing harmful emissions that would be released into the air. Despite all these positive effects, introducing renewable energy sources poses some challenges for existing power grids. Some of these challenges include reliability, maintenance, coordination, monitoring, system integration, and safety. Besides these obstacles, there's also a considerable deficiency in public education and awareness on renewable energy. Further education and research will decrease this deficiency and improve the potential utilization of renewable energy.

VIII. REFERENCES

1. *Chen, Y., & Lee, C. C. (2020). Does technological innovation reduce CO2 emissions? Cross-country evidence. Journal of Cleaner Production, 263, 121550.*
2. *Sreesha, C. H. (2022). Global Warming and Climate Change-National and International Movements. EPRA International Journal of Climate and Resource Economic Review (CRER), 10(9), 11-14.*
3. *Hannah Ritchie, Max Roser and Pablo Rosado (2020) - "CO_2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org.*
4. *Jiang, Y., & Khan, H. (2023). The relationship between renewable energy consumption, technological innovations, and carbon dioxide emission: evidence from two-step system GMM. Environmental Science and Pollution Research, 30(2), 4187-4202.*
5. *Alturki, A. (2022). The global carbon footprint and how new carbon mineralization technologies can be used to reduce CO2 emissions. ChemEngineering, 6(3), 44.*
6. *Triani, M., Yudison, A. P., Dewi, K., Sitanggang, R., Nugraha, A. D., & Rasgianti, R. (2023, January). Projections of greenhouse gas emissions from Indonesia's electricity production as a baseline for climate change. In AIP Conference Proceedings (Vol. 2554, No. 1). AIP Publishing.*
7. *Raihan, A. (2023). An overview of the energy segment of Indonesia: present situation, prospects, and forthcoming advancements in renewable energy technology. Journal of Technology Innovations and Energy, 2(3), 37-63.*

8. *Eroğlu, H., Cuce, E., Cuce, P. M., Gul, F., & Iskenderoğlu, A. (2021). Harmonic problems in renewable and sustainable energy systems: A comprehensive review. Sustainable Energy Technologies and Assessments, 48, 101566.*
9. *Shahzad, U., Kahrobaee, S., & Asgarpoor, S. (2017). Protection of distributed generation: challenges and solutions. Energy and Power Engineering, 9(10), 614-653.*
10. *Yee, S. (2015). Reactive compensation and voltage control with PV generation resources. Trimark Associates, Inc, Folsom, CA.*
11. *Setyawati, D. (2023). State-of-the-Art Indonesia Energy Transition: Empirical Analysis of Energy Programs Acceptance. Springer Nature.*
12. *Ionescu, C., Baracu, T., Vlad, G. E., Necula, H., & Badea, A. (2015). The historical evolution of the energy efficient buildings. Renewable and Sustainable Energy Reviews, 49, 243-253.*
13. *Markewitz, P., Kuckshinrichs, W., Leitner, W., Linssen, J., Zapp, P., Bongartz, R., ... & Müller, T. E. (2012). Worldwide innovations in the development of carbon capture technologies and the utilization of CO 2. Energy & environmental science, 5(6), 7281-7305.*
14. *Marocco, P., Ferrero, D., Gandiglio, M., Ortiz, M. M., Sundseth, K., Lanzini, A., & Santarelli, M. (2020). A study of the techno-economic feasibility of H2-based energy storage systems in remote areas. Energy Conversion and Management, 211, 112768.*
15. *Josia, H. R. (2023). Analysis of Nuclear Energy for Future Power Plants in Indonesia: An Assessment for Sustainable Energy Development. The Journal of Indonesia Sustainable Development Planning, 4(2), 173-194.*
16. *Fernández-Arias, P., Vergara, D., & Antón-Sancho, Á. (2023). Bibliometric Review and Technical Summary of PWR Small Modular Reactors. Energies, 16(13), 5168.*
17. *Sarkar, S. (2012). Power Transmission Options for Offshore Windfarms in Scotland. Department of Mechanical and Aerospace Engineering, University of Strathclyde.*
18. *Rehman, S., Shukla, R., Gautam, A., Kabir, A., Alam, S. S., Baba, K. V. S., ... & Soonee, S. K. (2021, December). Success Story of India-Bangladesh Power System Operation. In 2021 9th IEEE International Conference on Power Systems (ICPS) (pp. 1-6). IEEE.*
19. *Fan, Y., Liao, H., & Wei, Y. M. (2007). Can market oriented economic reforms contribute to energy efficiency improvement? Evidence from China. Energy Policy, 35(4), 2287-2295. doi: 10.1016/j.enpol.2006.07.011*
20. *Jorgenson, S. N., Stephens, J. C., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. The Journal of Environmental Education, 50(3), 160-171. doi: 10.1080/00958964.2019.1604478*