CHAPTER I

INTRODUCTION

1.1 Problem Identification

Renewable energy consumption is crucial as global energy demand rises and concerns about the environment grow. Shifting from fossil fuels to renewable energy is vital for protecting the environment, ensuring energy security, and fostering economic growth. As climate change and sustainability become pressing issues, it's important to analyze renewable energy consumption in BRICS+ countries to understand their progress and challenges in this transition.

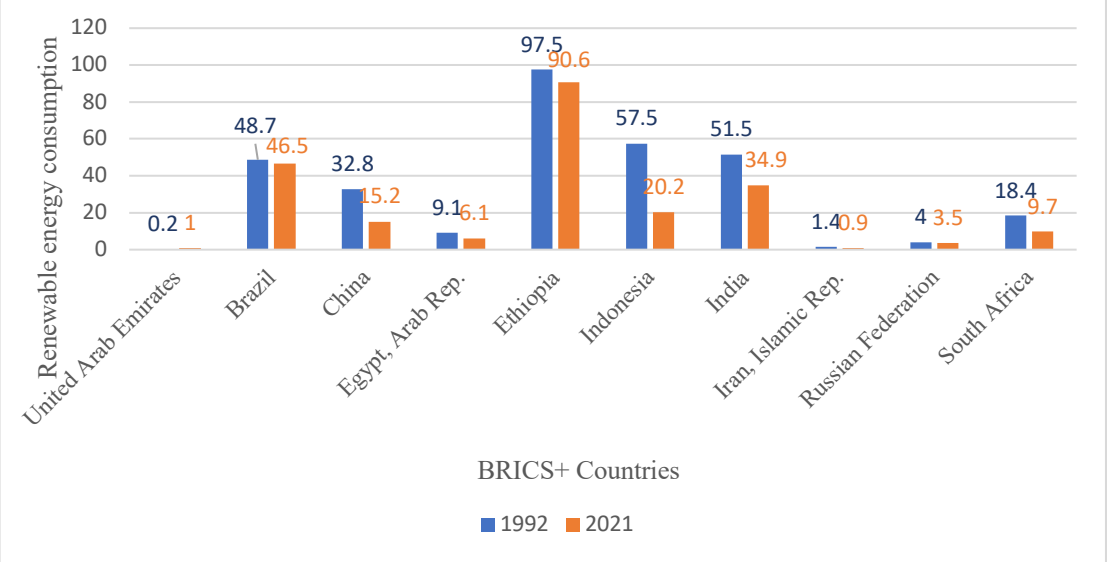
Table 1. 1 BRICS+ Energy Consumption in 2023

Country	Consumption (Mtoe)	Global Share (%)	Global Rank
China	4,060	26.3	1st
India	1,135	7.4	3rd
Russia	838	5.4	4th
Brazil	336	2.2	8th
South Africa	126	0.8	13th
Indonesia	298	1.9	9th
Iran	317	2.1	11th
UAE	101	0.7	25th
Egypt	102	0.7	27th
Ethiopia	18	0.1	73rd

Source: Enerdata (2024)

As appears in table 1.1, BRICS+ nations consume 48% of global energy, making energy consumption analysis crucial. China utilizes 4,060 Mtoe, 26,3% of the world's energy, and is expanding at 2.1% per year. This makes India the third-largest country with 1,135 Mtoe. This 7.4% share and 3.4% growth rate is pretty strong. Russia ranks fourth with 838 Mtoe, 5.4%. The rapid rise in energy consumption in BRICS+ nations presents problems and opportunities for

renewable energy. This research is crucial since BRICS+ energy choices affect the world. Large energy use and shifting growth rates affect global pollution, energy markets, and economic growth. Building on this foundational understanding of current energy consumption, it is crucial to examine how renewable energy consumption has evolved over the years, particularly between 1992 and 2021, as these shifts highlight the challenges and opportunities faced by BRICS+ nations in their energy transitions.

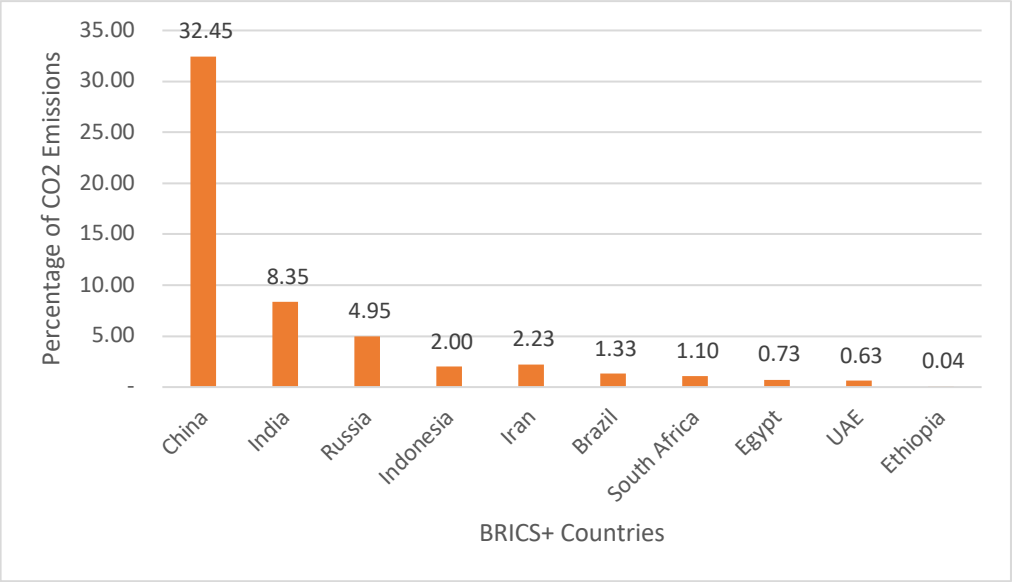


Source: World Bank (2023)

Graph 1. 1 Trends in Renewable Energy Consumption (% of Total Energy) in BRICS+ Countries

Renewable energy has grown in national energy strategy during the past 30 years. Renewable energy share of ultimate energy consumption varies per country. The 1992–2021 data shows that several emerging economies, particularly in Asia, have reduced their renewable energy contribution. Indonesia's renewable energy utilisation dropped from 57.5% in 1992 to 20.2% in 2021. China's renewable share fell from 32.8% to 15.2% and India's from 51.5% to 34.9%. Fast industrialisation, fossil fuel-based economic growth, and sluggish solar and wind

energy adoption caused these losses. Some nations use more renewable energy. The UAE increased its renewable contribution from 0.2% in 1992 to 1% in 2021 to diversify beyond oil. Hydroelectricity and biomass remain Ethiopia a top renewable energy user, sliding from 97.5% to 90.6%. These changes in renewable energy use show the complexity of the global energy transition and the growing relevance of carbon reduction. Since BRICS+ countries produce a major share of global CO2, their energy use affects their sustainability and global carbon emissions.



Source: Global Carbon Atlas (2023)

Graph 1. 2 Share of Global Carbon Emissions by BRICS+ Nations in 2023

BRICS+ countries' environmental impact dominated globally. They produce 50.6% of global CO2, becoming the biggest contributing factor in pollution. Environmental sustainability is linked to renewable energy use. Renewable energy reduces climate change and environmental impact. Khojasteh et al. (2024) say that relying more on green energy could greatly cut emissions, which would be good for the environment and people's health. If we wait to discover these links, some people may have trouble getting green technologies.

This might deepen economic inequalities and increase climate change-related financial concerns. These links show how urgent it is to modify energy policies due to climate change's rapid pace.

Climate change is an undeniable phenomenon of our era; the relevant question is not how we can hinder it but to what extent we might mitigate its effects. Recent data from worldwide organizations and government agencies strongly indicate that without decisive action in the coming years, the impacts of global warming will become permanent (Ducoing, 2019). Especially in places like Los Angeles, where the effects are becoming clearer, a lot of people are scared about climate change. Extreme heat waves, long droughts, and more pollution in the air are just some of the climate problems the city has had to deal with. All of these problems are getting worse because of climate change. These changes in the environment have a big impact on people's health, infrastructure, and general quality of life (Frits, 2025). People in the US are more aware of how important it is to move right away to lessen the effects of climate change because of a major case.

Renewable energy is affected by new technologies, government regulations, and market rivalry. Then, a stable economic growth funds green energy projects, which are expensive due to their complexity and rarity. Renewable energy technology can compete with traditional energy sources and ease the transition with government funding. By investing in renewable energy initiatives, resource efficiency can boost financial growth (Md. Qamruzzaman, 2024; Polat, 2021). The way these factors interact with each other shows how it connects to others.

On the other hand, the financial institution index, which assesses the depth, access, and efficiency of financial institutions, also demonstrates a significant relationship with renewable energy consumption. Research indicates that robust financial institutions facilitate access to financing and risk mitigation tools, which are critical for the development of renewable energy projects. For example, Kor & Qamruzzaman (2023) found that the strength of financial institutions, which shows how developed the economy is, greatly encourages the use of renewable energy by giving the needed money and lowering the risks of investments. Research shows that there is a strong link between economic growth and green energy. However, there are still big gaps that need to be filled. As we know, a banking system that is considered strong needs big investment in renewable energy projects. It starts a good cycle where both economic growth and the use of green energy move forward. In developing countries, it can be hard to get the money to use renewable energy sources.

It has previously been demonstrated that financial market indices, which demonstrate the general health and effectiveness of the financial markets, positively impact the use of renewable energy. Look at the study by Sun et al. (2023a) demonstrates how the efficiency of financial markets, particularly regarding access to funds, has a significant impact on the amount of renewable energy used. Additionally, the use of renewable energy may be impacted by financial growth in both direct and indirect ways.

Since renewable energy projects are typically expensive, financial growth directly facilitates their ability to raise the funds they require. This increases the projects' likelihood of success and appeals to investors due to their long-term return. Economic growth can be accelerated by financial expansion, which

increases demand for energy, especially clean or green energy sources that prioritize environmental sustainability (Qayyum et al., 2021; Zeqiraj et al., 2020). For instance, stable financial institutions can provide low-interest loans to encourage investment in renewable energy solutions, hence promoting the growth of renewable energy sources. The interaction between financial development and trade openness can facilitate the exchange of technology and best practices, to enhance renewable energy consumption (Ahmad et al., 2024).

On the other hand, some studies have found that there is not a strong link between using renewable energy and the development of finance. As various research affects different types of objects. Research conducted by Hafeez et al. (2022) found a negative effect on financial companies that made them use less renewable energy. This suggests that while financial efficiency is important, not all aspects of financial growth have been good for renewable energy. The fact that these results are so different from each research shows how complicated the links are and how important it is to study each case in detail in which country we were interested in. So, it is important to study the specific country that we wonder what the result is.

To see how these relationships fit into the bigger picture of the economy, we should also look at the effects of control factors like GDP, Inflation rate, and FDI (Asongu & Odhiambo, 2021; Zeren & Karaca, 2020). Learning about these mistakes, we can figure out how to manage the use of economic growth to expand green energy projects in the future. What it means by mistake is what is the concern and the problem in the research that can be lessons.

GDP, Inflation rate, and FDI are used as control variables, the link between economic growth and using renewable energy becomes a lot more complex

because these macroeconomics indicators are essential in a country. Changing patterns of energy use can be caused by changes in economic development, since rising GDP generally requires more energy. This connection's features might be changed by the energy sources that are used. For example, if the economy is doing well enough, inflation and GDP growth might all inspire people to invest in renewable energy, even if these things are linked to more people using fossil fuels but along the way people will more aware to change to non-fossil fuels (Belloumi & Aljazea, 2024; Iorember et al., 2020). This is why it is important to investigate how these factors work together to make laws that encourage sustainable energy use and, in turn, boost economic growth for policymakers.

The establishment of integrated energy markets can optimize resource allocation in areas reliant on renewable energy. Li et al. argue that inter-regional electricity trading promotes the development of clean energy by facilitating cooperative mechanisms among provinces, ensuring a reliable power supply through resource efficiency (Li et al., 2022). This coordinated approach underscores how financial and energy sectors must work together to support sustainable economic growth and clean energy use. In short, the correlation between financial development and renewable energy consumption is essential for powering the future sustainably. By aligning financial markets with renewable energy initiatives, economies can harness pathways that are both economically sound and environmentally responsible, showcasing a model for future growth.

It is very important that we solve the problems that make it hard for us to understand how people use clean energy. The world's energy needs are growing, so we need to think about how financial growth and the use of clean energy can

work together to help us reach our sustainability goals. A growing economy can lead to more clean energy use, which is good for both businesses and the environment (Diallo & Ouoba, 2023; Lei et al., 2021). This study is very important because it is part of a bigger conversation about energy use and economic growth. This study could have an impact on how policies are made.

According to previously mentioned issues and urgency, the title of this study is: **"Powering Tomorrow: Financial Development and the Clean Energy Transition in BRICS+ Nations."**

1.2 Problem Formulation

Based on the problem identification, this research will be focus on:

1. How do financial institutions and markets influence the adoption of renewable energy in BRICS+ countries, considering both linear and nonlinear effects in the short-run and long-run?
2. How do macroeconomic factors (GDP, FDI, and inflation) influence the connection between financial development and renewable energy consumption in BRICS+ economies?

1.3 Research Objectives

Based on the previous part, which is problem formulation, the objectives of this research are:

1. To explore the influence of financial institutions and markets on the adoption of renewable energy in BRICS+ countries, considering both linear and nonlinear effects in the short-run and long-run using both ARDL and NARDL models.

2. To explore how broader economic elements like GDP, FDI, and inflation influence the connection between financial development and the use of renewable energy.

1.4 Writing Format

The Main Section is divided into chapters and subchapters, namely as follows:

CHAPTER I : Introduction

This chapter discusses the problem identification, problem formulation, research objectives, and writing format.

CHAPTER II : Theoretical Framework

In this chapter discuss literature review of this research, previous research as an insight of this study, research framework, and hypothesis.

CHAPTER III : Research Methodology

In this chapter we discuss methodology, variables, source of data, analysis method, estimation analysis, estimation of error in variables and, diagnostic test.

CHAPTER IV : Data Analysis and Discussion

In this chapter discuss the result of analysis to conduct ARDL and NARDL models.

CHAPTER V : Conclusion and Recommendations

In this chapter discuss the conclusion of research from beginning to the end of research showing what insights from the analyses that have been done.