

CHAPTER I

INTRODUCTION

1.1 Background of Research

Climate change is among the global challenges currently faced by various countries in the world, due to the effects on human life from health, ecosystem sustainability, and also economic and social stability. The primary source of climate change is the rise in the number of greenhouse gas (GHG) emissions, in particular, carbon dioxide (CO₂) emissions that arise due to numerous economic activities, including manufacturing industry, power generation, and transportation. Overall, the GHG emissions may be measured under five major economic sectors, such as energy, industry, transportation, buildings, and AFOLU (Agriculture, Forestry, and Other Land Use) (Lamb et al., 2021). The International Energy Agency (IEA, 2024) states that the energy sector has over 75 percent of the overall GHGs emission worldwide, and thus the sector is considered one of the main areas in the emission reduction efforts in fighting climate change. Following the sustainable development agenda, most nations are currently swapping economic policies towards a green economy, which is a system that facilitates growth and social well-being devoid of environmental sustainability (UNEP, 2011).

Economic growth is the process of constantly increasing the production capacity of an economy in order to produce goods and services to boost the income of the people. Put differently, an economic growth can be considered as a rise of the national output, assessed by the gross domestic product (GDP) over a specific period (Todaro & Smith, 2020). However, economic growth is often accompanied by environmental degradation. Economic growth causes the depletion of natural resources and environmental damage like pollution, which takes the form of carbon emissions (Bento & Moutinho, 2016). Economic growth is fundamentally aimed at improving the well-being of people in every country. However, this process often faces trade-offs that can actually hinder the achievement of this goal. One negative

impact is climate change, which is an externality resulting from increased carbon dioxide emissions resulting from economic activity (Tol, 2012).

The majority of countries are making efforts to promote by increasing GDP, and that may lead to an eventual increase in greenhouse gas emissions (GHGs) which can cause an (CO₂) emission (Boutabba, 2014). Being a developing nation, Indonesia is experiencing a significant issue with the process of finding the balance between the economic growth objective and the commitment to reduce the CO₂ emission. World Bank statistics indicate that the Gross Domestic Product (GDP) in Indonesia has been growing at an average of 5-6 percent per year in the last 20 years (2025). According to the statistics published by Global Carbon Atlas (2025), Indonesia has been ranked as one of the 10 leading producers of CO₂ emissions in the global world, with the electricity sector playing a major role, as coal-fired power plants dominated. This is an indication that a majority of emissions are a result of energy use, as well as, energy consumption in Indonesia continues to rely on non-renewable energy. Even though the Indonesian government has made a net-zero emission target by 2060 and increased the renewable energy mix by the National Energy General Plan (RUEN), the energy transition in Indonesia remains slow and its realization is still far away.

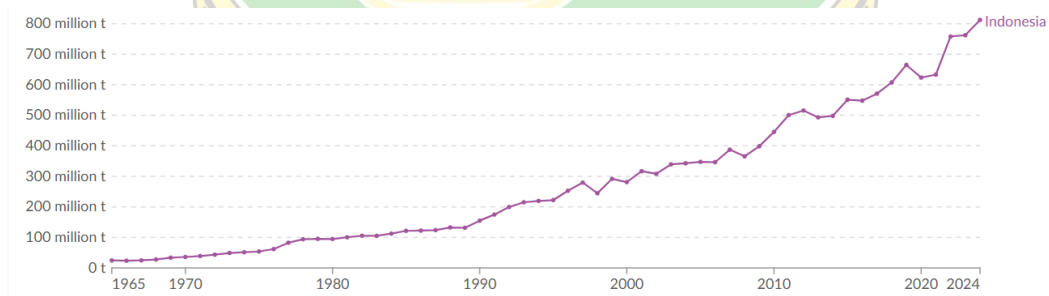


Figure 1.1 CO₂ Emissions in Indonesia (1965-2024)

Source : Our World in Data, 2025

According to the figure 1.1, Based on Annual CO₂ Emissions data provided by the Our World in Data, the trend of the development of carbon emissions in Indonesia over the period of 1965-2024 shows a significant upward trend. In 1965, the total emission of CO₂ in Indonesia was estimated to be about 24.7 million ton per year. This figure has been on a steady rise since with the continuing

phenomenon of economic growth, industrialization and rising energy demands, reaching about 812.2 million ton in 2024. In a span of nearly sixty years, therefore, the carbon emissions of Indonesia have more than thirty times. long-term trend is upward. This case represents a trade-off between economic growth and the quality of the environment. One of the key contributors to high carbon emissions is high reliance on fossil fuels. Sugiawan & Managi (2016) find that economic growth and fossil energy consumption significantly increase CO₂ emissions in Indonesia. The growth of carbon emission in Indonesia between 1965 and 2024 is an indicator of the close relationship that exists between the economic growth and the use of energy particularly non-renewable energy and the degradation of the environment.

At the international level, several agreements being made to combat climate change, such as Kyoto Protocol, which established Clean Development Mechanism for developing countries and Paris agreement (2015), which focuses on lowering the global temperatures by less than 2C above pre-industrial temperature and also the individual country should limit the quantity of its emissions by 31.89 percent on its own or even 43.20 percent with other countries by 2030 and to reach a completely Net Zero Emission by 2060, yet the implementation of this remains a very the fact that Indonesia is committed to a number of international environmental agreement remains contradictory. The phenomenon of increasing emissions is also complicated by the fact that Indonesia is one of the largest carbon emitters in the world and a significant coal exporter. International trade openness also can exacerbate environmental pressures, as increases exports and industrial activity often drive large scale fossil fuel consumption (Antweiler et al., 2001).

The urgency in reducing CO₂ emissions is not just to fulfil the global commitments, but also due to national economic and social interest. The rise in carbon emission has a direct effect on climate change, which leads to the occurrence of hydrometeorological disasters, rising sea levels, and decreased agricultural and infrastructure productivity (IPCC, 2014). Moreover, combustion of fossil fuels causes pollution that creates public health problems, increases healthcare costs, and reduces the competitiveness and productivity of the workforce.

The increase of carbon emissions in Indonesia is inseparably linked to the national energy structure, which remains heavily reliant on fossil fuel. The largest source of emissions in Indonesia is the energy sector, which is the coal-fired power plants. This reliance creates a dilemma of development, on the one hand, fossil fuels contribute to economic growth and electricity demand in Indonesia, and on the other hand, this reliance has created negative externalities like the type of air pollution and increased greenhouse gas emissions. This situation makes the energy transition the key to reducing CO₂ emissions without hindering development.

The statistics released by Our World in Data showed that non-renewable energy sources, namely, oil, coal, and natural gas, continued to dominate the energy sources in Indonesia. In Indonesia, the electricity is almost entirely produced by the use of fossil fuel and a small amount of the renewable sources play a role in electricity production in 1990. This scenario represented the extent to which economic development of the nation has depended heavily on fossil fuel. Although the share of renewable energy is gradually growing since the beginning of the 2000s as a result of the progress of hydropower. Its contribution to the energy is still relatively low in comparison to non-renewable energy sources, namely geothermal, solar, and biomass (IEA, 2024). The hypothesis offered by the EKC programs, which states that the quality of the environment will decrease, on average, as the economy of a country develops due to the increase in economic activity, but the quality of the environment will eventually increase as the economy keeps growing due to the fact that economic growth results in higher demand of environmental protection, and the technological advances that are provided also allow to manage the environment in a better way (Wang et al., 2024).

several researches have looked at the dynamics of relationship between economic growth, energy and carbon emission in Indonesia and other countries but have disparate outcome. In a study by Sugiawan & Managi (2016), they established that the EKC curve is applicable in Indonesia, although in the outside sample period, where the turning point is at a per capita income of approximately USD 7,729 and that renewable energy contributes strongly in reducing CO₂ emissions both in the short and long term. However, they do not follow the findings of

Muchran et al., (2021) who have shown that the EKC pattern was not observed in Indonesia during the time of the study and the consumption of non-renewable energy was still the main reason of emissions. The works of the study conducted by Massagony & Budiono (2022) are another step in the division of the energy consumption on the renewable and non-renewable energy in Indonesia. Their discovery indicates that non-renewable energy has a positive impact on the increase of CO₂ gas emissions, and renewable energy will probably reduce the emissions in the long-term. Although the concept of trade openness is not directly considered a variable of the study as an independent variable, the form of international trade as a leading exporter of fossil fuels suggests that the international trade can indirectly affect the dynamics of the emissions through the scale and composition effects. According to the Pollution Haven Hypothesis (Copeland & Taylor., 2003), once the trade liberalization is implemented in developing countries that have comparatively weak environmental regulations, it may lead to spread of pollution-intensive industries, which will in turn lead to increase of CO₂ emissions.

In this given study, the researcher will analyze the impact of economic growth, renewable energy, non-renewable energy, and the openness to international trade on CO₂ emission in Indonesia under the Environmental Kuznets Curve (EKC) model. This study model adapts the method employed by Muchran et al., (2021), who determine the impact of the income (GDP), renewable energy consumptions and the non-renewable energy consumptions within the (CO₂) carbon dioxide emission of Indonesia using EKC environmental model over the period of 1980 to 2018. The findings indicated that renewable energy use lowers environmental degradation, and non-renewable energy raises CO₂ emission, and GDP and GDP² coefficients are negative opposing the classical EKC assumption. Thus, this study try to extending the time period (1965-2024) and also variable trade openness.

Extending the sample period to 1965–2024 is an important contribution because it covers the early phase of Indonesia's industrialization through the current climate policy era, capturing structural economic and environmental dynamics that might have been missed in a shorter time period. Furthermore, the addition of the trade openness variable allows for an examination of the role of globalization and

commodity flows in influencing emissions, complementing analyses focused solely on energy consumption. The adopted econometric approach is also expanded in addition to the ARDL test for long-run, this research uses an error correction model (ECM) to distinguish between short-run and long-run relationships. So, the author is interested in conducting research with the title "Analysis of the Environmental Kuznets Curve in Indonesia: The Impact of Economic Growth, Renewable and Non-Renewable Energy Consumption, and International Trade on CO₂ Emissions". By using Indonesian time series data for the period 1965–2024 and the ARDL and ECM econometric approach, it is hoped that this study can provide an empirical contribution to understanding the economic and environmental growth dynamics in Indonesia in the long term.

1.2 Problem Identification

Therefore, the research problem can be explained as follows.

- a. Is the Environmental Kuznets Curve (EKC) model proven in Indonesia during the period 1965–2024?
- b. How does renewable energy consumption and non-renewable energy consumption affect CO₂ emissions in Indonesia?
- c. How does trade openness affect CO₂ emissions in Indonesia?

1.3 Research Objective

Based on the above background and problem formulation, the following research objectives can be formulated in a number of points:

- a. To test the validity of Environmental Kuznets Curve (EKC) in Indonesia during the period 1965-2024.
- b. To estimating the impact of renewable energy consumption and non-renewable energy consumption on the CO₂ emissions in Indonesia.
- c. To estimating the effect of trade openness on CO₂ emissions in Indonesia

1.4 Research Benefit

This research is expected to provide both theoretical and practical benefit:

- a. Theoretical Benefit

It is hope that this research can provide references an empirical contribution of the research about Environmental Kuznets Curve in Indonesia and the impact of economic growth, renewable and non-renewable energy consumption, and international trade on CO₂ emissions in the period 1965-2024.

b. Practical benefit

It is hope the findings of this study can be used into consideration by the government and the policymakers when developing economic development strategies in line with the reduction of carbon emission activities. The results of the contribution of renewable and non-renewable energy to CO₂ can be applied to assess energy transition policies, such as the attainment of national energy mix targets. In addition, the findings of this paper may give the stakeholders an idea of the significance of the energy integration policies, international trading, and growth of the economy in ensuring sustainable development.

