

# CHAPTER 1

## INTRODUCTION

### 1.1 Problem Identification

Throughout history, humanity has utilized fundamental energy sources, relying on human and animal power and the combustion of biomass materials such as wood and coal (Gigauri & Vasilev, 2021). The combustion of carbon-based fuels releases significant quantities of greenhouse gases, has led to rising global temperatures, extreme weather events, and severe environmental degradation, thus driving climate change and negatively impacting both human health and the environment (Sharma & Rajput, 2022). These effects are widespread, impacting all people, not just a select group. In addition, global greenhouse gas emissions can be categorized based on the economic activities responsible for their release into the air. IPCC (2022) says that the energy sector is the biggest source of greenhouse gas emissions in the world. This highlights how important it is to get rid of carbon in the energy industry to deal with the global climate crisis. As climate problems get worse around the world, switching to renewable energy has become an important strategy to make sure that development is sustainable.

The net zero emissions movement, which wants to cut carbon emissions by a lot and make up for any emissions that are left over using mitigation strategies, has also had a growing and bigger effect on international policy in recent years. Countries all throughout the world have set net zero targets as part of their commitment to the Paris Agreement. In the Association of Southeast Asian Nations (ASEAN) region, Vietnam has vowed to reach net zero by 2050, Indonesia by 2060, and Malaysia by 2050 (ACE, 2024). But these countries still depend a lot on fossil fuels, especially coal and natural gas, which provide most of their energy (IEA, 2021).

The globe uses a lot more renewable energy now than it did in 2022, when it reached over 70 exajoules and still growing significantly through 2023 (BP, 2024). The main reasons for this growth have been wind and solar electricity generation. Wind and solar power generation have been the main drivers of this expansion. It has almost doubled from 2019 to 2023, because of lowering

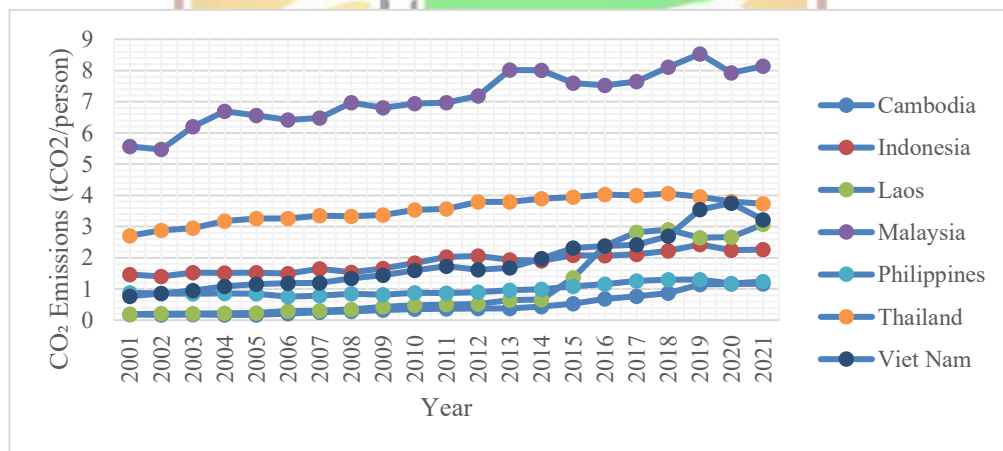
technology costs and rising worldwide investment. This increase is a sign of stronger international efforts to move toward low-carbon energy systems in order to fight climate change and meet the UN's Sustainable Development Goals. Southeast Asia is also taking part in this transition, but the pace of movement is still relatively slow and uneven.

Based on Table 1.1, CO<sub>2</sub> emissions in the ASEAN region rose from 1.5Gt in 2015 to 1.8 Gt in 2022. This increase also increased ASEAN's contribution to global emissions from 4.1% to 5%. This fact indicates that emissions intensity in the region continues to increase, making the need for a transition to clean energy and more effective policies.

**Table 1. 1 ASEAN Contribution to Global CO<sub>2</sub> Emissions**

Year	ASEAN Emissions (Gt)	% of Global Total
2015	~1.5	4.10%
2022	~1.8	5.00%

*Source: Enerdata (2023)*



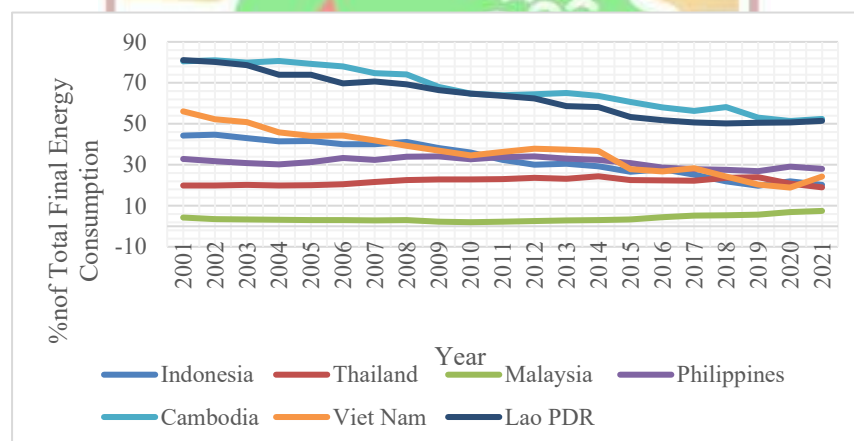
*Source: GlobalCarbon Atlas (2023)*

**Figure 1. 1 Carbon Emissions Share from Selected ASEAN Countries**

The figure 1.1 illustrates how carbon emissions evolved in some ASEAN nations from 2001 to 2021. Malaysia consistently had the highest emissions per person, staying significantly above those of other member states for the entire twenty years. Thailand and Vietnam both grew at a steady but moderate rate. After 2010, Vietnam's growth rate shot up sharply and eventually overtook Thailand's. Indonesia's emissions stayed mostly the same in the

intermediate range, while Cambodia, Laos, and the Philippines had the lowest level. However, their emissions have been going up in recent years and this disparity reflects differences in industrial activity, fossil fuel dependence, and national energy policies. The data highlights a critical regional challenge: high-emitting countries must accelerate renewable energy transitions to meet climate goals.

According to IRENA (2022), shifting energy portfolios toward renewables is vital for reducing CO<sub>2</sub> emissions and promoting long-term environmental sustainability. Without a unified policy approach, ASEAN risks widening the gap between emission-heavy economies and those advancing greener practices. These contrasts reinforce the urgency of integrated low-carbon strategies across the region to avoid deepening inequality and ecological stress caused by delayed energy reforms.



*Source: World Bank (2021)*

**Figure 1. 2 Renewable Energy Consumption in Selected ASEAN Countries**

ASEAN is one of the most dynamic regions in the world, with nearly 680 million inhabitants and strong economic growth that drives rapidly increasing energy demand (Enerdata, 2023). Despite its dependence on fossil fuels, the region has significant renewable energy resources, including geothermal in Indonesia and the Philippines, hydropower in the Mekong basin, and solar exposure across multiple countries. However, as illustrated in Figure 1.2 World Bank (2021), the share of renewables in total final energy consumption

follows different paths across member states. While Indonesia, Thailand, and Vietnam record declining trends, Cambodia and Lao PDR sustain high shares through their reliance on hydropower. This diversity, coupled with the urgent need of ASEAN to juggle economic growth, energy security, and climate responsibilities. These two forces lead to an important policy question: Can CO<sub>2</sub> emissions be reduced through greater use of renewables, all while supporting growth in ASEAN economies?

To understand the context of this research, it is important to understand the Environmental Kuznets Curve (EKC) theory. This theory explains that the relationship between economic growth and environmental degradation is not linear, but rather forms an inverted U-curve (Almeida et al., 2024). In the early stages of industrialization, CO<sub>2</sub> emissions increased sharply due to the use of fossil fuels. However, after a certain point, economic growth can actually reduce emissions through the implementation of cleaner technologies, stricter environmental regulations, and increased public awareness of sustainability. This serves as the basic reference for why renewable energy consumption, economic growth and CO<sub>2</sub> emissions are analyzed using a simultaneous framework in this study. To explain this relationship, Ecological Modernization Theory (EMT) is used to determine whether renewable energy consumption can simultaneously increase economic growth and reduce CO<sub>2</sub> emissions.

Worsening weather conditions in ASEAN, coupled with increasing electricity demand, have made renewable energy increasingly important (Enerdata, 2023). This study examines the relationships between renewable energy usage, CO<sub>2</sub> emissions, and economic growth in seven ASEAN nations from 2001 to 2021. This research adds to a broader discussion around how to create more robust, greener economies. Its results may inform ASEAN policy makers as they look for realistic ways to support clean energy while pursuing development.

Based on these challenges and the need for action, the title of this study is: “The Simultaneous Impacts of Renewable Energy Consumption on Economic Growth and CO<sub>2</sub> Emissions in ASEAN Countries.”

## 1.2 Problem Formulation

Based on the identified issues, this research will focus on the following questions:

1. To what extent does renewable energy consumption affect CO<sub>2</sub> emissions per capita and GDP per capita in a simultaneous system?
2. Does economic growth (GDP per capita) and CO<sub>2</sub> emissions, in turn, influence renewable energy consumption in ASEAN countries?

## 1.3 Research Objectives

Based on the formulated research problems, this study aims to:

1. Estimate the effect of renewable energy consumption on CO<sub>2</sub> emissions per capita and GDP per capita within a simultaneous equation framework.
2. Evaluate the reverse causal impact of GDP per capita and CO<sub>2</sub> emissions on renewable energy consumption.

## 1.4 Writing Format

The systematic discussion in this research is structured as follows:

Chapter I : Introduction.

This chapter presents the background of the study, problem identification, problem formulations, research objectives, and the systematic structure of the thesis.

Chapter II : Theoretical Framework and Literature Review

This chapter discusses the theoretical foundation related to economic growth, renewable energy consumption, and carbon emissions. It also includes earlier empirical studies, the conceptual framework, and hypothesis development important to the project.

Chapter III : Research Methodology



This chapter describes the used research technique, including variable definitions, type and source of data, model specification, and the econometric techniques applied in the study.

Chapter IV : Data Analysis and Discussion

This chapter presents the results of the IV–3SLS estimation.

Chapter V : Conclusion and Recommendations

This chapter outlines the overall conclusions of the research, summarizing key insights gained from the analysis conducted throughout the study.

