

## ABSTRACT

*This research aims to analyze the impact of Manufacturing Value Added on Greenhouse Gas Emissions within the framework of non-linear environmental curve testing across ten Southeast Asian countries (ASEAN-10). Responding to the debate over the existence of the Environmental Kuznets Curve (EKC) hypothesis in the region, this study examines the polynomial components of a cubic function to measure the dynamics of environmental degradation at various stages of industrialization. Quantitative analysis was conducted using a balanced panel data regression with a fixed effect model approach, corrected by the Panel Corrected Standard Error (PCSE) method over the period of 2010 to 2021, while incorporating Energy Intensity, Renewable Energy Consumption, and Gross Domestic Product (GDP) per capita as control variables.*

*The results indicate that an N-shaped Environmental Kuznets Curve (EKC) is empirically validated in ASEAN-10 countries during the 2010–2021 period. This finding is evidenced by the statistical significance of all Manufacturing Value Added (MVA) polynomial terms, namely  $MVA$ ,  $MVA^2$ , and  $MVA^3$ , which jointly capture the nonlinear relationship between manufacturing activities and greenhouse gas emissions. The estimated relationship suggests that increases in MVA initially lead to higher emissions, followed by a decline after the first turning point, and subsequently rise again after the second turning point as industrial development advances. These findings imply the presence of a rebound effect, whereby the expansion of advanced manufacturing activities may offset the environmental gains achieved through earlier technological and efficiency improvements. Furthermore, the positive coefficient of energy intensity and the negative coefficient of renewable energy consumption highlight the crucial role of clean energy management in the region. Therefore, strategies aimed at increasing industrial value added and strengthening ASEAN's integration into global manufacturing networks should be accompanied by greater investment in renewable energy transition and stricter decarbonization policies to prevent a resurgence of emissions at more advanced stages of industrial development.*

*Keywords: Manufacturing Value Added (MVA), Greenhouse Gas Emissions, Environmental Kuznets Curve (EKC), Rebound Effect, Panel Corrected Standard Error (PCSE), Southeast Asia.*