

ABSTRACT

Balancing economic growth and environmental protection has been a challenge in addressing climate change. In Indonesia, economic growth has historically been accompanied by the increase in CO₂ emissions. Indonesia's efforts to sustain economic growth while complying with the Paris Agreement, which targets a 31.89% reduction in greenhouse gas emissions by 2030, highlight the urgent need to decouple economic growth from CO₂ emissions. However, previous studies on decoupling in Indonesia have primarily relied on national-level time series data, offering limited insights into regional variations. To address this gap, this study investigates the decoupling dynamics between energy-related CO₂ emissions and economic growth in six selected provinces in Indonesia from 2011 to 2021, focusing on the manufacturing sector. Employing the Tapio decoupling model and logarithmic mean Divisia index decomposition analysis, this research classifies provinces based on their decoupling status and identifies the key drivers of emission changes at the provincial level. The results show that: (1) decoupling status varied across the selected provinces, with some demonstrated a more stable progress towards achieving decoupling, while others remained in negative decoupling or coupling states; (2) in the post-NDC period, all provinces improved their decoupling state, whereas in the post-COVID-19, most provinces regressed to less desirable states; and (3) energy efficiency improvements and a cleaner energy mix are critical factors to achieving decoupling. This study provides a detailed regional analysis as valuable insights for guiding Indonesia's low-carbon transition, supporting both economic growth and emissions reduction through targeted and effective policies around energy efficiency and energy structure.

Keywords: CO₂ emissions, Economic growth, Manufacturing sector, Indonesia, Tapio model, LMDI decomposition, Climate change mitigation

INTISARI

Menjaga keseimbangan antara pertumbuhan ekonomi dan pelestarian lingkungan menjadi tantangan penting dalam menghadapi perubahan iklim. Di Indonesia, secara historis, pertumbuhan ekonomi berkaitan erat dengan peningkatan emisi CO₂. Untuk memenuhi komitmen terhadap *Paris Agreement* dalam menurunkan emisi gas rumah kaca sebesar 31,89% pada tahun 2030, diperlukan upaya pemutusan (*decoupling*) keterkaitan antara pertumbuhan ekonomi dan emisi CO₂. Namun demikian, sebagian besar penelitian di Indonesia hanya berfokus pada analisis tingkat nasional, sehingga belum banyak menggambarkan variasi antarwilayah. Penelitian ini menganalisis dinamika *decoupling* antara emisi CO₂ bidang energi dan pertumbuhan ekonomi di enam provinsi di Indonesia selama 2011-2021, dengan fokus pada sektor manufaktur. Metode yang digunakan meliputi *Tapio decoupling model* dan analisis dekomposisi *Logarithmic Mean Divisia Index* (LMDI) untuk mengklasifikasi setiap provinsi berdasarkan status *decoupling* dan mengidentifikasi faktor utama yang mempengaruhi perubahan emisi di tingkat provinsi. Hasil penelitian menunjukkan bahwa: (1) status *decoupling* bervariasi antarprovinsi, dengan sebagian provinsi menunjukkan kemajuan yang stabil, sementara provinsi lainnya masih dalam kondisi *coupling*; (2) pada periode setelah NDC, seluruh provinsi mengalami perbaikan, namun sebagian kembali menurun pada periode pasca-COVID-19; (3) peningkatan efisiensi energi dan transisi ke energi bersih menjadi faktor utama yang mendorong *decoupling*. Penelitian ini memberikan pemahaman yang lebih mendalam mengenai variasi regional dalam upaya pengurangan emisi di Indonesia, serta memberikan masukan penting bagi perumusan kebijakan terkait transisi menuju ekonomi rendah karbon.

Kata kunci: emisi CO₂, pertumbuhan ekonomi, sektor manufaktur, Indonesia, *Tapio decoupling model*, dekomposisi LMDI, mitigasi perubahan iklim.