Embodied GHG Emissions in ASEAN: A Multi-Regional Input-Output Analysis

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Author: Asuka Matsuyama
Co-Authors: Shigemi KAGAWA

In the ASEAN region, often referred to as a global growth center, rapid economic expansion and population growth have led to a significant surge in energy demand, raising concerns about the corresponding increase in greenhouse gas (GHG) emissions. The population of ASEAN region has increased fourfold over the past 70 years and is estimated to reach 790 million by 2050.

Against this backdrop, ASEAN member states have committed to achieving carbon neutrality between 2050 and 2065 in alignment with the Paris Agreement. For instance, initiatives aimed at reducing greenhouse gas emissions include the installation of floating solar power plants in Singapore and the improvement of hydropower and wind generation in Laos. However, the region remains heavily reliant on abundant and inexpensive fossil fuels, and the challenges of coordinating efforts among member nations pose significant obstacles to decarbonization.

Fossil fuels are widely utilized across various industries, both as raw materials and as energy sources, directly and indirectly contributing to GHG emissions throughout ASEANâ€™s industrial landscape. Considering the dense interconnectivity of the regionâ€™s industrial networks, it is crucial to quantitatively evaluate the direct and indirect GHG emissions from domestic industries. Such insights can guide strategies for decarbonization tailored to the unique circumstances and characteristics of each member state.

To quantify the GHG emissions generated in ASEAN countries, this study utilized GLORIA database which provides the 2019 multi-regional input-output table (MRIO) covering 164 countries and 120 industrial sectors. Using the Environmentally-Extended Input-Output Analysis (EEIOA), we estimated direct and indirect GHG emissions for each of the 10 ASEAN countries. Additionally, we calculated GHG emissions per capita using the World Population Prospects data for these 10 countries and compared the results across countries.

The findings reveal that in 2019, the ASEAN-10 countries accounted for approximately 6% of global GHG emissions. Indonesia, the most populous ASEAN nation, recorded the highest total GHG emissions. On a per capita basis, Brunei reported the highest emissions, followed by Singapore, Malaysia, and Thailand. Bruneiâ€™s significant emissions are attributed to energy conversion processes, such as oil refining and power generation, heavily reliant on abundant petroleum and natural gas resources. In contrast, Cambodia and the Philippines, characterized by either the early stage of development or reliance on renewable energy sources like geothermal and hydropower, exhibited relatively low per capita emissions.

Furthermore, approximately 80% of GHG emissions in the ASEAN-10 are attributed to COâ‚‚, primarily driven by fossil fuel-dependent power generation and transportation. For instance, coal-fired power plants dominate energy supply in Indonesia and Thailand, while rapid industrialization has spurred increased fossil fuel consumption in Malaysia and Vietnam. Although Bruneiâ€™s low population size contributes to its high per capita emissions, the nation is also in a stage of active industrialization. Mitigating fossil fuel usage in these industrializing nations will be pivotal for ASEANâ€™s decarbonization goals.

The diverse economic structures and stages of development among ASEAN countries necessitate flexible and country-specific decarbonization policies. Moreover, strengthening regional cooperation

will be essential for reducing GHG emissions across ASEANâ€™s supply chains. In particular, reducing GHG emissions from industrializing countries remains an urgent priority, requiring measures such as utilizing foreign technologies to convert COâ‚‚. To achieve this, as seen in Japanâ€™s recently proposed AZEC initiatives, ASEAN countries should leverage advanced technologies from Japan and other partner countries within a regional cooperative framework. By sharing the common goal of economic growth in Asia and taking a leadership role in the international community, ASEAN countries should work together to promote decarbonization..