บทสังเคราะห์งานวิจัย

Economic Input-output Life Cycle Assessment of the 180 Industrial and Services Sectors in Thailand

Aweewan Mangmeecahi

Life Cycle Assessment (LCA) is a technique used to assess the environmental aspects and potential impacts of all stages of products or services. The work presented here proposes an Economic input-output life-cycle assessment (EIO-LCA) approach for the Thai economy of 180 industrial sectors to evaluate production and service values, energy consumption, and GHG emissions.

A few studies of EIO-LCA have been conducted in Thailand. According to the literature reviews, there are two areas of EIO-LCA research works. The first area is to develop the EIO-LCA model and the second area is to apply the EIO-LCA to its applications.

For the studies on developing the EIO-LCA model, Researchers presented the pros and cons of the process based analysis and input output analysis in the Thai context. One study reported that Petroleum and natural gas refineries sector was the largest energy consumption followed by road freight transport sector, electricity sector and cement sector, respectively. The largest GHG emissions are released by electricity sector, followed by ocean transport sector and cement sector, respectively. These sectors should reduce GHG emissions by replacing fossil fuel with renewable energy. Another group of researchers studied the embedded energy and GHG emissions in the final consumption. The direct GHG emissions in the final consumptions in Thailand were evaluated by imitating the approach in the energy sector of the revised 1996 Intergovernmental Panel on Climate Change guidelines for national GHG inventories. The indirect energy and indirect emissions were evaluated by using the 1998 IO table. Results showed that the highest energy intensive sector was the electricity sector where fossil fuel was primarily used, but the highest total GHG emitter was the cement industry where the major sources of the emissions were industrial processes and the combustion of fossil fuels. One researcher assessed the CO_2 emissions from various sectors in Thailand by applying the IO method. The author also analyzed elasticity of CO_2 emissions in 1995, 1998, 2000 and 2005 and the effect of changing coal and crude oil usage on carbon dioxide emissions. The result showed that the largest CO_2 emissions was transportation sector, followed by commercial sector, construction sector, and power generation sector. The CO_2 elasticity of transportation sector, the commercial sector, and the construction sector was 0.26, 0.11, and 0.09, respectively. If the country reduces crude oil and coal usage, CO_2 emissions were estimated to be reduced by 9.37 percent and 5.27 percent, respectively.

For the EIO-LCA implication studies, researchers developed an assessment method for sharing the GHG responsibility between the developed countries and developing countries. The three methods used in this analysis are Production-based Approach, Ownership-based Approach and Consumption-based Approach. A recent IO table and Energy Input Matrix of Thailand were used to calculate the responsibility of GHG. The researchers suggested Ownership-based Approach and Consumption-based Approach are the most suitable and fair methods for sharing the GHG responsibility since they also concern about carbon leakage issue, the shifting of carbon inventory, and carbon offshoring, the reallocation of production sites from the developed countries to developing countries. Tantivasadakarn et al. (2010) allocated the greenhouse gas responsibility between Thailand and her trade partners by using the consumption-based approach comparing with the production-based approach. The IO analysis was used in this study. It was found that in year 2004, Thai economy has emitted carbon dioxide on behalf of other countries via net exports around 6.82 percent of its production. The CO_2 inventory from the production based accounted for 196.52 million tons CO_2 while the counterpart inventory from the consumption based was 183.13 million tons CO_2.

Limmeechokchai and Suksuntornsiri (2007a) assessed the economy-wide CO_2 mitigations between selecting cleaner power generation options instead of pulverized coal-thermal technology of the undecided capacity by using energy input–output analysis. The input–output analysis presented the fuel-mix effect, input structural effect, and final demand effect by the change in technology of the undecided capacity. The cleaner technologies included biomass power generation, hydroelectricity and integrated gasification combined cycle. Results of the analyses showed that if the conventional pulverized coal technology was selected in the undecided capacity, the economy-wide CO_2 emission would be increased from 223 million tons in 2006 to 406 million tons in 2016. Renewable technology presented better mitigation options for replacement of conventional pulverized coal technology than cleaner coal technology. The major contributor of CO_2 mitigation in cleaner coal technology was the fuel mix effect due to higher conversion efficiency. The demand effect was the major contributor of CO_2 mitigation in the biomass and hydro cases. The embedded emission in construction of power plant contributed to higher CO_2 emission.

According to the research works mentioned above, researchers seem to rely on different data sources and assumptions. Thus, the results report very greatly and are not able to compare each other.