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PROMOTING SUSTAINABILITY IN EMERGING ECONOMIES VIA LIFE CYCLE THINKING

Preface

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Emerging economies have played an important role in driving global sustainability due to their high share of the world population, production, as well as consumption. Even so, emerging markets lag behind developed countries, and all countries face common challenges including energy security, environmental protection, and affordable energy for fulfilling the rapidly growing demand for energy (IEA 2013). Despite the age of science, technology, and innovations, the current development trends in developing regions may still pose threats to the environment, human health, and natural resources. According to the latest regional assessments in global environmental outlook (UNEP 2016a, b, c), major concerns include changes in demography and lifestyle, inequality, increased resource use with decreased efficiency and productivity, increased environmentally related health risks, increased vulnerability to natural hazards and extreme events, land degradation, resource scarcity, biodiversity and habitat losses, and widened gaps between policy and implementation. In order to leapfrog these problems in developing countries and avoid the environmentally harmful stages of development, it is necessary to have measures as well as tools for supporting both policy decision makers and producers for strategic planning.

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Green growth, low-carbon society, and cleaner production are ideas that are often discussed in environmental circles. Life cycle thinking is a key concept that binds these ideas. It is a useful analytical tool, not only as environmental LCA but also life cycle costing (LCC), social LCA (SLCA), and other related tools such as material flow analysis (MFA). This special issue aims to bring together experiences from emerging economies related to the application of life cycle assessment-based tools via case studies, industrial applications, policy applications, and even new methods or adaptation of existing ones to the local context.

One of the indicators of the development and mainstreaming of LCA is the development of the national life cycle inventory (LCI) database. One country that stands out in this context is Thailand where the national LCI database was started to be developed more than a decade ago. It currently has more than 700 datasets comprising ten sectors including natural gas, refinery, petrochemical products, infrastructure and transportation, construction materials, agriculture and agro-products, basic chemicals, waste management, and textiles (Chomkhamsri et al. 2017). This has helped the government in promoting LCA-based policy and also encouraged industry to be more receptive to conducting LCAs and related tools (Gheewala and Mungcharoen 2017). In fact, now the readiness of the national LCI is being used for testing the Product Environmental Footprint (PEF) which may need to be conducted by Thai companies producing parts and products for export to the European Union (Poolsawad et al. 2017). Thailand has been quite advanced in the development and implementation of LCA in Southeast Asia and has been working with countries in the region to promote the application of LCA, especially in the agrifood sector through the LCA Agrifood Asia network (Gheewala 2012).

Development of national databases, however, is not enough as LCAs by nature are global. They need to consider

the entire supply chain which is commonly spread over many countries. This brings forth the need for interoperability of databases which is confounded by the issue of confidentiality. However, the aspects of harmonized review criteria and review process are important and must be carried out while keeping in mind that there are high stakes vis-à-vis competition and trade (Vigon et al. 2017).

The development of national LCI databases is the first important step in supporting the applications of life cycle thinking and LCA tools to enhance sustainability in emerging economies. Life cycle thinking can be used as the logical conceptual approach for strategic environmental planning and management for the industrial sector such as a case of mining sector in the Philippines (Balanay and Halog 2017). Another aspect from a practical point of view when implementing LCAs for the industry is the need for sector/product-based standardization via environmental product declarations (EPD). This may pose certain challenges in the emerging economy context; thus, research is needed on whether it is appropriate to directly implement the EPDs formulated by developed countries or if there could be context-specific variations. These discussions are also sector-specific as shown by the study on Mexico's building sector (Arvizu-Piña and Burgos 2017).

The development of national databases and promotion of life cycle thinking in many of the emerging economies has led to the proliferation of LCA studies. Many traditional LCA studies have been conducted to assess the environmental performance of products. This special issue presents some of the studies that have focused on using LCA as a rigorous method for testing the perceived environmental advantages of products such as biodiesel from beef tallow (Magalini et al. 2017), hotspots analysis of office furniture (Medeiros et al. 2017), or environmental comparison of products such as bricks and palm oil (Prateep Na Talang et al. 2017; Bunchai et al. 2017) and processes such as waste treatment and construction (Hassanain et al. 2017; Sedpho et al. 2017; Salzer et al. 2017). In addition to conventional LCAs, allocation methods have also been considered in complex multiproduct systems such as oil refineries using multi-scale modeling (Silveira et al. 2017). The development and use of the LCA-based methods for water assessment such as water stress index and water deprivation have been tested for policy applications (Pingmuanglek et al. 2017; Nilsalab et al. 2017). New methods on valuation of environmental impacts have also been adopted to country-specific contexts and tested for policy application (Kaenchan and Gheewala 2017). The application of consequential LCA, which is relatively new to emerging economies, has been attempted in analyzing policy decisions showing the coming-of-age of LCA in these countries (Prapaspongsa and Gheewala 2017; Prateep Na Talang et al. 2017). The combination of life cycle -based environmental and economic tools is a first step towards life cycle sustainability assessment (LCSA); studies have been done using tools such as LCA, LCC, and economically extended material flow analysis (Bhochhibhoya et al. 2017; Khonpikul et al. 2017). Finally, a full LCSA has also been attempted considering LCA, LCC, and SLCA (van Kempen et al. 2017). Thus, it can be seen that the whole gamut of LCA and life cycle thinking-based tools have been used in several emerging economies across the world, in Asia, Africa, and America.

Under challenging conditions in emerging economies (e.g., needs for economic growth and industrial development and low environmental awareness), lessons learned from this special issue will be beneficial for both developed and emerging economies.

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