Potential Improvement of Environmental Regulation in the Thai Energy Industry by Application of Life Cycle Assessment

Trakarn Prapaspongsa[1,*] and Shabbir H. Gheewala[2,3]

[1] Department of Civil and Environmental Engineering, Mahidol University, Nakhon Pathom, Thailand
[2] The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[3] Centre of Excellence on Energy Technology and Environment, PERDO, Bangkok, Thailand
*Corresponding author. Tel.: +(66)2-889-2138 ext. 6396-7, Fax: +(66)2-889-2138 ext. 6388, E-mail address: Trakarn.pra@mahidol.ac.th, Trakarn.prapasongsa@gmail.com

Abstract: Recent public debates and protests on energy industry in Thailand due to concerns on existing and potential adverse environmental impacts, conflict of interest and the lack of scientifically reliable, transparent and easily accessible information have addressed the importance of continuously improved regulations and enforcement. This study aims to identify how LCA can potentially be applied for supporting environmental regulation improvement toward sustainable energy industry in Thailand. This research is carried out by literature analysis. The criteria for choosing regulations to be improved are (1) ease of application, (2) realistic time and manpower resource requirements for the analysis process, (3) limited data requirements. An overall framework of life cycle assessment applications for supporting environmental regulation improvement and enhancing environmental sustainability of Thailand's energy industry is illustrated. Specific types of recommended environmental regulations for the tool application are effluent standards, environmental quality standards, and environmental impact assessment. Future research includes comparative life cycle assessment studies on specific energy sources considering regulated and non-regulated pollutants as well as comparative environmental impact assessment studies with and without life cycle considerations.

Keywords: Life cycle assessment; Environmental Laws and Regulations; Environmental Standards; Environmental Impact Assessment; Sustainable Energy Industry.

1. Introduction

Over the last 40 years, the patterns of natural resource use in the Asia and the Pacific region might be considered as inefficient and unsustainable [1]. The varieties and intrinsic complexities in economic development, natural resource consumption and environmental impacts implicitly address the importance to holistically determine potential impacts on the environment and society within and across sectors in Thailand. In order to capture the holistic environmental impacts from the whole supply-chains of products/production systems, life cycle assessment (LCA) considering the inputs, outputs and potential environmental impacts under life cycle perspective could be applied. Recently, public debates and protests on industrial development have been dominant in Thailand due to concerns on existing and potential adverse environmental impacts, conflict of interest among stakeholders (i.e. industries, governmental agencies, NGOs, and the public), and the lack of scientifically reliable, transparent and easily accessible information [2-4]. The energy industry has been debated the most in terms of potential and existing adverse environmental effects. LCA with case studies on the energy industry could be targeted for pollution prevention and control as well as conflict resolutions. In Thailand, LCA has been promoted as a voluntary tool for pollution prevention and sustainable development whereas the aspect for legal improvements has rarely been investigated. Moreover, recent seminars and public hearings have also addressed the need for environmental regulation improvement [5-6]. Hence, the objective of this study is to identify how LCA can potentially be applied for supporting environmental regulation improvement toward sustainable energy industry in Thailand.

2. Experimental

The identification of potential LCA applications for supporting environmental regulation improvement is done by literature analysis. Firstly, environmental laws and regulations relating to energy industry in Thailand are reviewed and summarised. The potential linkages between the tool applications with the industry and regulations are established. The criteria for decision-support tool selection proposed in Department for Communities and Local Government: London (2009) are modified to be used for selecting and prioritising specific environmental regulation improvements [7]. The modified criteria are: (1) ease of application, (2) realistic time and manpower resource requirements for the analysis process, (3) limited data requirements.

3. Results and Discussion

Laws and regulations relating to environmental protection and pollution control for energy and mining industry in Thailand consist of several Acts and Notifications and are enforced by various governmental organizations. The most important environmental law in Thailand is the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (or NEQA 1992) prescribing important legal measures to control pollution and protect the environment. In order to enforce this law, many regulations have been prescribed and enforced. Based on NEQA 1992, this study proposes the overall framework to apply LCA for supporting potential environmental regulations to enhance the environmental sustainability of energy industry in Thailand as illustrated in Fig. 1. The chapters 3 to 7 of NEQA 1992 are re-organised into 3 main areas of this study as environmental protection, pollution control and monitoring and enforcement.

Emissions to air, water and soil from various energy production technologies can be assessed by the LCA tool to identify the hotspot processes and the priority pollutants of each energy source for impact reduction. The assessment can be directly and indirectly linked with the environmental regulations. With the use of the selection criteria, specific environmental regulations which LCA studies could be applied to identify potential improvements are: (1) effluent standards, (2) environmental quality standards, and (3) environmental impact assessment (EIA). The ease of application, realistic resource and limited data requirements for improving effluent and environmental quality standards could be obtained because only the recommendations based upon LCA studies aiming at identifying the priority pollutants

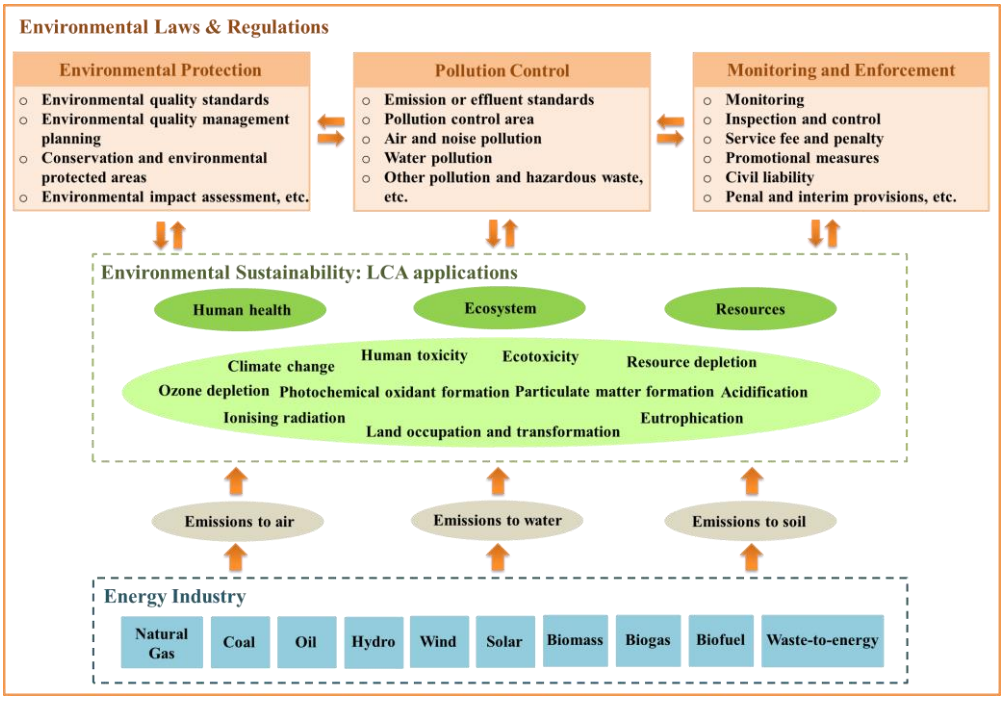

Figure 1. Overall framework of LCA applications for supporting environmental regulation improvement

regulated in the standards could be applied by the regulators. LCA studies can be conducted with the use of regulated emissions data which have been collected by various authorities. For non-regulated pollutants, life cycle inventory data could be obtained from relevant scientific peer-reviewed publications. When existing LCA case studies on specific products/sectors have been established, under consultation with LCA experts the regulators could update new input data and interpret whether there should be additional priority pollutants by themselves. For EIA, LCA could be applied for alternative prioritisation (i.e. by selecting the option with the lowest life cycle environmental impacts). Life cycle considerations could be partially applied in EIA to assess priority environmental impacts such as global warming and human health. Furthermore, the Royal Government of Thailand has agreed and ratified the Paris Agreement [8]. United Nations (2015) reported that the main aim of the Paris Agreement is "*to strengthen the global response to the threat of climate change in the context of sustainable development and efforts to eradicate poverty*" [9]. After achieving the threshold for entry into force on 5 October 2016, the Paris Agreement will enter into force on 4 November 2016 [8]. Climate change policies and regulations might have to be established (i.e. by controlling greenhouse gas emissions with new regulation establishment or existing regulation modifications). This aspect addresses the needs to consider the whole life cycle of a project/product system to effectively endorse the climate policy with respect to the new agreement.

Current gaps of the chosen regulations for controlling energy industry in Thailand could be high allowable limits of pollutants in comparison with other countries [6], limited controlled pollutants and the incomprehensive nature of assessment scopes. An example of the specific standards for potential improvements could be on emission standards for power plants in Thailand which consider SO_2, NO_x and particulate whereas US EPA has taken more pollutants (a. filterable particulate matter OR total non-Hg hazardous air pollutant (HAP) metals OR individual HAP metals, b. HCl or SO_2, c. Hg) into account [10-11]. All potential pollutants could be included in comparative LCA studies in order to consider the sufficient coverages of regulated and non-regulated pollutants as above-mentioned. Since energy production from different sources emits different pollutants affecting different environmental impacts, LCA studies should be specifically applied for supporting specific energy sources.

4. Conclusion

This study provides an overall framework of LCA applications for supporting environmental regulation improvement and enhancing environmental sustainability of Thailand's energy industry. Specific types of environmental regulations for the tool application are recommended. Future studies should consider specific regulations and specific improvement by assessing life cycle environmental impacts of electricity production from various energy sources. For specific recommendation, specific case studies on LCA of various energy sources with regulated and non-regulated pollutants as well as EIA with and without life cycle considerations will be needed.

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