Chapter 5

Conclusion as Policy Recommendations

December 2021

This chapter should be cited as

Study Team (2021), 'Conclusions and Policy Recommendations', in Morimoto, S., S. Gheewala, N. CHollacoop and V. Anbumozhi (eds.), *Analysis of Future Mobility Fuel considering the Sustainable Use of Biofuel and Other alternative Vehicle Fuels in EAS Countries.* ERIA Research Project Report FY2021 No. 18, Jakarta: ERIA, pp.135-139.

Chapter 5

Conclusion as Policy Recommendations

1. Introduction

The National Institute of Advanced Industrial Science and Technology (AIST) has been studying future mobility scenarios of East Asia Summit (EAS) countries since 2014. In the past AIST–ERIA project, the scenarios for India, Indonesia, and Thailand were examined considering the potential of biofuels and electrified vehicles (xEVs). As the result, well-to-wheel CO_2 emissions were estimated for several scenarios by creating energy mix model.

However, in the previous project, the sustainability of biofuels and xEVs has not yet been taken into consideration. Diffusion of xEVs can contribute to CO_2 reduction, but mfay affect mineral resource demand induced by motors and batteries. Therefore, the aim of this project is to analyse future scenarios of EAS mobility which highly contribute to the Sustainable Development Goals (SDGs) (7, 12, and 13) in consideration of the balance between transport CO_2 reduction, biofuel use, and mineral resources demand. The outcome will contribute to the EAS Energy Research Road Map (Pillar 3: Climate Change Mitigation and Environmental Protection corresponding to ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025 3.5 Programme Area No.5: Renewable Energy and 3.6 Programme Area No.6: Regional Energy Policy and Planning).

In fiscal year 2020, the first phase of this project was conducted. The working group meetings were conducted in November 2020 and May 2021. As the result, biofuel policies and strategies, as well as existing research on biofuels sustainability were assessed for the EAS countries (India, Thailand, Malaysia, Viet Nam, Indonesia, and Philippines). Moreover, a database was created to evaluate well-to-wheel CO_2 reduction and mineral resource demand based on the biofuel implementation and mobility electrification. This chapter describes the conclusion and progress of each study (chapters).

2. Biofuel Policies and Biofuel Implementation in East Asia Summit Countries

In chapter 2, existing biofuel policies and implementation plan from selected EAS countries were assessed as a foundation to accommodate emerging electric vehicle trends during mobility energy transition. Biofuel policies mechanism was analysed and past and existing biofuel polices and regulations in the context of potential EV scenario (discussed in Chapter 4) were reviewed.

As the conclusion, multi-benefits of biofuel implementation does not only lie upon reduced fossil fuel import and reduced tank-to-wheel CO_2 emissions, but also by added value and demand

creation for agriculture product. However, this biofuel policies and implementation schemes must be carefully pursued within the context of sustainability, especially during transition toward electric mobility in the future.

3. Review of Biofuels Sustainability Assessment and Sustainability Indicators in EAS Countries

The progress of sustainability assessment of biofuels in the East Asia region was evaluated with examples of some of the participating countries (India, Thailand, Indonesia, Philippines, Malaysia, and Viet Nam) using the sustainability indicators proposed by the earlier ERIA project on 'Sustainable Biomass Utilisation Vision in East Asia' (Sagisaka, 2008). In the first year, the indicators were introduced to the participating representatives from the different countries and an attempt made to collect existing information. This was anticipated to lead to information on the current status of sustainability assessment in the East Asia region and needs for collecting further information to fill the gaps in the existing available information or even reconsidering some of the selected indicators.

As the conclusion, this report provided an update on the status of sustainability assessment of biofuels in the East Asia region. Six indicators, two each for environmental, economic, and social assessment, were selected from the suggestions by the previous working group of ERIA (Kudoh et al., 2015). These indicators are also aligned with those provided by the Global Bioenergy Partnership (GBEP, 2011). The results have been collected based on information existing in the public domain and presented for Thailand, Indonesia, Malaysia, Viet Nam, Philippines, and India. Most of the countries have had some life cycle assessment studies for biofuels which cover at the minimum, greenhouse gas emissions. In general, greenhouse gas emissions reductions have been observed for biofuels as compared to the fossil counterparts, although some studies have cautioned that these reductions could be overturned should forest land be converted to agriculture for cultivating biofuel feedstock. However, water consumption for the environmental assessment as well as economic and social indicators were not identified in the literature. Only Thailand and Viet Nam have had studies covering most of the indicators. In Thailand, there have been several research studies from academia that have provided the information (e.g. Gheewala, 2013; Gheewala et al., 2011; Silalertruksa and Gheewala, 2011, 2012a, 2012b). On the other hand, for Viet Nam, the information has come from a recent study by the Food and Agriculture Organization of the United Nations (FAO, 2018). It is hoped that at the next step of the project, information on all the proposed indicators can be computed at the national level rather than at a case study level by using the approach suggested by the GBEP.

4. Vehicle Electrification and Consumption of Mineral Resources in East Asia Summit Countries

The long-term mineral resource demand associated with automobile electrification in EAS countries was estimated and the potential for recycling in these countries were assessed by determining the amount of waste of these mineral resources. Furthermore, effectiveness of introducing a circular economy in EAS countries was evaluated.

As the conclusion, the demand of neodymium is predicted to be a minimum of 2,996 ton/year (t/y) to a maximum of 4,809 t/y in 2050 based on Method 1 and a minimum of 3,200 to a maximum of 5,295 t/y in 2030 based on Method 2 (including India). If the recycle rate is 100%, secondary resources can cover 4%7 to 50% of neodymium demand based on Method 1 and 21 to 25% based on Method 2.

Moreover, the total demand of cobalt is predicted to be a minimum of 1,397 t/y to a maximum of 89,762 t/y in 2050 based on Method 1 and a minimum of 1,614 t/y to a maximum of 103,720 t/y in 2030 on Method 2. If the recycle rate is 100%, secondary resource can cover 42% of cobalt demand based on Method 1 and 16% based on Method 2.

However, considering that production of neodymium was 43,200 rare earth oxide t/y and cobalt was 140,000 t/y in 2020 (USGS, 2021), it is predicted to be difficult that world supply will meet the target of EAS mobility electrification due to the large increase of demand in China, the European Union, and the United States. Therefore, the need of considering the balance between biofuels and mobility electrification was revealed based on the potential of secondary resources and circular economy.

5. Conclusion and Future Aspects

This study assessed the policies and strategies for biofuels and mobility electrification, as well as existing research on biofuels sustainability for the EAS countries (India, Thailand, Malaysia, Viet Nam, Indonesia, and Philippines). Despite the data insufficiency, several databases were created to evaluate well-to-wheel CO_2 reduction of biofuel implementation and mineral resource (neodymium and cobalt) demand based on the mobility electrification.

As the conclusion, the synergies between biofuel implementation and mobility electrification were clarified, which highly contribute to the SDGs. Biofuel implementation will add extra value by demand creation for agriculture products and therefore, creating a circular economy will lead to an improvement on collecting waste agriculture products. This perspective is also similar for recycling mineral resources since secondary resources can covers 21% to 50% of neodymium demand and 16% to 42% of cobalt demand in mobility electrification. As the conclusion, creating a circular economy will bring multi-benefits for both agriculture and mineral resources sustainability and therefore, sustainability assessment from environmental, social, and economic indicators will be necessary.

For further studies, well-to-wheel CO_2 reduction of biofuel implementation and dynamic material flow analysis of mineral resource will be conducted. The sustainability assessment will then be conducted with more concrete data for each (environmental, social, and economic) indicators using country-level information rather than discrete and specific case studies from the literature that may have been designed for a different purpose. This will bring more uniformity to the overall sustainability assessment of biofuels for the region. Furthermore, the synergies as well as multi-benefits between biofuel implementation and mobility electrification will be more clarified with all sustainability indicators. At last, the sustainable mobility scenarios for EAS countries will be created considering the achievement of the SDGs.

References

Food and Agriculture Organization of the United Nations (FAO) (2018), 'Sustainability of Biogas and Cassava-based Ethanol Value Chains in Vietnam', *FAO Working Paper 69.*

Gheewala, S.H. (2013), 'Environmental Sustainability Assessment of Ethanol from Cassava and Sugarcane Molasses in a Life Cycle Perspective', In A. Singh, S.L. Olsen, and D. Pant (eds.) *Life Cycle Assessment of Renewable Energy Sources*, Springer, pp.131–43.

Gheewala, S.H., T. Silalertruksa, P. Nilsalab, R. Mungkung, S.R. Perret, and N. Chaiyawannakarn (2013), 'Implications of the Biofuels Policy Mandate in Thailand on Water: The Case of Bioethanol', *Bioresource Technology,* 150, pp.457–65.

Gheewala, S.H., S. Bonnet, K. Prueksakorn, and P. Nilsalab (2011), 'Sustainability Assessment of a Biorefinery Complex in Thailand', *Sustainability*, 3, pp.518–30.

Global Bioenergy Partnership (GBEP) (2011), *The Global Bioenergy Partnership Sustainability Indicators for Bioenergy* (First Edition). http://www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/Indicators/The_GBEP_Sustainability_Indicators_for_Bioenergy_FINAL.pdf (accessed 16 May 2021).

Kudoh, Y. et al. (2015), 'A Region-specific Methodology for Assessing the Sustainability of Biomass Utilisation in East Asia', *Sustainability*, 7, pp. 16237–16259.

Sagisaka, M. (2008), 'Sustainable Biomass Utilisation Vision in East Asia', *ERIA Research Project Report 2007, No. 6–3*. Jakarta: ERIA. https://eria-development.website/eria/Publications/Detail/sustainable-biomass-utilisation-vision-in-east-asia

Silalertruksa T. and S.H. Gheewala (2011), 'Long-term Bio-ethanol System and its Implications on GHG Emissions: A Case Study of Thailand', *Environmental Science and Technology*, 39, pp.834–43.

Silalertruksa, T., and S.H. Gheewala (2012a), 'Food, Fuel and Climate Change: Is Palm-based Biodiesel a Sustainable Option for Thailand? *Journal of Industrial Ecology*, 16(4), pp.541–51.

Silalertruksa, T. and S.H. Gheewala (2012b), Environmental Sustainability Assessment of Palm Biodiesel Production in Thailand', *Energy*, 43(1), pp.306–14.

United States Geology Survey (USGS) (2021), *Mineral Commodity Summaries 2021.* https://doi.org/10.3133/mcs2021