Chapter 4

Conclusions and Recommendations

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Chapter 4
Conclusions and Recommendations

1. Introduction

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

However, in the previous project, the sustainability of biofuels and xEVs was not taken into consideration. The diffusion of xEVs can contribute to CO_2 reduction but may affect the mineral resource demand induced by motors and batteries. Therefore, the aim of this project is to analyse future scenarios of EAS mobility that contribute to the Sustainable Development Goals 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 the 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. Biofuel policies and strategies, as well as existing research on biofuel sustainability, were assessed for the EAS countries (India, Thailand, Malaysia, Viet Nam, Indonesia, and the Philippines). Moreover, a database was created to evaluate well-to-wheel CO_2 reduction and mineral resource demand based on biofuel implementation and mobility electrification.

In fiscal year (FY) 2021, working group meetings were conducted in December 2021 and April 2021. As a result, 'well-to-tank' greenhouse gas (WTT GHG) emissions for producing biofuels, 'tank-to-wheel' GHG emissions for using biofuels, and demand and GHG emissions for producing mineral resources considering mobility electrification were evaluated. This chapter describes the conclusion and progress of each study (chapters).

In FY2022, working group meetings were conducted in January 2023 and April 2023. As a result, WTW GHG emissions for implementing biofuels and EVs were assessed for three different scenarios considering the improvement in energy sources. Moreover, mineral resources demand considering mobility electrification was evaluated and compared with supply data from the United States Geological Survey (USGS) and global demand forecasts of the International Energy Agency (IEA). Finally, barriers to implementing the vehicle electrification scenario in EAS countries were examined and the mobility scenario for each country was identified. This chapter describes the conclusion and progress of each study (chapters).

2. Tank-to-Wheel CO_2 Emissions from Biofuels/EVs and Mineral Resources Consumption in East Asia Summit Countries

In this chapter, GHG emissions considering the landscape of the current vehicle ecosystem in select Association of Southeast Asian Nations (ASEAN) Member States (Indonesia, Malaysia, Philippines, Thailand, and Viet Nam) and India are examined with the same projection of vehicle growth in the future as from the previous study (ERIA, 2022) but with an updated grid emission factor to assess GHG emissions as a result of collective efforts on EVs and biofuel in the transport sector. In particular, three different scenarios are considered based on the assumption of EVs and biofuel from the previous study (ERIA, 2022) and improvement in electricity sources.

This chapter further explores a bottom-up energy demand model for the transport sector from the previous study (ERIA, 2022), focusing on cars and motorcycles in selected countries using the well-respected Low Emissions Analysis Platform (LEAP) system with input data on population, GDP, vehicle history and projection, vehicle kilometres travelled (VKT), and fuel economy. The best available assumption must be made when data are not available to construct models for EVs and biofuel forecasts.

With the relatively robust vehicle ownership model, the Business-as-Usual (BAU) setting for energy consumption and WTT GHG emissions can be set as a baseline for investigation into the impacts of EVs and biofuel policy. Additional grid emission improvements from renewable energy are quantitatively assessed on reductions in transport GHG emissions. As pointed out in the previous study (ERIA, 2022), the motorcycle segment in these six countries emits similar GHGs to the car segment, and the electrification effect from the current target could achieve about 5% decarbonisation in each sector. Further grid emission factor improvement from the current policy could help further decarbonise by less than 2%, implying that further consideration may be needed to improve grid emissions. On the other hand, biofuel policy could help each sector decarbonise by 10%.

This chapter also explains the result of neodymium (Nd) and cobalt (Co) demand for vehicle electrification in EAS countries until 2040. This result is compared to Nd and Co supply from mining production by the USGS and other demand forecasts from the IEA to see the trendline for every forecast.

The demand of Nd for vehicle electrification in EAS countries is predicted to be 4,075 t/y in 2040. By comparing the IEA world Nd demand (of EVs) forecast of the Stated Policies Scenario, it was found that EAS countries account for about 37% of the world's total Nd demand for EVs. Considering the large increase in Nd demand in Europe, the United States, China, and other EV-implementing countries, EAS countries' 37% share of global demand is expected to create fierce competition with other countries.

Regarding Co, the demand for vehicle electrification in EAS countries is forecasted to be 53,324 t/y. By comparing the IEA world Co demand (of EVs) forecast of the Stated Policies Scenario, it was found that EAS countries account for about 41% of the world's total Co demand. Therefore, Co is also expected to create fierce competition with other countries.

3. Mobility Scenarios for East Asia Summit Countries

This chapter describes the conclusion of the barriers to implementing the vehicle electrification scenario in EAS countries based on the collected data and analysis from Working Group members. To accelerate the introduction of EVs, the recommendations to overcome these barriers will be explained and analysed. By analysing the barrier conditions, recommendations, and the availability of biofuel resources and other renewable energies, the future mobility scenario for each country is identified to find the appropriate emission reduction measures considering each country's characteristics.

In conclusion, Thailand has both feedstock resources for bioethanol and biodiesel, and E10-E20 and B10 would be solutions for decarbonising the current ICE fleets, whereas EV penetration will help decarbonise new vehicles. In Indonesia, considering the huge availability of both bioresources and other renewable energy resources inside the country, the Government of Indonesia has chosen not to prioritise EV development over biofuel development and, instead, is implementing both EV and biofuel development to accelerate the transition towards sustainable mobility. In the Philippines, gasoline and diesel demand are continuously increasing, and biofuels can be readily utilised with the existing infrastructure, compared to EV deployment, which is in its early stages. Some of the common concerns for the Philippine EV and biofuels industry during the concurrent implementation are the EV travel distance/range, infrastructure, and logistics, taking into consideration the archipelagic nature of the Philippines as well as the sustainability of feedstock. Viet Nam has not yet provided a specific target for EV production and consumption, but the Vietnam Automobile Manufacturers' Association (VAMA) has proposed three scenarios for electrified vehicles in Viet Nam. The fast scenario is to start electrifying vehicles from 2025 and reach 100% electrified vehicles by 2035, the medium scenario is to start electrifying vehicles from 2025 to 100% electrified vehicles by 2045, and the basic scenario is to start the process of electrifying vehicles from 2025 until reaching 100% electrified vehicles by 2050. In Malaysia, it is rational to increase the blending of biodiesel for commercial diesel vehicles whilst encouraging EV switching for passenger cars, which are mainly petrol vehicles. The biodiesel programme and EV adoption can complement each other with the aim to decarbonise different segments of the transportation sector. EVs are expected to become more popular in the future when key barriers, such as charging infrastructure, initial cost of ownership, servicing and maintenance, battery replacement cost, and battery charging cost, are slowly addressed.

Table 4.1 shows the result of the comparative analysis of the potential, advantages, and barriers for EVs in each country. In this analysis, the challenges, as well as policy recommendations for implementing EVs, were examined for each country.

Table 4.1. Comparative Analysis of the Potential, Advantages, and Barriers to EVs in Each Country

Country	Potential and Advantages	Barriers
Thailand	• EV promotion and supported charging infrastructure nationwide from the government • Subsidy for BEV models • Progressively issued industrial standards for electric cars, electric motorcycles, and charging equipment	• High insurance for EVs • Falling used car prices are also related to high battery costs, where newer models of BEVs have fewer battery warranty years • Necessity to upskill the workforce for EVs, ranging from engineers in the assembly line to mechanics to fix EVs
Indonesia	• Huge availability of both bioresources and other renewable energy resources inside the country • Government initial monetary and non-monetary incentives	• Electric cars are still expensive/unaffordable • Insufficient charging infrastructure • Lack of government incentives • Low availability of spare parts and repair and maintenance services • Local content requirements • Long charging times • Distance coverage is relatively short • Electricity supply (kWh/capita/year) is still low • Reluctance of transition
India	• Government is increasing the deployment of the renewable energy mix. • Government is promoting biofuels (blending of ethanol) and EVs on a large scale.	Investment challenges: • Investment gap • Complexity in valuing company assets • Current macroeconomic environment not conducive to investments • High upfront cost of EVs Infrastructure challenges: • Inadequate electrical supply network • Charging infrastructure obstacles Battery challenges: • High-voltage batteries are sizeable and heavy, affecting the handling of

Country	Potential and Advantages	Barriers
		EVs. Heavy batteries are prone to safety hazards, vulnerable damage, and thermal runaway. • Recycling/disposal of old batteries is problematic.
Philippines	• The Philippines is an agricultural country and has other potential biofuel feedstock sources. • Government fiscal and non-fiscal incentives.	• Market development: flooding concerns, inadequate or lack of capacity to invest, scepticism of technology due to lack of familiarity, etc. • Technical support: high spare parts costs due to low demand and limited financial capacity of local EV suppliers to stock a large volume of spare parts. • Battery disposal: lack of knowledge of battery recycling technology. • Charging/battery swapping services: lack of third-party battery leasing/swapping/charging/station providers, etc.
Viet Nam	• Government has given incentives, such as reducing the excise tax rate and/or registration fees for xEVs and biofuel vehicles. • Significant increase with the domination of EV models from VinFast, a local car maker and the only enterprise manufacturing electric vehicles in Viet Nam.	• Target for EV development strategy has not been set clearly. • Policy to support EV development is still limited. • Lack of charging infrastructure. • Price of EVs is still high.
Malaysia	• The government has extended the exemption of import duties on CBU electric vehicles until 2024. • EVs are currently exempted from road tax from January 2022 until December 2025. • Malaysia, being the second-largest producer of palm oil has embarked on a nationwide B10 and B20 (selected regions) biodiesel programme.	• High cost of EVs compared to ICEs. • Consumers' confidence in EV maintenance and breakdown services is generally low. • The ease of charging EV cars is another main concern for EV owners. Petrol cars can be refilled within minutes, but charging an EV with a DC fast charger will require 20–30 minutes. • The distribution network of charging stations is mostly concentrated in

Country	Potential and Advantages	Barriers
		cities and mostly in parking bays of shopping malls. • In Peninsular Malaysia, most electricity generation is from fossil-based power plants (coal, natural gas, and diesel). • High battery cost and replacement cost.

Source: Thailand: Energy Plan and Policy Office (2023); TISI (2022); Indonesia: Mapa (2022); Veza (2022); Candra (2022); Indonesian Government Regulation No. 8 of 2020, No. 74 of 2021; Jakarta Governor Regulation No. 3 of 2020; Minister of Finance Regulation No. 38 of 2023; Jakarta Governor Regulation No. 88 of 2019; India: Central Electricity Authority, Government of India (2023); Foreign Agricultural Service, U.S. Department of Agriculture; Philippines: PDOE (2021); PDOE (2022a); Draft CREVI, PDOE (2023b); Vietnam: National Assembly of Vietnam (2016); National Assembly of Vietnam (2022); Government of Vietnam (2022); Ministry of Finance, Vietnam (2015); VnEeconomy (2023); Malaysia: Low Carbon Mobility Blueprint 2021-2030; National Energy Policy 2022-2040.

4. Conclusion and Future Aspects

Following the FY2021 project results, this study assessed the WTW GHG emissions for implementing biofuels, and EVs were assessed for three different scenarios considering the improvement in energy sources. Moreover, mineral resources demand considering mobility electrification was evaluated and compared with the supply data of the USGS and the global demand forecast of the IEA. Finally, barriers to implementing the vehicle electrification scenario in EAS countries were examined and the mobility scenario of each country was identified.

In conclusion, the balance between biofuel and EVs is important in all EAS countries. In particular, whilst mineral resource constraints are important for EVs, price, infrastructure, and policy support are even more important. Comparing by country, Thailand and Indonesia can introduce biofuels and EVs in parallel, whilst the Philippines, Viet Nam, and Malaysia should give priority to biofuels in the initial stage, as they can utilise existing infrastructure and introduce EVs in the future when the price of EVs declines and infrastructure is in place.

For further studies, the implementation of biofuels must be assessed from wider perspectives. For example, producing and using biofuels will influence energy, food, and water consumption in many EAS countries. Identifying these synergies, as well as the multi-benefits between biofuel, energy, and water, can highly contribute to the achievement of the SDGs.