Executive Summary

The importance of reducing greenhouse gas (GHG) emissions in the transport sector has attracted attention worldwide, especially since the adoption of the Paris Agreement in 2015. To meet this target, East Asia Summit (EAS) countries have been making great efforts to introduce biofuels on a large scale, considering the potential of these resources. Meanwhile, the introduction of electrified vehicles (xEVs) is now expanding rapidly, and these can be another efficient option for reducing GHG emissions in the transport sector. Therefore, creating a future mobility fuel scenario with a balance of biofuel vehicles and xEVs is necessary.

In this regard, this project aims to analyse the future scenario of EAS mobility, which will contribute greatly to the Sustainable Development Goals (SDGs) (Goals 7, 12, and 13) in consideration of the balance amongst reducing transport carbon dioxide (CO_2), biofuel use, and the demand for mineral resources. The outcomes will contribute to the EAS Energy Research Road Map (Pillar 3: Climate Change Mitigation and Environmental Protection corresponding to the Association of Southeast Asian Nations (ASEAN) Plan of Action for Energy Cooperation 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 (FY) 2020, existing biofuel policies and implementation plans were updated from selected EAS countries as a foundation to accommodate emerging electric vehicle (EV) trends during the mobility energy transition. As a result, information on biofuel policies and implementation mechanisms, as well as potential CO_2 reductions, was collected. Moreover, progress on the sustainability assessment of biofuels in the East Asia region was evaluated with examples of some of the participating countries using the sustainability indicators proposed by the earlier ERIA project on 'Sustainable Biomass Utilisation Vision in East Asia'.

In FY2021, well-to-tank (WTT) GHG emissions from producing biofuels, tank-to-wheel (TTW) GHG emissions from using biofuels, and demand and CO_2 emissions from producing mineral resources considering mobility electrification were evaluated. For WTT GHG emissions, despite some variations in the emissions values from the different feedstock and countries, these were all lower than their fossil fuel counterparts (i.e. 2.92 kilogrammes/litre gasoline as compared to ethanol and 83.8 gCO_2 eq/megajoule diesel as compared to biodiesel). Moreover, the TTW GHG emissions are calculated according to the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) in this study. For fuel combustion in road transportation, the emissions factors are selected according to the Technology and Environmental Database. The TTW GHG emissions from fossil fuel combustion in road transportation comprise CO_2, methane (CH_4), and nitrous oxide (N_2O). These emissions are converted into the CO_2-equivalent units by multiplying them by the global warming potentials (GWP).

For the mineral resources demand, the demand for neodymium (Nd) is predicted to be a minimum of 4,075 tonnes/year (t/y) in 2040. If the recycle rate is 100%, secondary resources can cover 28.2% of total Nd demand in EAS countries. The total demand for cobalt is predicted to be 53,324 t/y in 2040. If the recycle rate is 100%, secondary resources can cover 16.1% of cobalt demand in EAS countries. However, considering that production of Nd was 43,200 t/y of rare earth oxide (REO) and cobalt was 140,000 t/y in 2020 (USGS, 2021), it is predicted to be difficult for the world supply to

meet the target of EAS mobility electrification regarding the large increase in demand in China, the European Union (EU), and the United States (US).

Following this progress, this report assesses the relationship between WTW GHG reduction of biofuel implementation and mobility electrification. In addition, it examines the mobility scenarios of EAC countries, considering mineral resource constraints, the price of EVs, domestic (charging) facilities, and taxation systems. Finally, the priorities for biofuels and EVs in each country, as well as the expected policies and actions for implementing biofuels and EVs, are analysed.

First, the landscape of the current vehicle ecosystem in select ASEAN Member States (Indonesia, Malaysia, Philippines, Thailand, and Viet Nam) and India is examined with the same projection of vehicle growth in the future as 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 biofuels in the transport sector. In particular, three different scenarios are considered based on the assumption of EVs and biofuels from the previous study (ERIA, 2022) and improvements in the electricity source. Moreover, mineral demand from the implementation of EVs (in this case Nd and cobalt) is estimated and compared with the supply forecast from the United States Geological Survey (USGS) and the International Energy Agency's (IEA) demand forecast. The results show that the motorcycle segment in these six countries emits similar GHGs as 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%. For the demand for neodymium and cobalt, the demand of EAS countries is predicted to cover about 37% (for neodymium) and 41% (for cobalt) of the world's total demand for EVs forecasted by the IEA's Stated Policies Scenario. Considering the large increase in demand in Europe, the US, China, and other EV-implementing countries, EAS countries' share of global demand is expected to create fierce competition with other countries.

Second, the barriers to implementing the vehicle electrification scenario in EAS countries are based on the collected data and analysis from the 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, the balance between biofuels and EVs is important in all EAS countries. In particular, the conclusion is that 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 will give priority to biofuels in the initial stage, as they can utilise existing infrastructure and will introduce EVs in the future when the price of EVs declines and infrastructure is in place.

The results of this study will contribute greatly to the SDGs (Goals 7, 12, and 13) in consideration of the balance amongst transport CO_2 reduction, biofuel use, and the demand for mineral resources. The outcomes will contribute to the EAS energy research roadmap (Pillar 3: Climate Change Mitigation and Environmental Protection corresponding to the ASEAN Plan of Action for Energy Cooperation 2016–2025, 3.5 Programme Area No.5: Renewable Energy, and 3.6 Programme Area No.6: Regional Energy Policy and Planning).

References

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