Executive Summary

Background, objectives, and scope

With a growing population, rising income levels, and expanding urbanisation, Asia's demand for oil is expected to increase rapidly. However, due to limited resource reserves, most of the countries in the region are heavily dependent on imports for their oil supply, which is a major, if not the most critical, concern in their energy policies. Though it has been debated intensively, biofuel is perceived as one possible option to address the oil security issue, since expanding the use of biofuels will not only result in reducing demand for oil, but will also contribute to the diversification of import sources for liquid fuels. Moreover, biofuel production also provides an additional way to increase the income of farmers.

This study focused on the Asian potential on the two types of biofuel—bioethanol and biodiesel. The objectives are to find the methods and policies for promoting the sustainable use of biofuels. The study is endorsed and supported by the Economic Research Institute for ASEAN and East Asia (ERIA), with a Working Group (WG) set up to oversee and coordinate the study. The WG is composed of biofuel policymakers from Indonesia, Malaysia, the Philippines, and Thailand; and researchers from The Institute of Energy Economics, Japan (IEEJ), who conducted the study and prepared the study report.

The study was conducted through three phases. The first phase focused on the biofuel development status and future biofuel demand and supply possibilities in four WG member countries—Indonesia, Malaysia, the Philippines, and Thailand. The second phase expanded the scope of the study to 16 countries, including all of the ASEAN countries and other countries in the region such as Australia, China, India, Japan, New Zealand, and South Korea. Although the scope of the study in the first and second phases was limited to the energy sector, the third phase expanded the analysis of the supply side to include the constraints of food and agriculture in addition to the potential of biofuel trade. In all phases, the study focused on conventional (or first generation) biofuels.

Major Findings

a. Sustainability (Reduction of fossil fuel consumption and CO_2 emissions)

With increasing energy demand, developing Asia will continue to increase its energy consumption. The prospect of fossil fuel shares in the final energy demand will continue to increase, with increasing oil demand, especially in the transport sector. Thus, replacing oil consumption with non-fossil energy is critical for preventing the increase of fossil fuel consumption in the future. The most cost-effective way is to replace oil consumption with the cost-competitive biofuels, as their competitiveness will improve with the prospect of rising oil prices in the long run.

b. Demand projection

Through this study, determinants of fuel consumption in the transport sector and biofuel-related policies were surveyed for the 16 countries. First, econometric models were applied to estimate future liquid fuel demand in the transport and power sectors.[1] Then, future biofuel demands of the region and each country were estimated by applying future demand prospects from the biofuel policies of each country. The result was that the total demands of the ASEAN and East Asian countries will reach nearly 36 million tonnes of oil equivalent (toe) of bioethanol and 37 million toe of biodiesel by 2035. The total demand of biofuels—over 70 million toe by 2035—is close to Indonesia's total oil consumption in 2011.

Demand outlook differs widely by country. This study shows that bioethanol demand will be topped by Indonesia from the early 2020s, followed by China, India, Thailand, and the Philippines. Similarly, biodiesel will be also be topped by Indonesia after the early 2020s followed by China, Thailand, India, and Malaysia. The results show an ambitious demand outlook by ASEAN countries, especially by Indonesia.

[1] Estimation for the power sector is limited to Indonesia and Malaysia because of their policies for using biofuel in the power sector.

c. Supply potential

The supply potential of biofuels was estimated by quantitative modelling using agricultural production function with an econometric analysis of each country and the region. Here, the potential of biofuels is defined as a residual from total agricultural feedstock production potential, minus the estimated demand for food. Assuming the market in the region is fully open, under the business-as-usual (BAU) scenario, the situation of no improvement in productivity and no utilisation of unused land shows that the current growth rate of supply potential is not quick enough to support the projected demand for biofuels. The result is that the total feedstock supply of the ASEAN and East Asian countries will reach nearly 10.1 million toe of bioethanol and 35.6 million toe of biodiesel by 2035. Although agricultural feedstock production for biodiesel (mainly palm oil) could be supported until around the 2030s, the bioethanol requirement or demand will reach the limit of supply by around 2015.

An alternative scenario—with full utilisation of unused lands and improved productivity— found that the total feedstock supply of the ASEAN and East Asian countries would reach nearly 22.6 million toe of bioethanol and 42.5 million toe of biodiesel by 2035. The results imply that this alternative scenario, with productivity improvements and effective land use, could expand so that supply can meet the region's demand until the 2020s for bioethanol, and the 2040s or later for biodiesel.

d. Needs of next-generation technologies

Although conventional technologies could continue to be the primary competitive technologies, next-generation technologies will be required to meet the additional future demand of biofuels, especially for bioethanol, by the 2020s.

It should be noted that the above timing of shortages assumes that productivity will improve, and that projected increase in demand will not change. This means the timing could be sooner if productivity fails to improve, whereas the timing could be delayed if future demand for biofuels could be decreased.

e. Biofuel trade

The above analysis is based on regional supply and demand. The supply potential and demand of each country differs widely, and this study found mismatches in supply potential and market sizes (demand). Countries with high biofuel supply potential may have a small domestic biofuel market, and vice-versa. Because of this mismatch, if there is no trade, the quantity of supply and consumption of biofuels in the region will be much smaller than if there is a fully open market in the future. Both types of biofuels could be down to about a half or less than that of a fully opened market by the 2030s.

The role of trade is very important. However, the current development of biofuel trades is still limited, compared to its potential. The prospects of limited trade could continue. There are two primary reasons for this, which could be shared in developing Asia. One reason is that biofuels are expected to contribute to rural and agricultural development through domestic production. In fact, in Asia, the biofuel market is linked to both food and energy markets, and whether the products can be domestically consumed or exported depends on not only the prices of oil products but also food prices. Another concern is energy security, especially for oil-importing countries. Therefore, the national biofuel policies of many Asian countries are oriented to promote the domestic production of food–biofuel–compatible feedstocks for both the energy and agriculture markets, which makes it challenging to become fully open in the future.

Trade limitations could bring different future prospects of shortage or surpluses by country, depending on the profile of the policies and agricultural characteristics of each country. The ambitious demand by ASEAN countries, especially by Indonesia, implies that some ASEAN countries (most likely including Indonesia) may face shortages earlier; whereas some countries (most likely including Malaysia) can sustain the surplus longer than those of assumed fully integrated markets.

f. Competitiveness

The current crude oil price level of around US$100/barrel (bbl) causes most of conventional biofuels in Asia to compete with oil products.[2] However, this study found there are cases where higher energy prices in a domestic market do not necessarily increase the supply of domestic biofuels. One case is the higher selling prices in international markets, which could be for food or energy. Another case is the higher prices in domestic food markets. The result is shortages of domestic biofuels, notably in Indonesia and Malaysia, which lack stringent implementation of biofuel mandates. If there are higher prices in domestic food markets, it should have contributed to the food security.

From an international perspective, the prices of energy and food in developing Asian countries are generally low compared to those in developed countries. The increase of feed stocks in export markets could benefit domestic farmers, but not domestic energy consumers. A stringent mandate for biofuels should be drafted in consideration of the interactions and relative competitiveness of domestic and international energy and food markets.

g. Food vs. fuel

It is generally believed that the global food crisis of 2007/08 was partly due to biofuel production. The experience in Asia also highlighted serious concerns about the rise of food prices and shortages in imports. Although later studies, including those of the World Bank, concluded that the contribution of biofuels' production on food prices was not as large as originally presumed[3], the concern is put into priority in this study.

Nonetheless, one of the findings in this study is that food-compatible biofuels have become very important as alternatives to oil products, and promoting these has become a national priority in energy and agricultural policies in many Asian countries, including ASEAN countries that suffered from rises in food prices like Indonesia, the Philippines, and Malaysia.

Policy Implications

[2] IEA (2013b).
[3] The World Bank (2010).

a. Main Arguments

As reviewed, liquid fuels could be a major energy source in Asia in the coming decades. Here, the collective benefits of the expansion of biofuels are not only regional energy security, but also the mitigation of global warming. The expansion of biofuels in Asia could benefit not only individual countries, but also the region. The issues are to find and expand the Asian potential of biofuels.

The potential depends on demand and supply outlook. The study's major finding on the demand side is the exceptionally large demand by Indonesia. Assuming Indonesia's demand will not change, one of the most important findings is that a shortage of bioethanol may soon be experienced, if there is no progress in the efforts to increase productivity and in using unused land effectively. Another important message from the findings is that biofuels in Asia should not be separately considered from agriculture, as it is already integrated into the market. The success of biofuel utilisation in Brazil and Thailand indicates that there are methods of sustainably developing food-compatible biofuels. In Asia, food-compatible biofuels will continue to be the primary sources; however, the supply potential of agriculture-oriented conventional biofuels in the region of 16 countries may fail to catch up to the fast growth of demand before the 2020s.

The core strategy suggested in this study is to improve the enabling environment: improve productivity and enhance regional cooperation for trade and energy security. Also, the development of next generation biofuels as a mid- to long-term solution should also be pursued in line with the development of energy–agricultural integration for the security of both sectors.

b. Policy Implications

1) Supply side

-Give incentives for increasing productivity and utilising unused agricultural land as energy–agriculture joint policy initiatives. The policy could benefit both the energy and agriculture sectors.

-Improve conversion efficiency from solid to liquid biomass.

2) Demand side

-Promote regional energy security through the biofuel trade.

-Promote best local practices of "sustainable" consumption/utilisation of biofuels.

-Promote domestic/local use of biofuels, including waste oil products from food industries.

3) Enabling market

-Use a domestic biofuel mandate to stimulate the local market to improve productivity and promote the use of unused agricultural lands.

-Share biofuel standard for interregional trade.

4) Sustainability/Food security

-Secure food allocation (production allocation or preferably through distribution).

-Enable domestic/local use of biofuels as a buffer for food security.

-Develop a sustainable development map of biomass utilisation in the future energy mix, with a vision of the role of biofuels.

5) Importance of collaborative study and development of next-generation biofuels

-Commercialise next generation biofuels within the next decade.

6) Different implications by type of country

-For energy importing countries like the Philippines and Thailand, policies to increase productivity and efficient use of land (utilisation of unused land) should be enhanced, as a joint effort of both the energy and agriculture sectors. For Indonesia, whose future demand is exceptionally large, further efforts will be required.

-Exporting countries with abundant supply source like Malaysia should pursue more stringent implementation of policies, such as the B5 mandate.

-A regional framework such as ASEAN could contribute to the research of next generation biofuels for the sake of the common interests of the region.