

Asia/World Energy Outlook

— Focusing on ASEAN Economies towards Market Integration —

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This paper presents the major results of a long-term outlook of energy supply and demand, and CO₂ emissions for Asia and the world, especially the Association of Southeast Asian Nations (ASEAN) region. The world's primary energy consumption will reach 18.9 Gtoe (billion tons of oil equivalent) in 2040, up 40% from 2014. During the same period, ASEAN's primary energy consumption will expand 2.2-fold, accounting for 14% of the global increment. ASEAN's coal consumption will increase 3.5-fold, accounting for 40% of the world's increment. One-fifth of global energy-related CO₂ emission growth (9.5 billion tons from 2014 to 2040) will be due to ASEAN. Due to a rapid increase in fossil fuel demand, ASEAN will become a net importer of fossil fuels. On the other hand, ASEAN countries will require enormous investment in energy resource development and infrastructure construction. In order to promote effective use of regional energy resources, infrastructure consolidation, such as power grid interconnection, can be expected to reduce energy imports, increase the energy self-sufficiency rate and suppress CO₂ emissions.

Keywords: Energy outlook, ASEAN, Integration of market, Energy investment

1. Foreword

In response to weak economic recovery in Western countries and economic modulation in China and other emerging countries, global energy consumption growth has decelerated over recent years. Over a medium to long term, however, global energy demand is expected to continue expanding due to global economic and population growth, centering on Asia. Following China and India, the Association of Southeast Asian Nations will contribute to such global energy demand expansion.

ASEAN has a population of 600 million, greater than in the European Union, including many countries with great economic growth potential, and is expected to continue strong growth. Given that ASEAN consists of countries in various economic development stages, ASEAN growth will become steadier if the ASEAN Economic Community, launched in late 2015 to repeal internal tariffs, increases its effectiveness.

Per capita energy consumption in the ASEAN region is still lower than in Japan and other

developed countries. As energy infrastructure development is insufficient in ASEAN countries such as Myanmar and Cambodia, the ASEAN region's non-electrification rate was as high as 19% as of 2013, with some 120 million people having no access to electricity. Economic growth will inevitably lead energy consumption to increase further.

ASEAN has Indonesia, Malaysia and other countries rich with fossil energy resources and still remains a net fossil fuel exporter. In the future, however, ASEAN will increase its dependence on fossil fuel imports as oil and other fossil fuel production in the region fails to catch up with fossil fuel demand growth. While ASEAN has great supply potential for renewable energy including hydro, geothermal and biomass, the uneven distribution of renewable energy resources has been a bottleneck for their development. In order to effectively utilize regional energy resources, ASEAN countries plan to internationally connect their energy infrastructures such as the electric grids.

For this paper, we prepared a long-term energy supply and demand outlook for Asia and other regions of the world, using a group of quantitative models, such as an econometric energy supply and

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demand model, based on actual economic, social, and energy supply and demand data and energy policy trends, as well as on economic growth and demographic assumptions. Focusing on the ASEAN region, we considered how robustly growing ASEAN energy demand would be satisfied, estimated energy-related investment and assessed the effects of electricity and other market integration.

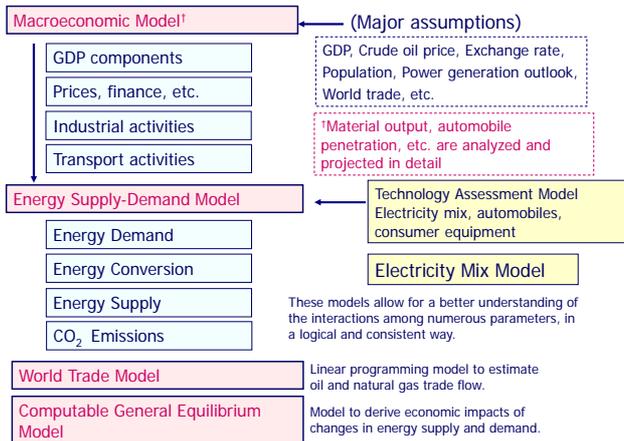


Figure 1 Basic structure of models

2. Model structure

Figure 1 indicates the basic structure of models used for a quantitative analysis in this study. Based on detailed energy balance data from the International Energy Agency, the core econometric energy supply and demand model uses various economic indicators, population, vehicle ownership, raw material production and other energy-related data collected from the World Bank’s World Development Indicators and other sources, for a regression analysis to project future energy supply and demand. Data used for the projection are mainly for the period between 1971 and 2014. Simulation focuses on annual projections between 2015 and 2040.

3. Assumptions for analysis

The future energy supply and demand structure will be greatly influenced by population, economic growth and other social and economic factors, as well as energy prices, energy-using technologies and energy and environment policies.

We referred to the United Nations’ “World Population Prospects” for population assumptions. Global population will increase at an annual average rate of 0.9% from 7.2 billion in 2014 to 9.2 billion in

2040. In many member countries of the Organization for Economic Cooperation and Development, downward pressure on population will increase under falling birthrates and aging population. In non-OECD countries as well, birthrates will decline in line with income growth and women’s social participation. Given that death rates will decline thanks to the development of medical care techniques and the improvement of food and sanitary conditions, however, population will continue increasing. ASEAN population will increase to 760 million by 2040, with annual growth averaging 0.8%. In the Philippines, Laos and Cambodia where young people are abundant, population growth will be higher. In Thailand where population is aging, population will peak in the mid-2020s and turn down later.

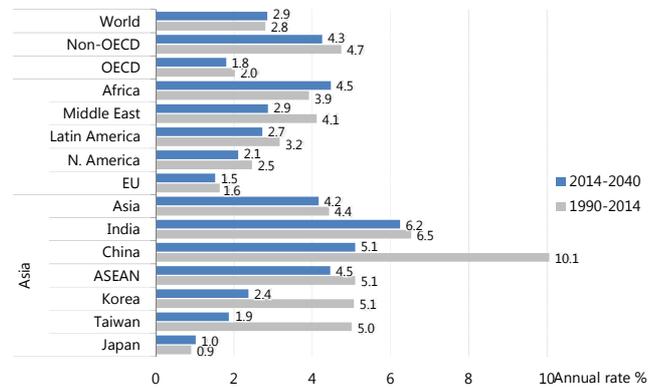


Figure 2 Economic growth assumptions

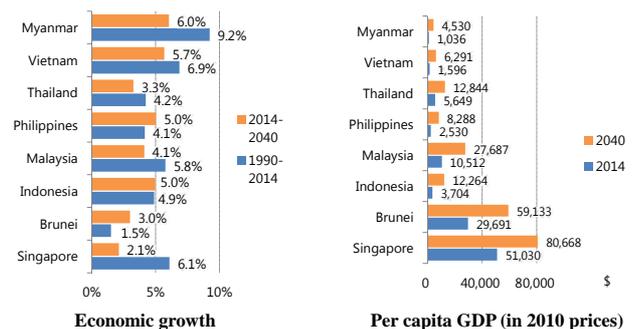


Figure 3 Economic growth and per capita GDP in major ASEAN countries

We assumed real gross domestic product growth as shown in Figure 2 by reference to predictions by the International Monetary Fund, the Asian Development Bank and other international organizations and governmental economic development plans. The world economy, though plagued with various challenges, will attain robust

growth over a medium to long term. Through 2040, the world economy will grow at an annual average rate of 2.9%. Non-OECD countries will post high growth, including Asian countries that will drive global economic growth.

Supported by its favorable location neighboring the giant markets of China and India, the ASEAN region has attracted growing investment from abroad such as Europe and Japan. Furthermore, the region launched the ASEAN Economic Community in late 2015 to accelerate economic growth through regional trade liberalization and market integration. Through 2040, ASEAN will post an annual economic growth rate of 4.5%, the third highest after Indian and Chinese growth. Per capita GDP will expand 2.5-fold to \$9,800 in 2040, still below the global average of \$17,000. Per capita GDP will fall short of reaching \$5,000 in Myanmar and Laos, indicating their great growth potential beyond 2040.

Among international energy prices, the real crude oil price will increase again due to growing demand mainly in non-OECD countries, the depletion of active oil fields, a shift to high-cost oilfield and risk factors in the Middle East, reaching \$75 per barrel in 2020 and \$125/bbl in 2040. Natural gas prices will also increase, though with the regional gaps of price narrowing on expanding inter-regional trade.

For projection in this study, the past trends are assumed to continue, reflecting past and present energy and environment policies. While the implements of policies and technologies with high possibility are taken into account, no aggressive energy conservation or low-carbon policies are assumed.

4. Analysis results

4.1 World/ASEAN energy supply and demand

(1) World energy supply and demand

Due mainly to economic expansion and population growth, global primary energy demand will increase at an annual rate of 1.2% from 13,700 million tons of oil equivalent in 2014 to 18,900 Mtoe in 2040. Non-OECD countries will account for about 90% of the increase. Particularly, Asian demand will expand 1.6-fold, capturing about 60% of the total

increase. Consumption in China, India and ASEAN will greatly expand, generating 92% of the Asian increase. Meanwhile, energy consumption will level off in mature economics such as Japan, Korea and Taiwan. The United States and the European Union will leave their energy consumption unchanged from 2014, reducing their share of global consumption.

Fossil fuels' share of global primary energy consumption will fall through 2040 but will still be as high as 80%. The share in Asia will be similar. Fossil fuels will cover 70% of future global consumption growth. Driven by the transport sector's oil demand in emerging countries, oil will retain the largest share of primary energy consumption through 2040. Natural gas will become the second largest energy source as the power generation sector globally expands gas consumption. Coal will post moderate consumption growth, with its share narrowing, as air pollution and climate change problems prompt the whole of the world to promote policies of holding down coal consumption. Renewable energy consumption will expand, with its share expanding, centering on wind and solar photovoltaics. Nuclear energy consumption will increase mainly in emerging countries including China and India.

On the supply side, the Middle East will remain the center of crude oil production growth. While unconventional oil production will drive a production expansion in North America, production in Europe and Eurasia will peak out around 2030. Natural gas production will expand widely in North America, Russia, the Middle East, China and Africa. In North America and China, shale gas will play a key role.

Global energy-related carbon dioxide emissions will increase from 33 billion tons in 2014 to 42.5 billion tons in 2040. Asia will account for more than 70% of the increase through 2040.

(2) ASEAN energy supply and demand

ASEAN's primary energy demand will expand 2.2-fold from 620 Mtoe in 2014 to 1,350 Mtoe in 2040. The increase will account for 14% of the global demand growth, exceeding present Japanese and Korean consumption combined. Per capita energy consumption will double to 1.8 toe in 2040, still less than half of the OECD average and the global

average of 2.1 toe.

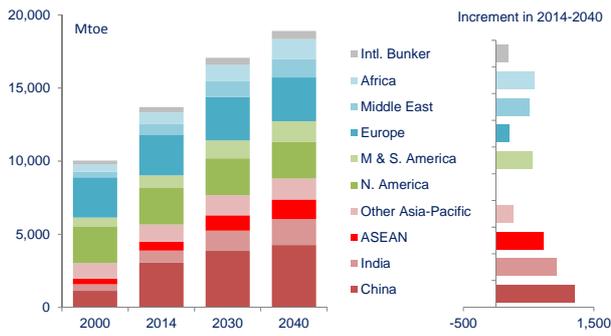


Figure 4 Primary energy demand by region

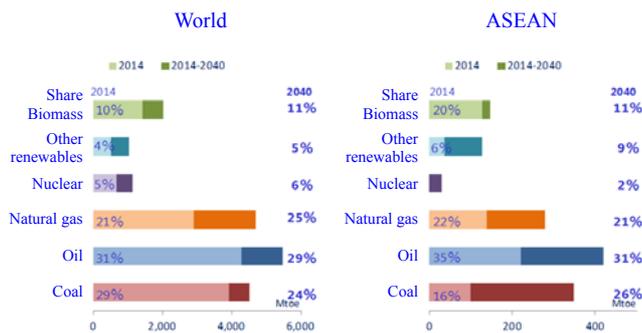


Figure 5 World/ASEAN primary energy demand mix

Fossil fuels will cover more than 80% of ASEAN’s primary energy demand growth. ASEAN’s dependence on fossil fuels will increase from 74% in 2014 to 77% in 2040. ASEAN coal demand will register the largest growth of 3.5-fold, accounting for 34% of total regional energy demand growth and about 40% of global coal demand growth. Coal demand growth will be led by coal for power generation. ASEAN will use cheap, abundant coal in the region to meet rapidly expanding electricity demand. Oil demand in 2040 will increase 1.9-fold from 2014, with automobile fuel accounting for half of the growth. Demand will also grow greatly for liquefied petroleum gas in the buildings sector and oil for petrochemical production. Natural gas demand will double by 2040, with gas for power generation accounting for the majority of the growth. The remainder of the growth will be for industrial utilization. Any increase in the buildings sector will be limited due to insufficient gas pipe infrastructure.

The ASEAN region has great potential to supply hydro, geothermal, biomass and other renewable energy. The Greater Mekong Sub-region, including Cambodia, Laos and Myanmar, has great hydroelectric generation potential, with many hydro

development projects being implemented. Hydroelectric generation will expand 2.2-fold by 2040, accounting for about 60% of growth in renewable energy electricity generation. Geothermal energy has great potential in Indonesia and the Philippines. Geothermal power generation will account for about 20% of total renewable energy generation growth. Wind and solar PV power generation will post the largest growth, but will account for only less than 1% of primary energy consumption in 2040. In ASEAN, firewood and livestock manure are used mainly in rural communities. While such traditional biomass fuel consumption will decline in line with urbanization and rising living standards, biofuel consumption for power generation and vehicles will expand. Biomass fuel demand will increase by some 20% by 2040, though with its share of the energy mix halving to 11%. Nuclear power generation has not been seen in the ASEAN region. From 2025, however, Thailand, Viet Nam, Indonesia and Malaysia will introduce nuclear power plants with a total capacity of 16 gigawatts. In 2040, nuclear will account for 4% of the electricity mix and 2% of the primary energy mix.

Energy-related CO₂ emissions in the ASEAN region will increase from 1.26 billion tons in 2014 to 3.14 billion tons in 2040, accounting for about 20% of global growth through 2040 and 27% of Asian growth.

The ASEAN region is relatively rich with energy resources and is a net energy exporter with the energy self-sufficiency rate standing at 125% at present. As for coal, Indonesia is the world’s largest steam coal exporter, exporting more than 80% of its production in 2014. While mainly Indonesia will expand coal production through 2040, regional demand will increase faster. The ASEAN region as a whole will manage to remain a net coal exporter. As regional oil production declines on the depletion of active oil fields, the degree of dependence on imports for oil in ASEAN will rise from 47% to 80%. While natural gas production will continue to expand in Indonesia and Malaysia rich with gas resources, regional demand will grow faster, with the region’s natural gas export capacity falling. The ASEAN region, though exporting 6 billion cubic meters of natural gas to

other regions at present, will become a net natural gas importer by 2030. As a result, ASEAN's energy self-sufficiency rate will slip below 100% by 2030 and plunge to 76% in 2040.

4.2 Energy-related investment in ASEAN and impacts of market integration

ASEAN will require massive investment in energy production (electricity generation) and transportation (electricity transmission and distribution) to meet rapidly increasing energy demand. ASEAN countries have enhanced energy conservation policies, forcing costlier products or equipment to be introduced. Cumulative energy-related investment between 2015 and 2040 will total some \$2.3 trillion, close to the present ASEAN GDP at \$2.4 trillion.

The energy-related investment will include \$1 trillion each in electricity and fuel supply. About 55% of the investment in electricity supply will be made in power generation facilities and the remainder in electricity transmission and distribution facilities. Of the fuel supply investment, about 80% will be made in upstream oil and gas field development, nearly 10% in liquefied natural gas and other fuel transportation facilities and the remainder in oil refineries. Energy conservation investment will total about \$220 billion. Nearly 60% of the investment will be made in the transport sector including fuel-efficient vehicles (such as hybrid and electric vehicles). Nearly 30% will be made in the buildings sector, including air conditioners and insulation, and the remaining 15% in the industry sector.

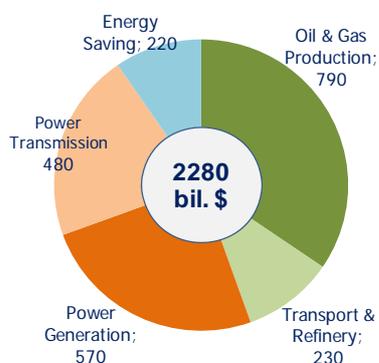


Figure 6 ASEAN energy investment (accumulated investment through 2040)

services toward market integration under the ASEAN Trade in Goods Agreement. The complete elimination of tariffs on goods and services within ASEAN will expand real regional GDP by 0.88%. In the energy field, oil and natural gas are subject to the tariff elimination. Given that many ASEAN countries have already repealed tariffs on these goods for regional trade, however, the oil and gas tariff elimination will boost real regional GDP only by 0.025%, with its market integration effect limited.

In the ASEAN region where energy infrastructure development is still insufficient, infrastructure facilities could be connected with each other to produce economic and environmental effects.

In the fossil fuel field, there is the Trans-ASEAN Gas Pipeline project covering all ASEAN countries. Under the project advocated in 1997, 13 pipelines have so far been completed, falling short of covering the ASEAN region. Problems behind the shortfall include a decline in gas export capacity in Indonesia and Malaysia assumed as exporters, as well as how to share construction costs. As ASEAN as a whole is in transition to becoming a net natural gas importer, regional gas pipeline construction is losing its legitimacy. The only feasible pipeline for future construction would link Indonesia's East Natuna gas field to Malaysia and Thailand. If output totaling 15 billion cubic meters is all exported to Malaysia to replace imported LNG, ASEAN may reduce external LNG import payments by a total of \$169 billion through 2040.

ASEAN countries such as Laos and Myanmar are rich with hydro resources. Effective utilization of the resources is aimed by connecting these countries and their vicinity to electricity demand areas. On Borneo Island that is also rich with hydro resources, a grid network could be enhanced within the island and connected to electricity demand areas including the Malay Peninsula and Java Island. While to achieve the regional power grid interconnection, initial investment in hydroelectric power plants and electricity transmission cables will increase, the interconnection will stabilize the grid network to reduce power generation reserve margins for limiting blackouts. Totally, the accumulated investment through 2040 will be \$70 billion larger. However,

ASEAN is repealing tariffs on goods and

hydroelectric generation expansion will allow ASEAN to reduce CO₂ emissions by 78 million tons or 5% and fossil fuel costs by \$164 billion.

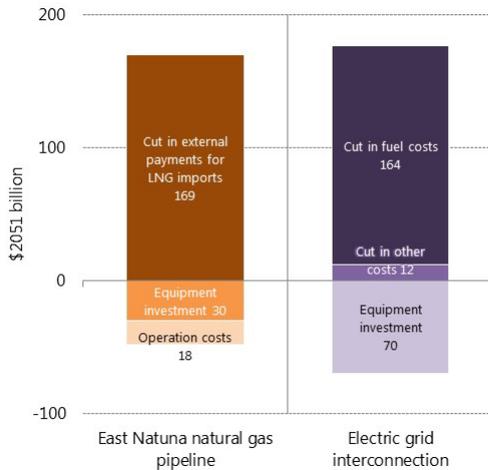


Figure 7 Economic effects of market integration

5. Conclusion

Global primary energy consumption in 2040 will expand by 40% from 2014, with the expansion centering on Asia. ASEAN consumption will increase 2.2-fold, accounting for 15% of the global expansion. While global coal consumption growth will decelerate with coal's share of the energy mix narrowing, ASEAN coal consumption will expand 3.5-fold mainly for power generation, capturing 40% of global coal consumption growth. ASEAN will account for 20% of global energy-related CO₂ emission growth through 2040 (9.5 billion tons).

Rapid growth in demand for fossil fuels will lead ASEAN to become a net fossil fuel importer. ASEAN will require massive investment in energy resources and infrastructure development. Power grid and other infrastructure interconnection to make effective use of regional resources will allow ASEAN to cut energy import costs, improve the energy self-sufficiency rate and decelerate CO₂ emission growth.

Reference

- 1) Institute of Energy Economics, Japan, "Asia/World Energy Outlook 2016".