Energy Transition and Sustainable Growth

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From an environmental perspective, the year 2021 has been very important with the scheduled COP26 meeting, later this year. There have been a series of events such as Biden's climate change summit, the release of the IEA Special Report, the ASEAN Summit, the G7 and G20 Energy and Climate Ministers' Meetings and finally the IPCC Sixth Report of the first Working Group (AR6-WG1). The IPCC report states that it *is unequivocal that human influence has warmed the atmosphere, ocean and land*[1]. The public's response to climate change is accelerating and companies are increasingly decarbonizing.

【Introduction】

This paper/summary is organized according to Session 2 of the April 2021 IEEJ/APERC Symposium. Because climate change is a challenge facing all of humanity and cannot be solved without all countries contributing a fair share, the Symposium invited representatives from different countries to discuss their energy. Within the all-embracing philosophy of sustainable growth, the main question was: "Can developing countries achieve the dual goal of carbon neutrality and economic growth?" The key is whether all humanity, including emerging and developing countries, can tackle climate change while moving in the same direction. As specific measures for developing countries cannot be fully and clearly identified, it would seem the carbon neutral (CN) movement is not perfect.

For the Symposium, we also asked the speakers if they learn anything from Covid-19 that would support achieving the CN target. Dr. Jirapongphan[2], who has served in many key positions in Thailand, including being the Minister of Energy, pointed out the importance of international cooperation and the need of sharing the benefits of economic growth with other regions. He also discussed overcoming the world efforts toward the decarbonization issue by utilizing all technologies, despite social needs and cultural differences. The vaccines to combat the corona virus are an example of international cooperation toward a common goal,

Dr. Srivastava of IIASA[3], who has long been involved in energy and environmental policy in India, explained that technological innovation should be expected, but warned that without a change in people's behavior, technology would not yield the expected effect. For example, when

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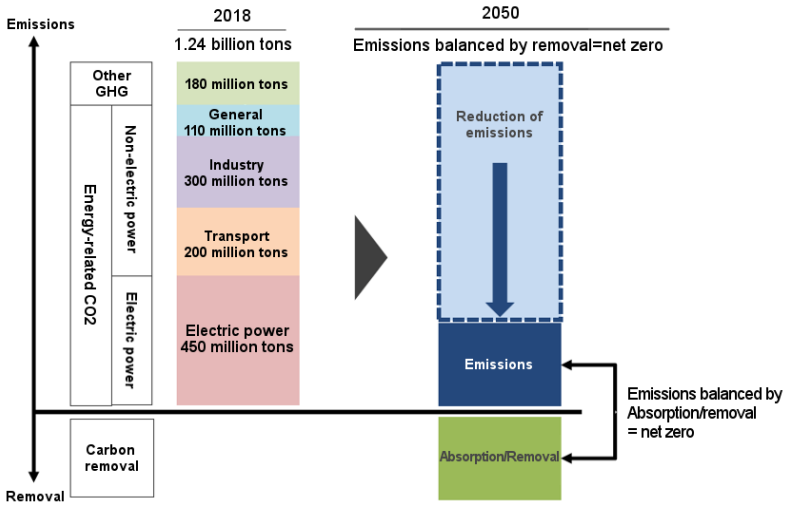
1 IPCC 6th Evaluation Report, First Working Group Report, Summary for Policy Officers (SPM), Sixth Assessment Report (ipcc.ch)
2 Dr. Siri Jirapongphan, Former Minister of Energy, Thailand, Current Advisor to the Ministry of Energy, Thailand
3 Dr. Leena Srivastava, Deputy Director General for Science, International Institute for Applied Systems Analysis (IIASA)

the pandemic behavior restrictions were lifted anywhere in the world, people quickly returned to pre-corona customs only to face a third, fourth, and fifth wave. If we don't quickly and fully reap the benefits of innovation, the cost of CN will keep rising. She argued that the role of government in introducing regulations and incentives is important for a successful energy transformation.

【Carbon Neutrality Targets and Challenges】

More than 120 countries and regions around the world have set "CN 2050" goals and many of them aim to net zero GHG emissions by 2050. Consequently, carbon neutrality refers to not only carbon dioxide but also includes all greenhouse gases (GHG) emissions (N_2O, methane, fluorocarbons, etc.). While it is difficult to completely eliminate emissions, net zero means that any remaining direct emissions can be offset by the "absorption" or "removal" of emissions by other means (Fig. 1). For the energy sector, reductions in carbon dioxide emissions are the main actions to combat climate change.

Fig. 1 Japan's GHG Emissions and Image of 2050 Net Zero



Source: Agency of Natural Resources and Energy Website：
https://www.enecho.meti.go.jp/en/category/special/article/detail_164.html

According to an IEEJ review[4] of the major countries (EU, UK, France, Germany, Japan, China) that identified specific scenarios and measures to achieve their target, the 5 main components that emerged are as follow. (1) energy saving, (2) electrification, (3) zero-emission power generation (renewable energy, nuclear power), (4) measures other than electric power, (5) absorption by forests, etc. for residual emissions, and CO_2 removal technology (BECCS, DACCS, etc.).

[4] Takahiko Tagami, "Trends in Major Countries toward Achieving Carbon Neutrality Targets: How Are Major Economies Trying to Achieve Carbon Neutrality? " (The 438th Annual Research Report Meeting), July 27, 2021.

With the first 4 components, GHG emissions are expected to decrease by about 80% by 2050 and the remaining amount would use the 5th component to absorb and remove the surplus. Final energy consumption will decrease by 30-40% from current levels, and the rate of electricity consumption (as a percentage of final energy) will rise to 40-60% by 2050, excluding China which expects 70%[5].

The ratio of renewable energy generation, which is key to reach zero emissions in the electricity sector, is slightly over 80% in the UK and EU, 75% in China and 54% in Japan. In 2050, the share of nuclear power will be between 9 and 16 percent in most countries, except for France[6], which is highly dependent on nuclear power. Hydrogen, which is attracting attention as a new fuel, accounts for about 20% of final energy consumption in 2050 in the UK and about 10% in China, Japan, and the EU. Including synthetic fuels and synthetic methane, those fuels will account for 18% in the EU and 15% in Japan which is expected to be high in hydrogen.

Most countries would absorb less than 20% of total emissions by 2050 (compared to the current level). While the amount of forest absorption in France and the EU should increase significantly, Japan is currently on a downward trend, with only about 4% of GHG's total in 2019. The amount of absorption by CO_2 removal technologies, including CCS, is particularly large in Japan (14%) and the UK (12%) relative to their total emissions in 2015-20.

【Emerging and Developing Countries and Carbon Neutral Targets】

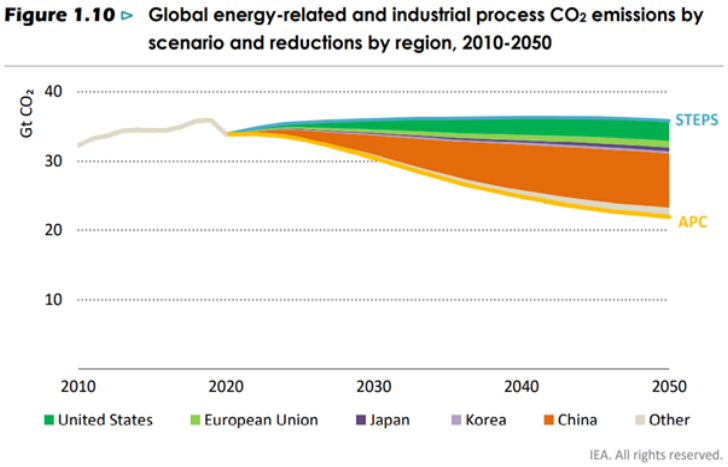
According to the IEA[7], only a limited number of CN-declared countries have specific policies. Fig. 2 shows the CO_2 emissions of the APC (Announced Pledges Case) in the IEA roadmap analysis. Compared to existing policy scenarios (STEPS) centered on current policies and existing technologies, emissions will decrease by 14GtCO_2 in 2050, mainly due to reductions in China and the United States, but emissions after the reduction will be 22GtCO_2, far short of net zero in 2050. The APC includes 44 countries and the European Commission, which have so far announced net zero and currently account for 70% of the world's emissions and GDP. These countries are China, the United States, the EU, Japan, South Korea, and others (U.K., Norway, South America, etc.). Southeast Asia, India, and African countries where the ratio of energy demand to CO_2 emissions is expected to increase in the future are not included in the APC; the future trends in these countries will be key.

[5] China's power consumption rate in 2050 is as high as 71%, and power consumption will be the key to realizing CN.

[6] France is targeting a combined share of 50% of renewable energy and nuclear power in 2035 but has not yet decided on 2050.

[7] According to the "Net Zero by 2050: A Roadmap for the Global Energy Sector" released in May 2021, CO_2 emissions will only be reduced to 30Gt in 2030 and 22Gt in 2050, as shown by the Announced Pledges Case (APC).

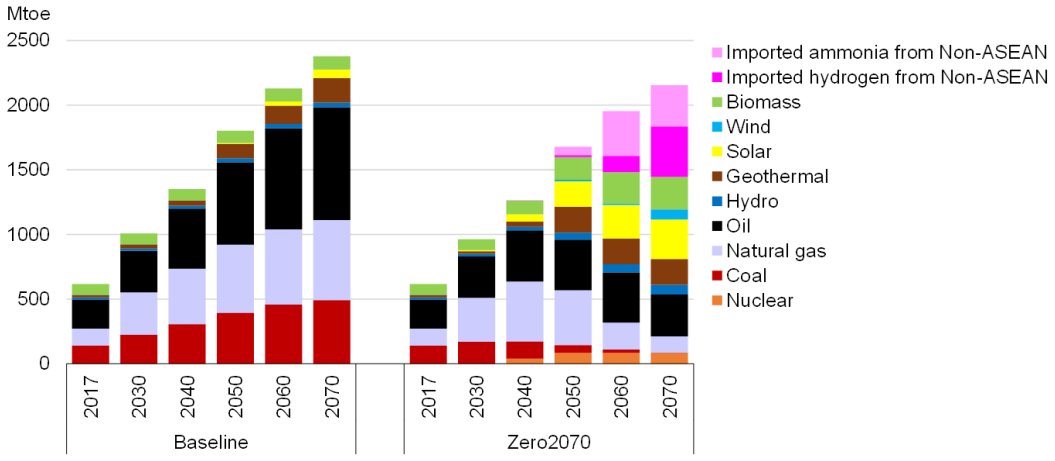
Fig. 2 Carbon Neutral Declaration Country Reduction Cases (APC, IEA Analysis)



Source: IEA, Net Zero by 2050: A Roadmap for the Global Energy Sector (May 2021)

The Economic Research Institute for ASEAN and East Asia (ERIA) and the IEEJ analyzed the economic impact of aiming for carbon neutrality across ASEAN. While ASEAN's energy demand is expected to continue to rapidly grow for a few more decades, the ERIA/IEEJ analysis compares the economic impact of different target years scenarios for achieving CN (2050, 2060 and 2070). The right side of Fig. 3 shows a scenario of ERIA/IEEJ analysis aiming for net zero by 2070. Until 2050, it is expected to shift from oil and coal-fired power generation to mixed-firing power generation of gas, ammonia, and hydrogen, and gas-fired power generation with CCUS. From 2050 onwards, in addition to solar and biomass power generation, 100% hydrogen and ammonia power generation will be required. Emissions from the transportation and industrial sectors are expected to continue in 2070, requiring technologies such as DACCS and BECCS as a means of reducing the remaining carbon dioxide.

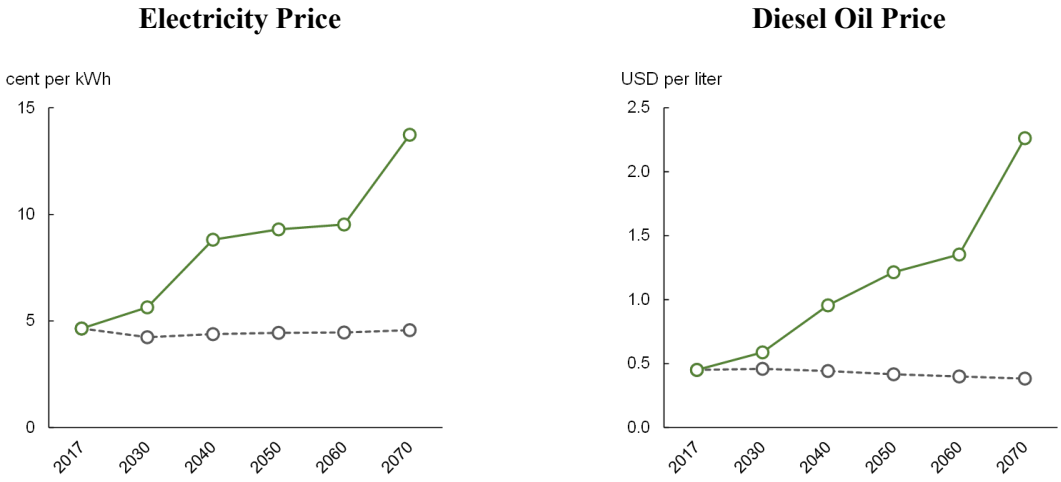
Fig. 3 Scenarios for Achieving Carbon Neutrality in 2070 across ASEAN



Source: ERIA-IEEJ, "Model Analysis for Carbon Neutrality in ASEAN by the Center for Economic Research in East Asia and ASEAN (ERIA) (Current Edition) " (June 2021)

The energy transformation towards achieving CN in the ASEAN region by 2070 will cause energy prices to rise substantially. Electricity prices could triple from current levels and light oil prices can rise five-times, straining people's lives (Fig. 4).

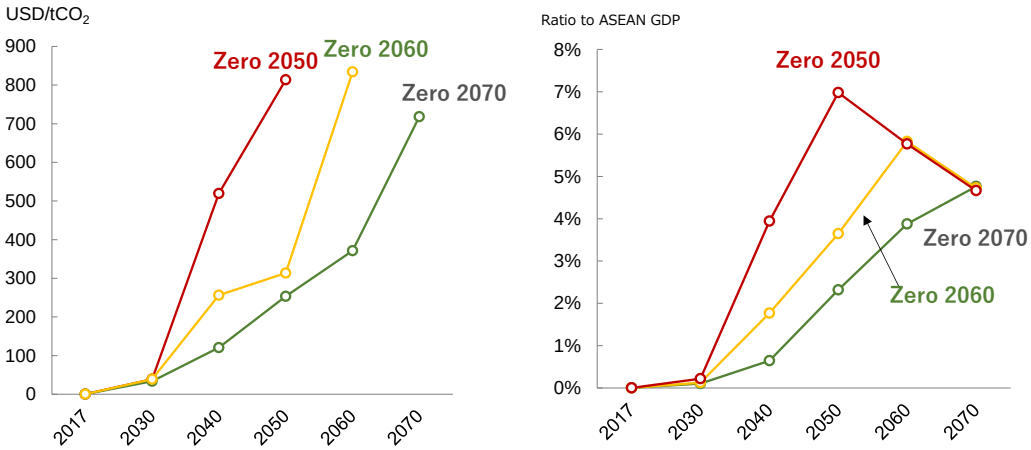
Fig. 4 Carbon Neutrality and Changes in Electricity and Diesel Oil Prices by 2070



Source: ERIA-IEEJ, "Model Analysis for Carbon Neutrality in ASEAN by the Center for Economic Research in East Asia and ASEAN (ERIA) (Current Edition) " (June 2021)

The left side of Fig. 5 shows the marginal cost of reducing CO_2. If the aim is to be carbon neutral by 2070, the cost of reducing the last ton of CO_2 will exceed $700, due to a sharp rise in costs after 2040. If the target is brought forward and CN is achieved by 2050, the marginal cost of reduction will rise to more than $800/ton by 2050.

Fig. 5 Marginal Reduction Costs and Ratio of Additional Costs to GDP



Source: ERIA-IEEJ, "Model Analysis for Carbon Neutrality in ASEAN by the Center for Economic Research in East Asia and ASEAN (ERIA) (Current Edition) " (June 2021)

The right side of Fig. 5 shows the annual additional cost expressed as a ratio to ASEAN's GDP. The ratio expands as various costs, including energy prices, rise and follows a different trajectory if the net-zero is achieved earlier or later. If it is net-zero in 2050, the cost will rapidly increase to 4% by 2040 then 7% by 2050, before declining to 5% of GDP by 2070. In the case of net-zero by 2070, it is small in 2040, about 2% in 2050 and reaching 5% of GDP by 2070. Consequently, setting a target year for achieving carbon neutrality early is expected to weigh on the economy, partly because the cost of the necessary technologies has not come down sufficiently.

The many developed countries' declaration for CN by 2050, should leave plenty of room for reflection as to whether it is also desirable for emerging and developing countries to aim for CN by 2050. Those countries have not yet benefited from economic growth to the same extent as the developed countries did.

Mr. Thomas, a debater at the IEEJ/APERC symposium and a former shell chief economist, said the scale of investment required for rapid decarbonization was enormous. The level of investments per capita in emerging and developing countries accounts for a significantly higher share of GDP, and disproportionally burdens those countries. He also pointed out that the 1.5-degree energy transformation to the world is a major issue that developed countries and some emerging economies should address. The developed countries should cover in part the increased investment burden on developing and emerging economies.

【In Conclusion】

The trend for "decarbonization", which implies a move or transformation towards cleaner energy, accelerated in part because of the introduction of additional policies for economic recovery from the economic disaster caused by Covid-19. Nuclear power which could have played the leading role for clean energy is becoming more costly, and there is a noticeable delay in its use in developed countries. Except for renewable energy, there are no other existing technologies to rely on.

The use of coal-fired power generation continues to increase in Asia which is considered the economic growth center for the world. Coal use is increasing even in China despite its CN declaration. Cars on the road will not be replaced by electric vehicles any time soon, and the need for oil products will continue for some time. It is difficult not only for Japan but also for the Asian emerging countries to completely and rapidly switch to renewable electricity. Therefore, it is expected that the use of gas-fired power, which is the cleanest fossil fuel, will also continue for some time. In the transition phase of the energy transformation, it is necessary for Asia to strongly appeal to the world that decarbonization of fossil fuels is important.

With an expected drop in production cost, blue hydrogen could be an option for Asia as a consumer and the Middle East as producers. It is necessary for countries to cooperate while competing. To reduce the cost of new forms of energy, including hydrogen, it is essential to not only create a demand, but it is also important to create rules and guidelines that reflect the circumstances of Japan and Asia (such as international standards).

For Asia, hydrogen will be an imported form of energy that relies on the willingness of foreign countries to supply and perform CCS. Therefore, “Energy security” continues to be a challenge. It is necessary to come up with a portfolio that considers responses through a variety of energy, technology, and system combinations.

Dr. Srivastava, a presenter at the Symposium, said that it is possible to get close to CN if the world fully utilizes the currently available technology. The CN targets can be achieved with the addition of a few new innovations and technologies and CCS. However, she stressed (1) the importance of strengthening international cooperation and governance based on a fair approach, (2) the need for resetting economic infrastructure and development by including sustainability, and (3) the will for spreading knowledge about sustainability throughout society. Mr. Thomas added that nature-based solutions improve habitats.

Energy is taken for granted most of the time, and its importance only recognized during emergencies. As the big wave of CN will be a major challenge for the next 30 years until 2050, the need for concerted efforts to not leave anyone behind will become imperative.

Writer’s Profile

Yukari Yamashita

Ms. Yamashita is responsible for quantitative and qualitative analyses on energy policy issues. Her team’s analyses and recommendations contribute greatly to the debate and policy making for Japan and international communities such as ERIA, APEC and IEA. The annual IEEJ’s Outlook is globally recognized for its timely analyses and pragmatic approach towards climate change. She has been serving as a member of various government councils and committees in the fields of energy and science & technologies. She also led miscellaneous international and regional energy cooperation programs through IEA, APEC, ERIA and IPEEC. She was the 2020 President of the International Association for Energy Economics (IAEE) and is the 2021 Executive Vice President of IAEE.

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