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of the Retail Electricity Market in Massachusetts, the United States

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Executive summary

Global energy supply and demand outlook (Reference Scenario)

Energy consumption will continue to increase despite energy efficiency that will improve to address climate change and energy security

- Under the Reference Scenario, and from the perspective of climate change and energy security, the rate at which the world's energy intensity per unit of gross domestic product (GDP) will decline is faster than in the past. However, as the macroeconomy expands beyond the rate of decline, global energy consumption in 2050 will increase by 1.3 times from 2020 to 17 649 million tonnes of oil equivalent (Mtoe). The Reference Scenario incorporates past trends and the expected effects of the extension of energy and environmental policies and technologies to date.
- The lack of upstream investment and the Russian invasion of Ukraine have raised concerns about a stable and sufficient supply of fossil fuels to meet the overall consumption which will continue to increase at an annual rate of 0.8%. The use of natural gas will grow at an annual rate of 1.3%, mainly to supply the power generation sector and will approach oil which is the largest energy source. Oil will expand at an annual rate of 0.7%, increasing mainly in the aviation, shipping, and petrochemical feedstocks sectors. Against the backdrop of air pollution and climate change, coal will peak around 2030 and begin to decline, falling below 2020 levels in 2050.
- Expectations for more non-fossil energy are growing as many countries aim to become carbon neutral. Solar photovoltaics, wind, and others will see the largest growth, increasing 3.9 times in 2050 compared to 2020. However, the share of non-fossil energy in total primary energy consumption will increase only slightly, from 20% in 2020 to 23% in 2050.
- Consumption in China, which had until recently driven the global demand growth, will peak around 2030 before turning downward while demand in India, the Middle East and North Africa, and the Association of Southeast Asian Nations (ASEAN) will continue to increase. India's consumption will surpass that of the United States and ASEAN's will surpass that of the European Union in the 2040s, making Emerging Market and Developing Economies in the energy and environmental fields all the more important.

Middle Eastern oil producers take advantage of their low production costs to lead crude oil supply. Russia is suffering from a severe shortage of upstream investment due to embargoes and sanctions, and its rate of decline is accelerating.

- In the medium-term, until 2030, the Organization of the Petroleum Exporting Countries (OPEC) and non-OPEC will both increase crude oil production. However, in Europe and Eurasia, where oil production was expected to decline over the medium to long term even before the Ukrainian war, the impact of Western countries' embargoes and sanctions will deepen Russia's lack of upstream investment and accelerate the pace of decline. Production in North America, led by the United States which increased output dramatically in the 2010s, will peak around 2030.

- From 2030, OPEC, especially the Middle East OPEC members with their abundant oil reserves and cheap production costs, will become increasingly prominent despite increases in production from Latin America. The share of OPEC crude oil in the global oil supply will rise from 34% in 2020 to 44% in 2050.
- Total world crude oil trade will increase as a result of rising oil demand. Imports will fall in Organisation for Economic Co-operation and Development (OECD) countries, where demand will decline, but imports from non-OECD countries will increase at a faster pace. Asia's dependence on imports will continue to rise, and while inflows from the Americas will increase, the Middle East will remain the largest supplier. Non-OECD Europe/Central Asia, especially Russia, will see an accelerated decline in exports to Europe and become more dependent on the Chinese market.

The LNG market is expanding due to abundant supply potential, but the outlook is uncertain

- The United States, the world's largest producer and consumer of natural gas, will continue to increase its production of natural gas, especially shale gas. Until about 2030, production will increase at an annual rate of about 1% and then stabilise.
- Australia, which slightly surpassed Qatar as the world's largest exporter of liquefied natural gas (LNG) in 2020, will experience steady growth in production. The increase is in part due to projects centring on the provision of complementary gas to existing LNG production facilities. The increase will moderate after 2030.
- In the Russian Arctic, construction is progressing for a second major LNG export project which had reached the investment decisions. However, the future of this project is uncertain due to the Russian invasion of Ukraine in February 2022.

Achieving decarbonisation is, realistically, a long-term commitment

- Decarbonisation has accelerated faster in Advanced Economies such as the United States and Europe. Emerging Market and Developing Economies have announced their intention to become carbon neutral, despite a long run coal demand that will expand in Asia, including India and ASEAN excluding China, and Africa. Global coal production will increase until the early 2030s in response to demand but after that, it will start to decline; the downward trend will intensify in the 2040s.
- Steam coal production will increase from 5 950 Mt in 2020 to 6 537 Mt in 2040 mainly due to increased demand for power generation. It then begins to slowly decline, reaching 6 311 Mt in 2050. Production of coking coal, used mainly as a raw material for steel production, will gradually decline from 1 014 Mt in 2020 to 824 Mt in 2050.

Electricity generation is expanding rapidly in Asia. Natural gas-fired power generation is the biggest source of electricity

- Global electricity generation will grow at an annual rate of 1.8%, rising to 45 777 TWh in 2050, 1.7 times higher than in 2020. 95% of that increase comes from Emerging Market and Developing Economies. Continuing its rapid economic growth, electricity generation in Asia will increase at an annual rate of 2.1% to reach 23 313 TWh in 2050, roughly half of the world's requirements.
- Although coal has the largest current share of the global power generation mix, natural gas will be the largest source of electricity in 2050. With a continuing upward trend in electricity demand in both Advanced Economies and Emerging Market and Developing Economies, ensuring a stable supply of natural gas remains an urgent and a long-term issue.
- In Advanced Economies, renewable energy will overtake natural gas as the largest source of electricity in the first half of the 2020s due to its rapid adoption. Of these, solar photovoltaic and wind, which have output variability, will account for 25% of the electricity generated in 2050. Measures to deal with these output fluctuations and the expansion of the network connecting the sites suitable for power generation and the location of demand will be issues.
- In Emerging Market and Developing Economies, renewable energy, especially wind, will continue to increase and replace coal as the largest power source in 2050. However, the role of coal-fired power generation in supporting the robust demand for electricity is no small matter, and it is necessary to develop a highly predictable investment environment and address environmental issues, such as air pollution.
- The role of nuclear is being recognised anew in Japan, Europe, and other countries from the perspectives of climate change countermeasures and ensuring energy security, especially after Russia invaded Ukraine. However, although new construction starts are underway, mainly in Asia, nuclear will not grow faster than the rate of increase in electricity demand through 2050, reducing its share of the power generation mix to 7%.

Advanced Technologies Scenario

Even under the Advanced Technologies Scenario, reaching global carbon neutrality by 2050 is far from being achieved. Further promotion of energy efficiency and climate change measures will require the full mobilisation of all means possible.

- The "Advanced Technologies Scenario" anticipates maximum carbon dioxide (CO_2) emission reduction measures based on the application opportunities and acceptability in society, including the full-scale introduction of newly factored hydrogen, and enhanced energy security measures. It should be noted that this outlook is a forecast-type of exercise that projects in the future based on the premise of the introduction of technology, etc. It contrasts with a backcast-type analysis that defines a future "landing point" and charts a possible path to reach it. Global final energy consumption under the Advanced

Technologies Scenario will be reduced by 5.2% in 2030 and 23.5% in 2050 compared to the Reference Scenario.

- Primary energy consumption will decline by 4.4% relative to the Reference Scenario in 2030 but will increase relative to 2020. After 2030, the reduction will accelerate as energy efficiency continues to improve. The reduction from the Reference Scenario in 2050 will only reach 18.5%, which is less than that of final energy consumption of 23.5%. This is due to the increased use of electricity and hydrogen, which have energy transformation losses.
- Fuel switching will also advance, reducing fossil fuel primary energy consumption by 1.1 Gtoe relative to the Reference Scenario in 2030 and 5.1 Gtoe in 2050. Despite a substantial growth in non-fossil energy of 0.4 Gtoe in 2030 and 1.8 Gtoe in 2050, the world cannot continue to maintain and improve its economy, society, and livelihoods without fossil fuels, even in the Advanced Technologies Scenario.
- Energy-related CO_2 emissions will be 31.2 Gt in 2030 (down 1.4% from 2020) and 16.9 Gt in 2050 (down 46.5%). In this scenario, CO_2 emissions would significantly reduce to levels equivalent to the *Announced Pledges Scenario* of the International Energy Agency (IEA) released in its "World Energy Outlook 2021". Consequently, such scenario is still far from a worldwide "Net Zero" emissions. The reduction from the Reference Scenario will amount to 20.1 Gt in 2050, of which China and India accounted for 38.1%.
- One of China's 2030 targets for Nationally Determined Contribution is to reduce CO_2 emissions intensity per GDP by more than 65% from 2005 levels, which is roughly equivalent to the Reference Scenario results. India's target of a 45% reduction in intensity, in its 2022 update, is roughly equivalent to results in the Advanced Technologies Scenario. On the other hand, the set targets to reduce emissions by the United States (50% to 52% reduction from 2005 levels), the European Union (55% reduction from 1990 levels), and Japan (45% reduction from 2013 levels), will fall short of the Advanced Technologies Scenario results.
- As expected, the Advanced Technologies Scenario requires less investment in fossil fuels than in the Reference Scenario, but further low-carbon investment in renewable energy and energy efficient equipment is required. The investment required in the 2040s, under the Advanced Technologies Scenario, is $35 trillion (at 2015 prices), $20 trillion more than in the 2010s, or an increase of $6 trillion from the Reference Scenario in the 2040s. The cumulative global energy investment requirement by 2050 will reach $88 trillion, or an average of $2.9 trillion per year.

Energy security strategy to address the Ukraine crisis and the energy transition

- A growing number of Asian countries are declaring themselves as also aiming at carbon neutrality. In addition to building a new energy infrastructure, free of carbon emissions, the world must focus on big problems that cannot be solved easily in the limited time we have (between 30 and 40 years). The problems include the mass disposal of existing equipment and job displacement, due to reworking the energy system. There is also a great deal of uncertainty surrounding the specific means of realisation.

- Asia faces a variety of challenges stemming from energy security. In emerging and developing Asia, where high economic growth is expected, it is essential to provide stably and inexpensively a large amount of energy. Considering the current trend toward a return to coal due to soaring energy prices, the amount of renewable energy available and their integrating costs, the transition from coal to natural gas is the realistic path forward. In doing so, the first phase of switching from coal to natural gas will involve increasing supply investments outside Russia while presenting a practical solution to the supply and cost problem. In the second phase, decarbonisation will be achieved by adding various measures, including the use of renewable energy and decarbonised natural gas.

- The so-called "4R technologies" is a tool to realise the decarbonisation of fossil fuels. Among them are the use of blue hydrogen produced by capturing CO_2 generated during manufacturing, the introduction of carbon capture and storage (CCS) technology in manufacturing plants and power plants, and carbon recycling technology that uses the captured CO_2 for other purposes.

Response to strengthening stable power supply and importance of nuclear power generation

- Under electricity deregulation, power generation facilities that are used infrequently in the market – with fewer generating opportunities – will be suspended and decommissioned. The introduction of renewables power generation has been expanded based on government support measures and in part caused the suspension and abolition of thermal power generation in many developed countries due to the decline in operating rates and the deterioration of profitability. As a result, the remaining power supply capacity of the entire electricity system declined. With a sudden surge in demand for electricity triggered by extreme heat or severe winter, combined with output declines and outages of power generation facilities (also caused by heat and cold waves), there are situations in which the balance between supply and demand becomes tight.

- Until now, the assessment of a stable supply of electricity has been to evaluate the possibility of a shortage of generating capacity (kW shortage) in response to increased demand. As decarbonisation policies proceed in the future, it is expected that dependence on a small number of power sources will increase. Another major issue is how to assess the risk of a shortfall in the amount of electricity generated (kWh shortage) when facing unforeseen events in a power source that the system heavily depends on.

- In a climate dominated by low-carbon arguments, the sharp rise in global fossil fuel prices since around 2021 and the Russian invasion of Ukraine in February 2022 put greater emphasis on securing a stable supply of energy. The role of nuclear in energy security is once more being recognised in Japan, Europe and elsewhere. The importance of its utilisation as a stable large-scale baseload power source under fossil fuel-fired power generation constraints has been highlighted anew.

- France and other countries announced ambitious nuclear targets while analysing the best mix with renewables. Plans to build new nuclear power plants are also underway in the United Kingdom and Eastern European countries. Expanding the operation of existing nuclear power plants and restarting them in Japan attract global interest. Attention is being paid to initiatives such as the introduction of a Regulated Asset Base (RAB) model, which is under consideration in the United Kingdom and can be considered as providing regulated returns to secure new investment in nuclear that will simultaneously achieve decarbonisation and stable supply.
- Nuclear is considered important from the standpoint of energy security, but it is also important for companies and countries in which nuclear is developed. A series of new projects by Western companies have faced delays in construction times and higher costs that far exceeded their original estimates. In one instance, it was pointed out that the company lost its construction know-how and was forced to change its design after construction began, due to regulatory requirements.

Critical mineral issues and energy, and economic security

- To achieve carbon neutrality, a massive adoption of renewable energy, electric vehicles, hydrogen and other low-carbon technologies is necessary. A new energy security challenge is emerging, caused by tight supply and demand for rare minerals (critical minerals), which are considered essential for these technologies. Like for fossil fuels, these resources are unevenly distributed around the globe.
- In the Advanced Technologies Scenario, the supply and demand for lithium, cobalt, neodymium, and dysprosium will be tight by the mid-2030s, mainly due to the increased penetration of electric vehicles. For nickel and cobalt, there are concerns that the cumulative demand by 2050 will exceed the sum of the total recycled supply and the resource reserves to cover long-term demand.
- Resources are concentrated in Chile, Argentina, Australia, and China for lithium, Indonesia and the Philippines for nickel, the Democratic Republic of Congo for cobalt, and China for the rare earth's neodymium and dysprosium.
- There are short-term and long-term perspectives on energy security. Unlike "flow-type" commodities such as oil and natural gas, which can face a significant impact in the event of a sudden supply disruption caused by some disturbance, "stock-type" materials are more resistant to short-term risks because even if a supply disruption occurs, the portion already imported can be incorporated into renewable energy facilities to provide energy. On the other hand, from a long-term perspective, it will be difficult to achieve carbon neutrality based on renewable energy, electric vehicles, hydrogen, etc., unless measures are prepared in advance to address the tightening of global supply and demand and uneven distribution of resources for critical minerals. While it will be essential to increase production at existing mines and promote the development of new mines for those types of ore that are feared to be in short supply, there are concerns that resource development

and export controls will be tightened in supplier countries in the future. Therefore, it goes without saying that demand countries are required to not only strengthen resource diplomacy aimed at securing interests, but they are also required to reduce import dependency and increase recycling rates to diversify sources of procurement, and to promote the development of technologies for non-use and reduced usage, as well as alternative technologies.

- On the other hand, supplier policies and the prospects for developing recycling, shifting and alternative technologies all involve uncertainty. Therefore, from the perspective of energy and economic security, consideration should also be given to balanced technology choices aimed at avoiding excessive reliance on specific carbon-neutral technologies[1].

Economic impact of green investment

- When investments in climate change measures create a virtuous cycle of emissions reductions and economic growth, it is called "Green growth". The results, however, may not be realised or they may appear differently in different economies and entities. It could create new disparities – (1) among developed economies and emerging/developing economies, (2) between developed and emerging/developing economies, (3) between economies that rely on fossil fuel exports and those that do not, and (4) within the population and citizens of the same economies.
- The cumulative additional green investment and consumption to realise the Advanced Technologies Scenario amounts to $14 trillion (at 2015 prices). If this green investment and consumption were carried out in a "No Financial Constrained" situation where the total amount of funds available could be increased at will, the GDP in 2050 would increase by $20 trillion (11.2%, an annual average of 0.4%). On the other hand, under a "Financial Constrained" situation in which the total amount of funds cannot be changed due to limited economic and financing capacity, GDP would be reduced by $6.2 trillion (3.5%, an annual average of 0.1%). "Financial constrained" means that incremental green investments will be offset by declines in investment and consumption in other areas.
- Under the No Financial Constrained Case, GDP and output would increase in many economies, but would decrease in economies such as those in the Middle East and the former Soviet Union that are highly dependent on mining (fossil fuels). In the Financial Constrained Case, GDP and output will decrease in many economies. However, in some developed countries and China, the decrease in the value of energy imports due to green investment and consumption is significant and GDP and output will increase, outweighing the decrease in investment in other sectors due to financial constraints.
- Investment is a new demand and a source of growth. However, if other investments are reduced in proportion to new investments in a situation of financial constraints and

[1] With the permission of the Japan Oil, Gas and Metals National Corporation (JOGMEC), this article presents a part of the results of its commissioned study, "Survey of Mineral Resource Supply and Demand to Achieve Carbon Neutrality" (FY2022), and details of the results will be reported at a seminar scheduled to be held by JOGMEC on 10 November 2022.

budget constraints, no new demand is created as a total amount. In addition, green investment is unlikely to be a source of growth because it is not itself an investment to expand production capacity. Relaxing financial constraints and providing sufficient funds are the key to achieving green growth.

- For smooth financing, it is necessary to use not only government budgets but also green finance, which is mainly funded by the private sector. It is important to clarify the direction of the environmental policies to limit risks and encourage investment. How to limit negative economic impacts and how to even out the different impacts between economies and industries is important.

Trend toward Reexamination of Full Liberalization of the Retail Electricity Market in Massachusetts, the United States

Kenichi Onishi*

In Massachusetts in the northeastern United States, full liberalization of the retail electricity market was introduced in 1998 but in recent years the electricity pricing of competitive suppliers has been set higher than the regulated pricing of the electric companies, and it has been pointed out that poor customers in particular have borne economic losses. For this reason, currently the state legislature is advancing legislative procedures in the direction of reexamining the liberalization of the retail electricity market targeting the electricity supply for residential retail customers.

Regarding the fully liberalized retail electricity market, it is thought that problems exist from the perspectives of "symmetry of information" and "literacy" in the household sector, unlike in the industrial sector and commercial sector. For example, customers have not obtained sufficient information from the retail electricity suppliers, do not appropriately carry out comparative examinations of the levels of pricing presented by retail electricity suppliers, and do not confirm the details of the contract conditions. In a market environment with these kinds of problems, room is created for retail electricity suppliers to engage in the opportunistic behavior of presenting to customers slightly more expensive pricing when executing contracts.

Going forward, if full liberalization of the retail electricity market is abolished in Massachusetts, there is a strong possibility that this kind of reform will spill over into other states. At a time when retail electricity prices are being raised in Western countries, the strengthening of regulations in the retail electricity market has become a global trend.

1. Moves to reexamine the full liberalization of the retail electricity market in Massachusetts

In the United States, currently full liberalization of the retail electricity market has been introduced in 13 states, including Massachusetts, and in Washington D.C. In Massachusetts, pursuant to the Massachusetts Electric Industry Restructuring Act established in 1997, electric companies were required to sell off their power-generating facilities, and then full liberalization of the retail electricity market was introduced from 1998.

In recent years, it has been seen as a problem that the market pricing of competitive suppliers is more expensive than the basic service pricing (regulated pricing) of the electric companies, and since 2018 the reexamination of full liberalization of the retail electricity market has been raised in the Massachusetts legislature. For this reason, legislative procedures are being advanced in Massachusetts for a Senate bill incorporating the provision that "beginning on January 1, 2023, no competitive suppliers shall execute a new contract or renew an existing contract for generation services with any individual residential retail customer" (S.2842).[1] Supposing the above prohibition is adopted, the customers receiving supply from a competitive supplier will switch in stages to supply from the electric companies.

In an on-line survey of residential retail customers in Massachusetts conducted by a consulting company, 79% of the respondents wanted to be able to choose their retail electricity supplier, so the bill does not necessarily have content which matches the wishes of the customers.[2] Furthermore, effects are anticipated such as customers becoming unable to select the options provided by the competitive suppliers for 100% renewable energy pricing.

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1 https://malegislature.gov/Bills/192/S2842.pdf

2 https://www.surveyusa.com/client/PollReport.aspx?g=80ba68b1-e967-4ebb-a0e3-eecdc5272928

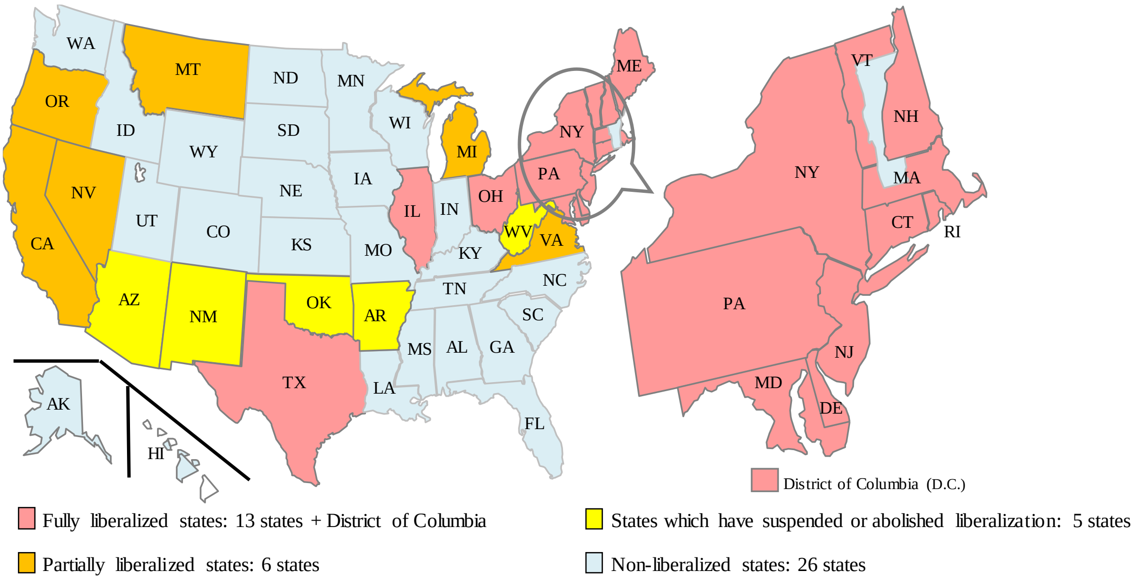

Fig. 1 The status of liberalization of the retail electricity market in each state of the United States

Source: Prepared by The Institute of Energy Economics, Japan (IEEJ)

2. The pricing structure in Massachusetts

In Massachusetts, there are electric companies in each of four regions and they supply electricity at the basic service pricing to customers who have not switched to competitive suppliers.[3]

The basic service pricing of the electric companies for residential retail customers in Massachusetts is normally revised every six months and the approval of the state government is necessary when raising prices. The basic service pricing is comprised of (1) the wholesale electricity procurement cost, (2) Renewable Energy Portfolio Standard (RPS) system compliance costs, and (3) administrative costs. Regarding (1), these are the costs incurred when the electric companies procure electricity from electricity producers based on competitive bidding. Regarding (2), these are the costs of the renewable energy value which is necessary to comply with the RPS stipulated by Massachusetts. Note that the basic service pricing constitutes the supply cost part while the power transmission and distribution pricing and taxes and other public charges, etc. are included in the final electricity pricing.

On the other hand, the market pricing of the competitive suppliers differs from the basic service pricing of the electric companies regarding the following points: (1) regarding prices, fixed prices and variable prices are applied, (2) regarding the contract term, a variety of terms such as 6 months, 12 months, 24 months, etc. are established, and (3) regarding the renewable energy ratio, the ratio that is mandatory under the RPS or a higher renewable energy ratio is established, etc.

3. The situation in the retail electricity market in Massachusetts

In Massachusetts, since full liberalization of the retail electricity market was introduced in 1998 the percentage of household electricity supply accounted for by the competitive suppliers (municipal aggregations) has been increasing year by year. In 2021 the percentage of electric companies was 43%, the percentage of competitive suppliers was 18%, and the percentage of municipal aggregations was 39%.

A municipal aggregation is a system under which municipalities purchase electricity in bulk from competitive retail electricity suppliers on behalf of the customers. Note that the aforementioned phasing out of the electricity supply to residential retail customers by competitive suppliers does not apply to municipal aggregations.

[3] https://www.mass.gov/info-details/basic-service-information-and-rates#basic-service-pricing-

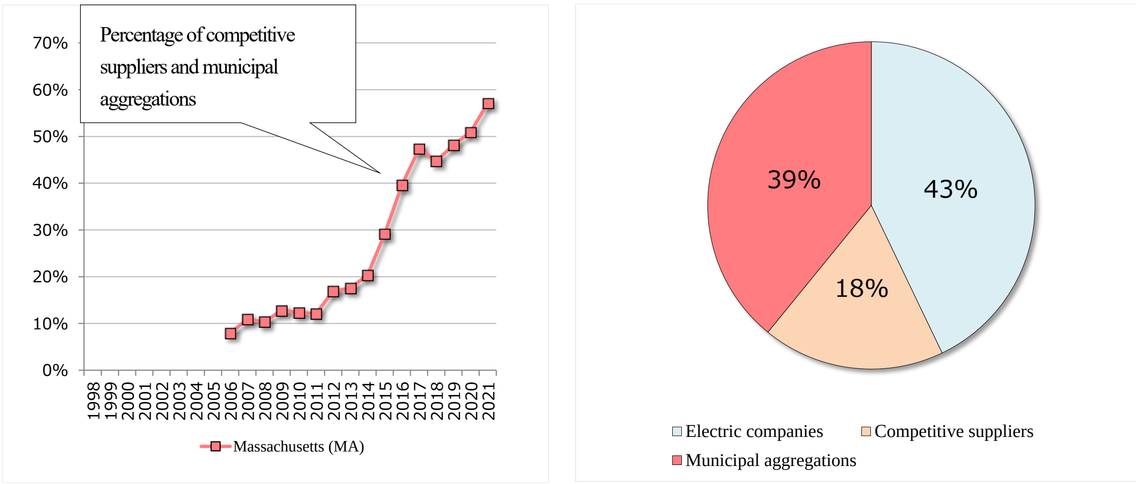

Fig. 2 Percentage of the household electricity supply of Massachusetts accounted for by each supplier type (left: the trend in the percentage of competitive suppliers and municipal aggregations; right: percentage by supplier type in 2021)

Source: https://www.mass.gov

Note: The market share of the amount of electricity sold (kWh) in December each year

4. Problems with the full liberalization of the retail electricity market in Massachusetts

The National Customer Law Center (NCLC), a nonprofit organization which handles customer problems, indicated in a report it published in 2018 that residential retail customers who had switched to competitive suppliers were charged more expensive electricity prices than the electricity prices of the electric companies.[4]

According to the report, the approval of the state government is necessary for the electric companies to raise electricity prices but competitive suppliers are able to freely change their electricity prices, so they are excessively raising their electricity prices during the contract terms. It indicated that there is a particular tendency for low-income customers to be paying excessive electricity prices, so there is a possibility that some of the competitive suppliers are deliberately providing misinformation to low-income customers in order to execute unfair contracts.

In response to this situation, the NCLC has recommended to the state government that it consider limiting the target of liberalization of the retail electricity market to the electricity supply to industrial and commercial customers and the electricity supply via the municipal aggregations system and then removing residential retail customers from the target of liberalization of the retail electricity market, etc.

Furthermore, the Massachusetts Attorney General's Office, in a report analyzing the benefits of retail electricity market liberalization for residential retail customers in Massachusetts in 2021, stated that Massachusetts consumers in the individual residential electric supply market paid $425.7 million more than they would have paid if they had received electric supply from their electric company during the five-year period from July 2015 to June 2020.[5] Moreover, it reported that in Massachusetts there was a tendency for low-income residential retail customers to choose competitive suppliers more, with low-income households at 31% while non-low-income households are only at 17%.

The report reaches the conclusion that industrial customers and commercial customers which have negotiating power may have benefited from liberalization of the retail electricity market but residential retail customers do not have negotiating power so they may incur economic losses if they switch from electric companies to competitive suppliers.

[4] https://www.nclc.org/images/pdf/pr-reports/competitive-energy-supply-report.pdf
[5] https://www.mass.gov/doc/2021-competitive-electric-supply-report/download

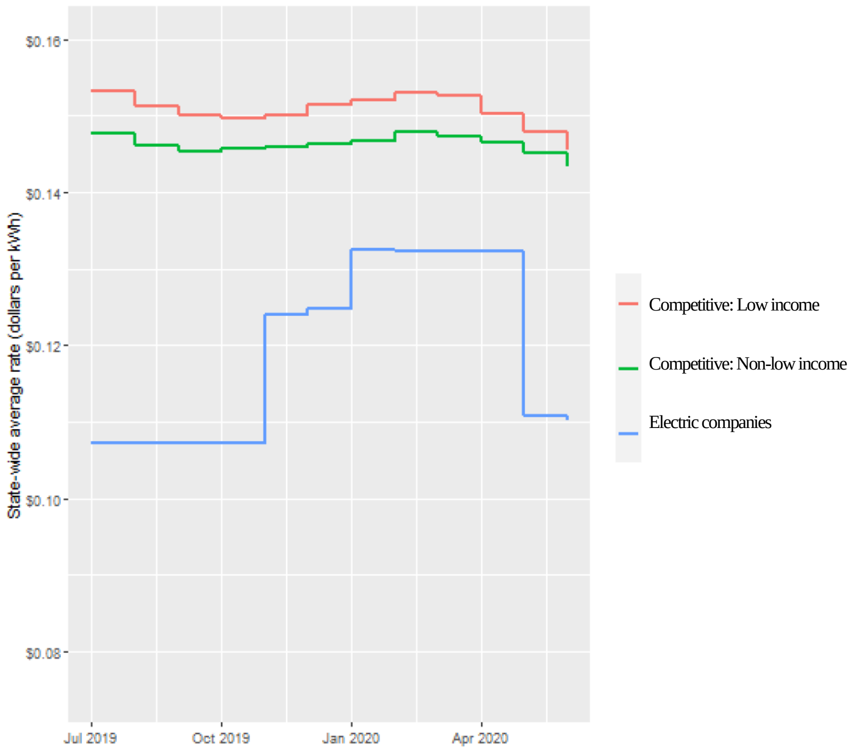

Fig. 3 Trend in the average rates of retail electricity suppliers in Massachusetts (July 2019 to June 2020)

Source: https://www.mass.gov/doc/2021-competitive-electric-supply-report/download

5. Hints obtained from the example of Massachusetts

Unlike with regulated pricing, the market pricing of retail electricity suppliers is not subjected to pricing reviews, etc. by regulatory authorities, and the suppliers are able to set whatever prices they like. Therefore, retail electricity suppliers carry out business streamlining and rationalization in an attempt to present cheaper prices than the regulated prices to their customers. Under normal conditions, this kind of behavior by retail electricity suppliers is expected to be the benefit of electricity liberalization.

However, it is thought that in any fully liberalized retail electricity market, not only in Massachusetts, there are problems from the perspectives of "symmetry of information" and the "literacy (of the customers)" in the household sector, unlike in the industrial sector and commercial sector. For example, customers have not obtained sufficient information from the retail electricity suppliers, do not appropriately carry out comparative examinations of the levels of pricing presented by retail electricity suppliers, and do not confirm the details of the contract conditions.

In a market environment with these kinds of problems, room is created for retail electricity suppliers to engage in the opportunistic behavior of presenting to customers slightly more expensive pricing when executing contracts. For that reason, regulatory authorities are required to take measures from the perspective of customer protection such as including provisions in the licenses, etc. of retail electricity suppliers and formulating guidelines, etc. for retail electricity suppliers. Furthermore, it is deemed to be necessary for the regulatory authorities to monitor the business activities of the retail electricity suppliers and take rectification measures as needed as after-the-fact regulation.

In Massachusetts as well, it is mandatory to submit the summaries of the electricity sales contracts for residential retail customers and the sales-related materials, etc. to the regulatory authorities, to record the sales calls made to residential retail customers and, in the case of carrying out door-to-door sales to residential retail customers, to notify the regulatory authorities of the contact information and door-to-door sales area, etc. of the person in charge at the retail electricity supplier, etc. Furthermore, measures such as imposing fines, etc. on retail electricity suppliers which have engaged in unfair sales activities have been taken in the past. We are forced to take seriously the fact that despite these kinds of rectification measures being taken on this occasion, it has been revealed that retail electricity suppliers have engaged in unfair sales activities with respect to residential retail customers, and in particular low-income households, and their electricity pricing levels continue to be more expensive.

Summary

If the full liberalization of the retail electricity market is abolished in Massachusetts going forward, it will be the biggest development since California abolished full liberalization due to the Californian electricity crisis at the beginning of the 2000s. In the United States, it has been indicated that excessive electricity prices are being paid to competitive suppliers not only in Massachusetts but also in Connecticut, Illinois, and New York State, etc., so this is becoming a social problem. For this reason, if full liberalization of the retail electricity market is abolished in Massachusetts, there is a possibility that this kind of reform will spill over into other states.

On the other hand, recently electricity prices have been rising globally due to fuel shortages, etc. against the background of the rebound from the decline in electricity demand due to the COVID-19 pandemic and the invasion of Ukraine by Russia. For this reason, customers have become more sensitive to rises in electricity prices than previously.

In Japan too, in the context of wholesale electricity market prices steeply rising, problems are emerging such as retail electricity suppliers greatly raising electricity prices, many competitive suppliers going bankrupt, and customers receiving electricity supply at the final guaranteed supply pricing because they are unable to execute new contracts or renew contracts, among others. On the other hand, it is also a fact that as a consequence of introduction of liberalization of the retail electricity market the competitive suppliers use their originality and ingenuity to create new business models.

In Japan, currently discussions are under way in national councils aimed at ensuring that retail electricity suppliers carry out risk-hedging appropriately and carry out sound business operation and that the customers can choose appropriate retail electricity suppliers. Moves for which there is a possibility that fundamental changes could be made to business regulations as in Massachusetts, the United States, are still limited, but the strengthening of regulations in the retail electricity market has become a global trend, so it is important to monitor this closely going forward.

STUDY ON RENEWABLE ELECTRICITY PROCUREMENT IN JAPAN

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EXECUTIVE SUMMARY

Renewable energy is expected to play an important role in Japan's carbon neutrality strategy. According to the Sixth Strategic Energy Plan (6th SEP), approved in October 2021, renewable electricity is expected to account for 36%~38% of the total power generation mix by 2030, which is much more ambitious compared to the target share of renewable electricity (22%~24%) set out in the previous SEP. At the same time, an increasing number of Japanese companies have been seeking direct renewable electricity procurement in recent years. For example, the number of Japanese companies joining RE100, a global renewable energy initiative for companies committed to 100% renewable electricity consumption, reached 69 in April 2022 from only three companies five years ago (2017).

Renewable energy deployment in Japan has seen rapid growth since the implementation of the Feed in Tariff (FIT) scheme in 2012. However, renewable power generation costs are still high compared to those of other countries and the high cost is passed on to electricity consumers in the form of FIT surcharges. Corporate purchases of renewable electricity can provide an option for supporting renewable energy deployment that imposes no additional burden on the general public. Yet, according to a RE100 report[1], Japan is one of the most challenging places in the world for companies to switch to 100% renewable electricity. High costs and limited supply are cited as the two largest problems.

Given this background, the Institute of Energy Economics (IEEJ) team conducted a study to reveal the main challenges of corporate renewable energy procurement in Japan and what policies and/or regulations are needed to address the issues pertaining to making Japan's renewable electricity market more friendly to corporate buyers. We interviewed various stakeholders, including renewable energy developers, electricity retailers, consumer companies, industry associations, as well as experts, to gain firsthand insight into the issues often raised.

Land constraints and grid integration were mentioned to be the two biggest concerns regarding future cost reductions of renewable power generation and the further expansion of renewable capacity. A mountainous country, Japan is not home to as wide an area of flat land compared to other countries and most of the low-cost flat land suitable for renewable power generation plants has already been developed. Geographic constraint is not the only reason behind the land use issue. The acquisition of land suitable for renewable projects can be time-consuming because of complex land use approval procedures, and more so when property rights are unclear. Moreover, there are growing concerns regarding the safety and environmental impact of renewable projects.

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[1] Andrew Glumac, Shailesh Telang, Claire Lambert (2020) *Growing renewable power: Companies seizing leadership opportunities,* https://www.there100.org/growing-renewable-power-companies-seizing-leadership-opportunities

Furthermore, current grid connection and grid operation rules are not favorable for new renewable projects. In Japan, the current grid connection rule for new projects follows the "first come first serve" principle. Free grid capacity for new projects is becoming increasingly limited. If a new power generation project requires grid expansion, the construction cost is partly borne by the project owners. The short-term solution to the grid connection constraints issue is the "non-firm" connection rule[2], which is currently applied to all high-voltage transmission connections. While "non-firm" connection can help more new renewable projects connect to the grid, there are concerns that the risk of unpredictable curtailment faced by the "non-firm" connected projects may harm the project's bankability. Further grid capacity expansion and improvement of grid utilization rules are needed to accommodate more renewable capacity.

Many RE100 companies rely on Environmental Attribute Certificates (EACs) for sourcing renewable electricity. In Japan, the largest EAC market, the Non-fossil Fuel Certificates market, is currently under reform. Consumers and brokers are allowed to participate in the FIT NFC market from the November 2021 auctions.

And the NFC tracking[3] is now managed by JEPX. The tracking system covers both FIT NFC and non-FIT NFC. NFC with tracking information can be used for RE100 reporting. The tracking system is expected to be further improved in the future.

In Japan, corporate PPA (Power Purchase Agreement)[4] markets are still at a preliminary stage and there is still room for improvement. A virtual PPA (VPPA) scheme (virtual corporate PPA without the involvement of electricity retailer), which is a popular corporate PPA scheme overseas, would require direct transactions of non-FIT NFCs. According to the latest rule revision of the NFC market, consumer companies with a VPPA contract can have direct transaction of non-FIT NFCs with renewable power generators when the renewable projects meet certain criteria. There are issues other than institutional barriers that need to be addressed to facilitate corporate PPA/VPPA[5] in Japan. For example, evaluating a consumer company's (off-taker) credibility to guarantee a long-term electricity purchase agreement is essential to the bankability of a renewable project. This has been expressed by developers as a primary concern regarding corporate PPAs/VPPAs. The lack of retailers with enough know-how on demand and supply balancing was also cited as a barrier to corporate PPAs/VPPAs.

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[2] Under the "non-firm" connection rule, even if there is no free grid capacity, the new power plant can still be connected to the grid but its generation will be first to be curtailed, without compensation, when there is grid congestion.

[3] Tracking system is typically an electronic database that registers basic information of each MWh of renewable generation such as, technology, location, operation year, etc.

[4] A corporate PPA is Power Purchase Agreement signed between a consumer company and a renewable power generator. Details of corporate PPA in Japan are stated in Chapter 2

[5] "PPA/VPPA" means physical PPA and virtual PPA

Given the circumstances stated above, we propose the following measures to further expand the supply of low-cost renewable electricity and improve the current situation of renewable electricity procurement for corporations such as corporate PPAs, in Japan:

[Measures for expanding renewable supply]

(1) Accelerate the implementation of local decarbonization initiatives and collect information on land ownership and required conditions for land acquirement approval during the wide area zoning process: Land constraints are one of the most significant problems pertaining to renewable energy development in Japan. The limited availability of optimal sites affects not only renewable power generation costs but also the future potential of renewable power development. While cross-ministerial efforts at the central government level are required to address this issue, the involvement of local governments is also indispensable. In the revision of the Act on Promotion of Global Warming Countermeasures, the Ministry of the Environment (MOE) reinforced the promotion of local government decarbonization initiatives. The local decarbonization initiative comprises two important elements: 1) the local renewable development target; and 2) the local decarbonization zone. Measures for local decarbonization zone include wide area zoning[6]. And according to the manual for wide area zoning developed by the MOE, not only environmental regulations at the country and prefecture levels but also local issues at the municipality level should be considered. Implementing local decarbonization zoning can accelerate the development of renewable energy and help lower power generation costs. Japanese EIA (Environmental Impact Assessment) procedures require the participation of the general public and approval from the prefectural government at various stages. This time-consuming requirement can be streamlined in the case of wide area zoning, where the local government and local communities have already participated in the zone selection process. On the other side, during the wide area zoning process, information collection regarding land ownership and providing the information that can be disclosed to renewable developers can help addressing the land acquirement difficulties in the renewable project development process.

(2) Improve grid integration conditions for renewable projects: Grid connection and grid utilization need to be more predicable to encourage investment in renewable projects. Uncertainties pertaining to grid connection, grid operation (associated with curtailment), and the electricity market price can undermine the predictability of a renewable project's revenue and thus have negative impact on renewable energy investment. To address such

[6] "Wide Area Zoning" is the process of designating area in a municipal for renewable development after consideration of national and prefectural environmental regulations as well as social concerns in the specific municipal, and negotiation with all stakeholders.

issues, data regarding power generation plants as well as the grid operation status need to be properly disclosed to electricity market participants. In the longer term, in addition to predictability issues, the increased accommodation of renewable electricity in the power grid will require accelerated procedures for grid utilization rules reflecting the environmental benefit of renewable energy.

[Measures for improving environment for corporate renewable procurement]

(3) Develop a user-friendly NFC market and improve the renewable tracking system: Direct consumer access to renewable NFCs and tracking renewable electricity are key elements of encouraging corporate renewable electricity procurement in Japan. Several factors should be considered while accelerating the rulemaking associated with NFC market reform and developing a tracking system that covers all renewable energy: It is important to develop a **user-friendly** scheme with new rules. For example, the tracking system can meet consumer companies' needs such as providing enough information for verification of additionality ("Additionality" means contribution to new renewable investment). And under current NFC market rules, the effective period of NFCs terminates at the end of June, regardless of the timing of NFC acquirement. Given the reporting timeframe for RE100 companies, for example, revising the current NFC effective period to one year after the generation period of the NFC, would allow more flexibility for reporting by consumer companies. It is also important that the renewable NFCs managed under the tracking scheme to be developed will be **compatible with the latest international standards,** including RE100 criteria**.** Further, to make the renewable certificate management and trading system be as developed as REC (Renewable Energy Certificate) in the United States or the GO (Guarantee of Origin) system in Europe, data from not only the renewable developers but also other stakeholders such as grid operators and retailers will be necessary. Therefore, further improvement of the renewable tracking system and NFC market is not only about renewable energy system. The relevant rules regarding the renewable tracking system and NFC market need to comply with the rules for data disclosure and management of the whole electricity system.

(4) Scale up the corporate PPA/VPPA market. Rapidly disclose relevant market regulation revision information companies and develop government guidance for corporate PPA/VPPAs. In response to the needs of consumer companies, the latest rule revision of the NFC market enables consumer companies with a VPPA contract to have direct transaction of non-FIT NFCs with renewable power generators when the renewable projects meet certain criteria. Detailed information about such market rule revision should be disclosed and reached to the companies rapidly. Given the complex market structure and regulation environment, accessible government guidelines can help relevant stakeholders to gain a better understanding of how corporate PPA/VPPA schemes work in

Japan, as well as what roles and responsibilities are expected of them by different stakeholders.

(5) Introduce consumer relief measures to reduce FIT surcharge burden: The increasing burden of the FIT surcharge shouldered by end users is a critical issue in Japan's renewable energy development. Given that the FIT purchase period is 10 to 20 years (depending on the type of technology), the current FIT surcharge is rooted in existing highly priced FIT projects that were approved in the initial years of the FIT scheme. In the longer term, to reduce FIT surcharge further bring down renewable power generation cost is necessary. And to promote the cost reduction, Japan has introduced auctions and has moved from FIT to market mechanism based FIP mechanism. However, even under the FIP mechanism, the premium paid to renewable developers is passed on to consumers, and thus there are still surcharge to consumers (surcharge caused by FIP).

Corporate PPAs for non-subsidized (non-FIT/FIP) renewable projects (corporate PPA with non-FIT/FIP renewable projects) can help encourage renewable energy development without increasing the FIT surcharge. However, newly contracted corporate PPAs cannot contribute to the reduction of the FIT surcharge caused by projects already approved. Consumer relief measures are needed to reduce the FIT surcharge shouldered by electricity consumers. When considering such measures one of the examples is Germany's case. For example, Germany has abolished consumer's renewable energy surcharge as of July 1, 2022, and has instead set up a climate fund (financed by revenues from **carbon pricing** and the **government budget**) to support renewable energy.

GLOSSARY

ANRE: Agency for Natural Resources and Energy
CDP: Carbon Disclosure Project
CfD: Contract for Difference
EAC: Environmental Attribute Certificate
EIA: Environmental Impact Assessment
FIP: Feed-in-Premium
FIT: Feed-in-Tariff
FY: Fiscal Year
GHG: Greenhouse gas
GO: Guarantee of Origin
JQA: Japan Association for Quarity
MAFF: Ministry of Agriculture, Forestry and Fisheries
METI: Ministry of Economy, Trade and Industry
MLIT: Ministry of Land, Infrastructure, Transport and Tourism
MOE: Ministry of the Environment
NFC: Non-fossil Fuel Certificates
OCCTO: Organization for Cross-regional Coordination of Transmission Operators, Japan
PKS: palm kernel shell
PPA: Power Purchase Agreement
REC: Renewable Energy Certificate
SBT: Science Based Targets
SEP: Strategic Energy Plan
TEPCO: Tokyo Electric Power Company Holdings
VPPA: Virtual Power Purchase Agreement

CHAPTER 1. BACKGROUND AND OBJECTIVES OF STUDY

Japan is committed to reducing its greenhouse gas (GHG) emissions by least 46% by FY 2030 relative to FY 2013 levels and to achieving carbon neutrality by 2050. The 6th Strategic Energy Plan (SEP) approved by the Cabinet in October 2021, right after the start of the Kishida administration, sets a roadmap toward achieving those targets. According to the 6th SEP, renewable electricity is expected to account for 36%~38% of the total power generation mix by 2030. This is much more ambitious compared to the target share of renewable electricity (22%~24%) set out in the previous SEP. To achieve the 36%~38% target, Japan needs to double its renewable power generation capacity from the current level (84GW in 2021) by FY 2030 (147~161GW).

At the same time, carbon neutrality goals have gained recognition beyond government policy and more companies are pursuing such goals under their corporate business strategies; and therefore, the corporate appetite for renewable electricity is growing. The number of Japanese companies joining RE100, a global renewable energy initiative for companies committed to 100% renewable electricity consumption, reached 69 by April 2022 from only three companies five years ago (2017). RE Action, an initiative for smaller companies and organizations with lower levels of electricity consumption[7] committed to converting to 100% renewable electricity by 2050 was established in 2019. As of May 2021, 258 entities have joined RE Action.

Renewable energy deployment in Japan has seen rapid growth since the implementation of the Feed in Tariff (FIT) scheme in 2012. And as mentioned above, renewable energy is expected to play an even more important role in Japan's future electricity supply.

Renewable power generation costs remain high in Japan compared to the global average level. Under the FIT scheme, renewable power generation is purchased at a pre-determined price that is higher than the average wholesale electricity price for a given period (10 to 20 years, depending on the renewable power generation technology). The additional cost is passed on to electricity consumers as a FIT surcharge included in their electricity bills. Given that almost all of the new renewable power generation capacity installed over the past 10 years is covered by the FIT mechanism, the rapid growth of renewable power installation has resulted in increasing financial burden on electricity consumers. Reducing the FIT surcharge is one of the most critical issues that need to be addressed for the further development of renewable energy in Japan.

The FIT mechanism has been the main driver of renewable development in many countries. However, because of the cost reductions achieved in renewable power generation, especially solar PV and wind, and the increasing burden of FIT surcharges shouldered by electricity end-users,

[7] Less than 50GWh/year

most countries are moving away from the FIT scheme, searching for new ways of supporting renewable energy development.

Corporate buyers have become an important driver of renewable development in recent years. Corporate purchases of renewable electricity provide an option for supporting renewable energy while imposing no additional burden in the form of FIT surcharges. It is reported that private companies bought 31.1GW of clean power in 2021[8], equivalent to about 37%[9] of total renewable capacity installation in Japan. Corporate renewable electricity purchases are expected to continue to positively contribute to renewable energy development in Japan. However, Japan is one of the most challenging places in the world for companies to switch to 100% renewable electricity according to a RE100 survey report[10]. High costs and limited supply are cited as the two largest problems.

Japan's electric power system reform has yet to be completed, and thus many market rules and regulations are still under development. Given this background, the IEEJ team conducted this study to reveal the main challenges in corporate renewable electricity procurement in Japan and what policies and/or regulations are needed to make Japan's renewable electricity market more friendly to corporate buyers. The IEEJ team interviewed various stakeholders, including renewable energy developers, electricity retailers, consumer companies, industry associations, as well as experts, to gain firsthand insight into the issues often raised.

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[8] BloombergNEF, (January 31, 2022) "Corporate Clean Energy Buying Tops 30GW Mark in Record Year", https://about.bnef.com/blog/corporate-clean-energy-buying-tops-30gw-mark-in-record-year/)

[9] capacity as of September 2021: 84GW

[10] RE100, (2020) "Growing renewable power: companies seizing leadership opportunities (RE100 Annual Progress and Insights Report 2020)", https://www.there100.org/growing-renewable-power-companies-seizing-leadership-opportunities

Chapter 2. Corporate renewable electricity procurement in Japan

As mentioned above, Japan is one of the most challenging countries in the world for companies converting to renewable electricity. High cost and limited options are the two biggest barriers to renewable electricity procurement in Japan, according to RE100 companies.

2.1. Issues with high cost and availability of renewable electricity

2.1.1 High cost

Data from the International Renewable Energy Agency (IRENA) reveals that the total installed cost of Japan's utility-scale solar PV is relatively higher than that of other countries (**Figure 1**).[11] In particular, Japan's installation costs, including inspection, electrical installation, and mechanical installation, occupy large portions of the total cost. Since Japan is prone to natural disasters such as earthquakes and typhoons, solar PV panels and equipment need to be disaster-resistant. Furthermore, solar power generation systems ten to be installed on the slope of mountainous areas due to limitations in suitable land. These factors add to the development costs.

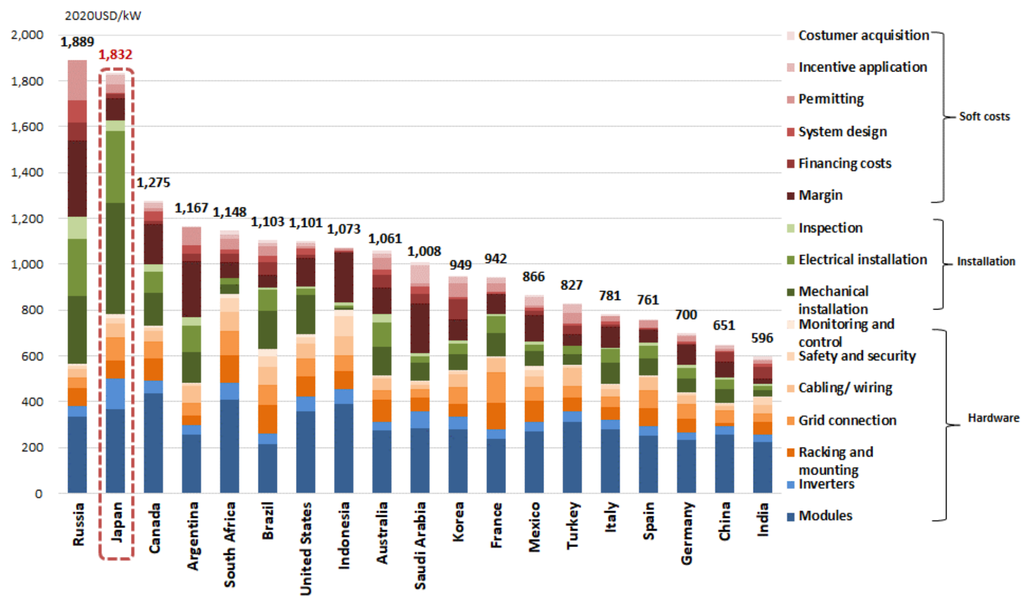

FIGURE 1. UTILITY-SCALE SOLAR PV TOTAL INSTALLED COSTS IN 2020

Source: compiled by authors based on IRENA (2021)

[11] IRENA, (2021) *Renewable Power Generation Costs in 2020*. International Renewable Energy Agency: Abu Dhabi.

Figure 2 presents weighted-average total installed costs for onshore wind in major countries. While other countries have experienced gradual cost reductions, Japan has struggled in following the front-runners and the cost difference between Japan and other countries became even larger in 2020. This situation is mainly explained by the lack of competition and economy of scale in Japan's wind industry.

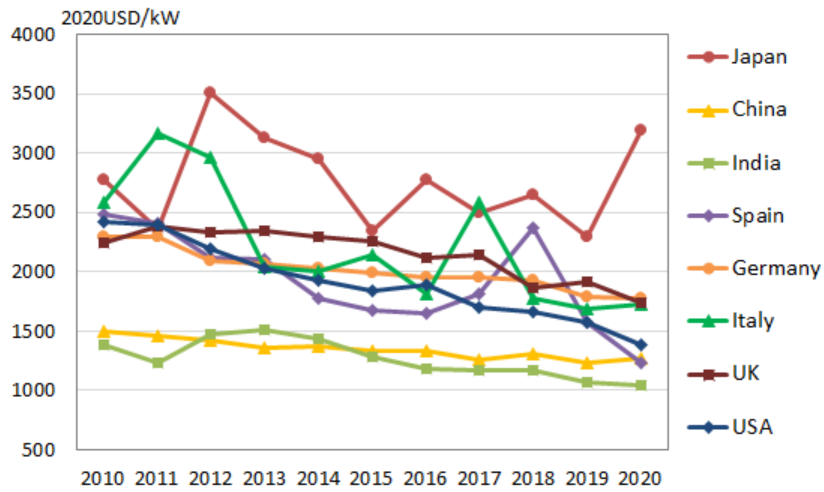

FIGURE 2. WEIGHTED-AVERAGE TOTAL INSTALLED COSTS FOR ONSHORE WIND [12]

Source: compiled by authors based on IRENA (2021)

The developers interview referred to land use as one of the major reasons behind high renewable power generation costs. According to the cost breakdown compiled by the Calculation Committee for Procurement Prices, the "land formation" cost included in the CAPEX for solar PV projects (larger than 10kW) has not decreased, but has rather increased over past years.

[12] The average cost is substantially affected by a high-cost project in a market like Japan where the number of wind power projects is much smaller than those of the solar PV, which may have caused some spikes seen in the cost trend.

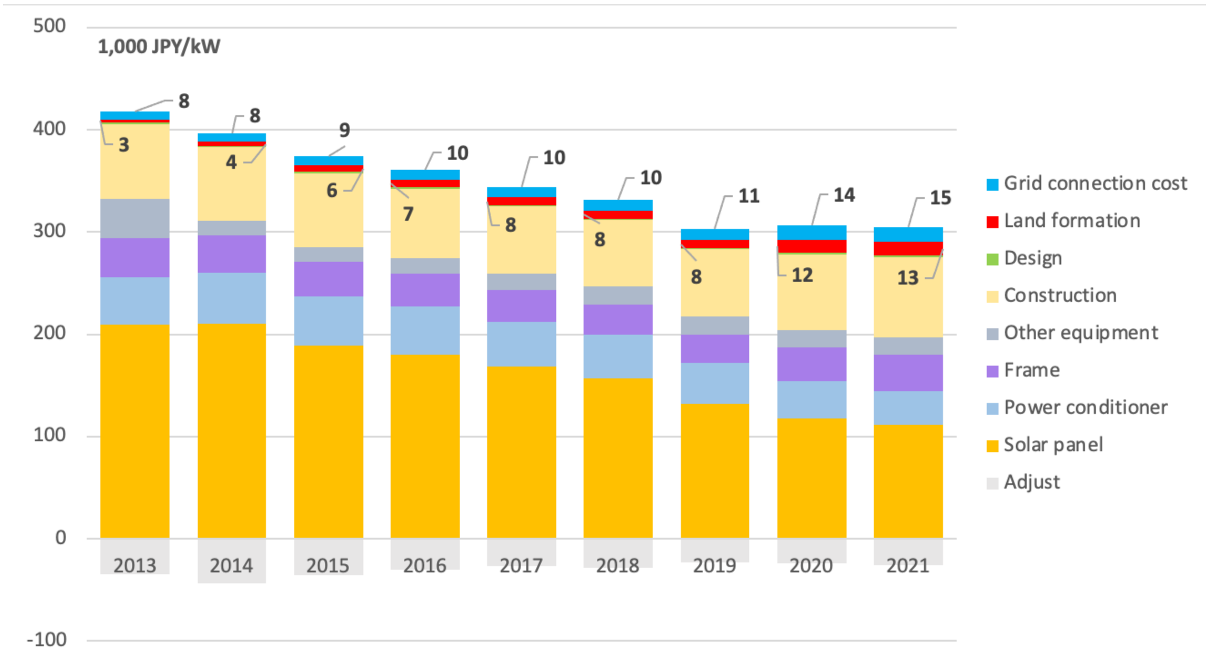

FIGURE 3. TRENDS IN CAPEX BREAKDOWN FOR SOLAR PV PROJECTS LARGER THAN 10KW

Source: Calculation Committee for Procurement Prices[13]

Flat land is not available in abundance in Japan compared to other countries. Existing projects have already occupied most of the flat land that can be acquired at a low cost and used for renewable power plant development. Geographic constraint is not the only reason behind the land use issue. The acquisition of land suitable for renewable projects can be time-consuming because of complex land use approval procedures, and more so when property rights are unclear. Moreover, there are growing concerns regarding the safety and environmental impact of renewable projects. As a result, the number of municipalities that have implemented regulations on renewable energy development has increased from 26 in FY 2016 to 134 in FY 2020 Some municipalities even limit or prohibit the installation of renewable power generation facilities in given areas. Lack of trust and cooperation from local communities can make the land acquisition process more difficult and costly.

Sometimes, acquirable land, including land that has been unused for more than two years and some industrial parks, cannot be utilized due to a lack of free grid connection capacity for new projects.

[13] Calculation Committee for Procurement Prices material, (2021) "Solar PV related issues" (73rd committee meeting on December 22, 2021), https://www.meti.go.jp/shingikai/santeii/pdf/073_01_00.pdf (Japanese only)

According to **FIGURE 3**, the grid connection cost has increased for new solar PV projects over recent years. Similar to the land constraint issue, most sites close to grid connection points are already occupied by existing power generation plants.

In Japan, although grid operators take on the construction work for grid connection, the construction cost from power generation site to substation is assumed by the power generator. If additional construction is necessary to accommodate the new generation in the local grid system, the cost will be paid by the generator or local electricity end-users depending on who will benefit from the new construction. When additional construction work is required in the high voltage transmission system (backbone transmission system), the cost will be passed on to end-users. The cap for grid construction costs that can be passed on to end-users is 41,000 JPY/kW. Costs that exceed the upper limit will be assumed by the generator (**FIGURE 4**).

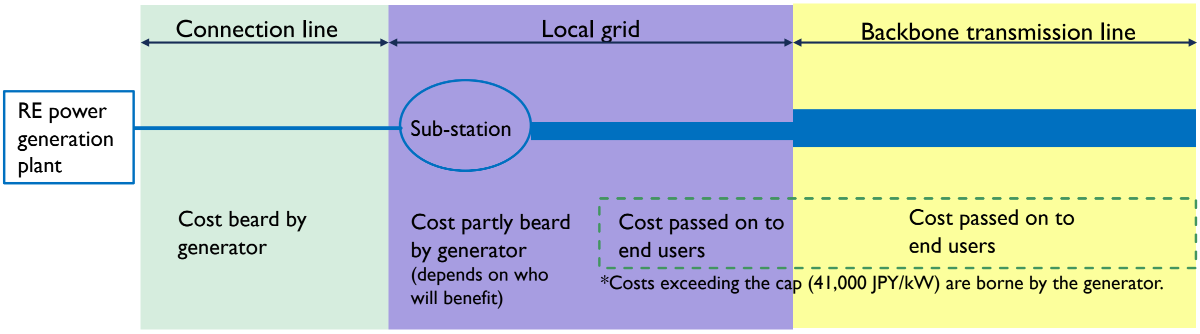

FIGURE 4 GRID CONNECTION COST ALLOCATION IN JAPAN

Source: compiled by authors based on METI[14]

Land and grid connection constraints can have indirect impact on renewable power generation cost. Because of land and grid constraints, and sometimes logistic constraints for onshore wind, it is difficult to develop large-scale renewable projects, especially solar PV and onshore wind projects, in Japan. As a result, the benefit of economic of scale is limited in Japan.

The developers interviewed also mentioned the following reasons for the high CAPEX of renewable projects high: time-consuming inspection and Environmental Impact Assessment (EIA) processes (especially for onshore wind projects), local community acceptance, etc. In terms of OPEX, the requirements regarding Chief Electrical Engineers hinder renewable energy development. Currently, power generation facilities exceeding capacities of 5MW and 50kV are required to appoint high-level Chief Electrical Engineers. However, there is a serious shortage of

[14] METI website (Grid Connection), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/grid/01_setsuzoku.html#setsuzoku01 (Japanese only)

eligible Chief Electrical Engineers. Furthermore, their payroll tends to be 2~3 times that of Class III Chief Electrical Engineers. Rule revisions[15] to solve this issue are ongoing.

High renewable power generation costs are passed on to electricity end users. Under the FIT scheme, the expansion of renewable power generation results in an increase of the total cost of purchasing power sourced from renewables. In other words, the burden on consumers who are obliged to pay the FIT surcharge increases in tandem with the promotion of the FIT scheme. The government estimates that in FY 2022, the total cost of purchasing renewable electricity will amount to JPY 4.2 trillion (USD 33 billion[16]), of which the total amount of surcharge will be JPY 2.7 trillion (USD 21 billion) (**FIGURE 5**). The surcharge has continuously increased from 0.22 JPY/kWh in 2012 to 3.45 JPY/kWh in 2022. Accordingly, the monthly surcharge per household has risen from 57 JPY/household in 2012 to 897 JPY/household in 2022[17]. On average, the share of surcharge against the total electricity tariff was 12% for household users and 16% for industrial and commercial users in 2020.

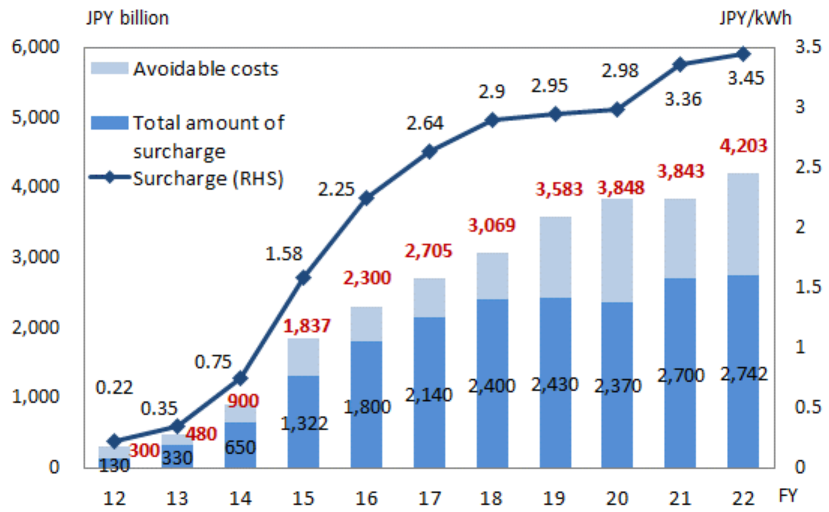

FIGURE 5 TOTAL FIT PURCHASING COST

Source: compiled by authors based on METI [18]

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[15] METI, (2022) "Rule Revision Regarding Chief Electrical Engineers "(The 10th Meeting of Working Group on Electricity Safety System on April 15, 2022), https://www.meti.go.jp/shingikai/sankoshin/hoan_shohi/denryoku_anzen/hoan_seido/pdf/010_04_00.pdf (Japanese only)

[16] 1 JPY = USD 0.0078

[17] Average electricity consumption per household is assumed at 260kWh per month.

[18] METI, (2022) "Prospective Renewable Energy Policy" (40th Mass Renewable Energy Introduction and Next-Generation Power Network Subcommittee on April 7, 2022), https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/040_01_00.pdf (Japanese only)

2.1.2 GRID CONSTRAINTS

Grid constraints are not only a reason for the high cost of renewable power generation but are also a major concern for the further deployment of renewable energy, especially variable renewable technologies, such as solar PV and wind.

Japan's grid network is regionally divided with limited capacity for interconnection between regions. The different frequency between eastern and western Japan exacerbates the problem. That is, the power grid runs on 50 Hz in the east, and 60 Hz in the west. Yet there are only four frequency converter stations capable of transferring a total of 2.1 GW. Furthermore, many regions endowed with renewable energy sources, such as Kyushu and Hokkaido, and some offshore wind sites are found in distant locations from the electricity demand center, such as the Tokyo and Osaka areas.

The current rule for intraregional grid balancing allows renewable power generation output to be curtailed after the output reduction of thermal power plants, the utilization of pumped hydro, and inter-regional adjustment. The curtailment of variable renewable electricity had been limited as it was previously observed only in the Kyushu region. However, in April 2022, renewable power generation was curtailed for the first time in the Shikoku and Tohoku regions, and in May in Hokkaido. The curtailment of variable renewable electricity is likely to occur in more regions.

Now that more regions are challenged with grid capacity constraints, it will be even more challenging to further connect and accommodate new renewable projects. In Japan, renewable power plants are not granted priority for grid connection. As shown in **FIGURE 6**, if there is free grid capacity, new power generation plants will be connected by the "first come first serve" rule.

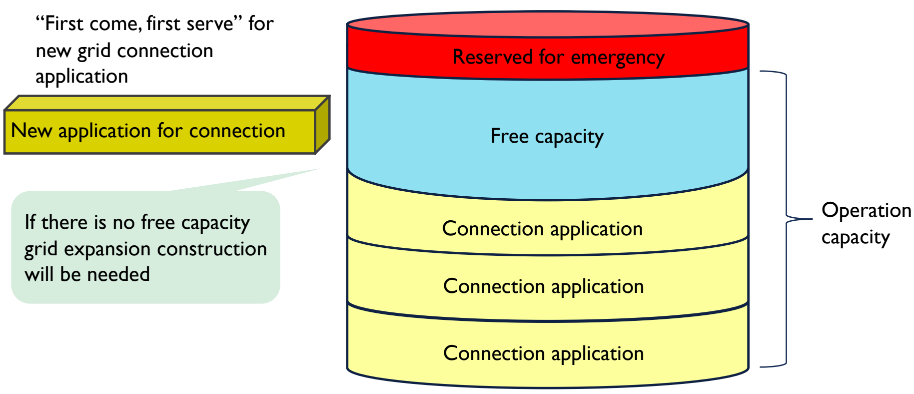

FIGURE 6. RULES FOR GRID LINE UTILIZATION

Source: depicted by authors based on METI[19]

[19] METI website (Grid Connection), https://www.enecho.meti.go.jp/category/saving_and_new/saiene/grid/01_setsuzoku.html#setsuzoku01 (Japanese only)

Grid connection constraints are a substantial issue in the further deployment of renewable energy in Japan. Therefore, a new grid expansion master plan is under development. However, grid expansion, especially backbone transmission line construction, may take more than ten years. Hence, utilizing the existing grid system is of significant importance in achieving the 2030 renewable energy target. One such measure is the “non-firm” connection rule. Under the “non-firm” connection rule, a new power generation plant can be connected to the grid even if there is no free grid capacity, on condition that its output will be first in line to be curtailed without compensation in the event of grid congestion. The “non-firm” connection mechanism was applied in January 2021 high voltage transmission lines across Japan with no free capacity. However, since April 2022, the “non-firm” connection rule is applied to all high-voltage transmission lines nationwide regardless of the availability of free capacity for new connections. As of 2021, applications for “non-firm” connection have reached a total of 3GW.[20]

Currently, the “non-firm” connection rule applies only to high-voltage transmission lines. The application of this rule to the local grid systems with lower voltage is also under consideration. TEPCO (Tokyo Electric Power Company Holdings) Power Grid is piloting the implementation of the “non-firm” connection rule to the local grid i in its service area. ”Non-firm” connection is an effective transitional solution for connecting more new renewable projects to the grid in the short-term. Yet, renewable generators share the concern that it is difficult to predict how much uncompensated curtailment will occur, and thus the impact it will have on the project cash flow.

In the long-term, the transmission capacity, especially the interconnection capacity between different regions, needs to be expanded so that a higher share of renewables can be integrated into the power grid. Taking into consideration the potential of renewable energy resources across Japan, the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) is currently formulating a cross-regional network development plan for grid enhancement.

2.2. Options for Renewable Electricity Procurement

Almost all types of renewable electricity procurement options are possible in Japan in theory. However, some options, such as, Environmental Attribute Certificates (EAC), physical corporate PPAs, virtual corporate PPAs, still face challenges in practice.

2.2.1 Environmental Attribute Certificates (EAC) and Tracking Renewable Electricity

(i) Current Status

[20] *Ibid.*

Japan currently has three different types of EACs: Green Electricity Certificates (bundled EAC), J-Credit (renewable electricity), and non-fossil fuel certificates (NFCs). They have been developed in different contexts, and thus bear different characteristics, as provided in **TABLETable** 1.

TABLE 1. COMPARISON OF EACS IN JAPAN

	J-Credit (from renewables)	Green Electricity Certificates	FIT NFCs	Non-FIT NFCs (renewable)
Year started	2001	2013	2018	2020
Target facilities	Power generated at renewable power facilities for self-consumption	Power generated at renewable power facilities for self-consumption	Surplus grid power generated at FIT power generation facilities	Surplus grid power generated at non-FIT power generation facilities
Renewable energy sources	Solar PV, wind, hydro, geothermal, biomass	Solar PV, wind, hydro, geothermal, biomass	Solar PV, wind, small and medium-sized hydro, geothermal, biomass	Solar PV, wind, hydro, geothermal, biomass
Issuer	METI, MOE, MAFF	Green Electricity Certificate issuer	Power generator	
Certifier	METI, MOE, MAFF	Japan Quality Assurance Organization (JQA)	METI	
Seller	Auctions held by J-Credit Scheme Secretariat; J-Credit holders or brokers (direct transactions)	Green Electricity Certificate issuer	Green Investment Promotion Organization (GIO)	Power generators
Buyer	Consumers	Consumers	Retailers, consumers	Retailers
Tracking information	Credit certification number, project number, project implementer (corporate number), location (area) of project, outline of project, type of project, target period, certified amount, amount of renewable electricity	Name of holder, serial number, amount generated, power type, generation period, certifier, issuer, date of issuance,	Facility ID, type of power generation facility, name of facility, name of owner, generation capacity, date of certification, date of commission, location of facility, allocated amount	
Amounts issued	1.07 million t-CO_2 (amount certified in 2021)	246 million kWh	around 90 billion kWh*1	around 90 billion kWh*1 (including direct transactions)
Price level (2021)	1.38 JPY/kWh	2-7 JPY/kWh	0.3 JPY/kWh	0.6 JPY/kWh

Notes:

*1 Based on FY2020 results (METI[21])

Source: Compiled by authors based on various government material

[21] METI, (2021) "Tracking FIT non-fossil fuel certificates" (Document 1 from the 33rd meeting of the Subcommittee on Mass Introduction of Renewable Energies and Next-Generation Electricity Networks, June 3, 2021), https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/033_01_00.pdf (Japanese only)

(a) Green Power Certificates

The Green Power Certificate scheme was launched in FY2001 by Japan Natural Energy Company as a voluntary initiative by private enterprises for the mass deployment of renewable energy. The Japan Quality Assurance Organization (JQA) certifies renewable power facilities and the power generated. Certificates are available for green power and green heat generated for self-consumption. Certified Green Electricity Certificates are sold by certificate issuer organizations.[22] Prices vary from 2-7 JPY/kWh, depending on the certificate issuer.[23]

FIGURE 7 shows the annual volume of Green Power Certificates issued by type of renewable energy. Biomass accounts for the majority of certificates. An increase in solar PV certificates was seen in 2020 with the addition of post-FIT residential solar power.

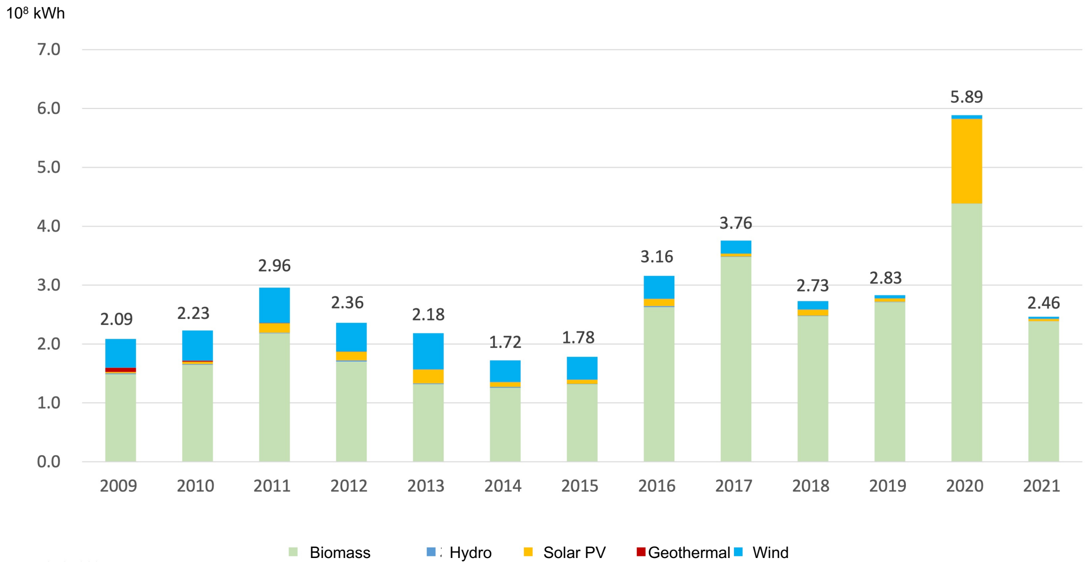

FIGURE 7. ANNUAL VOLUMES OF GREEN POWER CERTIFICATES ISSUED (2009-2021)

Source: JQA website

(b) J-Credits

The J-Credit scheme certifies the amount of carbon dioxide emissions reduced or absorbed through the self-consumption of renewable electricity, the introduction of energy efficient equipment, or forest management. The J-Credits issued for renewable electricity can be used as clean energy credits.

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[22] There are 37 issuers as of April 1, 2022.

[23] MOE, (2020) "What public organizations can do in the climate era: the challenge of achieving 100% renewables: Renewable energy procurement guidebook for public organizations", https://www.env.go.jp/earth/earth/re100_1/RE100guidebook.pdf (Japanese only)

The domestic credit system and the J-VER system were integrated in 2013 into the current J-Credit scheme, which is jointly operated by the Ministry of Economy, Trade and Industry (METI), the Ministry of the Environment (MoE), and the Ministry of Agriculture, Forestry and Fisheries (MAFF). J-Credits can be purchased 1) through intermediaries such as offset providers;2) by purchasing credits listed for sale; or 3) through auctions conducted by the J-Credit Scheme Secretariat. As shown in **FIGURE 8**, the average winning bid price of J-Credits has risen over the recent years, due to an increase in demand.

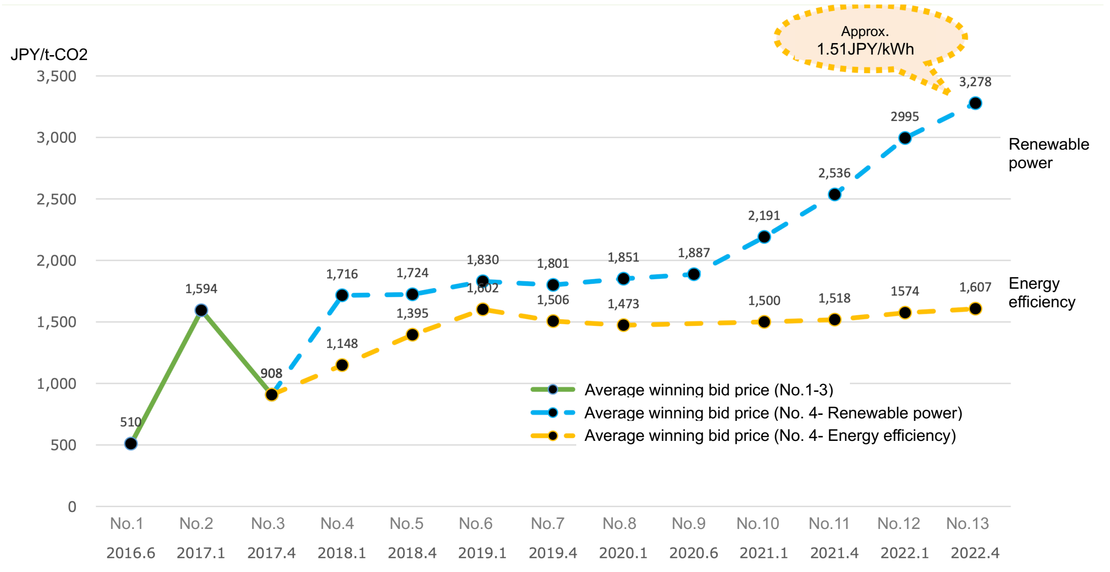

FIGURE 8. AVERAGE WINNING BID PRICE OF J-CREDITS

Source: J-Credit Scheme website[24]

(c) Non-fossil Fuel Certificates

Non-fossil Fuel Certificates (NFC) account for the majority of EACs currently issued in Japan[25].

This scheme was originally launched in 2018 for FIT electricity with two aims. First, having the "environmental value" of FIT electricity purchased by retail electricity suppliers seeking to sell products bearing that value was expected to reduce the costs shouldered by the general public (consumers) in the form of FIT surcharges. Second, NFCs could be used as a means for electricity retailers to comply with the 2030 target of procuring at least 44% of their supply from non-fossil fuel electricity including renewable energy under the Act on Sophisticated Methods of Energy Supply Structures (hereafter “Sophisticated Act”; enacted in 2009).

[24] https://japancredit.go.jp

[25] It should be noted that as indicated in Table 1, only an estimate is available for direct transactions; and therefore, a precise percentage of NFC in total traded clean energy credits cannot be given.

In 2020, the scheme was expanded to include non-FIT non-fossil fuel sources, including nuclear power, thus dividing NFCs into FIT NFCs, non-FIT NFCs (with renewable attributes[26]) and non-FIT NFCs (with no renewable attributes[27]). In August 2021, further reform divided the NFC market into the Renewable Value Trading Market covering FIT NFCs and the Sophisticated Act Compliance Market for non-FIT NFCs, thus excluding FIT NFCs from means of complying with the Sophisticated Act.

As of the November 2021 auctions, consumers and brokers are allowed to participate in the FIT NFC market. This, along with the increased amount of trackable NFCs available, has led to a significant increase in the amount of credits contracted. Direct transactions between power generators and consumers have been permitted for non-FIT NFCs (for certain projects[28]), on condition that they will conclude a corporate PPA. Transaction costs, including the fees required for membership in the Japan Electric Power Exchange (JEPX)[29], can be a challenge.

The minimum price of NFCs was brought down by 1 JPY/kWh to 0.3 JPY/kWh with the launch of the Renewable Value Trading Market in November 2021 with an aim to make the price of renewable power procurement closer to international levels. Yet, there remains an oversupply of credits in both markets (**TABLE 2**). It should also be noted that the May 2022 auctions ended with a 98.8% decrease in transactions for non-FIT NFCs, perhaps due to the impact of soaring wholesale electricity prices recently experienced by retailers, as well as an increase in direct transactions.[30]

TABLE 2. RECENT AUCTION RESULTS FOR NFCS

	FIT NFCs					Non-FIT NFCs (renewables)					
Fiscal year	FY2020		FY2021			FY2020		FY2021			
Contract date	2/12	5/14	11/26	2/10	5/13	2/10	5/13	8/27	11/25	2/9	5/12
Price (JPY/kWh)	1.30	1.30	0.33	0.3	0.3	1.2	0.9	0.6	0.6	0.6	0.6
Contract amount	446	350	1,929	1,341	2,139	10,570	2,276	1,744	1,846	2,825	35
Supply (Mil. kWh)	-	-	55,954	83,551	108,175	11,273	3,518	3,771	11,480	15,408	16,604
Bids	-	-	1,929	1,341	2,139	15,890	6,666	3,935	1,846	2,825	35

26 Electricity from non-FIT renewable

27 Electricity from nuclear and other non-renewable non-fossil fuel electricity

28 According to an interim report on discussions on the NFC market at government committee meetings, direct transactions for eligible non-FIT NFCs can be made between renewable generators and consumers. Eligible non-FIT NFCs include:

-Non-FIT renewable projects with COD after April 2022

-Post FIT renewable projects

FIP renewables are to be eligible.

29 Exemptions apply to members only participating in the NFC market.

30 For renewable non-FIT NFCs, direct transactions accounted for around fourfold of those purchased in the market in FY2021.

(Mil. kWh)											
Tracking (Mil. kWh)	226	271	1,837	1,341	2,139	-	-	890	990	-	-

Source: Compiled by authors based on METI[31]

(d) Tracking renewable energy attributes

For Green Power Certificates and J-Credits, relevant attribute information can be found on the relative websites. In response to calls for a system to track renewable attributes that can be used to claim the use of renewable energy under international initiatives, including RE100, CDP and SBT, the Agency Natural Resources and Energy (ANRE) launched a pilot tracking scheme in 2019. As of November 2021, following a pilot period, all FIT NFCs auctioned require tracking information.

For non-FIT NFCs, a pilot tracking scheme was launched in August 2021 (**FIGURE 9**). As a result, in the August and November auctions, 0.89 billion kWh and 0.99 billion kWh, respectively, out of the 1.74 billion kWh and 1.85 billion kWh contracted had tracking information.

Later in 2022, JEPX takes over the tracking scheme, which ~~will~~ covers all types of NFCs. NFCs with renewable tracking information can be used for RE100 reporting. The tracking system is expected to be further improved and though the system is free of charge at the moment in the future fees are supposed to be charged for system usage.

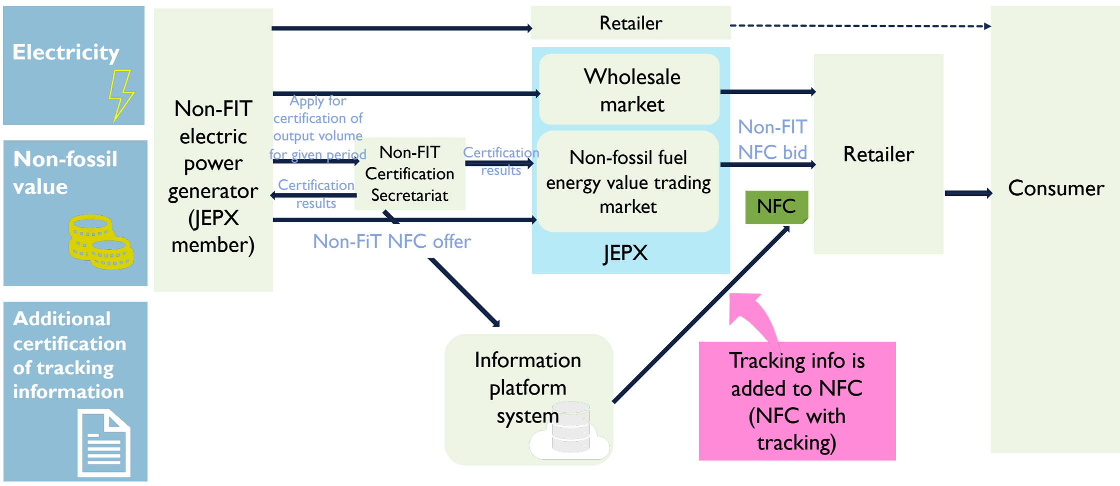

FIGURE 9. PILOT TRACKING SCHEME FOR NON-FIT NFCS

Source: Compiled by authors based on METI

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[31] ANRE, (2022) “NFC trading” (Document 6, 62nd meeting of the Working Group on System Design (Electricity and Gas Basic Policy Subcommittee, February 17, 2022), https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/062_05_00.pdf (Japanese only); ANRE (2021) “Pilot tracking scheme” (Document 3-2, 60th meeting of the Working Group on System Design, Electricity and Gas Basic Policy Subcommittee, December 22, 2022), https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/060_03_02.pdf (Japanese only)

(ii) Challenges to be overcome

While recent reforms have responded to the needs of many corporate renewable power procurers, many challenges remain.

The market mechanism has not worked as effectively as expected in the current NFC markets, as seen in the oversupply of credits. This implies that unresolved issues including not only the trackability of credits as aforementioned, but also the complexity of the market has undermined its attractiveness. For example, post-FIT power generation facility owners can choose among the Green Electricity Scheme, J-Credit Scheme or NFC scheme to acquire certification. In the longer term these different markets should be integrated at some point to create a user-friendly market for which rules for consumer participation are made clearer.

Given the approval of the 6th SEP and thus higher prospects of deployment of electricity from non-fossil fuels (including renewable energy), targets under the Sophistication Act may also be revised. A higher mandatory target share of renewables may lead to increased demand for NFCs in the future.

It should be noted that interviews with stakeholders revealed that despite dominant calls for lower credit prices, some stakeholders, including those from the real estate and manufacturing industries, as well as experts, felt that current prices did not fairly reflect the high procurement cost of renewable energy in Japan. And the tracking system that covers all NFCs is still not as sophisticated and user-friendly as that of REC in the United or GO in Europe. Therefore, some businesses that are willing to pay a premium that reasonably reflected the current situation in Japan were reluctant to purchase NFCs and felt more comfortable physically procuring renewable electricity. Given that NFCs are the most traded EACs in Japan, it is important to improve the quality of NFCs and pricing NFCs so that they fully reflect the environmental value of renewable electricity in Japan. Such improvements will make NFCs an attractive choice for both the renewable power generators seeking guaranteed revenue and for corporations seeking renewable electricity to convert to 100% renewable electricity consumption.

2.2.2 Corporate PPAs[32] /VPPAs

Although there are various options for corporations to procure renewable electricity, different methods have different impacts on renewable energy development. The “additionality” of new renewable power facilities has become a critical quality criterion for renewable electricity procurement around the world. Corporate PPAs can offer “additionality”. Although EACs continue to be the dominant method for renewable electricity procurement among many RE100 companies, corporate PPAs are becoming increasingly important (**FIGURE 10**).

[32] This report focuses on offsite corporate PPAs.

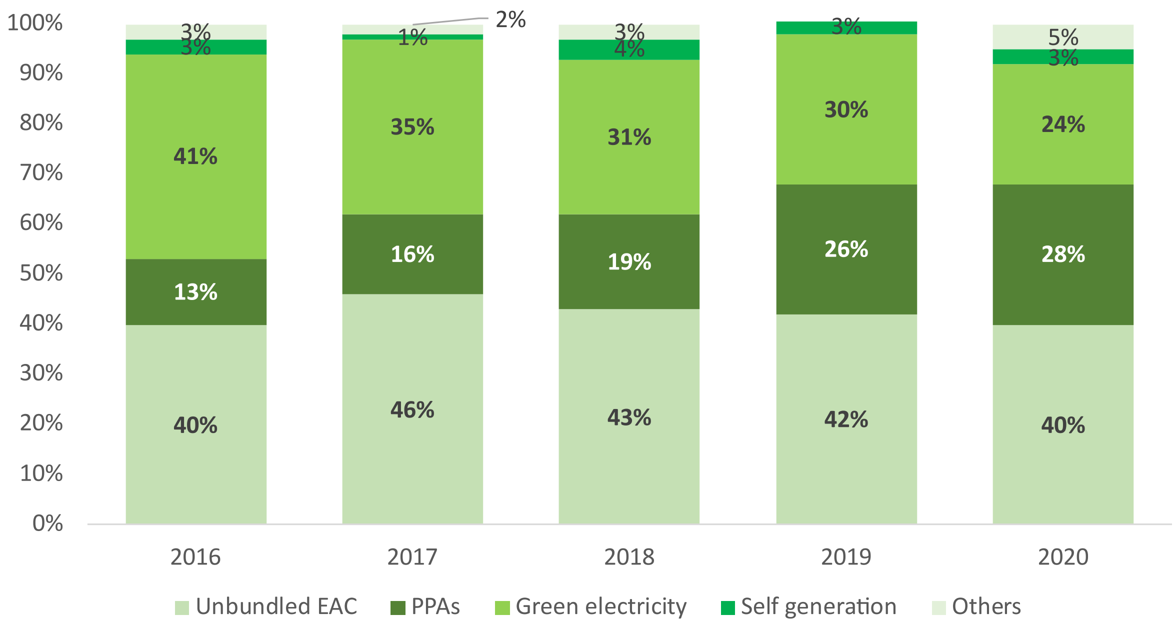

FIGURE 10 BREAKDOWN OF RE100 COMPANIES' RENEWABLE SOURCING OPTIONS

Source: RE100[33]

In a corporate PPA, a consumer company can conclude an electricity purchase agreement directly with a renewable power generator. Depending on the location of the renewable power generation site, corporate PPAs can be grouped into onsite PPAs and offsite PPAs. Globally most corporate PPAs are offsite PPAs, which can be broken down into two types: physical corporate PPAs and virtual corporate PPAs (VPPA).

In Japan, the electricity business rules were revised in 2021 so that consumer companies can conclude offsite PPAs directly with any non-FIT/FIP renewable power generator (direct offsite corporate PPA) under the self-wheeling rule. Before the rule revision, the consumer company and renewable generator had to have close business relations (for example, belonging to the same corporate group) to be able to conclude a direct offsite corporate PPA. If not, they had to sign the contract through an electricity retailer (indirect offsite corporate PPA) (**FIGURE 11**).

In Japan, non-FIT and non-FIP projects are eligible for direct offsite corporate PPAs. Consumer companies who are parties to such agreements using the self-wheeling program are exempted from FIT surcharges. Given the increasing financial burden of the FIT surcharge imposed upon commercial electricity consumers, direct offsite corporate PPAs can help consumer companies reduce their electricity bill. In a direct offsite corporate PPA that does not involve an electricity retailer, the consumer company and power generator are challenged with the burden of

[33] RE100, (2022) "RE100 annual disclosure report: Stepping up: RE100 gathers speed in challenging markets", https://www.there100.org/sites/re100/files/2022-01/RE100%202021%20Annual%20Disclosure%20Report.pdf

signing a wheeling contract, as well as the responsibility for supply-demand balancing and the imbalance penalty falls upon. However, consumer companies and power generators often do not have enough expertise on such matters. Therefore, this type of offsite corporate PPA is still not the major means of renewable electricity procurement for corporate renewable buyers at present. On the other hand, in an indirect offsite corporate PPA, consumer companies are required to pay the FIT surcharge and a premium to the retailer, but can avoid the complex grid operation-related responsibilities and contract procedures.

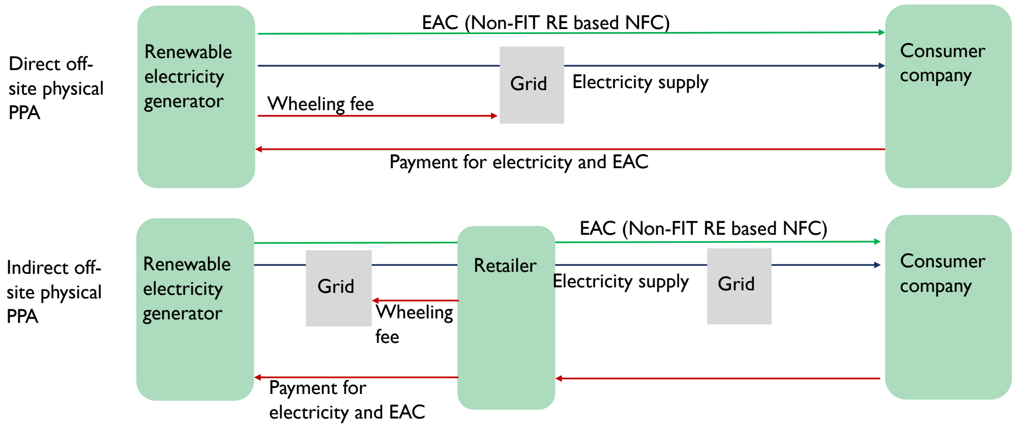

FIGURE 11 TYPES OF PHYSICAL OFF-SITE PPA IN JAPAN

Source: Depicted by authors based on MOE[34]

Virtual PPAs (VPPA) are also becoming increasingly popular. VPPAs are rapidly growing especially in the United States. The mechanism of VPPAs is shown in **FIGURE 12**. In a VPPA, the renewable power generator sells its electricity to the wholesale power market, whereas the consumer company has an electricity purchase contract with the retailer. Although the electricity is not physically delivered, the consumer company is able to purchase the total amount of renewable electricity and a corresponding amount of EACs (e.g. NFCs in the case of Japan) for a pre-negotiated price. The settlement follows the CfD (Contract for Difference) principle. When the market price is lower than the pre-negotiated VPPA price, the consumer company will pay the difference to the generator. In turn, when market price is higher, the generator is required to pay the difference to the consumer company. In a VPPA contract the EACs for the renewable electricity (NFCs in Japan) are transferred from the generator to the consumer company. Because the physical delivery of renewable electricity from the generator to the consumer company is not required in a VPPA, consumer companies can avoid wheeling charges due to the grid operator and the responsibility of supply-demand balancing. Therefore, this type of corporate PPA is much easier for consumer companies to engage in.

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[34] MOE and Mizuho Research & Technologies, (2021) “Off-site Corporate PPA” (revised in March 2022), https://www.env.go.jp/earth/off-site%20corporate.pdf (Japanese only)

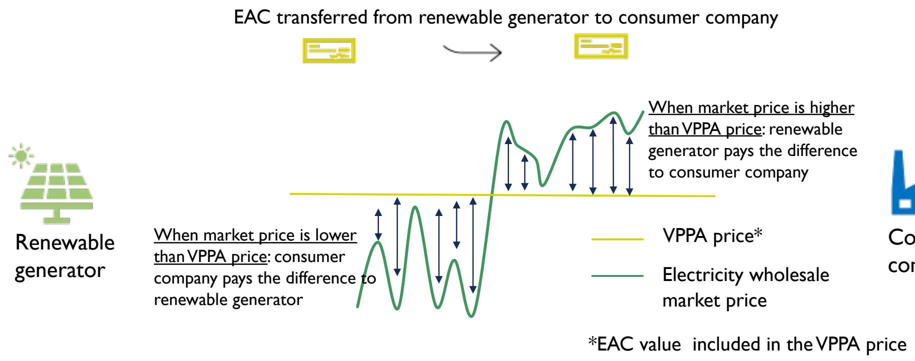

FIGURE 12. MECHANISM OF VIRTUAL PPA

Source: Depicted by authors based on MOE[35]

As with physical PPAs, there are direct and indirect VPPAs in Japan. To make the direct VPPA scheme work, the consumer company needs to be able to directly conclude a contract with the renewable electricity generator for electricity purchase and the transfer of the EACs for the renewable electricity. Electricity purchase agreements can be directly concluded between a consumer company and renewable generator in Japan by using the self-wheeling program (applicable to non-FIT renewable projects).

Although direct VPPAs are more common overseas, indirect VPPAs through an electricity retailer are also workable in Japan (**FIGURE 13**). Currently, the only type of credits that can serve as EACs for non-FIT renewable projects is the non-FIT NFC. For consumer companies concluded a VPPA contract the latest rule revision of the NFC market allows their direct non-FIT NFC transactions with renewable power generators for certain renewable projects[36].

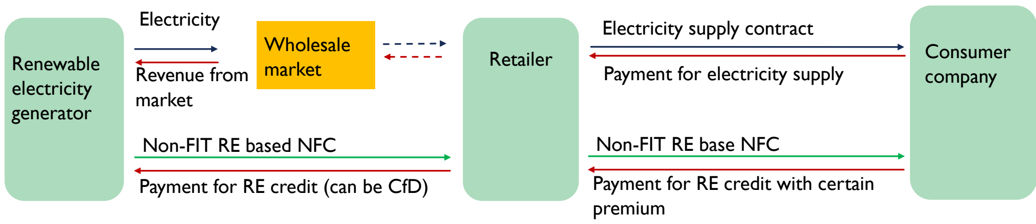

FIGURE 13. VPPA STRUCTURE IN JAPAN WITH INVOLVEMENT OF A RETAILER

Source: depicted by authors based on MOE[37] and Renewable Energy Institute[38]

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[35] *Ibid.*

[36] Eligible power plants include non-FIT renewable projects starting operation after April 2022 and post-FIT renewable power projects. FIP renewable project is also expected to be eligible.

[37] *Ibid.*

[38] Renewable Energy Institute, "RE Procurement Guidebook 5th Edition (2022 Edition)", https://www.renewable-ei.org/activities/reports/20220112.php

TABLE 3. OFFSITE CORPORATE PPA IN JAPAN

Types of Corporate PPA s		Overview
Physical PPA	Direct	• Consumer company and renewable power generator conclude direct electricity purchase contracts (non-FIT renewable power project) • Workable in Japan under the self-wheeling program
	Indirect	• Consumer company purchase renewable electricity from certain renewable power generator through an electricity retailer • Workable in Japan
VPPA	Direct	• Consumer company and renewable power generator sign virtual electricity purchase contract directly (non-FIT renewable project) • NFCs (non-FIT NFCs) from the purchased renewable electricity are directly transferred from renewable power generator to consumer company • The latest rule revision of the NFC market enables consumer companies with a VPPA contract to have direct transaction of non-FIT NFCs with renewable power generators when the renewable projects meeting certain criteria
	Indirect	• Consumer company signs virtual electricity contract with renewable power generator through an electricity retailer • NFCs (non-FIT NFCs) from the purchased renewable electricity are directly transferred from renewable power generator to consumer company through an electricity retailer • Workable in Japan

Source: Compiled by authors based on METI[39]

Under the FIT scheme, the purchase price and period of renewable electricity is predetermined by the government and this can guarantee a stable revenue for the renewable power generator. However, in a corporate PPA or VPPA, the purchase price and period are negotiated by the renewable power generator and buyer (off-taker). Therefore, whether a renewable power generator can expect a stable revenue from the project is dependent on the buyer's credibility and capacity to guarantee a long-term electricity purchase agreement. This has significant impact on the bankability of the renewable project. Many interviewees referred to buyers' credibility to be their biggest concern regarding corporate PPA/VPPA in IEEJ's interviews.

It should be noted that in Japan the renewable power generation is still subsidized under a FIT or FIP scheme. Therefore, for corporate PPAs or VPPAs to be an attractive choice fro renewable power generators, they need to promise a revenue level equivalent to that of FIT and FIP projects. Current government measures such as determining the FIT/FIP price through bidding,

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[39] METI, (2022) "Regarding Trading of Non-fossil fuel Credits" (62th Working Group on Policy Revision Electricity and Gas Basic Policy Subcommittee under the Electricity and Gas Industry Committee of the Advisory Committee),
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/062_05_00.pdf (Japanese only);
METI, (2021) "Regarding Demonstration of Renewable Tracking" (60th Working Group on Policy Revision Electricity and Gas Basic Policy Subcommittee under the Electricity and Gas Industry Committee of the Advisory Committee),
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/seido_kento/pdf/060_03_02.pdf (Japanese only)

which aim to encourage renewable projects to be independent from government subsidy, can contribute to the further growth of corporate PPA/VPPA.

Retailers are expected to play an important role in both physical and virtual corporate PPAs in Japan. Although consumer companies can directly conclude a corporate PPA with renewable power retailers, the involvement of electricity retailers in corporates PPA can help facilitate contracts, given the complexity of wheeling contracts and supply-demand balancing. However, concerns have been raised that only a limited number of retailers possess the expertise and know-how (for example, on supply-demand balancing) needed for concluding a corporate PPA/VPPA contract.

CHAPTER 3. POLICY RECOMMENDATIONS

(1) Accelerate the implementation of local decarbonization initiatives and collect information on land ownership and required conditions for land acquirement approval during the wide area zoning process.

Land constraints are one of the most significant problems pertaining to Japan's renewable energy development. The limited availability of optimal sites affects not only renewable power generation costs but also the future potential of renewable power development. The government is well aware of this issue and several government ministries have already taken measures to address it. In a national land planning committee meeting[40], The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is leading discussions on new national land planning towards achieving carbon neutrality. Securing enough land to facilitate renewable project development is one of the most important discussion points of the committee meeting. Outcomes will be reflected in the National Land Use Plan. This MLIT-led ongoing discussion on land use planning is also linked to the local decarbonization promotion initiative led by the Ministry of the Environment (MOE).

In the amended Act on Promotion of Global Warming Countermeasures, MOE reinforced the promotion of local government decarbonization initiatives. The local decarbonization initiative comprises two important elements: 1) the local renewable development target; and 2) the local decarbonization zone. MOE also established a committee[41] to promote the implementation of the local decarbonization initiative. The summary report[42] compiled by the committee outlined several important issues to be considered when setting up local decarbonization zones and acquiring permission for decarbonization projects (mostly renewable projects) in a decarbonization zone.

The committee's suggestions clarify different responsibilities expected for different stakeholders: central government, prefectural governments, municipalities, local communities, and private project developers (**FIGURE 14**). Furthermore, one of measures in local decarbonization zone is wide area zoning. According to the MOE's manual for wide area zoning, in the zoning process for renewable energy development, not only environmental regulations at the national and prefecture levels will be considered, environmental and social concerns at the municipal level also need to be taken into account. Therefore, the wide area zoning can be expected to help streamline

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[40] MILT, (2022) 6th Planning Committee meeting under the National Land Development Council, https://www.mlit.go.jp/policy/shingikai/kokudoseisaku01_sg_000275.html

[41] Council for Implementing the Amended Act on Promoting Global Warming Countermeasures toward Local Decarbonization

[42] MOE, (2021) "Summary Report of the Council for Implementing the Amended Act on Promoting Global Warming Countermeasures toward Local Decarbonization", https://www.env.go.jp/policy/council/51ontai-sekou/ref_1-1-1.pdf (Japanese only)

the permission procedures such as the Environmental Impact Assessment (EIA) for renewable project development.

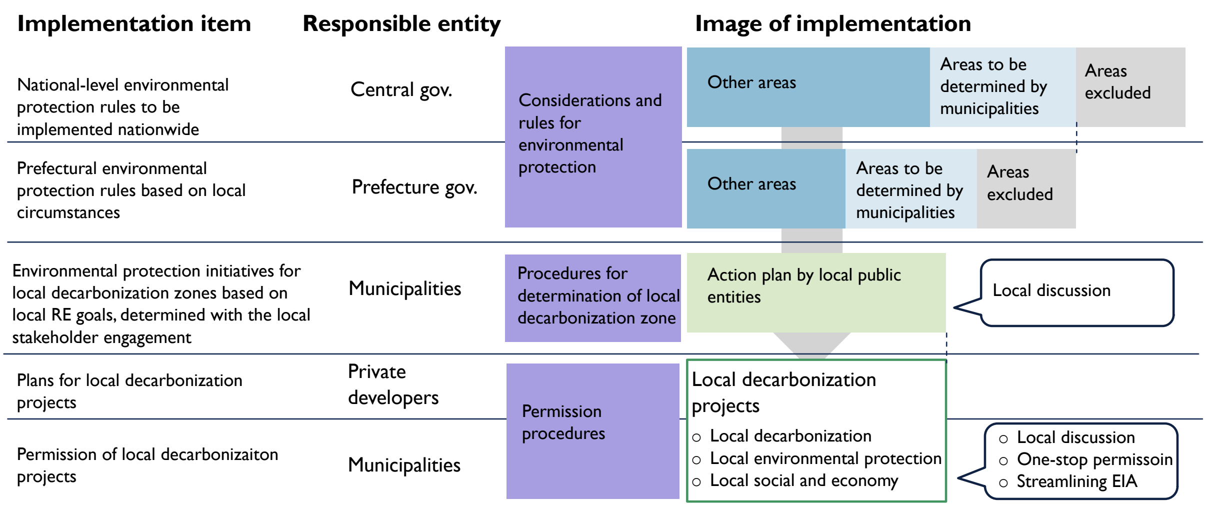

FIGURE 14. PROCEDURES FOR LOCAL DECARBONIZATION ZONE

Source: compiled by authors based on MOE[43]

The long duration of the EIA process is often referred to as one of the factors leading to high generation costs, especially for wind power. A shortened EIA process can not only contribute to lowering renewable development costs but also accelerating renewable power development. Japanese EIA procedures require the participation of the general public and approval from the prefectural government at various stages. (**FIGURE 15**). This time-consuming requirement can be streamlined in the case of wide area zoning, where the local government and local communities have already participated in the zone selection process.

[43] *Ibid.*

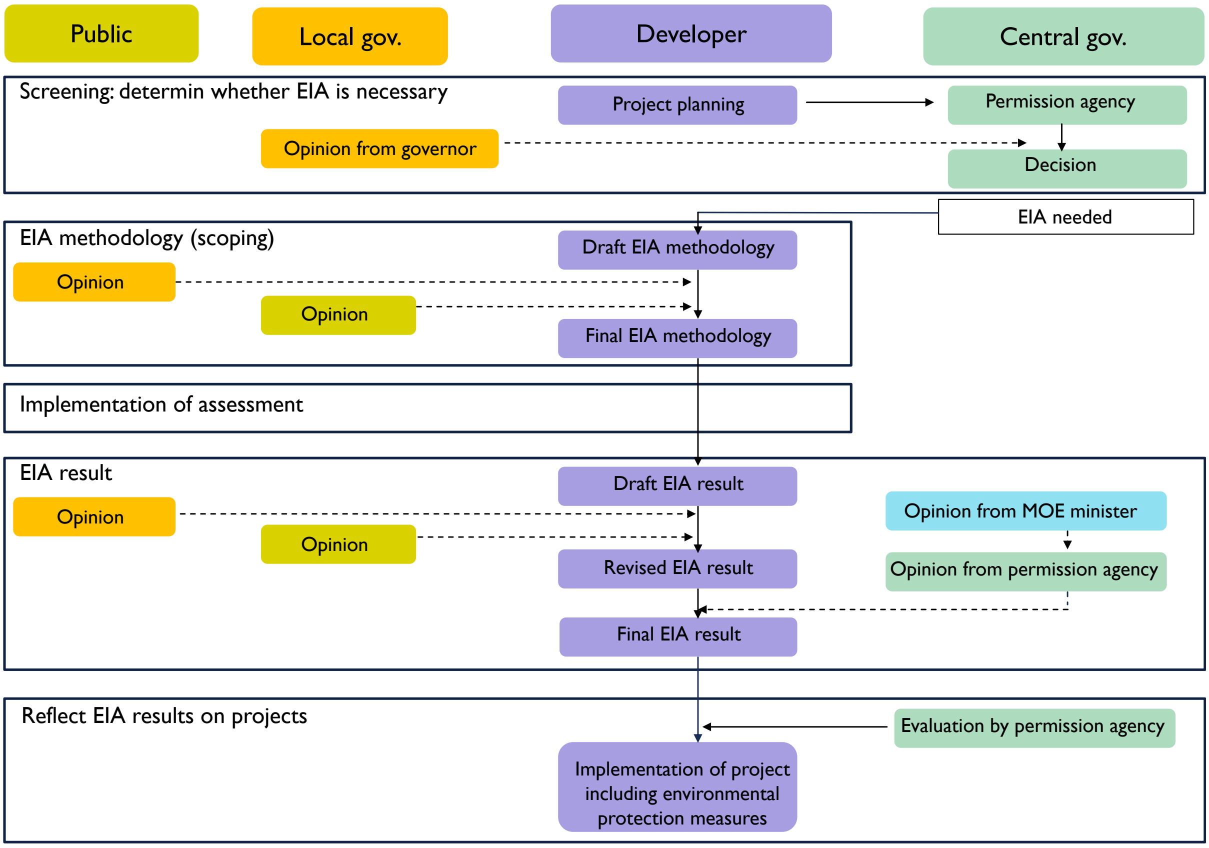

FIGURE 15. ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES IN JAPAN

Source: https://www.cas.go.jp/jp/seisaku/jouhouwg/hyoka/dai1/sankou6.pdf

The implementation of wide area zoning can help speed-up the development process of renewable energy projects. However, even though in the zoning process the environmental and social matters will be considered, there is little mention of land utilization issues in the zoning manual. Unclear land ownership and complicated and time-consuming land use approval process are sited to be one of the major issues hindering renewable development and resulting in high renewable development cost. Therefore, during the wide area zoning process, information collection regarding land ownership and providing the information that can be disclosed to renewable developers can help addressing the land acquirement difficulties in the renewable project development process.

(2) Improve grid integration condition for renewable projects

Grid connection and grid utilization need to be more predicable to encourage investment in renewable projects. Measures for accommodating more renewable electricity in the grid, such as grid expansion, and consumer-side renewable electricity solutions will also be needed in the future.

Accelerate improvement of data disclosure and data management rules to enhance "predictability": "Predictability" was the main concern among interviewees in terms of grid and electricity market issues. For example, new renewable power plants connected to the grid under the "non-firm" connection rule are subject to curtailment without compensation when grid congestion occurs. Interviewees were concerned that unpredictable curtailment may affect a renewable project's bankability.

From April 2022, most newly approved renewable projects will be covered by the FIP program, under which the renewable electricity purchasing price is linked to the electricity wholesale market price. Therefore, renewable power developers will face risks associated with market price volatility. Furthermore, more energy storage facilities such as batteries will be needed to accommodate more variable renewable power capacities. Market participants interviewed pointed out that the predictability of the market price, especially the price difference between different hours of the day, is key to the economic viability of energy storage facilities.

To improve the predictability of grid operations and the market price, data regarding power generation plants and the grid operation status need to be properly disclosed to electricity market participants. It is important for the government to accelerate the process of establishing data disclosure and data management rules for the electric power system. Data disclosure and management are also key to the digitalization of the electric power system. A proper database design can also simplify energy-related processes. For example, in Germany, all electricity and gas market participants (plant operators, network operators, and traders) are required to register with the Market Master Data Register (MaStR). Plant information, including the name, address, location, technology, performance value, is registered with MaStR and made available to the public.[44] With such information, one can assess the total capacity of power connected to the grid in a certain area and make a rough evaluation of grid congestion conditions.

Formulate inter-regional grid expansion and new grid utilization rules: In the longer term, the increased accommodation of renewable energy in the grid will indispensably require inter-regional transmission line expansion. An inter-regional grid expansion plan (Master Plan) is currently being developed under the leadership of OCCTO. At the same time, new grid utilization rules that incorporate the environment benefits of renewable electricity are also necessary. Several formulations of grid utilization and grid congestion management rules are currently under consideration (**FIGURE 16**). To make sure that grid constraints do not delay future renewable energy development, it is desirable to speed-up the future grid utilization rule making process.

[44] There is also some other registered information that is confidential

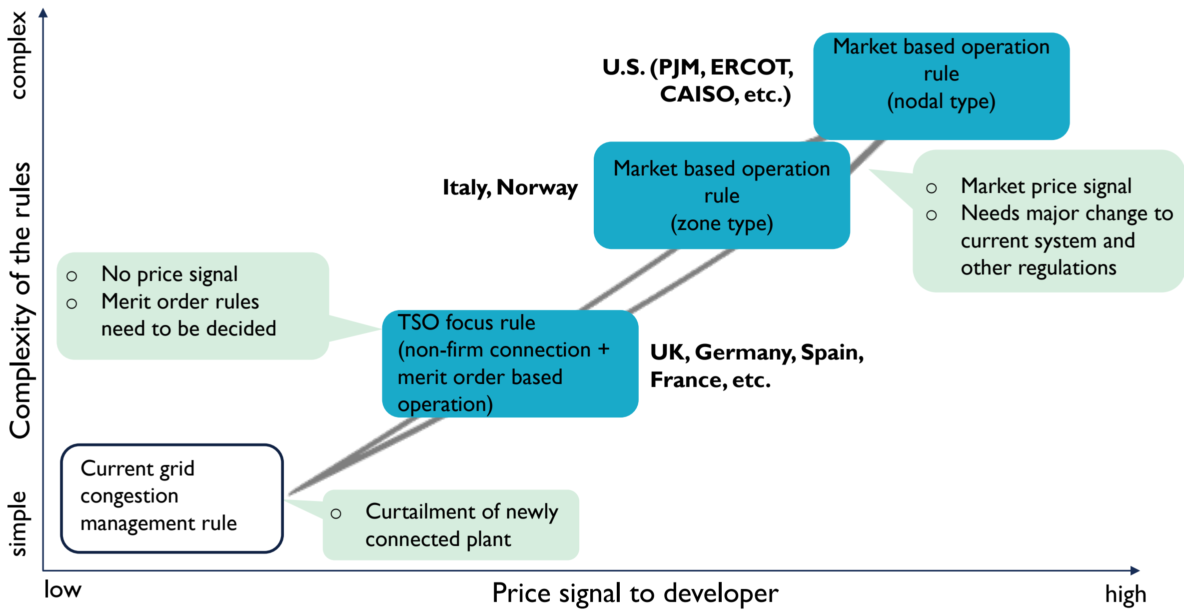

FIGURE 16 RULES UNDER CONSIDERATION FOR FUTURE GRID CONGESTION MANAGEMENT

Source: OCCTO[45]

(3) Develop a user-friendly NFC market and improve the renewable tracking system

Direct consumer access to renewable NFCs and tracking renewable electricity are key elements of encouraging corporate renewable electricity procurement in Japan. In response to strong calls for revision from consumer companies, the government is working on reforming NFC market rules and further improving a renewable tracking scheme applicable to all renewable projects. There are several factors that need to be carefully considered in the process:

User friendliness: One of the drivers of NFC market rule revision is increasing consumer companies' needs for procuring renewable electricity. Hence, it is important to design rules that are user-friendly for consumer companies. Under current NFC market rules, the effective period of NFCs terminates at the end of June, regardless of the timing of NFC acquirement. Given the reporting timeframe for RE100 companies, for example, revising the current NFC effective period to one year after the generation period of the NFC[46], would allow more flexibility for reporting by consumer companies. Furthermore, companies have different requirements for renewable electricity sourcing. Some companies emphasize "additionality" in their renewable electricity procurement, while others have special requirements for the location of renewable electricity

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[45] OCCTO, (2022) "Master Plan (Long-term Policy for Cross-regional Grid) Main Points" (17th Meeting of Council of Cross-regional Grid Master Plan and Grid Utilization Rules), https://www.occto.or.jp/iinkai/masutapuran/2022/files/masuta_17_01_01.pdf (Japanese only)

[46] The effective period rule for Guarantee of Origin in Germany

production. The renewable tracking system should be designed to provide renewable electricity buyers with clear and sufficient information to check whether the electricity or NFC they purchase will meet their corporate standards.

Compatibility with the latest international standards: It is important that the renewable NFCs managed by the tracking scheme for renewable power meet RE100 criteria. It should be noted that RE100 criteria are evolving and the latest international trends should be taken into account when improving the domestic renewable tracking system.

Compatibility with other regulations: in the future to make the renewable certificate management and trading system be as developed as REC (Renewable Energy Certificate) in the United States or the GO (Guarantee of Origin) system in Europe, data from not only the renewable developers but also other stakeholders such as grid operators and retailers will be necessary. Therefore, further improvement of the renewable tracking system and NFC market is not only about renewable energy system. The relevant rules regarding the renewable tracking system and NFC market need to comply with the rules for data disclosure and management of the whole electricity system.

(4) Scale up the corporate PPA/VPPA market. Rapidly disclose relevant market regulation revision information companies and develop government guidance for corporate PPA/VPPAs.

Japan's corporate PPA and VPPA market is still at the nascent stage. To scale up the market, information on regulation and rule revisions need to be rapidly disclosed to companies. For example, as stated in Chapter 2, to be able to execute a direct VPPA, the consumer will need to have direct access to non-FIT NFCs. In response to the needs of consumer companies, the latest rule revision of the NFC market enables consumer companies with a VPPA contract to have direct transaction of non-FIT NFCs with renewable power generators when the renewable projects meeting certain criteria. Detailed information of such market rule revision should be disclosed and reached to the companies rapidly.

Meanwhile, challenges pertaining to corporate procurement of renewable electricity can also be attributed in part to the complexity and uncertainty of market rules. As aforementioned, the Japanese renewable electricity market is undergoing change in many dimensions: revisions are being considered for NFC market rules, a renewable tracking scheme is being developed, the renewable support mechanism is shifting from a FIT scheme to a FIP scheme, and new electricity grid operation rules are under discussion. The current market situation can be overwhelming for many stakeholders, including developers, retailers, consumer companies, financial institutions, and local governments, involved in corporate renewable electricity procurement, In addition to the uncertainties of the market and regulations, the corporate PPA/VPPA business model is still new to many stakeholders. Therefore, although corporate PPA/VPPA schemes can be utilized in theory, the lack of proven successful cases and the confusion around market regulations make it difficult for companies to make business decisions to harness corporate PPA/VPPA schemes. At the early stages of market development, access to government guidance can help stakeholders to gain a better understanding of how corporate PPA/VPPA schemes work in Japan, as well as what roles and responsibilities are expected of them. Some effective measures include identifying the relevant authorities from whom to seek guidance and providing clear public guidance on the legal requirements that a VPPA needs to satisfy in order not to be treated as a derivative.

Not only general guidance but also guidance on specific issues can also be useful. For example, many interviewees mentioned that guaranteeing long-term electricity purchases as a major obstacle in developing corporate PPA/VPPAs. Under the FIT scheme, a long-term electricity purchase price is guaranteed by the government; and therefore, banks can be more confident in financing the renewable project. In contrast, in a corporate PPA/VPPA, the off-taker is a private company, whose credibility is an important factor in assessing the bankability of the renewable project. The lack of expertise in evaluating emerging schemes can also make banks hesitant in financing corporate PPAs/VPPAs for renewable electricity. Therefore, government guidance on evaluating the bankability of corporate PPAs/VPPAs can facilitate the financing of such renewable projects.

(5) Introduce consumer relief measures to reduce FIT surcharge burden.

As mentioned in Chapter 2, high renewable power generation costs are passed on to electricity consumers in the form of the FIT surcharge. The increasing burden of the FIT surcharge shouldered by end users is a critical issue in Japan's renewable energy development. Given that the FIT purchase period is 10 to 20 years (depending on the type of technology), the current FIT surcharge is rooted in existing highly priced FIT projects that were approved in the initial years of the FIT scheme. In the longer term, to reduce FIT surcharge further bringing down renewable power generation cost is necessary. And to promote the cost reduction, Japan has introduced auctions and has moved from FIT to market mechanism based FIP mechanism. However, even under the FIP mechanism, the premium paid to renewable developers is passed on to consumers, and thus there are still surcharge to consumers (surcharge caused by FIP).

Corporate PPAs for non-subsidized (non-FIT/FIP) renewable projects (corporate PPA with non-FIT/FIP renewable projects) can help encourage renewable energy development without increasing the FIT surcharge. However, newly contracted corporate PPAs cannot contribute to the reduction of the FIT surcharge caused by projects already approved.

Other countries are also faced with the challenge of increasing burden of FIT/FIP surcharges for consumers. One example of addressing the issue is to make the FIT/FIP surcharge be shouldered not only by electricity consumers but by all the energy consumers. In other words, consumers from other sectors also shoulder the cost of supporting renewable electricity development. Germany reduced its FIT surcharge (renewable energy levy) by 43%, from 6.5 eurocent/kWh to 3.72 eurocent/kWh as of January 2022. Alternately, the cost of supporting renewable energy will be partly financed using revenue from the carbon price on heating and transport fuels. The German government has also abolished consumer's FIT surcharge as of July 1, 2022 and has instead set up a climate fund to support renewable energy. The fund will be financed by revenue from **carbon pricing** and the **government budget**. The consumer relief measures in Germany offer a good example for Japan to consider when addressing its growing FIT surcharge issue.

APPENDIX RENEWABLE ENERGY DEVELOPMENT IN JAPAN

The current 6th SEP ensures the utilization of renewable energy as the major power source; and therefore, renewable energy will be adopted to the maximum possible level.[47] The SEP seeks to reduce the financial burden shouldered by consumers and to facilitate the social acceptance of renewable energy by local communities in the long term.

The 6th SEP sets an ambitious target for renewable energy with a share of 36-38% in power generation mix by 2030 (**TABLE A1**). The 2030 renewable energy target consists of solar at 14-16%, wind at 5%, geothermal at 1%, hydropower at 11%, and biomass at 5%. Among others, the solar power is planned to increase the share by more than double compared to the previous SEP. In terms of the capacity, the 6th SEP requires 147-161GW of renewables' capacity to achieve the target.

TABLE A1. THE 2030 RENEWABLE ENERGY TARGET IN POWER GENERATION

	The 5th SEP	The 6th SEP	
		Share	Capacity
Renewables in power generation mix	22-24% (237TWh – 251TWh)	36-38% (336TWh – 353TWh)	147-161GW
Solar	7.0%	14 – 16%	104 – 118GW
Wind	1.7%	5%	Onshore 17.9GW Offshore 5.7GW
Hydro	8.8 – 9.2%	11%	50.7GW
Geothermal	1.0 – 1.1%	1%	1.5GW
Biomass	3.7 – 4.6%	5%	8.0GW

Source: compiled by authors based on METI (2022)[48]

A.1 CURRENT STATUS AND ISSUES OF RENEWABLE ENERGY DEVELOPMENT IN JAPAN

(i) Current Status

One of the features of renewable energy development in Japan is that the solar PV has increased significantly compared to wind power. Japan's renewable power generation capacity reached 134 GW in 2021 (**FIGURE A1**). Solar PV generation capacity accounts for 56%, followed

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47 METI, (2021) "Outline of Strategic Energy Plan" https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/6th_outline.pdf (Japanese only)

48 METI, (2022) "Prospective Renewable Energy Policy" (40th Mass Renewable Energy Introduction and Next-Generation Power Network Subcommittee on April 7, 2022), https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/040_01_00.pdf (Japanese only)

by hydro with a share of 37%. The feed-in tariff (FIT) scheme implemented in 2012 especially contributed to boosting solar power, which increased about elevenfold from 6.6GW in 2012 to 74.2 GW in 2021. The generation capacity of wind and biomass has expanded steadily, although each account for a share of merely about 3% of the total renewable power generation capacity. Hydro and geothermal power have not shown notable growth partly because they require a long time and high costs to realize a project.

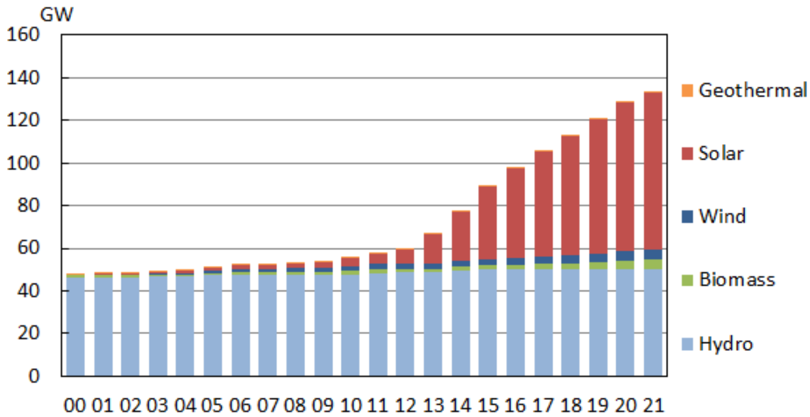


FIGURE A1 RENEWABLE POWER GENERATION CAPACITY IN JAPAN

Source: compiled by authors based on IRENA (2022)[49]

FIGURE A2 shows the current renewable power generation capacity and the 2030 target specified in the 6th SEP. The current capacity includes facilities in operation before and after the FIT scheme, and the non-operating facilities approved under the FIT scheme as of September 2021. The overall achievement rate of 55% indicates that Japan needs to ramp up the renewable energy development towards the 2030 target. In specific, an additional operating capacity of 40-54GW for solar and 13GW for onshore wind will be necessary to achieve the target.

[49] International Renewable Energy Agency (IRENA) (2022). *Renewable Capacity Statistics 2022*. International Renewable Energy Agency: Abu Dhabi.

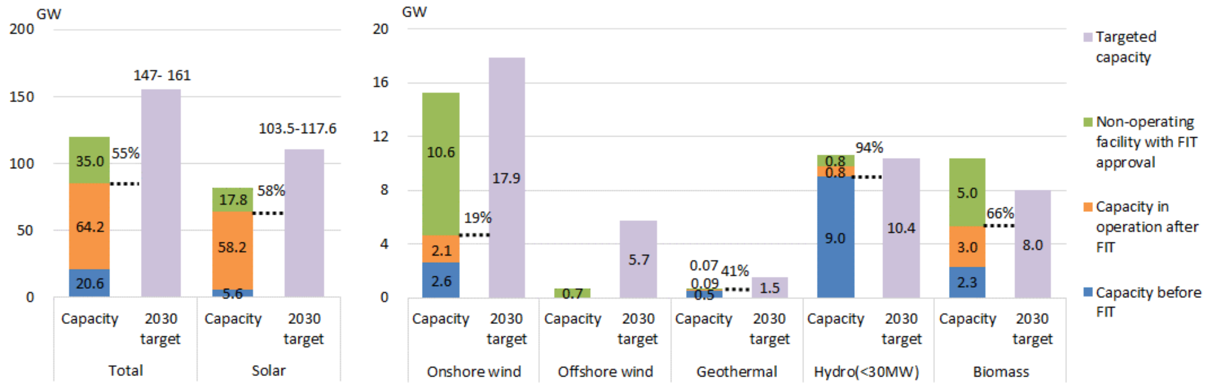


FIGURE A2. CURRENT RENEWABLE POWER GENERATION CAPACITY AND 2030 TARGET

Source: compiled by authors based on METI[50]

(ii) Issues by renewable energy source

Nevertheless, these renewable energy developments will be challenging for Japan due to several obstacles. The foremost serious issue is lack of adequate or flat land, which is found in common among the renewables. Given the fact that forestry covers 67% of Japan's total land area, the appropriate areas to be developed are getting limited as the renewable energy development is pursued further. For instance, the number of large-scale solar power projects with no less than 2MW capacity have reduced significantly in recent years. As to onshore wind power, almost half of the projects are planned in mountainous areas, which entails additional costs for extra land development and specific technology or equipment required.

An equally important subject for renewable energy development is the environmental aspect. Conflicts with local communities are often seen in the solar and onshore wind power projects. There are concerns about negative impacts on the environment and wildlife caused by the projects. It is fundamentally important to take appropriate measures to protect the environment or prevent incidents such as land sliding to help the local communities to understand and support the projects.

In addition, geothermal and biomass energy development projects need to deal with other issues, respectively. For the geothermal development, it is crucial to coordinate related regulations in place such as the Hot Springs Act and the Natural Parks Act which have restricted the progress in this field so far. The geothermal development also necessitates substantial expenses even in the initial phase to carry out geological survey and drilling tests, which imply high development risks.

In Japan, a substantial part of biomass fuel for power generation is imported wood pellets/chips and palm kernel shell (PKS). Prior to FIT approval, the sustainability of imported

[50] METI, https://www.fit-portal.go.jp/PublicInfoSummary

biomass fuels is evaluated based on a third-party certification scheme that certifies fulfillment of sustainability requirements.[51] However, some companies have their own criteria to define the sustainability of electricity from biomass. Therefore, some corporate renewable electricity buyer will choose not to purchase biomass power, even if it meets FIT sustainability requirements.

On the other hand, domestic wood biomass can be a source of sustainable biomass that can be further explored. Utilizing forest thinnings in biomass power generation can contribute to encouraging sustainable forest management and developing local employment, as well as the utilization of local resources. A system to ensure that the wood biomass supply is from sustainable forestry practices will be indispensable.

A.2 Major supporting policies

A major policy to support the renewable energy development is the feed-in tariff (FIT) scheme adopted in 2012. **TABLE A2** presents the tariff rates under the FIT scheme in Japan and they are acknowledged relatively higher at global level as illustrated in **FIGURE A3**. For instance, the tariff rates of commercial solar PV and onshore wind are set at JPY 11/kWh and JPY 16/kWh in 2022, respectively. The tariff rates for solar and onshore wind projects have gradually declined while those of geothermal, hydro, and biomass projects remained almost the same since the FIT scheme started.

The FIT Act was revised in 2017 to tackle issues such as the accumulation of non-operating facilities with FIT approval and increasing surcharge. Under the revised FIT Act, the auction system was introduced as a measure to reduce costs, which was expected to consequently relieve financial burden on consumers. In FY 2022, large-scale solar PV (250kW or above and less than 1,000kW), biomass (general wood with capacity of 10MW or above and liquid biomass), and onshore wind (50kW or above) are subject to the auction system. Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO) is designated to oversee the auction.

[51] In Japan, the Renewable on Sustainable Palm Oil (RSPO) for palm oil, and the Roundtable on Sustainable Biomaterials (RSB), the Green Gold Label (GGL), and the ISCC Japan Fit for PKS and palm trunk are recognized as the certification scheme as of FY 2022.

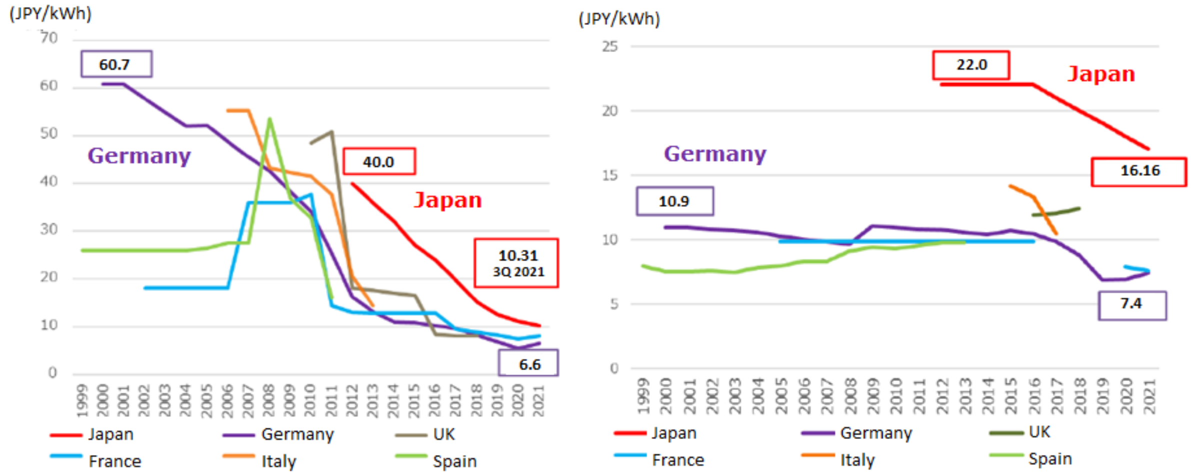
TABLE A2. FIT RATES

		Tariff rates (JPY/kWh)					Duration
Fiscal Year		2020	2021	2022	2023	2024	
Commercial solar PV	10 kW or above	auction (250kW or above)		auction (250-1,000kW)			20 years
		13(10-50kW) 12(50-250kW)	12(10-50kW) 11(50-250kW)	11(10-50kW) 10(50-250kW)	10(10-50kW) 9.5(50-250kW)		
Residential solar PV	Less than 10 kW	21	19	17	16		10 years
Wind	Onshore	18	17 (<50 kW)	16 (<50 kW)	15 (<50 kW)	14 (<50 kW)	20 years
			auction (50kW or above)				
	Offshore (fixed-bottom)	auction	32	29	auction		
	Offshore (floating)	36					
Geothermal	15,000 kW or above	26					15 years
	Less than 15,000 kW	40					
Hydro	5,000-30,000 kW	20 (5-30MW)			16 (5-30MW)		20 years
	1,000-5,000 kW	27 (1,000-5,000 kW)					
	200-1,000 kW	29 (200-1,000 kW)					
	< 200 kW	34 (< 200 kW)					
Biomass	Biogas	39			35		20 years
	Unutilized wood	40 (< 2MW)					
		32 (2MW or above)					
	General wood (e.g., imported pellets, sawmill residues, PKS)	auction (10MW or above)					
		24 (< 10MW)					
	Liquid Biomass (palm oil)	auction					
	Construction wood waste	13					
	Waste materials	17					

Note: The tariff rates for geothermal and hydro are those of new projects.

Source: compiled by authors based on METI[52]

[52] METI, https://www.enecho.meti.go.jp/category/saving_and_new/saiene/kaitori/fit_kakaku.html



Solar (2MW) Onshore wind (20MW)

FIGURE A3. PURCHASING TARIFF RATES

Note: 1€=JPY120, 1￡=JPY150

Source: compiled by authors based on METI[53]

As a part of the Act for Establishing Energy Supply Resilience which took effect in April 2022, the FIT scheme was reviewed and redesigned to make the renewable energy the major power source. A new scheme, the feed-in premium (FIP), is applied to the renewable energy that is likely to become competitive and for which a market-based support system is considered rather appropriate. Commercial solar PV, hydro, and geothermal with capacity of 1MW or above, biomass (general wood) with capacity of 10MW or above and liquid biomass with capacity of 50kW or above will comply with the FIP scheme from FY2022. The feed-in premium (FIP) scheme started in April 2022 along with the FIT scheme.

Under the FIP scheme, renewable power generators sell electricity directly at the market or over-the-counter transactions and receive a premium in addition to the market price. The premium is calculated as a difference between “the designated FIP price” and “the reference price.”

Premium (JPY/kWh) = the designated FIP price – the reference price

The designated FIP price for FY 2022 will be set through the auction for commercial solar with capacity of 1MW or above, biomass with capacity of 10MW or above and liquid biomass with capacity of 50kW or above, and at the equivalent level of the FIT rates for other renewables. The reference price is determined monthly based on the average wholesale price of the previous year

[53] METI, (2022) “Opinions on Renewable Energy Purchase Prices from FY2022 Onward” (The Procurement Price Calculation Committee (February 4, 2022)), https://www.meti.go.jp/shingikai/santeii/pdf/20220204_1.pdf (Japanese only)

with monthly adjustments. The non-fossil values and the balancing costs are also factored into the equation

On the other hand, the basic framework of the FIT scheme is to be maintained for the other renewable energy sources if they are utilized locally and expected to improve disaster resilience of the area. The locally utilized power sources need to meet the certain requirements to benefit from the FIT scheme. The requirements to be eligible for the FIT approval have been applied to commercial solar PV since FY 2020 and geothermal, hydro, and biomass since FY 2022 **(**TABLE A3). Furthermore, onshore wind with less than 50kW capacity will be included and the targeted capacity of biomass power will be changed to that of less than 2MW from FY 2023. The commercial solar PV is obliged to satisfy both conditions while the other renewables need to meet one of the requirements.

TABLE A3. REQUIREMENTS FOR LOCAL UTILIZATION

<table>
<tr><th>Renewable energy</th><th colspan="2">Requirements to be eligible for the FIT approval</th></tr>
<tr><td>Commercial solar PV (10-50kw)</td><td colspan="2">✓ Self-consumption at least 30%
✓ Black start capability and power outlet function for emergency use</td></tr>
<tr><td>Geothermal (<1MW)
Hydro (<1MW)
Biomass (<10MW)*
Onshore wind (<50kW)**</td><td>[Self-consumption type]
✓ Self-consumption at least 30%
✓ Power supply at least 50% of its retail electricity provided by a retailer or transmission and distribution operator to a local community where a power generation facility is located.
✓ Self-consumption of power at least 10% and heat for CHP</td><td>[Community-based type]
✓ Agreement on utilization of generated power/heat with a municipality
✓ Operated or financed by a municipality
✓ Power supply to a retailer operated or financed by a municipality</td></tr>
</table>

Note: * The targeted capacity of biomass power will be changed to that of less than 2MW from FY 2023.

** Onshore wind with capacity less than 50kW will be covered from FY 2023.

Source: compiled by authors based on METI[54]

From FY 2022, the renewable energy projects are supported by either FIT or FIP, depending on the energy source and capacity (**FIGURE A4**). New projects and FIT approved projects with no less than 50kW capacity are allowed to apply for the FIP scheme if it is preferred over the FIT scheme. The classification will be adjusted to reflect the renewable energy market and development situations.[55]

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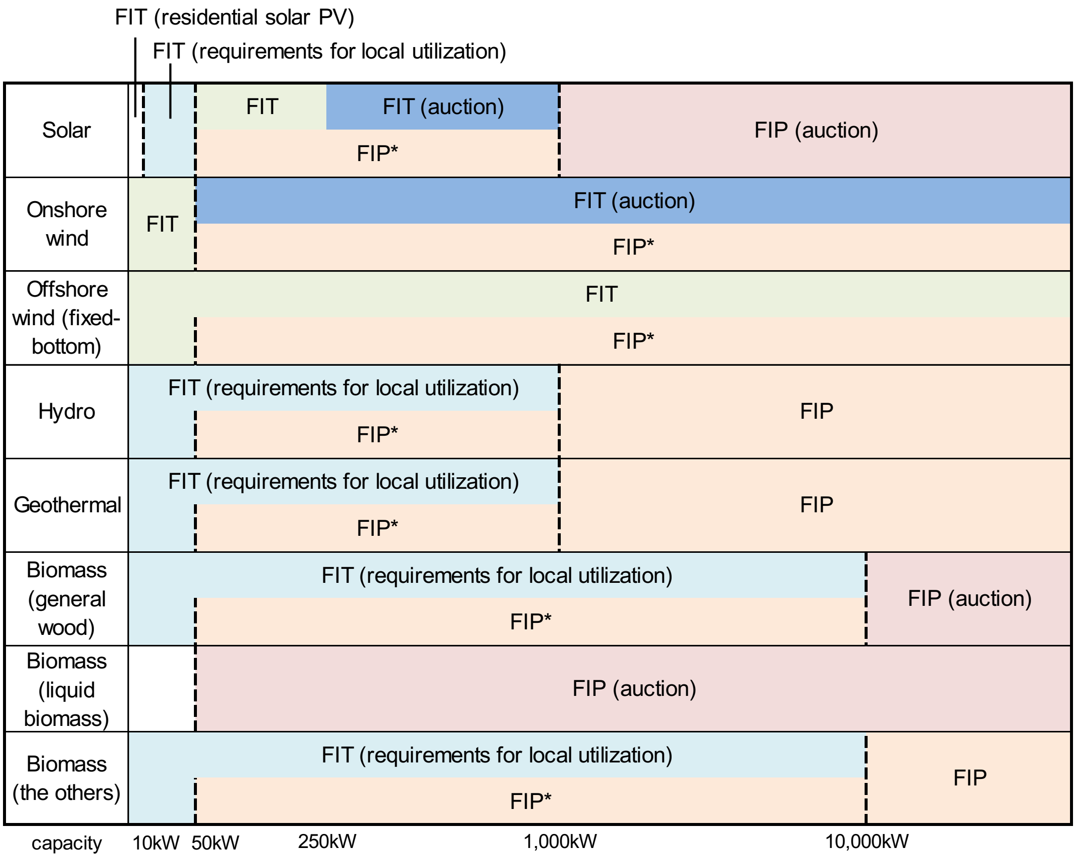
[54] METI, (2022) "Renewable Energy FIT/FIP Scheme Guidebook", https://www.enecho.meti.go.jp/category/saving_and_new/saiene/data/kaitori/2022_fit_fip_guidebook.pdf (Japanese only)

[55] The commercial solar PV registered under the FIP scheme will be expand to projects with capacity of 500kW or above from FY2023 and those of 250kW or above from FY 2024. Similarly, the targeted biomass (general



Note: * New projects and FIT approved projects no less than 50kW are allowed to apply for the FIP scheme if it is preferred over the FIT scheme.

FIGURE A4. RENEWABLE ENERGY SUPPORT SCHEME (FY 2022)

Source: compiled by authors based on METI[56]

wood and the others) capacity will cover those of no less than 2MW from FY 2023. Fixed-bottom offshore wind projects to which Marine Renewable Energy Act of 2019 do not apply are not subject to the auction in FY 2022 but they will be required to participate in the auction from FY 2023.

[56] METI (March25, 2022) "Renewable Energy Purchase Prices, Surcharge Rate, and Other Details related to FIT and FIP Schemes from FY2022 Onward to Be Determined",
https://www.meti.go.jp/english/press/2022/0325_004.html (Japanese only)

Tightening Electricity Supply-Demand Balance in 2022 and Challenges for 2030 Energy Mix

Seiya Endo*

Since the beginning of 2021, Japan has seen multiple cases in which rapid electricity demand growth amid severe weather conditions (unexpected heat and cold waves), a demand increase accompanying a recovery from the COVID-19 crisis, a drop in fossil-fired power generation capacity and other factors were combined to affect stable electricity supply. This paper reviews such cases in 2022 and summarizes relevant medium to long-term challenges, particularly those to strike a balance between the achievement of the 2030 energy mix goal and stable electricity supply.

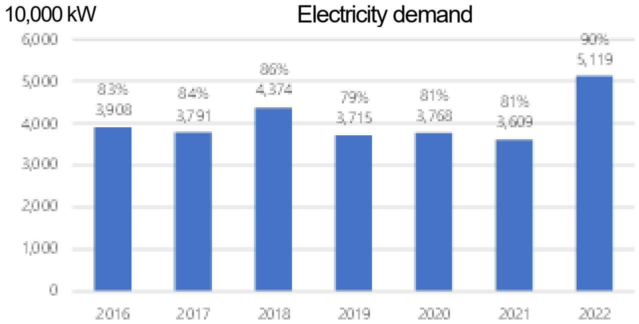
1. Cases of tightening power supply-demand balance in 2022

1-1. Mid-March outage and tightening supply-demand balance on occurrence of Fukushima Earthquake

In 2022, the electricity supply-demand balance tightened twice mainly in the Tokyo region. When an earthquake off Fukushima Prefecture on March 16 led some power plants in Tokyo and Tohoku regions to be shut down, an underfrequency relay was automatically activated, causing a temporary outage that affected about 2.1 million households. Later, power equipment troubles triggered the unscheduled suspension of equipment or power output decline for a total power generation capacity of some 3 million kilowatts in the service area of Tokyo Electric Power Company Holdings Inc.,[1] which were coupled with cold waves in the Kanto region to lower the power generation reserve margin[2] to 0% at an electricity demand peak on March 22.

1-2. Late June tightening supply-demand balance on occurrence of unusual heat waves

As the end of the annual rainy season was declared for the Kanto region on June 27,[3] far earlier than usual, heat waves mainly in eastern Japan pushed peak electricity demand in the Tokyo region up to a level that was over 10% more than the 43.74 million kW in the June 27 week of 2018, the highest record since the electricity market deregulation (Fig. 1). Then, the electricity supply-demand balance was feared to tighten mainly in the Tokyo region as the record rise in electricity demand was coupled with regular checks at some power plants ahead of the high - demand season.



* Percentages above bars represent supply capacity utilization rates (electricity demand/supply capacity)

Fig. 1 Peak electricity demand in the June 27 week in the Tokyo region (weekly average)

Source: Prepared from data published by TEPCO Power Grid

* Economist, Energy Data and Modelling Center (EDMC), IEEJ

1 Power generation information disclosure system, covering new power plant troubles in the relevant period. https://hjks.jepx.or.jp/hjks/outages

2 The power generation reserve margin, one of power supply stability indicators, represents the ratio of surplus power generation capacity to power demand. Usually, a margin of at least 3% is viewed as desirable for preparing for demand fluctuations and power plant troubles.

3 Later, the end of the rainy season was changed to around July 23.

In the face of the demand increase, TEPCO Power Grid postponed scheduled power plant checks to secure supply capacity and the Organization for Cross-regional Coordination of Transmission Operators made arrangements for procuring electricity from other regions. The government and Tokyo Electric Power Company Holdings provided preparatory information on the tightening supply-demand balance and requested electricity consumption savings through mass media and social networking services. Consequently, TEPCO Power Grid successfully secured the power generation reserve margin of 3-4% then and prevented any supply shortage.

1-3. Common points of the two cases: intermediate tightening and fossil-fired capacity decline

A common point of the two cases is that severe weather conditions triggered the tightening of the supply-demand balance in an intermediate period when regular checks on power plants are scheduled amid relatively lower electricity demand between January and August, when such tightening is a matter of concern due to annual demand peaks.

An apparent background factor is that less profitable fossil-fired power plants have been idled or decommissioned in line with the recent spread of renewable energy power generation and the restart of nuclear power plants, resulting in a decline in the electricity system's capacity to adjust supply to a demand increase amid severe weather conditions. While the decrease in fossil-fired power generation capacity is unavoidable, power utilities are required to enhance measures for stable electricity supply, including the maintenance of indispensable capacity.

2. Challenges for this winter

After the two incidents, the first matter of concern is whether stable electricity supply could be secured in the winter of FY2022. If the winter is the coldest in a decade, the power generation reserve margin is projected to range from 1.5% to 1.9% for seven regions from Tokyo to Kyushu,[4] slipping below the threshold of 3% required for stable supply.[5] If cold waves are coupled with any other adverse factor, electricity supply may fall short of satisfying demand.

The government and power utilities have debated and considered the potential supply shortages. In July, Prime Minister Fumio Kishida instructed then Economy, Trade and Industry Minister Koichi Hagiuda to secure the operation of nuclear power plants and the addition of some fossil-fired power generation capacity. Furthermore, the Organization for Cross-regional Coordination of Transmission Operators has assessed supply capacity in the winter, implemented risk assessment covering rare events and taken relevant measures.

However, risks for which Japan should prepare are not limited to a capacity shortage amid summer or winter peak demand. Capacity shortages triggered by severe weather conditions (and natural disasters like earthquakes) as seen in the intermediate period of 2022 and supply shortages caused by fuel supply interruptions amid the current Ukraine crisis are also matters of serious concern, for which Japan should prepare. A seesawing recovery from the COVID-19 crisis has made it difficult to anticipate electricity demand levels, complicating the problem of the tightening supply-demand balance. Particularly, the massive procurement of gas, which is relatively difficult to store, may entail the risk of failure to sell inventories when demand falls below anticipated levels.

3. Challenges for the 2030 energy mix target

3-1. Challenges for achieving the 2030 energy mix goal

The problem is not only for 2022 but also for the long term. I would like to assess challenges for stable electricity supply regarding the 2030 energy mix goal. Cited as such challenges are declining fossil-fired power generation capacity, uncertainties about renewable and nuclear energy power generation capacity, and fluctuating electricity demand.

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4 A document for the 74th meeting of a committee on adjustment capacity and supply-demand balance assessment by the Organization for Cross-regional Coordination of Transmission Operators (June 2022)

5 According to a document by the minister in charge of green transformation promotion on August 24, the estimated margin was raised to 3-4% for the Tokyo region and to 4-5% for the western Japan region.

- **Declining fossil-fired power generation capacity**

The 2030 energy mix goal in the sixth Strategic Energy Plan indicates that power generation would decline to 178 billion kilowatt-hours or 57% of the FY2021 level for coal-fired plants and to 187 billion kWh or 47% of the FY2021 level for liquefied natural gas-fired plants.

Power utilities' supply plans, as tabulated by the Organization for Cross-regional Coordination of Transmission Operators, indicate that power generation estimated for 2031 from power utilities' capacity plans would total 289.7 billion kWh for coal-fired plants and 323.0 billion kWh for gas-fired plants, deviating far from projections in the energy mix goal (Table 1). If coal-fired power generation capacity is reduced to meet the energy mix goal, dispatchable power capacity may decline faster than assumed in the supply plans, leading to doubts about stable supply.

Table 1 Power utilities' projected fossil-fired power generation capacity (100 million kWh)

		Results	Projections	
			Supply plans	6th Strategic Energy Plan
FY		2021	2031	2030
Fossil-fired capacity total		6,812	5,869	3,840
	Coal	2,791	2,897	1,780
	LNG	3,230	2,772	1,870
	Oil, etc.	173	200	190

Sources: Organization for Cross-regional Coordination of Transmission Operators: Tabulation of FY2022 supply plans
Agency for Natural Resources and Energy: Survey of Electric Power Statistics, 6th Strategic Energy Plan

- **Uncertainties about renewable and nuclear energy power generation capacity**

The energy mix goal indicates the ambitious expansion of nuclear and renewable energy power generation to achieve the greenhouse gas emission reduction goal of 46% from 2013 for 2030 in Japan's Nationally Determined Contribution. As for nuclear, Prime Minister Kishida in August vowed to restart seven more nuclear reactors from next summer in addition to the 10 restarted ones. If the 17 reactors operate at 80% of their capacity, their power generation will stand at around 120 billion kWh, far less than 188-206 billion kWh indicated in the energy mix goal, meaning that more nuclear reactors would be required to become operational.

Japan should make maximum efforts to increase these low-carbon power sources. Even if failing to reach the goal levels, Japan should secure sufficient power generation capacity.

- **Fluctuating electricity demand (Demand level and load curve fluctuations)**

Electricity demand fluctuations remain a key challenge.

Electricity demand at 864 billion kWh in the 2030 energy mix goal indicates an ambitious assumption that energy efficiency will improve 1.5 times faster than between 2013 and 2019. Without such energy efficiency improvement, electricity demand may become higher than projected.

Electricity demand curve changes may also be an attention-attracting factor. If electric vehicles diffuse further, electricity demand may increase further in the evening featuring a tighter supply-demand balance. This challenge could be eased through progress in the adjustment of supply and demand using demand responses and parked electric vehicles.

The tightening of the electricity supply-demand balance in 2022 indicated short to long-term challenges regarding stable electricity supply anew. It is indispensable for Japan to promote electricity system transition without affecting stable supply while GHG emission reduction initiatives are implemented toward the 2030 Nationally Determined Contribution goal and the 2050 carbon neutrality goal.

The Outlook for the Adoption of Electric Vehicles in the United States by 2050

~ Considered by extending the scenarios for the United States in the IEA Global EV Outlook 2022 ~

Ryohei Ikarii*

1. The important United States market for the automobile industry of Japan

According to the statistics of the Japan Automobile Manufacturers Association (JAMA), automobile sales by Japanese companies (including local subsidiaries) in 2019, before the COVID-19 pandemic, came to approximately 6.5 million units in the United States market. In the same year approximately 9.7 million automobiles were produced in Japan, so we can understand immediately how important a market the United States is for the automobile manufacturers and automobile-related companies of Japan. In that United States market, the shift from conventional automobiles using an internal-combustion engine to electric vehicles (EVs) is gradually progressing. Therefore, I decided to use the IEA Global EV Outlook 2022[1] (GEO) to estimate the number of new light-duty vehicles (LDVs) which will be sold and the number of LDVs that will be owned in the United States by 2050[i] and to consider the process of EVs coming to dominate the United States market.

2. The "conservative outlook" and "outlook according to the declaration" for sales of new EVs and number of EVs owned

2-1. Conservative outlook (STEPS extension case)

In the case of considering the outlook for the number of new EVs which will be sold based on STEPS, the conservative outlook of the GEO, in 2040 approximately 12.5 million of the LDVs sold will be EVs, so the EV ratio of the total number of LDVs sold will be 81% (Fig. 1, left). Subsequently, by about 2043 most of the LDVs sold will be EVs, and in 2050 more than 16 million EVs will be sold and the EV ratio will be 100%.

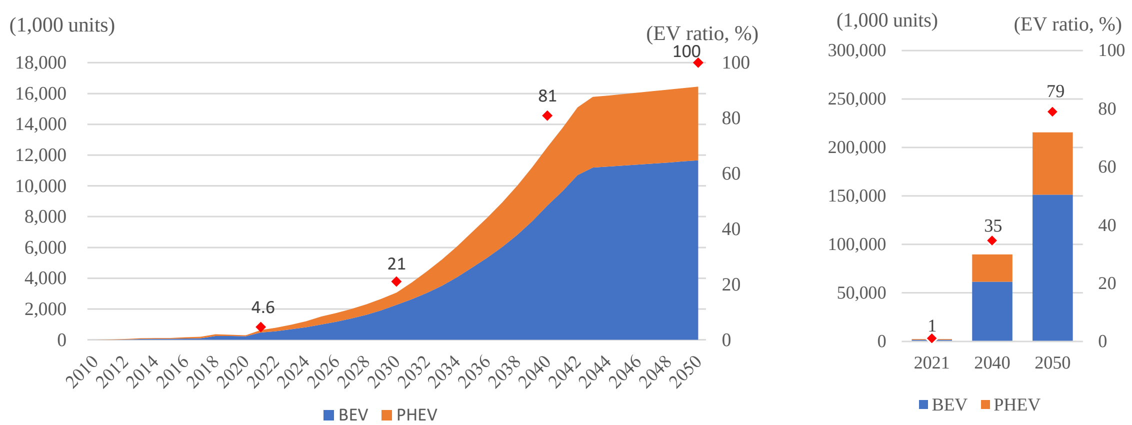

Fig. 1 STEPS extension case: sales of new EVs (left) and number of EVs owned (right)

Furthermore, regarding the number of EVs owned, approximately 90 million LDVs will be EVs in 2040, and the EV ratio of the total number of LDVs owned will be 35% (Fig. 1, right). Subsequently, in about 2044 the EV ratio will exceed

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[1] https://www.iea.org/reports/global-ev-outlook-2022

50%, in 2050 more than 215 million EVs will be traveling on the roads, and in about 2060 the EV ratio will exceed 98%.

2-2. Outlook according to the declaration (APS extension case)

On the other hand, in the case of considering the outlook for the number of new EVs which will be sold based on APS, namely the case based on the declaration by President Biden in August 2021 that the US will aim for 50% of automobiles sold to be zero-emissions vehicles (ZEVs) by 2030,[2] in about 2034 all vehicles sold will be EVs, and all of the approximately 15.5 million units sold in 2040 and approximately 16.5 million units sold in 2050 will be EVs (Fig. 2, left).

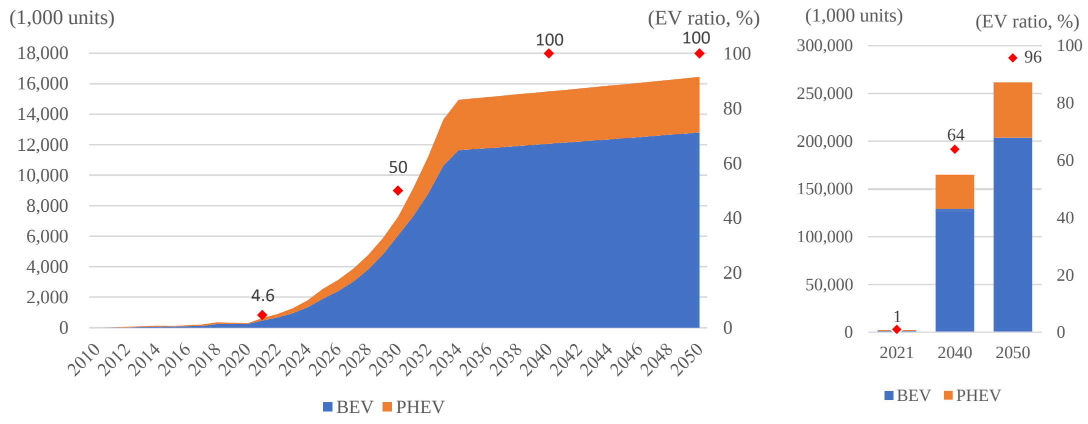

Fig. 2 APS extension case: sales of new EVs (left) and number of EVs owned (right)

Furthermore, regarding the number of EVs owned, in 2040 approximately 165 million of the LDVs will be EVs, and the EV ratio of the total number of LDVs owned will be 64% (Fig. 2, right). In 2050 the EV ratio will be 96% and more than 260 million EVs will be registered in the United States.

3. Even viewed conservatively, rapid EV adoption is unavoidable

On the basis of the number of new cars sold, an EV ratio of 80% will be achieved in 2040 in the STEPS extension case and between 2032 and 2033 in the APS extension case. The executive summary of the Electric Vehicle Outlook 2022 (EVO) by BloombergNEF[3] predicts that the EV ratio will be approximately 80% of the PLDVs sold in 2040 under the Economic Transition Scenario, the EVO's base case, which is extremely close to the STEPS extension case. In other words, even viewed conservatively, the EV ratio of new cars sold in the United States will be about 20% by about 2030, 50% by the middle of the 2030s, and approximately 80% by about 2040, and we can conclude that this is the shared view of IEA and BloombergNEF.

Approximately when will this forecast of the explosive adoption of EVs in the LDV market of the United States become a reliable forecast? Regarding this, Bloomberg[4] calls the point when the EV ratio exceeds 5% of the total number of units sold the tipping point. Not only EVs but also other new technologies such as electricity, television, mobile phones, the Internet, LED lightbulbs, etc. follow an S-shaped adoption curve. Bloomberg says that if we look at the examples of countries with advanced EV adoption, such as Norway, etc., the mainstreaming of EV demand in the automobile sales market is certain when EVs exceed 5% of the total number of units sold. In the United States the EV ratio of the LDVs sold in 2021 had already reached 4.6% and if we take into consideration the strong EV sales in the first half of 2022 the EV ratio

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[2] In the statement by President Biden, it is mentioned that fuel cell automobiles are also one type of ZEV, and the statement could be read as declaring that heavy-duty vehicles and two-wheeled vehicles will also be 50% ZEVs by 2030, but GEO interprets the statement as meaning that 50% of LDVs will be EVs.
[3] https://about.bnef.com/electric-vehicle-outlook/
[4] https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone

will probably exceed 5% this year, 2022. If this theory that "5% is the tipping point" is correct, there is a possibility that the transition to EVs will proceed rapidly in the United States.

Meanwhile, on the basis of the number of EVs owned, the time when the EV ratio will exceed 50% is 2044 in the STEPS extension case and 2038 in the APS extension case, so in both of these cases a substantial number of conventional vehicles utilizing internal-combustion engines will remain on the roads even in 2045. Japanese companies selling automobiles in the United States are in the situation of having to focus on sales of new EVs from the 2030s to the 2040s while continuing the maintenance of conventional vehicles.

4. The "now or never" situation for Japanese companies

According to this paper's outlook for the period until 2050, it will be difficult for not only Europe and China but also the United States to avoid the wave of electrification of vehicles; moreover, the pace of the electrification looks to be quite fast. Therefore, it is necessary for Japanese companies which have sold many conventional vehicles to keep in mind not only "attack," namely the EV sale business with respect to the electrification of the United States market which will progress rapidly from the 2030s to the 2040s, but also "defense," namely the maintenance business for conventional vehicles.

At the present time, the medium- to long-term sales plans of Japan's automobile manufacturers do not contradict this outlook. In August 2022, there have been developments such as California deciding on a proposed regulation to ban sales of hybrid vehicles as well from 2035 onwards, while Toyota and Honda have announced investments in EV battery plants inside the United States. Going forward, regarding "attack," Japanese companies will probably set themselves the questions of "can we find strengths in adding some kind of Japan premium on top of EVs?," "should we continue our efforts to expand the adoption of ZEVs other than EVs, such as fuel cell automobiles and hydrogen engine vehicles, etc.?," "should we expand sales channels for ZEVs in the heavy-duty vehicle (HDV) market for trucks, buses, etc. in which electrification has been relatively slow?," etc., as they consider their medium- to long-term strategies in greater detail. Furthermore, regarding "defense," they will probably deepen their considerations of converting conventional vehicles into carbon neutral vehicles by developing the new fuel technologies sector, including synthetic fuels (e-fuels), which use CO_2 as their raw material, and biofuels, etc. The United States market is an important overseas market, so Japanese companies must continue to consider and take action on the question of how to maintain their competitive advantage as a "now or never" situation. Needless to say, automobiles are a key industry in the Japanese economy.

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[i] The points to note regarding the estimate are as follows.

(1) Scenario-setting in the GEO

The GEO analyzes the current situation of EVs globally and estimates the global EV outlook by 2030 based on original scenario-setting. There are three scenarios: the Stated Policies Scenario (STEPS), the Announced Pledges Scenario (APS), and the Net Zero Emissions by 2050 Scenario (NZE). STEPS reflects existing policies and targets that have been legislated. The APS reflects the most recent declarations, regardless of whether or not these have been anchored in legislation or in Nationally Determined Contributions (NDCs). The NZE presents one path which is back casting from the achievement of net zero by CO_2 emissions by 2050.

(2) Basic approach of the estimate

GEO publishes the actual data from 2010 to 2019, the estimated data of 2020 and 2021, and the predicted data for STEPS and APS in 2025 and 2030. In this paper, in the form of using the data of these two scenarios to extend the trends of the GEO, I set the STEPS extension case and the APS extension case to make estimates of the total number of LDVs sold and owned and the number of EVs sold and owned in the United States by 2050.

(3) Estimate of the number of EVs owned

Please note that I made an original estimate of the number of EVs owned incorporating average lifespan, etc. based on the results of the estimate for number of units sold, so the EV ratios for the number of EVs owned for 2021 and 2030 differ very slightly from those of the GEO.

(4) The definitions of LDVs and EVs in the GEO data

The GEO classifies four-wheeled vehicles into four types: LDVs, trucks, buses, and vans. LDVs include passenger light-duty vehicles (PLDVs) and light commercial vehicles (LCVs). It is necessary to note that this definition comes close to combining the "Light-duty vehicle, short wheel base" and

"Light-duty vehicle, long wheel base" definitions of the US Bureau of Transportation Statistics, and differs from the classification of PLDVs and other commercial vehicles including trucks and buses, etc. in JAMA, Wards, and the International Organization of Motor Vehicle Manufacturers (OICA), etc. Furthermore, in the GEO, "EVs" means the sum of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

Analysis on subsidised retail gasoline prices and subsidy programme

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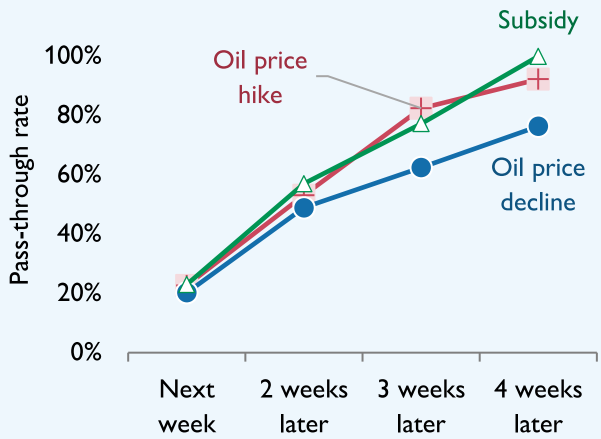
Summary

The timeframe for a drastic fuel oil price change alleviation subsidy programme, so-called gasoline subsidies, has been extended further. Subsidies for electricity and gas are also under consideration. Such large-scale and wide-range energy subsidies can contribute to protecting people and industry from price hikes. They, however, could impede energy conservation and low-carbonisation through their conflicts with other systems and changes in national sentiment and should be considered prudently. This paper analyses attention-attracting gasoline prices in relation to the pioneering subsidy programme.

The subsidy programme has had the great effect of suppressing prices. Despite a sharp rise in yen-denominated oil prices that reflected international oil price spikes and the yen's depreciation to the lowest level against the dollar in 32 years, retail gasoline prices have remained around the standard level. Meanwhile, there are people who are far from benefiting from the subsidy programme, even though it covers representative energy sources. Electric vehicle drivers, residents of homes with electric water- and space-heating systems, and non-kerosene-consuming households seen frequently in urban and warm regions, as well as companies using none of the fuels subject to the subsidy programme, do not benefit directly from the programme. Its effect of suppressing retail gasoline prices is not uniform throughout Japan.

Key factors to define retail gasoline prices include how oil price changes are reflected in or passed through into retail gasoline prices over the short term. Oil price changes and subsidies take nearly one month to be passed through into retail gasoline prices. While oil price hikes and declines are passed through into retail gasoline prices at different speeds, subsidies are passed through into retail gasoline prices to a similar extent and at a similar timing with oil price hikes in the direction of lowering retail gasoline prices.

Figure 1 | How oil price changes and subsidies are passed through into retail gasoline prices



When energy and other consumption subsidies and price controls in general are implemented to support the poorest, various problems may arise. This paper considers potential measures to 1/ clarify the subsidy programme as a drastic change alleviation measure, 2/ mitigate fiscal burdens and 3/ prevent wrong signals from being sent, while leaving the basics of the subsidy programme intact. More specifically, this paper considers a proposal that the government collects some part of the subsidies after the termination of subsidisation under a mechanism in which the subsidies are technically replaced with loans for partial repayments.

The implementation of energy consumption subsidies and price controls in various countries indicates that their citizens, at least under the current situation, have recognised not only the importance of low-carbonisation but also people's and industry's heavy dependence on fossil fuels and the necessity to secure quantitative energy

Keywords: Drastic fuel oil price change alleviation subsidy programme, gasoline, subsidies, pass-through

supply and stabilise prices. The enormous size of the subsidies and price controls, which is taken as indicating the risk of fiscal deterioration, may demonstrate how complicated the problems are with realistic responses towards low-carbonisation and the significance of the cost problem.

Gasoline subsidies extended repeatedly

As retail gasoline[1] prices topped the then standard level of 170 yen per litre on 24 January 2022, the drastic fuel oil price change alleviation subsidy programme, known as gasoline subsidies, was invoked. This is a temporary, emergency programme to alleviate drastic changes to prevent fuel price hikes from weighing on the economic recovery from the COVID-19 crisis[2]. The programme was designed to suppress retail price hikes by providing wholesalers and importers with financial resources for holding down prices[2], instead of triggering direct subsidy payments to consumers or suspending the special portion of national and local gasoline taxes. When the programme was published, its mechanism attracted attention.

Figure 2 | Mechanism for the drastic fuel oil price change alleviation subsidy programme to suppress fuel oil price hikes

Source: Translated from Agency for Natural Resources and Energy, https://nenryo-gekihenkanwa.jp/

In September 2022, the timeframe for the subsidies was extended until the end of 2022. While it was speculated that the subsidy unit price would be reduced from November 2022, the subsidy mechanism was left unchanged. Some media reports say that the timeframe may be extended until the spring of 2023. Prime Minister Fumio Kishida in his policy address to the National Diet on 3 October 2022, vowed to take an unprecedented bold measure to directly mitigate an increase in electricity bills. On 5 October, it was reported that the government was considering creating a system to ease the burden of gas price hikes. The government is thus expected to introduce large-scale and wide-range energy consumption subsidy systems one after another.

Such consumption subsidies can contribute to protecting people and industry from price hikes but are feared to impede energy conservation and low-carbonisation through their conflicts with other systems and changes in national sentiment. The current subsidy programme could become a precedent for measures to be taken when energy prices shoot up at the same pace as at present. Therefore, the subsidy programme may have no choice but to be related to the carbon neutrality goal. It is extremely important to prudently consider the handling of the programme. The following focuses on gasoline, which has attracted attention regarding the drastic fuel oil price change alleviation subsidy programme as a pioneering consumption subsidy system.

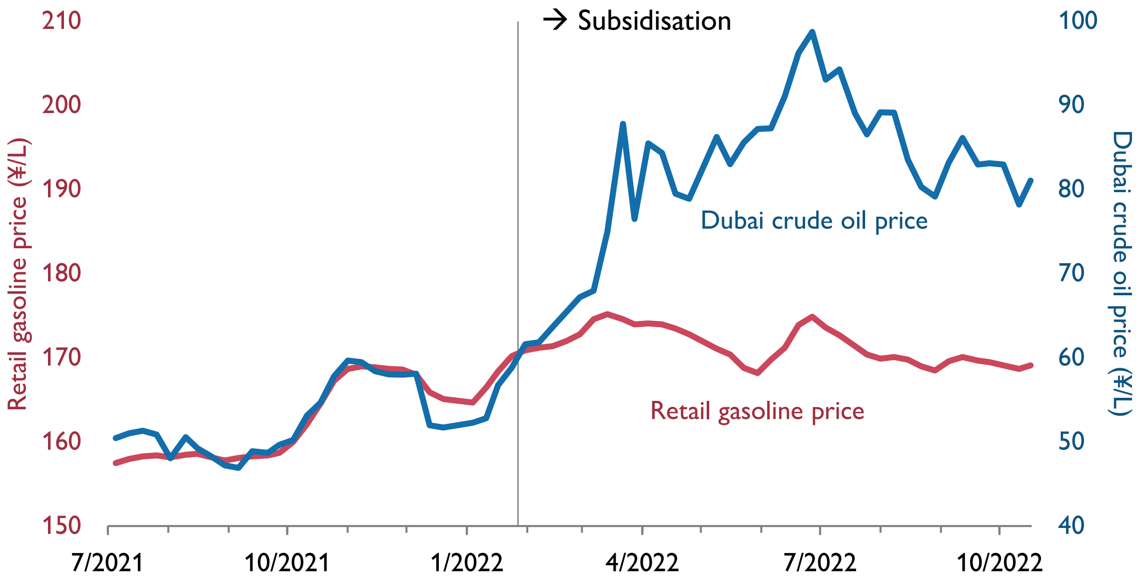
Immediate effect

The subsidy programme has had the great effect of suppressing prices. Despite a sharp rise in yen-denominated oil prices that reflected international oil price spikes and the yen's depreciation to the lowest level against the dollar in 32 years, retail gasoline prices have remained around the standard level (¥170/L then, ¥168/L at present) under the programme (Figure 3). According to the Agency for Natural Resources and Energy, the programme has had the effect of lowering retail gasoline prices by up to ¥41.9/L (Figure 4). Given that two-member or larger households purchase an average of 34 L of gasoline every month[3], the programme has cut their spending by an average of 1 000 yen per

[1] Regular gasoline. Hereinafter the same applies in this paper.
[2] Agency for Natural Resources and Energy, https://nenryo-gekihenkanwa.jp/ (in Japanese)
[3] Ministry of Internal Affairs and Communications "Family Income and Expenditure Survey", as of 2021, including diesel oil

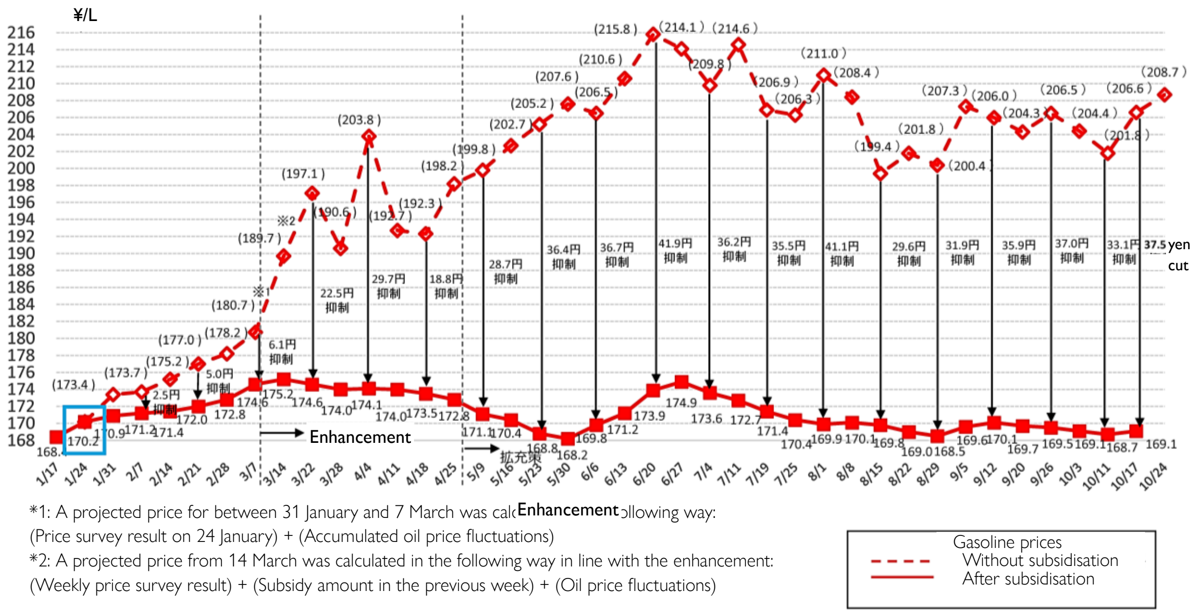
month over the past eight months. Beneficiaries from the programme are not limited to households. The programme covers not only gasoline (regular and premium) but also diesel oil, kerosene and heavy fuel oil. Aircraft fuel was also subjected to the programme after its implementation. Consequently, the programme's cost alleviation effect has supported a wide range of sectors from households to industry.

Figure 3 | Dubai crude oil and retail gasoline prices



Note: The Dubai crude oil price represents the average for a seven-day period ending on the Thursday in the week before the weekly retail gasoline price survey day (Monday).
Source: Agency for Natural Resources and Energy "Petroleum Products Price Survey", Nikkei Shimbun newspaper, etc.

Figure 4 | Effect of the drastic fuel oil price change alleviation subsidy programme (gasoline)



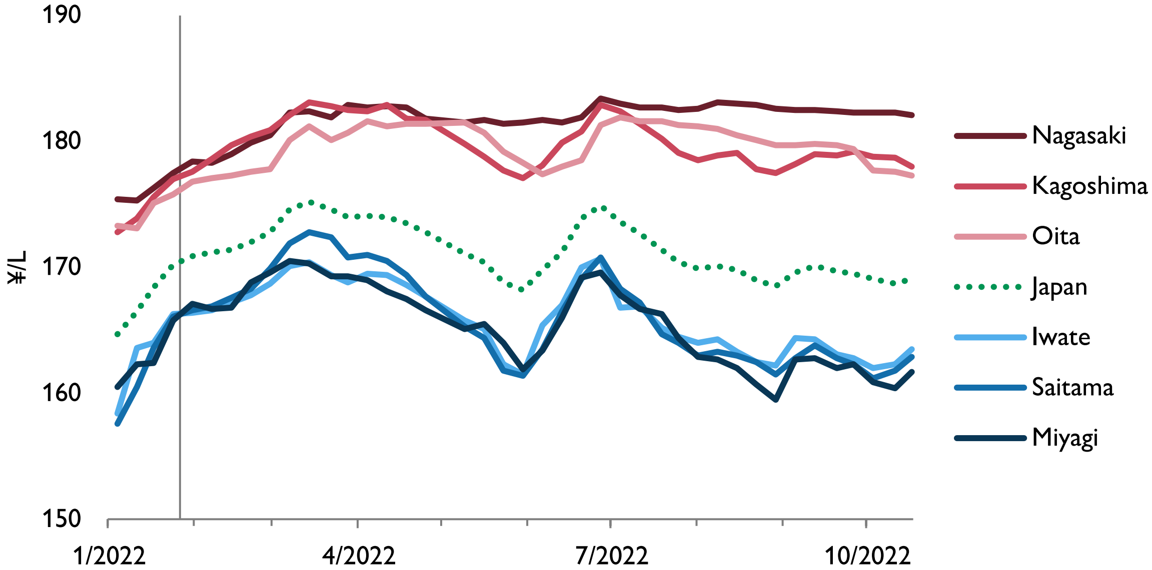
Source: Translated from Agency for Natural Resources and Energy, https://nenryo-gekihenkanwa.jp/pdf/result_rev36.pdf (in Japanese)

Patchy effect

Meanwhile, there are people who are far from benefiting from the subsidy programme. Drivers of electric and other vehicles[4] that do not use gasoline or diesel oil, residents of homes with electric water- and space-heating systems, and non-kerosene-consuming households seen frequently in urban and warm regions, as well as companies using none of the fuels subject to the subsidy programme, do not benefit directly from the programme.

The effect of suppressing retail gasoline prices is not uniform throughout Japan. Figure 5 indicates retail gasoline price trends in prefectures that have recorded the first to third lowest and highest average prices among the 47 Japanese prefectures since 31 January 2022. The three lowest-price prefectures are Miyagi, Saitama and Iwate. The three highest-price prefectures are Nagasaki, Oita and Kagoshima.

Figure 5 | Retail gasoline prices



Source: Agency for Natural Resources and Energy "Petroleum Products Price Survey"

Retail gasoline prices usually differ by region, reflecting various product costs, various sales costs attributable to different mixes of full- and self-service sales, supply-demand balances and competition conditions. In fact, the average gap between the three lowest-price and the three highest-price prefectures is as much as ¥15/L. However, attention should be paid to different price fluctuation patterns rather than price gaps between prefectures. Prices in the three lowest-price prefectures and the nationwide average show a roughly similar fluctuation pattern. In contrast, the three highest-price prefectures feature narrower price fluctuations that slightly lag behind nationwide average fluctuations. As a matter of fact, however, such trends in the highest-price prefectures are usually seen, irrespective of the subsidy programme.

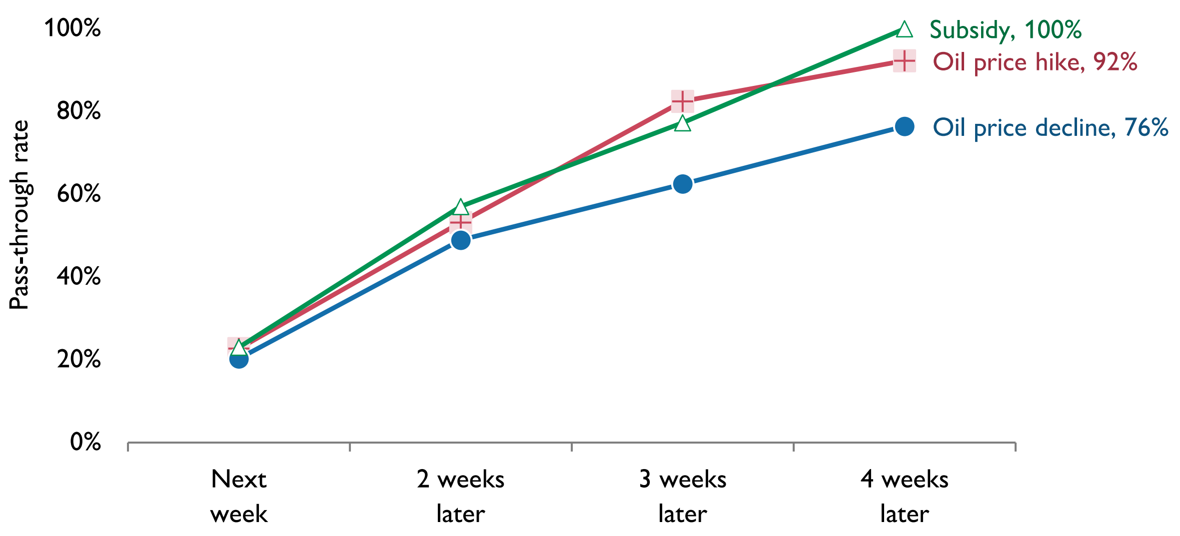
[4] Regarding taxis using liquefied petroleum gas, the Ministry of Land, Infrastructure, Transport and Tourism implements a drastic fuel oil price change alleviation programme for taxi business operators.

Passing through oil price changes into retail gasoline prices

Factors to define retail gasoline prices include how oil prices are balanced with retail gasoline prices over the medium- to long-term. Another important factor is how oil price changes are reflected in retail gasoline prices over the short term. The mechanism in which oil price changes are passed through into retail gasoline prices was estimated for the period between the invocation of the subsidy programme and the present day (31 January – 22 September 2022)[5]. In the estimation, consideration was given to the possibility that oil price hikes and declines may be passed through into retail gasoline prices differently. It was also assumed that subsidies would be fully passed through into retail gasoline prices at the end, meaning the pass-through rate at 100%[6]. The oil price was estimated from the Dubai crude oil price reported by the Nikkei Shimbun newspaper, in accordance with the calculation of the subsidy effect by the Agency for Natural Resources and Energy. However, the previous week's oil price represents the average for a seven-day period ending on the Thursday in the week before the weekly retail gasoline price survey day (Monday).

The estimation results indicate that oil price changes and subsidies take nearly one month to be passed through into retail gasoline prices (Figure 6). While oil price hikes and declines are passed through into retail gasoline prices at different speeds due to the impact of supply-demand and other conditions, subsidies are passed through into retail gasoline prices to a similar extent and at a similar timing with oil price hikes in the direction of lowering retail gasoline prices.

Figure 6 | How oil price changes and subsidies are passed through into retail gasoline prices

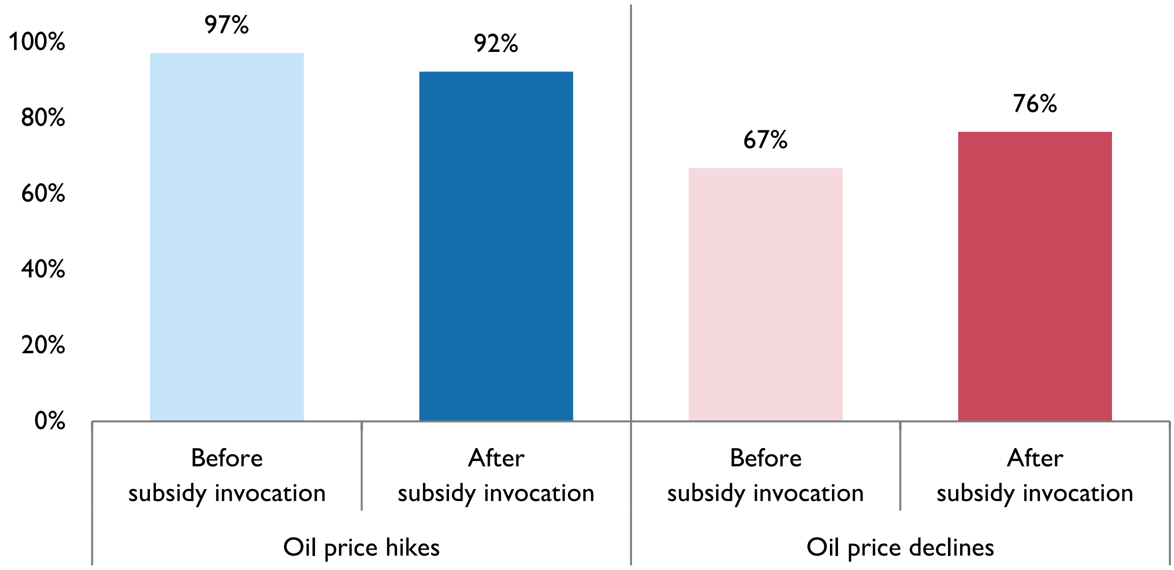


From the period (between 4 January 2021 and 24 January 2022) before the invocation of the subsidy programme, the pass-through rate increased for oil price declines while decreasing for oil price hikes slightly (Figure 7). Further analysis is required to determine whether the increase in the pass-through rate for oil price hikes is attributable to oil prices' downtrend after a peak in late June 2022, to growing attention to high gasoline prices, or to any other factor.

[5] It must be noted that the unit price in the real world is ¥0.1/L for subsidies, ¥0.5/L for wholesale gasoline prices, and ¥1/L for retail gasoline prices.

[6] This assumption could be viewed as a tough one but is designed to prepare for multicollinearity.

Figure 7 | How oil price changes were passed through into retail gasoline prices



Note: The period before subsidy invocation is between 4 January 2021 and 24 January 2022. That after subsidy invocation is between 31 January 2022 and 22 September 2022.

Inconsistency with past policies

It is pointed out that the drastic fuel oil price change alleviation subsidy programme has the potential to run counter to energy conservation and low-carbonisation policies. Furthermore, it is noted that consumption subsidies and price controls for energy and others in general to support the poorest have various problems[7]. This is because of the following:

1/ These measures to artificially lower relative prices could induce overconsumption, wasting, and supply capacity shortages.
2/ Subsidies could benefit those other than appropriate targets.
3/ It could be politically difficult to terminate subsidies.

Theoretically, direct subsidies (monetary payments) to the poorest may be viewed as more desirable. In reality, however, such direct subsidies to the poorest are technically difficult to implement[8].

Given these points, fuel consumption subsidies mainly in developing countries were viewed as problematic in the late 2000s, when energy price spikes including the rise of oil prices to record highs became a global challenge. Then, the Group of Twenty at its Pittsburgh Summit in 2009 formulated a G20 leaders statement at the initiative of developed countries, including the following passage[9]:

> *To phase out and rationalize over the medium term inefficient fossil fuel subsidies while providing targeted support for the poorest. Inefficient fossil fuel subsidies encourage wasteful consumption, reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change.*

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[7] In an old instance, healthcare for the elderly became free, leading to salon-like hospitals, social hospitalisation, a rapid rise in overall elderly healthcare costs and difficulties in national health insurance management. Recently, it is pointed out that a local government measure to make child healthcare free has induced excessive healthcare use.

[8] Japanese and other governments have failed to grasp household and personal income levels, making it difficult to identify the poorest.

[9] http://www.g20.utoronto.ca/2009/2009communique0925.html

This commitment has been maintained. For instance, the Joint G20 Energy-Climate Ministerial Communique in Naples in 2021 took up the commitment anew as follows[10]:

> *Noting that phasing out inefficient fossil fuel subsidies that encourage wasteful consumption is one of the key policies to reform harmful incentives and align finance flows with the Paris Agreement, we recall our 2009 Pittsburgh and 2013 Saint Petersburg commitments to phase-out and rationalise, over the medium term, inefficient fossil fuel subsidies while providing targeted support for the poorest. Such subsidies reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change...*

Nevertheless, developed countries including Japan have recently implemented large-scale energy consumption subsidies and price controls in response to energy price spikes caused by drastic changes, such as supply constraints amid an economic recovery from the COVID-19 crisis, the Ukraine crisis, and steep currency exchange rate changes. In this respect, we may have to understand that the latest energy price spikes have had great impacts so that realistic political responses have been required greatly.

Toward an exit

Meanwhile, problems regarding consumption subsidies have not been resolved over more than 10 years since the G20 Pittsburgh Summit. In fact, the drastic fuel price change alleviation subsidy programme may run counter to some government policies, such as energy conservation and electric vehicle promotion. The timeframe, which was supposed to be until March 2022 when the programme was established, has been repeatedly extended. Furthermore, combined with the increase in the cap subsidy unit price, the programme's spending size inflated from the initially planned level of ¥80 billion to as much as ¥3 trillion by December 2022, topping revenue from a 1% value added tax.

In September 2022, Indonesia had no choice but to reduce subsidies for gasoline and diesel oil due to the swelling size of fuel subsidies. In the same month, the United Kingdom announced Growth Plan 2022[11] including energy price controls, leading to concern about fiscal deterioration[12] that prompted the pound sterling to hit a record low against the dollar, with British bond prices plummeting to boost interest rates.

Given such situation, a proposal for Japan is considered in the following, with the fiscal burden issue taken into account.

Analysis on a draft proposal

The drastic fuel price change alleviation subsidy programme, which was developed over the short term with priority given to the early alleviation of burdens, is not a perfect system with various challenges fully taken into account. It may be important to consider how to overcome various challenges and give consideration to the Japanese economy, people's livelihood, and public finance.

Meanwhile, it is not realistic to reform the core of the ongoing programme. Given this point, we would like to propose the following measures to improve the programme as a trial only:

1/ Clarify the programme as alleviating drastic change,
2/ Mitigate fiscal burdens (beneficiaries' burdens), and
3/ Prevent wrong signals from being sent (to avoid inconsistency between policies).

The basic purpose of providing subsidies during a high gasoline price period is maintained. After subsidisation is suspended with retail gasoline prices falling below the standard level, however, the government should recover part of the subsidies to reduce burdens on taxpayers. Specifically, the government should collect money equivalent to subsidies

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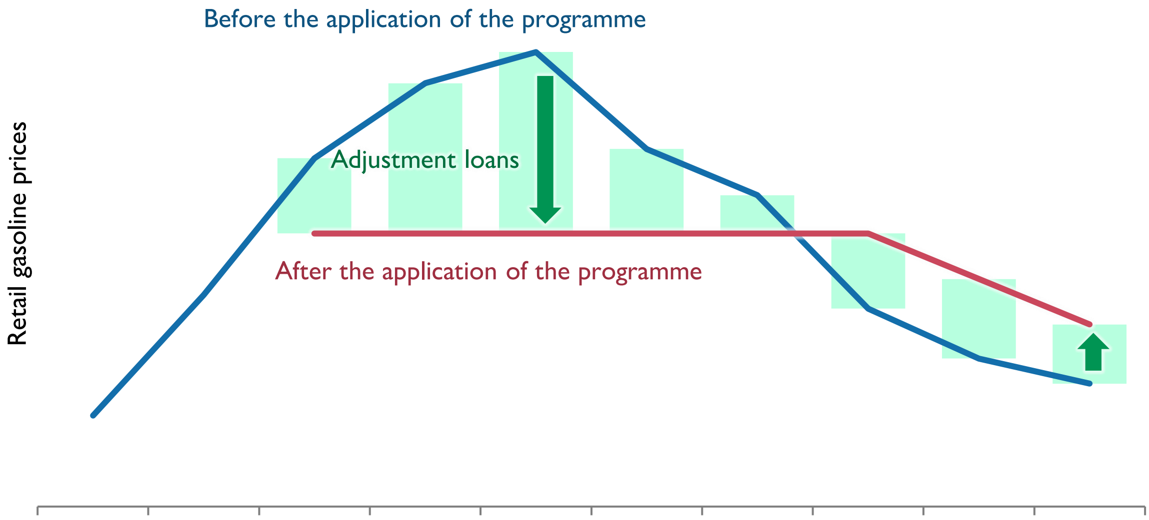
[10] http://www.g20.utoronto.ca/2021/210723-climate-energy.html
[11] https://www.gov.uk/government/publications/the-growth-plan-2022-documents/the-growth-plan-2022-html
[12] Measures to counter energy price spikes were estimated to cost £60 billion (about ¥10 trillion) in six months from October 2022. Tax cuts, another pillar of the plan, were projected at £45 billion (about ¥7 trillion) over a year. However, the government withdrew tax cuts for high-income earners (billions of pounds) on 3 October and almost all others on 17 October.

minus clerical costs from the petroleum product wholesalers that receive the subsidies (Figure 8). In this case, subsidies may be technically replaced with interest-free adjustment loans for partial repayments[13].

Figure 8 | Illustrated proposed revision to the drastic fuel oil price change alleviation programme



Until the government completes the collection, gasoline prices may rise[14]. However, the purpose of alleviating drastic changes to suppress wild fluctuations may be demonstrated more clearly. The government's partial recovery of its payments may work to minimise the programme's impact on public debt. At the same time, the programme may be understood as an emergency measure, contributing to easing its inconsistency with energy conservation and low-carbonisation policies. As a matter of course, however, this kind of proposal may contain various challenges. We would be pleased to see the proposal contributing to policy debates.

Implications of the subsidy system

European countries have implemented and planned energy consumption subsidies and price controls that feature far larger scales than Japan's drastic fuel oil price change alleviation subsidy programme and even indicate the risk of fiscal deterioration. Such responses to energy price spikes in Japan and other countries indicate that their citizens, at least under the current situation, have recognised not only the importance of low-carbonisation but also people's and industry's heavy dependence on oil and other fossil fuels and the necessity to secure quantitative energy supply and stabilise prices. Regarding realistic responses towards low-carbonisation, debates are seen on timeframes, technologies, stakeholders' and users' costs for infrastructure development, and their impacts. This may demonstrate how complicated the problems are with realistic responses towards low-carbonisation and the significance of the cost problem.

[13] It may be indispensable to consider various market conditions in contemplating this mechanism.
[14] Consumers may only face prices after the suppression of price fluctuations, meaning their overall payments remain unchanged.

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