Keidanren
Japan Business Federation

Rebuilding Japan's Electricity System

Electricity Policy to Realize Society 5.0

(Provisional translation)

Keidanren

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Message from Chairman on the Occasion of Publication of This Proposal

This Proposal was examined and formulated with awareness of the issue that Japan's energy sector, especially the electricity sector, faces crises. Japan has little fossil-fuel reserves. Nevertheless, it has established an environment that makes high-quality electricity available everywhere with almost no blackouts. However, since the Great East Japan Earthquake, the situations surrounding electricity have dramatically changed, causing the electricity sector to face serious issues. Meanwhile, it cannot necessarily be said that discussions on countermeasures against these issues involve many stakeholders. This Proposal describes such issues and recommends solutions to them.

There are broadly four issues with Japan's current electricity situations.

Firstly, the percentage of total electricity generation accounted for by fossil fuels, such as coal and natural gas, has reached around 80%. Although it was considered inevitable immediately after the earthquake, now that eight years have passed, the heavy reliance on fossil fuels has become a target of severe criticism from the international community from the viewpoint of global warming countermeasures.

Secondly, the proportion of renewable energy, such as solar and wind power generation, needs to be increased to address global warming, while areas suited to renewable energy are unevenly distributed throughout Japan, and there is a definite shortage of facilities to transmit such energy to areas of large consumption. A mechanism for stable incorporation of renewable energy into electricity networks has not been adequately developed.

Thirdly, although nuclear power safety measures have been thoroughly reinforced since the earthquake, resumption of plant operations has been delayed for various reasons, imposing a heavy financial burden on electricity companies.

Fourthly, as a result, electricity charges in Japan are high in comparison to other countries. Electricity system reforms, which have been promoted since before the earthquake, are partly aimed at curbing electricity charges by stimulating competition through liberalization. However, these reforms seem to have led to reluctance to invest in electricity.

The basis of energy and electricity policy is safety + +energy security (or stable supply), economic efficiency, and environment (S+3E). If nothing is done to address the aforementioned issues, however, any of the 3E could not be ensured. To avoid such a situation, it is essential to create an environment that encourages investment in technology development and new facility construction. The aim of this Proposal is to explore strategies to achieve it. Given that it takes a long time to solve energy and electricity issues, it is important to promptly launch and continuously implement appropriate measures. I hope that this Proposal will serve as a call for action.

Hiroaki Nakanishi
Chairman

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Introduction

Needless to reiterate, energy is the basis of daily lives and business environment. From the perspective of realizing a rich and vigorous economic society, based on its geographical and economic conditions, Japan's energy policy, with ensuring safety as a prerequisite, needs to pursue the balance of energy security (or stable supply), economic efficiency, and environment (S+3E) to the fullest extent.[1]

The international situation surrounding energy has changed significantly. There are many uncertainties, such as the rise of emerging economies, the Middle East situation with smoldering conflicts, the transformation of fossil fuel markets caused by the Shale Revolution, and the drastic decline in renewable energy costs ongoing around the world. In such unpredictable times, Japan needs to ensure stable energy supply by having a wide range of options and realizing the best mix of them.

In addition, following the adoption of the Paris Agreement in 2015, the international community has been increasingly calling for addressing climate change. The growing interest in ESG investment in the international capital market is one example of this trend. With a view to achieving the long-term goals of the Paris Agreement, Japan needs to aim for a significant reduction in greenhouse gas emissions on a global scale.

As 90% of greenhouse gas emissions in Japan originate from energy use, energy policy has an extremely important role to play in domestic emission reduction efforts. The government should achieve its medium-term target (reducing greenhouse gas emissions by 26% by fiscal 2030 from fiscal 2013 levels) by steadily realizing the targeted energy mix, and pursue decarbonization through innovation towards the long-term goals such as that of the Paris Agreement.

While responding to these needs of the times, Japan is required to strongly encourage energy and environmental investment to achieve growth. However, the cycle of investment in electricity, one of the major parts of energy sector, is now in a critical situation.

Since the Great East Japan Earthquake, investment in the electricity sector, except for some areas including nuclear power safety measures, has inevitably been sluggish due to various factors. They include the suspension of nuclear power plant operations, the introduction of a system of purchasing renewable energy at fixed prices (feed-in-tariff (FIT) scheme), electricity demand not predicted to significantly expand for the

[1] With regard to energy policy centering on S+3E, Keidanren has presented its policy proposals, including "Proposal for Future Energy Policy" (November 2017) and "Basic Views on Long-term Energy Strategy" (February 2018).

time being, and calls for downsizing operations in response to further progress of electricity system reforms. Japan now stands at a crucial juncture as to whether or not it can maintain the foundation of technological strengths and industrial competitiveness that it has accumulated so far as a natural-resource-poor, technology-oriented nation.

From a broader viewpoint, excessive reliance on thermal power generation, aging electricity infrastructure, and other issues are imposing a heavy burden, and failure to address this situation could hamper S+3E in electricity supply, which is the basis of daily lives and business activities. This could accordingly impede resolution of a wide range of important policy issues, such as climate change countermeasures, strengthening of industrial competitiveness, reinforcement of resilience, and revitalization of the regional economy.

In September 2018, the Hokkaido Eastern Iburi Earthquake triggered a service area-wide blackout. This unprecedented incident reminded people of the public nature and importance of electricity. It also made it widely known that stable electricity supply, which has been taken for granted, can be ensured only when electricity sources and networks are secured, and advanced operations matching supply and demand in real-time properly function.

Going forward, Japan will need to realize Society 5.0[2] ahead of the rest of the world, contribute to the UN Sustainable Development Goals (SDGs) on a global scale, and reinforce its international competitiveness. As society is being transformed into Society 5.0, which is based on digital innovation, electricity is likely to further grow in importance, making it essential to secure continuous electricity investment necessary for society. From the perspective of maintaining international competitiveness over the long term as well, it is necessary to examine and strengthen measures as soon as possible. To this end, it is expected that the members of society as a whole, including both electricity suppliers and users, will internalize electricity issues, that a next-generation electricity system will be developed taking advantage of the strengths of diverse business operators, and that nationwide discussions will be conducted.

The government is currently examining measures to secure electricity investment. From the perspective of building a next-generation electricity system through public and private collaborative initiatives, the business community's views on the current situation and proposals for the future are discussed in the following sections.

[2] Society 5.0 is a society that creates value by resolving social issues through the combination of digital transformation and the imagination and creativity of diverse people (Creative Society). It is the fifth new society for human beings following the Hunting Society, the Agrarian Society, the Industrial Society, and the Information Society. For details, see Keidanren's policy proposal, "Society 5.0—Co-creating the Future," published in November 2018.

1. General Remarks

(1) Situation surrounding the electricity system and the direction of policy

(i) Electricity systems around the world moving towards 3D

Currently, the direction of electricity systems around the world can be summarized with the keyword "3D," namely decarbonization, decentralization, and digitalization.

In terms of decarbonization, under the Paris Agreement, decarbonization of electricity sources needs to be promoted from a medium- to long-term perspective. It is important to pursue a long-lasting significant reduction in CO_2 emissions. To this end, it is essential not only to expand nuclear power and renewable energy, which are non-fossil-fuel sources that do not emit CO_2 in generating electricity, but also to combine efforts aimed at promoting the practical use of carbon dioxide capture, utilization and storage (CCUS) technologies and carbon recycling,[3] using hydrogen as an energy carrier, and utilizing highly efficient thermal power generation in the course of pursuing decarbonization. Expanding initiatives for decarbonization is expected to attract ESG investment as well.

With regard to decentralization, while responding to calls for decarbonization, decentralized electricity sources, such as small-sized renewables and fuel cells, are likely to be widely introduced to form an appropriate mutually complementary relationship with large-scale centralized electricity sources. Decentralized resources are expected to contribute to increasing energy efficiency in an economically efficient way, including through cogeneration of heat, hydrogen, and electricity. Meanwhile, decentralization would make the electricity system complicated. In addition, possible overlapping investment on the network side and the decentralized resource side during the transition period could cause socio-economic inefficiency. These issues need to be solved by upgrading technologies and systems.

As for digitalization, the wider use of AI, IoT, big data, and other technologies is likely to bring about broadly two kinds of benefits. One benefit is sophistication of existing businesses, such as shortening of the period of suspension for periodic plant inspections and trouble-shooting and labor-saving for transmission line maintenance. Another benefit is structural changes in the electricity system. Especially, more sophisticated transmission networks could enable peer-to-peer (P2P) electricity trading

[3] CCUS stands for Carbon dioxide Capture, Utilization and Storage. Among CCUS technologies, carbon recycling means a technology for capturing and reusing (recycling) especially CO_2 as carbon resources.

between prosumers[4] and facilitate the spread of advanced energy management that controls both supply and demand on a building or regional level. Advanced supply-demand management through digitalization is expected as a promising technological solution to address the progress of decentralization.

The direction of 3D is shared with that of Society 5.0, a society where social problems are solved with advanced technologies, and diverse lifestyle options are available and respected. Needless to say, promoting 3D requires development, enhancement, and deployment of technologies in wide-ranging areas related to electricity supply and demand. Japan needs to steadily encourage electricity investment for that purpose.

(ii) Overcoming sluggish electricity investment and moving towards Society 5.0

Turning to the current state of electricity investment in Japan, it has remained critically sluggish.

With the progress of liberalization, new entrants into the electricity industry have been increasing, mainly in the retail sector. Meanwhile, response to the resulting market competition and increased volatility has prolonged the sluggishness of investment in facilities and R&D from a medium- to long-term perspective.

Investment in construction and upgrading of large power plants has remained limited. Although a large amount of money has been spent in safety measures for existing nuclear power plants, resumption of operations has been slow, squeezing funds for electricity investment. In Japan, under the feed-in tariff (FIT) scheme supported by a huge public burden, investment in renewable energy has been expanding. However, too much investment weight has been given to solar power, which is a variable renewable energy (VRE) source, especially projects that are small in scale but not premised on self-consumption. In addition, a business environment that systematically eliminates risks has been guaranteed for generators by not only purchasing all electricity generated at fixed prices but also not holding them accountable for imbalances. As a result, many entities have made investments as part of asset management, and accordingly the majority of such investments cannot be evaluated as sustainable electricity investment.

As for the transmission and distribution business, with the expansion of renewable energy, etc., the need for next-generation electricity networks is becoming obvious. Meanwhile, partly due to an expected decline in grid power demand, the scale of investment is on the decrease.

[4] Prosumers are entities that play both roles as a consumer and a producer. This here assumes users who both generate/sell and use electricity, like individuals who own a roof-mounted solar power generation system.

If investment continues to be sluggish, it would not only impede electricity system reforms towards 3D but also cause electricity infrastructure in Japan to further deteriorate, possibly making it impossible to ensure S+3E, the basic principle of energy policy. To balance S+3E at a higher level and build human-oriented Society 5.0, free from energy constraints, it is necessary to improve the predictability of investment and encourage electricity investment from a total optimization perspective.

(2) Overview of electricity investment

In terms of electricity investment, money exchanges exist among electricity suppliers, namely between the generation (thermal, nuclear, and renewables), transmission and distribution, and retail sectors, through wholesale, wheeling, and other systems. In addition, such electricity investment networks are of course linked to entities other than electricity suppliers. Investment requires funding from financial institutions and investors. Further, funds for investment are ultimately borne by electricity users, such as companies and consumers, through electricity charges. Given the current situation where the burden of electricity charges is becoming heavier partly due to a year-by-year increase in FIT levies, a further rise in electricity charges may put a financial squeeze on businesses and households.

Meanwhile, because of its large scale, electricity investment will have a wider impact on society through economic activities, such as orders of related devices placed to equipment manufacturers. Ultimately, the investment will send a ripple effect also to members of the public who provide labor services, etc. Electricity investment is important not only in terms of energy and electricity policy but also from the perspective of Japan’s economic growth, especially regional revitalization.

A parallel progress of community-based energy projects and investment to realize next-generation distribution networks would accelerate decentralization and local investment cycles. As a result, in tandem with the progress of decentralization, nationwide electricity supply and networks will change, and new investment cycles will take place throughout Japan. Moreover, accelerated investment across the country will create new technologies and services. For example, new businesses utilizing analysis of data from smart meters and the like, IoT, AI, blockchain, and other technologies are likely to expand. Marketing these technologies to foreign countries will lead to the emergence of global investment cycles. This will enable Japan to take in the growth potential of foreign markets and increase technological self-sufficiency.

As such, encouraging electricity investment and strongly rotating the triple investment cycles are expected to ensure the steady progress of economic growth, regional revitalization, and decarbonization. Such a virtuous cycle between the environment and growth should be created.

(3) Specifying the vision for the electricity system beyond 2030

To secure investment in electricity-related businesses, encourage technological development, and efficiently build an electricity system in the era of Society 5.0 by promoting 3D, it is important to present a vision for Japan's electricity system.

Such a vision will help related business operators implement consistent and timely investment strategies, stimulating investment. Enabling each operator to invest while foreseeing the future state to some extent will likely help the country as a whole avoid excessive investment. Gaining business prospects provides a basis to ensure financing for the electricity business, in which it takes a long time to recover investment. In addition, clarifying the direction of Japan's energy policy, which seems opaque for people overseas, is expected to help attract foreign businesses and funding. Further, from the users' viewpoint, the future state of S+3E on the demand side will become predictable to some extent, which will likely enable them to make more appropriate investment decisions concerning domestic businesses.

Therefore, in drawing up its 6th Strategic Energy Plan, the government needs to present specific scenarios encompassing electricity sources, networks, demand, public burden, etc., regarding a long-term vision for the electricity system beyond 2030, while taking account of the overall picture of energy.

With regard to views on a vision for the electricity system beyond 2030, as shown in the 5th Strategic Energy Plan, there are various uncertainties in economic, social, and technological developments. While the energy mix for 2030 has been established as a single-track target, when looking ahead to beyond 2030, multiple scenarios need to be drawn up based on the direction identified at this point. In doing so, the government should increase predictability for private business operators by clarifying energy supply-demand forecasts and technological composition for each scenario, presenting technologies necessary for the future and key investment areas, and setting out parameters that determine where scenarios diverge, to promote the building of a next-generation electricity system.

Positioning of each electricity source towards 2050 in the 5th Strategic Energy Plan (Cabinet decision in July 2018)

Renewable energy	・Expectations are growing as a main power source as the result of declining prices and progress in digital technologies. ・The government will aim at making it an economically self-supporting, decarbonized main source of electricity. ・Issues that require breakthroughs by technological innovation must be fully confronted.
Nuclear power	・An option for decarbonization that is at the practical stage at this point. ・Japan will lower reliance on nuclear power as much as possible while attempting to expand economically self-sustaining and decarbonized renewable energy. ・The government will immediately begin strengthening human resources, technology, and industrial foundations.
Thermal power	・Fossil fuels will remain a main energy source during the transitional period towards the achievement of energy transitions and decarbonization. ・The policy will focus on shifting to the cleaner use of gas, encouraging the fadeout of inefficient coal thermal power generation, and supporting the global trends towards low carbon approach.

In drawing up scenarios, it is important to pay attention to the policy direction for other areas, including global warming countermeasures, but the government should not stick to those existing policy targets. While pursuing to balance S+3E at a higher level, the government needs to factor in elements influenced by external factors, such as the realization of innovations, and calmly present energy scenarios that is "possibly achieved," rather than the ideal state "to be achieved."

Further, assuming the technological level predictable at present, in view of Japan's geographical and economic conditions, excessive reliance on specific electricity sources and technologies would pose a high risk to daily lives and economic activities in the medium- to long-term future. When looking ahead beyond 2030, it is still essential to strictly observe the overriding principle of pursuing the best mix by combining wide-ranging options, including various electricity sources such as renewables, nuclear power, and thermal power, as well as a wide variety of energy storage technologies such as pumping, storage batteries, and hydrogen.

In addition, it is essential to acquire pubic understanding in formulating a new policy for energy, which supports the foundations of Japan, especially for the electricity system with a large weight in domestic policy. Having experienced the Great East Japan Earthquake, the adoption of the Paris Agreement, and Hokkaido's service area-wide blackout, Japanese citizens have become increasingly interested in energy policy throughout the 2010s. At this point, however, it is hard to say that accurate understanding of electricity policy has deepened. From the perspective of enhancing public understanding as well, in drawing up scenarios, the government should quantitatively simulate draft scenarios using model analysis and other means and conduct scientific discussions from a long-term viewpoint in advisory councils. Keidanren will actively participate in and contribute to such discussions.

Once long-term scenarios are completed, a framework for periodic review needs to be created to put them into the immediate policy direction. It is necessary to concretize network plans set out by business operators and related initiatives to be implemented by the government taking account of the reachability for each scenario, the remaining period, and other data available based on technical and economic verification.

Depending on the vision for a future electricity system, including a case where a remarkable improvement in technologies related to renewables and energy storage has pushed down their costs in Japan, there is potential to revolutionize business models for the electricity sector and related industries. This could promote a transformation of not only electricity suppliers but also the region and the broader economy and society as a whole. Through the process of examination, formulation, and review of future scenarios, the government needs to examine the social impact of achieving each scenario.

Given the long time and huge costs required to develop infrastructure, until scenarios are completed, the government should promptly examine how to develop a necessary environment to ensure that the development is undertaken in order of necessity for the future.

Further, in a future electricity system, regionality is expected to grow in importance. As small- to medium-scale electricity sources, including renewables, have emerged as new options, diverse forms of electricity supply and demand will likely be established by combining the demand characteristics of different areas such as heavy industrial areas, business districts, residential areas, and rural communities, and their geographical conditions such as water sources, geothermal heat, sunshine, wind conditions, and land use. In the future, it will also be important for each region to proactively consider its energy vision within the scope of nationwide scenarios

2. Electricity Demand

(1) Continuing efforts to improve energy intensity and expansion of the amount of economic activity

Demand for energy, including electricity, can be described as a product of energy efficiency and the amount of economic activity.

$$\text{Energy demand} = \frac{\text{Energy demand}}{\text{GDP}} \times \left(\frac{\text{GDP}}{\text{Population}} \times \text{Population}\right)$$

$$= (\text{Energy efficiency}) \times (\text{Amount of economic activity})$$

In general, it is difficult to increase investment in markets with no prospects for expansion in demand. Electricity is consumed in association with domestic economic activities. Therefore, robust economic activities in Japan are a prerequisite to make electricity-related businesses more attractive and encourage active investment. Especially given the prospect of declining population, it is essential to increase GDP through economic growth.

Meanwhile, improving energy efficiency—that is, saving energy and electricity—is basically a desirable initiative in terms of any of 3E. To this end, deepening efforts through continuous technology development is necessary. Japan is required to contribute to global warming countermeasures on a global scale by overseas deployment of energy-saving technologies that it has continued to refine since the oil crisis of the 1970s.

In light of these circumstances, Japan should promote industry and nurture seeds of new economic growth with an appropriate growth strategy while continuing public- and private-sector efforts to constantly improve energy intensity through energy and electricity saving initiatives. As a result, a certain level of demand for electricity is expected to be secured. The idea of expanding the scale of demand through economic growth while improving energy intensity by saving energy and electricity is aligned with the energy mix for fiscal 2030.

Additionally, in realizing Society 5.0 where diverse lifestyles coexist supported by digital technologies, electricity as infrastructure will further grow in importance. If the electricity system can respond to the needs of such a next-generation society, long-term electricity demand is likely to be created, including from benefits of economic growth.

(2) Paying attention to diverse demand-side needs

Electricity has strengths: for example, meticulous control is possible; it produces no emissions when used; and there is no need to use fire. By utilizing these strengths of electricity and promoting technology development for demand-side equipment, including electrified vehicles, and initiatives to lower the costs of electricity supply, electricity is expected to be used in forms optimal for society and economy.

Looking to electricity users, there are various entities and they cannot be described in a uniform way. Paying attention to diverse demand-side needs would make it possible to secure base demand for electricity in Japan.

For electricity-intensive sectors, such as materials and semiconductor manufacturing, it is critical to secure levels of electricity charges comparable with other countries. Future trends in electricity charges are one of the criteria for users to decide whether or not to invest in facilities whose service life is several decades. An increase in electricity charges could cause a decrease in inward investment by global companies as well as closures of small- and medium-sized enterprises which support the local economy, and in turn accelerate substantive production transfer to other countries. There are serious concerns that they will lead to a significant decrease in electricity demand and a deterioration of Japan's international competitiveness. Large-scale domestic demand should be secured by lowering electricity charges to a level comparable with other countries.

The data center business is a new electricity-intensive business and expected to further expand with a wider use of cloud, AI, and big data. One of the incentives to locate data centers in Japan is high-quality electricity supply. It is vital to maintain high-grade electricity that Japan has nurtured as a manufacturing-oriented nation.

In addition, in light of pressure from consumers, investors, and downstream businesses, some business operators are increasingly leaning towards renewables from the perspective of maintaining and enhancing competitiveness. However, even for such users highly conscious of the use of renewables, Japan's renewable energy premiums backed by the FIT scheme are too high, and accordingly any model of renewable energy use has not been established. It is essential to create an environment where affordable renewable electricity and/or environmental value are abundantly supplied.

Further, in responding to the needs of consumers, awareness is needed of the fact that there are various types of consumers, including those who want to use renewable energy even if they need to pay premiums, those who prefer an affordable plan because they consume a relatively high volume of electricity due to the use of various household appliances and other reasons, and low- or middle-income consumers whose access to electricity at reasonable prices should be secured. Especially, from the perspective of stimulating electricity demand by expanding the amount of economic activity, it is important to realize growth potential, including through increasing the amount of activity of senior citizens and revitalizing the regional economy. To this end, measures must be taken to form infrastructure, both hard and soft, including ensuring mobility.

To meet diverse demand-side needs as mentioned above, electricity suppliers are required to collaborate with business operators in other sectors and provide attractive electricity supply that will help avoid the shrinking of markets. Securing a certain market scale and smooth electricity investment is important to achieve S+3E and in turn to ensure Japan's economic growth and strengthen its industrial competitiveness. Given this, it is desirable for electricity suppliers and users, beyond their boundaries, to share and examine various ideas and explore strategies that will lead to a sound development of the electricity retail market.

3. Generation Sector

(1) Establishing wholesale markets

Electricity system reforms are transforming the electricity supply structure, in which supply traditionally has been realized by the Vertically Integrated Electric Power Companies (EPCOs) in principle, into one where supply is realized by collaboration among the generation, transmission and distribution, and retail sectors. Among them, the generation sector has already gone through liberalization.

However, merely forming a free wholesale market (kWh-based) would impede the medium- to long-term balance of 3E.

Since it is basically impossible to have inventory of electricity, in order to maintain stable supply, a supply capacity (electricity sources, etc.) exceeding the peak demand needs to be constantly secured. And, it is economically reasonable, at least in the short term, to operate the once established electricity sources as much as possible to earn revenue, as long as the revenue from selling electricity exceeds variable costs such as fuel costs. If a wholesale market based on electricity volumes (kWh) is established under these conditions, contract prices at this market would converge with variable costs of electricity sources with the highest variable costs among those contracted. In addition, large-scale introduction of renewables, whose variable costs account for an extremely small proportion of total generation costs, backed by policy support would accelerate oversupply, causing a further decline in market prices.

Under such circumstances, prospects for recovering fixed costs of investment in power generation would deteriorate at an accelerating pace and become more uncertain. From the medium- to long-term viewpoint, this would cause a prolonged shortage of investment in power generation, and investment would not be made until a price surge due to a shortage of supply capacity becomes obvious. It takes a certain lead time to develop electricity sources. During this period, concerns over a shortage of supply capacity would persist, threatening daily lives and business activities, which are based on stable electricity supply.

Given that electricity offers a high degree of public benefit, its supply cannot be left to the free market completely. It is important to strike a balance between stimulating competition and addressing issues of common good. The government is aware of these issues and holding vigorous discussions on establishing new wholesale markets. As part of this effort, a structure is being established where the value of power generation is subdivided and each form of value is transacted on a separate new market. It is necessary to examine what the power generation business should be like, taking account of these developments.

(i) Ensuring stable supply

Stable supply in the post-reform electricity system is to be ensured by designing a system that obligates retailers to secure supply commensurate with subscriber volume, transmission and distribution operators to coordinate supply-demand balance and frequency at the final stage (after gate close), as well as to procure supply capacity and adjustment capabilities from generators having electricity sources. It is a prerequisite for ensuring stable supply that all players in the generation, transmission and distribution, and retail sectors fulfill their roles.

Under such arrangements, there is no guarantee as to whether generators will secure adjustable electricity sources with declining utilization rates, and this depends on incentives provided by markets and generators' financing capabilities. Although the government is examining to put certain provisions in place with a capacity market and a supply-demand adjustment market as mentioned later, they might be inadequate as a countermeasure.

In anticipation of a shortage of electricity sources, a bidding system for electricity sources has been in place as a safety net. In the future, it could also be an option to have transmission and distribution operators own marginal adjustable electricity sources. At any rate, it is important to curb electricity volumes required for adjustment capability with a system designed to sufficiently incentivize operators to remedy imbalances and build a mechanism that appropriately allocates the burden of necessary costs for securing adjustable electricity sources. Examination should be conducted from the perspective of securing adequate adjustment capabilities and minimizing the user burden.

From the viewpoint of ensuring stable supply under a new power generation business where diverse entrants pursue economic rationality, it is also important to develop a grid code (requirements for connecting to the grid).[5] The Hokkaido Eastern Iburi Earthquake in September 2018 caused many wind farms to suspend power generation due to fluctuations of network frequency. A future-proof grid code that incorporates requirements for addressing such fluctuations of frequency and offering adjustment

[5] A grid code specifies requirements for electricity sources connecting to the transmission and distribution network to ensure system stability. For example, they could include a requirement to have a remote-control capability and a function to adjust output according to system frequency.

capabilities should be developed. In addition, mechanisms to ensure compliance with the code also need to be established.

(ii) Proper transaction of value related to power generation

With the creation of wholesale markets, competition surrounding the power generation business is expected to intensify. It is a prerequisite in considering policy that generators themselves first work on maximizing the efficiency of operation management and other work to adapt to the competition environment. For example, they should minimize the operation suspension period, including through the utilization of AI and IoT.

Then, in designing a new wholesale market system, the allocation of responsibilities and authority in markets needs to be clearly defined. For example, in the UK, which takes a lead in creating such markets, extensive roles are clearly divided between the system operator and the regulatory agency.[6] Referring to such overseas cases, a responsibility structure regarding markets should be examined.

In addition, there are concerns over the current examination on transaction of each value as listed in the table below.[7] It is recognized that the government is working to design a system for new markets, etc. with awareness of those concerns. However, given that individual decisions on investment in power generation will be made based on market design, great care must be taken in designing and operating such markets. In addition, looking ahead to the future, the government should pursue continuous improvements in the wholesale system, including the use of open direct transactions, to strike a balance at a higher level between stimulating competition and addressing issues of common good.

As long as designing a perfect system from the start is difficult, it is only natural that not only market design but also various systems are reviewed as necessary. However, if systems could be changed frequently or suddenly, individual business operators and financial institutions would not be able to conduct their business with predictability. Such a situation could discourage investment and lending. It is important for the government to clarify its policy guidelines and disciplines in advance and fully engage in dialogue with related parties to conduct system operation that brings out the vitality

[6] National Grid, a system operator, is consistently responsible for the whole process from developing future energy scenarios to planning and operating systems and conducting market operation. The Office of Gas and Electricity Markets (OFGEM) is the regulatory agency consistently responsible for approving future scenarios and network plans, reflecting them into wheeling charges, and regulating and monitoring markets, and promptly revises rules when any problem arises.

[7] In addition to value listed in the table, measures to ensure inertial forces should be examined. Discussions are needed in anticipation of a future increase in direct-current (DC) sources.

of the private sector.

System Design for Transaction of Each Value

Value	**Electricity volumes (kWh)** Electricity actually generated	**Capacity (kW)** Capability to generate electricity	**Adjustment capability (ΔkW)** Capability for short-term adjustments in supply and demand	**Environmental value** Value of power derived from non-fossil-fuel sources
Before system reform	Basically, internal direct transactions by General Electricity Utilities (GEU). Forming facilities considering the generation, transmission and distribution, and retail sectors as a whole.			(Unnoticed)
State after the start of system reform	Market transactions. The government requests former GEU to input surplus electricity at a marginal cost basis.	Mass introduction of renewables, separation of generation and transmission and distribution, and creation of a kWh-based market have made long-term revenue forecast for generators more uncertain.	Liberalization of power generation has caused a shift to the open application system by transmission and distribution operators.	Environmental value remains unknown in market transactions.
Direction of the government's reform	Create a competitive environment by establishing a **base-load market** and other means.	Establish a **capacity market**. Provide generators with incentives to maintain and newly develop electricity sources.	Establish a **supply-demand adjustment market** to ensure transparency of and expand area of procurement.	Establish a **market for transaction of non-fossil-fuel value**. Issue certificates to materialize the value.
Major concerns for the future	· Market prices at a marginal cost basis could lead to excessive competition. · How should a fair competition environment be realized for the future?	· Can incentives to create new electricity sources be secured before supply-demand tightening? · Reforms could cause the public burden to increase over the long run.	· Can necessary amount of adjustment capability be certainly secured? · Will the principles of competition work well?	· Reforms could unfairly distort competition in the generation and retail sectors. · Will regulatory measures under the Act on Sophisticated Methods of Energy Supply Structures become appropriate?

(iii) Verifying operation of market design as a whole

In addition to issues related to transactions of each value, developments in the entire electricity market after their operation starts are also important. It does not seem at present that mutual impacts between individual systems are fully assessed, and examination needs to be conducted.

Even in the US and European countries, which take the lead in electricity liberalization, there are no established strategies to meet the need for value other than electricity volumes that is materialized with the liberalization of electricity wholesale transactions in an integrated manner without impeding the purpose of liberalization. It is recognized that the Japanese government plans to implement necessary complementary initiatives while referring to relevant systems in foreign countries. We have no objection to that direction itself.

However, electricity wholesale transactions are transforming into complex ones for which multiple markets and hosts of entities are interconnected. Given the public nature of electricity, regulators should verify that the new system functions soundly as a whole at advisory councils and/or other open forums, while conducting simulations on the situation after the shift to a new system by using models or other means. Based on the verification results, additional measures should be deployed as necessary, such as flexible reform or abolition of sub-systems.

(2) Expanding the use of non-fossil-fuel sources

Non-fossil-fuel sources, namely nuclear power and renewables, are essential electricity sources in heading toward the goals of the Paris Agreement and pursuing decarbonization. In addition, utilizing nuclear power as a quasi-domestic energy source and renewables basically independent of imported fuels would contribute to strengthening energy security.

Non-fossil-fuel sources are characterized by basically low variable costs and high fixed costs. Accordingly, it is difficult to predict the recoverability of investment through wholesale electricity markets where prices are determined based on variable costs. In addition, partly because their output fluctuates depending on natural conditions, some renewables are not suited to market transactions based on predetermined contract volumes. Therefore, a market environment for non-fossil-fuel sources should be developed taking account of the characteristics of each source, so as to secure the medium- to long-term economic rationality of electricity supply while expanding the introduction of non-fossil-fuel sources.

Given that a market for transaction of non-fossil-fuel value will be opened, on the premise that the market environment will be fully developed, the environmental value of non-fossil-fuel sources will be evaluated based on the prices of non-fossil certificates, in principle.

(i) Turning renewables into a major electricity source

Renewables are an important energy source in terms of energy, environmental, and industrial policies. They can contribute to energy self-sufficiency as domestic electricity sources and to decarbonization as non-fossil-fuel sources, respectively. In addition, renewables are continually growing in importance also in terms of industrial policies of creating a business environment that can meet the needs of investors, consumers, business operators, and other entities who demand renewables and leading the world in developing renewables and energy storage technologies to realize Japan’s economic growth. With a view to turning renewables into a major electricity source, a prerequisite to meet these expectations, it is essential to fulfill three requirements, namely lower costs, stable supply, and sustainable business. To this end, an appropriate business environment needs to be created.[8]

Needless to restate, the current FIT scheme has contributed to expanding the introduction of renewables by reducing their business risks to the lowest possible level. At the same time, however, they impose an extremely heavy public burden.[9] Now that the costs of renewables are falling around the world, the FIT scheme even functions as a mechanism to protect expensive renewables in Japan.

The FIT scheme urgently requires sweeping reform. Examination should be started towards a radical review by the end of fiscal 2020 as set forth in the Feed-in Tariff Act (FIT Act).[10] To make renewables self-supporting, in addition to narrowing down targets of support, one option is to use a feed-in premium (FIP) scheme,[11] which is being widely adopted in Europe, for some types of electricity generation that continue to require public subsidies, instead of FIT scheme. In that case, the government should clarify the amount of public burden assumed under this scheme in advance and set

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[8] For basic views on renewables, also see a policy proposal titled “Request for Accelerating Initiatives to Turn Renewables into a Major Electricity Source,” published in October 2018 by the Planning & Coordinating Sub-committee of Keidanren’s Committee on Energy and Resources.

[9] The total purchasing costs in fiscal 2019 have reached 3.6 trillion yen per annum. The energy mix was formulated assuming that total FIT purchasing costs are 3.7 to 4.0 trillion yen when the proportion of renewables in total power generation becomes 22 to 24% in fiscal 2030.

[10] This provision is set forth in Article 2, Paragraph 3 of the Supplementary Provisions of the FIT Act.

[11] Feed-in Premium is a system of providing renewables, etc. with a premium based on certain criteria referring to market prices. Premiums are broadly divided into two types: one is adding a certain amount of premium to market price, and the other is covering the difference between market price and reference price with a premium.

purchase prices on the premise that environmental value is separately assessed in markets.

Among renewables, solar power and wind power are expected to rapidly become self-supporting. For the time being, to ensure the achievement of the goal for power generation costs, the focus of policy resource allocation should be placed on them by using the bidding system and other means. Then, in the near future, subsidy-free market pricing of electricity needs to be realized as swiftly as possible.

Offshore wind power, among VRE sources, is expected to prevail in Japan going forward. By introducing it in the form of geographically distributed large-scale wind farms, it might become possible to steadily increase the generation volumes of renewables and at the same time mitigate output fluctuations as a whole to a certain extent. It is desirable that, under the Act of Promoting Utilization of Sea Areas in Development of Power Generation Facilities Using Maritime Renewable Energy Resources enacted in November 2018, the government will lead environment enhancement initiatives, resulting in the sustainable and economically efficient introduction of offshore wind power generation.

Hydro power and geothermal power are expected to be utilized as base-load electricity sources because of their characteristics. However, at present their commercialization has been slow. Measures to further expand their introduction in the post FIT era should be examined. With regard to geothermal power, it is important to continue streamlining regulations by incorporating the latest scientific insights and to reduce development risks and costs by promoting technology development and taking systematic measures. As for hydro power, including pumping, its heavy construction costs are an issue that impedes its expansion. Certain public subsidies and other supports including for replacement should be provided as a supportive measure to make effective use of the potential of renewables and regional resources.

Biomass is similar to thermal power in terms of the cost structure and requires discussions taking account of its differences from other renewables. Small, local-production-for-local-consumption type biomass is an essential energy source to maximize the use of renewables. Based on the division of roles between business operators, local governments, and the central government, efforts need to be made for coexistence with communities, including through fostering residents' understanding. In addition to this, the government should examine subsidies and other support measures as part of agriculture, forestry, and fisheries policy, including reconstruction of the forestry industry, and waste disposal policy. Then, in terms of energy policy, on the premise of separately assessing environmental value in markets, biomass should be treated as equivalent to other electricity sources capable of cogenerating heat and electricity.

Further, it is expected that the self- and local-consumption type renewables that are not premised on selling electricity will expand, contributing to enhancing resilience and other aspects. A possible option is to provide those facilities with policy support taking account of benefits in local communities, etc.

Besides, as more consumers and investors demand a higher level of environmental friendliness, the number of cases is expected to increase where electricity users who pursue enhanced environmental suitability start developing renewable energy by themselves. This move is also helpful to expand the use of renewables. Servers and other electronic devices using direct current can increase energy efficiency by combining with solar power which generates electricity in direct current. If the economic rationality of renewables increases, a self-consumption model might be established for the growing data center business, etc. Continuing efforts must be made to develop an investment environment by clarifying the system and other means so as to promote efficient and proactive introduction of renewables, including the use of renewables installed both on-site and off-site.

(ii) Continuing use of nuclear power

The Fukushima Daiichi Nuclear Power Station accident in 2011 had a significant impact domestically and globally and caused tremendous damage, especially to affected areas. Even eight years after the accident, decommissioning of the power plants and reconstruction of affected areas are still incomplete. The business community will continue working with related parties to support the reconstruction of Fukushima.

Ensuring world-class safety levels is a prerequisite for continuing utilization of nuclear power. To this end, efforts must be made to conform with safety regulations, which have been greatly strengthened based on the lessons learned from the accident, and enhance voluntary initiatives. In addition to ensuring that business operators comply with safety regulations, related industries should work as one to pursue a higher level of safety in collaboration with government agencies and academic experts, including through activities of the Atomic Energy Association (ATENA) established in July 2018.

Meanwhile, nuclear power is an essential source of energy for Japan and the world as a whole to secure stable future energy supply and pursue decarbonization, at least in light of technological levels assumable at present.[12] While the government has made it

[12] For example, according to estimates by the Agency for Natural Resources and Energy, if solar

clear that it would restart nuclear power plants whose safety has been confirmed, it cannot be said that this is perceived as an adequately powerful message. The government needs to disseminate a clear message that it will utilize nuclear power continuously and safely.

From the viewpoint of electricity suppliers, it goes without saying that whether or not the continuing use of nuclear power is realized will have a decisive impact on prospects for the nuclear power business. However, in addition to this, a vision for energy supply and demand as a whole will also need to be fundamentally reviewed depending on whether or not nuclear power is used. Accordingly, there is a growing sense of uncertainty. Clarifying nuclear power policy means more than clarifying how to treat one type of electricity source.

Further, for local governments and residents of the regions where nuclear power plants are located, the prospects for nuclear power have an extremely large impact on the economy, employment, and future vision of the regions. With full awareness that the use of nuclear power has been promoted so far with the understanding and cooperation of the local governments and residents of the regions where power plants are located, the government needs to consolidate its overriding principle of continuing to use nuclear power while strengthening its safety together with local communities.

Amid uncertainty over the future of nuclear power, it is difficult to maintain technologies and human resources. Nuclear technologies, human resources, and industrial foundations owned by Japan are precious assets for our country with scarce natural resources to aim for S+3E. To pursue safer and higher levels of nuclear technologies on a continuous and long-term basis, the government needs to make clear its stance of securing these assets.

From this perspective, as well as further strengthening its efforts to restart existing nuclear plants whose safety has been confirmed, the government should clarify the long-term need for nuclear power and include replacement and new construction and expansion of facilities[13] in its policies.

In terms of investment in the nuclear power business, which underpins such policy,

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power and wind power are combined with energy storage technologies on the premise of using them as a base-load source of electricity as with nuclear power, even when solar and wind power generation costs have fallen to around 7 yen/kWh, the combined cost of solar and wind power and storage batteries is 69 yen/kWh, and the combined cost of solar and wind power and hydrogen is 32 yen/kWh (excerpt from Recommendations by the Round Table for Studying Energy Situations). On the other hand, the cost of nuclear power is below 11 yen/kWh at this point (excerpt from materials for the first meeting of the Round Table for Studying Energy Situations).

[13] New construction and expansion of nuclear power plants do not necessarily mean an expansion of nuclear power generation capacity because they might be conducted concurrently with decommissioning of aging plants.

ensuring the predictability of the business is essential. In particular, fostering public trust is a critical issue. The government and business operators need to honestly and thoroughly explain what kind of risks and benefits would take place depending on whether or not nuclear power is used, without falling into complacency associated with the myth of safety, and to call for wider understanding.

In addition, it is also important to improve the environment for back-end operations, such as reprocessing, decommissioning, and final disposal, and review damage compensation systems in case of nuclear power accidents, to ensure the predictability of the nuclear power business. These are areas where the government has a major role to play in nuclear power fields. The government is required to continue active examination and response. Thorough response to these issues is essential to earn public trust.

As for existing nuclear power plants that have undergone certain improvement of site environment and depreciation, it is important to steadily and swiftly restart them after confirming their safety and acquiring understanding from local communities. For eight years after the earthquake, huge costs have been spent for not only investing in additional safety measures, but also for maintaining operable conditions in preparation for restart. Although subject to a management decision that restart could enable the recovery of cost as well as the viewpoint of realizing the optimal energy mix, the slower the restart is, the more difficult the decision business operators would face. If decommissioning increases further, it would become hard to achieve the target proportion of nuclear power (20 to 22% of the total electricity sources) set forth in the energy mix for fiscal 2030.

In terms of investment, nuclear power is characterized by an extremely large initial investment. Recovering the investment through long-term stable operation is its basic business model. A stable business environment enabling increased capacity utilization rates and long-term operation would improve return on investment.

Needless to say, efforts by nuclear operators are important to ensure swift compliance with safety regulations. At the same time, however, regulatory agencies as well should promptly work to streamline regulations so that power plants as a whole can efficiently and effectively achieve safety levels at least equivalent to those required under the current regulations and speed up inspections through it.

In addition, the period of eight years that have passed since the earthquake to the present represents 20% of 40 years, the usual operational lifespan of nuclear power plants. Even if the lifespan is extended to 60 years, downtime would account for more than 10% of the lifespan. After conducting technical investigation on safety, the plant downtime should be excluded from the operational lifespan of 40 or 60 years to the extent possible. Besides, in the United States, nuclear power plants have started filing applications for extending their operational lifespan to 80 years. Technical investigation should also be conducted on safety in the case of further extending the lifespan to more than 60 years.

In addition, it is also important to promote steady technology development, ranging from safer technologies to new types of reactors, such as fast reactors, and nuclear fusion, to secure energy for human beings in the future. As an example, small reactors, for which technology development is advancing overseas, go against economies of scale, but if their economic efficiency improves partly due to future technology development, they might potentially be used as a decentralized electricity source. In addition to cogeneration of heat and electricity, for example, inexpensive manufacturing of hydrogen at high-temperature gas reactors is expected to contribute to realizing a hydrogen society. Examination should be made to find solutions to issues for enabling entries of new users such as industrial sectors, etc, non-electricity use, cogeneration of heat and electricity, etc.

(iii) Electricity and energy storage technology development and realization of a hydrogen society

Electricity and energy storage technologies are rapidly growing in importance with the expansion of VRE sources. Meanwhile, if letting nature take its course, investment would not expand at a sufficient speed and scale. The Japanese government, ahead of the demand expansion, should promote further development of storage batteries, hydrogen, and other related technologies where Japan’s strength lies, present a road map for reducing costs, and pursue practical implementation throughout society.

In addition to having a great significance in terms of electricity supply and demand, the electricity and energy storage sector is deeply intertwined with other energy policies and various industrial policies. Measures should be put in place from a broad range of perspectives.

Especially in the transport sector, individual governments and companies have launched initiatives by setting out their goals for electrification. This sector is likely to become a pioneer in practical implementation of electricity storage and hydrogen technologies throughout society. Also in Japan, in August 2018, the Strategic Commission for the New Era of Automobiles compiled an interim report. This report sets an ambitious goal of reducing greenhouse gas emissions from Japanese vehicles to be supplied to the world by around 80% (around 90% for passenger cars) by 2050 with the aim of realizing “Well-to-Wheel Zero Emission.” If this goal is achieved, the proportion of electrified vehicles in passenger cars is assumed to reach 100%. This report points out that, to this end, not only promoting technological innovation but also improving environment in terms of infrastructure and systems is essential. The public and private sectors should continue to collaborate in deploying strategies while maintaining an industrial policy perspective.

Since storage batteries equipped in electrified vehicles are introduced in society mainly for transportation use, they will become an energy storage resource available without taking account of cost-effectiveness in the electricity system. Active integration with the electricity system should be promoted by utilizing V2G[14] technology, reusing batteries once equipped in vehicles, and other means.

For a wider use of hydrogen, focus should be placed on technology development in each of the manufacturing, storage and transportation, and use phases. In the manufacturing phase, economic efficiency should be pursued by encouraging competition between diverse technologies, such as using surplus electricity from renewables, combining reformed fossil fuels and CCUS, and utilizing high-temperature gas reactors. In the storage and transportation phase as well, a wide range of carriers should be assumed, including liquefied hydrogen, ammonia, storage in alloy and organic compounds, and methanation. In the use phase, it is required to continue exploring the possibility of using hydrogen not only for transportation but also in the generation sector as well as to verify the possibility of the industrial use of hydrogen according to the extent to which hydrogen prices are lowered.

In January 2019, in his speech at the World Economic Forum (the Davos Conference), Prime Minister Shinzo Abe expressed his expectations to CCU (Carbon Capture and Utilization) and hydrogen as disruptive innovations to address climate change. Especially, as set out in the speech, if hydrogen prices fall to one tenth of the current level by 2050, the energy supply-demand conditions could be dramatically transformed. With a view to creating further innovations, public and private collaborative initiatives are expected to be accelerated.

4. Transmission and Distribution Sector

(1) Establishing next-generation electricity networks

In the transmission and distribution sector, establishing next-generation electricity

[14] V2G stands for Vehicle to Grid. It means supplying electricity from batteries equipped in electrified vehicles to the power grid. V2G enables the batteries of electrified vehicles to be treated as storage batteries connected with electricity networks, likely making it possible to control power charge and discharge according to the output of VRE sources and fluctuations in demand.

networks is a major goal and issue. Next-generation electricity networks will enable higher level of S+3E and pursuit of 3D (decarbonization, decentralization, and digitalization) mentioned in the General Remarks of this Proposal. Existing networks need to be progressively upgraded towards this direction.

To be specific, with regard to transmission networks, in order to transform traditional networks premised on large-scale power plants located in coastal areas into ones appropriate for power transmission from areas suited to large-scale renewable energy generation, optimization of transmission routes and capacity expansion where necessary need to be promoted successively. This is expected to result in further expansion of renewable energy, the key to decarbonization, and introduction of especially large-scale renewables with potential to lower costs, such as off-shore wind farms.

As for distribution networks, it is vital to utilize digital technologies for demand forecasting, monitoring, and control driven by AI and IoT. Optimum management of decentralized resources, such as small-scale renewables in harmony with local communities and storage batteries including EV, and electricity demand of each area has potential to significantly improve 3E. This will also make it possible to combine centralized and decentralized energy sources according to the needs of each user, and use them more flexibly. Further, it can be possible to enhance regional economic cycles through local production for local consumption within the area, such as electricity trade between neighboring houses.

Mass introduction of VRE sources anticipated during this transformation is a big challenge in ensuring network stability. In the not-so-distant future, a situation may arise where most demand is covered by VRE sources mainly during daytime hours. A mechanism to ensure network stability in such a case needs to be examined.

In addition, data-based management of the entire networks is expected to optimize operations throughout the transmission and distribution networks as a whole and enable effective implementation of the initiatives mentioned above. It will also become possible to deploy new business models based on information obtained from smart meters. In light of these circumstances, examination should be deepened especially on rules for data usage and handling of business and personal information.

Establishing international interconnections in Japan requires extremely careful examination taking account of not only the issue of how to allocate the construction cost burden, but also the geopolitical landscape of East Asia and energy security.

(2) Upgrading networks with a balance between social benefit and public burden

Electricity system reforms have facilitated shifting to a structure where power supply is realized through the collaboration between the generation, transmission and distribution, and retail sectors. Nevertheless, the transmission and distribution sector remains a monopoly for each area, in principle, and still a non-competitive sector. Therefore, business operators are expected to envision a desired state of the medium- to long-term future from the perspective of total optimization and develop next-generation electricity networks by efficient investment.

<u>(i) Promoting the establishment of cost-efficient next-generation networks</u>

Although building next-generation electricity networks is extremely important, the cost required is the biggest issue. The power networks are huge infrastructure. Once investment in hardware is decided, it will require enormous expenses. In the first place, existing power transmission and distribution infrastructure was intensively established in the high economic growth period and is generally aging. There are concerns that spending on upgrading the aging infrastructure alone will drive up the cost burden.

Therefore, as grid power demand is predicted to be sluggish, from the perspective of avoiding overinvestment and reducing electricity charges, maximum use should first be made of existing facilities.[15] The government has been examining and progressively implementing a Japanese version "connect & manage" approach. This approach is to expand business opportunities of generators and accessibility to renewables while curbing additional investment in facilities. We request the government to continue earnestly working with business operators to swiftly expand applicable systems and the scope of application.

On that basis, given that costs for network development are borne by the public, its need must be carefully assessed based on cost-effectiveness. Especially, transmission lines to transmit power from the areas suited for VRE sources will experience a decline in capacity factor, and thus there are concerns that it will become difficult to ensure economic efficiency. Assessment of cost-effectiveness should be based not only on reduced fuel costs but also on multi-faceted benefits, such as increased resilience, improved geographical integrity of market, enhanced network stability, and reduced greenhouse gas emissions, and data-based examination needs to be conducted.

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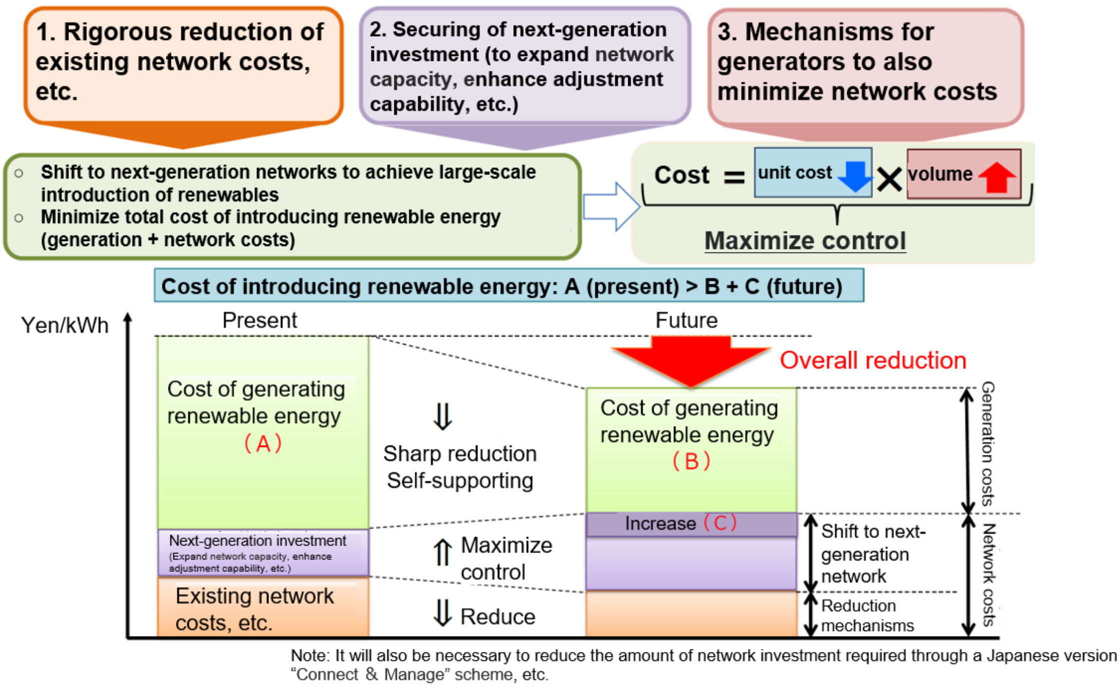
[15] To reduce existing network costs, it would also be meaningful to standardize specifications of equipment used by multiple business operators. With regard to the specifications of some equipment, such as overhead transmission lines, a framework has already been established where individual power transmission and distribution operators compile their roadmaps to realize such standardization and the government reviews them. Going forward, with the steady progress of specification standardization for applicable equipment, these initiatives are expected to be further enhanced and accelerated, including in terms of expanding the scope of applicable equipment and introducing international standards.

Appropriate methods should be developed referring to overseas cases.[16]

From the perspective of building next-generation networks and expanding renewables while curbing public burden, the government's policy calls for reduction of total unit costs (renewable energy generation costs + network costs) below current levels. Under this policy, it is required to build cost-effective next-generation networks while reducing unit cost burden by maintaining and expanding electricity demand.

Basic Government Policy on Electricity Network Cost Reform



(Source: Interim Report of Subcommittee on Mass Introduction of Renewable Energy and Next-Generation Electricity Networks (May 2018))

(ii) Examining diverse electricity supply models

In conducting cost-benefit analysis, universal services, which have traditionally been a prerequisite, should also be reviewed without making prejudgments.

At present, with regard to power transmission and distribution services, provision of electricity and a certain level of supply reliability are guaranteed throughout Japan. In addition, the levels of wheeling charges vary among transmission and distribution operators but are uniform within each area. However, the possibility cannot be ruled out that grid power demand will remain sluggish with the progress of aging population,

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16 For example, ENTSO-E, a power transmission operator in Europe, has been developing a monetary value-based assessment method for benefits from expanded and enhanced power transmission lines, mainly in terms of improvements in such elements as stable supply (reducing necessary reserve capacity, improving network stability, etc.), social and economic welfare (curbing power generation costs, reducing CO_2 emissions, etc.), and lower transmission loss.

depopulation in rural areas, and population decline. Further, decentralized electricity supply will likely accelerate this trend. Taking account of society in the future, it is vital to make social infrastructure including electricity networks more compact and networked in response to a certain level of population decline.

Meanwhile, the development of digital technologies, small power sources, and energy storage technologies will provide individual electricity users with new options for electricity use, free from traditional constraints, such as off-grid options.[17] In this era, diverse forms of electricity supply tailored to regions and lifestyles can exist. Electricity supply according to need without being bound by traditional uniform national supply models should be kept in mind. In that case, the system needs to be designed to ensure that the cost burden corresponds to forms of electricity supply.

Besides, multi-faceted examinations not bound by the status quo should be conducted, such as considering the possibility of offering a supply contract that does not guarantee stable supply in a certain condition.

(3) Securing next-generation investment

To build next-generation electricity networks by transmission and distribution investment whose appropriateness has been confirmed, funds for investment need to be secured. In doing so, it is essential to take account of the burden-benefit balance and examine how to allocate the burden between the generation, transmission and distribution, and retail sectors, or the breakdown of user burden, etc. Especially for investment across regions, due attention needs to be paid to the fact that, at present, the cost-bearer and the beneficiary are not necessarily the same.

(i) Wheeling charge systems

Currently, the wheeling charge system serves as a means of recovering funds for investment in transmission and distribution networks.

In existing wheeling charge systems, wheeling charges are set according to the cost calculated based on forecasts of future investment and expenses. As grid power demand is not predicted to expand, transmission and distribution operators are in a situation not conducive to investment decisions under rigid auditing[18] and ex-post-facto assessment. It is pointed out that, as a result, medium- to long-term investment incentives hold little attraction. Under the circumstances, transmission and distribution operators will be

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[17] Off-grid means meeting electricity supply and demand only through in-house power generation for self-consumption and local production for local consumption, without connecting to large-scale electricity networks.

[18] The government conducts auditing when transmission and distribution operators apply for raising wheeling charges.

required to significantly increase spending for investment in upgrading of aging facilities alone. Accordingly, additional investment in next-generation networks is considered almost unrealistic.

Therefore, it is necessary to reform wheeling charge systems continually based on steady recovery of investment with the fully distributed cost (FDC) method. Effective mechanisms to incentivize investment should be built into wheeling charge systems on the assumption of rigorously reducing existing network costs and maximizing the effectiveness of investment to create a structure that secures necessary funds for investment.

For example, the UK encourages necessary investment by providing incentives to achieve S+3E evaluation indicators.[19] In addition, a mechanism has been established that partially returns the reduced costs to business operators to incentivize cost reduction, thereby stimulating investment while increasing business efficiency.[20] Wheeling charge systems should be reviewed referring to such overseas cases.

(ii) Allocation of the burden of wheeling charges

In reviewing wheeling charge systems, the allocation of the cost burden should also be examined.

Under the current system, fixed costs of transmission and distribution infrastructure are largely recovered through volume-based user charges.[21] If this goes on, a decline in grid power demand could make it difficult to maintain electricity networks.

Moreover, if transmission and distribution facility costs increase with the aging of facilities and the expansion of solar and wind power generation, per-kWh wheeling charges would increase. This could in turn promote a shift to in-house power generation for self-consumption and lead to a further decrease in grid power demand.[22] The decrease in grid power demand could cause a further rise in unit wheeling charge, possibly resulting in the so-called death spiral, in which declining demand and increasing charges occur as a chain reaction.

Further, an expansion of in-house power generation for self-consumption and local production for local consumption resulting from an increase in decentralized VRE

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[19] Goals for shortening the blackout time and reducing CO_2 emissions, etc.

[20] Based on regulations on wheeling charges called RIIO (Revenue = Incentives + Innovation + Outputs) implemented in 2013.

[21] While the ratio of fixed costs and variable costs for the transmission and distribution business is 8:2, the ratio of base charges and volume-based charges in wheeling charges is 3:7.

[22] It is when grid electricity charges are predicted to structurally exceed the levelized cost of in-house power generation that a decision is actually made to establish new in-house power generation facilities. Under the current situation, given costs, time, sites, etc. required for installation, for the time being the introduction of roof-top solar panels is likely to accelerate.

sources would cause volumes of electricity flowing in networks to decrease, but not cause the same-level of decrease in peak electricity demand, including for disaster response. Taking account of resilience and other factors, it is difficult to reduce the installed capacity.

If these issues are actualized, it would become difficult to build next-generation electricity networks while curbing total costs. From the perspective of increasing economic rationality in society as a whole, it is necessary to establish the allocation of cost burden that prevents a decentralized supply-demand model using VRE sources, which relies on the networks for backup, from becoming cream skimming. Wheeling charge systems should be transformed into ones enabling fixed costs to be recovered through base charges with due consideration to impacts on citizens' standard of living.

A kW-based wheeling charge on the generation side, which the government is currently examining with a view to introduction as early as possible in 2020 or after, can be evaluated as one of the effective means to this end.

(iii) Views on expanding uses of FIT levies, etc.

Investment in electricity networks, in principle, should be funded by revenue from wheeling charges. Meanwhile, it is possible to envision applying funds other than wheeling charges to network development. Building next-generation electricity networks means developing infrastructure that supports a shift to renewables as a major electricity source. Especially from the perspective of emphasizing this aspect, in fundamentally reviewing the FIT scheme, which has achieved its initial objective, it is not impossible to envision using FIT levies for network development to have electricity users around Japan widely and shallowly bear the burden, as a means to be discussed. In doing this, as mentioned above, eligible investment should be determined necessary by cost-benefit analysis, etc., and made for next-generation network development whose costs are judged to be borne by users around the country based on proper verification.

In this case, as a prerequisite, it is unacceptable to simply expand the uses of the levies. The business community ardently hopes that electricity charges will decrease by the portion of reduced FIT burden and, at least under the current system, disagrees with the idea of applying the portion of reduced burden to other uses. If the government intends to expand the uses of levies, it would be essential to reform the FIT scheme, as mentioned in 3. Generation Sector, and package the expansion of uses of levies with the following four measures.

Firstly, as the meaning of levies will be shifted from the use of renewable electricity to be measured on a kWh basis to the network development to be examined on a kW basis, the burden should be measured not on a kWh basis but on a kW basis or on a contract count basis, for example. As such, how to allocate the burden should be fundamentally re-examined while taking account of its impact on daily lives and making thorough explanations to the public. In doing so, it is important to give due consideration to international industrial competitiveness and other factors.

Secondly, with regard to the total levy burden, upper limits envisioned for energy mix—3.7 to 4.0 trillion yen in total purchasing costs of renewable energy in fiscal 2030—should be strictly adhered to.

Thirdly, it is necessary to clarify gradual abatement of the total levy burden over time. In addition, the timing of ending support with levies should be clearly defined in some way.

Fourthly, to avoid making levies unassessed sources of funding, a structure needs to be established that requires the disclosure of amount calculation elements and methods, breakdown of uses, and other information, as well as technical examination of charges.

In light of the above perspectives, careful examination should be conducted to secure funds for next-generation investment in an appropriate way. To this end, it would be essential to compare advantages and disadvantages of the scenario of funding next-generation networks solely through wheeling charges and the scenario of applying funds other than wheeling charges, such as levies.

5. Finance

Electricity system reforms are changing risk and return in electricity business-related finance. In addition to means of recovering investment, which the government is currently studying, financing measures also need to be examined.

With the issuance of secured bonds by former GEU ending, power generation businesses, including new entrants, will take ordinary financing methods going forward. Meanwhile, in the event of a financial crisis or other critical incident, the corporate bond market could become dysfunctional. In fact, in fiscal 2011 immediately after the Great East Japan Earthquake, the total amount of corporate bonds issued by ten big EPCOs decreased by around 1 trillion yen. Additionally, although adjustable electricity sources built by generators play an indispensable role in the electricity system, due to a decline in their utilization rates resulting from increased VRE sources, the investment recovery period is expected to become longer. As a result, there is a concern that financing will become more difficult going forward.

Further, in the transmission and distribution business, the FDC method will be maintained for the time being. Meanwhile, because a business recovering investment over an ultra-long term will become independent, attractiveness as an investment and loan destination will be needed. A mechanism capable of attracting long-term funds should be established.

Given the importance of securing stable electricity supply into the future, certain provisions should be put in place not to stop the flow of funds into electricity infrastructure. From this viewpoint, measures such as preparation of a two-step loan framework utilizing the Fiscal and Investment Loan Program (FILP) should be considered as a means of raising funds for adjustable sources of electricity and transmission and distribution networks, including a safety-net role. This framework is expected to help attract private funds as well.

With a view to building a next-generation electricity system, it is also vital to create an environment that enables financing from both Japan and abroad. Among institutional investors around the world, there is a trend towards consideration of ESG factors. It is desirable to prepare a structure that attracts ESG investment by using contribution to decarbonization, etc. as leverage.

As electricity system reforms have driven changes in finance, the public and private sectors should keep in step with each other to develop new financing models, thereby creating an environment that attracts domestic and international capital to Japan's electricity business.

Conclusion

Once constructed, infrastructure plays its role over a long period of time. This characteristic can obscure the fact that no form of infrastructure can continue in use forever. Currently, electricity infrastructure continues to fulfill its role with stable supply as its core. However, when leveling necessary investment, it is hard to say that the required scale of investment is made. The postponement of electricity investment can help constrain the present burden but would be bound to result in a future bill. In light of the current situation that the national important infrastructure is sustained by the private sector, the government needs to design appropriate systems and continually verify and revise them to secure necessary investment. The business community will actively participate in discussions to this end.

The various proposals presented in this document set out the direction that should be taken for the government to pursue higher levels of S+3E and accelerate 3D in Japan as part of this process. Due to large uncertainties over the long-term future, such as 2050, it is difficult to foresee at this point to what extent 3D actually progresses, while it is certain that the electricity system will be forced to undergo substantial changes. Business models for the electricity sector and related industries have already been gradually changing due to electricity system reforms and changes in world markets, but there is potential for these models to be revolutionized in the future. In that case, changes in the electricity system would impact not only electricity but also extremely broad areas, including the regional economy, national land use, and industrial structure. Japan needs to develop an image of future electricity systems under multiple scenarios that factor in uncertainties, envision the corresponding change of society, and examine measures required to achieve its goals. On that basis, the government must broadly share the future direction with the public and promote national efforts to realize it.

We hope that the entire country will work together to break the crisis of prolonged impasse, ensure strong and sound development of not only the electricity system but also Japan's economy and society as a whole, and bring Society 5.0 to fruition.