Energy Efficiency Subcommittee
Interim Report

—Prospects for demand-side energy policy—

July, 2023

General Resources and Energy Research Committee
Energy Efficiency and New Energy Subcommittee
Energy Efficiency Subcommittee

1. Background

The international energy situation has been changed after Russia's invasion to Ukraine last year, and amid soaring energy prices, many countries have taken significant measures to improve energy efficiency in the short-term and long-term. In the midst of this energy crisis, the importance of a stable energy supply has been reaffirmed, which has led to the acceleration of global efforts toward carbon neutrality, including those for renewable energy (hereafter referred to as "renewable"). These energy policy areas (such as energy efficiency and renewable) were the central agenda items at the G7 Hiroshima Summit chaired by the Japanese government [1].

This time, the Energy Efficiency Subcommittee of the Energy Efficiency and New Energy Subcommittee of the Advisory Committee for Natural Resources and Energy (hereinafter referred to as the "subcommittee") will take these developments into consideration when considering future issues of demand-side energy policy. Background is provided as below.

1) Global Trends

The range and scale of demand-side efforts across the world in response to the energy crisis that began last year were unprecedented. Energy efficiency is being strengthened as an immediate measure as the world faces the energy crisis. In May 2022, the EU formulated the REPowerEU plan, which aims to reduce energy consumption, diversify energy supply sources, and promote clean energy as a means to quickly shift away from dependence on imported fossil fuels from Russia and realize a transition to clean energy. Energy efficiency is positioned as an important pillar along with the energy source diversification, and clean energy production. To realize this plan, the EU will use the "Recovery and Resilience Facility" to provide EUR 250 billion in low-interest loans and subsidies (2022-2026). Approximately 30% of this amount will be spent on improving the efficiency of industrial production processes and renovating residential building to save energy. Under the "Inflation Reduction Act" enacted in August 2022 in the United States, of the total $369 billion in the clean energy sector, $60 billion, or about 16%, will be invested in energy efficiency over 10 years. Among emerging countries, China, India, and ASEAN countries are implementing energy efficiency measures as medium- to long-term climate change and energy security measures, while Thailand and other countries that are highly dependent on energy imports were implementing power conservation measures in 2022.

In preparation for the G7 Climate, Energy and Environment Ministers' Meeting in April this year, active exchange of opinions on energy efficiency and demand-side energy transitions with G7 countries, including holding workshops hosted by the Japanese government and the International Energy Agency (IEA). In the course of the workshop, they reflected on their responses to the oil crisis in the 1970s, and great interests were expressed in Japan's efforts to save electricity after the Great East Japan Earthquake in 2011.

Among these discussions with respect to policies on the demand side of energy, with an eye to carbon neutrality, a shift in definition is taking place – with respect to energy efficiency: energy efficiency definition is shifting from saving energy demand to transforming to non-fossil energy, electrification, and demand response (DR).

[1] For example, in the communiqué at paragraph 25, following is expressed. "We commit to holistically addressing energy security, the climate crisis, and geopolitical risks. In order to address the current energy crisis caused by Russia's war of aggression against Ukraine and achieve our common goal of net-zero emissions by 2050 at the latest, we highlight the real and urgent need and opportunity to accelerate clean energy transitions also as a means of increasing energy security at the same time."

In the Ministerial Statement of the G7 Climate, Energy and Environment Ministers' Meeting in April this year, it was agreed to develop from energy efficiency policies to "policies for decarbonizing energy demand" as follows.

Reference 1: Ministers' Communiqué of the G7 Climate, Energy and Environment Ministers' Meeting (April 16 , 2023)

63. Energy efficiency: We highlight the role of energy efficiency as the "first fuel" as a key pillar in the global energy transition towards net-zero GHG emissions in 2050. We emphasize the value of energy efficiency and energy savings across all sectors in enhancing energy security, access and affordability; reducing GHG emissions and mitigating environmental impacts; and creating economic growth and reducing energy poverty. We recognize the need for efforts on the demand side to reduce energy consumption, building on successful measures we have already taken in response to the current energy crisis including, information campaigns, influencing and responding to consumer preferences, demand flexibility measures and promoting energy-efficient equipment and solutions, while addressing possible rebound effects. We call on the IEA to assess the impacts demand reduction measures have already had in response to current pressures to identify and share best practices, and make recommendations. Furthermore, we recognize the importance of effective and efficient regulatory frameworks and share the view on the need to leverage public and private financing to promote both technological and non-technological solutions. We underline the need for 'energy efficiency first' to be recognized as a driving principle for our actions to ensure that energy efficiency and energy savings are duly taken into consideration in policy, planning and investment decisions. We also note that energy efficiency regulations, such as vehicle fuel efficiency regulations, building codes, minimum energy performance standards, energy performance certificates, and energy reporting systems for large scale consumers continue to gain momentum. **These measures will leverage further efforts to decarbonize energy demand, with strategic approaches including electrification, fuel switching, grid flexibility, digitalization of energy demand information and disclosure of energy and climate related information. We welcome the IEA's analysis on this evolution of energy efficiency regulatory frameworks in alignment with demand side decarbonization targets and will share this information with governments, including those of emerging economies, to support strengthened energy efficiency policies[2].** In this effort, we note that the IEA projects that a global acceleration of primary energy intensity improvements of 4 percent per year until 2030 is needed to be consistent with its Net Zero Scenario.

Furthermore, at the G7 Hiroshima Climate, Energy and Environmental Ministerial Summit held in May, an agreement was reached on the importance of "development of energy policies on the demand side".

Reference 2: G7 Hiroshima Leaders Communiqué (May 20, 2023)

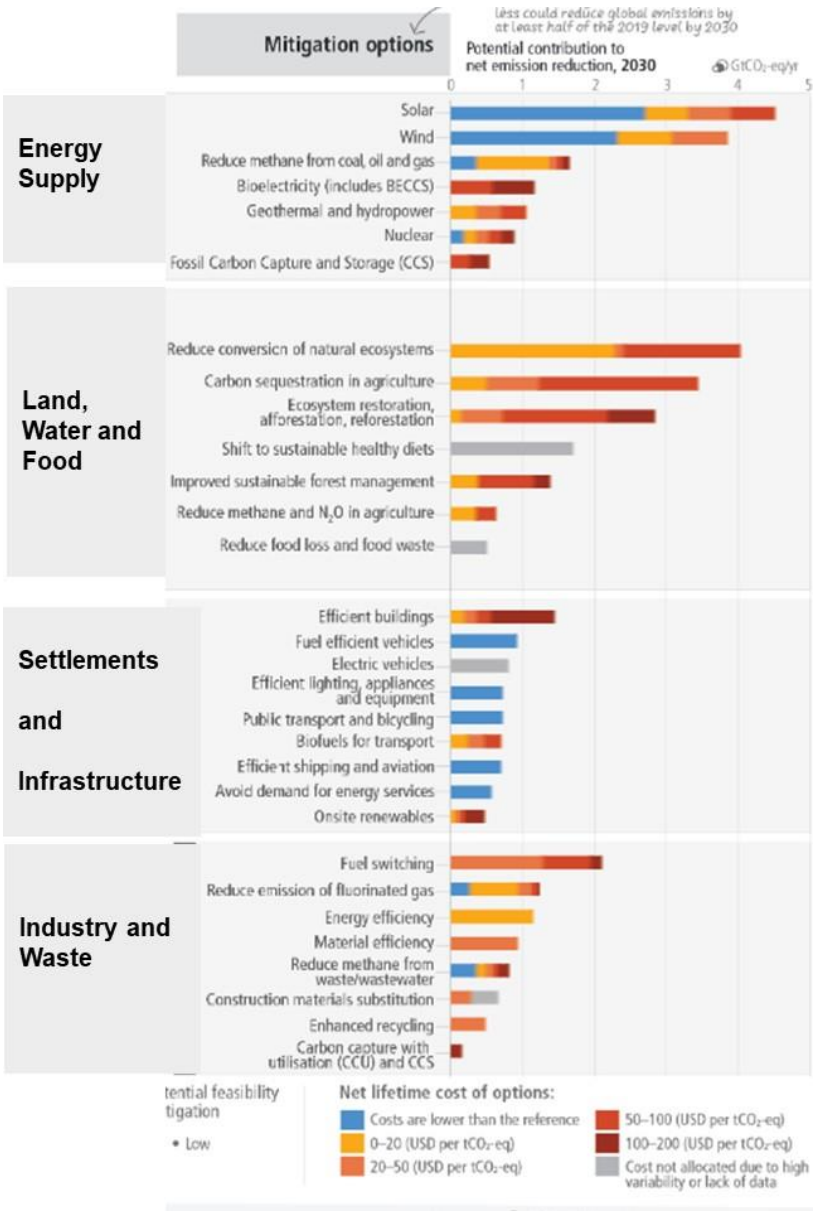
(Paragraph 19 on climate change) "We will take further action on supply-side measures and **recognize the need for further decarbonization efforts on the demand-side** such as promoting changes in infrastructure and material use and end-use technology adoption as well as promoting sustainable consumer choice."
(Paragraph 25 on energy) "Through our experience in coping with past and current energy crises, we highlight the importance of enhanced energy efficiency and savings as the "first fuel," and of developing demand side energy policies."

As indicated in the G7 Hiroshima Leaders' Communiqué, the importance of demand-side energy transitions is gaining increasing attention in the wider context of global warming countermeasures. In the Synthesis Report of the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) released in March this year, the costs of various energy/non-energy mitigation options are listed, and energy-saving measures for automobiles, equipment, etc. are presented as low-cost

[2] This statement in the communiqué was published on 14 April 2023 in the IEA booklet "The Evolution of Energy Efficiency Policy to Support Clean Energy Transitions". It summarizes the situation in which conventional "energy efficiency policies" are evolving into "policies for decarbonizing energy demand" such as electrification, fuel conversion, and system flexibility in the building, transport, and industry sectors. It will be developed into a long report.

measures with a lot of room for GHG emissions reduction, along with renewable energy such as solar and wind power.[3]

Reference 3: Diagram of IPCC AR6 Synthesis Report (published on March 20, 2023)



(Source) IPCC Sixth Assessment Report Synthesis Report Summary for Policymakers

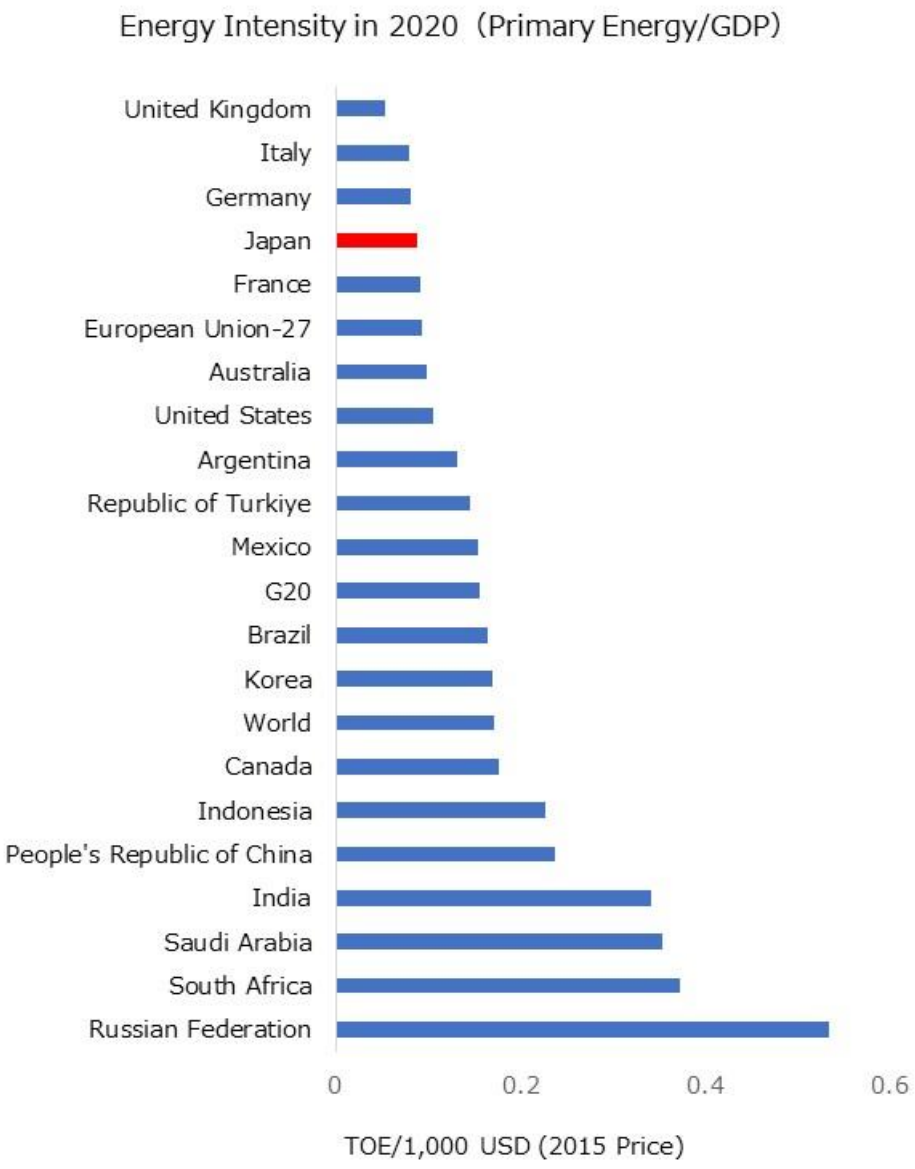
In the midst of these trends, in Europe, the United States, and other countries, various policies such as the decarbonization of residential heat demand are being considered. For example, in the United Kingdom, a gradual phase out of the use of fossil-fuel gas boilers for new heating equipment is being planned. On the other hand, there is a movement to oppose the ban on gas boilers in the Southern and Midwestern regions of the United States by enacting state laws that ban to ``ban gas connections in new homes and buildings.''

[3] A report released last year by the IPCC Working Group 3, which conducts a more detailed analysis of demand-side mitigation measures for AR6, stated that "The replacement of lights, appliances, and office equipment, including ICT, water heating, and cooking technologies could reduce more than 8% and 13% of the total sector baseline emissions in developed and developing countries respectively, typically at negative cost." (IPCC AR6 WG3 Full Report , p.992).

2) Japan's demand-side energy policy

Japan, which relies on foreign countries for most of its energy supplies, has been required to make effective use of its limited energy resources. Until now, Japan has implemented thorough measures in both regulatory measures under the Act on Rationalizing Energy Use(Law No. 49 of 1979) enacted in 1979 in the wake of the oil crisis, as well as budgetary and tax support measures. Japan has been promoting energy-saving initiatives, and as a result of these efforts, Japan has been recognized as having the world's highest level of energy efficiency, especially in the manufacturing industry. On the other hand, if we look at an international comparison of energy intensity (calculated as primary energy consumption per GDP) without adjusting for differences in industrial structure, etc., an analysis by the Institute of Energy Economics, Japan using IEA data for 2022 shows that in the G20, Japan's energy intensity has ranked the 4th position.

Reference 4Primary Energy Intensity in 2020 by the IEA : International Comparison of Basic Units



(Note) GDP is at 2015 prices, USD exchange rate conversion.
(Source) The Institute of Energy Economics, Japan (2023). Partially modified from IEA (2022) "World Energy Balances".

Japan is ranked the 7th in the "International Energy Efficiency Scorecard" by ACEEE (American Council for an Energy-Efficient Economy), which is an index that qualitatively evaluates the energy

efficiency efforts of each country. Japan was ranked the 1st in the industry sector, the 3rd in the national effort, the 9th in the transportation sector, and the 16th in the residential/commercial sectors.

Reference 5: International comparison by ACEEE (2022)

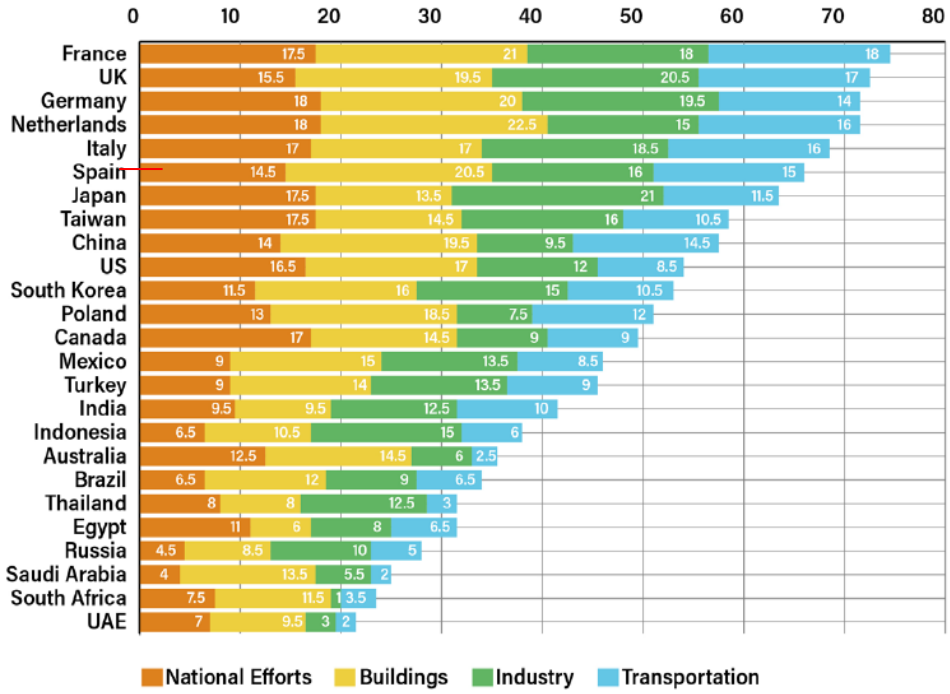


Figure 3. Overall scores and rankings

(Source) ACEEE (2022) International Energy Efficiency Scorecard

On the other hand, in order to achieve carbon neutrality in 2050, it is necessary to dig deeper into energy efficiency. The Global Warming Countermeasures Plan approved by the Cabinet in October 2021 set the CO2 emissions reduction target of 46% compared to FY2013, a significant improvement from the previous target of 26 %. In particular, a large reduction target of 66 % has been set for the residential sector. In the 6th Basic Energy Plan, the energy efficiency target of 12.08 million kL in oil equivalent for the residential sector is set. This corresponds to approximately[4] 30 % of the energy currently used in the residential sector. As for the residential sector, by fiscal year 2030, 2.53 million kL (by newly built houses) and 910,000 kL (by residential home renovations) will be saved through strengthening of the Act on Improvement of Energy Use Performance of Buildings(hereinafter referred to as the "Building Energy Conservation Act"). For high-efficiency water heater, 2.65 million kL of energy savings is required – a greater energy efficiency requirement compared with those than measures for newly built houses.

In addition, in order to achieve carbon neutrality in 2050, it is necessary to thoroughly implement energy efficiency on the demand side and promote the introduction and expansion of non-fossil energy such as renewable energy. With regard to efforts on the demand side, the 6th Basic Energy Plan, which was revised in 2021, highlights that "we will promote thorough energy efficiency while it is important to build an institutional framework expanding the introduction of non-fossil energy through electrification, hydrogen, etc. on the demand side".

Reference 6: Related descriptions in the 6th Basic Energy Plan

[4] The energy consumption of the residential sector in 2021 was 46.04 million kL. (From the Comprehensive Energy Statistics 2021 Energy Supply and Demand Results (final report) released on April 21 , 2023)

(3) Expand introduction of non-fossil energy through electrification, hydrogen based on thorough energy efficiency on the demand side and decarbonization on the supply side.

In order to achieve carbon neutrality by 2050 and the ambitious goal of reducing greenhouse gas emissions by 2030, we will promote thorough energy efficiency. It is necessary to build an institutional framework to encourage all kinds of efforts to contribute to S+3E, such as expanding the introduction of non-fossil energy through electrification and hydrogen.

In response to this trend, in May 2022 , the Act on Rationalizing Energy Use was revised, and the name of the law was changed to the " the Act on Rationalizing Energy Use and Shifting to Non-fossil Energy " (hereinafter referred to as the "Energy Conservation Act") .), and newly established measures for conversion to non-fossil energy (hereinafter referred to as "non-fossil conversion") and electricity demand optimization (DR). In the industry sector, large-scale consumers such as factories that consume more than 1,500 kL of energy annually are required to report on non-fossil conversion and electricity demand optimization. Also, in the transport sector, freight transport companies and shippers that consume more than a certain amount of energy are required to report on non-fossil conversion.

On the other hand, among the final energy consumption in Japan, the energy consumption of companies subject to regular reporting under the Energy Conservation Act is about 80% in the industry sector, about 60% in the commercial sector, and about 10% in the transport sector[5]. Therefore, for residential (air conditioners, passenger cars, etc.) and small and medium-sized enterprises (industrial operations, transportation), there are no non-fossil conversion/DR measures based on existing mechanisms such as the energy efficiency periodic reporting system.

In addition, with the expansion of the introduction of variable renewable energy, when the power supply is expected to exceed the demand, the output curtailment of renewable energy power sources to ensure the balance between supply and demand is increasing, and the need for DR efforts is rising.

Against this background, it is necessary to encourage further energy efficiency improvement, non-fossil fuel conversion, and DR efforts, especially in the residential and small and medium-sized enterprises.

2. Direction of policy formulation

Among the policies based on the Energy Conservation Act, in addition to direct regulation (regular reporting system) for large-scale consumers, there is an "indirect regulation" that promotes energy efficiency for small-scale consumers (residentials and small and medium-sized enterprises) who are not subject to the regular reporting system. As a regulation, Japan has developed the Top Runner Program and the information provision system for general consumers. In this subcommittee, "Approach from energy consuming equipment" and "Approach from energy retailers" were examined as a future direction for strengthening energy efficiency, non-fossil conversion, and DR for residentials and small and medium-sized enterprises. These approaches are maintained within the framework of "indirect regulations" of the Energy Conservation Act.

Specifically, we have been deliberating on (1) non-fossil energy conversion of energy consuming equipment, and (2) DR for energy consuming equipment as an "approach from energy consuming

[5] A simple trial calculation using data from the Energy Conservation Act Periodic Report and Comprehensive Energy Statistics shows that the Energy Conservation Act covers about 79% of the industrial sector and about 61% of the commercial and other sectors out of the final energy consumption according to the boundaries of the Law. In addition, the Energy Conservation Act covers about 9% of freight and passenger final energy consumption in the transport sector, including private cars.

equipment". Also, we have been deliberating on the provision of information and services from energy retailers to consumers as an (3) "approach from energy retailers".

1) Non-fossil energy conversion of energy consuming equipment

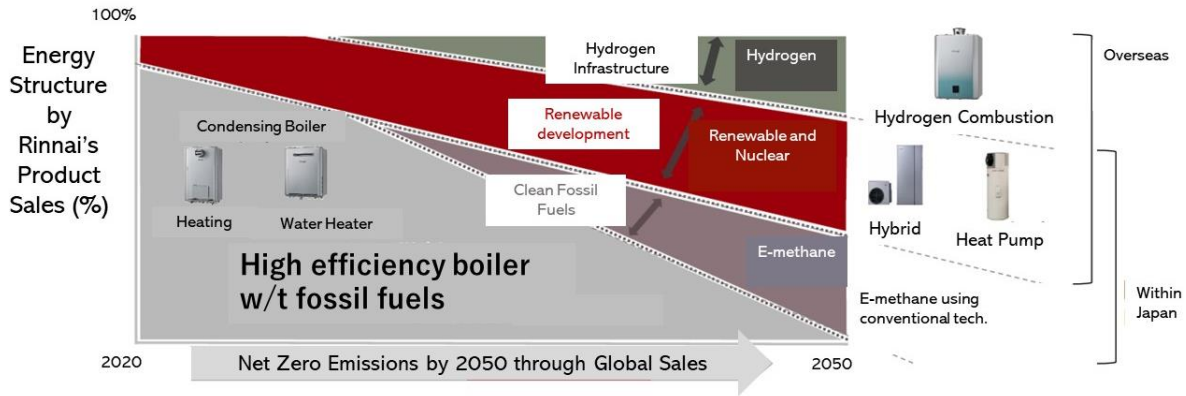
To achieve carbon neutrality in 2050, it is important to promote the shift to non-fossil energy not only on the energy supply side but also on the demand side. The 6th Energy Basic Plan highlights the importance of “expanding the introduction of non-fossil energy through electrification and hydrogen, etc.” In particular, unlike those companies subject to the regular reporting system of the Energy Conservation Act, for the residentials and small and medium-sized enterprises, a sufficient regulatory system for switching to non-fossil energy on the demand side is not in place aside from the provision of economic incentives (for new buildings, from 2025, the Revised Building Energy Conservation Act makes it compulsory to comply with energy efficiency standards).

Even in the Plan for Global Warming Countermeasures, which is inextricably linked to the Basic Energy Plan, the 2030 emission reduction target for the residential sector is -66%, the largest reduction rate among major sectors. About 30 % of the current CO2 emissions in the residential sector are attributable to hot water supply, and even in the 2030 energy efficiency target, hot water supply accounts for the largest share of the residential sector at 22 %. Therefore, the discussion in this subcommittee focused on water heaters.

In addition, in Europe, each country is[6] proceeding with the introduction or planning of regulations prohibiting the installation of new fossil fuel boilers in order to achieve carbon neutrality. Gas boilers were the mainstream for heating in Europe (unlike the situation in Japan that many of the household utilizes air conditioners for heating purpose); nevertheless, they are similar in that they focus on residential heat demand.

Safe, convenient and comfortable hot water supply facilities have played a role in the significant improvement in the living environment under Japan's rapid economic growth. It was the Japanese manufacturers that developed various water heaters that matched the housing situation in Japan. Half a century has passed since that dawn, and in the movement toward carbon neutrality mentioned above, major water heater manufacturers in Japan are developing and selling energy-saving water heaters, as well as heat pump water heaters, hybrid water heaters and hydrogen-fired water heaters. These efforts are not only from the perspective of contributing to decarbonization, but also a growth strategy for capturing global trends and capturing global markets.

Reference 7: Rinnai Corporation's Carbon Neutral Efforts



[6] In addition to non-fossil fuels such as hydrogen and biomethane, hybrid heating that combines heat pumps and gas boilers is also considered as an option.

(Source) From the company's presentation materials at the 40th subcommittee on April 24, 2023

The government will also support these efforts through policies such as GX (Green Transformation. Transformation of the entire economic and social system by shifting the fossil fuel-centered economic, social, and industrial structure since the industrial revolution to a clean energy-centered one.). For example, with regard to promoting the introduction of high-efficiency water heaters, 30 billion yen was allocated in the supplementary budget for FY2022, and subsidies for residential fuel cell, hybrid water heaters, and heat pump water heaters have started.

In addition to these economic measures, from the perspective of promoting the non-fossil energy conversion of energy-consuming equipment in the residential consumers and small and medium-sized businesses, etc., this subcommittee had held discussions with equipment manufacturers and importers (hereinafter referred to as "equipment manufacturers, etc.") for their requirements on the transition toward the production of non-fossil fuel hot water supply equipment. As with the current Top Runner Program, this system will consider the energy supply and demand situation (including the difference in conversion to non-fossil energy for each energy type) and relevant trend of technological development in the field, and require equipment manufactures to achieve a certain non-fossil energy ratio by the target year.

In order to further consider such a mechanism, it is necessary to conduct detailed discussions on the following items ① to ③.

① Target equipment and timing

During the course of discussion at this subcommittee meeting, we focused on household energy consumption and discussed water heaters, which are the largest demand factor, as an example. For example, just looking at residential water heaters, there are gas water heaters, kerosene water heaters, electric water heaters, heat pump water heaters, hybrid water heaters, and household fuel cells. The product configuration differs depending on the manufacturer. In considering target equipment and its timing (starting date of the system and target fiscal year), these points should be taken into consideration, and we should continue to consider this issue.

② Non-fossil energy target

In the Top Runner Program for energy-saving equipment, energy-saving targets should be set using evaluation standards based on JIS and international standards, such as APF (year-round energy consumption efficiency) of air conditioners and fuel efficiency (km/L) of automobiles. However, regarding the issue of non-fossil energy conversion of equipment, the degree of non-fossil energy is greatly affected by the degree of non-fossil energy on the electricity and fuel side (not determined by equipment alone). Non-fossil fuel conversion cannot be realized only through development and sales by manufacturers. On the other hand, the government, energy suppliers, and their industry associations have set medium- to long-term targets for non-fossil fuels and electricity in order to achieve carbon neutrality. It is hoped that equipment manufacturers will prepare equipment that supports the supply side targets. While referring to such preparation plans for future development and sales, more detailed considerations should be made for realistic system design. There are various methods (electrification, hydrogen, e- methane, etc.) toward non-fossil energy for meeting the residential heat demand, and each energy supplier is engaged with the efforts toward meeting the carbon neutral target through technological innovation and sales efforts. Building on the various stakeholders' engagement, system should be in place to develop indicators that can evaluate such efforts based on various methods in a

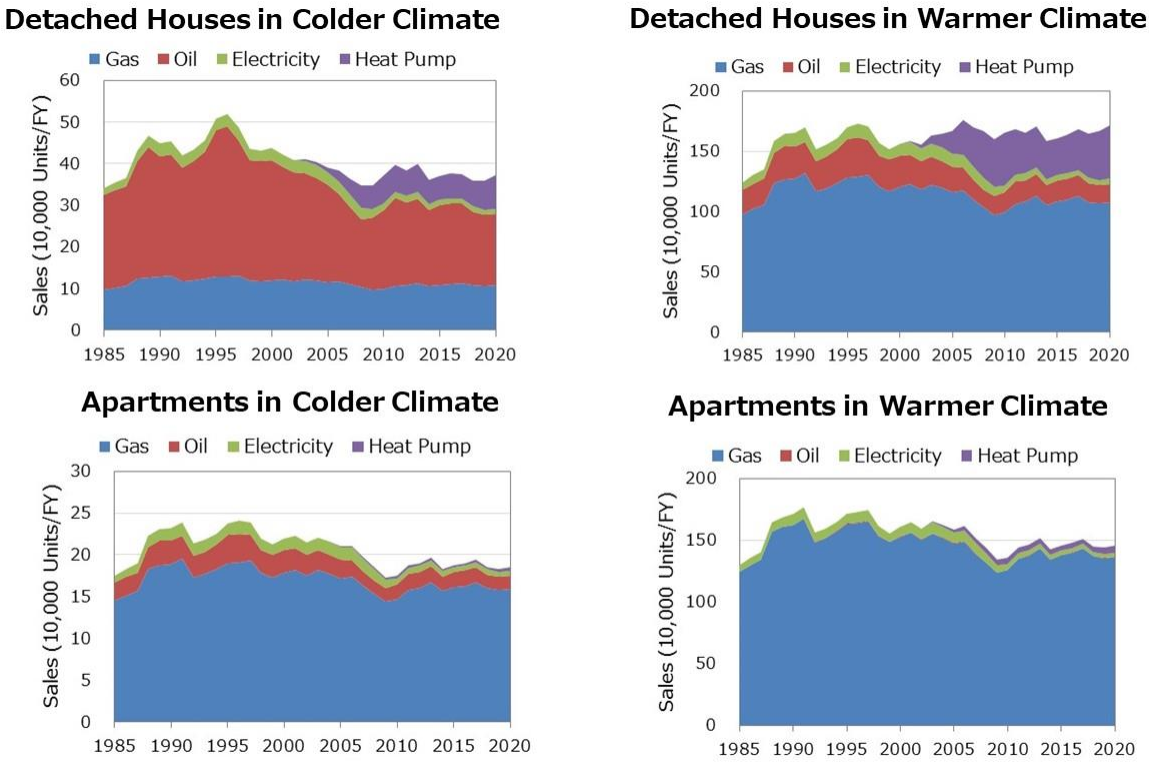
technology-neutral manner (for example, a comprehensive index based on the CN contribution of electricity, hydrogen, and e-methane, etc.).

For the purpose of detailed planning for such indicators, we will not only focus on the environmental aspect, but also on the supply side and the demand side in the energy policy of the whole country such as the Basic Energy Plan, based on the so-called "S + 3E": safety, energy security enhancement, economic efficiency and environmental protection.

③ Consideration of demand characteristics

Residential heat demand in Japan varies greatly depending on the climate conditions and the type of dwelling, and therefore the performance required of energy-consuming appliances also changes. For example, in detached houses in cold climate conditions, kerosene water heaters are widely used, and heat pump water heaters, whose energy consumption efficiency decreases under extremely cold outside temperatures, are less popular. In addition, since the space required to install a hot water tank is severely constrained in apartment complexes and small detached houses in urban areas, the introduction of heat pumps and residential fuel cells is limited. Furthermore, as the number of residential members is expected to decrease in the future, it will become difficult economically to invest in high-performance water heaters with low demand for hot water supply. Technologies overcoming these challenges need to be developed.

Reference 8: Trends in the number of residential water heaters shipped by climate and by type of residential building (1985-2020)



(Source) From secretariat materials at the 40th subcommittee meeting on April 24

Furthermore, it has been pointed out that in rental housing, the burden and benefits of energy-saving investment are divided between the landlord and the tenant (the so-called "owner/tenant problem"), so it is difficult for the landlord to perceive the merits of energy-saving investment, which hinders investment.

It is essential to fully consider such demand-side characteristics when considering target equipment and non-fossil energy targets. It is also important to continue improving the efficiency

of energy-consuming equipment based on the Top Runner Program, including in cases where it is difficult to install hot water storage tanks in housing complexes, etc., making it difficult to switch to non-fossil energy.

Rather than giving up on these issues as "insurmountable", concerted efforts are necessary among the Japanese stakeholders to develop technologies for carbon neutrality, just as Japanese water heater manufacturers have created products that are suitable for the housing situation in Japan through technological development. (For example, heat pumps for cold regions and small hot water storage tanks suitable for collective housing, etc.) In addition, the government will take strong policy measures, such as providing economic incentives to support the technological development of water heater manufacturers, and the creation of a forum for promoting product development in collaboration with related industries (energy suppliers, housing manufacturers, etc.).

In addition, in order to decarbonize the residential heat demand, especially in cold regions, it is important not only to produce equipment for meeting carbon neutrality, but also to strengthen the insulation performance of houses. Efforts involving existing houses, such as the "energy-saving housing campaign" implemented by the three ministries; including Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure, Transport and Tourism, and the Ministry of the Environment, are also necessary, and should continue to be implemented in cooperation with each ministry and agency.

2) Energy consuming equipment

Renewable energy output curtailment had previously been implemented only in the Kyushu area, but with the recent increase in the introduction of solar power generation, the area has expanded, and it is now being implemented nationwide. The annual output curtailment rate in the Kyushu area remains at around 3-4%, but if no countermeasures are taken, it is expected to increase in further. As the introduction of variable renewable energy such as solar power generation is expected to expand, in order to stabilize the power system, it is important not only to ensure flexibility on the supply side and strengthen the interconnection of the grid, but also to respond to the demand side. On the demand side, it is conceivable to flexibly adjust to the fluctuating power supply, such as by lowering power demand when there is a tight supply-demand balance and raising power demand when output is controlled.

Last year's revision of the Energy Conservation Act introduced measures to encourage DR to be implemented by factories and offices subject to the regular reporting system. DR efforts are already underway to adjust the operating hours of facilities with high output, such as electric furnaces, through contracts with electric power companies and specified wholesalers (hereinafter referred to as "aggregators"). On the other hand, in homes and small offices, the amount of output per either “demand turn up” or “demand turn down” is small, so it is expected that it will take more time to develop the utilization of DR resources compared with the large-scale factories. In addition, it seems difficult to continue such DR manually (behavior induction). Therefore, the following “DR ready” market circumstances are necessary to be created in future.

A) [Business operators] There are many services such as aggregators that can remotely control (or automatically control) these resources.
B) [Markets, etc.] These DRs are effectively used in the electricity market, etc.
C) [Equipment] Various devices (or resources) installed in households are equipped with remote control functions as standard.

Of these, A) and B) are being discussed at the "METI's Study Group on Next-Generation Distributed Power Systems". Specifically, the number of aggregators is increasing year by year, reaching 48 as of the end of May 2023. In order for these aggregators to enter the balancing market with low-voltage resources from FY2026, solutions to problems arising from individual device measurement and detailed examination of market rules are under considerations.

C) was discussed in this subcommittee with reference to overseas cases. For example, in the state of South Australia, based on energy-saving regulations for home appliances, home air conditioners, water heaters, EV chargers are required to be equipped with DR-compatible functions (standard AS4755 that specifies the external DR control devices with a function that can communicate remotely). In the UK, from 30 June 2022, standard EV charging facilities for home and work use sold in the UK are required to be equipped with smart features to default EV charging during off-peak hours. In Japan, as the curtailment of renewable energy increases, it is possible to absorb surplus electricity by equipping various devices installed in houses and other facilities with remote control functions as standard, while it is important to reduce the cost so the people can enjoy infrastructure.

In this subcommittee, from the perspective of realizing the potential of low-voltage DR resources, referring to the Top Runner Program, a mechanism to require equipment manufacturers, etc. to introduce a certain DR ready function will be considered by the target year. With respect to air conditioners, models that can be remotely controlled are also becoming popular. In order to further study such mechanisms, it is necessary to continue having discussions on the following items from ① to ③.

① Target equipment and timing

As mentioned above, in order to expand DR in the low-voltage sector such as residential consumers, it is necessary to make DR ready including businesses other than equipment and markets. It is also a prerequisite that the economic environment for cost recovery is in place. It is essential to consider the timing of establishing a DR ready environment, including elements other than equipment such as service providers and markets, and to plan the target year and timing of system introduction. Furthermore, even without government intervention, it is possible that standards and specifications related to DR ready will be formulated in the midst of market competition, and their introduction will proceed naturally. While taking these points into consideration, regarding the mechanism to require manufacturers to produce equipment with DR ready functions through regulations such as the Energy Efficiency Top Runner Program, the applicable targets and the timing of introduction will be as follows: It is necessary to proceed with careful consideration while gaining the understanding of the parties concerned. In addition, this subcommittee commented that "it is important to accelerate the efforts of private businesses by announcing the usefulness of DR ready with the spread of such equipment in mind in the future."

At present, a water heater with a heat pump function can be considered as a device that has a high output (kW) and its operation timing can be shifted. Existing heat pump water heaters, which have been installed on the premise of nighttime operation, are difficult to change its operational timing to daytime. Residential room air conditioners operate during the peak power demand in summer and winter, so its potential effect on DR is estimated to generate large peak shift potential[7], but compared to heat pump water heaters that can shift the heating time from

[7] According to Daikin Industries' presentation at this subcommittee (conducted on April 24, 2023), it is assumed that all residential air conditioners on the market would be controlled from the outside, and 30% of them are in operation. If power consumption is reduced by 10% at peak times, negawatt power (instantaneous) that can be created is about 1.9 million kW.

night to day, the peak shift potential is limited. Also, it is necessary to consider the risk of affecting the user's comfort and health (heatstroke risk). Furthermore, in the future, if EVs ownership increase according to national targets, the potential for peak shift of charging time in residential household (e.g., charging EVs with high output (6 kW) immediately after returning home in the evening) is expected. It is expected that there will be a certain degree of shift to late-night hours and surplus solar power generation hours during the day. However, it is necessary to keep in mind that the usage patterns of EVs differ by household.

In addition, along with making such equipment DR ready in the future, electricity retailers will develop price menus that encourage consumers to engage in DR (for example, dynamic pricing and time-based pricing (ToU)) and rewards (incentives) for DR behavior are provided prior to making the device DR ready. From this point of view as well, this subcommittee is discussing the introduction of a regular reporting system for retail electricity suppliers. (See "3) Energy retailers to consumers" as below.)

② Equipment DR ready requirements

For device to be DR ready, it is a prerequisite that each device communicates with the HEMS (Home Energy Management System) installed in the home, or communicates with manufacturers, aggregators, via wireless LAN, ensuring that devices can communicate with each other regardless of manufacturer (interoperability). Various methods have been developed for DR at home, such as ECHONET-Lite and the cloud of various manufacturers. With a view to expanding the spread of DR targeting residential consumers, considering how aggregators and manufacturers can comply with the DR command, we will consider how communication protocols should be, while paying attention to the situation such as international competition for standards. A more specialized study should be conducted. At this time, it is also important to consider that the technical specifications are not restricted to Japan, but that they do not hinder the global expansion of companies. In addition, since devices will be connected, it is also an important requirement that appropriate cyber security countermeasure functions and operation systems are implemented.

The ideal of DR ready is to contribute to the optimization of electricity demand (and provide incentives to do so) without the consumer feeling any trouble or burden. The IEA report, which organizes international discussions on DR ready for EVs, states as follows: "Smart charging should be ready (for users), but smart charging is not necessarily compulsory."

It is important to note that the minimum standards for charging points and vehicles must make them ready to conduct smart charging but not necessarily oblige smart charging. EV users must still have the final choice to participate in managed charging schemes based on their specific needs.
IEA (2022), Grid Integration of Electric Vehicles

It is also important to carefully provide consumers with information, including the policy significance and social benefits of DR ready, and foster their understanding.

③ Cost/benefit analysis

Making a device DR ready is expected to incur additional costs not only for the device but also for development, manufacturing, and operation such as installation on the cloud side. In the current Energy Efficiency Top Runner Program as well, raising the target for energy consumption performance such as APF of air conditioners will lead to an increase in the costs of equipment manufacturers, so this point is taken into consideration when setting the target. In other words, cost is also an important factor in making device DR ready. In addition, when DR services are immature and social benefits do not lead to consumer benefits, it is also necessary to provide policy support for the costs borne by consumers.

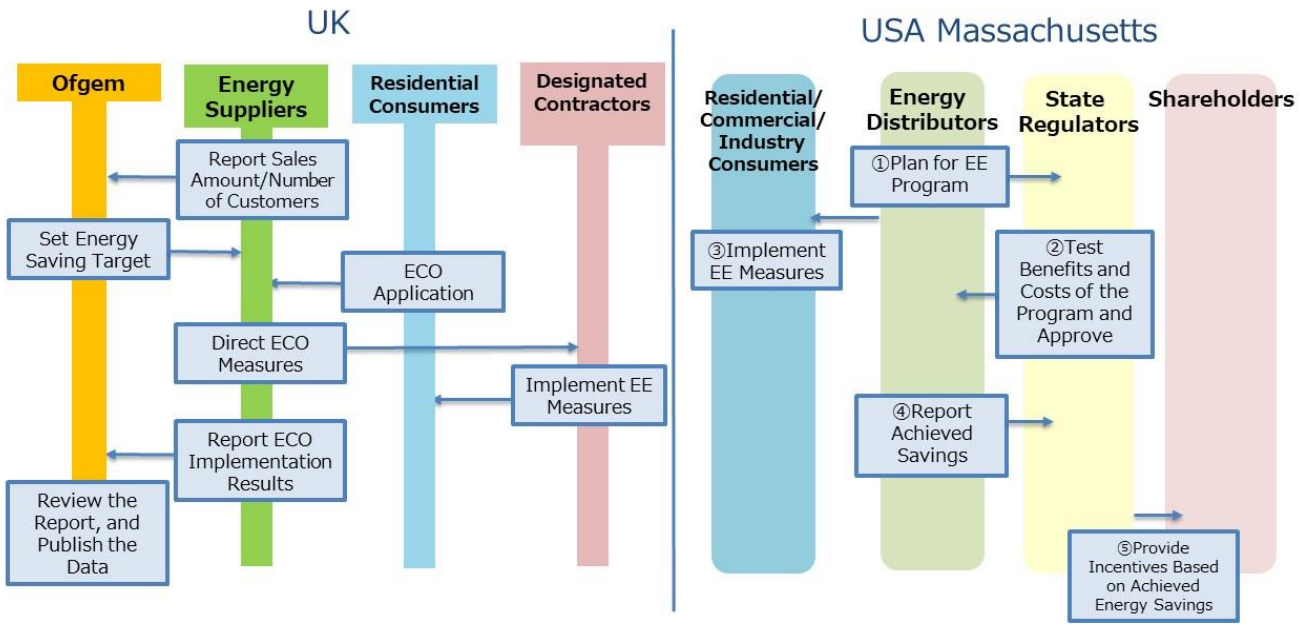
In addition to the cost, it is important to evaluate the benefits of DR ready not only for consumers but also for the entire power system, and to consider policies based on the cost and benefit analysis. In doing so, it should also be taken into consideration that the social benefits of DR ready are expected to expand significantly in some regions as the introduction of renewable energy expands in the future.

When looking at the social benefits brought about by DR from a broader system-wide perspective, it is conceivable that there will be cases where investment in transmission and distribution facilities becomes unnecessary due to the implementation of DR. From the perspective of curbing the increase in social costs, it is also important to consider how wheeling charges should be such that consumers are encouraged to take DR and the social benefits are returned to consumers who implement DR.

3) Energy retailers to consumers

Since energy efficiency is an action that leads to cost reductions for consumers, a business has been established in which energy management is provided as a service and the cost reductions of large-scale consumers are received as service fees. On the other hand, for small-scale energy consumers such as residential consumers and small and medium-sized enterprises, it is difficult to establish a business in which individual contracts are concluded, energy management services are provided, and compensation is provided. For this reason, efforts are spreading overseas to require energy suppliers, which have contacts with consumers, to promote energy efficiency for their customers. In 1994, the United Kingdom was the first country in the world to introduce the Energy Company Obligation, which sets energy-saving targets for energy suppliers and implements them on the consumer side. In 1996, the state of California in the United States launched a Public Goods Charge, which does not set targets for business operators, but implements an energy-saving program on the consumer side using power bills as the source of funds. In 1999, Texas introduced a system called the Energy Efficiency Resource Standard (EERS), which sets energy-saving targets for energy suppliers and implements energy-saving programs on the consumer side. Currently, 27 states in the United States have been implementing EERS for electric power only, and 18 states have been implementing the same system for electric power and gas. In the EU, white certificate systems were introduced in Italy (2005) and France (2006). After that, the Energy Efficiency Directive enacted in 2012 stipulated the implementation of Energy Efficiency Obligation as an effort target for member countries. Since then, the implementation has expanded.

Reference 9: Energy supplier obligation system in the UK, and Massachusetts.



In Japan, based on the provision of information to general consumers in the Energy Conservation Act (Article 165 of the Law), the Energy Efficiency Communication Ranking System evaluates the efforts of energy retailers has started from fiscal 2021. This system ranks businesses that proactively provide information that leads to energy efficiency for customers (five stars is the highest rating). The System has been progressing as to announce specific efforts such as power saving by businesses.

Reference 10: Status of participation in the FY2022 Energy Efficiency Communication Ranking System (form submission status)

	2021	2022
Retail electricity supplier	• Number of companies that submitted: 88 companies (Number of invitations sent: 808 companies*2) • Response rate: 11%	• Number of business operators submitted: 136*1 (Number of invitations sent: 727 people*2) • Response rate: 19%
City gas retailer	• Number of business operators submitted: 70 (Number of invitations sent: 200) • Response rate: 35%	• Number of companies submitting: 41*1 (Number of invitations sent: 200) • Response rate: 21%
LPG retailer	• Number of companies submitted: 6 companies	• Number of companies submitting: 6 companies *1

*1: All business operators with more than 300,000 contracts (business operators that are known) have submitted forms.

*2: The number includes retail electric power companies including those that do not supply electricity to general residential consumers.

On the other hand, during the operation of this system for the past two years, the response rate of business operators was low, the consumer recognition was insufficient, the contribution to consumer behavior change could not be grasped, and the evaluation results were not disclosed. There is an opinion that it is necessary to collect and compare quantitative data on behavioral change. Since this system requires businesses to respond voluntarily, there is concern that asking businesses for more detailed data itself will lead to a further decline in the response rate.

In order to deal with these issues, this subcommittee had discussed a system that will elevate an energy efficiency communication ranking system, and require energy retailers to report to the government regarding the information and services that can encourage consumers to promote energy efficiency, non-fossil conversion, and DR. With regard to the retail business of electricity and city gas, in light of the fact that full liberalization has been implemented for residential consumers as well, we will strive to promote energy efficiency for consumers through ingenuity through mutual entry beyond the barriers of energy retailers. It is also important to provide price menus and services that lead to behavioral changes. Through the energy efficiency communication ranking system from FY2021 to FY2023, it is expected that a considerable amount of knowledge such as good practices of businesses and evaluation methods for efforts will be accumulated. In addition, regarding non-fossil energy efficiency and DR, considering that the amended Energy Conservation Act has expanded the scope of

the law to include conversion to non-fossil energy and optimization of electricity demand, these matters are also included in the report items.[8]

In order to further consider such a mechanism, it is necessary to conduct detailed discussions on the following items ① to ③.

① Eligible retailers

The Energy Efficiency Communication Ranking System targets electric, gas, and LP gas businesses. These businesses are assumed to be the target of the new mechanism to be examined this time. In addition, there are small and medium-sized businesses in the target industries, and it would be an excessive burden to require such businesses to submit periodic reports to the government. Meanwhile, it is assumed that eligible businesses will be cut off based on criteria such as the number of contracted customers and the amount of energy supplied; nevertheless, measures that encourage non-eligible businesses to actively provide information and services (for example, business operators' "energy-saving information provision tool for consumers" prepared and provided by the Agency for Natural Resources and Energy) is also important.

In addition, it is important to organize the targets and purposes so that they do not overlap with other laws and regulations that apply to energy retailers[9] (for example, the Energy Supply Structure Advancement Act sets a non-fossil power source ratio target for retail electric power companies.).

② Matters to be reported

It is assumed that consumers will be requested to provide information and report on service provision regarding energy efficiency, non-fossil fuel conversion, and electricity demand optimization, but even now, information and service provision in a wide range of fields is provided by each business operator.

Reference 11: Examples of initiatives by energy retailers introduced by this subcommittee

"Enecali Plus" (TEPCO Energy Partner)

A flat-rate equipment usage service that allows the introduction of a solar power generation system. A solar power generation system is installed on the customer's rooftop, and the generated electricity can be used freely by the customer. At the end of the 10 -year or 15- year contract period, the equipment will be transferred to the customer free of charge. In addition to solar power generation systems, TEPCO also proposes combinations of electrical equipment such as storage batteries to suit the lifestyles of the customers.

There are examples that energy retailers are providing energy-saving diagnostic services to consumers using smart meter data, offering rebates related to the introduction of high-efficiency equipment, and implementing DR as services.

[8] According to a survey of highly rated retail electric power companies, etc. in the 2022 evaluation of this system, half of the target companies provide power menus centered on non-fossil energy, and 40% provide a power menu that contributes to demand optimization, and the expansion of this scope is consistent with the direction of business operators' efforts.

[9] Examples include: the Law Concerning the Promotion of Environmentally Conscious Use of Energy Sources and Effective Use of Fossil Energy Raw Materials by Energy Suppliers (the Law for Advancement of Energy Supply Structures), and the Energy Retailing Laws under the Electricity Business Law.

In future deliberations, we should deepen our discussions on the items to be reported, taking into consideration the actual situation, the purpose of the system, and precedent overseas cases.

It was also pointed out in this subcommittee that it is important to set quantitative targets that lead to "outcomes" such as changes in consumer behavior and savings in energy consumption. It is important to impartially assess the achievement of this outcome goal. For example, initiatives that lead to the promotion of DR among consumers include input (providing price menus, etc. that encourage consumers to DR), output (number of contracts for the price menu), and outcome (annual DR realized by the contract). However, if the outcome evaluation criteria (baseline setting in the case of DR volume) are not standardized, more detailed organization and analysis should be done.

Reference 12: Input/output/outcome arrangement diagram
(The following items are intended as examples of the framework of this subcommittee in the future, and are not intended to prejudge future consideration.)

	Input target	Output target	Outcome target
Energy efficiency	• Provision of subsidies and price menus to promote the introduction of highly efficient gas water heaters, heat pump water heaters, etc. • Provision of information such as real-time energy consumption and advice on Energy Conservation Act using smartphone apps, and point programs • Residential consumers and small and medium-sized enterprises Implementation of energy efficiency diagnosis	• Number of contracts for various menus • Number of installed equipment • Number of accesses through information provision services, etc. • Number of energy saving diagnosis implementations, etc.	Due to the increase in the number of contracts for 〇〇 and the expansion of the introduction of ●●, we expect to save energy consumption by about kJ.
Non-fossil conversion	• Provision of a menu that provides incentives for combining solar power generation and gas appliances, etc. • Provision of electric power menus derived from renewable energy		About ◆kJ is expected to be converted to non-fossil energy due to an increase in the number of contracts related to 〇〇 and the expansion of the introduction of ●●.
DR	• Providing rate menus and point services that promote DR • Supporting the introduction of EcoCute, which effectively utilizes surplus solar power generated during the day • Supporting the introduction of gas equipment that can		The increase in the number of contracts related to 〇〇 and the expansion of the introduction of ●●, DR is expected to be implemented for about ◆ kW / kWh .

	contribute to DR, such as Ene-Farm and cogeneration		

The Energy Conservation Act includes measures for electric utilities (preparation and publication of plans for implementation of measures that contribute to the optimization of electricity demand; Article 159 of the Law) . Integration into the reporting system is also efficient from an operational point of view.

③ Mechanism to be recognized by consumers

In the discussion of this subcommittee, it was decided that "a periodical reporting system based on the periodical reporting system for large-scale consumers such as factories" was used. It is hoped that energy retailers that have contact points with consumers will actively present their plans and regular reports to consumers and other stakeholders. For energy retailers, being able to appeal to society, for example, the "contribution to emission reduction" by supporting the efforts of consumers leads to motivation to take action. In addition, since the "pledge and review" type initiatives of such businesses will reach the eyes of consumers and will be actively selected, the government will also promote disclosure methods with a list and comparisons between businesses. We should devise new ideas while learning from precedent overseas cases, such as benchmarks for doing so and incentives for businesses that are actively working on them.

3. How to proceed with future discussions

Deepening consideration of the issues mentioned above and advancing energy policies will contribute to the implementation of the items internationally agreed upon at the G7 this year, the realization of the Japan’s 6th Basic Energy Plan, and efforts toward carbon neutrality by 2050. It is expected that in the deliberations of this subcommittee, as a common issue for each discussion items, when creating a new mechanism as a regulatory measure, it is necessary to consider the energy supply and demand situation, trends in the development and diffusion of new technologies, cost/benefit analysis, etc. It was pointed out that careful discussion should be conducted on setting target companies and equipment and setting target years and target numbers. At the same time, expectations were expressed for the possibility of greatly advancing initiatives such as non-fossil conversion and DR, which were previously thought to be difficult for residential consumers and small and medium-sized enterprises. In addition, it was confirmed that similar policy targets have been set overseas and efforts are being made to realize such possibilities through a wide variety of regulations and economic support.

This subcommittee will continue its deliberations, and while taking into consideration the domestic and international situations surrounding energy policy, we will aim to present a systemic approach to this issue by the end of this year.