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RENEWABLE ENERGY INSTITUTE

Proposal for 2030 Energy Mix in Japan

(First Edition)

Establish a Society Based on Renewable Energy

Summary

2 September 2020

Renewable Energy Institute

Introduction

From now into next year, Japan will have some major choices to make on its energy policy.

March 11 of next year marks ten years since the Fukushima nuclear disaster which could have destroyed all of eastern Japan. Yet the safe, secure energy system demanded by the large majority of people in the nation can hardly be said to have been achieved. The COP26 conference, which was delayed because of COVID-19, has been rescheduled for November of next year. Already this year localized torrential rains have caused major damage, particularly in western Japan. Without quick and substantial reductions in carbon dioxide emissions, the climate crisis we are facing will only deepen.

The Japanese government has announced that it will be revising its Global Warming Countermeasures Plan ahead of COP26, and it is expected to also begin working on corresponding revisions to its Strategic Energy Plan. To prevent the tragedy of another nuclear disaster and to safeguard the lives and property of all people from the climate crisis, in revising its plans, Japan needs to choose a path forward based primarily on renewable energy so that it no longer has to rely on nuclear power and, ultimately, on fossil fuels.

This Proposal for 2030 Energy Mix in Japan (First Edition) is Renewable Energy Institute's proposal on which choices Japan should make. As suggested by being the 'First Edition,' these recommendations are not the end. They do not cover every point of discussion concerning what is needed to realize the aims of energy policy, which are to achieve decarbonization, ensure stable supply, reduce risk, and provide affordable energy. We have released them at this early date out of a desire to stimulate active debate from an early stage among all participants: experts, companies, relevant government ministries and agencies, local governments, NGOs and others.

Countries around the world are transitioning to sustainable energy systems. There are differences, of course, due to the different circumstances in each country, but what a majority of countries have in common is the intention to supply around half of their electric power or more with renewable energy by 2030.

Even in Japan, prefectural and municipal associations of major cities representing over 84 million people, around two-thirds of the total population of Japan, are proposing that the 2030 renewable energy target be raised to 'over 40%' or 'at least 45%.' The Japan Association of Corporate Executives, one of the country's three major economic associations, has proposed a 2030 target of 40%, and among major electricity consumers like members of the RE-Users and others, there is a growing consensus in support of an even more challenging target. This is being fueled by increasing recognition of the vital importance of renewable energy growth not only to climate action but to regional revitalization, economic growth and increasing new business opportunities.

In the hope of forming a broad consensus on the sustainable energy mix that Japan should adopt, we would ask for your forthright opinions and your active participation in constructive debate.

September 2020
Renewable Energy Institute

This is the English summary of the Japanese edition that was published on 6 August 2020. The Japanese edition can be downloaded from: https://www.renewable-ei.org/activities/reports/20200806.php

<Related Reports>

Proposal for Energy Strategy Toward a Decarbonized Society:

Achieving a Carbon-Neutral Japan by 2050 (April 2020)

https://www.renewable-ei.org/en/activities/reports/20190416.php

Chapter 1 Required Acceleration of the Energy Transition

The energy mix for fiscal 2030 determined by the government consists of 22-24% renewable energy, 20-22% nuclear power, and 56% thermal power. As of fiscal 2018, renewable energy had grown to 17%, whereas nuclear power was just 6%.

Nuclear power plants are resuming operations, but given the current state of their progress, it has to be concluded that achieving even half of 20%, the lower end of the range, will be exceedingly difficult. Unless growth in renewable energy goes well beyond the existing target, coal- and natural gas-fired thermal power will inevitably increase, which will make it very hard for the country to achieve its emission reduction target. The energy mix put forth by the government is already unfeasible; it needs to be revised as soon as possible.

It will soon be ten years since the Fukushima nuclear disaster, and the time is now for fundamentally strengthening climate actions. Japan needs to accelerate its energy transition. Based on the experience of other countries, it is clear that increased energy efficiency and growth in renewable energy must play a central role in this transition.

These recommendations outline a sustainable energy mix and present the policy issues involved to achieve it.

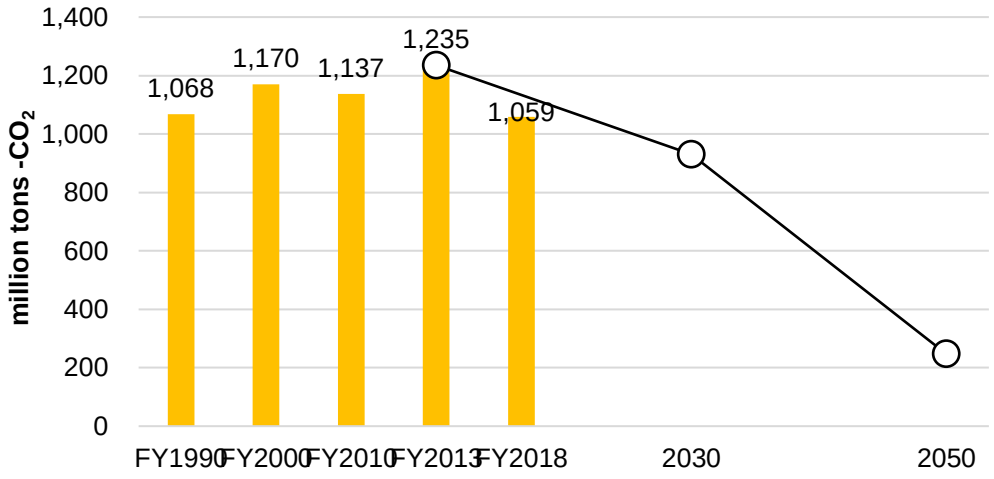
Chapter 2 Current Energy Supply-and-Demand

Final energy consumption in fiscal 2018 was 11% lower than fiscal 2010, and total electricity demand also declined by 11%, to 930 TWh in fiscal 2018, from 1,045 TWh in fiscal 2010.

Even though most of the country's nuclear power plants are not operating, CO_2 emissions from energy sources in fiscal 2018 declined 7% compared to fiscal 2010, to 1.06 billion tons, the first time the figure has fallen below fiscal 1990 levels. This decline is the result of decreased consumption of fossil fuels from lower energy consumption as well as growth in renewable energy.

With regard to energy costs, whether or not necessary energy services can be made available at affordable prices is an important issue, and from this standpoint, we considered the utility bills of regular households as a percentage of their actual income. Utilities were 3.2% of income in fiscal 2010, and after the nuclear accident, in fiscal 2013, they rose to 3.5%. By fiscal 2018, however, they had fallen back to 2.9%. The burden of energy costs on household finances is actually lower than it was in fiscal 2010 before Fukushima and the renewable energy surcharge.

Figure 2-4 CO_2 Emissions from Energy Sources: Trends and Government Targets



Note: The bar graph shows actual emissions. The line graph to fiscal 2030 shows government targets.

Source: By Renewable Energy Institute based on National Institute for Environmental Studies, Greenhouse Gas Inventory Office of Japan (2020), "GHG Emissions Data of Japan (1990-2018 Final Figures)"

Chapter 3 Potential for Renewable Energy Deployment by 2030

The factors restricting the growth of renewable energy in Japan have been, primarily, the high cost of power generation, restrictions related to grid connection, and site restrictions. We have used empirical methods to consider two scenarios based on deployment amounts to date and plans that are currently clear: the transition promotion scenario in which these restrictions are eliminated or ameliorated to promote the deployment of renewable energy by government policy, and the current policy scenario in which current systems (including those planned) and policies are maintained without major changes.

Table 3-1 Overview of FY2030 Renewable Energy Projections

	Source	Actual	FY2030		
			Gov't	Current	Transition
Installed capacity (GW)	Solar PV	56	64	102	145
	Wind	4	10	23	29
	Geothermal	1	1-2	1	2
	Bioenergy	5	6-7	8	8
	Hydro	21	49	23	24
Electricity generated (TWh)	Solar PV	63	75	123	173
	Wind	7	18	65	82
	Geothermal	3	10 -11	4	7
	Bioenergy	24	39 -49	51	52
	Hydro	81	94 -98	82	84
	Total	**177**	**237 -252**	**324**	**398**

Note 1: Actual figures for electricity generated are from FY2018; installed capacity figures are as of the end of FY2019
Note 2: Figures for electricity generated from renewable energy do not include output curtailment.
Note 3: Hydropower figures in government forecasts include pumped storage power, but this is not included in REI estimates.

Source: Actual figures at end-FY2019 for bioenergy are from FiT statistics,and other sources. For other power sources, figures are prepared by Renewable Energy Institute based on connection capacities of general transmission and distribution providers.

Solar PV

The prospects for deployment of solar PV are largely affected by available site and economic restrictions. We estimated deployment amounts while considering these two restrictions for three different types of systems: 1) residential solar PV for private consumption, 2) industrial solar PV for private consumption, and 3) ground-mounted photovoltaic power plants for electricity sales.

In the case of roof-top systems (types 1 and 2), there is still a large amount of available roof space that has not been used. Just in the case of private homes, less than 10% of detached houses in Japan have solar PV on their roofs.

Regarding ground-mounted photovoltaic power plants (type 3), after considering land physically available for installation by fiscal 2030, we found that including abandoned farmland, converted golf courses, unoccupied land and fields, etc., the total available land amounted to 150,000 hectares. The total output of systems that could be installed when taking into account topography (solar cell capacity) was found to be 112.4 GW (DC). Solar PV plants of 10 kW or more deployed as of the end of 2019 had an output of 44.3 GW (grid connection capacity), so compared to this, there is the potential for three times this amount.

Table 3-2 Estimated Usable Land and Potential Installed Capacity

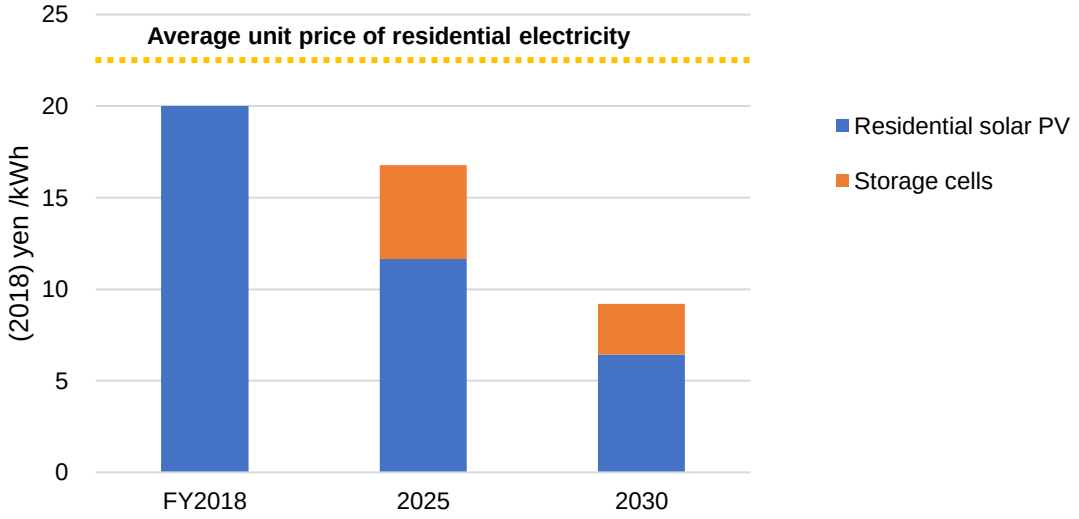
Item/unit	Total area	Percent usable	Usable area	Installed capacity
	10,000 ha		10,000 ha	GW(DC)
Forests (existing + forecast to 2019)	-		1.4	6.7
Unoccupied land, fields (privately owned)	15.5	10%	1.6	12.9
Storage yards	2.5	5%	0.1	1.0
Parking lots	5.1	5%	0.3	2.1
Golf course conversion	-		2.3	12.3
Other, unknown	5.5	5%	0.3	1.5
Abandoned farmland	42.3	15%	6.3	52.9
Additional conversion + additional dilapidated farmland	12.0	10%	1.2	10.0
Lake and marshland	24.0	1%	0.2	2.0
Reservoirs	21.0	5%	1.1	8.8
Vacant house conversion	4.7	5%	0.2	1.9
Unusable buildings (dilapidated buildings, etc.) – corporate owned	0.3	10%	0.0	0.2
Total			15.0	112.4

Note: Regarding area per unit of installed capacity, according to the Ministry of the Environment's "Considerations on Environmental Impact Assessments for Solar PV Projects," installed capacity (on AC end) per 100 ha is 37 MW on average. From this we set the area per kW for hilly land like mountains and forests while taking into account an overload rate of 130% and future increases in the efficiency of solar cell modules. For undulating land like golf courses, it was assumed that the hilliness was somewhat less than mountains and forests.

Source: By Renewable Energy Institute based on the Ministry of Land, Infrastructure, Transport and Tourism (2013) "Basic Survey on Household/Corporate Land and Corporate Buildings," the Ministry of Agriculture, Forestry and Fisheries (2017) "Dilapidated Farmland: Current Status and Measures," Study Commission on Forest Development Approval Standards related to Solar PV Projects (2019) "Report of the Study Commission on Forest Development Approval Standards related to Solar PV Projects," the Ministry of Internal Affairs and Communications (2019) "2018 Housing and Land Survey," and National Golf Course Managers Association (NGK) (2019) "Trends in Number of Golf Courses, Total Users and Usage Taxes, etc. from the Standpoint of Usage Tax Imposition"

Residential solar PV generating costs as of 2018 were already lower than the average unit sales price used for residential electricity charges. Solar PV systems with storage cells are estimated to reach a level by 2025 that is significantly lower than the average unit sales price for residential electricity charges. Industrial solar PV generation costs will likely be close to 10 yen/kWh by around 2025. The weighted-average unit sales price for special high voltage electricity in fiscal 2018 was 12.2 yen/kWh, and for high voltage electricity, it was 16.3 yen/kWh, so the figure is lower than both of these.

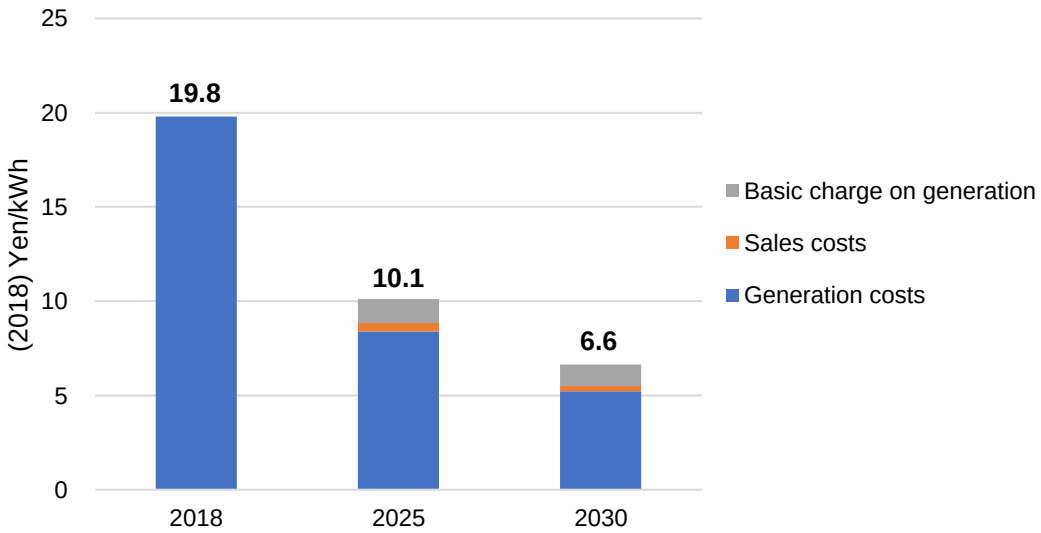
Figure 3-1 Generation Cost Estimates for Residential Solar PV Systems with Storage Cells



Source: Generation costs are calculated based on residential fuel cell price projections from Bloomberg NEF (2019) and solar PV system prices from Renewable Energy Institute's estimates. Stationary storage cells are assumed to store all surplus electricity during the day for consumption from evening to night with efficiency of 90%.

Solar PV costs for electricity sales are projected to fall to around 7 yen/kWh by fiscal 2030, even when taking into account a basic charge on generation, which is scheduled to be introduced. This is lower than what generation costs will be in fiscal 2030 for new thermal and nuclear power plants, so solar PV will be highly cost competitive. However, wholesale electricity prices are determined by variable costs like fuel prices at existing thermal power plants, and, further, wholesale electricity prices in afternoon hours tend to decrease when solar PV is generating at significant levels. This situation makes it difficult for solar PV intended for electricity sales to become economically self-sufficient.

Figure 3-2 Generation Cost Estimates for Future Ground-mounted Solar PV



Note: The estimation method is the same used in Kimura (2019), "Solar Power Generation Costs in Japan: Current Status and Future Outlook;" individual cost items are estimated and totaled, and calculations are made setting service life, capacity utilization, overload rate, and discount rate. Also, the basic charge on generation is set at 1,800 yen/kW per year and included in operation and maintenance costs.

Source: Renewable Energy Institute

Even in the current policy scenario, residential and industrial solar PV generation costs will decrease to a level lower than electricity purchase prices, so it is highly likely that economic benefits will be generated and such systems will spread on their own. It is possible that solar PV for electricity sales will lag behind in terms of economic self-sufficiency due to declines in wholesale electricity prices.

In order to accelerate deployment of residential and industrial solar PV, it will be important to create conditions that enable developers to accelerate deployment by strengthening energy standards for buildings and enhancing incentives for renewable energy use by electricity consumers. Putting in an appropriate carbon pricing system would be an effective means of accelerating deployment of solar PV for electricity sales.

In the transition promotion scenario, we have estimated that taking these measures would increase deployment by approximately 40% compared to the current policy scenario and reach output of 145 GW.

Table 3-3 Solar PV Installation Capacity Projections (GW)

	FY2019	FY2030	
		Current policy scenario	Transition promotion scenario
Residential (roof-top)	11.3	20.3	25.8
Industrial (roof-top)	n/a	15.7	36.1
Commercial (ground)	44.3	66.1	82.8
Total	55.6	102.1	144.6

Note: Installed facility is on the grid connection (AC) end

Source: End-2019 figures are from operating capacity in statistics under the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities

Wind power

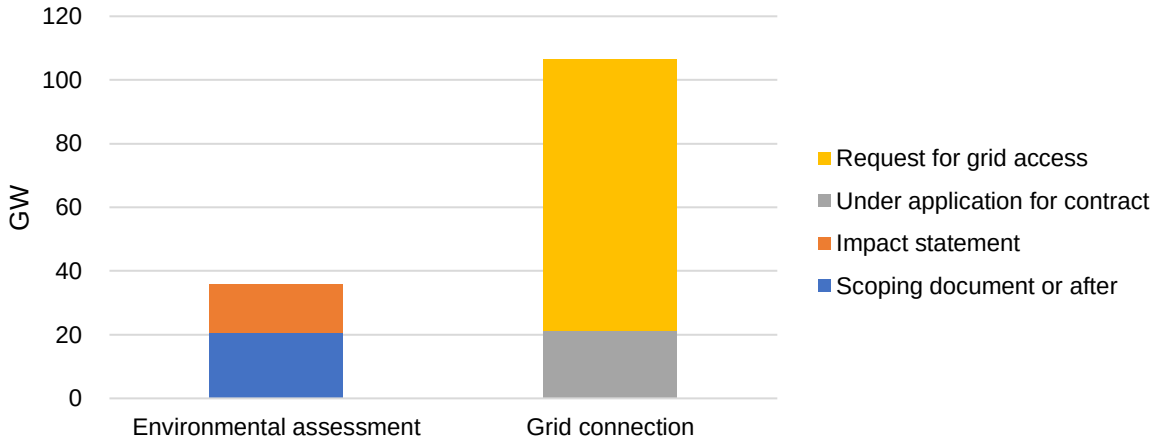
Wind power has been driving renewable energy growth along with solar PV around the world, but in Japan its deployment lagged substantially behind due to grid connection restrictions, site restrictions, environmental assessment procedures that required considerable time, and the high level of related costs.

However, more recently, the Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities was legislated in 2019 and, thereafter, in July 2020, the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation was established, so there is now some momentum toward further expansion of the wind power industry.

With regard to generation costs, there is still the potential for cost reductions in Japan through larger turbines and market growth, and, according to Bloomberg NEF, even in Japan, moving toward fiscal 2030, onshore wind power costs are projected to decrease to 4.9-6.7 cents/kWh (5-7 yen/kWh), and offshore costs, to 5.1 cents/kWh. These figures are significantly lower than the government's generation cost projections for new thermal power plants in fiscal 2030.

In light of the current situation, with regard to environmental assessments and the possibility of grid connection, which are the major factors regulating deployment of wind power, we investigated the scale of the facilities currently engaged with these procedures at present and made estimates based on this. Facilities engaged in environmental assessment procedures as of the end of fiscal 2019 had total output of around 36 GW, and the total for facilities completing grid connection contract applications and those having applied for connection consideration was approximately 107 GW. Based on this, in the current policy scenario, 23 GW is projected to be deployed by fiscal 2030, and in the transition promotion scenario, 29 GW would be deployed.

Figure 3-5 Wind Power Environmental Assessments and Grid Connection Applications



Source: Compiled by Renewable Energy Institute based on the connection and application status pages of each general transmission and distribution provider on the Ministry of the Environment's Environmental Impact Assessment Network (http://assess.env.go.jp/)

Table 3-5 Installed Capacity for Possible Wind Power Deployment by FY2030 (GW)

	FY2019	FY2030	
		Current policy scenario	Transition promotion scenario
Onshore	4.3	16.6	19.2
Bottom-mounted	0.0	6.7	10.0
Floating	0.0	0.1	0.1
Total	4.4	23.3	29.3

Source: Renewable Energy Institute

Renewable Energy Deployment in FY2030

Current Policy Scenario

Costs for solar PV will continue to come down, and deployment of solar PV systems for private residential and industrial applications will continue to make headway. Wind power, too, will steadily go online as projects complete environmental assessment procedures currently underway. At the same time, the basic charge on generation, which is scheduled to be introduced going forward, functions to diminish the cost competitiveness of renewable power sources. The plan is to continue gradually implementing bioenergy power plants, small and medium-sized hydropower plants, geothermal power plants and other power sources within the framework of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities. As a result, we have estimated renewable energy power output in fiscal 2030 to be around 324 TWh. This is around two times the level of renewable power output in fiscal 2018.

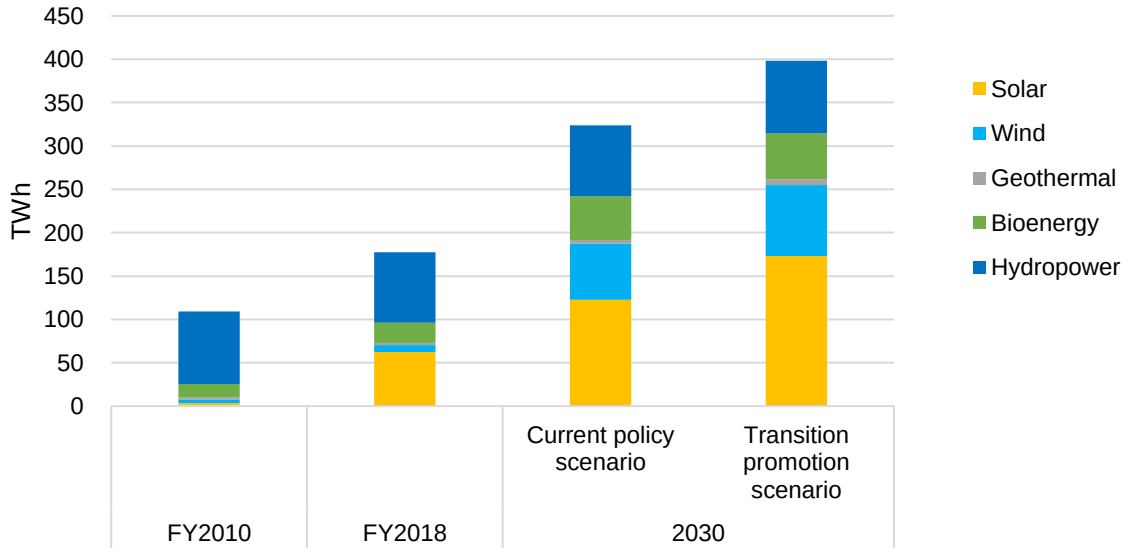
Transition Promotion Scenario

This scenario sets ambitious medium- and long-term assumptions for bidding under the Renewable Energy Special Measures Act, and projects that a stable bidding system will continue until the market can become self-sufficient. In addition, it assumes operational improvements and necessary enhancements on important transmission lines, which are necessary for further growth to wind power in particular, making it possible to more quickly connect to the grid. Further, it assumes that introduction of carbon pricing will put an appropriate cost burden on fossil fuels and that other necessary steps will be taken to accelerate deployment of renewable energy.

As a result of these measures and the decreasing cost of solar PV and wind power, a path comes into view for autonomous growth in the electricity sales sector that does not rely on economic aid. For the private consumption model as well, it will not only be economically advantageous, under this scenario installation on new homes and buildings will be mandatory, which will result in stable annual growth in new deployment.

In light of the above, we have projected renewable power output for fiscal 2030 at approximately 398 TWh. In this scenario, the renewable energy market will be competitive even compared to existing fossil fuels and have the potential to continue to grow in a sustained manner beyond 2030.

Figure 3-8　Electricity Generated from Renewable Energy



Note: Electricity generated figures do not include output curtailment amounts.

Source: By Renewable Energy Institute with actual figures from the Ministry of Economy, Trade and Industry's "Comprehensive Energy Statistics of Japan"

Chapter 4　Sustainable Energy Mix

From Fossil Fuels to Renewables

Japan's energy policy has been trapped by the thinking that since Japan is a resource-poor country it has no choice but to secure fossil fuel resources and develop nuclear power as a semi-domestically produced energy.

However, it is now possible to supply low cost renewable energy on a large scale, and the energy supply is no longer dominated by only a few nations. Japan is rich in renewable energy resources, and has the chance to free itself from sole focus on fossil fuels, from the curse of being resource poor.

With the climate crisis impacts, the day when neither oil, coal, nor natural gas will be tolerated as a fuel source is on the near horizon. As we move to a decarbonized society, the nature of energy security, in which securing fossil fuels has been the ultimate issue, will also need to be completely transformed.

Predicated on switching to a system based on renewable energy, we propose that the following four goals should be the aim of a sustainable energy mix.

1. Achieve a decarbonized society
2. Ensure stable supply not dependent on fossil fuels
3. Reduce risk from natural disasters and terrorism
4. Supply affordable energy

Energy demand forecasts

In the government's demand forecasts, GDP growth of 1.7% is expected to continue during the period to 2030, but the actual GDP growth rate from 2013 to 2019 has averaged 0.9%. We revised this overestimated forecast and made estimates that are not based on the assumption of new innovative technologies or the structural transformation of industry but on the increased performance and more widespread utilization of energy efficiency technologies that have already been established and are already beginning to be used.

As a result, whereas final energy demand in fiscal 2030 is 12,620 PJ in the current policy scenario (same as government forecasts), in the transition promotion scenario, it is 9820 PJ. This represents a decrease of 25% from fiscal 2018. Electricity demand in the current policy scenario is 980 TWh, while in the transition promotion scenario, it is 850 TWh.

Table 4-3 Final Energy Consumption Projections (PJ)

	FY2010	FY2013	FY2018	FY2030			
				Current policy	Transition promotion	Current policy (vs. FY2018)	Transition promotion (vs. FY2018)
Industry	6,745	6,515	6,118	6,580	4,890	8%	-20%
Commercial	2,411	2,292	2,108	2,170	1,610	3%	-24%
Household	2,169	2,044	1,833	1,470	1,330	-20%	-27%
Transport	3,387	3,236	3,066	2,400	1,990	-22%	-35%
Total	14,712	14,086	13,124	12,620	9,820	-4%	-25%

Source: 2010, 2013 and 2018 figures are from the METI Comprehensive Energy Statistics; 2030 current policy figures are converted data from the Agency for Natural Resources and Energy "Long-Term Energy Supply and Demand Outlook Related Document" (https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/011/pdf/011_07.pdf); and transition promotion figures are prepared by Renewable Energy Institute

Table 4-4 Electricity Demand Projections (TWh)

	FY2010	FY2013	FY2018	FY2030			
				Current policy	Transition promotion	Current policy (vs. FY2018)	Transition promotion (vs. FY2018)
Industry	382	364	351	380	310	8%	-12%
Commercial	336	324	317	350	270	10%	-15%
Household	299	284	261	230	220	-12%	-16%
Transport	18	18	18	20	50	14%	185%
Total	1,035	990	946	980	850	4%	-10%

Source: 2010, 2013 and 2018 figures are from the METI Comprehensive Energy Statistics; 2030 current policy figures are converted data from the Agency for Natural Resources and Energy "Long-Term Energy Supply and Demand Outlook Related Document" (https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/011/pdf/011_07.pdf); and transition promotion figures are prepared by Renewable Energy Institute

Energy mix in current policy scenario

Renewable energy's share is higher in this scenario than in the government's energy mix (22-24%), but it remains at around 30%. Supply of nuclear power is set with 3% as the lower limit—in this case the nuclear reactors that operate are only those that have already resumed operation and will not have reached their operating life of 40 years—and with 7% as the upper limit—in this case all other nuclear reactors already approved by the Nuclear Regulation Authority also operate. For coal-fired power, the targeted supply is set at government mandated 26%. For oil-fired power and the like, we assume use of byproduct gases and other sources, so it remains at around 2%. To meet the remaining portion of electricity demand, the scenario assumes natural gas-fired power at 35-39%.

Table 4-5 Current Policy Scenario Electricity Demand and Energy Mix (TWh)

	FY2010	FY2018	FY2030	Share
Electricity demand	1,035	946	980	
Electricity generated	1,149	1,051	1,070	
Renewable energy	109	177	320	30%
Nuclear	288	65	30～80	3～7%
Coal	320	332	280	26%
Natural gas	334	403	370～420	35～39%
Oil, etc.	98	74	20	2%

Source: Renewable Energy Institute

Transition promotion scenario (sustainable energy mix)

Though electrification will advance, greater energy efficiency and changes in activity loads will reduce electricity demand to 850 TWh. Renewable energy, which was taken up in Chapter 3, will account for 45% of electricity generation as all five power sources—solar PV, hydro, wind, bioenergy, and geothermal—continue their growth. Nuclear power is projected at zero in light of the current lack of momentum for resuming operations, its declining economic efficiency, and the overall sustainability of the energy mix. Additionally, to achieve the goals of the Paris Agreement, coal-fired power needs to be phased out, so its use is not included in this scenario. Natural gas-fired power has lower emissions than other forms of thermal power, and also is superior in terms of flexible output adjustments, so it is a good fit for variable renewables. To achieve a decarbonized society, the electricity sector must convert to 100% renewable energy as soon as possible, but in 2030, along with renewable energy sources, natural gas thermal will play a central role in electricity supply.

Table 4-6 Sustainable Energy Mix (TWh)

	FY2010	FY2018	FY2030	Share
Electricity demand	1,035	946	850	
Electricity generated	1,149	1,051	890	
Renewable energy	109	177	400	45%
Nuclear	288	65	0	0%
Coal	320	332	0	0%
Natural gas	334	403	480	54%
Oil, etc.	98	74	10	1%

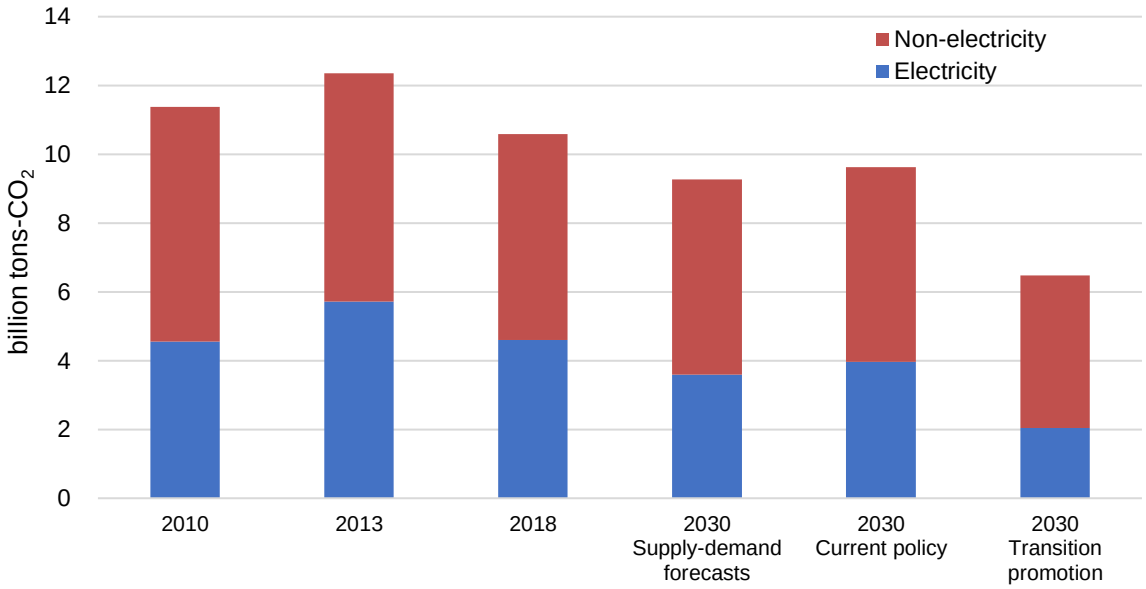
Source: Renewable Energy Institute

Table 4-7 Energy-Derived CO_2 Emission Calculations (100 million tons-CO_2)

	FY2010	FY2013	FY2018	FY2030		
				Gov't supply-demand forecasts	Current policy	Transition promotion
Total CO_2 emissions	11.37	12.35	10.59	9.27	9.63	6.48
From electricity	4.55	5.72	4.60	3.60	3.96	2.04
From other	6.82	6.63	5.99	5.67	5.67	4.44

Source: 2010, 2013 and 2018 figures are from the Agency for Natural Resources and Energy "Comprehensive Energy Statistics of Japan" (https://www.enecho.meti.go.jp/statistics/total_energy/results.html); 2030 supply-demand forecasts are from the Agency for Natural Resources and Energy "Long-Term Energy Supply and Demand Outlook Related Document" (July 2015, https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/011/pdf/011_07.pdf) ; 2030 current policy (scenario) figures are calculated by Renewable Energy Institute based on supply-demand outlook documents; and 2030 transition promotion (scenario) figures are prepared by Renewable Energy Institute.

Figure 4-3 CO_2 Emissions Calculation Results



Source: 2010, 2013 and 2018 figures are from the Agency for Natural Resources and Energy "Comprehensive Energy Statistics of Japan" (https://www.enecho.meti.go.jp/statistics/total_energy/results.html); 2030 supply-demand forecasts are from the Agency for Natural Resources and Energy "Long-Term Energy Supply and Demand Outlook Related Documents" (July 2015, https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/011/pdf/011_07.pdf); 2030 current policy (scenario) figures are calculated by Renewable Energy Institute based on supply-demand outlook documents; and 2030 transition promotion (scenario) figures are prepared by Renewable Energy Institute.

Sustainable energy mix: significance and challenges

The sustainable energy mix for fiscal 2030 envisioned here can be evaluated as follows in light of the four proposed goals.

- Carbon dioxide emissions from the electricity sector are reduced substantially to 204 million tons-CO_2 from the government's supply-and-demand forecast of 360 million tons-CO_2. Total emissions, including electricity and other sectors, totals 648 million tons-CO_2, a 47% decrease compared to fiscal 2013 and ahead of the government's energy-related CO_2 emission reduction target of 25%by a significant margin.
- The share of domestically produced renewable energy rises substantially and dependence on imports is lowered, which contributes to the stability of the energy supply.
- On the matter of reducing risk from natural disasters, terrorism and other such events, the mix, above all else, does not rely on nuclear power, so the risk is greatly reduced. Moreover, renewable energy sources are generally decentralized, so there is little risk of a large-scale power source being suddenly eliminated due to an earthquake or other disaster.
- Regarding the goal of an affordable energy supply, natural gas-fired generation will increase but dependence on fossil fuels will be significantly lowered. Imports of natural gas, coal and oil for power generation totaled an estimated 4.5 trillion yen in 2019. Fossil fuel prices vary substantially depending on price and currency fluctuations on international markets, so they are difficult to accurately predict for 2030, but by phasing out coal- and oil-fired power, total fossil fuel imports for power generation can be expected to be reduced by around 1 trillion yen.

Going forward, the following two issues will require further consideration.

- Stable supply at all hours: Electricity supply and demand must be constantly balanced. This means there needs to be sufficient supply capacity to meet demand at all hours of the day and night. In the evening and night in particular when supply capacity from solar PV declines sharply, meeting electricity demand could become problematic if demand is maintained at a high level. To ensure supply stability, supply capacity must not be allowed to run short. By analyzing supply and demand going forward, the possibility of supply shortages will need to be analyzed while various systematic and technical considerations are made in order to avoid such shortages while taking into account the effects of market mechanisms.
- Affordable energy supply: In the transition promotion scenario, it will be necessary to conduct a study on the degree of burden placed on regular citizens by electricity costs. In the study, it will be necessary to consider renewable energy cost levels, changes in wholesale electricity prices caused by increased supply of renewable energy, the impact of carbon pricing, and other matters, so we will be taking up these issues in future studies.

Chapter 5 Policy Challenges for a Sustainable Energy Mix

To deploy renewable energy to the level of the transition promotion scenario and achieve a sustainable energy mix, policy and system reform are both needed; particularly important are rigorous electricity system reforms, introduction of carbon pricing, and revision to land use regulations.

Electricity system reform

To increase supply from renewable power sources going forward, what is needed is not special measures that privilege renewable energy but to ensure it is handled fairly in generation, retail and transmission. Establishing a fair electricity system will take reforming mechanisms designed to protect existing power sources like coal-fired thermal and nuclear through their preferential use. In our proposal from May 2020, in this regard, we made 18 recommendations on generation, retail and transmission sectors, on unbundling generation and transmission, and on the role of regulatory authorities in establishing a fair and competitive electricity system.

Market mechanism for decarbonization: carbon pricing

Japan has not yet introduced carbon pricing and has not evaluated the environmental impact of carbon dioxide with precision. According to cost estimates for new power plants by Bloomberg NEF, solar PV and onshore wind power will be less expensive than coal-fired or natural-gas fired thermal power by 2025 even in Japan, but existing coal-fired plants are projected to remain the least expensive option. According to Renewable Energy Institute's estimates, changing this will require the introduction of a carbon price of at least 5,500 yen/ton-CO_2. In the OECD's Economic Survey of Japan as well, it is pointed out that solar PV costs (at the power plant scale) would be less than coal-fired thermal (including storage costs) before 2030 if a carbon price of USD 50/tons-CO_2 could be assumed.

The UK introduced a carbon price floor in 2013 on top of EU-ETS in order to push forward its decarbonization policy. As a result, coal-fired thermal, which had been 38% of annual electricity supply in 2012, dropped precipitously to just 2% as of 2019.

Japan's 'global warming tax' is 289 yen per ton of CO_2 emissions, an extremely low level that has practically zero effect. Japan should stop delaying and institute carbon pricing as soon as possible.

Reconsider land use regulations

The transition promotion scenario projects new ground-mounted solar PV of around 38.5 GW to be deployed going forward by fiscal 2030. This is based on the assumption that abandoned farmland, golf courses, and unoccupied land and fields, primarily, will be converted. To smooth the siting and installation process on this type of land, efforts must be made to ensure harmony with the natural environment and with local communities. Adjustments also need to be made with the various siting restrictions stipulated in existing law, including the Cropland Act and Act on Establishment of Agricultural Promotion Regions (Agricultural Promotion Act).

To promote new deployment by fiscal 2030 while ensuring harmony with the natural environment and local communities, it will be important to rebuild the local development process while including local residents and other stakeholders and while utilizing existing mechanisms like the Act on Promoting Generation of Electricity from Renewable Energy Sources Harmonized with Sound Development of Agriculture, Forestry and Fisheries.

Increase use of renewable energy by companies

To achieve a sustainable energy mix, along with systemic reform, non-governmental actors have a large role to play at the execution stage, and a movement is accelerating among major companies to increase use of renewable energy. These companies are not only promoting their own use, they are also calling for growth in renewable energy for Japan as a whole. Based on the opinions of 20 major companies working to increase renewable energy use, in January 2020, Renewable Energy Institute, together with CDP Japan and WWF Japan. proposed three strategies and nine measures to make Japan a country more readily conducive to use of renewable energy.

Strengthen executive powers of local governments

Since the Great East Japan Earthquake and Fukushima nuclear disaster of March 2011, most local governments in Japan have begun initiatives aimed at increasing deployment of renewable energy. In July 2020, the Renewable Energy Council (in Japanese 自然エネルギー協議会), an association for the promotion of renewable energy made up of 34 prefectures, issued recommendations calling on the government to set a target of over 40% renewable energy by 2030, and the Designated City Council (in Japanese 指定都市自然エネルギー協議会)made up of 19 ordinance-designated cities, called on the government to set a 2030 target of at least 45%, the level necessary for renewable energy's conversion into a primary power source, and incorporate it into its sixth Strategic Energy Plan.

For local governments to play a central role in renewable energy growth going forward, their executive powers need to be strengthened, and mechanisms are also needed at the national level to provide them the resources they need in terms of personnel, experience and funds.

Chapter 6 Energy Policy Choices

Green Recovery after Pandemic

COP26 was postponed to 2021 due to COVID-19 which spread rapidly in the world since the start of the year, but strengthening initiatives to address the climate crisis remains as important as ever. In fact, the pandemic has further raised the importance of energy policy choices. The enormous amount of funds for recovery from the economic crisis must not simply restore the status quo but be used to help achieve a decarbonized society.

With enormous investment being made to recover from the COVID-19 crisis, the importance of the EU Taxonomy created by the European Commission is increasing further. The power generation methods recognized by this standard as sustainable economic activity are only those with emissions factors of 100 gCO_2eq/kWh or lower. Nuclear power emissions are almost zero, but opinion is divided on whether or not nuclear power significantly hinders achievement of other environmental objectives, so the matter is on hold as of the present. The result is that only renewable energy sources are clearly recognized by the EU Taxonomy as sustainable generation methods.

Changing Japan over the next ten years

From 2020 to 2021, Japan will have to make some major choices regarding its energy policy. The Plan for Global Warming Countermeasures is scheduled to be revised before COP26, which has been postponed until 2021, and reconsideration of the Strategic Energy Plan will also begin alongside this. Japan needs to raise its GHG reduction target by 2030 to bring it in line with the Paris Agreement and 1.5℃ targets, and change to an energy mix that is suitable for this.

Dramatic growth in renewable energy must be central to the effort. Even within the government, there is increasing momentum toward promoting renewable energy growth beyond previous levels, but whether the scale and speed will be commensurate with the energy transition taking place globally, and whether it will be enough to avoid a climate crisis depend on the choices the government makes in the immediate future.

Like the sustainable energy mix proposed by this report and like the targets called for by motivated companies and local governments, renewable energy's share by 2030 needs to be raised to at least around 45%.

The government's most recent council documents point out the importance of renewable energy growth, but they also clearly show the government intends to continue nuclear power and coal-fired thermal power called high efficiency. With the rest of the world making the COVID-19 recovery a trigger for transitioning to a decarbonized society, if the Japanese government continues its adherence to coal and nuclear power, the gulf between Japan and the world will widen further.

In Germany, renewable energy's share of the power mix was 17% in 2010, but the country raised it to 44% in 2019, and according to preliminary figures for the first half of 2020, it now exceeds 50%. The UK, from 2012 to 2019, dramatically reduced coal-fired thermal's share from 38% to 2%. If the Japanese government sets a clear target for making the energy transition based on high deployment of renewable energy and creates conditions that allow companies and local governments to demonstrate their true powers in working to reach it, the country will be able to effect a major transformation in ten years.

Japan is blessed with a highly varied natural environment with four distinct seasons. If we can open our eyes to renewable energy—solar PV, wind, hydro, geothermal, and biomass—we will realize we are not a resource-poor nation at all, rather we are truly rich in the resources of sustainable energy. Moving toward 2030, we need to draw on these rich resources and create a country free of dependence on coal and nuclear power. This is the energy policy choice we are advising the government to make.

Proposal for 2030 Energy Mix in Japan (First Edition)

Establish a Society Based on Renewable Energy

Summary

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