# Consideration of Private Companies Promoting Efforts to Reduce Greenhouse Gas Emissions in Japan and the U.S.

## ～ From the Viewpoint of Utilization of Renewable Energy, etc. in the Electric Power Related Field ～

*Jun Makita **Miyuki Tsunoda

Summary

In the U.S., regardless of declaration of withdrawal from the Paris Agreement by President Trump, many private companies are promoting efforts to reduce greenhouse gas emissions, such as utilization of renewable energy and thorough energy conservation. They aim to solve social problems through business by linking important social issues to their own initiatives such as corporate philosophy, business strategy, and environmental management.

Especially in recent years, they have focused on procurement of necessary electricity from zero emission power supply (non-fossil power supply) source including renewable energy that does not emit greenhouse gases, in addition to efforts to strengthen energy conservation and improve energy efficiency. Due to the remarkable reduction in power generation costs related to renewable energy globally, they have launched a large project to construct and invest in large-scale wind power and solar power plants.

For example, California's global IT-related companies [1], such as Apple, Google, Amazon, and Facebook, are working on high goals of covering 100% of the electricity consumed in their facilities with renewable energy by procurement and utilization from outside. Especially, Apple and Google announced that they have already achieved these high goals in April 2018 [2].

In this paper, Chapter 1 reviews environmental and energy policies aimed at reducing greenhouse gas emissions in the U.S. and Japan. In addition, we review recent situations and prospects of the electricity

* Senior Researcher//Electric Power Group//Fossil Fuels & Electric Power Industry Unit//The Institute of Energy Economics, Japan

** Researcher//Electric Power Group//Fossil Fuels & Electric Power Industry Unit//The Institute of Energy Economics, Japan

1 The abbreviation "GAFA" is commonly used, taking the 4 initials of G (Google), A (Apple), F (Facebook) and A (Amazon). These 4 private companies, the world's 4 largest IT companies, are platformers that provide business foundations to external companies. They accumulate an overwhelming amount of data using the internet and smartphones and are developing a wide range of businesses utilizing them over the world. The total market capitalization of the 4 private companies as of April 13, 2018, is about 2.8 trillion dollars (about 300 trillion yen).

2 In recent years, the tendency for global private companies in Europe and the U.S. to join the international business initiative RE 100//EP 100//EV 100 is gradually appearing. (They are operated by the UK non-profit organization "The Climate Group" and related organizations)
Private companies who are willing to decarbonize are members of RE 100 and set their goals. As of the end of March 2018, 131 companies are affiliated. Among them, US companies account for about 30% of all. In Japanese companies, 6 private companies including Sekisui House and AEON are members. Each initiative aims to share issues, experiences and best practices and to accelerate the efforts of each company. The goals that each initiative is seeking are as follows.
◇ RE 100: 100% procurement of renewable energy necessary for business operation
◇ EP 100: Doubling energy efficiency (50% improvement in energy saving efficiency, etc.)
◇ EV 100: Transition to EV (Electric Vehicle)

policy including renewable energy. As for the U.S., especially, we also check on state government policies and initiatives in detail.

In Chapter 2, we analyze and organize the efforts of two private companies, Apple and Google, which are the most advanced private companies in the world. We investigate each company from the viewpoint of utilization of renewable energy, etc. in the electric power related field.

And in Chapter 3, as examples of Japanese private companies, we analyze and organize the efforts of two private companies, Sekisui House and AEON. We investigate their private companies in detail, which enthusiastically promote efforts to reduce emissions.

Finally, in Chapter 4, we compare and analyze the recent situation of renewable energy in the U.S. and Japan. We organize and consider respective data focusing on aspects such as cost, location, contract form and so on. And, in Chapter 5, we summarize the results of consideration.

## Introduction

In the U.S., regardless of President Trump 's withdrawal from the Paris Agreement, many private companies are promoting efforts to reduce greenhouse gas emissions, such as utilization of renewable energy and thorough energy conservation. They aim to solve social problems through businesses by linking important social issues to their own initiatives such as corporate philosophy, business strategy, and environmental management.

Especially in recent years, they have focused on procurement of necessary electricity from zero emission power supply (non-fossil power supply) source including renewable energy that does not emit greenhouse gases, in addition to efforts to strengthen energy conservation and improve energy efficiency. Due to the remarkable reduction in power generation costs related to renewable energy globally, they have launched a large project to construct and invest in large-scale wind power and solar power plants. For example, California's global IT-related private companies, such as Apple, Google, Amazon, and Facebook, are working on high goals of covering 100% of the electricity consumed in their facilities with renewable energy by procurement and utilization from outside.

Among them, Apple and Google, which we analyzed as examples in this paper, announced that they had already achieved their goals in April 2018. As companies become widely known for acting by showing their contributions to sustainability in corporate philosophy and management policy, consumers come to think about their sustainable products and their companies in association. Looking at market capitalization as of April 13, 2018, Apple is No.1 in the world with 886.5 billion dollars (about 95 trillion yen), and Google is No.2 in the world with 718 billion dollars (about 77 trillion yen). Compared with 218.4 billion dollars (about 23 trillion yen) of Toyota Motor Corporation, which is No.30 in the world (No.1 in Japan), the economic scale of the two top U.S. companies is about 3 to 4 times that. In this way, they are not at a level that is merely an improvement in performance but are coming to have great influence on private companies in each country aiming to realize a sustainable society through businesses.

Even in Japan, Apple stores, head office buildings and research facilities are covered with 100% renewable energy. In addition, electric power consumed in the manufacturing process by Japanese suppliers of parts for manufacturing iPhones, etc. is covered with 100% renewable energy as Apple's management policy. In this way, they are expanding their approach globally.

Japanese private companies also have been pursuing efforts to reduce greenhouse gas emissions. In fact, efforts to introduce renewable energy have progressed since the start of the "Feed-in Tariff system (FIT)" in 2012. Even now, in terms of cost, it has been dependent on the FIT and still not been economically independent. Besides, there are many problems to overcome, which are location constraints, restrictions on system operation, and securing adjustment power, etc. Japan is very different from the U.S., which is in a blessed environment. In Japan, there are no large-scale private companies with huge financial resources such as Apple and Google. There are few private companies that are investing large amounts of money in construction of large-scale wind power plants, etc. and that can cover all electricity consumed by the company with 100% renewable energy. Nevertheless, recently, some major private companies in Japan have begun to join RE 100. These private companies set goals in a way that is synergistically linked to their businesses in terms of their efforts to reduce greenhouse gas emissions, and they are developing approaches through their businesses.

Considering the real situation in Japan, we estimate the number of private companies aiming at achievement gradually increases in the future while mixing a wide range of efforts including energy saving

and utilization of zero emission power supply. We consider that it is important to set reachable and realistic goals not necessarily narrowing down to emission reduction only by renewable energy.

In this paper, we review environmental and energy policies aimed at reducing greenhouse gas emissions in the U.S. and Japan. In addition, we review recent situations and prospects of the electricity policy including renewable energy. Especially, we analyze and organize the efforts of two private companies in the U.S., Apple and Google, which are the most advanced companies in the world. We investigate each company from the viewpoint of utilization of renewable energy, etc. in the electric power related field.

And, as examples of Japanese private companies, we analyze and organize the efforts of two private companies, Sekisui House and AEON. We investigate their private companies in detail, which enthusiastically promotes efforts to reduce emissions.

Finally, we compare and analyze the recent situation and trend, etc. regarding renewable energy in the U.S. and Japan. We organize and consider respective data focusing on aspects such as cost, location, contract form and so on.

# 1. Environment, Energy Policy and Greenhouse Gas Emission Outlook in Japan and the U.S.

## 1-1 Trends in the U.S.

### 1-1-1 Federal Government Environment and Energy Policy

On June 1, 2017, President Trump declared withdrawal from the Paris Agreement. This means the suspension of the implementation of NDC (the reduction goal "Reduce greenhouse gas emissions by 26 to 28% compared with emissions in 2005 by 2025") submitted to the UNFCCC (United Nations Framework Convention on Climate Change) in September 2016. At the same time, regarding CPP (Clean Power Plan) [3] introduced by the former administration of President Obama to reduce greenhouse gas emissions in the power generation sector, the policy of suspension, review and withdrawal was indicated by Presidential Decree in March 2017. In response to this, the Director General of the EPA (Federal Environmental Protection Agency) began administrative procedures for the withdrawal of the bill. As part of the procedure, the EPA has solicited public comment [4] on the withdrawal of the bill with a deadline of April 26, 2018. Since the EPA has an obligation to respond to these opinions received in the process of abolishing the CPP, future trends should be closely watched.

Figure 1-1 Comparison on Environment and Energy Policy of Obama and Trump Administration

| Policy | Former Obama Administration | Current Trump Administration |
|---|---|---|
| Climate Change Measures | ■NDC (Reduction target "Reduce greenhouse gas by 26 to 28% compared to emissions in 2005 by 2025") was submitted to UNFCCC (United Nations Framework Convention on Climate Change)<br>■Ratification of the Paris Agreement (September 2016) | ■Expression of withdrawal from the Paris Agreement (June 2017) |
| Regulation on Emission by Power Plant | ■ A clean power plan for existing thermal power plants was announced (August 2015)<br>■ Each state was required to reduce the CO2 emissions of thermal power plants by 32% by the year 2030 compared with 2005.<br>Specifically, it was required to implement either (1) High efficiency of coal-fired power, (2) Substitution of coal-fired power plant by gas-fired power plant, and (3) substitution of coal-fired power plant by renewable energy and nuclear power plant.<br>■ Administrative procedures for the withdrawal of CPP and the creation of new regulations began (October 2017)<br>■ The recruitment of public comment on withdrawal of CPP is closed (April 2018) | ■ Administrative procedures for the withdrawal of CPP and the creation of new regulations were started (October 2017)<br>■ The recruitment of public comment on withdrawal of CPP was closed (April 2018) |
| Coal policy | ■ Strengthen coal regulation from the viewpoint of alleviating climate change and prevention of air pollution<br>■ DOI (Department of the Interior) established a regulation not permitting coal mining at places where water sources are adversely affected for water source protection (December 2016) | ■ Congress passed a bill to revoke coal mining regulations aimed at conserving water resources and President signed (February 2017) |
| Gas and Crude oil policy | ■ Following a sharp increase in domestic oil and gas production due to Shale Revolution and a decline in crude oil prices, the embargo of crude oil which had been ongoing since 1975 was canceled (December 2015)<br>■ Following the expansion of shale gas production, export of LNG regulated from 1938 was approved (2011) | ■ Continue the policy of exporting crude oil<br>■ Continue the policy of exporting LNG<br>Promoted export of U.S. LNG to Asian countries such as Japan, Korea, China and India, Poland, Hungary and Baltic countries concerned about dependence on Russia (July 2017) |
| Nuclear policy | ■ Promote the following as part of "Clean Energy Employment"<br>・Assistance for loan guarantee for the establishment of nuclear power plant<br>・Support for research and development of new type such as Small Modular Reactors (SMRs) | ■ President Trump announced that he will conduct a comprehensive review of nuclear energy policy to revive and expand nuclear power generation, which is a zero-emission power supply (June 2017)<br>■ On the other hand, the Ministry of Energy 's nuclear-related technology development budget was greatly reduced. |
| Renewable Energy Policy | ■ Renewable energy support measures at the federal level approved by Congress (December 2016)<br>5 years extension of PTC (Production Tax Credit ) to solar power generation and ITC (Investment | ■ Continue support measures<br>PTC to solar power generation and ITC to wind power generation |

(Source) Created by author based on DOE, EPA homepage

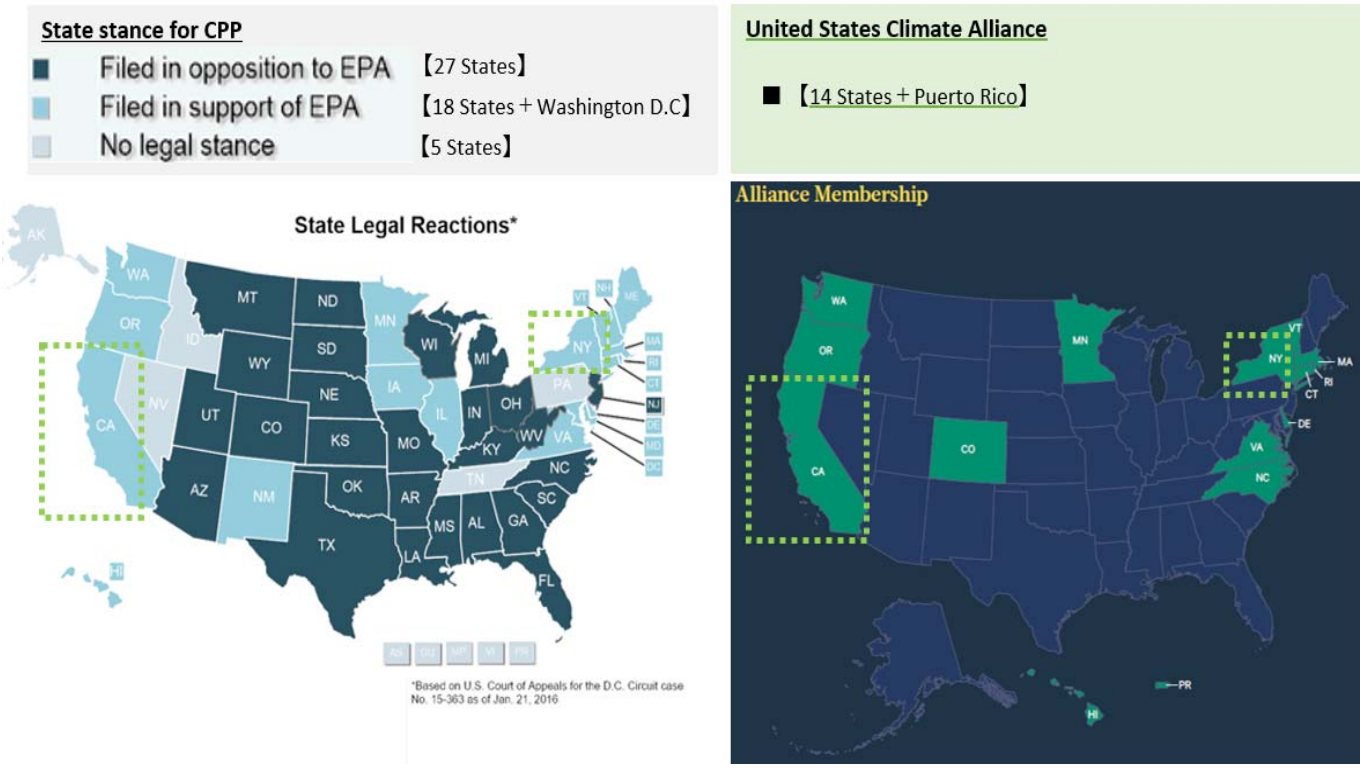
[3] The Obama administration announced the Climate Action Plan in June 2013. Although this action plan itself had no legal binding force, there were provisions concerning domestic $CO_2$ emission reduction, introduction of renewable energy, increased energy efficiency, and cooperation for international climate change countermeasures. Following this climate change action plan in August 2015, President Obama and the EPA announced the CPP which is a rule of regulating $CO_2$ emissions from existing and new thermal power plants. However, due to the Federal Supreme Court decision issued in February 2016, the CPP is currently suspended until the final decision on the legality of the CPP is made. The CPP indicated each state's $CO_2$ emission reduction goals (by 2030 $CO_2$ emissions reduction by 32% compared with 2005). Specific plans for each state towards achieving the goal are to be made for each state based on the power supply configuration situation.

[4] Along with the CPP, Apple and Google have been engaged in large-scale investment in renewable energy, so they officially expressed their opinions to suspend the CPP abolition in April 2018 before the due date of opinion solicitation.
"Apple to the EPA: Leave Obama's Clean Power Plan Alone (April 9, 2018)" Reuters
: https://futurism.com/apples-epa-filing-clean-power-plan/
"Google Submits Public Comment Backing Clean Power Plan (April 26, 2018)" Android News, Google
: https://www.androidheadlines.com/2018/04/google-submits-public-comment-backing-clean-power-plan .html

### 1-1-2 State Government Environment and Energy Policy

Meanwhile, at the state government level, the United States Climate Alliance was formed. This alliance is a bipartisan coalition by governors of states, such as California state and New York state. It was formed on the same day that President Trump announced withdrawal from the Paris Agreement. Although this alliance was not legally binding, it was obliged to ensure commitment to comply with the Paris Agreement. Member states recognize that climate change is a serious threat to the environment, residents, community and economy, and by acting ambitiously it is possible to achieve the goal within the U.S. and the world. As of April 2018, 14 states and Puerto Rico are underway to achieve the reduction goal "Reduce greenhouse gas by 26 to 28% compared with emissions in 2005 by 2025" under the Paris Agreement. The total of these states and regions' populations accounts for 36% of the total population in the U.S.

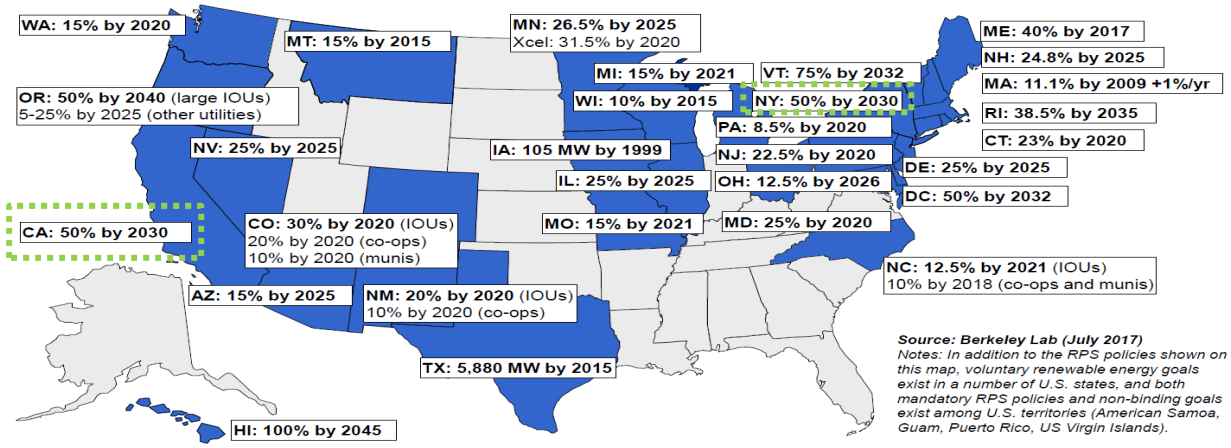
Figure 1-2 State Stance for CPP [left] / United States Climate Alliance Member State [right]




(Source) Created by author based on National Conference of State Legislatures and U.S. CLIMATE ALLIANCE 2017 REPORT

As we can see from Figure 1-2, since the era of the former Obama administration, the CPP is mainly supported in West Coast regions such as California state (CA) and Northeast regions such as New York state (NY). It turns out that these states and the member states of the United States Climate Alliance are almost the same. There are 27 states that support the abolition of the CPP. In those states, the coal industry that digs up coal in the production area and the steel industry are the industrial based. Many coal-fired power plants are located there. These states require the elimination of regulations from the viewpoints of stopping industrial decline and maintaining employment.

Figure 1-3 Implementation Status of Renewable Energy Portfolio Standard (RPS System)



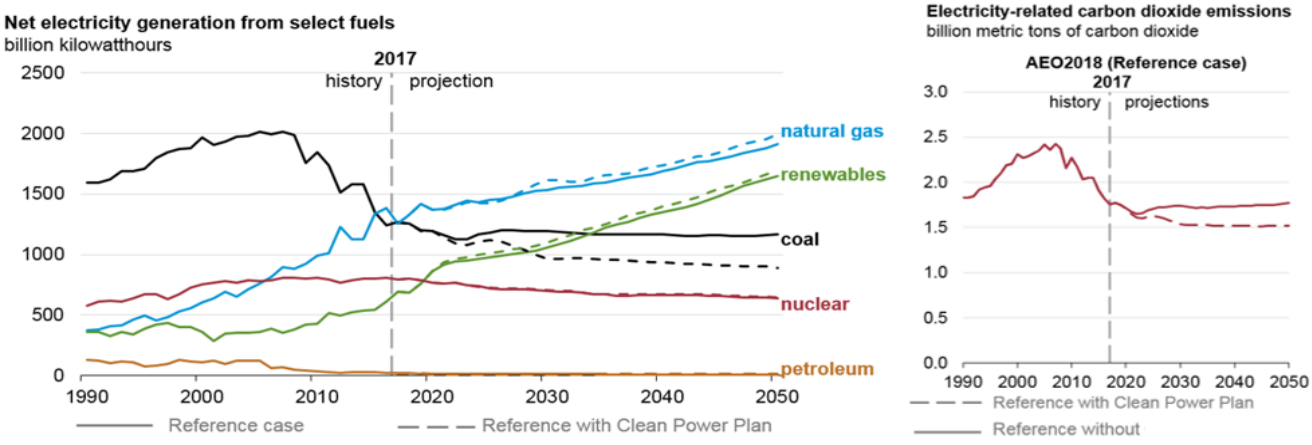

(Source) FERC "Database of State Incentive for Renewable & Efficiency (DSIRE)"

Figure 1-3 shows the implementation status of the "RPS system [5]" requiring all electricity companies or retail electricity companies in the state to supply a certain percentage of electricity from renewable energy. It shows the achievement year and achievement ratio of the goal in each state. As of July 2017, the RPS system is implemented in 29 states out of 50 states and Washington, D.C. Among them, California state (CA) and New York state (NY) have set a high achievement ratio goal of renewable energy to 50% by 2030.

### 1-1-3 Outlook for Greenhouse Gas Emissions by Federal Government

In the U.S., as mentioned above, there is a plan for introduction of the CPP in the federal government for reducing greenhouse gas emission, but there is no explicit policy objective on energy mix like Japan. The DOE (U.S. Department of Energy) creates several scenarios as "Annual Energy Outlook." And based on them, the DOE announces the outlook of future power supply configuration.

Figure 1-4 Outlook for Electricity Generation by Power Supply Source and $CO_2$ Emissions




(Source) EIA "Annual Energy Outlook 2018"

[5] The RPS system is legislated at the state level. As of July 2017, 29 states and Washington, DC, which is being implemented, cover 56% of the total retail sales electricity in the U.S. There are 8 states that also set non-legally binding targets. The state governments control the amount of introduction, but the determination of the procurement price etc. is done through the market. In the U.S., renewable energy of 57 GW was newly introduced under the RPS between 2000 and 2015. Among them, the introduction of wind power is the largest, accounting for 64% of them. Since 2010, the introduction of solar power also expanded gradually, becoming the largest in the single year of 2015, accounting for 69% of them.

Figure 1-4 is a reference case issued in February 2018, but it is divided into two scenarios, one with the CPP and another with the scenario when the CPP is discontinued, and their future projections are issued. Both scenarios are expected to continue the present trend where the amount of electricity generated by coal-fired power plants with high $CO_2$ emissions will decline until 2050 and that the amount of electricity generated by gas-fired power plants and renewable energy will increase instead. However, if it becomes a reference case (when the CPP is abolished), it is expected that $CO_2$ emissions will turn to increase.

In the U.S., although policies on environment and energy exist at the federal level, policies on the electricity market are mainly implemented by state governments. As a result, the accumulation of each policy at the state level leads to a power supply configuration at the federal level [6]. In other words, depending on each state government's environmental policy (RPS system, etc.) and electricity business system (electricity separation, retail liberalization, electricity fee approval, etc.) and the results of various measures and capital investment based on the management judgment of each electricity company, the future of the whole country is influenced. Although we will discuss the details in a later chapter, in addition to these, many private companies have been accelerating their efforts to reduce greenhouse gas emissions, such as procurement, investment and energy conservation of renewable energy in recent years. These are becoming one of the new factors that will influence the future.

In this way, the accumulation of emission reductions at the state level and the private company level is progressing, and as a result, there is a possibility that the initial greenhouse gas emission reduction goal of the U.S. may be achieved [7]. Meanwhile, at the federal government level centered on President Trump, in addition to the discontinuation movement concerning the CPP, measures to prevent the closure of coal-fired power and nuclear power plants are being considered from the viewpoint of national security [8].

Since there are such new moves, the trend will continue to be watched.

### 1-1-4 Situation in California State and New York State

As mentioned above, in the U.S., it is divided into states that place importance on environmental efforts and states that do not. As an example of the former, we see more details about two states (California state and New York state) that are working on a particularly high goal, which are the most advanced states in the U.S. that set climate change countermeasures at the core of energy policies.

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[6] Investment Tax Credit (ITC) and Production Tax Credit (PTC) are being implemented as measures to promote the introduction of renewable energy even at the federal level. By utilizing these, individuals and companies introducing renewable energy can receive income tax or corporate tax deductions. PTC, which was deducted according to the amount of generated electricity, was introduced as a timed legislation in 1992, but it is still continuing now. It is targeted for wind power that can start construction by 2019. The deductible amount is 2.3 cents / kWh, after that it is supposed to be reduced by 20% every year until 2023. ITC, which deducts a certain percentage of the investment amount by tax, is scheduled to expire by 2019 and the deduction rate is 30%, but it is reduced from 3 years to 26% in 2020, 22% in 2021. After 2022, it is scheduled to be fixed at 10%. Even under the Trump regime, tax reduction policy for wind power construction is continued.

[7] Responsible Investor, Paul Hodgson『Paul Hodgson: A year from the US withdrawal from COP21: Investors are still in』 Issued on: June 1, 2018 https://www.responsible-investor.com/home/article/cop21_investors_are_still_in/

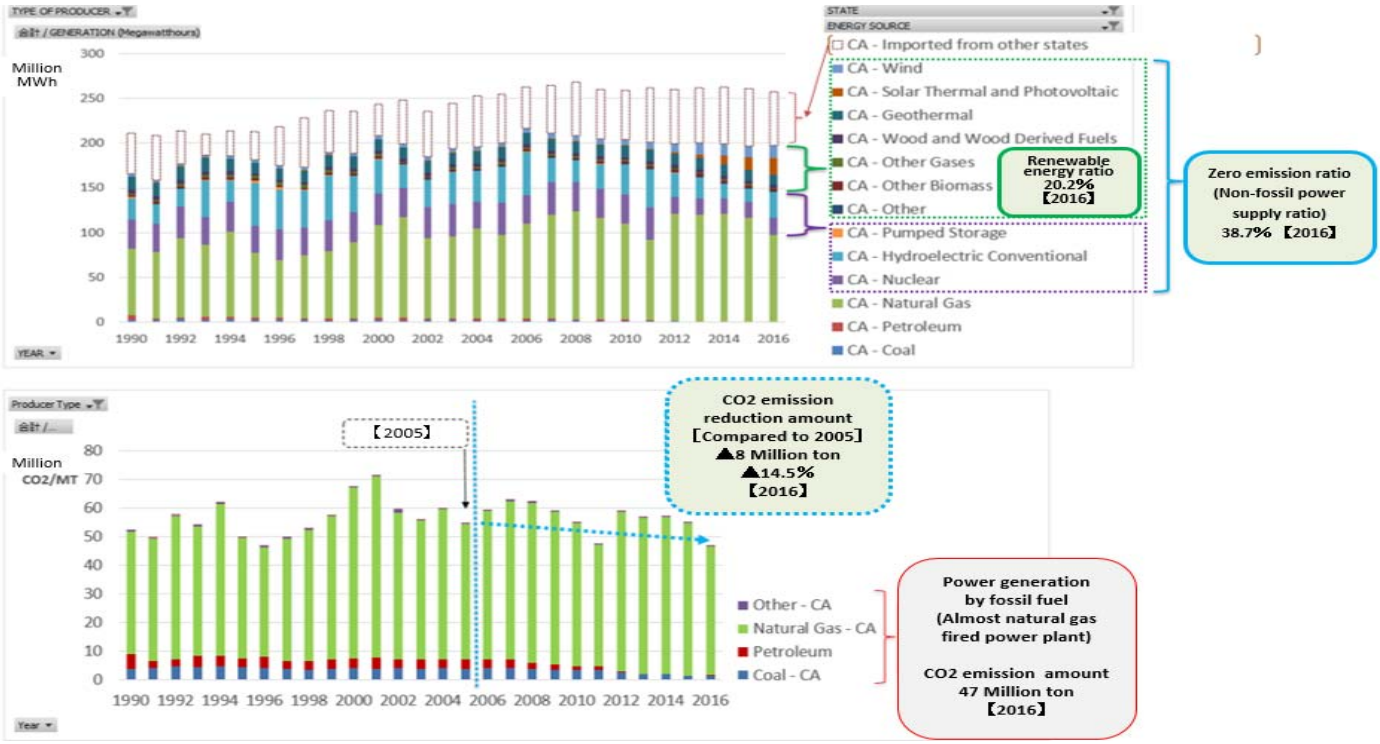
[8] On June 1, 2018, President Trump has instructed Energy Secretary Perry to take emergency measures to prevent the closure of power plants. As closing of power plants capable of securing fuels such as coal fired power and nuclear power generation progresses, the important part of the US energy mix will decline and affect the resilience of the power supply network. It is an instruction from the viewpoint of national security.
The White House Statement from the Press『Secretary on Fuel-Secure Power Facilities』 Issued on: June 1, 2018
https://www.whitehouse.gov/briefings-statements/statement-press-secretary-fuel-secure-power-facilities/

(1) California State

In 2006, which was the era of governor Arnold Schwarzenegger, California state enacted state law [9] on greenhouse gas emissions regulations for the first time in the U.S. and set a goal to reduce emissions in 2020 to the same level as in 1990. After that, in August 2016, it extended the goal achievement year from 2020 to 2030 and aimed at strengthening the goal by reducing emissions by 40% compared with 1990 levels.

Regarding the "California Renewables Portfolio Standard Program" established in 2015, the state set the proportion of renewable energy in the amount of retail sold within the state to 25% by the end of 2016. In addition, it decided the goal of 33% by 2020 and 50% by 2030. The actual result at the end of 2016 was a high level of 27% [10].

Figure 1-5 California State Trends of Generated Electricity by Power Supply Source / Imported Electricity [upper] and $CO_2$ Emission in Power Generation Sector [lower] [1990-2016]




(Source) Created by author based on EIA "Electric Power Annual 2017"

The upper part of Figure 1-5 is a graph showing the trend of the generated electricity by California's power supply source and the imported electricity from other states. The renewable energy ratio in 2016 is as high as 20.2%, and the ratio of zero emission power supply (non-fossil power including nuclear power and large-scale hydropower) source is as high as 38.7%. This corresponds to about 40% of the total electricity [11].

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[9] In California state, emissions trading covering the entire state (cap and trade) was gradually introduced since 2012 in accordance with this law. Also, on July 19, 2017, the California State Assembly approved a bill to extend the current goal deadline to control to the same level as 1990 from 2020 to 2030.

[10] As for the 3 electricity companies (PG & E, SCE, and SDG & E) which are California's IOUs (Investor-owned utilities: large private electricity company), the average performance at the end of 2016 was as high as 35%. California Public Utilities Commission『RENEWABLES PORTFOLIO STANDARD ANNUAL REPORT』NOVEMBER 2017

[11] In California, electricity demand within the state is chronically above supply, so imports from electricity generated at power plants outside the state are many. In 2016, the imported electricity accounts for 23.3% of the total electricity consumption. Although not classified in the graph, the amount of electricity generated by renewable energy is included in the amount of imported electricity. Therefore, the actual figures of the renewable energy ratio and the zero emission power supply ratio in the total amount of state power consumption are somewhat increased numerical values.

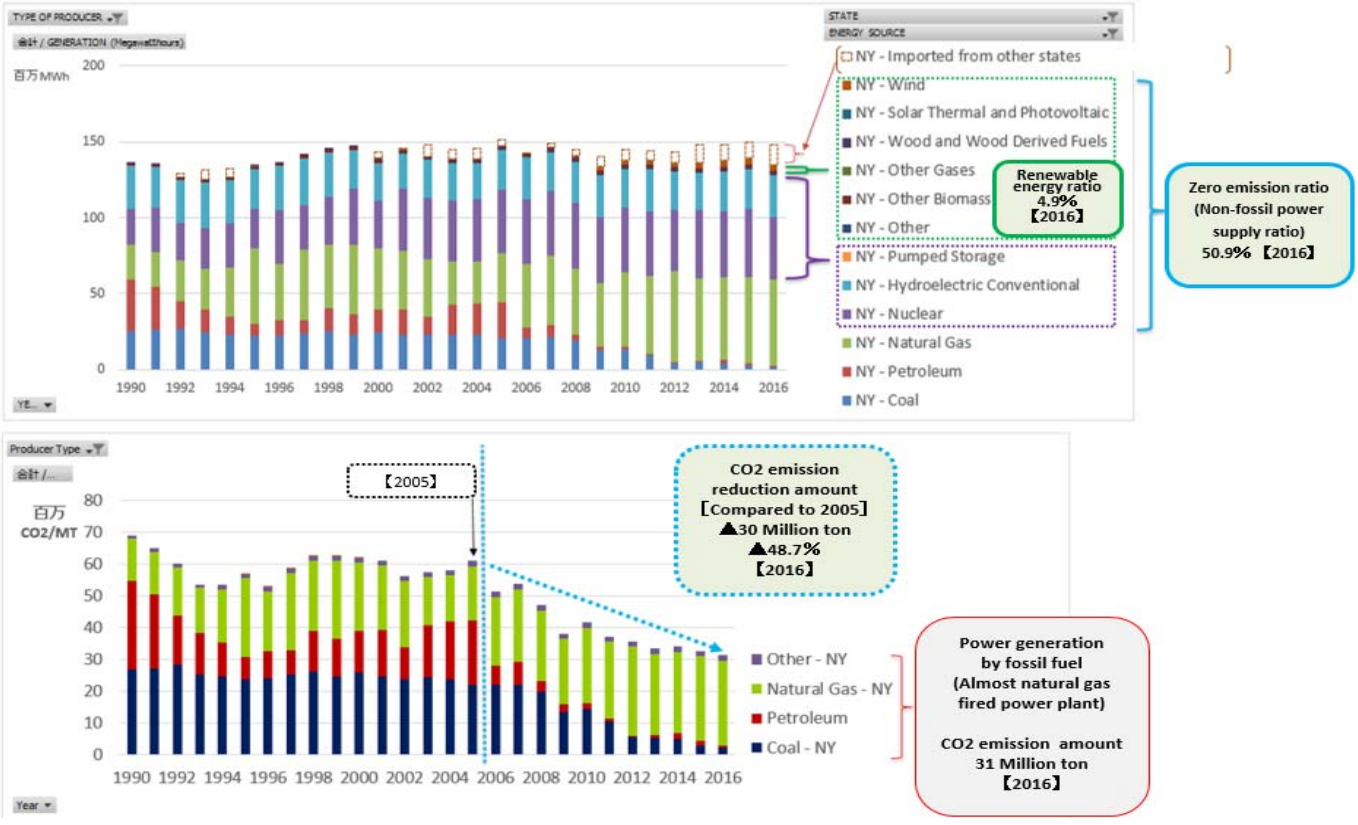
The lower shows the trend of $CO_2$ emissions in the power generation sector. The state is steadily making progress towards the goal of reducing emissions in 2030 by 40% compared with 1990 levels. It is a reduction of 14.5% from 2005, which is the base year of NDC.

### (2) New York State

In 2014, New York state formulated "Reforming the Energy Vision (REV)" under the leadership of Governor Andrew Cuomo. It set a goal of reducing greenhouse gas emissions by 40% compared with 1990 levels by 2030 and set a high goal of reducing emissions by 80% compared with 1990 levels by 2050.

Under the Clean Energy Standard based on REV, the state decided to raise the proportion of renewable energy in the state's retail electricity consumption to 50% by 2030. RES obliges all electricity companies and retail electricity companies within the state to purchase a certain amount of Renewable Energy Certificates ("REC"). REC is issued to renewable energy generation companies according to the amount of power generation. In addition, the state covers about one-third of the state's electricity consumption with nuclear power generation. The Zero Emission Credit Scheme [12] obliges all electricity companies and retail electricity companies in the state to purchase a certain amount of Zero Emission Credit ("ZEC"). It is a system to evaluate the environmental benefit of nuclear power that does not emit $CO_2$.

Figure 1-6 New York State Trends of Generated Electricity by Power Supply Source / Imported Electricity [upper] and $CO_2$ Emission in Power Generation Sector [lower] [1990-2016]




(Source) Created by author based on EIA "Electric Power Annual 2017"

[12] Qualified power plants that meet public needs can receive ZEC for 12 years from April 1, 2017, to March 31, 2029. As of October 2017, qualified power plants are the nuclear power plants of Patrick, Ginna and Nine Mile Point in the northern part of the state. The annual purchase volume of ZEC is set to an upper limit of 27,618,000 MWh based on the annual power generation amount of these power plants. New York State Energy Research and Development Organization (NYSERDA) bought the ZEC, and state-owned electricity companies purchase ZEC under contract with NYSERDA. The price of ZEC is determined in two years and is $17.48/MWh for the first two years (April 1, 2017, to March 31, 2019)..

The upper part in Figure 1-6 is a graph showing the trend of generated electricity by power supply source of New York state and imported electric energy from other states. The renewable energy ratio in 2016 is 4.9%, which is lower than California's 20.2% and the U.S. overall average of 9.0%. However, the ratio of zero emission power supply (non-fossil power supply including nuclear power and large-scale hydropower) source is as high as 50.9%, accounting for more than half of total electricity.

The lower part shows the trend of $CO_2$ emissions in the power generation sector, which shows that, in 2030, it is a high achievement of 48.7% reduction from the 2005 level.

Thus, in addition to converting from coal-fired power plants to gas-fired power plants with relatively low emissions, New York state has maintained nuclear power plants with zero emission. Through these measures, we can see that the state has comprehensively reduced emissions and achieved substantial results.

Under the RPS system, many states that obligate electricity companies or retail electricity companies to introduce a certain percentage of renewable energy are permitted to fulfill their duties by REC, which is traded on the market. Meanwhile, in recent years, many users including private companies are increasingly procuring green electricity derived from renewable energy generation, and in 2016, approximately 6.3 million users nationwide procure about 95 million MWh of green electricity [13]. Regarding Zero Emission Credit Scheme that evaluates the environmental benefits of nuclear energy, in addition to New York state mentioned above, systems have already been introduced and utilized in Illinois state.

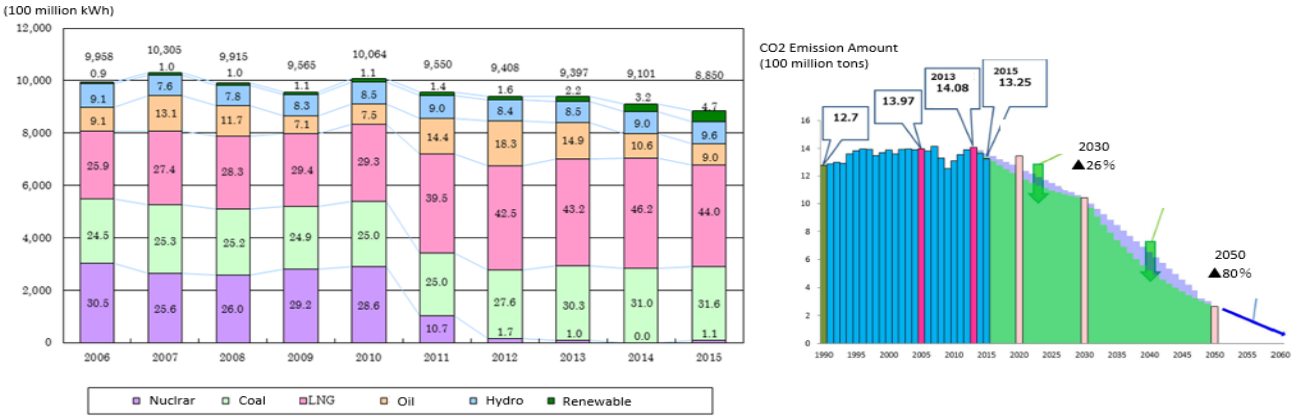
Moreover, preparations for the introduction are advanced also in the eastern region such as New Jersey state [14], Ohio state, and New Hampshire state.

## 1-2 Trends in Japan

### 1-2-1 Government's Environment and Energy Policy

Japan has set a medium-term goal of "reducing emissions by 26% compared with fiscal 2013 by 2030," which was submitted to the United Nations when ratifying the Paris Agreement, and is working towards substantial reductions in emissions. In addition, Japan has set a long-term goal of " reducing emissions by 80% compared with fiscal 2013 by 2050" based on a global warming plan.

Figure 1-7 Trend of Generated Electricity by Power Supply Source / Greenhouse Gas Emission Amount




(Source) Federation of Electric Power Companies, Ministry of Environment "Study group on the way of carbon pricing"

13 According to the report of the National Renewable Energy Laboratory (NREL), the number of users increased by 45% and the electricity sales volume increased by 19% compared with 2015.

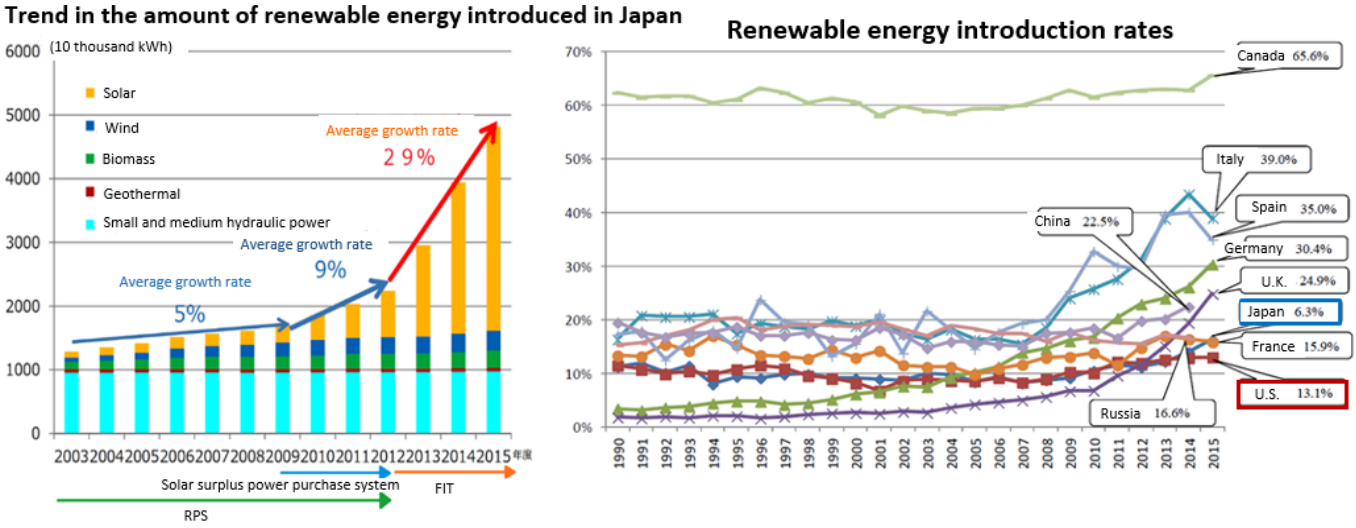
14 On April 12, 2018, the New Jersey Parliament passed a bill to raise the ratio of renewable energy generation to 50% in 2030. At the same time, a system that recognized the environmental value of nuclear power generation, which accounted for about 40% of the state's power generation, was introduced. Both nuclear power and renewable energy were positioned as a drastic reduction of greenhouse gas emissions.

Particularly in the electricity business field with a large amount of greenhouse gas emissions, the "Energy Supply Structure Upgrade Act [15]" requests retail electricity companies to expand the use of non-fossil energy. The law sets standards for the electricity non-fossil power supply ratio to be supplied to retail electricity companies. They are required to increase to more than 44% by 2030.

Also, in the "Long-Term Energy Supply and Demand Outlook" indicated in 2015, the ratio of renewable energy in the energy mix (power supply configuration) in 2030 is set to 22 to 24%. This level is expected to be maintained even in the fifth energy basic plan currently under development.

## 1-2-2 Renewable Energy Introduction Policy

Figure 1-8 Trend in Renewable Energy Introduction in Japan / Comparison of Renewable Energy Introduction Rates in Main Countries




(Source) Agency for Natural Resources and Energy homepage, Ministry of the Environment homepage

In Japan, the introduction rate of renewable energy has increased rapidly by the solar surplus electricity purchase system that started in 2009, and the FIT system introduced in 2012. Especially after the introduction of FIT, the growth rate is remarkable, which shows that during the period from 2013 to 2015, it increased at an average annual growth rate of 29%. The share of renewable energy generation in the total amount of electricity is 16.3% as of the end of 2015, but it is still low in the world compared with other developed countries. Also, introduction of renewable energy is extremely concentrated in solar power generation, and introduction of other renewable energy besides solar power generation has not yet advanced much.

In this way, most renewable energy generation companies are constructed and operated as a power source based on the application of FIT. The generated electricity is bought by the regional power transmission and distribution companies stably at a fixed price. By doing so, they secure profitability. For this reason, at present, there are few cases of self-consumption in the renewable energy generation facility without using FIT. Even if there are some cases, their installation scales are small.

The environmental value purchased through FIT is organized as belonging to all electricity users who pay

15 It is the law which takes necessary measures to promote energy suppliers such as electricity, gas, oil companies, renewable energy such as solar and wind power, non-fossil energy such as nuclear power and to promote effective use of fossil energy raw materials. In the "Standards for Electric Utility's Decision on the Use of Non-Fossil Energy Sources" revised in 2016, the proportion of non-fossil electric power supplied by retail electric utilities was set at 44% or more in FY 2030.

levies for promotion of renewable energy. Therefore, if private companies intend to procure environmental value directly from renewable energy generation companies, it is necessary to contract with a power supply source that does not use FIT.

Table 1-1 Means for Procuring Environmental Value from Renewable Energy and Zero emission Power Supply Sources in Japan

| | Green Power Certificate (Other than FIT) | J-Credit【Renewable energy】(Other than FIT) | Green Power Contract Menu by retail electric power company (Other than FIT) | Non-fossil certificate (FIT) | Non-fossil certificate (Other than FIT) |
|---|---|---|---|---|---|
| Object | Renewable energy power supply not applying FIT (Mainly self-consumption) | Renewable energy power supply not applying FIT (Mainly self-consumption, mostly solar power generation for home) | Zero emission power not applying FIT (Renewable energy・Hydropower, etc.) | Renewable energy power supply applying FIT (From FY 2017) | Zero emission power not applying FIT (Hydropower・Nuclear power, etc.) (From FY 2018) |
| Power supply identification | JQA[16] certifies renewable energy power supply (Identification) | Certification Committee approves renewable energy project (Identification) | A retail electric power company is identified | Impossible | Impossible |
| Buyer | Companies, Government, Retail electric power companies, etc. | Companies, Government, Retail electric power companies, etc. | Company, Office, Individual | Retail electric power companies | Retail electric power companies |
| Trading volume results | Approximately 300 million kWh【FY 2016】 | Approximately 1.5 billion kWh【FY 2016】(Converted from CO2 emissions) | AEON head office announces that it has been supplied with "Aqua Premium" (Green Power Contract Menu with 100% supply by large hydropower plants by TEPCO EP) | 5,155,5 578 kWh【contract amount on 1st bidding (May 18th, 2018)】(Annual contract amount is expected to be over 50 billion kWh) | －【Scheduled to start from 2019 onwards】 |
| Price | 3 to 4 yen/kWh (FY 2016 results) | Variable according to bidding situation In bid conducted in April 2017, average was about 0.5 yen/kWh. (CO2 Emission Conversion) | No information (Due to bilateral confidential contracts) | Minimum bid price 1.3 yen/kWh | To be determined |

(Source) Agency for Natural Resources and Energy homepage, Ministry of the Environment homepage

From the above, when Japanese private companies aim to achieve the 100% goal of renewable energy procurement, like RE 100 members, they will choose either of the following means ;

◇ They own renewable energy generation facilities and cover them with their own consumption

◇ They have a bilateral contract with a retail electricity company that provides a green power contract menu to supply renewable energy (not applying FIT)

◇ They procure green power certificates, etc. from external suppliers.

As described later in Chapter 4, the cost of renewable energy generation is still high in Japan, about twice as high as in the U.S. To have large-scale facilities, huge financial resources are required. Therefore, although it is possible to select an external procurement method derived from the zero emission power

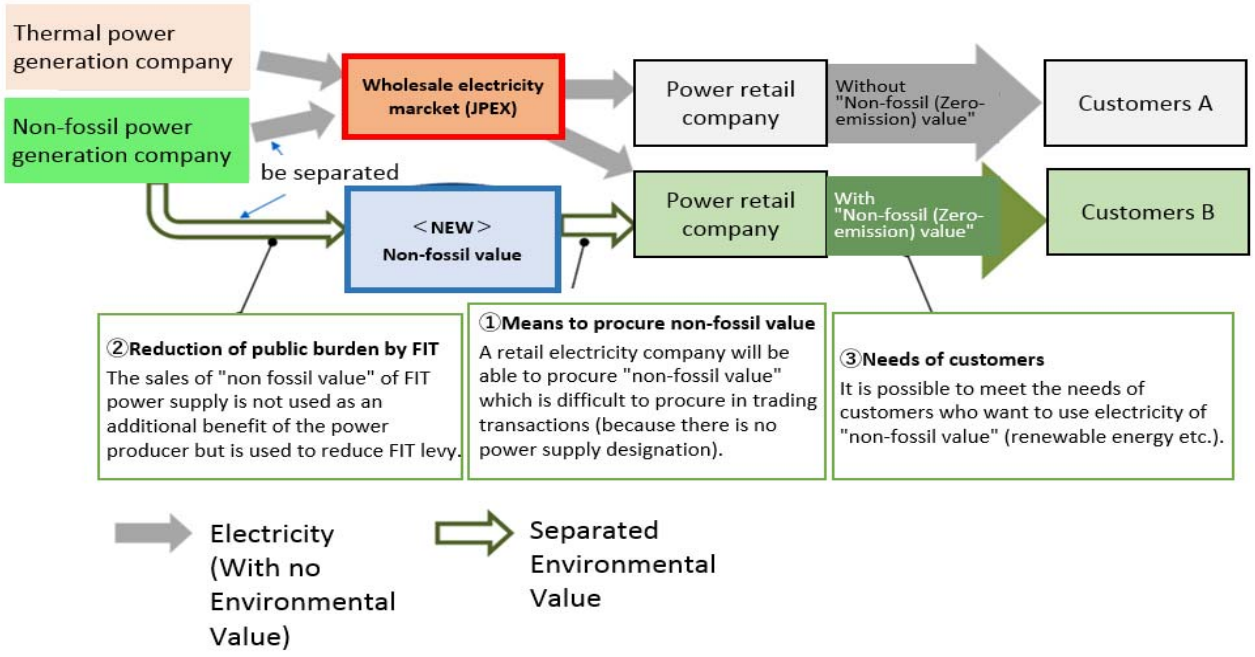
[16] In April 2018, this function and work were transferred from the Green Energy Certification Center in the Institute of Energy Economics Japan to the Green Energy Certification Office of the Global Environment Division in the Japan Quality Assurance Organization (JQA).

supply source (e.g., Green power contract menu "Aqua Premium [17]" of TEPCO Energy Partner), in Japan, it is estimated that there is almost no green power contract menu with 100% supply from renewable energy sources [18]. Regarding Green Power Certificate, the actual results in FY 2016 are not as large as about 300 MWh. Therefore, it is not under the situation where private companies, etc. can purchase in large quantities. Considering these situations, the hurdle for Japanese private companies to join RE 100 seems to be still high.

Under such circumstances, a mechanism to issue the environmental value purchased through FIT attributable to all electricity users who pay levies as non-fossil certificates was newly started. Non-fossil certificate bidding transactions are conducted through Japan Electric Power Exchange (JPEX).

### 1-2-3 Non-fossil Certificate

Figure 1-9 Overview of Non-fossil Value Trading Market




(Source) Agency for Natural Resources and Energy homepage

Currently, the non-fossil value trading market opened in April 2018 deals with solar power generation, wind power generation, etc., which is FIT power supply source. Although the first bid was held in May 2018, 26 bidders were few from the high bidding price, etc. The contract rate was as low as 0.01%, which resulted in many problems. For that reason, studies are under way to review and improve the system [19].

It is said that the non-fossil values originating from the FIT power supply source account for over 50 billion kWh annually, which is very large compared with the Green Electricity Certificate and J-Credit, which have been used as a means of external procurement until now. Therefore, if the market functions well and the contracted amount increases, the amount of procurement by retail electricity companies will also

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17 Contract menu for corporations established by TEPCO Energy Partner in March 2017. It supplies electricity generated by TEPCO Group's hydropower plant (excluding the pumped type and the power to which the FIT is applied) to the contractor. It is the first domestic contract menu to sell only electric power generation by hydropower plant. Contracted users can reduce greenhouse gas emissions by covering all or part of the electricity consumption with the electricity of this plan.

18 Since there is no obligation for the retail electricity company to make an announcement concerning individual contracts, it is impossible to accurately grasp the existence or contents of the green power contract menu.

19 From fiscal 2019 onward, it is planned to expand the zero emission power supply source other than FIT power supply source as a transaction goal, and non-fossil value to be traded is expected to increase.

increase. It is expected that opportunities to provide private companies with a green power contract menu utilizing this procurement will increase. In addition to contract menus with renewable energy of 100%, there will be an increasing number of green power contract menus with zero emission power supply sources such as large hydropower, etc. Private companies actively participating in RE 100 for reduction of emissions are expected to make use of procurement of environmental value through these as one means to achieve their goals.

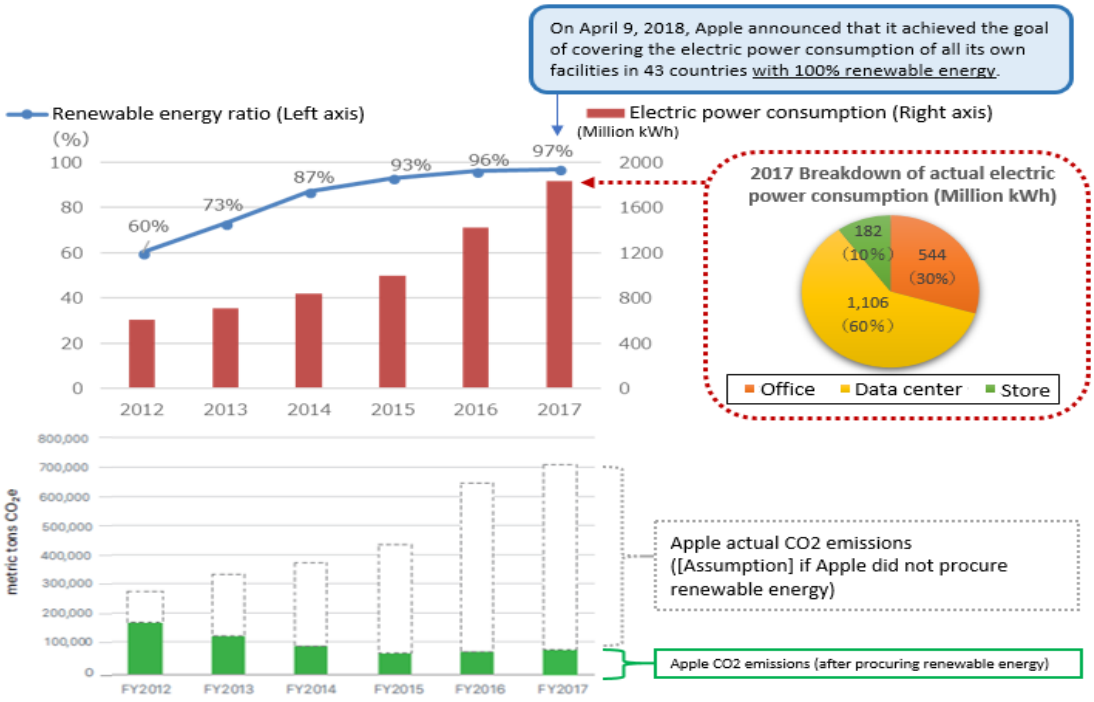
Utilization of Renewable Energy Certificates (REC) separated from electricity procurement is permitted as a standard for achieving the goal of RE 100. However, at this moment, it is not yet clear whether Japanese non-fossil value meets the criteria of RE 100 certificates. There is no doubt that all non-fossil certificates in Japan are generated electricity by FIT power supply derived from renewable energy. However, it does not specify the power generation facilities and is not tied directly [20]. Because RE 100 emphasizes information on power generation facilities of companies procured, it is not yet known whether non-fossil certificates would be certified or not. In the future, if the demand for non-fossil certificates increases, it will be possible to promote the willingness of bidding by retail electricity companies. Therefore, the future trend must be closely watched.

[20] Non-fossil certificates do not include specific information on types of renewable energy such as solar power and wind power in addition to the location of power generation facilities.

## 2. Efforts of Private Companies in the U.S.

### 2-1 Apple

Figure 2-1 Electricity Consumption / Renewable Energy Ratio / $CO_2$ Emissions Trend【2012-2016】




(Source) Created by author based on Apple Environmental Responsibility Report 2018 Progress Report, Covering FY2017

IT companies such as Apple and Google have large business scales and large influences on the environment because they consume a large amount of electricity at their own facilities such as data centers. For that reason, they have been working on improving consumption efficiency and saving power from an early stage. In addition to these measures, Apple has aimed to cover renewable energy such as solar, wind and geothermal power for all data centers, offices and stores in 43 countries around the world.

As can be seen from Figure 2-1, since 2012, while the amount of electricity consumption has been increasing every year as the business expands, they have also worked on expanding renewable energy procurement volumes at the same time. In 2017, the proportion of renewable energy in power consumption increased to 97%. By procuring and utilizing renewable energy, Apple has reported that it has reduced greenhouse gas emissions from its own facilities around the world by 54% and avoided emissions of approximately 2.1 million tons. They cut emissions of about 600,000 tons even in the year of 2017 alone, and if they did not utilize renewable energy, they reported that these emissions would have tripled compared with 2011.

And, on April 9, 2018, Apple announced that they have already achieved the goal of covering the electricity consumed in business operations of the whole world with 100% renewable energy [21].

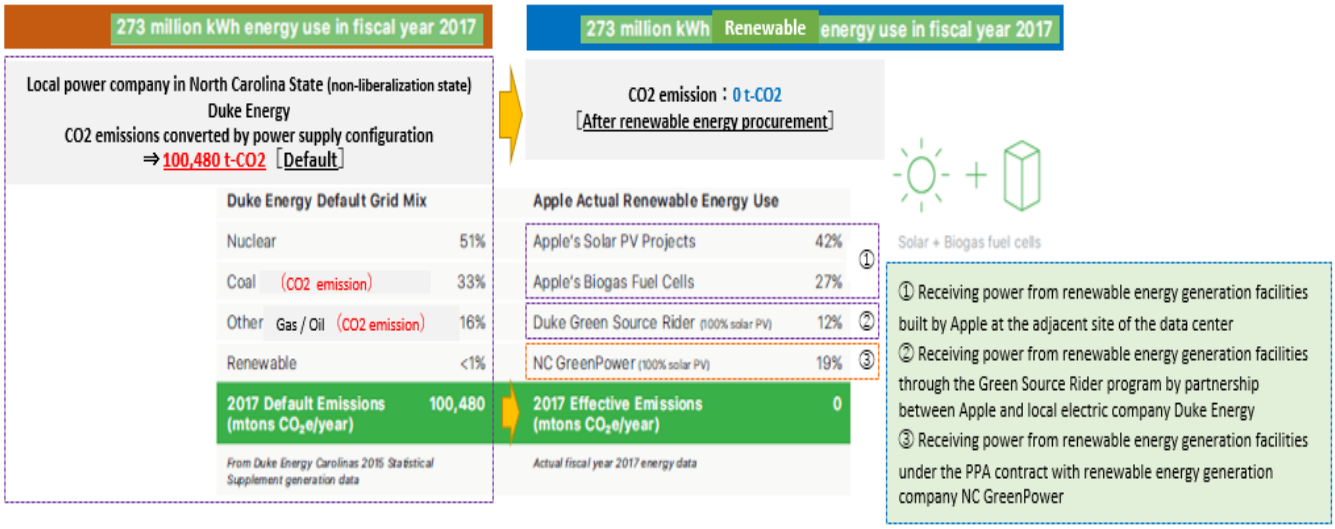
[21] Apple News Room (April 10, 2018): https://www.apple.com/jp/newsroom/2018/04/apple-now-globally-powered-by-100-percent-renewable-energy/ Strictly speaking, it is based on the definition that "We have procured renewable energy generation capacity sufficient to satisfy the all electricity consumption of our facilities from renewable energy sources

In the U.S., the following 4 means are mainly used when private companies set goals and aim to achieve them.

(1) Introduce renewable energy generation facilities on their own premises and utilize the generated electricity for their own electricity consumption. (= Onsite power generation)
(2) Purchase "Green Power" plans' electricity from a local power company
(3) Procure electricity by concluding a long-term power purchase agreement (hereinafter referred to as "long-term PPA") with renewable energy power producers (independent power producers, etc.)
(4) Procure environmental values (REC, etc.) from the outside

Many companies aim to achieve these goals by combining the above methods. In the U.S., purchasing collectively the value of environment and electricity is expressed as "Bundle," and purchasing only the environmental value is expressed as "Unbundle". Apple has focused on building renewable energy generation facilities in the area where the company's base is located and directly procuring electricity and environmental value without procuring environmental values from outside. As of January 2018, they have procured about 66% of total renewable energy from their own renewable energy generation facilities. Ultimately, they are aiming to cover 100% only with the power owned by their facilities.

Figure 2-2 Breakdown of Renewable Energy Procurement at Data Center in North Carolina State




(Source) Created by author based on Apple Environmental Responsibility Report 2018 Progress Report, Covering FY2017

Figure 2-2 shows the energy consumption at the data center of Maiden, North Carolina state and breakdown data on procurement indicating that it was covered by 100% renewable energy disclosed in the Environmental Responsibility Report by Apple.

The data center consumed 273 million kWh of electricity in 2017. And the $CO_2$ emissions (default) are converted to 100,480 tons when it is assumed that all electricity consumption is covered by electricity from the local electric power company Duke Energy. This is because, in the power supply configuration of Duke Energy, the proportion of nuclear power that does not emit $CO_2$ is 51%, while $CO_2$ is emitted by receiving electricity

owned by our company and other companies". Therefore, it is not that they are directly covered with renewable energy generation. It also includes Japanese Apple stores, Japanese corporate headquarters, and research facilities in Yokohama. As for the electricity used in these facilities, Apple procures electricity derived from renewable energy. A huge solar panel is also installed on the roof of Yokohama's research facilities.

from coal, gas, and oil thermal power plants accounting for 49% in total. However, Apple procured 273 million kWh from the following renewable energy generation facilities.

◇ Receiving electricity from a total of 50 MW of solar power plants constructed adjacent to the data center and 10 MW of biogas fuel cell
◇ Receiving electricity from 20 MW of solar power plants through the alliance program (Green Source Rider [22]) with local electric power company Duke Energy
◇ Receiving electricity from a total of 86 MW of solar power plants through long-term PPA with local renewable energy power generation company NC GreenPower.

As a result, Apple reported to be able to reduce the total of $CO_2$ emissions to zero in 2017.

Figure 2-3 Apple and Supplier Renewable Energy Generation Project in the world


(Source) Created by author based on Apple Environmental Responsibility Report 2018 Progress Report, Covering FY2017

As of April 2018, Apple is working on 25 renewable energy generation projects (total: 626 MW) in the world, and 15 projects (total: 775 MW) are in the construction stage. The breakdown of renewable energy generation facilities owned by Apple is 48% wind power, 46% solar power, 5% biomass, 1% hydro-electric power.

Apple outsources most assembly and parts supply related to the manufacture of the iPhone, Mac, iPad, etc., and announces that 23 suppliers [23] involved in these outsourcing also cover electricity consumed in the manufacturing process with 100% renewable energy.

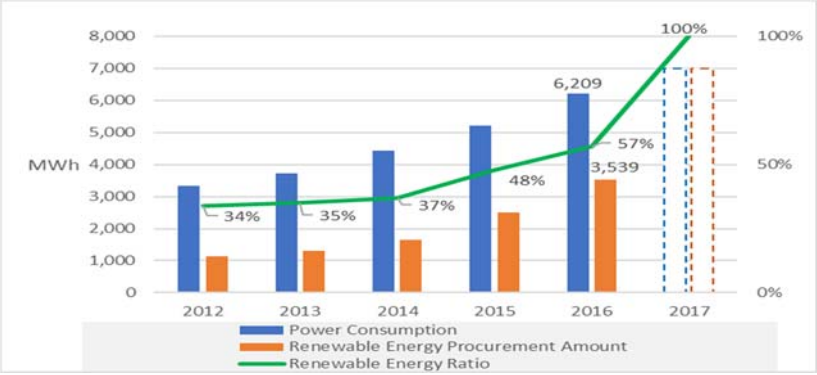
Figure 2-3 also includes projects that suppliers are working on.

[22] Since June 30, 2012, in North Carolina State which is a non-liberalized state (regulatory state), a new program, which a user with a new electricity demand load of at least 1 MW can acquire both electricity and environmental value by concluding a power receiving contract tied with renewable energy generation facilities, became possible. Apple partnered with local power company Duke Energy to build a 20 MW solar power plant. Under the power receiving contract, Apple pays a fee that adds the renewable energy generation cost and the management cost to the existing wheeling charge.
Meanwhile, it is possible to evaluate the equipment capacity cost and power generation cost of Duke Energy that can be avoided by renewable energy generation, and to receive the cost evaluation as environmental value (REC).

[23] The factories of these assembling companies and parts supply companies also include Japanese companies, which are IBIDEN CO.,LTD. and TAIYO INK MFG. CO., LTD.

## 2-2 Google

Figure 2-4 Trends of Electricity Consumption / Renewable Energy Procurement / Renewable Energy Ratio 【2012-2017】




(Source) Created by author based on Google Environmental Report 2017

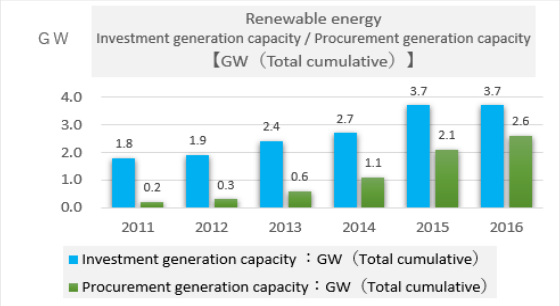
With the expansion of business, Google is a company that has a large amount of electricity consumption among many IT companies operating data centers. Since electricity cost is the largest element of data center operation cost, Google has been working on procurement and securing of energy for a long term as a means of defense against energy price fluctuations.

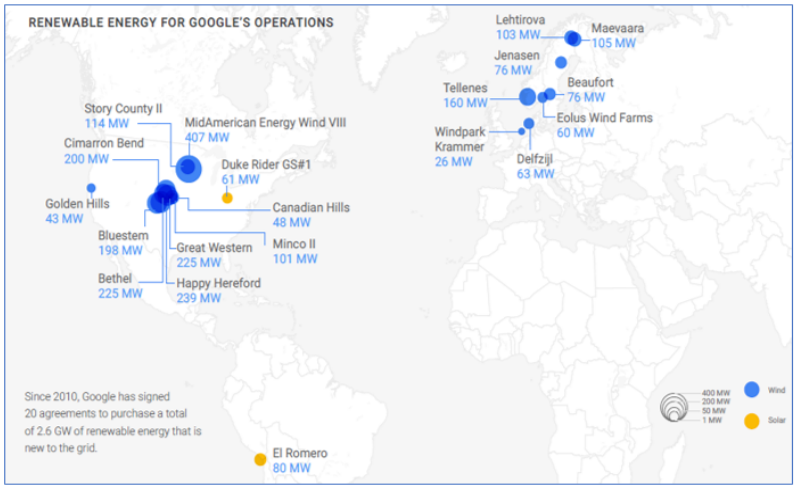
Google has concluded long-term PPAs (19 contracts, wind and solar power facilities, generation capacity: total of about 2.6 GW) with many renewable energy power generation companies in the U.S., South America and Europe. Google supplies the procured power to 14 data centers and offices around the world.

On April 4, 2018, Google announced that they have already achieved the goal of covering the electricity consumed in business operations of the whole world with 100% renewable energy received from renewable energy generation facilities that Google invested in and built mainly [24]. As shown in Figure 2-4, the ratio of renewable energy procurement in 2016 was 57%, but during 2017, by investing a total of 3 billion dollars and securing about 400 MW of renewable energy generation capacity, Google reported that they have already reached 100%.

[24] Google homepage (April 4, 2018)
https://www.blog.google/outreach-initiatives/environment/meeting-our-match-buying-100-percent-renewable-energy/

Figure 2-5 Investment Generation Capacity / Procurement Generation Capacity Trend【2011-2016】
Renewable Energy Project in Operation

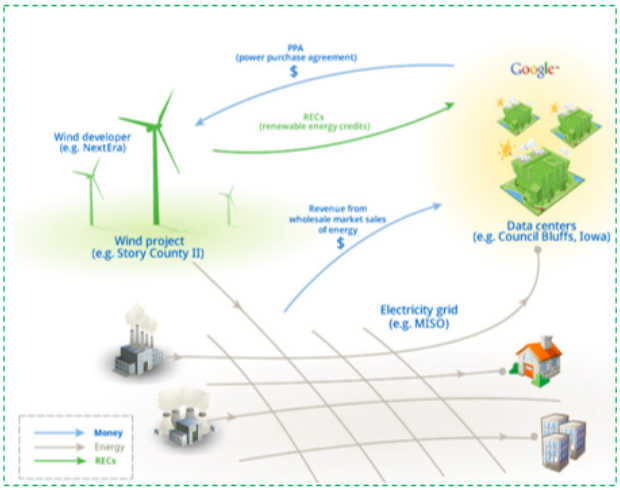


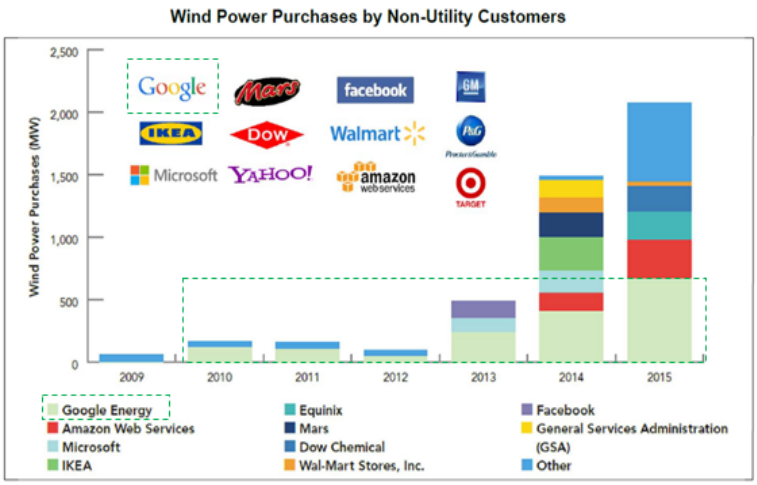




(Source) Created by author based on Google Environmental Report 2017

As shown in Figure 2-5, since 2010, Google has invested about 2.5 billion dollars in the renewable energy generation business in the U.S., South America and Europe (total power generation capacity: 3.7 GW). Especially, investment in large wind power accounts for 90% or more and it is a characteristic part. Google has long focused on procurement through long-term PPAs and plans to focus on direct investment in the renewable energy business in the future and ultimately aims to procure only from investment projects.

Figure 2-6 Long-term PPAs of Google and Renewable Energy Power Generation Companies




(Source) Google Environmental Report 2017

As shown in Figure 2-6, by mainly concluding a long-term PPA with renewable energy power producers, Google has procured electricity and REC for achieving the goal. Renewable energy power generation companies can obtain stable income guarantee by allowing large-scale users like Google to agree on long-term and continuous purchase. Moreover, it can also utilize this to further raise funds. Especially, Google has the largest amount of procurement from wind power generation in the U.S. It also leads to the promotion of investment in next new projects, and a virtuous circle is being created.

Since renewable energy (wind power generation/solar power generation) procured by Google is a variable power supply, the supply and demand gap of time and place occurs. There is no choice but to adjust power

supply such as thermal power generation. As it cannot substantially reduce $CO_2$ emissions to zero, Google is considering reducing the supply-demand gap by securing on-site storage and strengthening interconnection with the grid operation as the next new step. Google continues to pursue efforts aiming for true 100% renewable energy procurement.

## 3. Efforts of Private Companies in Japan

Efforts to reduce carbon by Japanese private companies are often due to energy conservation. Regarding renewable energy, it was not so much compared with private companies in Europe and the U.S. However, in recent years, private companies in Japan are increasingly pursuing initiatives such as introducing renewable energy generation facilities into their factories and shops to consume themselves.

Since the full liberalization of electricity retail sales that began in April 2016, retail electricity companies have started to provide eco-friendly green power contract menus such as "100% renewable energy power supply menu." Environments that enable procurement of electricity from renewable energy through contracts are also being created. There are also situations in which power procurement from renewable energy is possible through retail contracts.

There are not many, such as in Europe and the U.S., but some private companies aiming at achievement have started setting high goals with the proportion of procurement from renewable energy as 100%.As of the end of April 2018, the following six private companies joined the RE 100 and are making their efforts.

Table 3-1 Goal and Initiatives for RE 100 Member Companies in Japan

| | 100% Goal | Major Efforts |
|---|---|---|
| Ricoh | 2050 | Introduction of solar panels, introduction of woody biomass, practical application of micro hydro power generation, etc. |
| Sekisui House | 2040 | Purchase surplus electricity after the end of the FIT from the owner of a house equipped with solar panels sold by Sekisui House, etc. |
| ASKUL | 2030 | 100% utilization of renewable energy at head office and distribution center by 2025<br>100% utilization of renewable energy in the whole group by 2030 |
| Daiwa House Industry | 2040 | Renewable energy power generation business utilizing its unused land, Introduction of self-sufficiency office of electric power combining solar power generation and storage batteries |
| Watami | 2040 | Installation of solar panels in stores, purchase of electricity from local power generation facilities, etc. |
| AEON | 2050 | Installation of solar panels in stores, purchase of electricity from local power generation facilities, etc. |

(Source) Created by author based on homepage and press materials of each company

Among these six private companies, we would like to look at the examples of Sekisui House and AEON which are actively working.

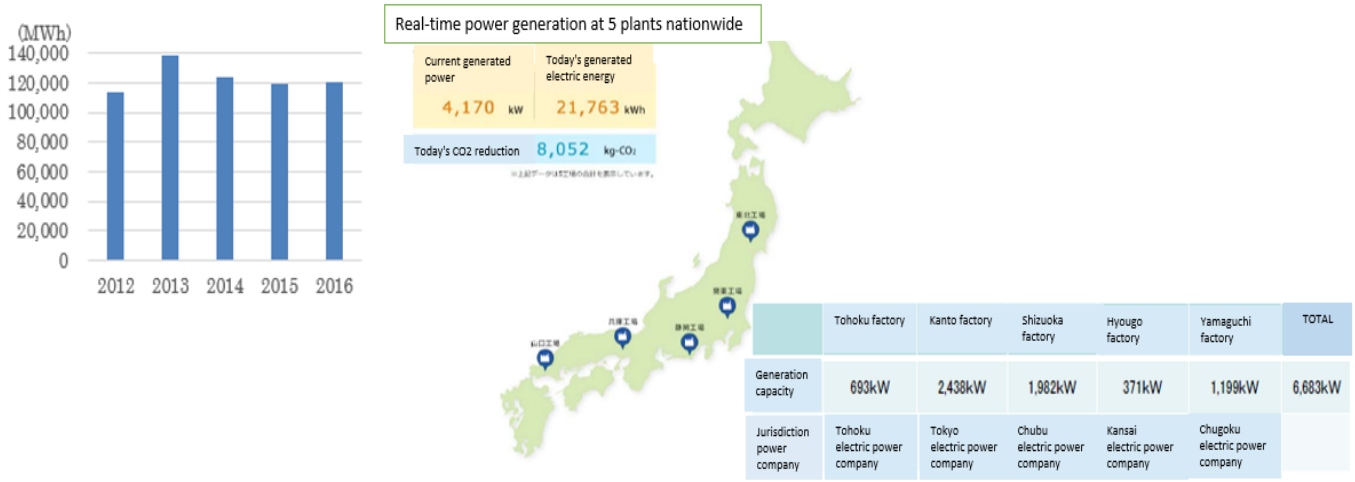
### 3-1 Sekisui House

Sekisui House Co., Ltd. ("Sekisui House") is the first private company in the domestic construction industry to join RE 100. In 2008, Sekisui House announced "Decarbonization Declaration: 2050 Vision," and at COP 21 in 2015, signed the "Joint Declaration at the Building and Construction Division" and declared compliance with the Paris Agreement.

In this way, Sekisui House is actively working on the environmental efforts.

### 3-1-1 Electricity Consumption and Renewable Energy Amount

Figure 3-1 Electricity Consumption and Mega Solar Power Plant in Sekisui House Group




(Source) Created by author based on Sekisui House homepage, "Sekisui House Sustainability Report"

Sekisui House is working on the following goals to cover electricity consumed in their group's business activities with renewable energy.

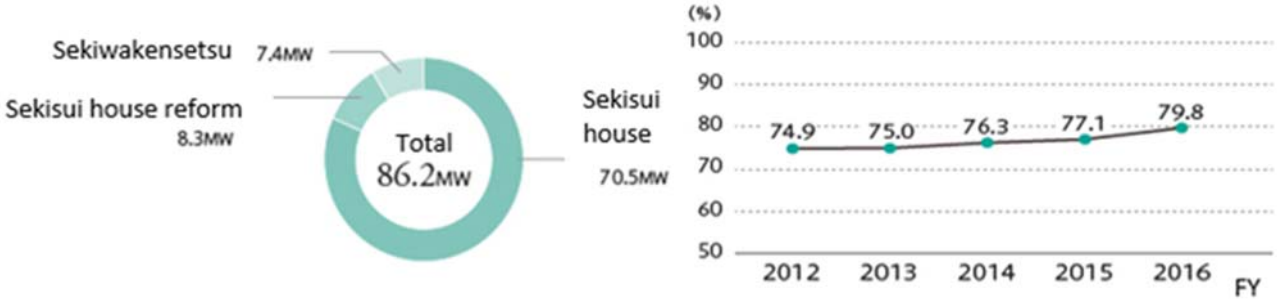
・Mid-term goal：Covered with 50% renewable energy by 2030

・Final goal ：Covered with 100% renewable energy by 2040

The total electricity consumption in FY 2016 is 120,533 MWh. Sekisui House is promoting reduction of electricity consumption by energy saving. Regarding renewable energy, large-scale solar power generation facilities totaling 6.7 MW are installed at five domestic factories to increase the amount of power generation.

### 3-1-2 Electric Power Related Business

Figure 3-2 Annual Installation of Solar Power Generation Facilities 【2016】
Installation Rate in Newly Constructed Independent Houses 【2012-2016】




(Source) Sekisui House homepage

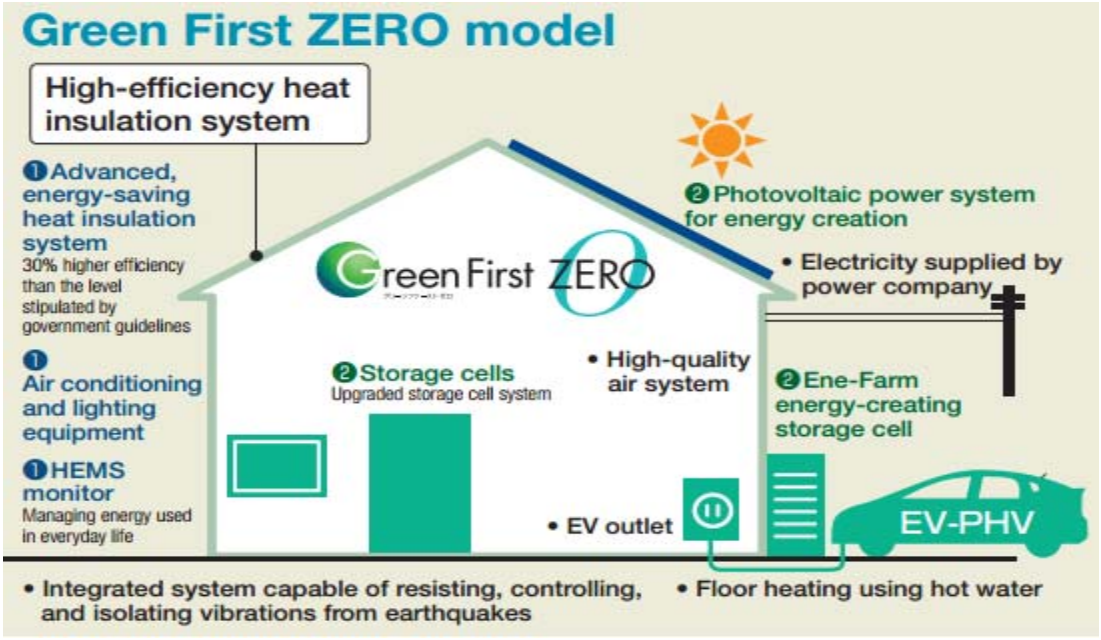
Sekisui House is engaged in the project to promote the installation of solar power generation facilities at the time of construction and remodeling of houses as an effort by group companies. As shown in Figure 3-2, the annual installed capacity of solar power generation in FY 2016 is 86.2 MW. In addition, the installation rate of solar power generation facilities promoted along with the construction of newly constructed independent house is a high achievement of 79.8%.

In this way, the installed capacity of solar power generation installed in the house exceeds 650 MW in total, and it is estimated to be equivalent to about 650,000 MWh in terms of annual power generation. This corresponds to the amount that can cover the annual electricity consumption of the Sekisui House group's business activities［Actual results in 2016：120,533 MWh］.

In the future, with the termination of solar power surplus electricity purchase system [25], Sekisui House plans to purchase surplus electricity utilizing the network with the home owner who installed solar power. By increasing the procurement volume of renewable energy through this means, Sekisui House has announced that it will actively utilize its own electricity consumption to achieve the goal of 100% renewable energy.

### 3-1-3 Efforts toward the Environment through Business

Figure 3-3 Overview of Green First Zero




(Source) Sekisui House homepage

In the housing industry, Sekisui House has pioneered the supply of low-carbon houses, which greatly reduce energy consumption, due to high insulation and energy saving performance. In September 2009, Sekisui House began promoting the environmentally friendly housing "Green First" and, in 2013, "Green First Zero." The latter was ahead of the government-promoted Net Zero Energy House ("ZEH [26]"). Because "aiming for zero energy balance (aiming to generate energy to offset energy consumption)" is the concept, solar power generation facilities are installed in most houses, and as a result, cumulative installed capacity is over 650 MW.

Sekisui House introduced ZEH, which is advanced environmentally-friendly housing in Japan, at COP 22 held in Marrakech, Morocco in November 2016. Also, Sekisui House announced its efforts toward the environment through its business and received high praise worldwide.

Sekisui House is promoting efforts with the goal of increasing the ZEH ratio to over 80% by 2020.

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[25] Following the application of the surplus electricity purchase system that began in 2009, the residential solar power generation facility introduced will finish the fixed purchase period of 10 years from 2019 onwards. Also, with regard to the power supply for which the purchase period under the FIT system started in 2012, the purchase obligation under the law is going to disappear. Therefore, after the end of these systems, surplus electricity would be utilized as self-generated consumption or be sold by individual contract (free contract). Sekisui House will take this opportunity and purchase from the owner of the house and plan to utilize it to achieve its goals.

[26] ZEH is a house aiming for plus or minus "zero" balance of annual primary energy consumption (air conditioning, hot water supply, lighting, ventilation) by increasing the heat insulation and energy saving performance of the house, and by creating energy with solar power generation and fuel cells.

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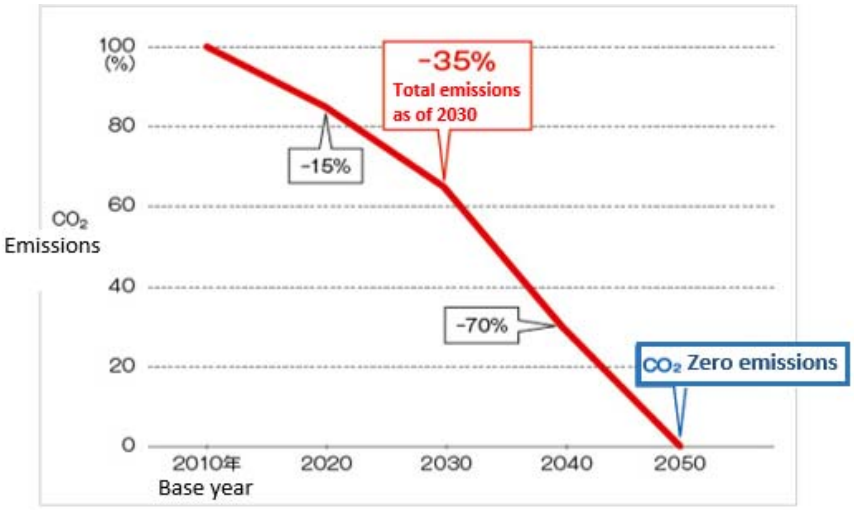
## 3-2 AEON

Figure 3-4 AEON Greenhouse Gas Emission Reduction Goal




(Source) AEON homepage

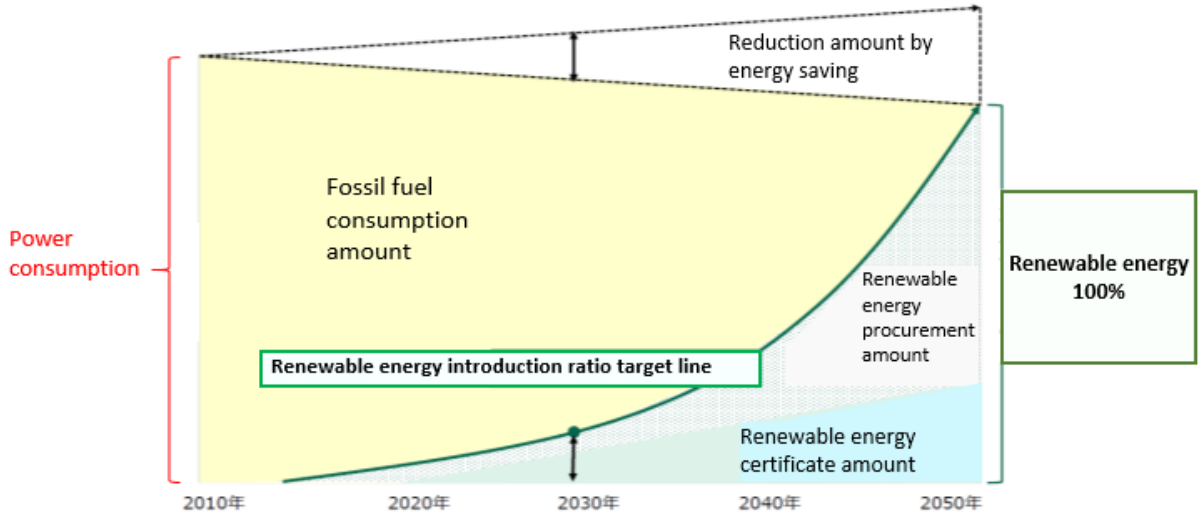
AEON Co., Ltd. ("AEON") formulated the "Decarbonization Vision 2050" in March 2018. By 2050, the goal was set to zero greenhouse gas emissions at more than 21,000 stores in the group. Also, it set an intermediate goal of reducing greenhouse gas emissions in 2030 by 35% compared with the 2010 level.

AEON joined RE 100 for the first time as a major Japanese retail electricity company with the goal setting of this "decarbonation vision 2050" and internationally declared a high goal of covering the group's power consumption with 100% renewable energy by 2050. For this reason, initiatives such as installing and promoting solar panels in their facilities have been started sequentially.

### 3-2-1 Electricity Consumption and Renewable Energy Amount

The amount of electricity consumed by AEON is about 7.4 billion kWh/year in FY 2017, which is very large, equivalent to about 1% of the total electricity consumption in Japan. Therefore, if all the electricity consumption is covered by procurement from renewable energy, the burden of procurement costs will be greatly increased, so the impact on management for AEON will be very large.

Figure 3-5 Image of Emission Reduction by Energy Conservation and Renewable Energy at AEON stores




(Source) AEON homepage

As shown in Figure 3-5, AEON plans to reduce electricity consumption through energy conservation at all stores and plans to install solar power generation facilities and increase the procurement amount of renewable energy on its own. As of the end of 2016, there are already 62,000 kW of renewable energy generation facilities, and by 2020, AEON plans to introduce about 200,000 kW of large-scale renewable energy generation facilities, mainly solar power generation.

Furthermore, by utilizing a certificate as an external procurement measure of environmental value and by selecting the green power purchase contract menu with zero emissions power such as renewable energy and hydroelectric power generation, AEON aims to achieve the goal. The AEON headquarters building is procuring electricity derived from zero emission power sources by concluding a green power purchase contract menu "Aqua Premium" that supplies only electricity generated by hydroelectric power generation with TEPCO Energy Partner.

In addition to the active introduction of solar power generation facilities, the AEON Group stores also purchase electricity derived from renewable energy in the area where stores are located. AEON stores are also working on community revitalization and regional contribution by local production of energy.

### 3-2-2 Electric Power Related Business

Figure 3-6 Image of Power Trading Business by AEON delight


(Source) AEON homepage

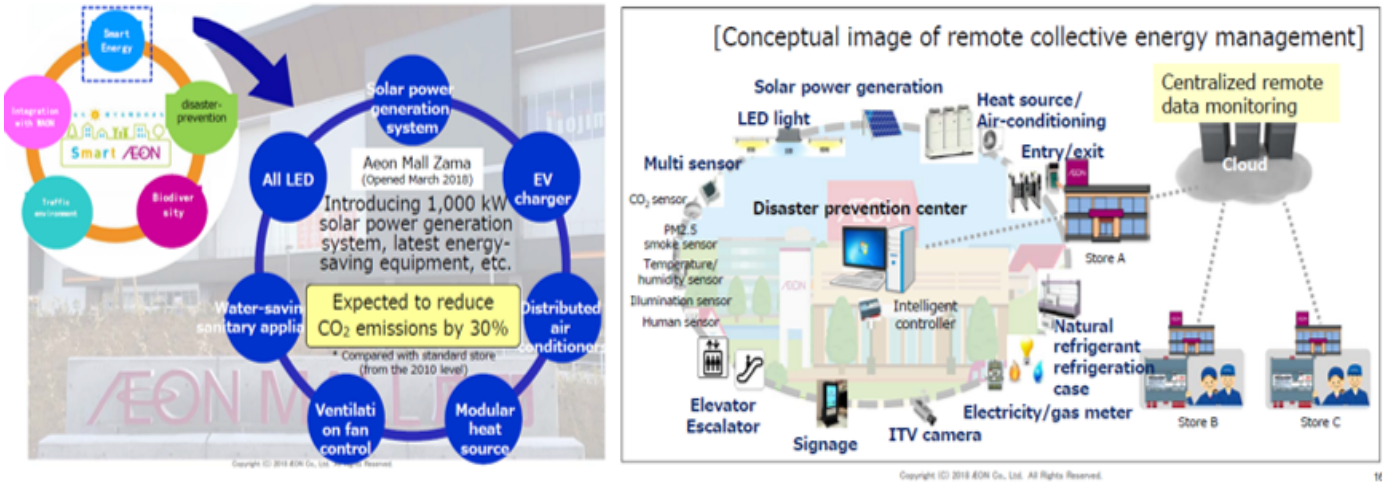
AEON delight, a group company that collectively carries out facility management of AEON stores, has started a demonstration project to trade electricity between AEON stores since April 2018. It utilizes a direct trading platform business of electricity and environmental value [27] by DIGITAL GRID Corporation that AEON invests in. AEON will install special equipment in 35 stores in FY 2018 and 1,000 stores in FY 2019, and after that, plans to start energy management and retailing on the platform to be completed in FY 2019.

In the future, with the proper value on renewable energy traded, AEON group companies are planning to provide surplus electricity generated by their own companies and households in addition to clean electricity generated by renewable energy power generation companies to neighborhood large power users and general households.

[27] DIGITAL GRID Corporation is a venture company founded in October 2017. Besides AEON delight, Tokyo Gas, Nihon Unisys, etc. also contribute. AEON delight provides facility management that collectively fulfills outsourcing needs related to the management and operation of facilities and environments surrounding users. In the future, AEON delight plans to monitor power consumption of facilities in real time, including utilization of renewable energy and saving energy. Through reduction of electricity cost, AEON delight aims to contribute to the realization of a sustainable energy society linked with "Decarbonization Vision 2050".

### 3-2-3 Efforts toward the Environment through Business

Figure 3-7 Conceptual Image of Remote Collective Energy Management




(Source) AEON homepage

To tackle the reduction of total electricity consumption, from the viewpoint of decarbonization, AEON is promoting the development of "The next generation Smart AEON" store which has evolved from the conventional "Smart AEON" store. They are introducing next-generation smart technology combining energy saving and renewable energy, utilization of AI and big data, and centralized remote data monitoring of energy utilizing IoT. By doing so, the aim is to evolve from partial optimum energy to total optimum, and to actively utilize renewable energy electricity generated in the region.

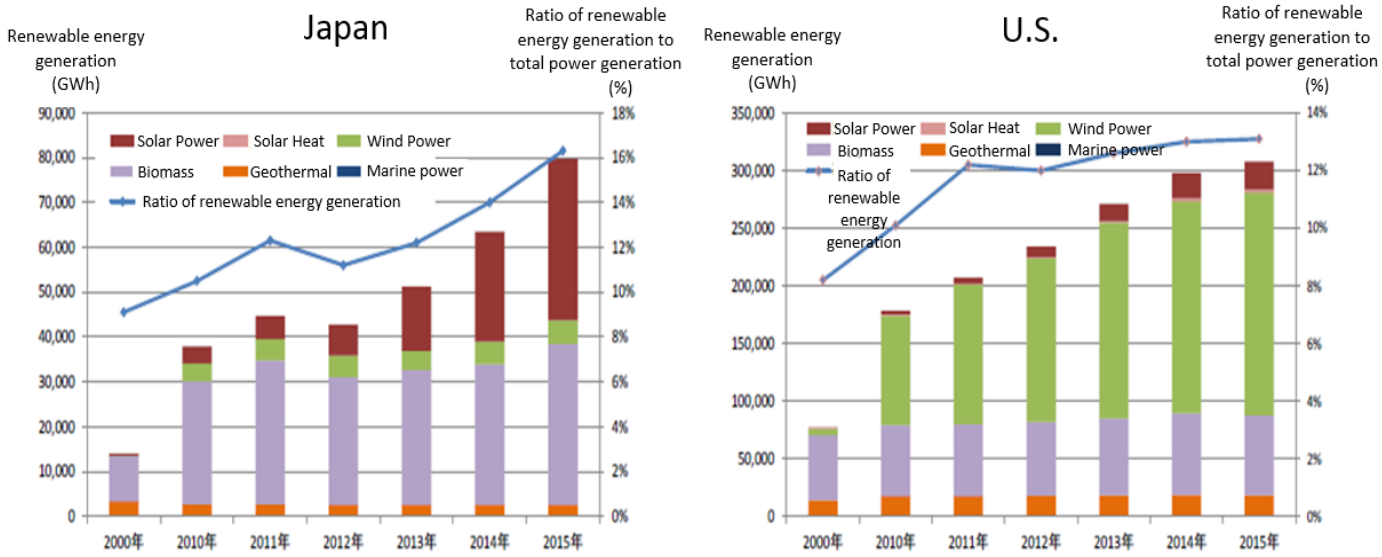
Moreover, AEON MALL, a group company, joined the EV 100 for the first time as a Japanese company in November 2017. AEON MALL declares that it will work toward promotion of development of EV infrastructure and announced that it has already installed EV chargers in all domestic shopping malls in February 2018.

In this way, AEON sets goals in a manner that ties synergistically with its business to environmental efforts related to reducing greenhouse gas emissions and is developing a group-wide approach through business.

# 4. Comparative Study on Renewable Energy Situation in Japan and the U.S.

## 4-1 Comparison of Renewable Energy Generation and Retail Electricity Price

Figure 4-1 Renewable Energy Generation and Ratio of Renewable Energy to Total Power Generation in Japan and the U.S. Trend【2000-2015】




(Source) Ministry of the Environment "Survey on measures to expand introduction of renewable energy over the medium to long term toward realization of low carbon society in FY 2016"

As can be seen from Figure 4-1, since the FIT system began in July 2012, the capacity of renewable energy generation facilities, mainly solar power, will increase by about 60% compared to the previous year in 2013 and by about 50% more than the previous year in 2014. The proportion of renewable energy (including hydroelectric power) to the total power generation amount gradually increased from the 10% level after 2010, reaching 16% in 2015.

Most of the increase in facility capacity is due to solar power generation for business use, and the cumulative introduction capacity since the start of the FIT system is about 27 GW. Looking at the ratio of renewable energy generation to total power generation, the share of biomass was the largest until 2014, but after the introduction of the FIT system, solar power generation has grown rapidly, reaching a maximum share of 45% in 2015.

In the U.S., wind power generation is the largest among renewable energy, accounting for about 8% of total electricity generation including nuclear power and thermal power as of 2015. Solar power generation has also continued to grow in recent years, and the facility capacity in 2014 is about five times that in 2010, about eight times in terms of the amount of electricity generation.

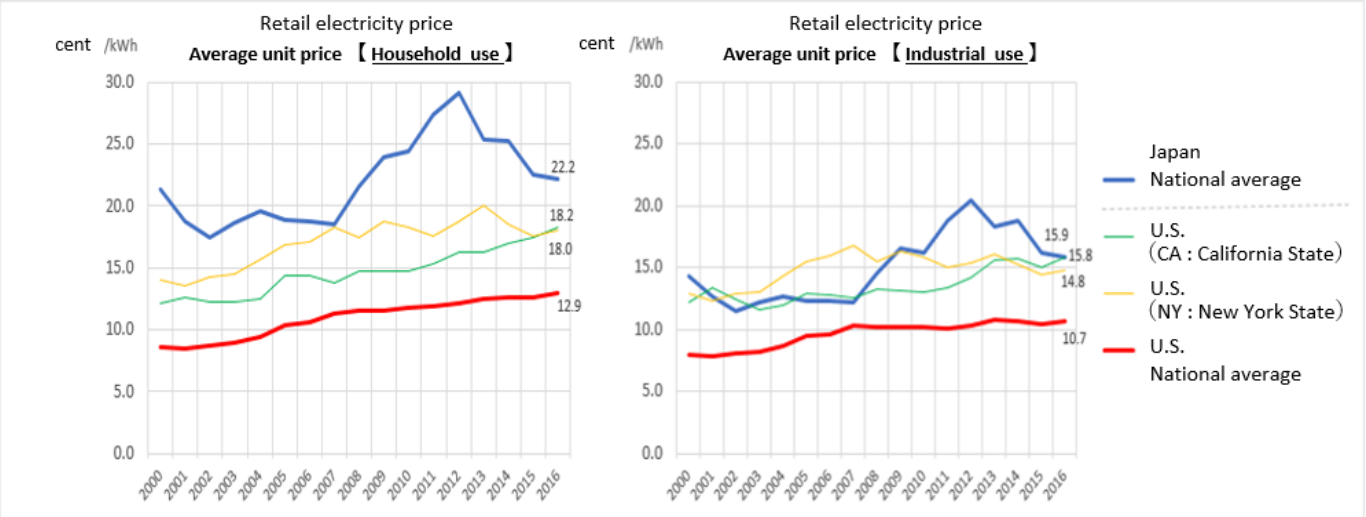
In this way, in recent years, both countries have increased the amount of renewable energy generation, and the ratio of renewable energy to total electricity generation is 16% in Japan and 13% in the U.S.

As mentioned above, by the FIT system which began enforcement in Japan since 2012 and by the RPS system which began enforcement in various states of the U.S. since around 2000 (California state: 2002 state, New York state: 2004, etc.), the national and each state government has promoted the introduction of renewable energy [28].

The FIT system sets a higher electricity price than usual for renewable energy generation and obliges local electric power companies (in the case of Japan, transmission and distribution companies) to purchase. On the other hand, the RPS system obliges state power companies (in the case of the U.S., mainly retail electricity companies, etc.) to procure renewable energy generation more than a certain percentage according to the sales electricity amount. The procurement electricity price of renewable energy generation is characterized by being determined based on the supply and demand of the renewable energy generation market.

As mentioned above, although there is a difference between both systems, in both cases, the electric power company purchases (or procures) electricity generated by renewable energy. For this reason, when selling electricity to users, the costs are substantially transferred to the retail electricity price, which substantially affects the rise.

Figure 4-2 Retail Electricity Price in Japan and the U.S.
Trend of Average Unit Price (Household use / Industrial use)【2000-2016】




(Source) Created by author based on U.S. Energy Information Administration, IEA "Energy Prices and Taxes"

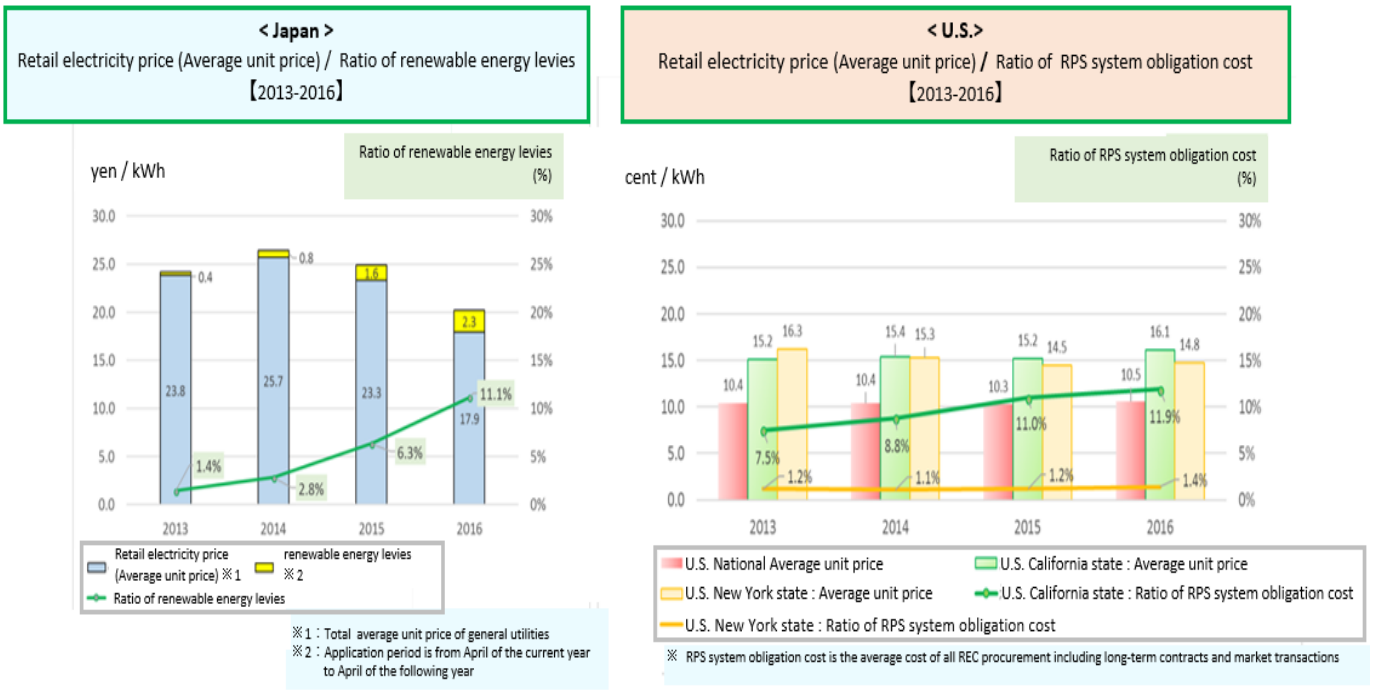
Figure 4-2 is a graph comparing the level of retail electricity price in Japan and the U.S. since 2000, divided for household use [left figure] and industrial use [right figure].

For example, comparing the results for home use in 2016, the national average of Japan (22.2 cents/kWh) is about 10 cents/kWh higher than the national average (12.9 cents/kWh) in the U.S. Comparing in the U.S. alone, New York state and California state, which set high reduction goals for greenhouse gas emissions, have remained at a level of about 5 to 8 cents/kWh higher than the national average of the U.S.

[28] In Japan, the RPS system was introduced in 2003 once. The government obligated electric power companies to raise renewable energy more than a certain percentage by the specified goal year. As the years passed, although the spread of renewable energy had been progressing little by little, the ratio of renewable energy to total electricity generation was only 1% in 2010, which was 7 years after the start of the system. Because of this circumstance, the question of the spreading effect of the RPS system was raised. For that reason, there was growing demand for a change to the FIT system which decided an appropriate transaction price for each power source individually and guarantees purchase over a long period of time. After the start of the FIT system on July 1, 2012, it was decided that the RPS system would be phased out during the five years since 2017.

Since 2000, New York state has been on a higher level than California by 3 cents/kWh, but it has declined in recent years after reaching 20 cents/kWh in 2013. On the other hand, California state has been on an upward trend since 2000 and exceeds New York state in 2015.

Figure 4-3　Trend of Renewable Energy Levies and RPS System Obligations Cost in Japan and the U.S. 【2013-2016】




(Source) Created by author based on U.S. Energy Information Administration, METI "Electricity Business Manual", and Berkeley Laboratory "U.S Renewables Portfolio Standards 2017 Annual Status Report"

Next, we would like to compare the retail electricity price level with the impact by the FIT system and the RPS system of both countries. Figure 4-3 is a graph showing the trend of the ratio of renewable energy levies on the Japanese retail electricity price [left figure] and the ratio of the RPS system obligation cost to the U.S. retail electricity price [right figure].

As mentioned above, in Japan, since the FIT system has been started, the cost required for electricity companies to purchase is a system that all users pay as part of retail electricity price [29]. A renewable energy generation promotion levy is imposed on each user in proportion to the amount of electricity used. In fiscal 2013, the unit price for levies was only 0.35 yen/kWh and the ratio of retail electricity price was only 1.4%, but in fiscal 2016, the unit price for levies was 2.64 yen/kWh and the ratio of retail electricity price was 11.1%. As we can see, the burden on users has increased substantially.

Meanwhile, in the U.S., regulatory authorities in each state that have adopted the RPS system allocate an obligation to electricity companies in state. Their electricity companies procure renewable energy through long-term contracts and market transactions to fulfill the assigned obligations. For this reason, it is different from Japan that the cost of renewable energy procurement is added as a levy and it is not a form of direct burden to the users. However, since the rise in cost is eventually added to the retail electricity price, it leads to an indirect burden to the user.

[29] Since April 1, 2018, obligation to purchase electricity derived from FIT has been imposed on power distribution companies (transmission and distribution companies and specified transmission and distribution companies).

According to published data aggregated by state, since 2013, the procurement cost for fulfilling obligations allocated by the RPS system in New York state has been at the level of 1.1 to 1.4% of electricity price. On the other hand, the procurement cost in California state has been at a high level of 7.5 to 11.9% of the electricity price.

Both New York state and California state have set high goals to reduce greenhouse gas emissions by 40% compared with 1990 levels and the renewable energy ratio to 50% by 2030. In California state, the electricity price level continues to rise as the proportion of renewable energy increases, indicating that the influence is becoming more noticeable.

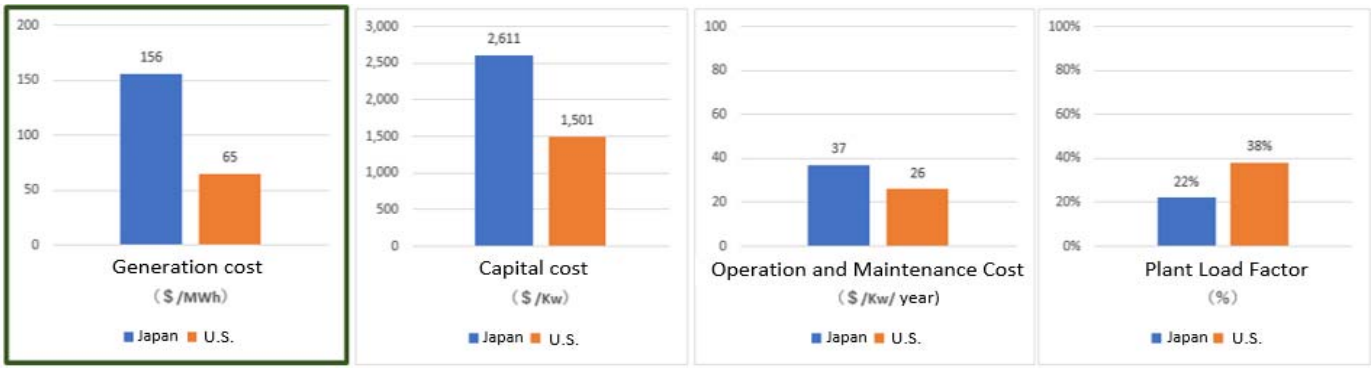
## 4-2 Comparison of Renewable Energy Cost

### 4-2-1 Status of Wind Power Generation

Next, we compare the situation between Japan and the U.S. on wind power and solar power generation, which are the main sources of renewable energy.

As shown in Figure 4-1 above, as of the end of 2015, while the amount of wind power plants installed in the U.S. is the second largest in the world with approximately 75 GW, Japan is only about 3 GW. There are such big differences between the two countries.

Figure 4-4 Comparison of Wind Power Generation Cost and Plant Load Factor in Japan and the U.S. 【2016】



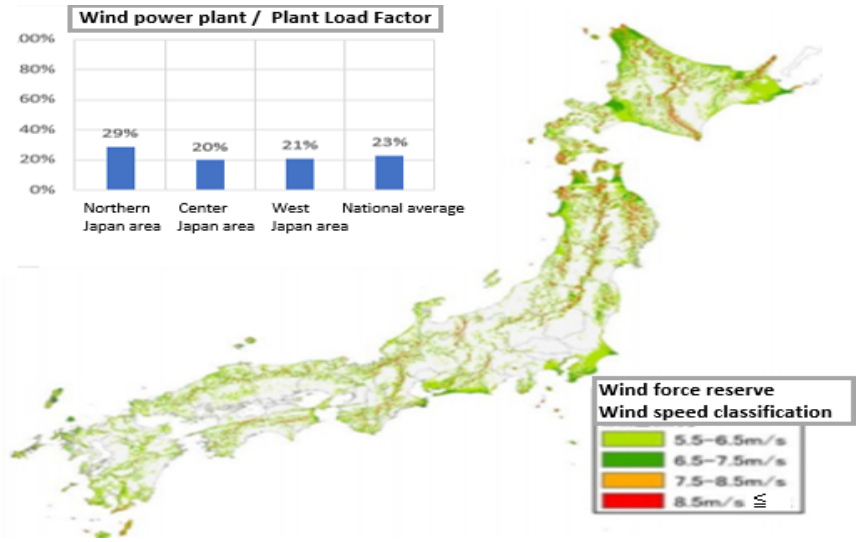

(Source) Created by author based on Bloomberg New Energy Finance

As can be seen from the comparison graph in Figure 4-4, the background that wind power generation is not introduced in Japan compared with the U.S. is that there is a difference of about 2.5 times power generation costs between Japan and the U.S.

From the comparison of capital cost and operation maintenance cost, in addition to the fact that there are few plains on which wind power generation can be located and therefore construction costs become high in Japan, the scale of installation facilities is small, the wind turbine construction cost per capacity is high, and stable power generation system and maintenance system are not established, which leads to high power generation cost as a result. Besides generation cost, the risk burden of power generation companies is heavy, such as land use control and long-term environmental assessment. Moreover, because the area with good wind conditions is limited and the annual average wind speed is low, the annual average facility utilization rate in Japan is also 22%, which is significantly lower than 38% in the U.S.[30]. Thus, it turns out that Japan has various problems geographically and structurally.

[30] The world average of the annual average plant load factor is 31%, and the U.S. with a vast flat land is in a privileged location environment like Brazil and Australia. (Source) Bloomberg New Finance

Figure 4-5　Average Wind Speed Map and Average Plant Load Factor at Wind Power Plant in Japan

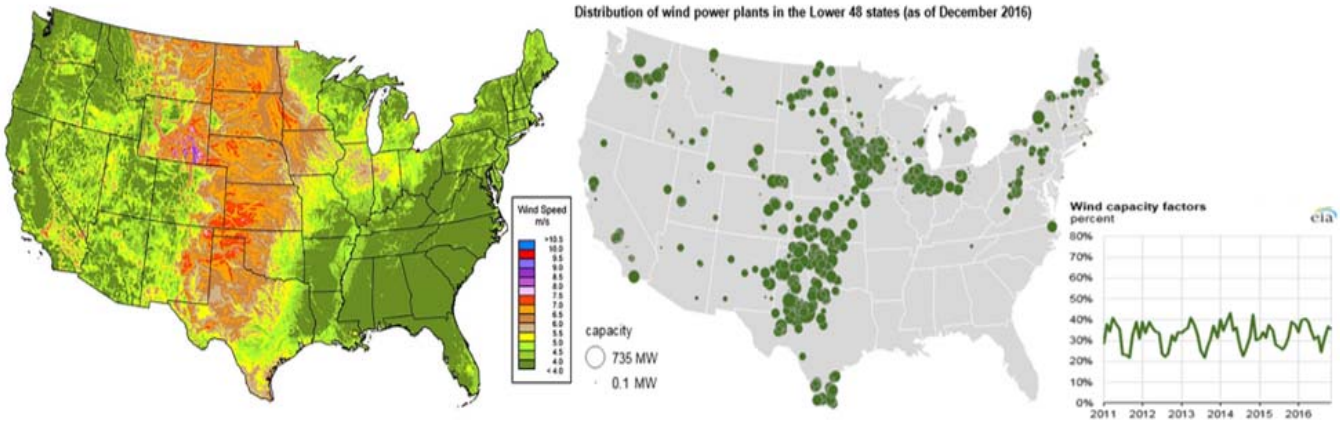



(Source) Natural Resources and Energy Agency, Natural Energy Foundation

Figure 4-5 is a map showing the wind conditions throughout Japan by wind speed. A suitable location of a wind power plant is generally 5.5 m/s (yellow green color) or more, and it is said that it is necessary to be 6.5 m/s (green color) or more as an investment project that can be profitable [31].

As can be seen from the above map, the area of 6.5 m/s (green color) or more is only about 10% of the whole country. The annual average plant load factor in the northern Japan region is 29%, which is higher than the national average of 23%, so domestic wind power plants are concentrated in the Hokkaido and Tohoku regions with good wind conditions. On the other hand, since the power network systems in these areas are weaker than urban areas, there are many systematic problems such as connection cost and capacity constraint. Therefore, various countermeasures such as system upgrading, and expansion of wide area operation are taken [32].

Figure 4-6　Average Wind Speed Map and Plant Load Factor at Wind Power Plant in the U.S.




(Source) EIA "National Renewable Energy Laboratory"

[31] Since wind power generation changes by 30 to 40% if the wind speed differs by 1m, it is estimated that when the wind speed doubles, the power generation will be about 8 times.

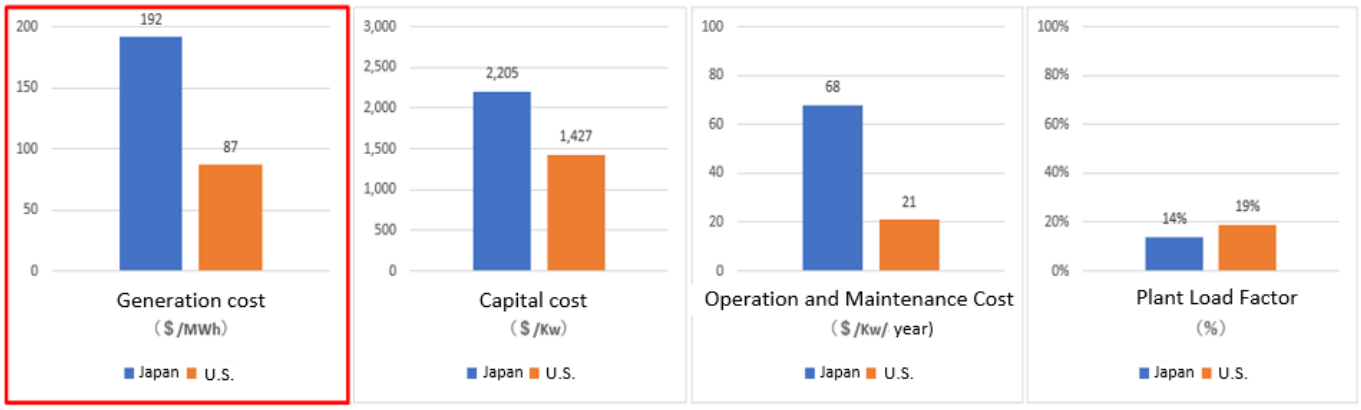
[32] To maximize the introduction of wind power generation in these areas, it is necessary to expand the area of operation of the Kitahon interconnection line, expand the operation of the wide area by interregional interconnection lines, and improve the usage rule. In addition, especially in the Hokkaido area, because of the lack of adjustable power sources such as thermal power generation capable of responding to output fluctuations of wind power generation, wind power generation (output of 20 kW or more) is necessary to take measures to mitigate short-term and long-term output fluctuations (through site storage batteries, etc.).

Figure 4-6 shows the wind condition map of the U.S. We can see that there are many suitable areas with wind velocity classification of 6.5 m/s (orange color) or more and 7.0 m/s (red color) or more, mainly in the central region such as Texas state. Large scale wind farms are widely located where large groups of thousands of kW scale stand on hundreds of scales. The average plant load factor is 25 to 40%, which is very high compared with Japan.

In this way, the business environment surrounding wind power generation differs greatly from the U.S., so in Japan, power generation companies hesitate to invest. Therefore, unless the government sets and guarantees a high purchase price under the FIT system [33], it is difficult for power generation companies to secure profits and recover stable costs. Thus, in Japan, wind power generation is not yet a cost-competitive power supply source.

### 4-2-2 Status of Solar Power Generation

Figure 4-7 Comparison of Solar Power Generation Cost and Plant Load Factor in Japan and the U.S. 【2016】



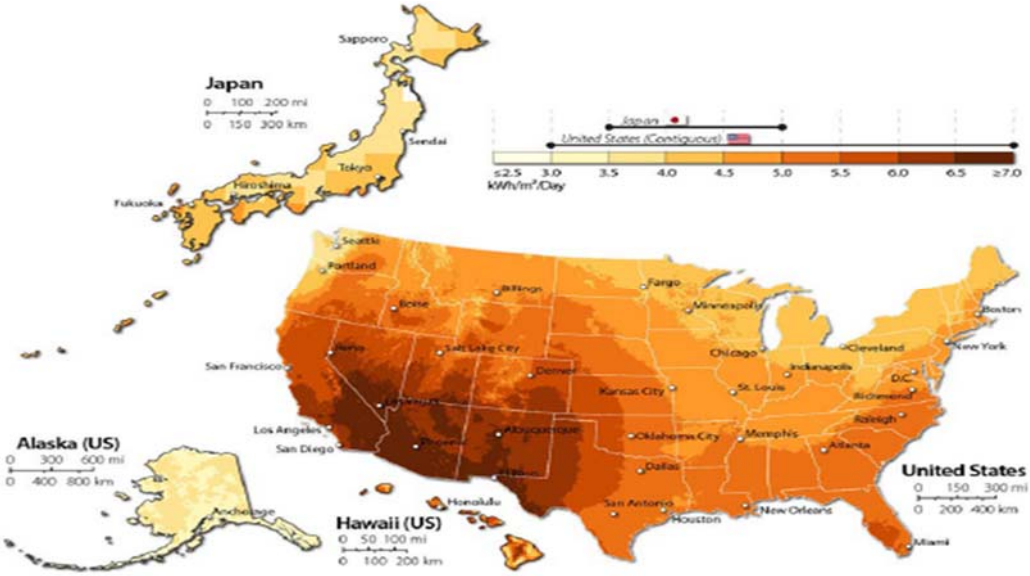

(Source) Created by author based on Bloomberg New Energy Finance

Next, we compare the situation of solar power generation. As of the end of 2015, the installed capacity of solar power generation in Japan was the second largest in the world at about 11 GW and the U.S. was the third with about 9 GW. However, in 2016, the introduction of solar power generation in the U.S. rapidly expanded, so the U.S. is now the second largest in the world, surpassing Japan.

Compared with wind power generation, which has not spread so far, Japan is ranked in the world in terms of introducing solar power generation. This is because the introduction of the FIT system in 2012 has rapidly expanded, mainly for business use of 10 kW or more. On the other hand, as can be seen from the comparison chart of power generation costs in Figure 4-7, as of 2016, the generation cost of solar power generation is about 2.2 times higher than that of the U.S.

[33] The FIT scheme procurement price of land-based wind power generation since October 2017 is 21 yen//kWh + tax in the case of over 20 kW and is 55 yen//kWh + tax in the case of less than 20 kW. The procurement period for both is 20 years.

Figure 4-8 Average Solar Radiation Map in Japan and the U.S.




(Source) Created by Natural Resources and Energy Agency based on Bloomberg New Energy Finance

Also, as can be seen from the average solar radiation map in Figure 4-8, in the U.S. regions with good climate conditions suitable for generation with solar radiation levels of 6.5 to 7.0 kW/㎡/day are spread throughout the country, mainly California state, etc. in the southwest part. On the other hand, in Japan, solar radiation levels of 3.5 to 5.5 kW/㎡/day are spread throughout the country. A generally suitable place of 5.0 kW/㎡/day level is limited to a part of the Kyushu and Shikoku regions. As a result, the average plant load factor in Japan is 14%, which is lower than 19% in the U.S.

Therefore, introduction of solar power generation is also supported by the high purchase price of the FIT system [34]. It is not yet a cost-competitive power supply source, unlike wind power generation.

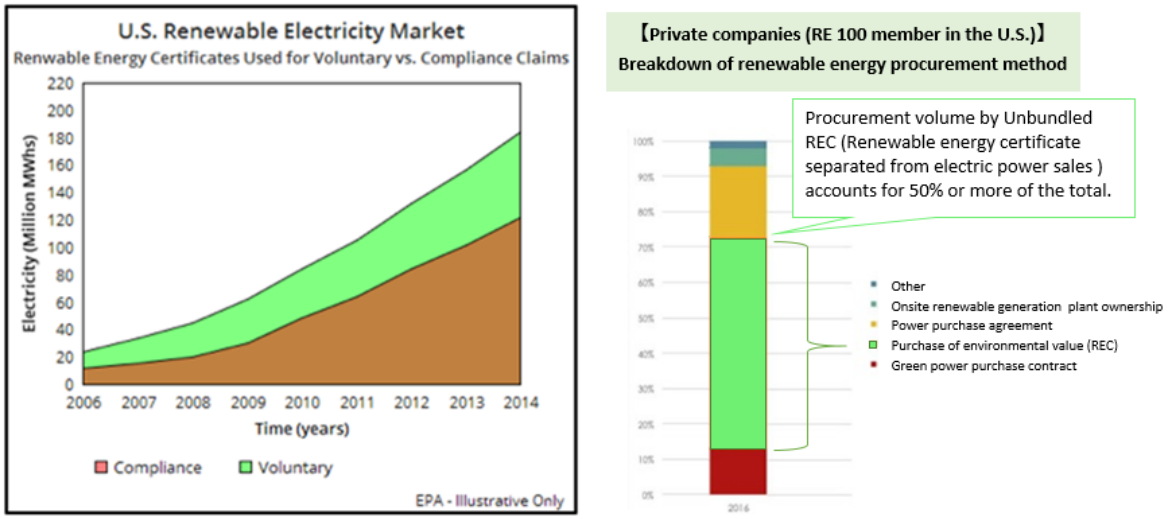
[34] The FIT system procurement price of land-based wind power generation since October 2017 is 18 yen//kWh + tax in the case of over 10 kW and is 26 yen//kWh + tax in the case of less than 10 kW. The procurement period for both is 20 years. The FIT system procurement price of solar power generation after October 2017 is 18 yen//kWh + tax for 10 kW or more but less than 2,000 kW, 26 yen//kWh for less than 10 kW (in the case that there is an obligation to install output control equipment). In the case of 2,000 kW or more, after the fiscal year 2017, the bidding system is applied. Regarding the procurement period, 10 kW or more is 20 years, and less than 10 kW is 10 years.

## 4-3 Market Transactions of Environmental Value and Long-term Power Purchase Contract (Long-term PPA)

As mentioned above, in Japan, the power generation cost of renewable energy is still high and there is no cost-competitiveness. For this reason, the amount of renewable energy procured by private companies other than electricity companies mandated to purchase under the FIT system has not increased much except for some aggressive private companies.

On the other hand, in the U.S., as the cost-competitiveness of renewable energy generation is increasing, not only electricity companies but also private companies have greatly increased the amount of renewable energy procurement. In the states where the RPS system is introduced, electricity companies within the states are obliged to procure a certain percentage of renewable energy. Meanwhile, even in the states where the RPS system is not introduced, private companies enthusiastic about reducing greenhouse gas emissions are expanding procurement of renewable energy for achieving the set goals.

Figure 4-9 Trend in REC Market Transaction Volume [left] and Breakdown of Renewable Energy Procurement Method of RE 100 Member Private Companies in the US [right]



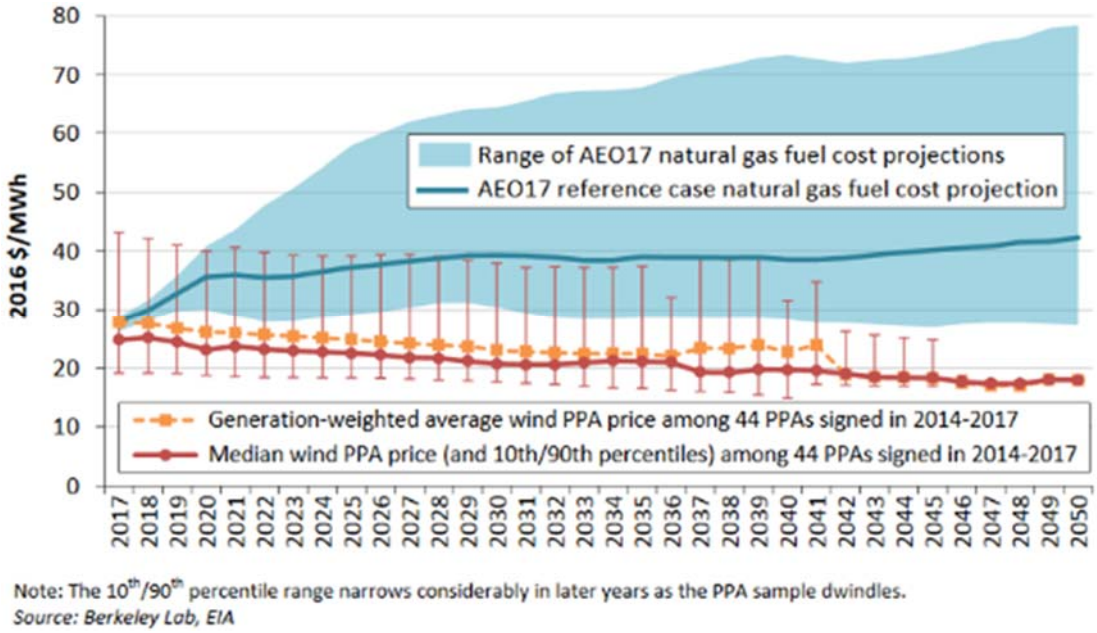

(Source) The Climate Group/CDP

Figure 4-9 shows a breakdown of renewable energy procurement methods for private companies that join RE 100 in the U.S. We can see that the amount of procurement by the renewable energy certificate (Unbundled REC) separated from electric power sales accounts for 50% or more of the total. This is because private companies, which are large-scale electricity users, are procuring and using them to achieve the set goals of renewable energy introduction and sustainability.

Many of the world's top companies, including the global IT companies based in Silicon Valley in California state, Starbucks in Washington state, and P&G in Ohio state, are environmentally conscious, contributing to sustainability as part of their brands. By pursuing REC procurement that makes full use of its abundant financial capability, they are aiming to achieve the goal of covering 100% of the electricity used by their companies with renewable energy.

In addition, Apple and Google that we analyzed in Chapter 2 do not use the method of procuring only REC through market transactions. They have achieved the 100% goal of renewable energy procurement only by making use of long-term PPAs with renewable energy generation companies and direct investment in renewable energy generation businesses.

Figure 4-10 Wind Power Generation Long-term Power Purchase Agreement (Long-term PPA) Average Price in the U.S.




(Source) Berkeley Lab, EIA

Also, as mentioned above, in the U.S., renewable energy generation such as wind power and solar power is becoming cost-competitive, compared with existing power generation sources such as gas-fired power. Especially, wind power generation costs tend to be further reduced due to the benefits of technologies leading to higher plant load factor, such as larger and slenderer wind turbines and increased hub height (from ground to rotating shaft).

Figure 4-10 shows the average price of 44 long-term PPAs between the wind power generation companies and the electricity companies or private companies, which are the large-scale electricity users, during the period from 2014 to 2017 in the U.S. For example, when looking at a line graph (red) obtained by weighted average of power generation capacity, we can understand that the longer the period is, the lower the price is.

◇ $22/MWh for the contract period (10 years) from 2017 to 2027

◇ $20/MWh for the contract period (20 years) from 2017 to 2037

In addition to the advantages that fuel cost, which is one of the main variable costs, is zero and fuel prices are not affected by market fluctuations, except for repair expenses, etc., basically it consists only of fixed expenses where depreciation proceeds as the year goes on, so it is expected that there is a high possibility that the cost reduction trend will continue over the long term.

On the other hand, according to the EIA's energy forecast, it is assumed that prices of domestic natural gas, which are declining in recent years, are uncertain but will be on an upward trend in the long term. In the reference case, it is assumed that it will change from $36 to $43/MWh after 2017.

The total cost of gas-fired power generation is largely dependent on the price of natural gas, which is the fuel required for power generation. (Although it cannot be said unconditionally because there are other costs to compare differences besides fuel prices), since the long-term PPA price of wind power generation is below the assumed cost of natural gas fuel over the long term, we can see that it is expected to be a long-term and stable cost-competitive power supply source.

Upon considering the construction investment of a new power plant, the electricity companies consider the various risks such as fluctuating fuel prices and future environmental regulations. Also, since private companies (large-scale electricity users) such as Apple and Google have regarded the data centers' power consumption cost as the largest cost factor, they have procured electricity from the viewpoint of not only environmental concerns but also long-term and stable means to avoid the risk of fluctuations in electricity prices. We can see that long-term PPAs of wind power generation for electricity companies and private companies has become one of the low-cost and low-risk options that deal with both these factors.

We consider that such avoiding fluctuation risk of fuel price and electricity price can be a promising merit for Japan with its high dependence on imports. Of course, wind power and solar power are variable power supply sources whose output depends on natural conditions, and cannot be uniformly compared with regulated power supply sources such as gas-fired power plant, which is excellent in load followability, frequency control, and voltage maintenance, etc. However, when the cost of renewable energy generation declines and become cost-competitive at a level that does not depend on the FIT system, in Japan as well, there is a possibility that the case where renewable energy power generation companies and private companies conclude long-term PPAs will increase in the future.

On the other hand, thermal power generation, which can be operated flexibly and contributes to stabilization of power quality, is also an indispensable power supply source from the viewpoint of supporting renewable energy whose output varies. Therefore, it is necessary for the adjustment cost required together with the expansion of the introduction of renewable energy to be properly burdened by renewable energy power generation companies and private companies implementing procurement.

What is needed is not a biased measure aimed at only the expansion of renewable energy but also an appropriate measure to be developed while the ratio of variable renewable energy expands. It is necessary to make it possible to recover the cost corresponding to the value of the power supply source for adjusting flexibly. Therefore, a measure to improve such a mechanism will be also needed.

## 5. Conclusion

We confirmed the recent situations and prospects about the environmental and energy policies of the U.S. and Japan. Regarding the U.S., we also confirmed the measures at the level of the state government in detail and analyzed that many private companies were promoting efforts to reduce greenhouse gas emissions such as through renewable energy use and thorough energy conservation, regardless of the declaration of withdrawal from the Paris Agreement by President Trump. Especially Apple and Google, global IT companies in California, have already achieved the goal of covering 100% renewable energy with the electricity necessary for the business declared in RE 100. We realized that they were no longer at a level that was merely an improvement in their performance, but also at a level that would have a significant impact on private companies in other countries seeking to realize a sustainable society through business.

Until a few years ago, while everyone recognized the advantage of renewable energy without emitting greenhouse gases, it was not a situation where private companies were able to proceed with the development and procurement of renewable energy due to the high generation cost. The government had to obligate procurement to electricity companies, etc. to promote the introduction and had to reduce power generation cost by financial support such as introduction assistance and tax deduction, etc. for renewable energy power generation companies. In the U.S., by the RPS system (29 states and Washington, D.C., oblige electricity companies to purchase a certain percentage of renewable energy), and in Japan, by the FIT system (the government obliges electricity companies to purchase renewable energy for a certain period at the price set by the government), both country's governments have induced and promoted the introduction of renewable energy politically.

California state has set a high goal to reduce greenhouse gas emissions by 40% from 1990 levels by 2030 and has also set the ratio of renewable energy to 50% of the amount of electricity sold within the state by 2030 based on the RPS system. Thus, environmental regulations are strict and the top level in the U.S. In addition, the awareness of residents and private companies of the environment was originally high, and a green charge program was introduced in accordance with the liberalization of the electricity market. Many companies and organizations have appealed to environmental actions socially, and cultures that earnestly recognize environmental value as a cost have been developed. The renewable energy cost (cost to fulfill the obligation of the RPS system) in electricity price accounts for a high percentage of about 12% in 2016, and the average retail electricity price became also about 1.5 times that of the national average in the U.S. and at a very high level. However, the fact that there are many residents and private companies that allow premium for renewable energy is one of the factors that supports such markets. In addition to these strict environmental regulations of state governments and high awareness of the environmental value of residents and private companies, since global IT companies (large-scale electricity users) such as Apple and Google regard the data centers' power consumption cost as the largest cost factor, they have procured electricity from the viewpoint of not only environmental concerns but also long-term and stable means to avoid the risk of fluctuations in electricity prices. We can see that long-term PPAs of wind power generation for electricity companies and private companies would be one of the low-cost and low-risk options that deal with both these factors. For example, the number of private companies procuring renewable energy by directly contracting long-term PPAs with renewable energy generation companies are increasing. It depends on the condition of the fuel price, but it is becoming comparable with gas-fired power generation due to the recent decline in renewable energy generation cost. Especially, Apple and Google are planning to further promote efforts to set up a renewable energy generation project as a means of defense against fluctuations in fuel price and electricity price. They

recently announced that they are planning to cover 100% of the power consumption of their own facilities only by procurement from their own projects.

When the CPP was introduced by the former Obama administration, many citizens thought that further policy initiatives were needed to achieve the goal "reduction of greenhouse gas emissions by 26% to 28% compared with 2005 by 2025" submitted at the time of the Paris Agreement. However, as conversion from coal-fired power to gas-fired power progressed by price factors and the accumulation of emission reductions at the state level and private company level is progressing as mentioned in this paper, some views that there is a possibility of reaching the GHG emission reduction goal in the U.S.

On the other hand, at the Federal government level centered on President Trump, in addition to trends relating to the continuation of the CPP, there are currently new moves such as considering measures to prevent the closure of coal-fired and nuclear power plants from the viewpoint of national security. Therefore, the future trend of the Trump regime continues to be watched.

In this paper, the situations of renewable energy in Japan and the U.S. were analyzed by comparing wind power generation and solar power generation. In Japan, the renewable energy generation cost has not yet decreased so much that private companies can procure and utilize themselves independently in an environment without the FIT system, and moreover, the economic scale of private companies in Japan is also very small compared with the top global private companies in California state, such as Apple and Google. Because of this great difference, private companies in Japan have not yet been able to do the same thing as private companies in the U.S. Also, the location environment of wind power generation and solar power generation in Japan is not favorable, but the average plant load factor is low at present. In addition, since they are variable power sources that are largely dependent on the weather, system constraints on operation and control must also be considered.

The U.S. has a vast land area and favorable weather conditions, and there is a history that technologies capable of coping with variable power supply have been developed, since wide-scale system operation and monitoring control has been improved from an early stage. Thus, the environment surrounding renewable energy varies in many ways. Therefore, we think that Japan should not proceed with extreme emphasis on renewable energy alone in the effort to reduce greenhouse gas emissions. We think that it is important that, by combining other zero-emission power sources (non-fossil power supply) such as large hydroelectric power and nuclear power, and thermal power sources indispensable for the stable operation of the power network system such as frequency adjustment, while balancing the strengths and weaknesses of each power supply, environmental and energy policies are being promoted comprehensively.

Japan has set a high goal of "26% reduction of greenhouse gas emissions by 2030 compared with 2013". To achieve this goal, the ratio of generation from zero emission power sources (renewable energy, hydroelectric power, nuclear power) must be increased to 44% in 2030. However, from the viewpoint of the generation ratio of renewable energy excluding large hydroelectric power, it is only 7.3% as of the end of 2016, so we predict that it is not easy to aim for achievement only by renewable energy. Therefore, in addition to promoting further introduction of renewable energy, we think that it is necessary to mix each power source in a comprehensive manner, such as restarting nuclear power generation and increasing the efficiency of thermal power indispensable for the stable operation and frequency adjustment of the power network system, and it is necessary to proceed with balanced measures.

In this paper, we analyzed at the environmental and energy policies in New York state in detail. New York

state does not necessarily stick to increasing the amount of renewable energy to be introduced and has a realistic viewpoint to lead to substantial emission reductions and a viewpoint to suppress the rise in the electricity price level as much as possible. We think that these are viewpoints that Japan also should follow.

Recently, in Japan, some major private companies have begun to join RE 100, too. Sekisui House and AEON that we analyzed this time set goals in a way that is synergistically linked with their businesses and approached efforts to reduce greenhouse gas emissions through their businesses. It is necessary to recognize that realizing the same efforts as California's top global private companies is a tremendously high hurdle. Therefore, given the situation in which Japan finds itself, a reduction goal that can be reached should be set in a way that does not necessarily narrow down to emission reduction only by renewable energy. In the future, in Japan, we anticipate that private companies that aim to achieve the goal will increase while mixing wide efforts including energy saving and utilization of zero emission power sources, etc.

We consider it is very important that the public and private sectors in Japan share the social issues and it is necessary that a mechanism that enables private companies to tackle their businesses and social tasks, that is, a mechanism that allows private companies to respond appropriately to the needs of seeking environmental appeal, is arranged.

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