A STUDY ON THE FOUNDATION FOR EXPANDING DEVELOPMENT OF NEW AND RENEWABLE ENERGY

By

AHN, Joo Hoon

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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EXECUTIVE SUMMARY

Challenges in the energy sector facing humanity are largely divided into stable energy supply and demand, reduce of climate change and environmental impact, energy poverty. Human beings must overcome such energy problems and make sustainable development. To this end, improvement of energy efficiency and expansion of low-carbon energy are considered as the key elements of the policy. The International Energy Agency (IEA) has argued that improving energy efficiency and expanding low-carbon energy technologies are key solutions for greenhouse gas reductions. In particular, the role of new and renewable energy has been emphasized in the decarbonization strategy of the electric power sector. As such, interest in new and renewable energy is rising worldwide (In this paper, I will name new and renewable energy as renewable energy). Renewable energy, one of the new growth industries, is gaining popularity as an environmental friendly future energy replacing fossil fuels with little greenhouse gas emissions. As a result, the size of new and renewable energy market is gradually increasing. In other words, major developed countries around the world are putting a lot of efforts and financial resources to preoccupy the rapidly growing renewable energy market. In addition to developed countries, developing countries such as China, India and Brazil are actively participating in the development of new and renewable energy technologies. In particular, it can be said that the new climate system, which came into effect in the Paris Agreement in 2015, provided all necessary and sufficient conditions for energy conversion. As a result, the Korean government, which put off the burden of the climate change convention and ignored the voice of energy conversion, had to concentrate on the conversion to renewable energy. Therefore, Korea is also putting a lot of resources into the renewable energy field to preoccupy the world market under the vision of low carbon green growth. In the future, this competitive environment is expected to become more intense. In particular, the strengthening of the policy on renewable energy sector in Korea is expected to minimize the impact of international oil price fluctuations and reduce dependency on high energy imports. Also, renewable energy is expected to become more popular as an energy source to replace nuclear power. The cost of generating renewable energy is still higher than that of existing energy sources. Therefore, technological innovation that can lower the power generation cost is very important. Government support policies can also be an important factor for industrial growth. In particular, in the power industry, in order to reduce greenhouse gas emissions from coal-fired power plants, it is essential to improve the efficiency of power plants,

develop new energy storage technologies, and spread renewable energy. Technological innovation is an important factor in expanding the development of renewable energy. However, prior to this, it is more important to improve the government's support policy and resident acceptability, and to improve various systems and regulations. In this study, I analyze the present state of renewable energy development and obstacles that suppress it, and discuss the improvement plan.

CONTENTS

I. Introduction

1. Changes in surrounding conditions

1.1 Changes in external environment

At the Plenary Meeting (COP21) of the 21st UN Climate Change Conference in Paris in December 2015, 195 parties signed the Paris Climate Convention. The accord stated that greenhouse gas emissions will be phased out in order to prevent the global average temperature from rising more than 2 ℃ compared to pre-industrial level. This is a new climate agreement to be applied after 2020, replacing the Kyoto Protocol adopted in 1997. In the Kyoto Protocol, only developed countries have had a greenhouse gas reduction obligation, but the Paris agreement requires all participating countries to meet their reduction targets. COP21 can be said as the transition from the Kyoto Protocol system centered on developed countries to the 'New Climate System' in which all nations participate. The world is paying attention to renewable energy as an alternative to solve the problems of climate change and nuclear power plants, and major countries such as the United States are rapidly transforming their energy policies.

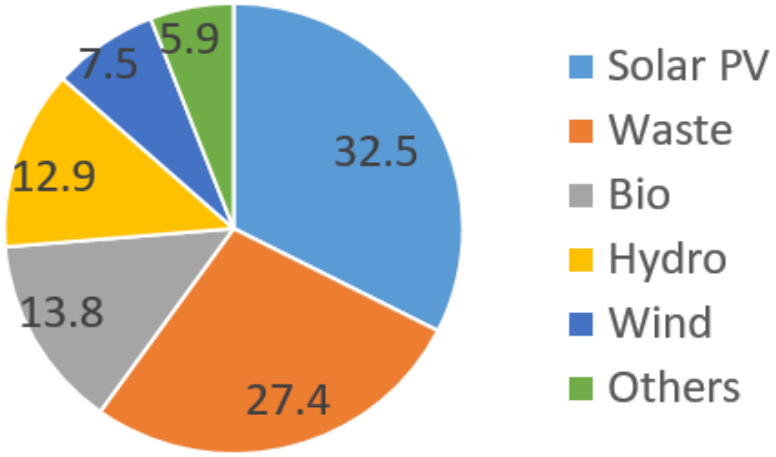
1.2 Changes in internal environment

Discussions on reducing coal emissions and de-nuclearization are rapidly advancing due to the new climate system, the Fukushima nuclear plant accident, the frequency of recent earthquakes, and serious internal and external changes such as air pollution problems. Among the 100 tasks of the five-year plan, which was recently announced by the Korean government, it is said that the policy of finding and fostering environmentally friendly future energy will be greatly strengthened. In particular, the government announced renewable energy 3020, which aims to achieve a 20% share of renewable energy by 2030. The main content is to actively promote the expansion of renewable energy. To achieve the 3020 target, it is necessary to supply 53GW of renewable energy facilities by 2030. This means that new facilities with annual average of about 3.78GW should be supplied by 2030, which is more than twice the current supply trend (annual average of about 1.7GW). Accordingly, the government announced the eighth power supply basic plan reflecting the goals and direction of the policy after establishing the energy conversion road map. In particular, PV and wind power companies are expected to directly benefit from this policy. In addition, new equipment market is expected to be activated to solve the intermittent problem of renewable energy.

2. Status of renewable energy in Korea

2.1 Domestic status of renewable energy supply

The proportion of renewable energy supply to domestic primary energy in 2016 is 4.78%, which is a 0.16% p increase from 4.62% in 2015. The average annual renewable energy supply growth rate from 2007 to 2016 is 10.75%, which is about 4.3 times the annual primary energy supply growth rate of 2.46% for the same period. If narrow the period from 2010 to the last six years (2011 ~ 2016), the annual average renewable energy supply growth rate and primary energy annual average supply growth rate will be 13.15% and 1.24%, respectively; renewable energy supply is growing ten times faster than primary energy supply. As shown in Figure 1, by separating renewable energy sources, it can be seen that Solar PV, bio, and wastes have contributed substantially to the expansion of renewable energy supplies.



[Fig. 1] Domestic supply of renewable energy sources (%)

Source : Korea energy coporation

Since 2010, the annual growth rate of solar PV has exceeded 40%. Solar power (28.7%), hydro power (32.9%) and wind power (25.4%) increased by more than 25% compared with 2015. Nevertheless, the proportion of existing bio and waste is so high that the supply structure of biotechnology and waste is not easily changed. Renewable energy generation also showed similar characteristics to supply. As in the case of primary energy supply, the share of generation is also very high, with bio and waste accounting for more than 70% of total renewable energy generation, accounting for 15.4% and 55.9%, respectively. On the other hand, despite the increase of solar power, wind power and hydropower generation by more than 25% compared to 2015, the share of total renewable energy generation still accounted for only 12.6%, 4.1% and

7.0%, respectively. The proportion of domestic renewable energy power generation is growing at a rate of more than 1% p over the last four years, 3.95% in 2013, 4.92% in 2014, 6.61% in 2015 and 7.22% in 2016. However, due to the high proportion of waste, the portion of electricity generated excluding non-renewable wastes is only 1.4% of the International Energy Agency (IEA) standard in 2015, which is the lowest among the 34 OECD countries. Moreover, the remaining 32 countries except Israel and Korea have at least 10% share of renewable energy generation, so the gap among the OECD countries is very large (see table 1).

Country	Share of New&Renewable (%)	Rank	Country	Share of New&Renewable (%)	Rank
Iceland	100	1	Greece	29.2	18
Norway	97.7	2	Ireland	27.6	19
New Zealand	80.1	3	England	24.9	20
Austria	76.4	4	Slovakia	22.7	21
Canada	65.6	5	Belgium	20.8	22
Sweden	62.4	6	Japan	16.3	23
Swiss	62.4	6	France	15.9	24
Denmark	60.8	8	Mexico	15.2	25
Portugal	47.2	9	Estonia	14.4	26
Finland	43.5	10	Poland	13.8	27
Chile	41.5	11	Australia	13.7	28
Italy	39.0	12	USA	13.1	29
Spain	35.0	13	Netherlands	12.4	30
Turkey	32.1	14	Czech	10.6	31
Luxembourg	31.0	15	Hungary	10.5	32
Germany	30.4	16	Israel	2.2	33
Slovenian	29.4	17	Korea	1.4	34

Table 1. Proportion of renewable energy generation by OECD countries (2015)
Source: Korea Energy Corporation

2.2 Domestic status of renewable energy industry

According to the data of Korea Energy Corporation, the number of enterprises related to renewable energy industry is 405 and the number of employee is 14,412 in 2016. Total sales including domestic consumption, exports and overseas production is about 10.1 trillion won, and investment amount is 796.5 billion won. In 2016, most industrial indicators except for overseas plant sales recorded minus growth of 10% compared with 2015. Looking at the domestic renewable energy industry by sources, it can be seen that solar PV occupies the highest proportion in all sectors including employment, sales and investment. In particular, it accounted for more than 80% of total sales, investment and overseas plant sales. On the other hand, bio and wastes maintain a similar share like it of solar PV in the number of enterprises, but it is inferred that they are operated in a relatively small scale because of the huge difference in employment numbers and sales. As of July 2017, exports of polysilicon and ingot products to China amounted to US $ 570 million, of which US $ 640 million is exported, making it highly dependent on China. This is because more than 90% of the global ingot and wafer market is dominated by Chinese companies. In the case of solar cells and modules, exports to the United States accounted for 50% (US $ 470 million) of exports of US $ 970 million, followed by Japan (US $ 170 million), the Netherlands (US $ 100 million) Germany (US $ 34 million), and Vietnam (US $ 30 million).

3. Statement of the problem

According to the Renewable Energy Status Report released by REN21, Korea has implemented a wide range of renewable energy policies compared to other countries. However, as mentioned, the share of renewable energy in South Korea is relatively low and lags behind the international trend. As a result, the level of contribution of renewable energy to energy security enhancement and greenhouse gas reduction is lower than that of European countries. The Korean government's renewable energy policies are largely divided into technology development, dissemination, and industry development. Domestic dissemination programs are broadly divided into renewable energy equipment subsidies, renewable energy subsidies, dissemination to public buildings, renewable energy facilities, Feed-in Tariffs (FIT) and Renewable Portfolio Standards (RPS). For reference, the FIT system, which was implemented since 2002, has been replaced by the RPS system from 2012. Let us look at dissemination of renewable energy. The solar and hydropower reaches or exceeds the supply target. However, most renewable energy sources such

as wind, marine and bio-energy have not reached their targets. Scholars in related fields claim that the limitations and causes of failure to achieve the goal are lack of social acceptance, initial market weakness, supplier - oriented dissemination and policy issues.

4. Significance of problem

It is important to note that the Korean government's plan now focuses on "renewable energy" in the concept of renewable energy as defined in existing laws. The existing "New Energy and Renewable Energy Development, Use and Promotion Act" conceptually defines both new and renewable energy. However, the current government clarifies the policy direction that places emphasis on renewable energy rather than new energy by introducing 'renewable energy' as a main goal and implementing measures in the implementation plan. In the face of global environmental changes such as global warming and meteorological changes, countries around the world have become aware of the need for development that meets the needs of the present generation and does not harm the safety of future generations. This was expressed in 1987 in the UN's report "Our Common Future" as "Sustainable Development". From an environmental point of view, sustainable development means "making economic growth while protecting the environment without destroying natural resources". It specifically means the reduction and regeneration of fossil fuels that emit carbon emissions. Since the concept of sustainable development has been claimed, countries around the world have been interested in alternative energy sources such as renewable energy as a practical alternative to fossil fuels. This interest has been further heightened these days due to the melt down accident at the nuclear power plant in Fukushima. So what is the current situation of renewable energy in Korea? CCPI (Climate Change Performance Index) newly introduced new renewable energy evaluation items from 2013, and it turned out that Korea's response to environmental energy, which recorded "bad", turned into "very bad".

In fact, there have been institutional improvements and efforts to foster renewable energy. If so, the question remains. Despite these efforts, why is renewable energy business in Korea continuing to show a slower growth rate than other countries? What are the limitations of Korea's renewable energy policy? Why is Korea constantly raising the issue of regulatory and residential acceptance of renewable energy? This study aims to provide policy proposals for expanding the development of renewable energy. This research also has a very important meaning as a step to expand the field of renewable energy development in Korea, which has remained stagnant.

5. Research topics

5.1 Current Status of Korea's renewable energy development policy and problems.

5.2 An example of a foreign country improving the problems of renewable energy development policy.

5.3 Domestic and overseas cases overcoming regulation of renewable energy business and acceptance of residents.

5.4 Policy recommendations to improve policy, regulation, and public acceptance.

Ⅱ. Literature Review

This paper researches various reports and papers on the status of renewable energy development policies in Korea and in other countries along with various regulatory and resident acceptance issues related to renewable energy development. It was not easy to find related data because of the approach from various viewpoints such as policy, regulation, system, and resident acceptance. Therefore, various improvement plans derived from this study should be continuously improved.

Ⅲ. Method

1. Procedure

It is essential to investigate the relevant papers before starting study on policies, regulations and residents' acceptance of renewable energy projects. Regarding the policy sector, I refered to the literature analyzing the current state of domestic renewable energy policy, the policy effects of FIT and RPS, and the cases of improving the problems of foreign renewable energy support policy. Regarding various laws and the acceptance of residents, I refered to the literature analyzing obstacles to the expansion of renewable energy development projects in Korea and domestic and overseas improvement cases. After this process, I analyzed the current status of renewable energy in Korea and analyzed the factors that hinder the progress of renewable energy sector. And I refered to the success stories of overseas leading countries and I will propose improvement plans that are appropriate to the situation in Korea.

2. Policy for the development of renewable energy

2.1 Preliminary research on domestic renewable energy policy

The Korean government abolished the FIT system, which had been implemented since 2002 due to the rapid increase in government financial burdens, and introduced the RPS system from 2012. The FIT system is a system in which the government supports the difference between the base price of renewable energy and the market price. Unlike the FIT system, which supports different prices by energy source, the common price of renewable energy is determined in the market in the RPS system. The FIT system promotes the supply of renewable energy producers by supporting public funds. On the other hand, the RPS system requires obliged suppliers to supply a certain percentage of total generation with renewable energy. Under the RPS system, when a government or regulator establishes a mandatory quantity with obliged supplier, the obliged supplier must achieve the mandatory quantity within that period or, if not, pay a fine. If it cannot comply with the mandatory requirements, it is possible to cover the mandatory amount by purchasing a renewal certificate (REC: Renewal Energy Certificate) from new and renewable generation companies. The REC, which is calculated as the amount of electricity generated and sold by renewable energy, is issued by the government. It is also possible to trade in the market for the issued REC. The obliged supplier in the RPS system may be a power generation company or a power retailer.

According to Kwon (2014), the FIT system is a pricing policy and the RPS system is a representative example of quantity policy. The policy superiority between the two systems has yet to come to a definite conclusion. For example, Batlle et al. (2012), Bergek and Jacobsson (2010) and Woodman and Mitchell (2011) have shown that the FIT system can reduce market risks and ensure profitability of renewable energy companies. In addition, Finon and Perez (2007) suggest that the FIT system is relatively simple to execute and thus the transaction costs are small. On the other hand, Frondel et al. (2010) assessed FIT system of Germany as an environmentally ineffective and not economically efficient policy. In particular, it has been argued that the guarantee of generation price for each energy source has resulted in distortion of market competition between energy sources. Table 2 summarizes the advantages and disadvantages of the FIT system and the RPS system, which were alleged in previous discussions.

	FIT Sys.	RPS Sys.
Advantages	• Market risk is small. – Promoting investment for new and renewable energy • Differential support according to technology level • Simplified policy enforcement reduces transaction costs	• Cost reduction by market competition is significant. • New and renewable energy development targets can be set explicitly.
Disadvantages	• Since the market competition is small, the cost reduction effect is small. • Information asymmetry makes it difficult to determine an appropriate level of pricing.	• The market risk is high : possibility of investment reduction. • Transaction costs are relatively high. • There is a possibility that the potential technology will be removed from the market.

Table 2. Comparison of advantages and disadvantages of FIT system and RPS system

Yoo (2015) analyzed the effect of adopting RPS system in Korea. He analyzed the factors affecting the international competitiveness of renewable energy industry with the System GMM. According to the result of the analysis, the GDP used as the control variable has a positive effect on exports, and the patent affects both the total and intermediate goods excluding the final goods. Also, although the FIT system positively affects the international competitiveness of final goods, the RPS system is generally not important and has no impact on international competitiveness. The problem with the FIT system is that government spending is rapidly increasing because the government makes up for the difference between the unit price of electricity generation and the standard unit price. However, as can be learned from the success stories of Germany and other European countries, the FIT system is a very important policy for the growth of new and renewable energy. In particular, the fact that Japan changed FIT system to RPS system and introduced FIT again after international competitiveness had fallen, and the fact that the US recently implemented the FIT system gives many lessons to the Korean government.

In addition, Kim, et al. (2016 a, b) analyzed the effect of introduction of RPS system through panel regression analysis using renewable energy generation amount for each of 16 provinces

from 2005 to 2014. Solar PV, wind, bio, and fuel cell power generation (MWh) were used as dependent variables. Policy factors were applied as the most important independent variables, and the implementation of the RPS system was applied as the main variable. In addition to the RPS regulatory variables, economic factors, power factors, and energy factors, which are considered to affect renewable energy generation, were selected as control variables in order to find out how the implementation of the RPS system affected renewable energy generation. As a result of the analysis, it was confirmed that the implementation of the RPS system had a statistically significant positive effect on the total renewable energy generation. This shows that the RPS system, which has high penalties and punitive elements, was effective in increasing domestic renewable energy generation. As a result of analysis by each energy source, it was confirmed that the RPS system had a statistically significant positive influence only on solar PV and bio. However, contrary to the theoretical expectation that the RPS system will secure competitiveness through policy development and cost reduction, the phenomenon of relying on convenient bio to meet the mandatory requirements poses many challenges for the Korean government.

2.2 Renewable energy support policies of overseas major countries

The renewable energy subsidy system in EU countries consists of three categories: feed-in t ariff (FIT), feed-in premium (FIP), green certificates (GC). The FIT system was adopted in 20 E U countries as the most widely applied support system for promoting the supply of renewable en ergy. EU countries do not apply the FIT system to all renewable energy sources at the same time, but they mainly applied to the development of solar PV, offshore wind power, and hydropower r esources. In addition, the feed-in premium (FIP) system has been applied in countries where the cost of renewable energy generation has been considerably competitive (Finland, Germany, Italy, UK, etc.). FIP system is applied to the energy source applying FIT (Czech Republic, Germany, It aly, UK etc.) or only for specific renewable energy source (offshore wind power, bio energy). In particular, Germany's market-friendly FIP system is applied differently to equipment that exceeds a certain size among those requiring FIT. Under a feed-in premium (FIP) system, electricity from renewable energy sources (RES) is typically sold on the electricity spot market and renewable energy providers receive a premium on top of the market price of their electricity production. Payment level is based on a premium offered above the market price for electricity; this premium can either be constant, or it can vary based on a sliding scale. Renewable energy

providers can enjoy high rewards when market prices increase, but also run a corresponding risk when they decrease; in order to avoid a large divergence between profits and losses, it can be designed with payment caps and/or floors. FIP provide an incentive for RES operators to respond to price signals of the electricity market, i.e. to produce electricity when demand is high and/or production from other energy sources is low. They also encourage RES investors to consider expected load patterns in the engineering of the RES project (e.g. choice of site and turbine type for wind parks, orientation of PV modules). FIP therefore contribute to an increased integration of RES into the electricity market, resulting in a more efficient combination of electricity supply with demand. This is becoming increasingly important with rising shares of renewable energy in electricity generation. In addition, GC system is similar to the RPS system. GC system gives electric power companies the obligation to produce a certain percentage of the power supply as renewable energy, and issues a corresponding certificate. The electric power companies acquire added value by trading the issued certificates.

Recently, many countries are paying attention to the case of Germany, which is regarded as the implementing the most successful renewable energy policy. Germany's energy policy has been based on the main goals of economic efficiency, supply stability and environmentally friendly use of energy. Germany is Europe's largest industrial country and the largest power consumer, an energy importer that relies on imports for about 61% of its primary energy consumption. Since the 2000s, Germany has continuously renewed its support policy on renewable energy, and has spread renewable energy around the power generation sector. In particular, Germany established the New Energy and Efficient Energy Act (EEG), which is regarded as the most successful renewable energy policy in the world in 2000 and laid a decisive foundation for the expansion of German renewable energy. In 2002, the Atomic Energy Act was revised and the first nuclear power plant policy was declared. In 2011, after the Fukushima nuclear power plant accident, German government reintroduced the policy of de-nuclearization through social agreement. The EEG has been revised four times since the enactment of to adjust the base price for generating electricity and the target of expanding the annual renewable energy to meet the changing environment. Through the continuous improvement of these policies, the spread of renewable energy has been rapid. However, as renewable energy generation power increased, the wholesale price of the electric power market declined. The wholesale price of electricity in Germany is determined by the marginal cost of bidding power and the law of

supply and demand. However, regardless of the marginal cost, the energy source that determines the wholesale price has changed from LNG to less expensive anthracite coal as the renewable generation amount that is bought first is increased. As a result, the wholesale price of electricity declined. Also, the cost of implementing the FIT system continued to increase, so that the EEG levy on electricity consumer fees continued to increase. Wholesale prices have fallen, and the EEG levy, which end consumers pay, has been raised, resulting in an increase in the electricity bill. To reduce EEG burden on consumer, the German government reduced the amount of FIT support for renewable energy providers and reduced EEG exemptions for some companies. A certain size of small and medium sized photovoltaic facilities were obliged at least 10% of the production power to directly trade in wholesale market without EEG support. As the supply amount of renewable energy, the cost of implementing FIT, and the burden of electricity bills have increased, the German government has introduced a competitive system based on the proliferation of renewable energy. By introducing the Direct Marketing system, government support has gradually been reduced and the consensus of building a market competition system has been expanded. Through this system, renewable energy providers sell power directly to third parties in the wholesale market. The Direct Marketing system induces direct trading of renewable generation electricity at times when wholesale prices are high due to high demand. When introducing the system in 2012, renewable energy providers were able to choose between FIT and Direct Marketing system, but after 2014, new renewable energy providers of 500 kW or more were obliged to participate in direct marketing system. After 2016, new renewable energy providers of 100kW or more were obliged to participate in direct marketing system. In addition, since the introduction of the competitive bidding system, the market premium will be determined through bidding between new and renewable energy providers from 2017 onward.

Germany's renewable energy sector will continue to grow. Germany's renewable energy policy started with an environmental perspective. However, as opinions increasingly focused on economy, the consensus spreads about the need to gradually reduce government support and build a market competition system. So far, if the goal was to establish and spread high-cost, low-efficiency facilities on the market, it is now proceeding to build a market competition system between renewable energy and base-power generation. Also, the profit structure of new and renewable businesses is diversifying. It is creating diverse business models such as inter-personal power trading and third-party power trading from merely generating revenue by relying on

government subsidies. In Korea, the importance of renewable energy is increasing day by day, and the market size will gradually expand. In addition to government policy, it is necessary to constantly monitor Germany's case to anticipate the role of market participants or future markets.

In Japan, the RPS system was introduced in 2003. The reasons for adopting the RPS system are as follows. If the fixed price purchase is guaranteed under the FIT system, the incentive to reduce costs to new energy generation companies is difficult to work. On the other hand, the RPS system provides an incentive for reducing costs by setting the available capacity. Also, under the FIT system, the ubiquity of renewable energy has a disproportionate effect on the competition among power generation companies, as power generation companies nearest to renewable energy facilities are obliged to purchase renewable energy. On the other hand, under the RPS system, only a mandatory amount can be traded as a certificate. Therefore, it is possible to impose the obligation to introduce the RPS system even to power generation companies in the area where renewable energy source is small. This can alleviate the cost burden. In other words, Japan's RPS system was intended to reduce the cost of new energy according to the market principle, and to equalize the cost burden among electric companies. As Japan introduced the RPS system, the number of new and renewable generation facilities increased from 57,419 in 2004 to 519,966 in 2009. In detail, the implementation situation by 2008 exceeded the mandatory amount. However, it is pointed out that the introduction of new energy is suppressed because the target amount is small. In addition, there was a point that the development of renewable energy industry was proceeding slowly because the purchase price of power generation companies was low. In order to overcome this, opinions were suggested to increase the target amount, and expand the RPS application range. Regarding the RPS system in Japan, renewable energy providers are in a very weak position to negotiate power prices (electric companies are in a monopoly position). In addition, the proportion of solar PV in renewable energy supply was relatively low in 2008 (9.5%). This was because only the total amount was set without specifying the mandatory amount by energy source. As a result, there was a tendency to focus on bio, which is relatively low in electricity production cost. Therefore, the RPS system was evaluated as not contributing much to the expansion of the renewable energy supply despite the achievement of the electric utility's target. In addition, incentives for participating companies were lacking.

According to Kim and Park (2011), this suggests that implementation of the RPS system does not ultimately contribute to the expansion of renewable energy. Even if the RPS is

introduced, it is desirable to set a high amount of duty or to separate the equipment type energy such as solar PV and wind power from the RPS system and implement the FIT system as a separate support. The fact that Japan, which had lost its lead in the renewable energy sector due to the failure of the solar PV policy, is reintroducing the FIT system suggests implication to Korea.

3. Improvement of institution and residents' acceptance for spreading of renewable energy

3.1 A perspective on regulation

The problems surrounding renewable energy regulation have been constantly raised because the central and local governments have shown different stances toward regulation. For example, from the regime's point of view, the Central government has set up macro-agendas and plans for fostering renewable energy, and has prepared various implementation plans. But the situation is different when the central government's plan is left to local governments. The actual situation facing each local government is specific and different from each other. The 'generalized agenda' drawn from the central government does not fit well with local governments. If central government try to apply generalized measures without seriously considering regional specificities and imbalances, they will face the opposition of local residents. For this reason, the central government, which is trying to promote renewable energy, and the local governments, which face real problems, are often confronted each other. In addition, the central government and local governments are confusing the related industry by issuing guidelines and regulations that are staggered or by establishing and operating various standards in local governments such as 'Guidelines for Operating Permit for Development Activities'. The regulation that shows the greatest difference among local governments in terms of regulation is 'regulation of separation distance'. The regulation of separation distance is a restriction that prohibits the construction of power facilities such as solar PV and wind power within a certain distance from roads, residential areas, sightseeing spots, and public facilities. There are a lot of conflicts in relation to wind power generation and there are conflicts related to the location of photovoltaic power generation. Other issues include the incentive for encouraging the participation of residents in the community being sporadically promoted.

3.2 A perspective on acceptance

The challenges faced by renewable energy supply can be broadly divided into technology, finance, law and system, and acceptance. The reliability of renewable energy technologies, such

as photovoltaic power generation and the conditions related to technology, finance, laws and systems are improving day by day. While social support and political acceptance on renewable energy are improving, local community resistance is increasing in many parts of the world. Various claims, including the loss of environmental quality and comfort, have emerged as reasons to oppose the location of renewable energy facilities at the local level. There are three categories of social acceptance, especially those that cause local opposition: the environment, NIMBY, and opportunism. The environmental opposition arises from the fear that renewable energy projects could harm the local environment and the residents. Threats to local flora and fauna, damage and contamination of native areas (eg river dams, transmission lines across forests), noise and health effects are major environmental reasons against new developments. The NIMBY phenomenon is a very personal type opposition that is caused by compensation for economic loss, desire to return to the situation before the new development. The NIMBY phenomenon is motivated by personal emotions rather than by more grand goals such as the environment. For example, the NIMBY phenomenon appears to be a fear that the project threatens local tourism, degrades the value of real estate or undermines the landscape through transformation of rural landscape. Opportunistic opposition to a project is usually driven by the maximum additional benefits (beyond the original scope of the project) or from intent and action to gain personal benefit through development. This type of opposition is often difficult to grasp directly because it is often expressed as an environmental issue or NIMBY issue. But unlike other motives for opposition, opportunistic opposition does not want the project to fail.

Lee and Yun (2015) pointed out that civil complaints and development permits are the biggest obstacles to the renewable energy business. Indeed, many projects have been delayed or canceled by these local acceptance problems. In addition, conflicts often arise between renewable energy providers and residents regarding the location of renewable energy production facilities. Construction of power generation facilities has positive and negative aspects at the same time, causing conflicts between stakeholders. In particular, as conflict becomes more serious, it can be expanded to collective action. This can lead to anxiety and distrust in local community, so that renewable energy development projects can be postponed or canceled. So, as the dissemination of renewable energy increases, the acceptance of residents becomes more important. Therefore, improvement of various systems and regulations and acceptance of residents must be solved in order to expand renewable energy development business.

3.3 Overseas improvement cases

In order to improve residential acceptance, intensive research has been conducted in Europe on ways to share the benefits of renewable energy generation with residents. The findings shows that benefit sharing can be classified into village fund, local ownership, compensation, spot benefits, local employment contract, energy tariff reduction, and indirect social benefits. Each benefit-sharing approach has a certain impact on mitigating factors that affect residents' acceptance. Regarding environmental issues, rewards can be seen as the most effective way of benefit sharing, with respect to the NIMBY phenomenon. The most effective way to mitigate the NIMBY phenomenon and opportunism is that the residents (area) owns the power plant and shares the benefits (spot benefits). Therefore, economic benefits and distribution of benefits can positively affect residents' acceptance on renewable energy generation facilities.

In foreign countries, residents participate in renewable energy generation projects in various ways. The resident participatory wind power project uses wind energy to reduce greenhouse gas emissions and provide economic benefits to local residents, investors, businesses, schools, institutions, or communities. The Danish government actively encouraged the participation of residents by providing extraordinary support and incentives for the promotion of wind power projects to meet national energy and environmental policies. They also exempted residents from taxes on wind power and helped residents buy wind turbines and sell electricity on favorable conditions. In Denmark, cooperatives played a leading role in building wind farms in a traditional way. By 2000, 84% of wind turbines were owned by various cooperatives. As the wind power support policy changed in the 2000s, the extension of the wind power plant owned by residents had been delayed. However, with the goal of supplying 50% of electricity consumption by wind power by 2020, efforts to improve the acceptance of residents through the expansion of wind power are resuming in Denmark.

In the early 1900s, German resident co-operatives began to build and operate utility companies. This history has developed into an energy cooperative, and the proportion of ownership and operation of renewable energy generation business has increased. One of the most important factors in renewable energy supply is residential acceptance. The best way to increase the acceptance of residents in renewable energy facilities such as wind power is to ensure that the benefits of renewable energy facilities are returned to the local community. If residents are allowed to have some of their ownership of the power generation business, residents themselves

tend to learn more about renewable energy and tend to reduce their opposition. The ownership structure of wind power is 12,160MW (39.4%) owned by institutional and strategic investors, 3,147MW (10.2%) owned by energy suppliers, and 15,547MW (50.4%) owned by residents. If the resident power plant is further subdivided, 1,295MW (4.2%) is owned by private ownership, 6,301MW (20.4%) is owned by civil energy company, and 7,951MW (25.9%) is citizen ownership nationwide.

In Japan, a variety of citizen participatory new and renewable energy projects have emerged, Hokkaido Green Fund is one of them. The Hokkaido Green Fund was formed with the aim of creating a green future with citizens participating. The members who joined the fund set up a fund to construct and operate a civilian power plant by imposing 5% of the monthly electricity fee. In principle, the Green Fund will be used to support the construction of renewable energy generation facilities in the region where the funds are generated. In particular, it is being used as a fund to raise awareness of environmental education and renewable energy in educational facilities such as schools and kindergartens. The Green Fund encouraged civilian wind power generation to effectively raise funds. As the cumulative effects of civil wind power generation in the operation process, the acceptance of renewable energy has become stronger.

Ⅳ. Analysis and Administrative Recommendations

1. Improvement methods for renewable energy development support policy

At present, as the importance of renewable energy becomes bigger, it is necessary to objectively analyze the problems of the current system and to supplement the policy of supporting renewable energy by referring to overseas cases. According to Kwon (2014), because the FIT system has problems such as the uncertainty of the size of the budget support, many countries introduced a system to limit the total amount. And, in RPS systems, there is a problem that immature technology is eliminated early in the market. In order to solve this problem, he proposed several ways to give discriminatory financial support for each renewable energy sources through weighting or separately quota. He also argued that lowering the price volatility risk can increase investment stability and supply. In regards to the current status of renewable energy supply in Korea, we can see that the technology has not matured yet. Leading nations such as Germany, which is leading the renewable energy sector, have established renewable

energy facilities from the FIT system. As dissemination of renewable energy expands, they gradually introduces a market competition system. Therefore, it is necessary to gradually expand the technological development and dissemination by applying FIT to renewable energy sector such as solar PV, which the current government is paying attention to. In addition, the RPS currently in operation has the advantage that it can achieve a fixed renewable energy supply goal cost-effectively, but it has drawback in that dissemination of small and medium-sized renewable energy with low competitiveness is disadvantageous. Small and medium-sized renewable energy power generation has value more than the absolute amount of renewable energy supply because it can utilize the roof and idle space of buildings in Korea where urbanization is highly advanced and it can contributes to enhance social acceptance for renewable energy expansion. Supplementary measures must be taken in order to encourage such small and medium-sized renewable energy generation under the RPS system.

Recently, Korea has implemented the Korean FIT system for small sized solar PV operators. The Ministry of Commerce, Industry and Energy and the Korea Energy Corporation announced that they would apply for a small-sized solar fixed-price contract (Korean-type FIT) from July 2018. This system was introduced to improve the profitability of small-sized solar PV companies and convenience of electricity sales procedures. Existing small-sized renewable energy companies have difficulty in accessing information due to the complicated procedure of participation to RPS system. Moreover, profitability has been deteriorated due to SMP price decline. To solve these problems, the Korean-type FIT system was created by combining the merits of RPS and FIT for small-sized photovoltaic power plants through 3020 implementation plan on renewable energy. Applicable facilities for this system are solar power plants of less than 30 kW and solar power plants of less than 100 kW operated by cooperatives.

However, according to recent media reports, this system, which was introduced for stable profitability and convenience, is regarded as unattractive system for renewable energy companies. According to the Korea Renewable Energy Center, as of September 2018, the number of applications for Korean-type FIT is only about 1,000, which is less than half of the target. The reason for this is that the scope of coverage for the Korean-type FIT system is too limited. There is little or no renewable energy projects less than 30kW. Most renewable energy projects are being carried out between 100kW and 500kW. Participants also say that there is no big difference in the process of licensing. The intention to expand the participation of small-sized

solar PV companies and increase the acceptance of renewable energy is getting worse. It is necessary to focus on solar PV operated by local residents and cooperatives and to adjust the scope of participation of renewable energy companies considering market conditions.

A key element of the RPS system is the transaction of REC. For example, in the case of float type solar PV facilities with a high power generation cost, it is very difficult to secure economic efficiency with the current REC system. This is because a relatively low-priced REC is traded first, regardless of the type of renewable energy source. This results in the phenomenon of concentrating on a specific REC, which is low in power generation cost and can be developed with easy technology. Therefore, energy sources that need to be strategically developed, such as float type solar PV, should be ensured at a relatively high price.

In addition, in order to expand dissemination of renewable energy, additional costs are needed in addition to the current cost for electricity supply. In the current electricity market and electricity billing systems, it is almost impossible for these additional costs to be properly returned to renewable energy companies. Regulatory market conditions, such as policy uncertainty in the REC trading market, are causing problems such as instability in REC prices. In order to solve this institutional contradiction, it is necessary to integrate the REC trading market into the electricity market so that the additional costs of the obliged suppliers can be transferred to the electricity bill.

2. Improvement methods for renewable energy system and resident acceptance

The central government should support local governments to carry out their own activities while carrying out the renewable energy projects. However, the central government has a tendency to unilaterally conduct projects. For example, in the case of the offshore wind power project in the Southwest, the central government proceeded without consultation with the local government, resulting in serious problems with the project. The central government should provide a framework for renewable energy projects, identify policies, and provide directions for smooth progress. It is also necessary to improve the system so that local governments and citizens can respond to climate change crises together. Especially in the field of environmental law, cooperation principle is more important than anything else. However, the central government is only putting economic logic. Renewable energy projects are focused on large-scale projects, and local governments and citizens are largely excluded from participation in the production of renewable energy. A local environmental administrative system should be

established to manage the local environment in an integrated way, away from the unreasonable and inefficient operating system of the central government. It is necessary to develop renewable energy suitable for the characteristics of the region centering on local governments and establish sustainable energy supply and demand system. To do this, it is necessary to cooperate with the local community. How, then, will we draw local community co-operation? As there is a fundamental negative view on renewable energy projects such as the rebellion of local residents, demands for excessive compensation, and environmental problems, it is necessary to establish a system that can coexist with local community such as local governments and local residents.

As noted in the overseas case mentioned above, the common feature of the major countries that lead renewable energy projects is that the residents led the initial renewable energy projects. The Korean government needs to refer to examples of leading countries. In Korea, funds are provided for renewable energy projects above a certain scale. But, since the amount is small, it is not helping to improve the relationship between businessmen and residents. As a kind of compensation for the transmission tower conflict area, the Korean model of renewable energy residential power plant was also studied and the incentive was guaranteed for the solar PV led by the residents of specific area. However, this also did not help to improve relations either. In order to activate renewable energy business of the resident participation type in domestic circumstances, the following measures need to be considered. Local governments, the public sector, private operators, and local residents will lead renewable energy business and improve their acceptance by sharing economic benefits with local residents.

In detail, there are several methods: The public sector leads renewable energy business, where the residents are guaranteed a certain rate of return and participation opportunities in the investment. Then, the energy cooperative sets up and operates the power plant, where the benefits is distributed to the members composed of local people, and residents contribute to private power generation business. These methods need to be applied depending on local conditions. It is desirable to approach the issue of acceptance of residents in renewable energy business from the viewpoint of the distribution of the benefit sharing system. In addition, as the business model is diversified, the revenue sharing model for resident participation also needs to be diversified. For example, the introduction of a tax system to expand local residents' participation and increase profits needs to be examined. To this end, it is necessary to improve related laws such as the Law for Supporting the Area around the Power Plant.

In addition to enhancing the acceptance of residents, various systems and regulations that are obstacles to the smooth implementation of renewable energy projects should be improved. First of all, excessive restrictions by local governments, such as restrictions on separation distance, should be eased. When promoting renewable energy projects, local governments should judge the hazards of each project and allow the approval process of development activities to proceed promptly. Also, in the case of float type solar power, which is emerging as an environmentally friendly renewable energy these days, a number of restrictions should be revised. First, solar power facilities are excluded from the permission to use national forests. However, float type solar power installations are installed on the surface of water, and since only the electricity room is installed in national forest, forest destruction is smaller than other renewable energy sources. Therefore, it is necessary to establish an exemption provision for float type solar power for the permission for use of national forests. Furthermore, when installing the electricity room in the mountain area, it is necessary to obtain permission for exclusive use of the mountain area. However, this system can only be used for mountainous areas with roads (prescribed by law). Because of the geographical characteristics of the large-scale float type solar power development site, most of the electricity room sites are mountainous. And it can be developed without destroying the mountains by using existing ‘forest road’. Therefore, it is necessary to add a renewable energy facility to a facility item that can be installed without a road.

Ⅴ. Conclusion

The RPS system has been recognized as an alternative to solve the problems of the FIT system because it can reduce the cost of development by facilitating the achievement of the policy target through mandatory allocation and promoting competition. On the other hand, eleven members of the National Assembly have begun to take interest by initiating a revision bill for the revision of the Act on the Development, Utilization and Promotion of New Energy and Renewable Energy in July 2016, which aimed to re-introduce the FIT system. According to these lawmakers, the profitability of the small-scale renewable energy companies with power generation capacities of 100kW or less has been severely deteriorated due to the abolition of the grants. As a result, the production of renewable energy in the form of small scale distributed power sources is difficult to spread. In addition, citizens' voluntary operation of renewable energy projects such as civil power plant, village energy project, and citizen-funded solar cooperative cooperatives are shrinking, resulting in a contrary to the government's renewable energy activation policy.

In addition, with the introduction of the RPS system, there is a phenomenon that concentrates on dissemination of specific renewable energy sources such as solar PV and bio. Therefore, if only the RPS system is implemented, there is a possibility that technological development is shrinking and the probability of survival of small companies is low. Therefore, fully agree with the view that institutional support is necessary for small companies to coexist. It should be considered to strengthen or complement both systems by separating the new type of renewable energy such as solar PV and wind power from the RPS system and implementing the FIT system as a separate support. The Korean-type FIT system that has been introduced recently needs to be improved considering the situation of the renewable energy market. REC transactions are also a key element of the RPS system. In the current system, it is necessary to actualize REC weights as it is difficult to secure economies of renewable businesses. To eliminate the institutional contradiction in the REC trading market, it is necessary to incorporate the REC trading market into the electricity market so that the additional costs of the obliged suppliers can be transferred to the electricity bills.

In Korea, as dissemination of renewable energy facilities increases, friction and conflict about facility location frequently occur. In particular, there are frequent cases where residents

and environmental groups are opposed. However, the increase in the share of renewable energy in the power generation sector is an unavoidable task for enhancing energy security and achieving national GHG reduction targets. Therefore, as there is a fundamental negative view on renewable energy business, it is necessary to establish a system that can coexist with local communities such as local governments and local residents. When referring to overseas cases, it is desirable to approach the issue of acceptance of residents in the renewable energy business from the viewpoint of the distribution of the benefit sharing system. It is necessary to develop a resident participation type business model in order to expand the development of renewable energy in Korea, especially to improve resident acceptance and various systems. Furthermore, as business models are diversified, revenue sharing models for residents' participation should be diversified and institutional backed.

In addition, it is needless to say that various systems and regulations which are obstacles to the smooth implementation of renewable energy business should be improved along with the enhancement of residents' acceptance.

Profit allocation and improvement of the system are not the only solutions to resolve the conflicts surrounding renewable energy. It should not be overlooked that improving citizen participation, such as fair procedures and democratic communication, is also an important factor. And above all, balanced social awareness of renewable energy should be established. Based on the social support for new and renewable energy, the business model for participatory participation based on the site conditions should be realized through concrete business design and successful pilot project. If this happens, it will be an important turning point in revitalizing the domestic new and renewable energy business.

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