A Study on New and Renewable Energy Policy Changes and Market Analysis in Korea

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Abstract

The importance and necessity of renewable energy applications have become a major issue around the world in the viewpoint of energy consumption reduction. One of the effective ways to reduce greenhouse gases is for the government to enact mandatary policies for renewable energy systems, like renewable portfolio standards and a renewable feed-in tariff, to encourage the people and organizations of public and private sectors. There are three success factors (policy, technology, and market) in the renewable energy field. This study has been conducted to analyze changes in the policy and market trends of new and renewable energy in South Korea. Based on the results of changes in policy and market status, there are specific institutional improvements in South Korea compared to the overseas renewable energy policies. It can be concluded that the efficiency of government policy is closely related to the new and renewable energy market in South Korea.

Keywords: Mandatory new and renewable energy supply system (RPS: Renewable Portfolio Standards), Reference price purchase system (FIT: Feed-in Tariff), Generation difference system, Green building rating system (G-SEED)

1. Introduction

Buildings consume a lot of energy to facilitate the comfort and activities of occupants. The increase in energy consumption leads to an increase in the use of fossil fuels, resulting in greenhouse gas emissions, which cause global warming. Therefore, it is necessary to continuously search for ways to replace existing fossil fuels. Besides, rising energy prices and high dependence on energy imports increase the need to develop alternative energy sources. Considering these points, this study reconsiders the policies for new and renewable energy and seeks an institutional improvement plan. In the related fields, improvement of the plan through the policies by comparing them with the policies of foreign countries that are ahead of the establishment of the active system and the market was to analyze. In the case of this paper, improvement plans for new and renewable energy systems in South Korea, focusing on comparative laws and legislative policy research methodology and drawing on existing literature and public data, are analyzed.

2. Current Status of and Policies for Domestic New and Renewable Energy

2.1. Current Status and Prospect of Domestic Energy

South Korea's energy consumption in 2015 was 273 million toe, the eighth in the world. Considering that the gross domestic product index is ranked 14th in the world, South Korea seems to use more energy than the scale of the economy as shown in the table 1[1, 2]. South Korea's total energy imports in 2017 amounted to USD 109,466 million, and dependency on imports was 94.2%, making it very vulnerable to energy security [3].

Table 1: List of Countries by Energy Usage (2015)

Classification	China	US	India	Russia	Japan	Germany	Brazil	**Korea**	Canada	France
Energy Consumption (million toe)	(1st)	(2nd)	(3rd)	(4th)	(5th)	(6th)	(7th)	(8th)	(9th)	(10th)
	2,987	2,188	851	710	430	308	298	**273**	270	247
GDP Ranking (PPP Value)	1	2	3	6	4	5	8	14	17	10

Domestic energy production, including nuclear power generation, was 49 million toe in 2017, of which nuclear power generation accounted for 64.4% of total production. Coal power generation is on a declining trend, while

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new and renewable energy is steadily increasing. In response to the rapidly growing domestic demand for electricity, power generation is continuously increasing at an average annual rate of 4.4%, and the proportion of new and renewable energy generation in total power generation is steadily increasing. Table 3 shows the domestic energy production status through time [4].

Table 2: List of Countries by Energy Usage (2015)

Year	Dependence on Energy Imports (%)	Total Energy Imports (Unit: Million USD)				
		Coal imports	Oil imports	Natural gas imports	Uranium imports	Total
2000	97.2	2,186	31,594	3,882	225	37,888
2010	96.5	13,131	90,903	17,006	225	121,654
2013	95.7	13,074	133,961	30,645	1,018	178,698
2014	95.2	12,114	129,890	31,403	731	174,137
2015	94.8	9,961	73,106	18,779	869	102,715
2016	94.7	9,310	58,873	12,170	589	80,942
2017	94.2	15,179	77,680	15,616	991	109,466

Table 3: Domestic Energy Generation Status

Year	Coal	LNG	Water Power	Nuclear Power	New & Renewable	Total
1990	7,748	-	1,590	13,222	797	23,356
2000	1,868	-	1,402	27,241	2,130	32,641
2005	1,274	518	1,297	36,695	3,961	43,745
2013	817	463	1,771	29,283	8,987	41,321
(%)	-2.00%	-1.10%	-4.30%	-70.90%	-21.70%	-100%
2014	787	322	1,650	33,002	10,956	46,716
(%)	-1.70%	-0.70%	-3.50%	-70.60%	-23.50%	-100%
2015	794	188	1,223	34,765	12,839	49,809
(%)	-1.60%	-0.40%	-2.50%	-69.80%	-25.80%	-100%
2016	777	154	1,400	34,181	13,575	50,087
(%)	-1.60%	-0.30%	-2.80%	-68.20%	-27.10%	-100%
2017p	703	341	1,487	31,615	14,964	49,109
(%)	-1.40%	-0.70%	-3.00%	-64.40%	-30.50%	-100%
Increase & decrease rate	△5.6%	△3.4%	0.30%	0.90%	12.20%	2.40%

2.1. Changes and Major Contents of New and Renewable Energy Related Laws

The government started commercialization and supply of photovoltaic power and waste power with the enactment of the Alternative Energy Development Promotion Act in 1987 and promoted the development of new and renewable energy technologies. Subsequently, in 1997, starting with the First Basic Plan for the Development, Usage, and Dissemination of Alternative Energy Technologies, basic plans for new and renewable energy were established in 2003, 2008, and 2014 as sub-implementation plans of the National Energy Basic Plan, and these are underway. In the Second Basic Plan, a target of 5% of primary energy supplied by new and renewable energy by 2011 was set. In the Third Basic Plan, 11% of primary energy will be supplied by new and renewable energy until 2030, and the 11% supply target of new and renewable energy was revised until 2035. The government's new and renewable energy policies are divided into technology development, dissemination, and industrial cultivation. Among them, South Korea is implementing various new and renewable energy support policies such as regulatory policies and targets, financial incentives, and public financing. Domestic dissemination programs include subsidies for new and renewable energy facilities, support for loans for new and renewable energy facilities investment, mandatory renewable energy facilities for public buildings, the Difference Compensation Act, and a mandatory new and renewable energy supply system. Since 2012, the Difference Compensation Act, enforced from 2002, has been replaced by Renewable Portfolio Standards (RPS). The Difference Compensation Act enforced in South Korea is a kind of feed-in tariff (FIT) in which the government supports the difference between the base price and the market price of each of the new and renewable energies. The RPS is a system that requires electricity suppliers to fill a certain amount of production with new and renewable energy [5]. The government has supported the

renewable energy generation difference from the electric power industry-based fund, but when the financial burden increased and the problems of the system, such as the lack of the technology development promotion function, were exposed, the FIT was abolished from 2012, and the RPS has been enforced since [6]. At present, 13 power generation companies with more than 500 MW of power generation facilities have been obliged to supply electricity, and RPS targets include photovoltaic, wind, hydro, tidal, biogas, landfill gas, biomass, fuel cell, coal gasification power generation (IGCC), refuse-derived fuel (RDF), and by-product gas. According to the RPS, compulsory operators must supply 10% of the electricity generation with new and renewable energy by 2022.

2.2. Current Status of New and Renewable Energy

New and renewable energy accounted for 7.0% of power generation and 13% of facility capacity in 2016 [7]. When comparing the ratio of renewable energy generation of South Korea to major countries, it is low. Looking at the composition by renewable energy sources, it is waste and bio-oriented, but recently photovoltaic power and wind power are on the rise. Table 4 shows the ratio of new and renewable energy supply, and Table 5 shows the production by new and renewable energy types [8].

Table 4: Proportion of New and Renewable Energy Supply

Year	Total Power Generation (MWh)	Total New and Renewable Energy Generation (MWh)	The Proportion of New and Renewable Energy Supply (%)		
			Renewable Energy	New Energy	Sum
2005	364,639,331	3,950,000	1.08	0.00	1.08
2006	381,180,709	3,899,368	1.02	0.00	1.02
2007	426,647,338	4,394,830	1.03	0.00	1.03
2008	422,355,126	4,227,477	1.00	0.00	1.00
2009	433,603,745	4,617,886	1.07	0.02	1.04
2010	474,660,205	5,889,553	1.24	0.04	1.20
2011	501,527,009	17,345,647	3.46	0.06	3.40
2012	532,190,711	19,498,064	3.66	0.07	3.59
2013	543,098,496	21,437,822	3.95	0.11	3.84
2014	546,248,948	26,882,190	4.92	0.17	4.75
2015	560,973,575	37,078,863	6.61	0.20	6.41
2016	561,825,749	40,655,802	7.24	0.27	6.97
2017	577,331,030	46,623,321	8.08	0.48	7.60

Table 5: New and Renewable Energy Production by Type

Year		2005	2010	2012	2014	2015	2016	2017
New and Renewable Energy Production		4,879,211	6,856,284	8,850,739	11,537,366	13,292,990	14,178,408	16,448,386
Renewable Energy	Solarthermal	34,729	29,257	26,259	28,485	28,469	28,495	28,121
	Photovoltaic	3,600	166,152	237,543	547,430	849,379	1,092,832	1,516,349
	Wind power	32,472	175,644	192,674	241,847	283,455	355,340	462,162
	Water power	918,504	792,294	814,933	581,186	453,787	603,244	600,690
	Ocean	-	223	98,310	103,848	104,731	104,562	104,256
	Geothermal	2,558	33,449	65,277	108,472	135,046	162,047	183,922
	Hydrothermal	-	-	-	-	4,791	5,989	7,941
	Bio	181,275	754,623	1,334,724	2,821,996	2,765,657	2,765,453	3,598,782
	Wate	3,705,547	4,862,296	5,998,509	6,904,733	8,436,217	8,742,727	9,358,998
	Total	4,878,685	6,813,938	8,768,229	11,337,997	13,061,532	13,860,688	15,861,222
New Energy	Fuel cell	526	42,347	82,510	199,369	230,173	241,616	313,303
	IGCC	-	-	-	-	1,285	76,104	273,861
	Total	526	42,347	82,510	199,369	231,458	317,720	587,164

Table 6: General Table of New and Renewable Energy Industry

Items	Number of Companies	Employment	Sales					Investment Scale
			Total	Domestic	Export		Overseas Factory	
	(ea)	(people)	100 million won	100 million won	100 million won	100 million won	100 million won	100 Million won
Photovoltaics	118	7,522	64,358	19,331	36,740	3,249	8,287	7,731
(%)	26.0	54.0	67.4	47.6	85.1	85.1	70.9	95.5
Solarthermal	17	195	167	164	3	-	-	0
(%)	3.7	1.4	0.2	0.4	0.0	-	-	0.0
Wind Power	27	1,853	10,957	2,485	5,064	448	3,408	120
(%)	5.9	13.3	11.5	6.1	11.7	11.7	29.1	1.5
Fuel Cell	15	588	3,262	2,238	1,024	91	-	49
(%)	3.3	4.2	3.4	5.5	2.4	2.4	-	0.6
Geothermal	24	335	1,006	1,002	4	-	-	18
(%)	5.3	2.4	1.1	2.5	0.0	-	-	0.2
Hydrothermal	3	25	47	47	-	-	-	-
(%)	0.7	0.2	0.0	0.1	-	-	-	-
Hydraulic	5	100	107	92	15	1	-	-
(%)	1.1	0.7	0.1	0.2	0.0	0.0	-	-
Bio Energy	121	1,647	12,597	12,286	311	28	-	155
(%)	26.7	11.8	13.2	30.3	0.7	0.7	-	1.9
Waste Energy	124	1,662	2,964	2,964	-	-	-	25
(%)	27.3	11.9	3.1	7.3	-	-	-	0.3
Total	438[i]	13,927	95,463	40,608	43,161	3,817	11,694	8,097
(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[i] The number does not coincide with the sum of the number of companies by energy source (454), as it excludes the duplication of companies operating two or more industries of new and renewable energy sources and two or more items operating on the same energy source.

Regarding the current status of the new and renewable energy industry, the total number of companies is 438, and waste, bio, and photovoltaic power account for 80% of the total. In the case of the number of employees, the proportion of photovoltaic power workers was the highest, at 54%, followed by the proportion of wind power workers, at 13%. Total sales of new and renewable energy amounted to 9,546.3 billion won, and the photovoltaic power and wind power industry accounted for 79% of total sales. Total exports of new and renewable energy amounted to 4,316.1 billion won (45% of total sales). In particular, the photovoltaic power and wind power industry accounted for 97% (4,180.4 billion won) of new and renewable energy exports, leading the exports. Total sales of new and renewable energy of overseas plants is 1,169.4 billion won, which includes only photovoltaic power (828.7 billion won, 71%) and wind power (340.8 billion won, 29%) exist, and total investment for new and renewable energy is 809.7 billion won, with photovoltaic power accounting for the highest proportion, at 95% [9]. Table 6 shows the current status of the new and renewable energy industry [10].

2.2. The 4th Basic Plan for New and Renewable Energy

The plan period of the 4th Renewable Energy Basic Plan is from 2014 to 2035, and it was established by the Minister of Industry, Trade, and Energy with a period of five years. The main objective is to supply 11% of primary energy using new and renewable energy by 2035, and it sets the annual average growth rate of 6.2% for new and renewable energy from 2014 to 2035. The plan aims to decrease the ratio of waste energy and foster photovoltaic power and wind power as core energy sources. From 2012 to 2025, the proportion of waste energy in new and renewable energy sources will be reduced from 68.4% to 29.2%, that of wind power will be increased from 2.2% to 18.2%, and that of photovoltaic power will be increased from 2.2% to 14.1%. is the plan aims to supply13.4% of the total electricity with new and renewable energy in 2035. Table 7 shows the ratio targets of primary energy sources [11]. Through this plan, the RPS obligatory supply was re-adjusted by considering the obligatory performance conditions, and the means to fulfill the obligations are diversified to improve the implementation conditions so that the effectiveness of new and renewable energy supply and financing projects can be improved in line with the changes in the market and technological developments. In order to increase investments for new and renewable energy, in the plan, the division based on the land category will be abolished to promote the supply based on the market principle of photovoltaic power by giving different weights in accordance with installation type and scale as a way of enhancing the rationality of REC weights. For the small scale, preferential treatment is given by considering the relatively high cost and environment preservation possibility. For

the large scale, the weight was set in consideration of the environmental problems such as deforestation and the convenience of the scale economy. The weight was increased according to the size of the site more than installing on general sites in consideration of the increase in the investment cost when installing on buildings or on the water surface. In order to prevent the exploitation of weights by scale such as power plant splitting, a combined weighting system that applies the sum of stepwise weightings to the total installation capacity was introduced. A variable weighting option was introduced for energy sources that require high initial investment costs such as offshore wind power, tidal power, and geothermal power as a non-photovoltaic system. The RPS supply certificate (REC) transaction market was revitalized by creating a fair transaction environment between sellers and suppliers. The cycle of establishing the REC spot market was increased from one to two times per month by new and renewable energy source, and the transaction system was improved from one-way to two-way to ensure equal participation in the market. The supply project plan was reorganized into centering on the convergence type and the investment economy to change into a convergence type-supply project led by local communities, bailing out the individual house and building unit support. For the loan business plan, flexible financing support targets considering the market conditions were selected, and lending businesses for technology commercialization were established in addition to the existing production, facilities, and working capital financing, to support smooth market penetration of superior technologies. Funding for photovoltaic facilities will be resumed to support the national power infrastructure, such as large power transmission lines, and local-residents- participating projects such as eco-friendly energy towns. For public institutions, the obligatory installation ratio of new and renewable energy facilities was increased. The obligatory supply ratio targets of new and renewable energy supply to public buildings will be increased from 20% to 30% by 2020, and the ratio by year will be gradually increased through stages.

Table 7: Ratio of New Renewable Energy Supply to Primary Energy Supply

Year	2012	2014	2020	2025	2030	2035
The ratio of new and renewable energy supply	3.2	3.6	5.0	7.7	9.7	11

Table 8: Targets of Proportion by Primary Energy Standard Source

Classification	Year				Annual average increase rate (%)
	2012	2014	2025	2035	
Solarthermal	0.3	0.5	3.7	7.9	21.2
Photovoltaic	2.7	4.9	12.9	14.1	11.7
Wind power	2.2	2.6	15.6	18.2	16.5
Bioenergy	15.2	13.3	19.0	18.0	7.7
Hydrothermal	9.3	9.7	4.1	2.9	0.3
Geothermal	0.7	0.9	4.4	8.5	18.0
Ocean energy	1.1	1.1	1.6	1.3	6.7
Waste energy	68.4	67.0	38.8	29.2	2.0

Table 9: Adjustment of Private Obligatory Supply Ratio (Plan)

Category	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Current	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	-	-
Change	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0

Table 10: Adjustment of the Obligatory Ratio of New and Renewable Energy Supply to Public Institutions by Year (Plan)

Category	2014	2015	2016	2017	2018	2019	2020–
Current	12	13	14	15	16	18	20
Change	12	15	18	21	24	27	30

2.3. Renewable Energy 3020 Implementation Plan

The concrete implementation plan of Renewable Energy 3020, which will increase the proportion of renewable energy generation to 20% by 2030, is based on the opinions of all walks of life collected by the TF, which is composed of experts from industry, government, academia, and research institutes, over a period of six months. It was established by the Minister of Trade, Industry, and Energy. It aims to supply more than 95% of new facilities with clean energy, such as photovoltaic power and wind power, through public-participation projects and large-

scale projects [7]. The vision of the implementation plan is to change into a participatory energy system that enhances quality of life so that energy conversion in which all subjects participate and enjoy can be accomplished. The main driving strategy is to shift from waste and bio-centering to the supply of clean energy such as photovoltaic power and wind power and to encourage the participation of local residents and the general public, rather than focusing on foreigners and business operators. In terms of implementation method, it changes from an unplanned development of individual sites to planned development of large-scale projects. Figure 1 shows the proportions of participation type of renewable energy generation up to 2030.

Renewable energy		2017	2022	2030
The proportion of power generation		7.6%	10.5%	20%
National power plant	Urban area	290,000 houses	760,000 houses	1.56 houses
	Rural area	0.1GW	3.3GW	10GW

Figure 1: Renewable energy supply target

3. Current Status and Policy of Oversea New and Renewable Energy

3.1. Expansion of New and Renewable Energy Sources in the US (State of California)

The Trump Administration in the United States claims to support the creation of wealth and jobs through the development of its wealth of shale resources as the key to energy policy. At the national policy level, it has not presented notable policy objectives for expanding the supply of new and renewable energy. Nevertheless, the supply and expansion of new and renewable energy is being deployed at the state government level, and in the State of California, legislation (SB10) requiring that 10 percent of the electricity in the state be covered by renewable energy (including carbon-zero energy sources) was passed in the Parliamentary Public Utilities and Energy Committee (July 3, 2018). SB10 revised the Renewable Portfolio Standard (RPS) target under SB350, which came into effect in 2015, and is now in force and aims at using 10% of the electricity in the State of California with renewable energy and zero-carbon energy sources such as nuclear power by 2045. In SB10, RPS targets are not limited to new and renewable energy sources but also include zero-carbon energy sources such as nuclear power. Meanwhile, the California Energy Commission unanimously adopted the 2019 Building Energy Efficiency Standards, which mandates the installation of solar panels in new housings and low-rise apartments, on May 9, 2018 [13].

3.2. EU (Strengthening the European Union's New and Renewable Energy Supply Targets)

On June 14, 2018, the EU Executive Council, the European Parliament, and the Council of the European Union agreed to increase the ratio of renewable energy in final energy consumption to 32% by 2030 [11]. The European Executive Council, the European Parliament, and the Council of the European Union agreed to increase the target of renewable energy in final energy consumption to 32% from the current 27% by 2030 in triangular negotiations for the revised Renewable Energy Directive (RED II). The agreement also includes a clause in which the new and renewable energy target can be raised and the means by which at least 14 percent of transportation energy consumption will be filled by renewable energy by 2030 changed, through an interim review in 2023.

3.3. The Goal of Germany's New and Renewable Energy Policy

In Germany, the Energy Initiative 2010 provides a step-by-step energy and climate change targets until 2050. It aims to cut energy demand and expand new and renewable energies with the goal of reducing greenhouse gas emissions by up to 80% to 95% by 2050. The final energy share ratio of renewable energy is planned to increase from 14.9% in 2015 to 60% in 2050. Germany has set a policy goal of reducing primary energy demand by up to 50% by 2050 compared to 2008 by promoting energy efficiency.

3.4. The Goal of France's New and Renewable Energy Policy

France applies the energy and climate change policy directions and policy goals proposed by the European Union's 2020 Climate and Energy Package and the 2030 Climate and Energy Policy Framework. France's energy conversion policy aims to reduce greenhouse gas emissions and energy demand through increased energy efficiency, to increase the role of renewable energy, and to reduce nuclear power. France aims to expand the share of final energy consumption to 23% in 2020 and 32% in 2030 by promoting the supply and expansion of new and

renewable energy through energy conversion and to increase the proportion of power generation by new and renewable energy to 40% by 2030. Looking at the specific method, it presents the new and renewable energy development target to increase the entire new and renewable energy generation capacity from 52 GW in 2018 to 71–78 GW in 2030, compared to 41 GW in 2014. The Energy Conversion Act set a goal of reducing the primary energy consumption of fossil fuels to 30% by 2030 compared with 2012. The goals of primary energy fossil energy consumption reduction are set at oil (23.4%), coal (37%), and natural gas (15.8%) by 2023.

3.5. The Goal of the UK's New and Renewable Energy Policy

The UK has implemented a plan to increase the proportion of new and renewable energy in the country's final energy consumption to 15% by 2020 through the National Renewable Energy Action Plan (2009). The UK government aims to increase the proportion of new and renewable energy in electricity generation by up to 30% by 2020 and to supply the proportion of low-carbon energy sources at 40%. It also plans to cover 10% of transportation fuel with biofuels. The UK government is making efforts to increase the proportion of clean fuel to 80% by 2032 and to convert the power generation sector into a clean power system by applying the Contract for Difference (CfD). It plans to establish a 10% clean power system by 2050.

3.6. The Goal of Japan's New and Renewable Energy Policy

The Japanese government has set a goal of expanding the proportion of new and renewable energy up to 13–14 fold compared to primary energy by 2030 through the Long-term Energy Supply Prospect announced in 2015 in accordance with the Fourth Energy Basic Plan. The Japanese government set the electricity production target at 1060 billion kWh by 2030 and has proposed 12,989 ~ 13,214 kW targets for the expansion of new and renewable energy generation facilities. In 2030, the Japanese government plans to have renewable energy electricity sources of 2–24% (1.0 to 1.1% from geothermal energy, 3.7 to 4.6% from biomass, 1.7% from wind power, 7.0% from photovoltaic power and 8.8 to 9.2% from hydropower), 27% from oil, 27% from natural gas, 26% from coal, and 2–20% from nuclear power.

3.7. The Goal of China's New and Renewable Energy Policy

China set a goal of increasing the proportion of non-fossil energy among primary energy consumption to 15% by 2020 to reduce its heavy dependence on coal. China also set the goal of 680 GW of new and renewable energy generation capacity and 190 TWh of generation capacity [13]. The National Energy Agency (NEA) of China proposed the goal of expanding the capacity of non-fossil energy generation facilities to 740 GW and power generation capacity to 200 TWh by 2018 through the 2018 Energy Business Guidance Opinion. China selected wind power as the main energy source for expanding the proportion of non-fossil energies and planned to build a new construction size of 25 GW and a new expanded facility capacity of 20 GW.

4. New and Renewable Energy Vitalization Plan through Improvement of Domestic Systems

It will be necessary to have a plan to support small-scale projects with a capacity of 100 kW or less for new and renewable energy facilities and to vitalize participation through cooperatives. The introduction of the Korean-type feed-in tariff should be introduced for a limited time, ensuring profitability and streamlining the procedure for small-scale projects. In order to stabilize profits and simplify procedures for passive small business operators due to unstable profits and complicated procedures, it is necessary to improve the system so that they can generate stable profits for 20 years by making six major domestic power generation companies make mandatory purchases. A plan to omit the REC issuance and bidding procedure can also be considered. As targets of the Korean-type FIT, it is desirable to examine the application for the time being of 5 years for cooperatives and farmers of less than 100 kW and individual business operators of less than 30 kW.

In a way that provides incentives for social economy companies (cooperatives) and civil-funded projects, the government must develop a plan in which any cooperative consisting of local residents can form a regional renewable energy cooperative through investment in photovoltaic power generation projects and sharing dividend income. For example, through the establishment of a special purpose company (SPC) for photovoltaic power generation projects among new and renewable energies, it is necessary to conduct lending and repayment for photovoltaic power funds invested by local residents and to share dividend income.

Regarding ways to revitalize new and renewable energy through the implementation of large-scale projects, a plan for intensive promotion of projects falling under 5 GW among the projects proposed by private and public

organizations needs to be established. It is necessary to support this by reviewing pre-approval and preemptive grid-connected photovoltaic power generation and to seek ways to utilize the idle sites of nuclear plants or coal-fired power plants. The next step is to increase the ratio of Renewable Energy Portfolio Standard (RPS) requirements for large power generation companies to promote investment. This is expected to actively encourage the implementation of large-scale projects.

Regarding city-type private photovoltaic power, it is necessary to improve the offset transaction system for expanding the supply business and expansion of the rate reduction benefit in photovoltaic power generation installations. It is necessary to prepare for the case where the power generated from the private photovoltaic power generation cannot be used up. Regarding the improvement of the setoff transaction system, which is used to deduct the electricity bill, in the case of the private residential photovoltaic power system, it is necessary to seek ways to utilize the surplus power after the offset processing.

It is necessary to actively utilize the zero-energy building certification system as a means to implement national greenhouse gas reduction goals and promote the use of new and renewable energy. Zero-energy buildings refer to buildings minimizing energies lost to the outside through the outer covering of buildings by applying external insulation and double windows and minimizing the energy consumption by devoting energies for air conditioning and heating by utilizing new and renewable energy such as fuel cells, photovoltaic power generation, and geothermal systems. If the ratio of the primary energy production to the primary energy consumption is more than 20%, it is possible to obtain the zero-energy building certification. If a zero-energy building certification is obtained, new and renewable energy installation subsidies will be given priority and the acquisition tax will be reduced by up to 20%. In addition, it is possible to deduct up to 6% of the income tax or corporation tax on a part of the investment cost of energy-saving facilities, such as new and renewable energy facilities and BEMS.

The instability of the tax support system for new and renewable energy will deter investments in new and renewable energy. In South Korea, the Tax Exemption Restriction Act and the Restriction of the Local Tax Act specify the closing period of tax support for new and renewable energy, thus giving some predictability [16]. However, there is instability due to the extension of the closing period because the closing period is short. Until now, most of the closing period of tax support for new and renewable energy has been extended, and the instability has not been realized [17]. On the other hand, investors incur the risk that the support measures can be stopped when the closing period ends. In order to raise the proportion of renewable energy generation to 20% by 2030 under the situation where the proportion of new and renewable energy power generation is low compared to major countries', sustainable and stable taxation support is needed. In order to reduce the instability of the tax support system and increase the consistency of the policy, it is desirable to set the closing period to five years or more that is longer than the current three years.

Table11. Analysis of G-SEED certified projects for preliminary certification from September 2016 to April 2018 (Residential: 211 projects, Non-residential: 85 projects) [19]

Credit Category	Residential		Non-residential	
	Weight	Average score	Weight	Average score
Land Use and Transport	10	3.93	10	5.85
Energy and Pollution	25	14.09	30	19.96
Material and Resources	18	9.55	15	10.22
Water Management	10	3.86	10	6.28
Maintenance	7	6.32	7	6.54
Ecological Environment	10	2.58	10	3.34
Indoor Environment	20	13.45	18	10.21
Total	100	53.78	100	62.4

The contents of the evaluation item: the use of new and renewable energy of G-SEED (Green Standard for Energy & Environmental Design), which is being implemented by the Ministry of Land, Transport, and Maritime Affairs and the Ministry of Environment under the government's management, should be improved. Buildings over 3,000 ㎡ in total area run by public institutions are required to obtain the G-SEED, and local governments have established standards of mandatory acquisition for buildings over a certain size. Looking at the current situation, since 2008, the installation rate of new and renewable energy facilities has not been significantly increased. In order to meet the government's goal of supplying 11% of primary energy with new and renewable energy by 2035, it will be necessary to increase the installation rate of new and renewable energy by 2.5–5%. It is necessary to find a way to make the ratio of new and renewable energy facilities different between private and public sectors.

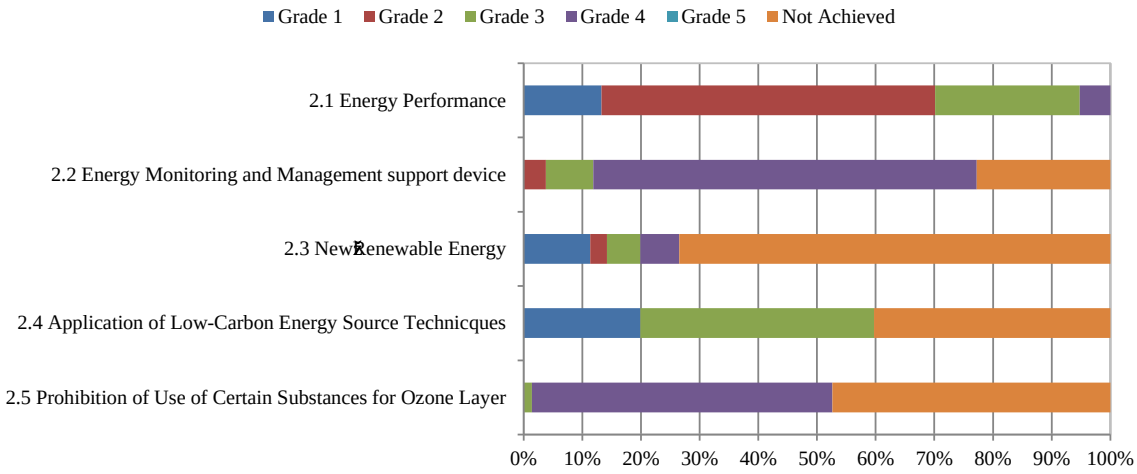

Figure 2: Analysis of achieved credit points for Energy and Pollution in G-SEED 2016 v1.2 (September 2016~April 2018; 211 residential projects)

Table 11 shows the number of projects that achieved preliminary certification of G-SEED from September 2016 to April 2018. It can be seen that the weighting and average acquisition scores of the energy sector, which includes renewable energy items, are higher than other credit categories'. Figure 2 indicates the weight ratio of each credit category in energy and pollution of G-SEED for residential projects from September 2016 to April 2018. The number of residential buildings that did not achieve a score of 2.3 New and renewable energy credit is the highest compared to other credit categories. It seems that the residential projects need support systems such as tax concessions, installation cost grant, and interest discount by government in order to promote the installation of new and renewable energy facilities.

5. Conclusion

It is necessary to focus on the creation of the ecosystem of the new and renewable energy market for the transition from government-led models to private partnerships. It is necessary to raise voluntary private investment through market-friendly system design, proposing a profitable business model, deregulation, and finding suitable models for new and renewable energy supply. It is also necessary to secure a self-sustaining capacity for sustainable growth through entry into overseas markets and to have a green building certification system and a zero energy building certification improvement plan.

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