A CRITICAL STUDY OF SUPPORTING SCHEME FOR RENEWABLE ENERGY

By

Hyeon-Chul PARK

THESIS

Submitted to
School of Public Policy and Management, KDI
in partial fulfillment of the requirements
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ABSTRACT

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Peak oil and climate change are the main factors to foster transition from fossil fuel energy system to renewable energy system. Today, U.S. is trying to prolong the fossil fuel energy system, and EU is making haste with the energy system transition to renewable energy. The financial, administrative, and especially political support are essential for the development of renewable energy technologies, shaping up of renewable energy market, and mature of renewable energy industry. Feed in tariffs system and Renewable portfolio standards system are representative among the various supporting schemes. When we have researched global experience, particularly the cases of EU, Feed in tariffs system is more superior to the Renewable portfolio standards system in the empirical field. Recently, Korean government is attempting to lower the standard price of Feed in tariffs system, and to change the supporting scheme from Feed in tariffs system to Renewable portfolio standards system in short-term scenario. The result from global experience centering on EU cases research is that maintaining the Feed in tariffs system is more advantageous to diffusion of renewable energy in Korea.

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INTRODUCTION

Renewable energy (RE) means energy obtained from energy sources in nature such as solar power, wind power, hydro power, bio gas, biomass, bio diesel, landfill gas and wave power. These day, faced with the exhaustion of fossil fuels including oil and climate change resulting from the intensive consumption of fossil fuels, the global society is adopting RE as sustainable energy sources. The transition is primarily based on the characteristic of renewable energy sources (RESs), namely, inexhaustible stable supply. In addition, RE emits no greenhouse gas or little compared to fossil fuels, so it is the ultimate means of coping with climate change.

Currently the development level of the RE industry and market varies among regions and countries. For example, Iceland with rich hydro power sources has already realized hydrogen economy based on the generation of hydrogen using hydro power. However, not every country is rich in hydro power generation resources, so the Iceland model cannot be a global model. Although there can be some difference in the abundance of RES among regions, wind and sunlight can be adopted as RESs by almost every country. Thus, different from endowed resources like fossil fuel, RE is free from geographical concentration. Therefore, success in the transition of energy from fossil fuel to RE depends on individual country's will and governmental support for fair competition between RE and fossil fuel.

There are various RE support systems, for instance, enhancing the price competitiveness of RE by reducing or abolishing fossil fuel subsidies or imposing carbon taxes on fossil fuel according to the emission of greenhouse gases, providing direct incentives for the production and consumption of RE, developing and spreading RE technologies directly by the government, etc.

The most effective policies in developing RE technology and industry and forming the RE market are supporting schemes that assist in the production of RE electricity. Because electricity is the base of all the other types of energy, the energy generating electricity is regarded as the axial energy. FIT and RPS are the two most representative ones among supporting schemes for the generation, transmission, distribution and consumption of RE electricity.

Feed in Tariffs (FIT) system, which sets a premium price for Renewable Energy Source-Electricity (RES-E) and supports it in the governmental level. Another system is Renewable Portfolio Standards (RPS), in which the government sets the obligatory level of generation for power generation companies and has power distributors buy the generated electric power.

The present study purposed to determine which of the two supporting schemes is more effective in the development of the RE industry and technology and the growth of the RE market in Korea. We assume that FIT is a more capable scheme and more appropriate

particularly considering the level of the RE industry and technology and the maturity of the RE market in Korea.

This thesis tests this hypothesis as follows.

First, Chapter 2 reviews papers published by the Commission of the European Communities that contain count logic on the author's hypothesis. In addition, we will review papers that support the author's hypothesis.

In addition, Chapter 3 examines the background of the emergency of RE as a substitute for fossil energy. This is because the switch of axial energy from fossil energy to RE implies not only the change of energy source but also the change of social system. This was pointed out appropriately by Lewis Mumford (1934, 1961) and Amory B. Lovins(1977). Chapter 3 explains the background of energy transition mainly using the limitations and side effects of the fossil fuel regime, and shows the difference between the U.S. and the EU, the two gigantic energy-political bodies, in their choice of energy path surrounding RE, which is free from such limitations and side effects.

Next, Chapter 4 reviews the history and results of competition between FIT and RPS in the EU to be the uniform RE supporting scheme, and studies a number of nations in the EU that adopted FIT or RPS. In Chapter 4, we discuss 'Under which scheme was production more cost-effective?', 'Which scheme was more capable for expanding the volume of the RE industry and

market?' and 'Which scheme was more capable for the promotion of slowly developing RE technologies like solar energy technology?' All these will prove the validity of the relatively higher capability of the FIT scheme assumed by the author.

Next, in Chapter 5, this thesis examines the history of RE policies in Korea. In addition, we make a critical review of the Korean government's recent policies to lower the standard price of FIT and switch the supporting scheme from FIT to RPS.

The conclusion of this paper emphasizes that, among RE power generation supporting schemes, FIT is the most capable one and an ideal policy should be based on the scheme. With the conclusion, we propose a number of revisions of governmental policies for the development of the RE industry and technology and the growth of the RE market in Korea.

Ⅰ. Hypotheses and Literature Review

Firstly, FIT is the most capable supporting scheme for expanding RE.

Secondly, if the hypothesis that FIT is more capable than any other supporting schemes is valid, the hypothesis that the Korean government's attempt to switch the supporting scheme from FIT to RPS must be stopped is also valid.

To prove the hypotheses above, we first review previous researches on supporting schemes such as FIT and RPS.

In 2001, the EU established EU standards for the generation of electricity from renewable energy sources by announcing Directive 2001/77/EC as a guideline of European Parliament and of the Council. Particularly to establish a uniform RE supporting scheme, the guideline demanded the member countries to submit reports on the operation and success of supporting schemes adopted by them and this triggered controversies over RE supporting schemes, which have been being continued until now.

The guideline was published in the name of the European Parliament and of the Council but it merely indicated the scope of political responsibility, and actually it was drafted by Directorate-General for Energy and Transportation. The basic position of Directorate-General for Energy and Transportation can be summarized as follows. The activities of Directorate-

General are covered in detail in 1-1 of Chapter 4.

- Within EEC, goods should be traded freely without national barriers. This principle should be applied to electricity in the same way. Thus, a unitary electricity market should be created in the dimension of the EU.

- The unitary electricity market must trade electricity generated under uniform power generation rules.

- In the situation that various RESs have different characteristics and each EU member country has different RESs advantageous to the nation, the price mechanism should not be intervened in by any government. RES-E must be generated under the market mechanism based on competition.

-Under FIT, the government pays tariffs to RES-E generators for the difference between the market price and the standard price set by the government, which is distant from the market mechanism. Because difference in tariffs among countries is directly linked to competitiveness in the future unitary electricity market, it hinders the formation of a unitary RE electricity market in the EU. On the contrary, under RPS supplemented by the certification system guaranteeing RES-E, the government suggests the target of RES-E generation, and if generators achieve the target they can sell not only generated RE but also certification papers, which

increase the generators' profits. Furthermore, as generators compete with one another for generation projects, cost-efficiency is improved. Because of its market-friendliness faithful to the principle of competition and cost-efficiency, PRS can be the uniform supporting scheme of the EU.

Directorate-General for Competition also tried a special administrative action that supported the position of Directorate-General for Energy and Transportation. The position of Directorate-General for Competition toward governmental subsidies is manifested in 'Community guidelines on state aid for environmental protection' published in 2001. Directorate-General for Competition regarded FIT in Germany as a state aid and brought it to the European Court of Justice, charging that it violated the law of the EU prohibiting subsidies. The incident ended in favor of Germany but Directorate-General for Competition has been maintaining the same position and affecting the member countries' decision on their RE supporting scheme. This will be discussed further in 1-1 of Chapter 4.

Publishing a communication paper in 2005, the Commission of the European Communities settled controversies over supporting schemes triggered by Directive 2001/77/EC in 2001. The Commission assumed that it was difficult to compare FIT and RPS due to the short history of RPS, but it requested the member nations to attempt the harmonization of FIT, the

green certification system and RPS.

Although its position in 2001, which recommended RPS and the green certification system supplementing RPS as the uniform supporting scheme of the EU, was changed, the commission still had RPS in mind as the core supporting scheme.

On the other hand, Korea lowered the standard price of FIT in June 2006 and is trying to change the supporting scheme to RPS. These changes are contained in a policy draft paper for 'Policy Inquiry Commission' of the Ministry of Commerce, Industry and Energy based on *A Study for Innovation of Feed in Tariffs System* (Korea Electrotechnology Research Institute, 2006 [Korean]), a research by Rhee Chang-ho et al. conducted from the end of 2004 to the beginning of 2006. On the other hand, the objective of this research is similar to that of previous researches such as *Promotion of Renewable Electricity Market* (Rhee Chang-ho et al., 2005), *Conditions to Introduce the Renewable Portfolio Standards in Korea* (Chang Han-soo, Choi Ki-ryun and Kim Su-duk, 2005) commissioned by the Korean government for switching of the supporting scheme to RPS. This will be discussed in detail in Chapter 5.

Many researchers criticized and examined the positions of the Commission of the European Communities and the Korean government.

First, Lauber (*Renewable Energy at EU Level*, 2002) explained the background of Directive 2001/77/EC and pointed out that the guideline was the starting point of competition

surrounding supporting schemes in the EU. In addition, through *REFIT V. RPS: Regulatory Competition between Supporting Schemes in the EU* (2002), Lauber evaluated FIT more dynamic than RPS in the early stage of the RE industry and technology and said that, though FIT and RPS can be used by stage according to RSE, the correct time of change is different from country to country depending on environment.

Midttund and Gautesen (2005) also viewed that the matter in changing supporting schemes is appropriate time. In particular, they pointed out that governmental policies should be different for mature and immature RE technologies.

Bechberger and Reiche (2005) said that FIT is more efficient than RPS in increasing the RE capacity.

Lorenzoni (2002) mentioned that, since its change of supporting scheme from FIT to RPS in 2002, Italy has been unable to utilize various REs but concentrated only on competitive RESs.

Stenzel et al. (2003) evaluated that Austria rich in hydro power resources adopted FIT in 2003 in the governmental level and had a turning point of the development of RES technologies and industries in addition to the hydro power industry.

In 2040, the European Photovoltaics Industry Association (EPIA) and Greenpeace suggested a long-term scenario that can meet 21% of global electricity demand with solar PV,

and for this they emphasized the necessity of FIT, a supporting scheme for the development of all RES technologies together, because of different standard prices among RESs.

In his study on 30 years' history of German energy policies, Lauber (2004) laid his finger on the fact that the country consistently promoted the system supporting higher costs during the early period of the RE industry and became the biggest RE industry country in the world today.

Di Nucci, Maria R., Lutz Mez, and Danyel Reiche (2005) maintained that the key factor for the development of the RE industry is not the abundance of RES but the appropriate and consistent governmental support, using the case that Germany has 20 and 40 times larger off-shore wind turbine capacity, respectively, than the U.K. and France although its coastline is much shorter than the two countries.

Diekmann, J. and Kemfert, C. (2005) pointed out that RPS is known to be theoretically more cost-efficient than FIT but according to Germany's experience during the period from 2000 to 2004 the country could save € 1.7 billion by adopting FIT as its supporting scheme to develop the RE industry compared to the adoption of a different supporting scheme.

Sawin (2004) admitted that experiences had proved the superiority of FIT to RPS but pointed out that just one support scheme is not sufficient but there should be additional supporting systems supplementing the main scheme. In particular, he suggested principles that

governmental policies should follow to develop the RE industry.

Mathis (2003) said that it was FIT that had led the expansion and industrialization of wind turbine capacity in Denmark, Spain and Germany and German FIT, which defined high standard price, long guarantee period and grid access priority, was particularly effective.

Johansson and Turkenburg (2004) also pointed out the importance of sufficient price and fair and easy grid access and particularly the importance of long-term stability of the supporting scheme.

Sasagaw (2004) analyzed that the implementation of distributed generation of RES-E requires the voluntary participation of citizens who want to own small- and medium-size generators and the dramatic growth of the wind power industry in Denmark was possible owing to the explosive participation of citizens who wanted to possess their own wind turbines.

These researches will be reviewed mainly in Chapter 4 and 5.

Ⅱ. Background of Energy System Change

Lewis Mumford maintained, “The age following the Industrial Revolution is a paleotechnic phase ruled by the order of fossil energy technology and the capitalism of this age is caboniferous capitalism.”[1] He pointed out that the order of fossil energy technology, which can be sustained only through the intensive consumption of carbon, must be dissolved.[2] As Mumford was concerned, the international society has walked up the road of intensifying oil-dependent economy.

Amory B. Lovins criticized industrialized countries’ energy policies for taking the rise of energy demand for granted and taking other fossil fuels like coal and nuclear energy as alternative energy sources, expecting the limit of oil production. Defining these energy strategies as ‘hard energy paths,’ he pointed out that these strategies stand on the wrong assumption that the rise of energy demand is natural for economic growth. Lovins believed that economic growth can be separated from the rise of energy demand through high energy efficiency and energy saving. In addition, he pointed out that demand for energy should be met fundamentally by the use of RE, and called the energy strategy soft energy paths distinguished

[1] Mumford, Lewis. *Technics and Civilization*. New York: Harcourt Brace & Company, 1934, pp51~ 211
[2] Mumford, Lewis. *The City in History: Its Origins, Its Transformations, and Its Prospects*. New York: Harcourt Brace Jovanovich, Inc., 1961, p263

from hard energy paths.[3]

1. Global Economic Imbalance and Peak Oil

IMF forecasted that the imbalance of current account throughout the world resulting from the high oil price as of 2006 will last for a while. The negative external effect of high oil price is expanding the imbalance of current account as a global problem.[4]

The high oil price is the most enormous negative external effect confronting world economy. Today the world is dominated by highly oil-dependent economic system, which may stop immediately without oil. Moreover, in the current situation that the world economy has been integrated into a body through finance, the high oil price has a direct effect on exchange rates, which is in turn manifested as inflation pressure upon world economy. The problem is that the high oil price is not a temporary phenomenon. This is a fundamentally different point of the present high oil price from the oil crisis in 1973 and 1979. High oil prices in the past were caused by short-term factors such as the prearranged action of oil producing countries and the Middle East war, and the crises were resolved and the oil price went down when such political instabilities were settled. As for today's high oil price, however, although there are short-term

[3] Lovins, Amory B. *Soft Energy Paths: Toward a Durable Peace*. New York: Ballinger, 1977, pp38~39, 54~57

[4] Rebucci, Alessandro and Nikola Spatafora. *Oil prices and Global Imbalances*. In: *World Economic Outlook-Globalization and Inflation*. Washington, DC: International Monetary Fund, April 2006

causes, namely, political instabilities in the Middle East including the Iraq War and Israel's bombing of Lebanon that is likely to be expanded to the 5th Middle East war, a more fundamental cause is the worldwide recognition that oil product is approaching or has passed the peak.

The oil crisis threatening world economy is even aggravated because each country has to pay out additional expenses included or not included in the oil price in order to resolve energy insecurity. Stable oil supply requires additional expenses, which work as negative external effects. A good example of such additional expenses is the military expense paid by the U.S. for the Iraq War. To wage the Iraq War, the U.S. is spending ＄30~60 billion each year. The value of oil imported from the area during the same period was merely ＄20 billion.[5]

Brown (2006) criticized that the government, oil companies and oil consultants put too much trust in the forecast of the peak oil by computer modeling, in which the quality of basic data and assumptions have a significant effect on the conclusion, and pointed out that the oil crisis may come earlier than expected. He said that, rather than listening to assertions denying the coming of oil crisis, we should observe how the oil majors behave. For example, Exxon Mobil raised $8.4 billion of profit in the last quarter of 2004, highest in the industry, but it spent almost $10 billion to purchase stock. Chevron Texaco also spent $2.5 billion to pile up oil stock.

[5] Graham E. Fuller and Ian O. lesser. "Persian Gulf Myths". *Foreign Affairs*. May-June 1977, pp42~53

These actions support petroleum geologists' contention that 95% of oil fields have already been developed.[6]

Jad Mouawad asserted, "Undiscovered commercially profitable oil fields are only 5%." [7] This warns that human beings are faced with the peak oil. A representative petroleum geologist advocating the approach to the peak oil is Colin Campbell, the founder of Association for the Study of Peak Oil & Gas (ASPO). He explains the peak oil as follows. "The term Peak Oil refers the maximum rate of the production of oil in any area under consideration, reorganizing that it is a finite natural resource, subject to depletion."[8] Furthermore, Kenneth Deffeyes insisted that the oil peak would come at the end of 2005 or the beginning of 2006.[9]

The peak oil is the first pressing reason for the international society to get out of the energy system based on fossil fuel. Oil is not recyclable but is a consumptive resource, which is not renewable after burning. The crisis of exhaustion of fossil fuel, a natural resource, is easily linked to resource weaponization. Currently the Middle East and oil producing countries in South America are under the influence of enormously powerful resource weaponization politics. The resource weaponization politics leads to competition among non-oil producing countries for control over insufficient oil and wars surrounding oil like the 1st and 2nd Iraq War. The

[6] Brown, Lester R. *Plan B 2.0*. New York: W.W.Norton & Company, 2006, pp23
[7] Mouawad. "Big Oil's Burden of Too Much Cash". *New York Times.* February 12, 2005
[8] http://www.peakoil.net
[9] Kenneth S. Deffeyes. *Beyond Oil: The View from Hubbert's Peak*. New York: Hill and Wang, 2005

worldwide crisis of security resulting from excessive dependency on foreign countries for fossil fuel is the first reason for changing the energy system.

2. Unfair Conventional Energy Subsidies

Conventional energies such as oil and coal have run their business with an enormous amount of subsidies. As shown in Table 1, Bjorn Larsen (1994) pointed out that subsidies for the oil, coal and gas industries amount ＄210~220 billion each year.[10] He also concluded that fossil fuel subsidies must be reduced steadily because they are linked to the increase of carbon dioxide emission and shock the price of fossil fuel.[11]

Table 1. World Total Subsidies for Fossil Fuel (millions U.S.＄)

	Coal	Gas	Petroleum	Total	Total/GDP
Former USSR	17000	63000	65000	145000	10~13%*
China	3300		4600	7900	1.8%
Poland	6600	130		6730	10%
Czechoslovakia	2100	460	380	2940	6.0%
Brazil		50	900	950	0.2%
Venezuela		1750	3600	5350	10.6%
Mexico	90	600	1550	2150	1.0%
India	2550		4250	6800	2.3%
Indonesia			5100	5100	5.0%
Saudi Arabia			5000	5000	4.8%

[10] Larsen, Bjorn. *World Fossil Fuel Subsidies and Global Carbon Emissions in a Model with Interfuel Substitution*. Policy Research Working Paper 1256. Washington, DC: World Bank, February 1994, pp7~9

[11] Larsen, Bjorn. 1994, Ibid., p22

South Korea	1650		1100	2750	1.2%
South Africa	1550			1550	
Egypt		350	3000	3350	10.75
Iran		2300	9100	11400	8.0%
Romania	600	800		1400	3.7%
Bulgaria	750		450	1200	6.0%
Total	36190	69440	104030	209660	

Source: Policy Research Working Paper 1256
* Assuming per capita income in the range of US $4000~5000

Brown (2006) said that many of fossil fuel subsidies are hidden from tax payers' eye and military expenses for the Iraq War, which is for holding control over oil fields in the Middle East, are good examples of hidden subsidies.[12]

During the single year in 2001, American tax payers paid ＄257 billion of car-related subsidies, which is ＄2,000 per each tax payer. Glickman (2001) criticized that car-related subsidies are encouraging the emission of carbon dioxide and, considering that some of the tax payers are poor without a car, the government's car subsidies are after all supporting the rich driving cars with money from the poor.[13]

In the process of the growth of world economy by over 7 times since 1950, the negative external effect of conventional energy has never been discussed as a problem. Brown (2006) pointed out that such an irrational economic distortion of conventional energy is fatal to the

[12] Brown, Lester R. 2006, op. cit., pp77~78
[13] Glickman, Mark M. *Beyond Gas Taxes: Linking Driving Fees to Externalities*. Oakland CA: Redefining Progress, 2001, p1

market.[14] In particular, negative external effects from global warming are so dreadful that they prompted UNFCCC and the Kyoto Protocol regime. To correct negative external effects from climate change, some countries began to abolish subsidies disrupting climate. For example, Belgium, France and Japan are abolishing coal subsidies by stages.[15] Germany cut coal subsidies from ＄5.4 billion in 1989 down to ＄2.8 billion in 2002.[16]

On the contrary, the U.S. is increasing subsidies for the fossil fuel and nuclear energy industry. It is because the country has adopted fossil fuel and nuclear energy as the source energy of hydrogen economy that it is promoting ambitiously. In 2002, Green Scissors reported that subsidies to the energy industry in the U.S. for the last 10 years reached ＄33 billion. By sector, ＄26 billion was paid to the gas industry, ＄3 billion to the coal industry, and ＄4 billion to the nuclear energy industry.[17]

EU established the polluter-pays principle through environmental tax reform based on the communication paper[18] issued by the Commission of the European Communities in 1977, and is imposing various environmental taxes including CO_2 and SO_2 taxes, NO_x taxes, water

[14] Brown, Lester R. 2006, op. cit., p228
[15] Dunn, Seth. "King Coal's Weakening Grip on Powers". *World Watch*. September/October 1999, pp10~19
[16] Robin Pomeroy. "EU Ministers Clear German Coal Subsidies". *Reuters*. June 10, 2002 http://www.planetark.com/dailynewsstory.cfm/newsid/16354/story.htm
[17] Pica, Eric. Ed. *Running On Empty: How Environmentally Harmful Energy Subsidies Siphon Billions from Taxpayers-A Green Scissors Reports 2002*. Washington, DC: Friends of the Earth, 2002, pp2~3
[18] COMMISSION OF THE EUROPEAN COMMUNITIES. *Environmental Taxes and Charges in the Single Market-Communication from the Commission, COM (97) 9 final*. Brussels: COMMISSION OF THE EUROPEAN COMMUNITIES, March 26, 1997

abstraction taxes, waste water taxes, pesticides taxes, fertilizers taxes, landfill taxes, aggregates taxes, packaging taxes and batteries taxes.[19] The results of such efforts are most remarkable in Germany. The country executed a plan to switch taxes from labor to energy in 1999. By the plan, energy consumption decreased by 5% until 2001. The revenues were spent to increase the use of renewable energy. Moreover, 45,400 new jobs were created until 2003, and additional 103,000 jobs are expected until 2010.[20]

3. Climate Change Politics

The urgent reason for the international society to change the energy system is climate change caused by the consumption of fossil fuel. As shown in Table 2, the average temperature on earth shows a record-high rise due to the increase of the emission of carbon dioxide, the most representative greenhouse gas.

Table 2. Global Average Temperature and Carbon Emissions from Fossil Fuel Burning, 1950~2004, and Atmospheric Concentrations of Carbon Dioxide, 1960~2004

Year	CarbonDioxide	Temperature	Emissions

[19] ECOTEC. *Study on the Economic and Environmental Implications of the Use of Environmental Taxes and Charges in the European Union and its Member States*. Brussels: ECOTEC, 2001, pp24~25

[20] Donald W. Aitken. "Germany Launches Its Transition: How One of the Most Advanced Industrial Nations Is Moving to 100 Percent Energy from Renewable Sources". *Solar Today.* March/April 2005, pp. 26~29

	parts per mill. by vol.	degrees Celsius	mill. tons of carbon
1950	n.a.	13.87	1,612
1955	n.a.	13.89	2,013
1960	316.9	14.01	2,535
1965	320.0	13.90	3,087
1970	325.7	14.02	3,997
1975	331.2	13.94	4,518
1980	338.7	14.16	5,177
1981	339.9	14.22	5,004
1982	341.1	14.07	4,959
1983	342.8	14.25	4,942
1984	344.4	14.07	5,113
1985	345.9	14.04	5,274
1986	347.2	14.12	5,436
1987	348.9	14.27	5,559
1988	351.5	14.30	5,774
1989	352.9	14.19	5,881
1990	354.2	14.37	5,969
1991	355.6	14.32	6,053
1992	356.4	14.14	5,921
1993	357.0	14.14	5,917
1994	358.9	14.25	6,067
1995	360.9	14.38	6,205
1996	362.6	14.24	6,350
1997	363.8	14.40	6,445
1998	366.6	14.56	6,440
1999	368.3	14.33	6,274
2000	369.5	14.31	6,385
2001	371.0	14.47	6,479
2002	373.1	14.54	6,743
2003	375.6	14.52	6,999
2004 (prel)	377.4	14.48	7,210

Source: Vital Sign 2006, p41 (Originated from GISS, BP, IEA, CDIAC, DOE, and Scripps Inst. of Oceanography.)

In the global level, the most serious side effect of hard energy paths is climate change. The international society's reaction to climate change began in 1988. In 1988, the United

Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) organized the Intergovernmental Panel on Climate Change (IPCC). IPCC issued the 1st report in 1991. According to the report, the cause of climate change is global warming resulting from human beings' social and economic activities. Based on the 1st report of IPCC, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in 1992 adopted the United Nations Framework Convention on Climate Change (UNFCCC). By the convention, the major fossil fuel consuming countries in the long-term process of industrialization since the Industrial Revolution, namely, the member countries of the Organization for Economic Cooperation and Development (OECD) and the member countries of Annex I consisting of the nations of transitional economy, which were former socialist countries, resolved to reduce the emission of greenhouse gases down to the level in 1990 until 2000. However, there was the consensus that the convention on climate change without binding power has a limitation in suppressing climate change. Thus, the 3rd Conference of the Parties (COP-3) in Kyoto, Japan in December 1997 adopted the Kyoto Protocol, which defined the obligatory goal and time limit of reduction. Based on the agreement, the 1st period for the obligatory reduction of emission was set from 2008 to 2012, and Annex I countries agreed to reduce the emission of greenhouse gases by 5.2% on the average from the level in 1990. Each country's target of reduction ranged between 8~10% according to its economic condition and

will to reduce.

Soon after in 2001, the international society announced Marakesh Accord, which contained specific agreements on the procedure and method of ratifying and executing the Kyoto Protocol. However, the effectuation of the Kyoto Protocol was faced with two major problems, namely, the withdrawal of the U.S. the biggest greenhouse gas country and the deferring of ratification by Russia. The two nations' absence resulted in failure to meet one of conditions for the effectuation of the Kyoto Protocol, 'the emission of Annex I countries that ratified the protocol must exceed 55% of the total emission of Annex I countries.' The effectuation was postponed for this reason, but on November 18 2004 Russia deposited the ratification instrument to the secretariat of IPCC and the base for the effectuation of the Kyoto Protocol was prepared. The protocol was finally effectuated on February 16 2005. With the effectuation, Annex I countries began to reduce the emission of greenhouse gases. While UNFCCC declared the reduction of greenhouse gas emission, the effectuation of the Kyoto Protocol means the start of practical efforts to attain the goals of the convention. Currently the international society is negotiating about post-Kyoto plans. One of major agendas is reduction in developing countries such as Korea, China and India, which were excluded from the 1st obligatory reduction. Although Korea is a Non-Annex I country, the National Assembly ratified UNFCCC in October 2002, so it can maintain its status as a developing country until 2012, the

end of the 1st reduction period. However, Korea is highly possible to be included in the countries subject to obligatory reduction in the 2nd period (2013~2017). Korea is an OECD member and the 9th biggest carbon dioxide emission country (1.9% of the total emission in the world).

UNFCCC is a sign that the international society began to choose and practice soft energy paths. The Kyoto Protocol adopted RE as a means of preventing climate change, paying attention to its carbon-neutral characteristic.

4. Damages to the Environment and Health

The International Center for Technology Assessment executed a research on the question of "What is the real price including costs like fossil fuel subsidies to take care of harms of fossil fuel to public health? What is the social cost of 1 gallon of gasoline?" According to its report, the oil industry gets tax deduction, subsidies and the protection of oil fields in overseas by the army for stable supply, but medical expenses for treating respiratory diseases from the burning of fossil fuel are paid by individual consumers. When considering the sum of indirect costs including tax deduction, subsidies, military expenses and medical expenses, the real price of 1 gallon of gasoline including public health expenses is ＄9. The average price per gallon in the U.S was $2 in 2005. Accordingly, the reasonable price of gasoline should be $11 per gallon.[21]

[21] International Center for Technology Assessment. *The Real Price of Gasoline*. Report NO. 3, Washington DC: International Center for Technology Assessment, 1998, p34

The negative external effects of fossil fuel are not limited to public health. The more dreadful and fundamental negative external effect is global warming. Signs of crisis in the global environment caused by the increase of greenhouse gas emission from fossil fuel are being reported continuously. According to IPCC, the concentration of CO_2, the greatest greenhouse gas, is continuing record-high growth.

> The atmospheric concentration of CO_2 has increased from 280 ppm (280 parts of carbon dioxide to every million parts of air) in 1750 to 367 ppm in 1999.[22]
> An increase of 31%. The present CO_2 concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years. The current rate of increase is unprecedented during at least the past 20,000 years.[23]

According to IPCC, the record-high increase of carbon dioxide emission is inviting global warming again.

> The global average surface temperature (the average of near surface air temperature over land, and sea surface temperature) has increased since 1861. Over the 20th century the increase has been 0.6 + or - 0.2C. (IPCC)[24]
> The globally averaged surface temperature is projected to increase by 1.4 to 5.8C over the period 1990 to 2100.[25]

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[22] Intergovernmental Panel on Climate Change(IPCC). *The IPCC Third Assessment Report 2001. The Scientific Basis-Technical Summary of the Working Group I Report, Summary for Policy Makers*. IPCC, 2001, p39
[23] IPCC. 2001, Ibid., p7
[24] IPCC. 2001, Ibid., p2
[25] IPCC. 2001, Ibid., p7

The emission of greenhouse gases from conventionalenergy has led to global warming and, as a result, damages in the environment and public health have increased sharply throughout the world. Table 3 and 4 presenting the results of surveys by WHO show the correlation of climate change with diseases and mortality rate.

Table 3. Estimated mortality (000s) attributable to climate change in the year 2000, by cause and subregion

Subregion	Malnutrition	Diarrhoea	Malaria	Floods	Cardiovascular disease	All causes	Total deaths/ million population
AFR-D	8	5	5	0	1	19	66.83
AFR-E	9	8	18	0	1	36	109.40
AMR-A	0	0	0	0	0	0	0.15
AMR-B	0	0	0	1	1	2	3.74
AMR-D	0	1	0	0	0	1	10.28
EMR-B	0	0	0	0	0	1	5.65
EMR-D	9	8	3	1	1	21	61.30
EUR-A	0	0	0	0	0	0	0.07
EUR-B	0	0	0	0	0	0	1.04
EUR-C	0	0	0	0	0	0	0.29
SEAR-B	0	1	0	0	1	2	7.91
SEAR-D	52	22	0	0	7	80	65.79
WPR-A	0	0	0	0	0	0	0.09
WPR-B	0	2	1	0	0	3	2.16
World	**77**	**47**	**27**	**2**	**12**	**166**	**27.82**

Source: Anthony J. McMichael A, Campbell-Lendrum D, Kovats S, and Edwards S, et al. 2004, p1606

Table 4. Estimated disease burden (000s of DALYs) attributable to climate change in the year 2000, by cause and subregion

Subregion	Malnutrition	Diarrhoea	Malaria	Floods	All causes	Total DALYs/ million population
AFR-D	293	154	178	1	626	2 185.78
AFR-E	323	260	682	3	1267	3 839.58
AMR-A	0	0	0	4	4	11.85
AMR-B	0	0	3	67	71	166.62
AMR-D	0	17	0	5	23	324.15
EMR-B	0	14	0	6	20	147.57
EMR-D	313	277	112	46	748	2 145.91
EUR-A	0	0	0	3	3	6.66
EUR-B	0	6	0	4	10	48.13
EUR-C	0	3	0	1	4	14.93
SEAR-B	0	28	0	6	34	117.19
SEAR-D	1918	612	0	0	2538	2080.94
WPR-A	0	0	0	1	1	8.69
WPR-B	0	89	43	37	169	111.36
World	**2 846**	**1 459**	**1 018**	**193**	**5 517**	**925.35**

Source: Anthony J. McMichael A, Campbell-Lendrum D, Kovats S, and Edwards S, et al. 2004, p1607

The tables above on the correlation between climate change and health damages based on measurement data collected by IPCC, climate change in the past has already inflicted damages upon health. Furthermore, we can expect that the damages will be aggravated if climate change continues. The problem is that the damages are severe particularly in developing countries in Africa and Southeast Asia.[26] In this way, one of negative external effects of fossil fuel is damages to the environment and health.

[26] Anthony J. McMichael A, Campbell-Lendrum D, Kovats S, and Edwards S, et al. *Global Climate Change*. In: Ezzati M, Lopez A, and Roders A et al. *Comparative Quantification of Health Risks, Global and Regional Burden of Disease Attributable to Selected Major Risk Factors*. Geneva: World Health Organization, 2004, p1609

5. Different Choices of Energy Pass of USA and EU

In response to the Kyoto Protocol regime, the biggest carbon dioxide emitters the U.S. and EU adopted conflicting policies.

In March 2001, U.S. President George W Bush declared withdrawal from the Kyoto Protocol regime, and soon in May 2001 announced national energy policies containing the early plan on the theory of hydrogen economy. United States Department of Energy (DOE)'s 'A NATIONAL VISION OF AMERICA'S TRANSITION TO A HYROGEN ECONOMY-TO 2030 AND BEYOND' announced in December 2005 is clearer on the vision of hydrogen economy and more specific on the production of hydrogen based on fossil fuel compared to the report in May. Again in February 2002, Freedom Car Initiative was publicized, which revealed the plan to develop hydrogen fuel cell vehicles. Following this, President Bush declared 'Hydrogen Fuel Initiative' in his New Year's address in 2003. 'Hydrogen Fuel Initiative' contains the plan to invest $1.2 billion in fostering hydrogen economy centering on hydrogen fuel for the next five years (2003~2007).[27]

All plans for hydrogen economy in the U.S. intend to produce hydrogen from fossil fuel. The National Hydrogen Energy Roadmap announced by DOE in 2002 made it clear that, along with RE, nuclear energy would be used to produce hydrogen.[28]

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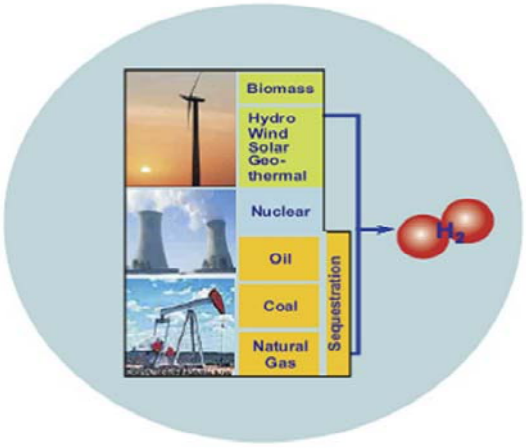
[27] http://www.whitehouse.gov/news/releases/2003/02/20030206-12.html
[28] United States Department of Energy(DOE). *Executive Summary*. In: *National*

Production — Government-industry coordination on hydrogen production systems is required to lower overall costs, improve efficiency, and reduce the cost of carbon sequestration. Better techniques are needed for both central-station and distributed hydrogen production. Efforts should focus on improving existing commercial processes such as steam methane reformation, multifuel gasification, and electrolysis. Development should continue on advanced production techniques such as biological methods and nuclear -or solar- powered thermochemical water-splitting.[29]

On the other hand, Hydrogen Posture Plan published in February 2004, which summed up plans related to hydrogen economy, mentions fossil fuel and nuclear energy as the source energy(See, figure 1) to be used in the production of hydrogen.[30]

Figure 1. Domestic Hydrogen Production Options



SOURCE: DOE, Hydrogen posture Plan (2004)

Hydrogen Energy Roadmap. Washington, DC: DOE, 2002, p7

[29] DOE. Ibid., 2002, piii

[30] DOE. *Hydrogen posture Plan*. Washington, DC: DOE, 2004, p ii

Along with its domestic policies for driving hydrogen economy, the U.S. continued international attempts to frustrate UNFCCC, which pursued the reduction of carbon dioxide emission and RE-based alternatives. On June 25 2003, the U.S. organized the Carbon Sequestration Leadership Forum (CSLF), an international joint research conference for developing carbon dioxide disposal technology. In addition, the International Partnership for the Hydrogen Economy (IPHE) was founded under the leadership of the U.S. The country also initiated the establishment of the Asia Pacific Partnership on Clean Development and Climate, another international partnership related to climate change, on July 28 2005. The international partnership was criticized severely in the international society particularly by international environmental NGOs. Insisting that the manifesto of the Asia Pacific Partnership on Clean Development and Climate is an outward show without authenticity and effect although it urges 'to strengthen cooperation for the development and transfer of technologies to cope with climate change,' international environmental NGOs criticized as follows.[31]

> Without targets, timetables nor market based incentives to encourage the deployment of already developed clean energy technologies the Asia Pacific Partnership on Clean Development and Climate is an empty and meaningless shell that will not help us avoid dangerous climate change.
> …We note that there is already a wide range of commercially viable technologies (such as wind power, solar power and sustainable biomass) that can be deployed immediately.

[31] Greenpeace International, WWF International, and others. *NGO CHALLENGE TO THE ASIA PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT AND CLIMATE BACKGROUND*. Common public statement of International Environmental NGOs. January 10, 2006, pp1~2

> These technologies are tested and proven, and simply require incentives for wider deployment. Developed countries that are sincere in their wish to mitigate greenhouse gases and assist in development will focus their efforts on establishing effective mechanisms to transfer these proven technologies. If the final agreement focuses primarily on nuclear and coal technologies, including Carbon Capture and Storage (CCS) which is as yet unproven and not commercially available, the Partnership will have failed in its task of finding genuine solutions to the climate crisis.

Emission from the six countries (the U.S., Australia, Japan, China, India and Korea) joining the Asia Pacific Partnership on Clean Development and Climate occupies 47.9% of the total emission. In the meetings of UNFCCC, the U.S. opposed the transfer of technology to developing countries with the logic that 'the government cannot force private enterprises to transfer their technologies to other countries.' However, leading the foundation of the partnership, it insisted upon cooperation for the transfer of technology and, based on that, induced the participation of major greenhouse gas emission countries, which occupied around 50% of green gas emission in the world. However, KFEM criticized that behind the partnership was hidden the intention of the U.S., which is inferior to EU in greenhouse gas reduction technology, to hold hegemony in the world energy market through 'hydrogen economy.'

American-edition hydrogen economy is producing hydrogen using nuclear energy and coal, which is distant from genuine hydrogen economy using RE. The intention of the U.S. is obvious when we see the execution of obligatory reduction by the Kyoto Protocol and relevant international agreements. Under the Kyoto Protocol, developed industrial countries are obliged

to reduce by 5.2% based on the level in 1990 during the 1st period of obligatory reduction and decide the target of the 2nd obligatory reduction through negotiation from the end of 2005 to 2007. EU wants to increase reduction during the 2nd period and the participants in the partnership want to stage and diversify the level of reduction considering each country's technological and industrial level. This virtually means the shrinkage of reduction.[32]

Hydrogen itself is not a new recyclable energy. It is simply an energy carrier. Depending on the energy used to generate hydrogen, it can be clean energy or the opposite. The American hydrogen initiative chose nuclear energy and coal instead of RE as the source energy of hydrogen, so it is nothing but a mere extension of the oil age.

A more fundamental criticism of the hydrogen drive policy by the U.S. comes from Hermann Scheer, the President of International Parliamentary Forum on Renewable Energies (IRENA). According to his valid criticism, energy is wasted in generating hydrogen with source energy and again in putting the hydrogen in fuel cells, transporting and consuming it in users' places. If hydrogen is generated using RE and contained in fuel cells, it is physically a waste. Hermann Scheer asks why we do not use RE directly and answers. It is because the centralized large-scale facilities for generating hydrogen and convenience in transportation and storage represented by fuel cells are similar to the production and transportation system of conventional

[32] Korean Federation for Environmental Movement(KFEM). *Break up! The Asia Pacific Partnership on Clean Development and Climate which is paralyzing the Kyoto Protocol*. KFEM public statement. Seoul[Korean]: November 18, 2005

energy. Thus, the infrastructure of conventional energy can be utilized as it is. According to his criticism, conventional energy companies are plotting the dreadful fraud to keep holding their energy power in the RE age.[33]

In 1996, EU issued a green paper and adopted RE as the future energy source, and established related strategies in the dimension of EU.[34] The green paper revealed the target of RE production in EU as follows.[35]

> Against the background already described above, a doubling of the share of renewables by 2010, which would mean a contribution of renewable sources of energy in gross inland energy consumption of about at 12% could be an ambitious, but realistic objective.12

Table 5. Main indicators in Renewable Energy in the European Union

	EUR 12 1991	EUR 12 1994	EUR 15 1991	EUR 15 1994
Share of RES in Total Inland Consumption (%)	3.7	3.9	5.2*	5.4
Capacity All Hydro (MWe)	57303	57932	87303	88331
Capacity Wind (MWe)	645.5	1626.7	652.5	1671.7
Capacity PV (kWp)	8726	29143	n.a.	n.a.
Capacity Geoth. Elect (MWe)	530	509	n.a.	n.a.
Elect. Production All RES (GWh)	174364	205613	290513	324232
of which (%):				
Hydro	92.8	91.5	91.7	91.1
Wind	0.6	1.6	0.4	1.1
PV	0.0.	0.0	n.a.	n.a
Geothermal	1.8	1.6	n.a.	n.a.

[33] Hermann Scheer. "*Wasserstoffwirtschaft?*". In: *Energieautonomie*. München[German]: Verlag Antje Kunstmann GmbH, 2005, pp97~103

[34] COMMISSION OF THE EUROPEAN COMMUNITIES. *Communication from the Commission-Energy for the Future: Renewable Sources of Energy-Green Paper for a Community Strategy, COM(96) 576*. Brussels: COMMISSION OF THE EUROPEAN COMMUNITIES, November 20, 1996

[35] COMMISSION OF THE EUROPEAN COMMUNITIES. Ibid., 1996, p30

Biomass	4.8	5.3	6.8	6.8
Biofuels Production (ktoe)	n.a.	257.6	n.a.	n.a.

Source: EU Green Paper COM(96) 576, 1996 (Originated from Eurostat)
* 1992

Following this, in 1997, EU published White Paper COM (97) 599 Final, setting the goal of supplying 12% of energy consumption with renewable energy until 2010 and suggesting action plans to develop RE.[36] EU also issued another green paper for stable energy supply in 2000. In the green paper, EU forecasted that its overseas dependency for energy supply would rise from 50% up to 70% in 2030. In addition, it expected the rapid rise of oil price. The green paper also said that, in addition to these problems, climate change and the construction of internal energy market were grave challenges that EU was faced with. It was the reason for publishing the green paper to show the necessity of new energy strategies in the dimension of UE to cope with this situation. In the green paper, EU decided to give tomorrow's priority to the appropriate control of the rise of energy demand and overseas energy dependency. Particularly to attain the goal to supply 12% of energy consumption with renewable energy in 2010, it decided to put political priority to new and renewable energy sources and to provide financial or tax incentives for this. The green paper was meaningful in that it clarified issues to establish energy security strategies in EU. Accordingly, it recognized the role of nuclear power in the

[36] EUROPEAN COMMISSION. *White Paper for a Community strategy and action plan-Energy for the future: Renewable sources of energy-Communication from the Commission, COM(97)599 final*. Brussels: EUROPEAN COMMISSION, November 26, 1997

dimension of energy mix, and proposed the construction of internal energy market in EU.[37]

In 2001, the European Parliament and the Council of the European Union announced a directive for increasing the production of RES-E. The directive defined RE-related terminology such as RES and RES-E, and specified EU's execution plans such as EU members' national indicative targets, RES-E supporting schemes, guarantee of the origin of RES-E, and the connection of RES-E to the grid system. The directive stated that a unitary RES-E supporting scheme in the dimension of EU would be adopted after reports on experiences by countries adopting different RES-E supporting schemes such as FIT and RPS were reviewed in 2005. However, it guaranteed competition among RES-E supporting schemes from 2012 by putting a 7 years' period of system transition.[38] On the other hand, the provision on competition among RES-E supporting schemes contained in the directive is working as a background of today's change of RE supporting schemes in Korea.

In July 2005, the European Commission published a green paper dealing with energy efficiency in areas such as energy industry, transportation and buildings.[39] Following this, in

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[37] EUROPEAN, COMMISSION. *Green Paper-Towards a European strategy for the security of energy supply-Communication from the Commission, COM(2000) 769 final*. Brussels: EUROPEAN COMMISSION, November 29, 2000

[38] *Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market*. 2001. European Parliament and of the Council

[39] Directorate-General for Energy and Transport of EUROPEAN COMMISSION. *Green Paper on energy efficiency-Doing more with less*. Belgium: EUROPEAN COMMISSION, June 22, 2005

December, the Commission of the European Communities published communication from commission, which answered for issues related to the unitary supporting scheme in EU suggested in Directive 2001/77/EC in 2001.[40] The communication paper concluded that it was difficult to decide the unitary supporting scheme in the dimension of EU at that time in December 2005 because it was difficult to compare RPS (combined with Green Certification System) and FIT and their cost-effectiveness because they had been executed only a short period. However, among RES supporting schemes analyzed in the communication paper, the FIT scheme appeared to be overwhelmingly superior. First of all, the most superior system in the wind energy sector was FIT in Germany, Spain and Denmark.[41] The most superior system in the biomass sector was the centralized co-generation plant using straw combustion in Denmark, which was based on FIT and supported by tax relief and investment.[42] In the biogas sector as well, high efficiency was reported by four countries adopting FIT and two adopting the green certification system.[43] In the solar photovoltaic energy sector, Germany, which adopted FIT together with additional supporting schemes such as soft loans, showed the most rapid growth, and was followed by the Netherlands and Austria that adopted the same supporting scheme. Particularly in this sector, quota obligations and tax measures provided few incentives to

[40] COMMISSION OF THE EUROPEAN COMMUNITIES. *The support of electricity from renewable energy sources-Communication from the Commission, COM(2005) 627 final*. Brussels: COMMISSION OF THE EUROPEAN COMMUNITIES, December 12, 2005
[41] COMMISSION OF THE EUROPEAN COMMUNITIES. 2005, Ibid., p7
[42] COMMISSION OF THE EUROPEAN COMMUNITIES. 2005, Ibid., p7
[43] COMMISSION OF THE EUROPEAN COMMUNITIES. 2005, Ibid., p8

investment in PV technology. As a result, quota obligations and tax measures developed technologies applicable at the cheapest price and were ineffective in promoting PV technology. On the other hand, Denmark, Spain, the Netherlands and Austria executed the PV supporting scheme as a part of their long-term policies for developing the PV technology market.[44] The communication paper pointed out that the competition for the superiority of supporting schemes triggered by Directive 2001/77/EC might cause harmonization that combines the advantages of these schemes. That is, it introduced FIT in Germany, Spain and France and the green certification system adopted in the Iberian market and the Swedish-Norwegian market to be worth for EU members to attempt harmonization of their advantages.[45]

On March 8 2006, EU published a green paper that dealt with EU's measures to cope with energy supply security and climate change.[46] The green paper laid its finger on RE as the core of sustainable and competitive energy security strategies for EU to cope with climate change and its high dependency on overseas supply for fossil energy, and presented a road map for renewable energy to expand RE.

Considering what have been presented above, EU's energy strategies are distinguished from those of the U.S. While the U.S. is pursuing hydrogen economy based on fossil fuel and

[44] COMMISSION OF THE EUROPEAN COMMUNITIES. 2005, Ibid., p41
[45] COMMISSION OF THE EUROPEAN COMMUNITIES. 2005, Ibid., p16
[46] COMMISSION OF THE EUROPEAN COMMUNITIES. *Green Pepaer-A European Strategy for Sustainable, Competitive and Secure Energy, COM(2006) 105 final*. Brussels: COMMISSION OF THE EUROPEAN COMMUNITIES, March 8, 2006

nuclear energy, which is virtually a hard energy path extending the fossil fuel system, EU is walking a soft energy path centering on RE. Korea will get lessons on how to lead its national energy policies from the two gigantic economic blocks' choice of their energy system. It's the time for the Korean government to consider seriously Mumford's (1934) distinguished view that the change of major energy is not simply a change in the type of energy but the transition of the energy system interlocked with the entire social system.

Ⅲ. Case Study-centering EU Members

Hermann Scheer, the president of IRENA and a member of the German National Parliament at that time, designed the FIT system, which is the core of Energy Sources to the Public Gird (StrEG) a law to support RE in Germany effectuated in 1990. The bill was passed unanimously including the support of conservative parties such as Christlich-Demokratische Union (CDU) and Christlich-Soziale Union (CSU). However, as the bill was passed and its effect grew bigger, political powers supporting conventional energy struggled to disable the system. Particularly in 1997, they attempted to lower the standard price of wind energy together with the government, but it was frustrated by RE market forces growing rapidly since 1990 and environmental forces like Greens. This shows that FIT of StrEG expanded the RE market successfully until it could withstand attacks from conventional energy powers. Afterward, StrEG was reinforced further by EEG in 2000 and promoted Germany to the top RE country in the world. Centering on RE, StrEG changed the old idea that RE is not economically efficient and is subsidiary energy rather than major energy. George Lakoff defined this kind of policies as slippery slope initiative creating new social frames.[47] RES-E supporting schemes draw such strategic initiative. Once people acknowledge RE and agree on the necessity of policies to

[47] George Lakoff. *Don't Think of an Elephant: Know Your Values and Frame the Debate-The Essential Guide for Progressives*. US Vermont: CHELSEA GREEN PUBLISHING, 2004, pp32~33

expand the RE industry and market, it is already concluded that there should be a new energy system centering on RE. This is why we should choose a supporting scheme and to withstand any attempt to disable the supporting scheme based on old frames.

1. Which is a More Capable Supporting Scheme?

RE is neutral to greenhouse gases, creates much more jobs than fossil fuel, benefits the environment, and lowers the energy dependency of countries without fossil fuel natural resources. After all, it supports world economy by improving energy security of the world. However, they are not the reasons for transforming the energy system to RE-based one.

Centering Germany, EU is walking the road to transition to RE system. The most critical policy accelerating the transition of energy system in EU is supporting the production of RES-E, and systems related to the support are called RE supporting schemes. Currently EU is making observation and research to expand the RE industry and market in each member country that applies different supporting schemes until a unitary supporting scheme is established in European Community in 2012. That is, individual supporting schemes are competing with one another in terms of efficiency and cost. EU has supporting schemes compete with another in order to establish a unitary supporting scheme because it envisions a united economic community. EU intends to create a unitary market for energy like the markets of other products.

It plans to integrate the energy market until 2007. It is difficult for the member countries to trade RE produced and priced under different supporting schemes in the unitary market. Thus, EU is going to unify the supporting scheme so that RE is produced and priced by a single standard and traded in the unitary market. That is, RE should be produced fittingly to the market principle for its trade.

2. Beginning of the Debate, Directive 2001/77/EC

Directive 2001/77/EC is important in that it defined national indicative targets of RES-E consumption until 2010. It also addressed two hot controversial issues, principles for RE supporting schemes and the guarantee of origin of RES-electricity. What is more, Directive 2001/77/EC demanded to cut external costs of energy.[48]

As presented in the table below, Directive 2001/77/EC suggested the national indicative target of each country in RES-E ratio to be achieved in its gross electricity consumption until 2010. The Directive 2001/77/EC has two goals until 2010. One is to increase the percentage of RES-E in gross electricity consumption to 22.1%, and the other is to raise the percentage of RES up to 12% of the total energy consumption. These targets correspond to EU's Kyoto

[48] *Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market*. 2001. European Parliament and of the Council. Article 8

Protocol commitments to reduce greenhouse gases.

Table 6. Reference values for Member States'national indicative targets for the contribution of electricity from renewable energy sources to gross electricity consumption by 2010

	RES-E TWh 1997	RES-E % 1997	RES-E % 2010
Belgium	0.86	1.1	6.0
Denmark	3.21	8.7	29.0
Germany	24.91	4.5	12.5
Greece	3.94	8.6	20.1
Spain	37.15	19.9	29.4
France	66.00	15.0	21.0
Ireland	0.84	3.6	13.2
Italy	46.46	16.0	25.0
Luxembourg	0.14	2.1	5.7
Netherlands	3.45	3.5	9.0
Austria	39.05	70.0	78.1
Portugal	14.30	38.5	39.0
Finland	19.03	24.7	31.5
Sweden	72.03	49.1	60.0
United Kingdom	7.04	1.7	10.0
Community	**338.41**	**13.9**	**22**

Source: Directive 2001/77/EC, ANNEX

Directive 2001/77/EC provoked disputes over support schemes. An issue was which is a more promising approach between renewable energy certificates combined with quotas and fixed feed-in tariffs. The first proposal submitted by Directorate-General for Energy and Transport suggested that a unitary supporting scheme based on competition is compatible with

electricity liberalization. The proposal was based on tendering systems executed in a number of countries at that time. However, it overlooked the fact that competition also existed in countries executing fixed feed-in tariffs. A tendering scheme is composed of competitive biddings by RES-E generators who try to win fixed price contracts. Such a bidding system was operated in the U.K. According to Mitchell (2000), however, the system also known as the NFFO system was not so successful in expanding the production of RES-E in the U.K. and France, and was maintained unnoticed in Ireland.[49]

In general, EU countries adopting tendering schemes like the U.K. are rich with sources for wind power generation. However, the result of tendering schemes in these countries was contrastive to the success of the RES-E market based on fixed feed-in tariffs in countries like Germany, Spain and Denmark, which occupied 80~90% of wind power generation facilities in EU.[50]

Lauber (2002)[51] criticized Directorate-General for Energy and Transport that they paid attention only to systems compatible with electricity liberalization or a system of tradable certificates.

Directorate-General for Competition is another key agent in EU's RE policies. In 2001,

[49] Mitchell, Catherine. *The England and Wales Non-Fossil Fuel Obligation: history and lessons. Annual Review of Energy and the Environment.* Vol. 25, 2000, pp285~312
[50] Lauber, Volkmar. *Renewable energy at EU level*. In: *Handbook of Renewable Energies in the European Union*. Edited by Danyel Reiche. Frankfurt: Peter Lang publishing group, 2002, p32
[51] Lauber, Volkmar. 2002, Ibid., pp25~36

Directorate-General for Competition published community guidelines that contained the suggestion to restrict governmental energy subsidies.[52] Directorate-General for Competition also sometimes brings member countries before the court for the violation of the community state aid regime. Viewing fixed feed-in tariffs as governmental subsidies, Directorate-General for Competition pressed the governments of the member countries to avoid fixed feed-in tariffs in their policies. In particular, the case that it presented to the European Court of Justice against German fixed feed-in tariffs has a significant meaning in competition among RE supporting schemes up to now. For the case PreussenElektra v. Schleswag brought by Directorate-General for Competition, the European Court of Justice judged that the German system of fixed feed-in rates cannot be viewed as governmental subsidies.[53]

The judgment was not just from a pure legal decision but also from open political struggles. Organizations advocating fixed feed-in tariffs include European associations of renewable energy producers, particularly EREF (European Renewable Energies Federation), Eufores (European Forum for Renewable Energy Sources), EWEA (European Wind Energy Association), European Photovoltaics Association (EPIA), European Biomass Association, FEDARENE (European Federation of Regional Energy and Environmental Agencies), etc. On

[52] EUROPEAN COMMISSION. *Community guidelines on State aid for environmental protection*. Document 301Y0203(02). Official Journal C 037, 03/02/2001, pp3~15
[53] European Court of Justice. *Judgment in Case C-379/98, PreussenElektra v Schleswag*. March 13, 2001

the other hand, open political offensives for supporting FIT were taken by environmental NGOs such as Greenpeace and WWF.

The European Council believed that the RE market can be in harmony with the unitary electricity market in Europe to be formed in the future through providing all member countries with a unified legal structure or simply providing general principles for valid RES-E.[54] Directive 2001/77/EC decided to provide simple general principles. Article 4(2) of Directive 2001/77/EC indicated that the member countries should submit a report on the success of their support scheme until 2005. In addition, it proposed that even if the European Community adopts a unitary supporting scheme the countries have 7 years' transitional period. This means that the community framework will not be decided until 2012 and there will be competition among the support schemes including FIT and RPS during the period.

On the other hand, even after several months from the judgment of the European Court of Justice for the case of *PreussenElektra v. Schleswag*case in June 2001, Directorate-General for Competition continued investigation on whether new German feed-in law (the EEG) is a governmental subsidy or not. The action made investors doubt whether the feed-in-law would continue, which in turn caused the instability of investment.[55] By continuing the debate

[54] Lauber, Volkmar. 2002, op.cit., p30
[55] Nagel, Bernhard. "Rechtliche und politische Hindernisse bei der Einführung Erneuerbarer Energien am Beispiel Strom". *Solarzeitalter* Vol. 13 No 4, 2001[German], pp14~20. p17

concluded by the court, Directorate-General for Competition kept pressing the member countries to avoid the German scheme.

Another debate of Directive 2001/77/EC took place over Article 5, which demanded the certification of the origin of RES-E. The debate was also about supporting schemes.

Some member countries cast doubt on the commission, thinking that the provision on the guarantee of origin was to introduce the system of tradable certificates linked to RPS, which was given priority by the commission for a long time. Under the system of tradable certificates, RES-E power generation companies can sell generated electricity and, on the other hand, sell certificates embodying the greenness of electricity that they generate. The certificates can be traded at exchange rates set by market prices. In the opinion of the commission, the certificates would promote the trade of RES-E in EU, accelerate the development of areas with favorable conditions and, ultimately, lower costs. When Directive 2001/77/EC was discussed, Denmark, the Netherlands, the U.K., Italy and the Flemish part of Belgium were favorable to the system of tradable certificates. Sweden and Austria were the advocates of the system. Of course, Germany was the biggest opponent of the system.[56]

Article 7 of Directive 2001/77/EC, which was about grid access, provided the relation between RES-E producers and transmitters/distributors. The purpose of the provision was to

[56] Lauber, Volkmar. 2002, op.cit., p33

prevent RES-E producers from being discriminated in the cost of grid access and transmission/distribution. The original proposal of the commission reported to the European Parliament was to give RES-E companies priority in grid access. The Council revised the proposal to 'guaranteed access.' However, priority access is still acknowledged. Transmission system operators should concede priority access to RES-E producers as long as the national electricity system permits. The provision is important in many areas where grid companies are antagonistic to RES-E and try to refuse their access.[57]

Article 8 of Directive 2001/77/EC is about external costs and subsidies/summary report on implementation. This article was resisted by fossil fuel companies and their political groups, but was included in Directive 2001/77/EC reflecting the political position of EU leading UNFCCC. The article demanded the member countries to submit reports on external costs in generating electricity with non-renewable sources and the effects of public subsidies to power generation. The purpose of the article was to give price competitiveness to RES-E in the electricity market. Currently the competitiveness of RES-E is severely restricted by the fact that the total external cost of conventional energy is not included in its price system and that conventional energy receives more subsidies than RES-E. Research on ExternE project shows that the price of electricity generated using coal and oil in EU will be twice higher. If external

[57] Lauber, Volkmar. 2002, op.cit., p34

costs related to the environment and health are included, the gas price will rise by up to 30%.[58]

Even in wind energy, which is the most price-competitive RES, price is one of major obstacles to its rapid growth. In this context, the most critical problem is that conventional energy sources do not reflect their external costs sufficiently in their price and they receive subsidies more than the minimum level. According to Ruijgrok (1997) and Goldemberg (2001), the total amount of conventional energy subsidies throughout the world reached $250~300 billion a year in the mid 1990s.[59]

The external cost problem can be corrected at least in EU by imposing carbon taxes on fossil fuel. The attempt of Directorate-General for Competition to abolish governmental subsidies in the process of applying Directive 2001/77/EC, which contains provisions on the staged abolition of hidden subsidies for fossil fuel and nuclear energy, is expected to attain the goal. In March 2002, the European Parliament passed by an overwhelming majority a bill demanding nuclear power companies to keep financial reserves for the disposal of nuclear energy wastes and disintegrate the reserves into separated funds. This means that nuclear energy companies do not want any more to use subsidies for increasing their market power. The voting was a turning point that created a battlefield in which both RE and electricity companies can

[58] Milborrow, David. "External Costs and the Real Truth". *Windpower Monthly*. January 2002, p32
[59] Ruijgrok, E. and Oosterhuis, F. *Energy Subsidies in Western Europe*. Amsterdam: Greenpeace, 1997

compete on the same footing. Analyzing wind turbines and solar PV modules using experience curves, Neij (1998) pointed out that RES-E technologies have higher potential for cost reduction than conventional energy technologies.[60]

3. Competition of FIT Vs RPS

Bechberger and Reiche (2005) asserted that between the two fundamental supporting schemes, namely, FIT and RPS, FIT is dominant obviously. According to them, FIT is more effective than RPS in increasing the capacity of clean energy.[61]

FIT was introduced first by Portugal in 1998. Since it adopted FIT by the StrEG law in 1990, Germany developed it further into EEG in 2000. Spain and Denmark adopted FIT in 1994 and 1992, respectively, and decided to switch it to RPS in 1999 but switched in 2000 after several times of postponement. However, quotas are not forced. Fifteen EU countries have adopted FIT and, if Flandes and Belgium that introduced partially for solar PV are included, 17 countries have adopted. France and Czech Republic adopted FIT in 2001, Slovenia in 2002, Hungary in 2003, and Cyprus in 2004. On the other hand, the Netherlands introduced RPS in

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[60] Neij, Lena. *Analysis of technological change in the energy sector: The use of experience curves to analyse cost reduction of renewable energy technology(ENER Bulletin 22.98).* Paper delivered at Technological Innovations Sustainable Development and the Kyoto Conference(25th ENER Joint Seminar). Edited by Watson, Jim. Denmark Roskilde: ENER January 29~30, 1998, pp4~6

[61] Bechberger, Mischa and Danyel Reiche. "Europe banks on fixed tariffs". *new energy.* 2/2005, p14

1998 and executed for around three and a half year and switched to FIT in July 2001. Poland adopted FIT in 1993 and switched to RPS in 2001. Belgium executes FIT for solar PV but has been applying RPS for other RES since 2001.

Italy adopted FIT in 1992 and maintained it until 2002, and adopted RPS in 2002. It is reported that Italy, which is executing RPS as a system supplementary to the Tradable Green Certification system, questions the effectiveness of these systems in long-term market approach and withholds new investments. In addition, it is reported that only RES, which has competitiveness among RE's, becoming the winner. In conclusion, without full commitment by the local and central governments, Italy expects that the national goal until 2010 proposed in Directive 2001/77/EC will not be attainable.[62]

Austria adopted RPS in 2000 and operated it until 2002 but returned to FIT at the beginning of 2003. As shown in Table 7 and 8, the percentage of RES-E in the total electricity consumption changed its trend from gradual increase to sharp decrease with the introduction of RPS in Austria. In addition, it hit the lowest level in 2003, the last year under the RPS system. From the beginning of 2003, however, it began to grow with subsidies under the FIT system and attained a high growth rate in 2004. On the other hand, wind power generation in Austria during

[62] Lorenzoni, Arturo. "*Leaving REFIT fort the green certification market: a jump in the dark?*" *(ENER Bulletin 25.02).* Paper delivered at ENER Forum 3: Successfully Promoting Renewable Energy Sources in Europe. Denmark: Pitney Bowes Management Services Denmark, 2002, p88

the same period increased by around six times. This record, which was made while the percentage of RES-E in the total electricity consumption was going down, shows that investment was concentrated on wind power. This is the evidence that RPS chooses only the winner among RES. On the other hand, in 2003 when the FIT system was reinstated, wind power generation increased significantly from 366GWh to 924GWh. This suggests the dynamic market forming function of FIT.

Table 7. Contribution of electricity from renewables to total electricity consumption (%)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2010
EU 25countries	13.2	12.8	12.4	12.8	13.1	13.1	13.7	14.2	12.7	12.7	13.7	21.0
EU 15countries	14.2	13.7	13.4	13.8	14.0	14.0	14.7	15.2	13.5	13.7	14.7	22.0
Belgium	1.1	1.2	1.1	1.0	1.1	1.4	1.5	1.6	1.8	1.8	2.1	6.0
Czech Republic	3.0	3.9	3.5	3.5	3.2	2.7	2.8	3.2	3.8	2.1	4.0	8.0
Denmark	5.6	5.8	6.3	8.8	11.7	13.3	16.4	17.4	19.9	23.2	27.0	29.0
Germany	4.3	4.7	4.7	4.3	4.9	5.5	6.8	6.5	8.1	8.2	9.7	12.5
Estonia	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.5	0.5	0.6	5.1
Greece	6.4	8.4	10.0	8.6	7.9	10.0	7.7	5.2	6.2	9.7	9.5	20.1
Spain	17.7	14.3	23.5	19.7	18.6	12.8	15.7	20.7	13.8	21.7	18.2	29.4
France	19.7	17.8	15.3	15.2	14.4	16.5	15.1	16.3	13.7	13.0	12.9	21.0
Ireland	5.5	4.1	4.0	3.8	5.5	5.0	4.9	4.2	5.4	4.3	5.1	13.2
Italy	18.0	14.9	16.5	16.0	15.6	16.9	16.0	16.8	14.3	13.7	15.9	25.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
Latvia	52.8	47.1	24.5	46.7	68.2	45.5	47.7	46.1	39.3	35.4	47.1	49.3
Lithuania	4.1	3.3	2.8	2.6	3.6	3.8	3.4	3.0	3.2	2.8	3.5	7.0
Luxembourg	3.0	2.2	1.7	2.0	2.5	2.5	2.9	1.6	2.8	2.3	3.2	5.7
Hungary	0.5	0.4	0.6	0.6	0.4	0.5	0.5	0.5	0.5	0.4	2.3	3.6
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0

Netherlands	1.9	2.1	2.8	3.5	3.8	3.4	3.9	4.0	3.6	4.7	5.7	9.0
Austria	70.1	70.6	63.9	67.2	67.9	71.9	72.0	67.3	66.0	53.4	58.8	78.1
Poland	1.6	1.6	1.7	1.8	2.1	1.9	1.7	2.0	2.0	1.6	2.1	7.5
Portugal	36.1	27.5	44.3	38.3	36.1	20.5	29.4	34.2	20.8	36.4	24.4	39.0
Slovenia	31.8	29.5	33.0	26.9	29.2	31.6	31.7	30.4	25.9	22.0	29.1	33.6
Slovakia	17.0	17.9	14.9	14.5	15.5	16.3	16.9	17.4	18.6	12.0	14.3	31.0
Finland	24.8	27.6	25.5	25.3	27.4	26.3	28.5	25.7	23.7	21.8	28.3	31.5
Sweden	42.7	48.2	36.8	49.1	52.4	50.6	55.4	54.1	46.9	39.9	46.1	60.0
United Kingdom	2.1	2.0	1.6	1.9	2.4	2.7	2.7	2.5	2.9	2.8	3.7	10.0
Bulgaria	2.2	4.2	6.4	7.0	8.1	7.7	7.4	4.7	6.0	7.8	8.9	:
Croatia	41.7	42.6	56.2	38.8	38.3	45.1	40.0	42.7	33.9	29.4	41.0	:
Romania	23.4	28.0	25.3	30.5	35.0	36.7	28.8	28.4	30.8	24.3	29.9	:
Turkey	39.5	41.9	43.0	38.1	37.3	29.5	24.3	19.1	25.6	25.2	30.9	:
Iceland	99.9	99.8	99.9	99.9	99.9	99.9	99.9	100.0	99.9	99.9	100.0	:
Norway	99.5 (p)	104.6	91.4	95.3	96.2	100.7	112.2	96.2	107.3	92.2	89.8	:

Source: Eurostat[63]
(:) Not available
(p) Provisional value
Note: Figures over 100% are due to export of hydro electricity

Table 8. Electricity generation by origin: wind (GWh)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EU 25 countries	2357	2974	4069	4846	7330	11277	14216	22249	26975	35705	44356	58521
EU 15 countries	2357	2974	4068	4845	7327	11271	14210	22240	26958	35633	44184	58330
Euro area	1008	1384	2367	2952	4488	7185	9798	16144	21205	28892	36659	48962
Euro area12countries	1056	1421	2401	2988	4525	7258	9960	16595	21205	28892	36659	48962
Belgium	8	9	9	8	8	11	13	15	34	57	90	129
Czech Republic	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	1034	1137	1177	1227	1934	2820	3029	4242	4306	4877	5561	6583
Germany	674	909	1712	2078	3034	4593	5528	9352	10456	15856	18859	25270
Estonia	–	–	–	–	–	–	–	–	–	–	–	–
Greece	48	37	34	36	37	73	162	451	756	651	1021	1121

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http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,39140985&_dad=portal&_schema=PORTAL&screen=detailref&language=en&product=Yearlies_new_environment_energy&root=Yearlies_new_environment_energy/H/H2/H23/ebc19728

Spain	116	175	270	338	716	1352	2744	4724	6966	8704	12075	15601
France	2	5	5	7	11	20	37	77	131	268	391	573
Ireland	15	18	16	14	50	169	187	244	334	388	454	655
Italy	4	6	10	33	118	232	403	563	1179	1404	1458	1847
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	1	1	2	2	4	3	11	48	49
Lithuania	–	–	–	–	–	–	–	–	–	–	–	–
Luxembourg	0	0	0	0	3	11	18	27	26	25	26	39
Hungary	–	–	–	–	–	–	–	–	–	–	–	–
Malta	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	174	238	317	437	475	640	645	829	825	910	1330	1867
Austria	0	0	1	5	20	45	51	67	172	203	366	924
Poland	0	0	1	0	2	4	4	5	14	61	124	142
Portugal	11	17	16	21	36	88	123	168	256	362	496	816
Slovenia	–	–	–	–	–	–	–	–	–	–	–	–
Slovakia	–	–	–	–	–	–	–	–	–	–	–	–
Finland	4	7	11	11	17	24	49	78	70	64	93	120
Sweden	48	72	99	144	203	316	371	457	482	608	679	850
United Kingdom	219	344	391	486	665	877	850	946	965	1256	1285	1935
Turkey	0	0	0	0	0	5	21	33	62	48	61	58
Norway	7	9	10	9	10	7	25	31	27	75	218	260

Source: Eurostat[64]
(–) 'Not applicable' or 'Real zero' or 'Zero by default'

Austria traditionally relies on hydroelectric power. As of 2001, hydro power stations of over 10MWp occupied 68% of the total electricity supply. Electricity from fossil fuel was 29.3%, and only 3.7% came from 'new' renewable energies such as wind, solar and biomass. Because traditionally the local governments in Austria had autonomy in energy policies, the diversity of RE support policies was a problem. There were nine Länder laws and nine local

[64] Eurostat . ibid. , At the same frame

decrees. In addition, there were 100 FIT prices and the ratio of the lowest price of solar PV to the highest one was 1 to 36. It was a challenging task for policy makers to integrate them.[65] Only in January 2003, uniform FIT began to be executed and feed in tariffs is applied to biomass, solar PV and wind.

Among RES, solar PV is least price-competitive. From the perspective of mix within RE, however, it is the most important RES along with wind. Thus, it is a hardly adoptable RES under the PRS system that emphasizes costs. For this reason, investment was concentrated on wind power resources in most countries that adopted RPS as their supporting scheme.[66] As shown in Table 8, all the three countries (Germany, the Netherlands and Spain) showing the fastest growth of solve PV adopted FIT as their supporting scheme. FIT induces investment by applying different tariffs if RES is different, so fosters the even development of RES.

Table 9. Photovoltaic capacities installed in the EU (in MWp)

	2003			2004			2005		
Country	on grid	off-grid	Total	on grid	off-grid	Total	on grid	off-grid	Total
Germany	408,000	23,000	431,000	908,000	26,000	934,000	1508,000	29,000	1537,000
Netherlands	38,760	4,680	43,440	44,300	4,800	49,100	46,300	4,900	51,200
Spain	14,559	12,352	26,911	23,800	13,700	37,500	42,500	15,200	57,700
Italy	14,300	11,700	26,000	18,500	12,500	31,000	23,000	13,000	36,000

[65] Stenzel, Till, Tim Foxen, and Robert Gross. *Review of renewable energy development in Europe and the US*. A report for the DTI Renewables Innovation Review. London: Imperial College London Centre for Energy Policy and Technology, October, 2003 ,pp43~47

[66] Grotz, Claudia and Dörte Fouquet. "No need for fast harmonisation". *new energy.* 6/2005, p11

France	3,820	17,250	21,070	8,000	18,300	26,300	13,800	18,867	32,667
Luxemburg	13,000	0,000	13,000	23,200	0,000	23,200	23,266	0,000	23,266
Austria	14,660	2,173	16,833	16,493	2,687	19,180	18,223	3,207	21,430
U.K.	5,189	0,714	50903	7,386	0,778	8,164	9,786	0,878	10,664
Greece	1,107	2,37	3,244	1,257	3,288	4,544	1,412	4,032	5,444
Sweden	0,200	3,600	3,800	0,194	3,672	3,866	0,254	3,922	4,176
Finland	0,163	3,239	3,402	0,193	3,509	3,702	0,223	3,779	4,002
Portugal	0,397	1,672	2,069	0,500	2,200	2,700	0,600	2,700	3,300
Denmark	1,675	0,170	1,845	2,035	0,255	2,290	2,335	0,305	2,640
Belgium	0,874	0,053	0,927	1,210	0,053	1,263	1,712	0,053	1,765
Czech Rep.	0,200	0,130	0,330	0,269	0,147	0,416	0,380	0,150	0,530
Poland	0,047	0,060	0,107	0,069	0,165	0,234	0,085	0,232	0,317
Cyprus	0,150	0,040	0,190	0,255	0,090	0,345	0,490	0,135	0,625
Hungary	0,025	0,075	0,100	0,055	0,083	0,138	0,085	0,091	0,176
Ireland	0,000	0,080	0,080	0,000	0,100	0,100	0,000	0,300	0,300
Slovenia	0,001	0,066	0,067	0,006	0,094	0,100	0,118	0,098	0,216
Slovak Rep.	0,000	0,060	0,060	0,000	0,060	0,060	0,000	0,060	0,060
Lithuania	0,000	0,017	0,017	0,000	0,017	0,017	0,000	0,017	0,017
Malta	0,008	0,000	0,008	0,006	0,000	0,006	0,015	0,000	0,015
Latvia	0,000	0,004	0,004	0,000	0,004	0,004	0,000	0,005	0,005
Estonia	0,000	0,002	0,002	0,000	0,002	0,002	0,000	0,003	0,003
Total EU	**517,135**	**83,274**	**600,409**	**1055,728**	**92,504**	**148,231**	**1692,584**	**100,934**	**1793,518**

Source: EurObserv'ER 2005, 2006 (Present author compiled)
*preliminary

4. Which is the Winner in the Empirical Field?

Lauber (2002) analyzed the outcomes of RES-E supporting schemes in EU in 2002, and proposed policies on RES-E supporting schemes to EU members and other countries that planned to develop RE.[67] Lauber (2002) summarized criticisms of FIT and RPS as in the table

[67] Lauber, Volkmar. *REFITs v. RPS: REGULATORY COMPETITION BETWEEN SUPPORTING SCHEMES IN THE EU*. Paper delivered at Global Windpower Conference. Paris, May 2~5, 2002

below.[68]

Table 10. Critic argument of FIT & RPS

	FIT	RPS
National level	A prevalence of inefficient investments and excess profits among efficient investors A high degree of political risk since the state may at any time change the rules of the game	Insufficient growth impulses to RES-E production and fail to meet the national indicative targets of Directive 2001/77/EC High risks and relatively low rewards for the RES-E equipment industry, thus slowing innovation Not easy to lead to variations in the price of certificates especially in small markets, with resulting investor insecurity Unfavorable for small, decentralized RES-E generation
EU level	Restraints on trade, because that premium prices are reluctant to be paid to foreign RES-E generators An inefficient international division of labour, since the use of renewable resources may be encouraged in areas with poor resource endowment*	Uneconomic as it will either produce windfall profits in countries or areas with low generation costs, or else inhibit windpower development in countries with lower wind speeds

Source: Lauber, 2002 (Present author compiled)
*such as wind or solar photovoltaics in Germany, when wind conditions are much better in North-western Europe and solar radiation more abundant in its Southern parts

In conclusion, Lauber (2002) pointed out that what is more important is 'Which supporting scheme is more appropriate for a specific stage of RE technology development?' than 'Which supporting scheme is superior?' For example, FIT is essential for the development of technologies such as solar PV, but the scheme fit for wind power is different depending on the stage of development. Thus, he presumed that it is hard to make correct timing for the switch of supporting scheme and the timing is different among countries and seasons.[69]

[68] Lauber, Volkmar. 2002. Ibid., pp2~3
[69] Lauber, Volkmar. 2002. Ibid., p5

Midttund and Gautesen (2005) assumed that appropriate timing is important in switching the supporting scheme and pointed out that if the timing is inappropriate it is difficult to develop RE and, on the other hand, if a system enforcing competition and pressure for efficiency is not introduced even after the maturity of the market the volume of the supply market will exceed demand and excessive costs will become a problem. They said that policies for mature technologies should be different from those for less mature technologies, and appropriate policies in terms of time lead the growth of new industries and minimize social costs.[70]

On the other hand, there are researches maintaining that the application of a specific supporting scheme is necessary for the development of a specific RE source. The European Photovoltaics Industry Association (EPIA) and Greenpeace calculated that 27% of annual growth rate until 2009 and 34% between 2010~2020 are required for solar PV to win 1% of global electricity demand until 2020. In addition, they calculated that when 15% of annual growth rate is maintained from 2020 solar PV will serve 21% of global electricity demand in 2040. That is, for coming several decades, the solar PV equipment industry needs high technology innovation. As prerequisites to realize the scenario[71], the European Photovoltaics

[70] Midttun, Atle, and Kristian Gautesen. *Feed in or Certificates? Competition or Complementarity? Combining a Static Efficiency and a Dynamic Innovation Perspective on Greening of The Energy Industry*. A study of Renewable Energy and Liberalisation in Selected Electricity markets-Forum Project(01/2005-02/2007). Berlin: REALISE FORUM, 2005, p8

[71] European Photovoltaics Industry Association(EPIA)/Greenpeace. *Solar Generation-solar electricity for over 1 billion people and 2 million jobs by 2020*. Brussels: EPIA/Greenpeace, 2001

Industry Association (EPIA) and Greenpeace pointed out that FIT must support the solar PV industry as follows.

> Particularly in industrialized and emerging economies, the introduction or expansion of premium feed-in tariffs with guaranteed lifetimes must be a cornerstone of all future promotion mechanisms for solar electricity.[72]
> The simplicity of the feed-in tariff concept and its low administrative costs means that it is a highly effective and efficient tool for boosting the role of solar electricity in national energy mixes.[73]

Lauber (2004) regarded Renewable Energy Sources to the Public Gird (StrEG) established in 1990 as the beginning of laws supporting the development of RES-E in Germany. In addition, he believed that the 100/250 MW wind programme for creating a market for wind power generation by the law and the 1,000 solar roof programme for creating a market for solar power generation supported higher costs for laying the foundation of the RES-E industry and led the creation of the early RE market in Germany. He also pointed out that significant external costs in the process were ignored for all practical purposes.[74]

Through the 1990s, Germany expanded REindustry through governmental subsidies under StrEG including the expansion of the 100 MW wind programme to the 250 MW wind

[72] European Photovoltaics Industry Association(EPIA)/Greenpeace. 2001. Ibid., p8
[73] European Photovoltaics Industry Association(EPIA)/Greenpeace. 2001. Ibid., p46
[74] Lauber, Volkmar, and Lutz Mez. "Three decades of renewable energy politics in Germany". *Energy & Environment.* Vol. 15, No. 4, July 15, 2004, p600

programme and the 1,000 solar roof programme to the 100,000 solar roof programme. Following this, the country established The Renewable Energy Sources Act (EEG) in 2000 to replace StrEG, and revised it in 2003 and 2004. Through EEG, Germany aimed at raising the percentage of RES-E in the total electricity consumption to 12.5% until 2010 and 20% until 2020.

In March 2001, Directorate-General for Competition , one of the sub-divisions of the European Commission, appealed to the European Court of Justice, insisting that EEG in Germany is a type of governmental subsidy. However, the court judged that feed-in tariffs in Germany is not a governmental subsidy. Directive 2001/77/EC announced in September 2001 took a neutral position toward FIT, and clarified that it would guarantee competition with other supporting schemes centering on RPS (quota and certificate system) maintained by Directorate-General for Competition until 2012 and decide a unitary European supporting scheme based on the results. Even after the judgment, Directorate-General for Competition continued to insist that RPS is superior to FIT in terms of down price, competition and accelerating the installation of new RES-E capacity. Different from the contention, the wind power of the U.K., which adopted representative RPS (quota and certificate system), is more expensive than that of Germany despite better wind power sources. Lauber (2004) forecasted that such a situation would not be reversed easily.

> The quota/certificates system is most advanced in the United Kingdom, where it was introduced in 2002. So far, it has led to prices per kWh which, for wind power, are substantially higher than those under RESA, despite the particularly favorable wind conditions in the UK which do not prevail in Germany. … As to the record of installed capacity in the UK, it is slowly improving but not likely, within the next two decades, to approach German levels, despite a resource base, which is not only better but also much broader[75]

In three years' application of EEG based on feed-in tariff, Germany increased the percentage of RE in the total energy consumption from 6.7% in 2000 to 8% in 2003. In particular, wind power increased by around 3.2 times from 4,500MW at the end of 1999 to 14,500MW in 2003, and biomass by twice, and photovolatics by over six times.

According to Di Nucci, Maria R., Lutz Mez, and Danyel Reiche (2005)[76], Germany has a coastline shorter than the U.K. and France but it owned an off-shore wind turbine capacity 20 times higher than the U.K. and 40 times higher than France. The availability of resources is an important factor for the success of the RE industry but it does not guarantee the success. There should be policies and supporting schemes fit for the situation of the country. The most important factor for the success of the RE industry in Germany, Denmark and Spain was planning security. These countries acquired planning security by providing well-designed FIT to investors. In particular, Germany guaranteed FIT for 20 years. Considering these experiences,

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[75] Lauber, Volkmar, and Lutz Mez. 2004. Ibid., p618

[76] Di Nucci, Maria R., Lutz Mez, and Danyel Reiche. *Workpackage 3 Country report Germany*. A study of Renewable Energy and Liberalisation in Selected Electricity markets-Forum Project(01/2005-02/2007). Berlin: REALISE FORUM, 2005, p31

the supporting scheme design criterion for the even development of various RES is technology-specific remuneration for RES-E. For example, Germany led development by setting the FIT of solar PV higher than other RES. Germany has experienced success in the RES-E industry. The Germany RE industry created 15 jobs until 2005. Furthermore, German FIT showed higher cost-efficiency than RPS. There was also a report that if RPS was the supporting scheme of Germany, Germany households would have paid additional € 1.7 billion during the period of 2000~2004.[77] It is natural for Germany to be reluctant to change the successful German-style FIT. Currently in Germany, social organizations and political parties except the German Electricity Association (VDEW) and the Freie Demokratische Partei (FDP) are favorable to EEG based on German-style FIT. This suggests the direction of the revision of EEG to be made in 2007.

Sawin (2004)[78] pointed out that FIT has increased the RES-E capacity and lowered prices through technological progress, and formed economy of scale through history. However, he stated that the introduction of FIT does not guarantee success, and for success, tariffs must cover costs, investors' earning rate should be guaranteed for a long period, the development of

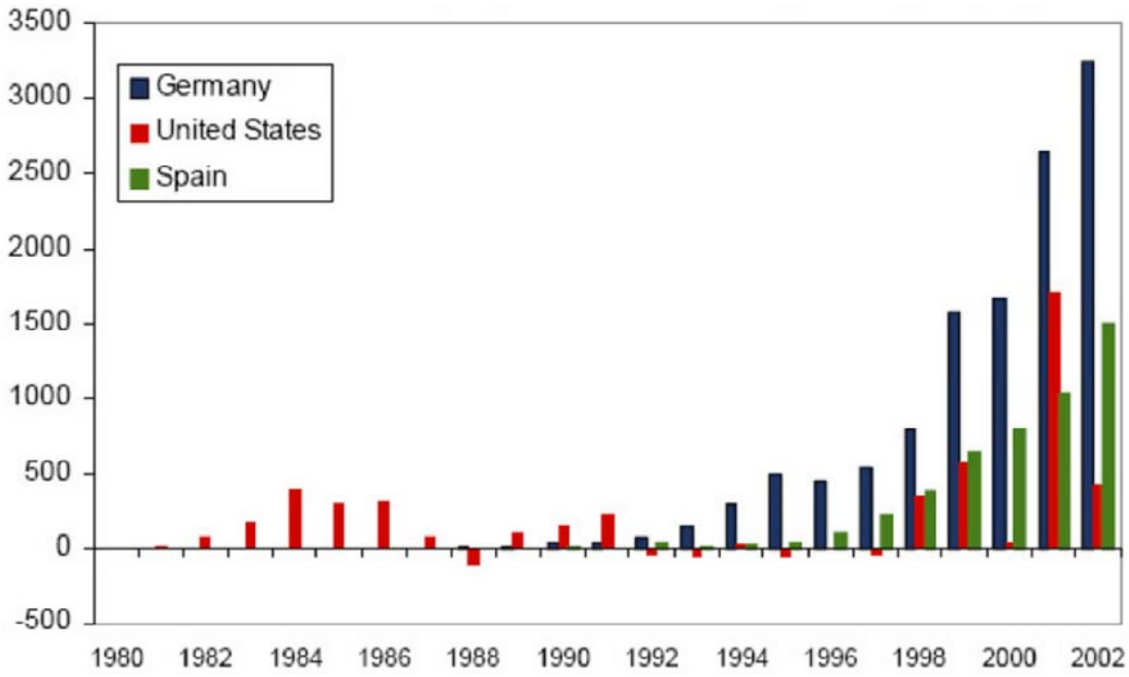
[77] Diekmann, J. and Kemfert, C. "Erneuerbare Energien: Weitere Förderung aus Klimaschutzgründen unverzichtbar". *DIW Wochenbericht* Nr. 29, July 20, 2005[German]

[78] Sawin, Janet L. *National Policy Instruments: Policy Lessons for the Advancement & Diffusion of Renewable energy technologies Around the World*. Thematic Background Paper of International Conference for Renewable Energies 2004. Bonn, 2004

specific RES technologies should be encouraged, and grid access should be easy. On the other hand, he evaluated that well-designed RPS has potential for effective working but it is practically difficult to design it properly and there is the risk of irregular overheating and shrinkage of the market.[79] Sawin (2004) mentioned political stability, long-term, credible, enforceable and consistent policies as critical factors for both systems.[80] A case from which we can learn with regard to this point is the U.S. The U.S. was the first country that paid attention to the potential of RE but it lost the early initiative because of the change of policies and ineffective supporting policies. In Figure 2, Sawin (2004) depicted the mistake of the U.S. and the success of Germany and Spain. The U.S. began to install wind power generation facilities in the early 1980s earlier than any other countries, but the facilities have not shown the tendency of steady growth. Furthermore, the absolute capacity is smaller than Germany and Spain. This result is consistent with the history of American RE policies that have repeated go-stop arbitrarily. On the contrary, Germany and Spain particularly Germany has shown consistent and dynamic growth from the late 1980s to 2002. This suggests the consistent RE support policies based on FIT in Germany.

[79] Sawin, Janet L. 2004. Ibid., p2, 5, 27
[80] Sawin, Janet L. 2004. Ibid., p17

Figure 2. Annual Wind Capacity Additions (net) in Germany, the U.S. and Spain



Source: Sawin, Janet L,. 2004, p39
Note: According to Sawin's special comment, this figure shows the importance of consistent policy.

Mathis (2003) pointed out that fed-in tariffs led the installation and industrialization of wind turbines in Denmark, Germany and Spain and evaluated that German FIT was particularly efficient. Mathis (2003) mentioned three success factors of German FIT: first, REgal security that began in 1990 and has been maintained until now; second, high premium prices that provide investors with financial security and increase new market participants; and third, the strong commitment of the government, which is the most important factor. The last factor is essential for RE sectors like solar PV that show relatively slow maturity of the technology and

the market compared to other RES.[81]

Johansson and Turkenburg (2004)[82] enumerated factors important in designing and executing successful supporting schemes for RE as follows. They are, first, sufficient prices for renewable energy carriers, second, long-term stability of support mechanisms, third, fair and easy access to the electricity grid, forth, transparent and efficient procedures for obtaining necessary permits, and fifth, clear building codes. On the other hand, as to supporting schemes, they evaluated based on actual experiences that FIT is more effective and appropriate than RPS in the maturity of wind turbine technology, etc.

> Empirical evidence suggests that in a real world carefully designed stepped FITs are the more effective and thus more preferable instrument for a mature technology such as wind turbines.[83]

In his study on cooperative wind turbine projects in Denmark, Sasagaw (2004) analyzed that the increase of privately owned wind turbines played a decisive role in the growth of the wind power industry in Denmark. At the end of 2000, 59% (1,380,000kW) of wind turbines in

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[81] Mathis, Arno. *The Role of the Government in the Development and Diffusion of Renewable Energy Technologies-From British and German Experiences to a European Scenario*. Salzburg: Salzburg University, March, 2003, pp164~165

[82] Johansson, Thomas B. and Wim Turkenburg. "Policies for renewable energy in the European Union and its member states: an overview". *Energy for Sustainable Development*. Volume VIII No. 1 Special issue on renewable energy policies in Europe. March 2004, p22

[83] Johansson, Thomas B. and Wim Turkenburg. 2004. Ibid. p23

Denmark were owned by individuals, 24% (568000kW) by cooperative associations, 15% (355000kW) by electricity companies, and 1% (2.7000kW) by others. The explosive growth of privately owned wind turbines was supported by a voluntary agreement in 1984 based on the FIT system, by which electricity companies, wind power generation companies and wind power generation facility manufacturers guaranteed 75~85% of the retail price. On the other hand, in 1992, the government officially introduced the FIT system as a supporting scheme and guaranteed power generation companies 85% of the retail price as well as economic efficiency by giving priority for grid access.

Sasagaw (2004) analyzed that the wind power generation supported by citizens' participation brought positive social effects, activating local economy and arousing broad social support to policies for breaking away from the fossil fuel system. The Danish case is evidence that the RE industry can mature more efficiently by citizens' participation rather than by a small number of power companies armed with large-scale facilities and a historical experience showing the positive role of citizens in the switch of the energy system.[84]

In the discussion on FIT and RPS above, we can confirm the following facts.

First, FIT has more empirically successful cases than RPS. In particular, successful countries promoted the market and the industry through FIT during the early period of the RE

[84] SASAGAWA, Momoyo. *Diffusion of Renewable Energy and Its Effect on Society-A Case Study of Cooperative Wind Turbine Projects in Denmark-*. Tokyo [Japanese]: The University of Tokyo, January, 2004, pp21~31

industry.

Second, among success factors for the expansion of RE, factors higher than supporting schemes such as FIT and RPS are the government’s will and the consistency of policies.

Third, when the supporting scheme is switched from FIT to RPS, the timing must be appropriate. The appropriate time for the switch is after the accumulation of RE capitals and facilities.

Ⅳ. Case Study-Korea

1. Renewable Energy History in Korea

In Korea, the development and distribution of RE technologies was initiated with the enactment of “the Alternative Energy Technology Development Promotion Act” in 1987. Through a number of revisions, the current framework law is “the New/Renewable Energy Development, Use and Distribution Promotion Act.”

Based on the law, the government paid a total of 1,162.5 billion won of subsidies from 1988 to 2005. Specifically, 323.1 billion was invested in RE technology development and 839.4 billion won in assistances and loans for the installation of RE facilities. At the end of 2005, RE occupied 2.2% of the total national primary energy or 5,013,000 toes. This has the effect of substituting $2 billion of oil import and reducing 15 billion ton of reduction of CO_2 emission. The price of all these effects is $450 million.

Although it seems that a large amount of budgets has been spent, the reality is different. The amount spent from the Electricity Industry Foundation Fund (FIT is financed by this fund) to buy RES-E in 2005 was around 7.5 billion won. This is less than 0.5% of the Electricity Industry Foundation Fund, which is almost 1.8 trillion won as of 2005. Even if the RE industry is expanded and subsidies increase by 10 times up to 75 billion won, it is merely 5%.

On the other hand, around 250 billion won were spent in supporting anthracite coal power generation, LNG power generation and steam supply and power generation. Furthermore, more than 300 billion won is planned to be invested in the construction of nuclear waste management facilities and as special subsidies for developing landscape around nuclear power plants to be planned or under construction. The government worries about financial pressure, expecting that the total amount of RE electricity purchase will exceed 1 trillion won after 10 years, but if the current trend continues, the amount to be spent for anthracite coal power generation and nuclear power facilities is expected to be over 5 trillion won in the same period.[85]

Table 11. 2006~2011 National Renewables Supply Target In Korea (1000TOE)

RES	2003 year		2006 year		2011 year	
	supply	share (%)	supply	share (%)	supply	share (%)
Solar thermal	41.4	0.93	101.5	1.45	318.1	2.39
Bio	197.0	4.43	495.0	7.07	1,050.0	7.87
Waste	3,080.0	69.20	5,050.0	72.13	7,540.0	56.54
Solar PV	2.7	0.06	21.9	0.31	341.2	2.56
Wind	13.1	0.29	125.9	1.80	1,311.4	9.83
Small hydro	50.0	1.12	111.0	1.59	446.0	3.34
Fuel cell	-	-	0.4	0.01	147.1	1.10
Geothermal	0.8	0.02	12.1	0.17	160.8	1.21
Ocean	-	-	0.7	0.01	431.5	3.24
Hydrogen	-	-	-	-	1.3	0.01
Coal use	-	-	-	-	374.6	2.81
Subtotal	3,385	76.05	5,919	84.54	12,122	90.90

[85] Lee, Pil-Ryol. *About the meaning of generation by Renewable energy Resources and the controversial points of a KERI study*. New Version of the presentation paper delivered at New·renewable energy policy Forum, March 8, 2006 [Korean] http://energyvision.org

Hydro power*	1,066	23.95	1,082	15.45	1,213	9.10
Total	4,451	100	7,001	100	13,335	100
Total Energy consumption	215,825		237,589		269,323	
New ·Renewable energy supply share(%)	2.06		3.0		5.0	

Source: 2th National plan for renewable energy technologies development & use·diffusion 2003~2012, Ministry of commerce, industry and energy, 2003
*Large-scale hydro power. Generally this sector is not recognized as a renewable energy setor.

In December 2002, the Korean government set the goal of RE distribution at 3% of primary energy in 2006 and 5% in 2011 in 'the 2nd Basic Plans for National Energy'.

To attain the goals, in December 2003, the Korean government established 'the 2nd Basic Plans for New/Renewable Energy Technology Development, Use and Distribution in 2003~2012.' The plans stated that the percentage of waste materials would be reduced in RES and the percentage of photovolatics, wind power, etc. would be extended. In addition, the plans suggested the goal of technology development, aiming to raise the technology level, which is 50~70% of developed countries at present, to 70~90% until 2011.

On the other hand, strategic support to photovolatics, fuel cells and wind power was promised. Particularly for photovolatics and fuel cells, the government planned to enhance the technological power up to the third position in the world. To attain the goal of RE distribution, the plans were expected to require around 9.1 trillion won during the period from 2004 to 2011. In addition, the achievement of the national goals in 2011 was expected to bring the effects of supplying 2 million kW of power and substituting 64 million barrel of oil consumption.

2. Controversial Points of Feed In Tariffs in Korea

Korean introduced FIT in May 2002[86]. The law included the provision that for FES-E FIT will be supported for five years' period of application. Then, the guideline was revised in 2003, extending the period of application to 15 years. Article 2 of the Additional Rules of the revised guideline specified that the standard price and the period of application should be readjusted on October 11, 2006.

By the guideline, research was carried out to set a new standard price by Korea Electrotechnology Research Institute (KERI) from 2004.[87] During the period the government held six public hearings with civil organizations and RE companies for revising the FIT system.

The total quantity of RES-E produced based on the Directive (2002) until the end of 2005 was 1,094GWh, and a total of 218 billion won of tariffs was paid. However, current RE generation in Korea is merely 1% of the total electricity consumption, and it is generally forecasted that, under the current trend, the national goals of 2006 are hardly attainable and so are those of 2011. Environmental NGOs presume that the impatience is the background of the idea that, taking note of the characteristic that most of electricity in Korea is supplied by the six major power generation companies, if the government imposes the obligatory level of

[86] *Directive of standard prices for electricity based on alternative energy*. 2002. Ministry of commerce, industry, and energy [Korean]
[87] Rhee, Chang-Ho, and other. *A Study for innovation of Feed in tariffs system*. Korea electrotechnology research institute. 2006 [Korean]

generation to these companies the supply of RES-E can be expanded in a short time.[88]

The result of *A Study for Innovation of Feed in Tariffs System* was submitted as a policy draft paper for 'Policy Inquiry Commission' (by the Ministry of Commerce, Industry and Energy) on June 31 2006. The characteristics of the policy draft paper are summarized as follows.

Firstly, general downsizing of the standard price

Secondly, designs concentrated on middle- and large-scale facilities

Thirdly, introduction of REP as a supporting scheme to replace FIT

As the standard for utilization rate is focused on optimal places and large-scale facilities, these characteristics limit the participation of citizens who want to generate power on a small scale and disrupt the consistency of policies by changing the supporting scheme only after four years since introduction. Thus, it is likely that the RE industry sends an insecurity signal to the market and discourages the general participation of citizens. These problems aggravate the weak points of the existing FIT system adopted in 2002, namely, the low standard price and the absence of priority for grid access. Concerning the improvement plans in 2006, Lee Pil-ryeol (2006) criticized as follows.

[88] Personal Interview with Kim, Hye-Jung who is the Secretary General of KFEM and Yeom Guang-Hee who is a campaigner of The Team Coping with Energy problem · Climate Change in KFEM . At office of KFEM, 2006. 8. 16 [Korean]

Renewable electricity should be sold at a high price for 15 years. It is the current FIT system that is designed so that only a small profit can be made if electricity is generated and sold diligently without any trouble during the period. If the standard price is lowered, RES-E generators are likely to suffer a loss. The consequence is obvious. It is cutting the sprout of RES-E business, which is growing very slowly.[89]

Table 12. New Feed In Tariffs in Korea

Power source		capacity	Capacity detail		New Price (₩/kWh)		Present Price	Note
					Fixed	Not fixed		
Solar Photovoltaics		3kW above	30kW above		677.38	–	716.40	Reduction rate 4% (after 3 years)
			30kW below		711.25	–		
Wind energy		10kW above			107.29	–	107.66	Reduction rate 2% (after 3 years)
Hydro-energy		Until 5MW	General	1MW above	86.04	SMP*+15	73.69	
				1MW below	94.64	SMP+20		
			other	1MW above	66.18	SMP+ 5		
				1MW below	72.80	SMP+10		
Bio-energy	LFG	Until 50MW	20MW above		68.07	SMP+ 5	61.80	
			20MW below		74.99	SMP+10	65.20	
	Biogas	Until 50MW	150kW above		72.73	SMP+10	New rule	
			150kW below		85.71	SMP+15		
	Biomass	Until 50MW	Ligno-Cellulosic Biomass		68.99	SMP+5	New rule	
ocean energy	Wave power	50MW above	Most high tidal range 8.5m above	none Seawall	62.81	–	62.81	
				none Seawall	76.63	–		

[89] Lee, Pil-Ryol. *the meaning of generation by Renewable energy Resources and the controversial points of a KERI study.* In: *The proposal of Feed in tariffs system's innovation for diffusion & replenishment of renewables*. The presentation paper delivered at New·renewable energy policy Forum. Seoul: The society for the renewable energy policy research of National Assembly & Centre for Energy Alternative, March 7, 2006, pp8~9 [Korean]

			Most high tidal range 8.5m below	being Seawall	75.59	–		
				None seawall	90.50	–		
Waste incineration		Until 20MW	–		–	SMP+ 5	SMP +CP**	
Fuel cell		200kW above	Biogas use		234.53	–	New rule	Reduction rate 3% (after 2 years)
			Other use (mainly natural gas)		282.54	–		

Source: Paper for 'Policy Inquiry Commission' originated from *A Study for Innovation of Feed in Tariffs System* of KERI, 2006
*SMP- System Marginal Price
**CP- Capacity Payment
Note: guarantee application period for 15 years about all Renewable Energy Sources

Lee Pil-ryeol (2006) pointed out the absence of consideration for solar PV, which is most costly for developing technologies and industrializing. According to a report by KERI (2006), the photovolatics utilization rate was fixed at 16% and the standard price was calculated based on the rate. The utilization rate of 16% is a result from surveying six power plants with capacity of over 30kW. However, the utilization rate of small-size generators was not surveyed. When we calculated the utilization rate of 5 out of six small-size business generators using the method of KERI, the maximum utilization rate was 13.5%, which is far different from 15% reported by KERI. Moreover, none of current solar PV plants in Korea are operated more than a year. In general, data from a survey on utilization rate are reliable when the survey is researched on performance of generation of a generator at least for 2~3 years.

Lee Pil-ryeol proposed to amend FIT for solar PV again based on the following criteria. First, solar PV plants for business should be approached, dividing them into small-size (around

10kW) and large-size, and second, large-size facilities, the current tariff (716.4won/kWh) should be applied and the term of guarantee should be extended to 20 years. In addition, for small-size facilities, subsidies should be provide only for less than 30% and a tariff of 716.4 won/kWh be applied for 15 years, or 830 won/kWh is applied for 15 years, or 1,020 won/kWh is applied for 10 years.[90]

The present author had an interview with Rhee Chang-Ho (Director, KERI Electricity Industry Policy Research Group), who is the research manager of *A Study for Innovation of Feed in Tariffs System* (July 2004~March 2006). The interview was focused on problems in the policy paper of the Policy Inquiry Commission.

Under the below Premise of "The standard price is not only a signal for inviting to the market but also a signal for discouraging those unqualified in size and capacity from entering the market," Rhee Chang-Ho explained that the adjustment of FIT is to cope with the fall of facility prices due to the growth of the RE industry throughout the world. In addition, he explained that the introduction of RPS is for supplementing FIT but not for changing the main supporting scheme. According to his opinion, the market misunderstood the signal of governmental policies.[91]

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[90] Lee, Pil-Ryol. March 8, 2006. op.cit. at the same frame [Korean]
http://energyvision.org

[91] Park, Hyeon-chul. "the spring of Renewable Energy is running dry?". *Hamkesaneungil*. Agust, 2006, pp16~21 [Korean]

However, in the panel discussion on new and renewable energy on March 7 2006 held jointly by the society for 'the renewable energy policy research of National Assembly' and 'Centre for Energy Alternative', private RES-E companies insisted in a unanimous voice that the change of the supporting scheme is fatal to the industry and the market, the standard price should be raised, and subsidiary support measures should be added.[92]

In the discussion above on the change of the supporting scheme in Korea, the following problems are identified.

Firstly, switching to RPS that requires costly administration, denying the historical and empirical superiority of FIT in developing technologies and spreading facilities during the early period of the industry

Secondly, limiting the participation of small and medium companies by downing the standard price and restricting the spread of privately owned energy systems

These problems are expected to cause failure in the expansion of RE, the extension of the fossil fuel regime, continuous crisis in energy security, the increase of subsidies for the stable supply of conventional energy under ever-increasing demand and consequent rise of economic external costs, the increase of social expenses to cope with social resistance against

[92] Lee, Pil-Ryol, Heo Gyeong-Chun, Kim Doo-Hun, and others. *The proposal of Feed In Tariffs system's innovation for diffusion & replenishment of renewables*. the presentation paper delivered at New·renewable energy policy Forum. Seoul: The society for the renewable energy policy research of National Assembly & Centre for Energy Alternative, March 8, 2006 pp8~59 [Korean]

nuclear energy, etc.

Previous researches reviewed in this study conclude that FIT should be executed intensively at the beginning to lay the ground of the industry, and the switch of the supporting system should be made in the stage of maturity of the industry and the market when RE facilities have been accumulated and various RES technologies have been developed. It is not a correct time for Korea to change its current supporting system. This is obvious when the level of RE (the record of power generation, the capacity of generation facilities, etc.) in Korea is considered. The market and the industry have just begun to sprout in Korea. The government's switch of the supporting scheme must be reconsidered cautiously. Moreover, the standard price should be raised to attract more small and medium private companies (excluding the six major generators originated from the power generation business of 'Korea Electric Power Corporation -KEPCO' In April 2, 2001) into the market, and the term of guarantee should be extended longer. In particular, more FIT should be invested in sources such as solar PV, for which it is difficult to develop technologies.

CONCLUSION

RE was chosen as alternative energy to cope with negative external effects that the oil-dependent world economy is faced with including high oil price as approaching to the peak oil, problems in the environment and public health and global warming. Hydrogen, which is commonly regarded as one of RE's is not RE but an energy carrier. Thus, the future energy policies of the U.S. envisioning hydrogen economy based on fossil fuels such as coal and nuclear energy are practically an attempt to extend the fossil fuel regime.

RE policies of Europe is worth being referred actively. Europe is executing RE support policies in the dimension of EU, and has led the dramatic growth of the RE industry and market through the FIT system. EU's successful experience in RES-E support policies tells that the first key to success is 'the consistency of policies' and furthermore 'the government's will.'

However, this research has limitations as follows. FIT and RPS exist in various forms depending on their combination with other additional supporting schemes such as green pricing, green certification and bidding. Discussions in this research do not cover all possible combinations of these schemes. The optimal combination will be different among countries and depending on the maturity of the industry and the market. Therefore, it is reasonable to assume that the optimal supporting scheme will also be different from country to country.

Nevertheless, it is FIT that has led the development of the RE industry and market in Europe, and it is a solid historical experience that the scheme has produced powerful effects in the early stage of the RE industry. Furthermore, this study confirmed through case study in Chapter 4 and 5 that the efficiency of a supporting scheme depends on the consistency of policies and the government's will to maintain the consistency.

The Korean government needs to review the case of the U.K. the largest economic power in Europe adopting RPS but falling behind Germany adopting FIT in the RE industry, and the case of Denmark that switched to RPS after developing the RE industry successfully with FIT and then returned to FIT. In addition, the review should lead the Korean government to maintain and reinforce the current FIT scheme.

For the reinforcement of FIT in Korea, we suggest policies as follows.

First, there should be regulations on grid access priority.

Second, it is desirable to induce the participation of many citizens through special support for small-sized RE generators below 10kW.

Third, it is necessary to ease the risk of initial investment in RE generators by raising the standard price, which has been lowered. At least until the RE industry and market in Korea develops to the level of the EU, higher tariffs should be paid steadily.

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