



National Study on New and Renewable Energy for Korea

RISPO II Final Workshop ('08 March 26-28)

LEEJIN KIM

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Economic and Energy Indicators



	Unit	1990	2000	2002	2003	2004	2005
Population	person	42,869	47,008	47,640	47,925	48,199	48,461
Primary energy consumption	million TOE	93.2	192.9	208.6	215.1	220.2	229.3
(Growth rate)	%	(14.1)	(6.4)	(5.2)	(3.1)	(2.4)	(4.1)
GDP growth rate	%	9.2	8.5	7.0	3.1	4.6	4.0
Final energy consumption	million TOE	75.1	149.9	160.5	164.0	166.0	172.1
(Growth rate)	%	(14.0)	(4.7)	(4.9)	(2.2)	(1.2)	(3.7)
Overseas energy dependency	%	87.9	97.2	97.1	96.9	96.7	96.4
Energy import in Total import	%	15.6	23.6	21.2	21.4	22.1	25.5
CO ₂ emission from energy use	million ton	227	428	439	448	452	-
NRE supply	1000 TOE	335.9	2,131.0	2,922.3	4,436.4	4,582.4	4,884.1
Ratio on NRE/ Total energy consumption	%	(0.36)	(1.1)	(1.4)	(2.1)	(2.1)	(2.13)

Source: MOCIE, 2006



RE Potential



RE Sources	Availability (1,000 toe per Year)	Geographical Potential
Solar Thermal	3,500,000	
PV	390,000 (Generation: 1,560,000GWh/year)	
Wind	16,174	
Waste	13,545	
Biomass	2,316	
Small Hydro	1,314	
Geothermal	910	
Ocean	348	
Total	3,924,607	

Source: MOCIE, 2005



National RE Target and Evaluation



『2nd 10-year Basic Plan for NRE Technology RD&D』
 : NRE supplies 5% of Primary Energy Consumption by 2011
 NRE supplies 7% of Total Electricity Consumption by 2011

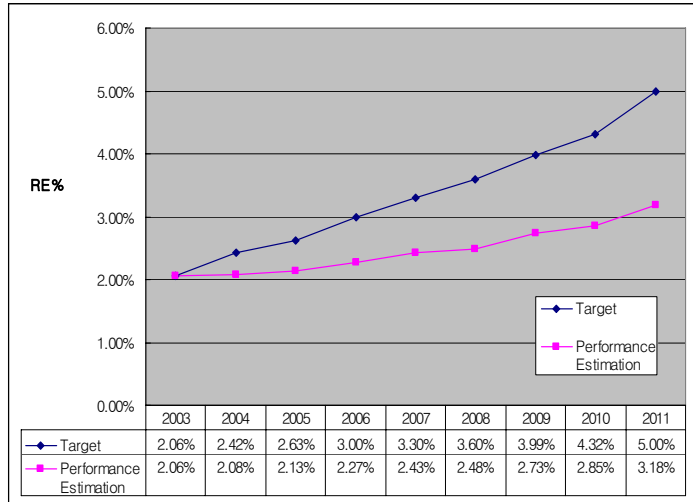
(Unit: GWh)	2005	2006	2007	2008	2009	2010	2011	2012
Prospective Electricity Demand	311,056	321,179	330,452	339,452	347,673	355,324	362,924	369,973
Electricity Supply by RE	6,677.9	7,835.6	9,168.4	11,065.8	13,169.9	18,282.0	25,354.0	30,938.0
Target Ratio	2.1%	2.4%	2.8 %	3.3 %	3.8 %	5.2 %	7.0 %	8.4 %

Source: MOCIE, 2003

❖ Actual energy supply by RE between 2003~2005 only met 85% of the target values on average.

❖ Based on the current performance, the future rates of performance are estimated, and the energy supply ratio by RE only reaches to 3.18% in 2011, compared to the target ratio of 5%.

→ There is a problem with policy implementation.



Source: PCSD, 2007



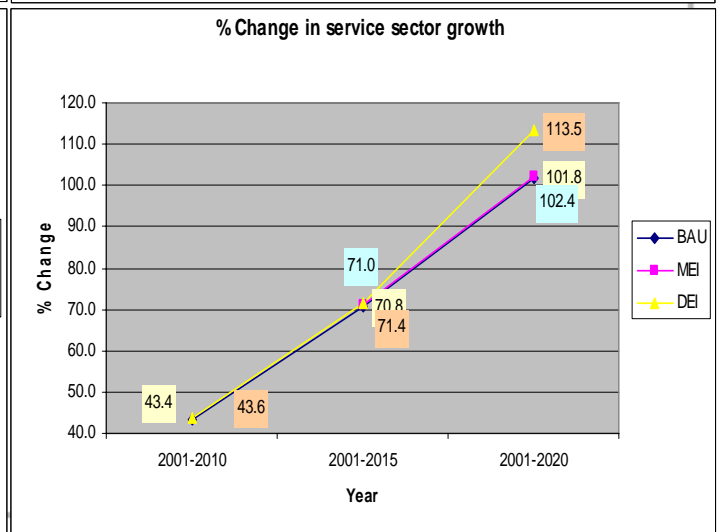
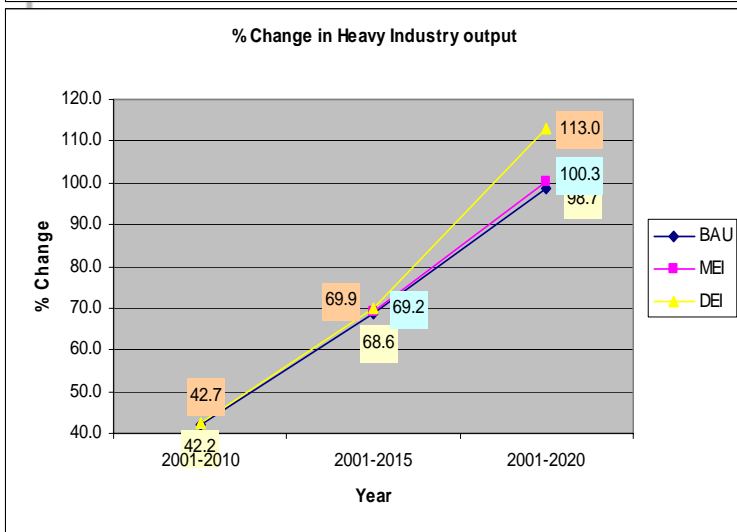
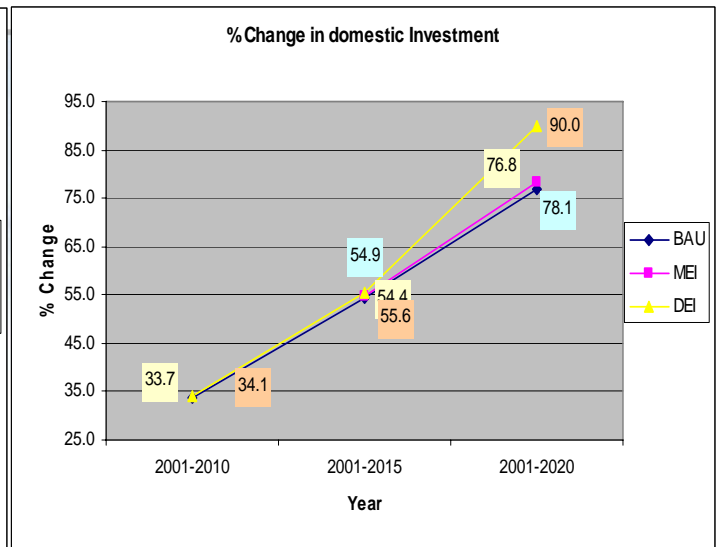
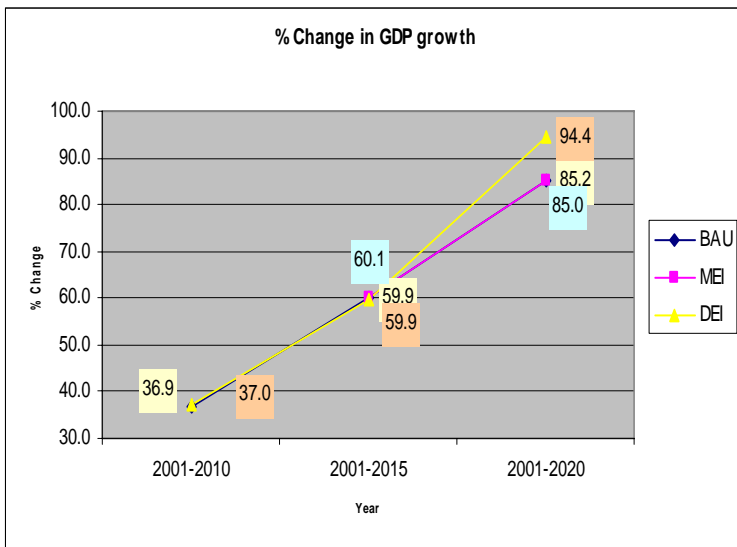
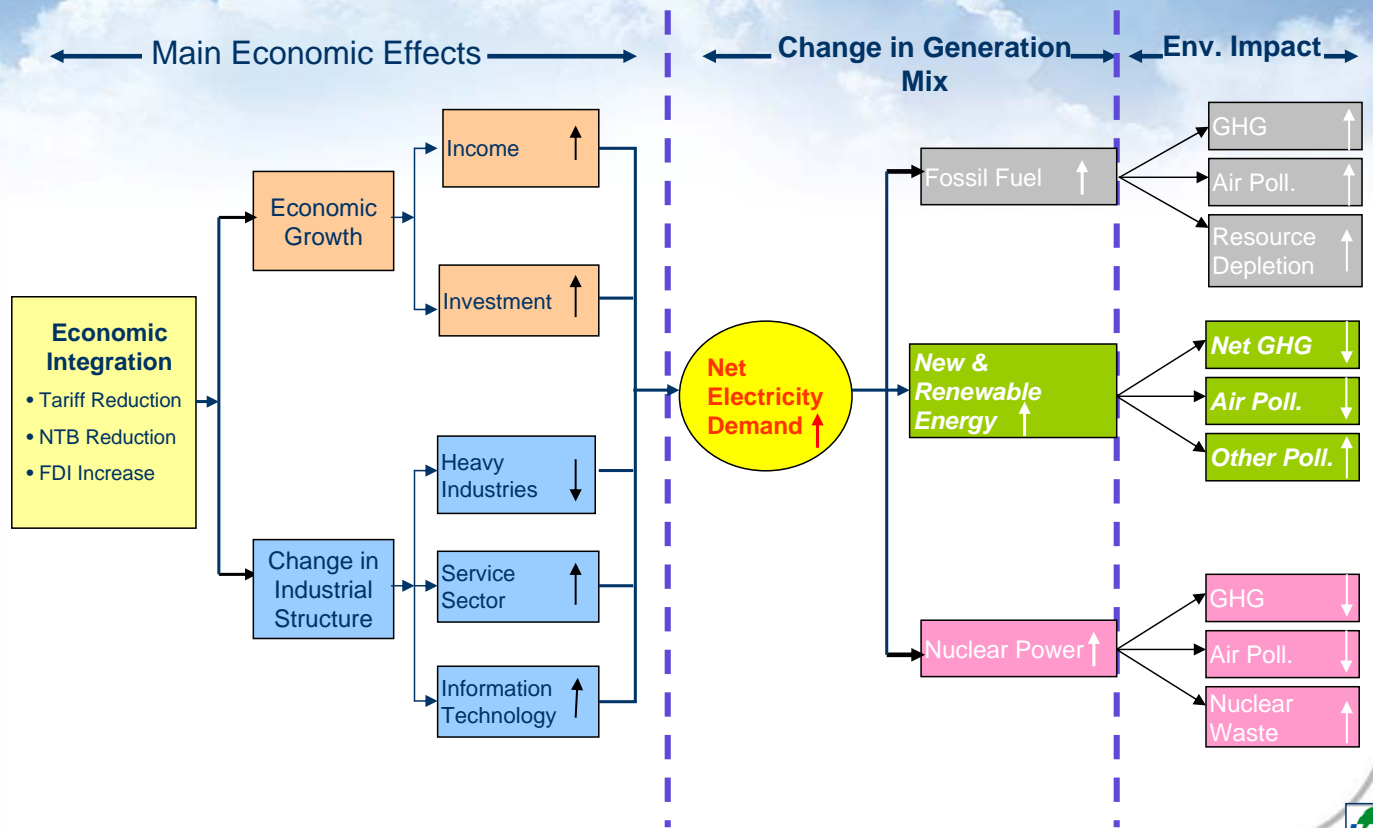
Discussion on Existing RE Policies



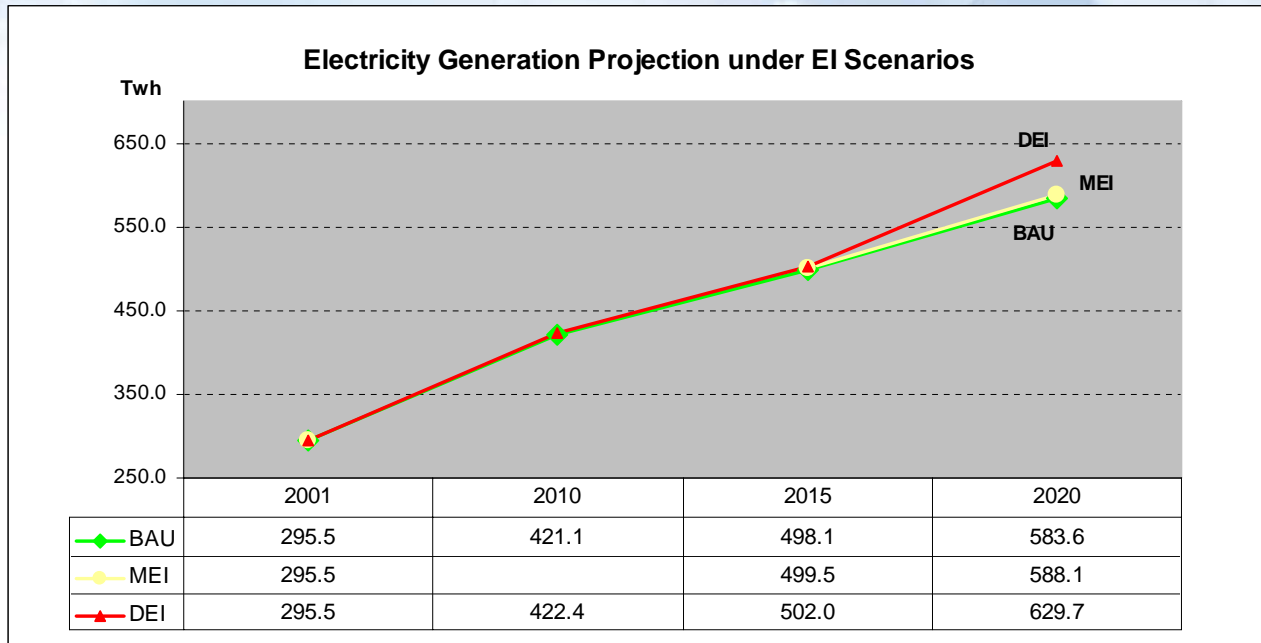
- ❖ **RE accreditation and certification system**
 - Still unreliability of the quality of RE technologies
- ❖ **RE installation obligation to public buildings**
 - Limited to only public buildings so that only minimal effects
 - Limited to certain RE technologies
- ❖ **Feed In Tariff (FIT)**
 - The most effective, but financial burden on government
 - Discrepancy between budget allocated and actual allocation for FIT
- ❖ **Low interest loans, tax incentive and subsidy program**
 - Complicated process raising practicality issue



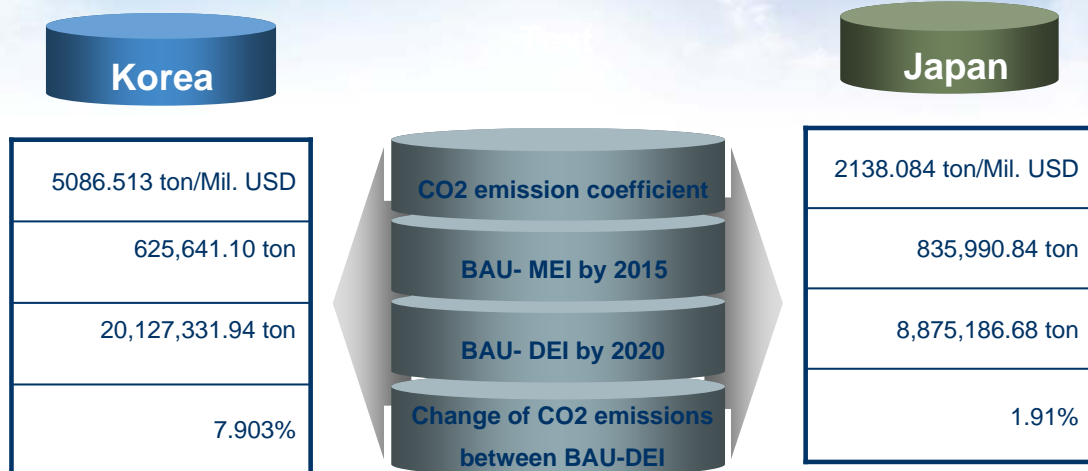
Effects of Economic Integration



Effects of EI on Electricity Sector



Effects of EI on Emission Level



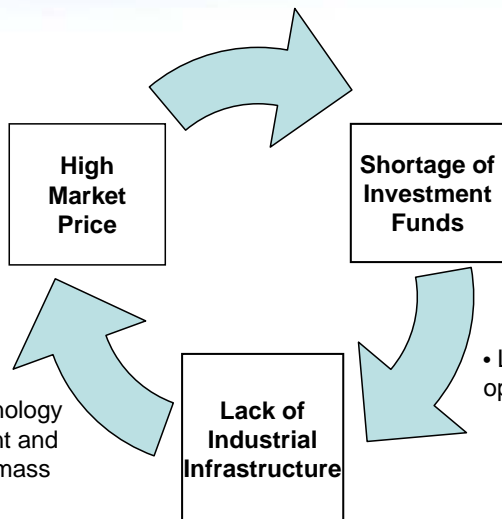
➔ Due to economic integration, CO2 emissions from the electricity sector in Korea by 2020 will increase by 7.9% and 20 Mt compared to the baseline scenario that the values are much larger than the cases of Japan or any other countries including Vietnam and Indonesia.



Challenges to promote RE



- High dependency on governmental budget
- Difficulty in market-oriented promotion



• Slow technology development and difficulty in mass production

• Limited market opportunities

Source: MOCIE, 2005

Low economic efficiency

- ❖ High unit costs of construction
Ex) X\$/kW by wind = 1.3X\$/kW by thermal power
Y\$/kW by PV = 10Y\$/kW by thermal power
- ❖ Ineffective rate of operation
Ex) Approximately 20% depending on environmental factor
- ❖ Difficulties in cost reduction through mass production, due to small market size
Ex) 1.1~1.3 times higher cost of production compared to that of conventional power

Limited Investment

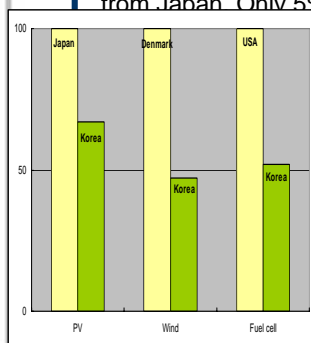
- ❖ Low level of governmental budget allocation
Ex1) Only 1/10 of investment for the last 10 years compared to Japan and 8% of that of the USA
Ex 2) The discrepancy between budget allocated and actual budget to meet the national target



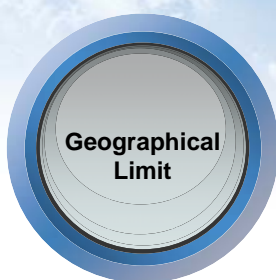
1. Major Difficulties



- ❖ Overall technical level of RE of Korea corresponds to 50~70% of developed countries.
- ❖ Most solar cells are imported from Japan. Only 5% of cells and



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- ❖ Even though Gwangwon province has good condition to generate wind power, many parts of this region are under protection, so development is restricted.
- ❖ To generate PV power requires vast land, and the geographical features of Korea comprised by many hills and mountains as well as housing structure mainly occupied by apartments limit geographical potential for RE development.



- ❖ On average, only 210 of researchers are currently working on each RE field.
- ❖ No specified field of study is existing under the current education system.
- ❖ Only a few industry and university associated R&D centers are existing.



2. Regulatory & Institutional and other Barriers



Cost Structure

- ❖ The average electricity price in Korea (0.075\$/kWh in 2005) is rather cheap, so RE become economically uncompetitive compared to conventional power.
- ❖ Under the current cost structure, no external cost is taken account, and subsidies to conventional power generation are still existing.

Regulatory & Institutional System

- ❖ Majority of RE policies are based on Voluntary Agreement.
- ❖ There is inconsistency of RE promoting policies and the existing regulations such as land planning and utilization act and construction ordinance.
- ❖ The separation between departments managing energy and environmental sectors may cause the sporadic R&D and deployment programs and restrict consistent RE promotion.

Public Awareness & Reliability

- ❖ The public awareness of RE is still very low. That may cause NIMBY attitude toward RE facilities and restrict public participation depreciating the RE promotion initiatives.
- ❖ Consumers perceive RE technologies are not entirely reliable in their operation, and the continuous management is not realized well in practice.



SWOT Analysis



<p style="text-align: center;">Strength</p> <ul style="list-style-type: none"> ❖ GHG emission reduction ❖ Correspondence to Kyoto protocol ❖ Fossil fuel import reduction ❖ Abundant energy generation potential 	<p style="text-align: center;">Weakness</p> <ul style="list-style-type: none"> ❖ Non-competitive price compared to conventional power ❖ Monopolistic electricity market ❖ Technological and financial deficit ❖ Lack of the market reliability ❖ High dependency on geographical conditions
<p style="text-align: center;">Opportunity</p> <ul style="list-style-type: none"> ❖ National supply target ❖ Increase in environmental awareness ❖ Societal interest in sustainable management considering of external cost ❖ Expensive safety measures in nuclear power plants 	<p style="text-align: center;">Threat</p> <ul style="list-style-type: none"> ❖ Policy uncertainty ❖ Fossil fuel subsidies ❖ Government inclination toward nuclear power ❖ Implementation of demand-side management and energy efficiency technology



Policy Recommendations



- ❖ Renewable energy should be redefined, and the balanced promotion of each RE should be encouraged instead of the partial preference to particular RE sources.
- ❖ The overall policy implementation should be improved by the balanced application of governmental intervention and the market driven approach.
- ❖ The public awareness and community involvement should be raised.
- ❖ The private sector participation and investment should be encouraged through subsidies, loans, and tax incentives.

Full Cost Account

- ❖ External cost such as environmental and social cost caused by the use of conventional power can be regarded.
- ❖ Environmental benefit such as GHG reduction and social benefit such as health improvement, market creation as well as oil import reduction obtained through RE power can be considered.

RPS

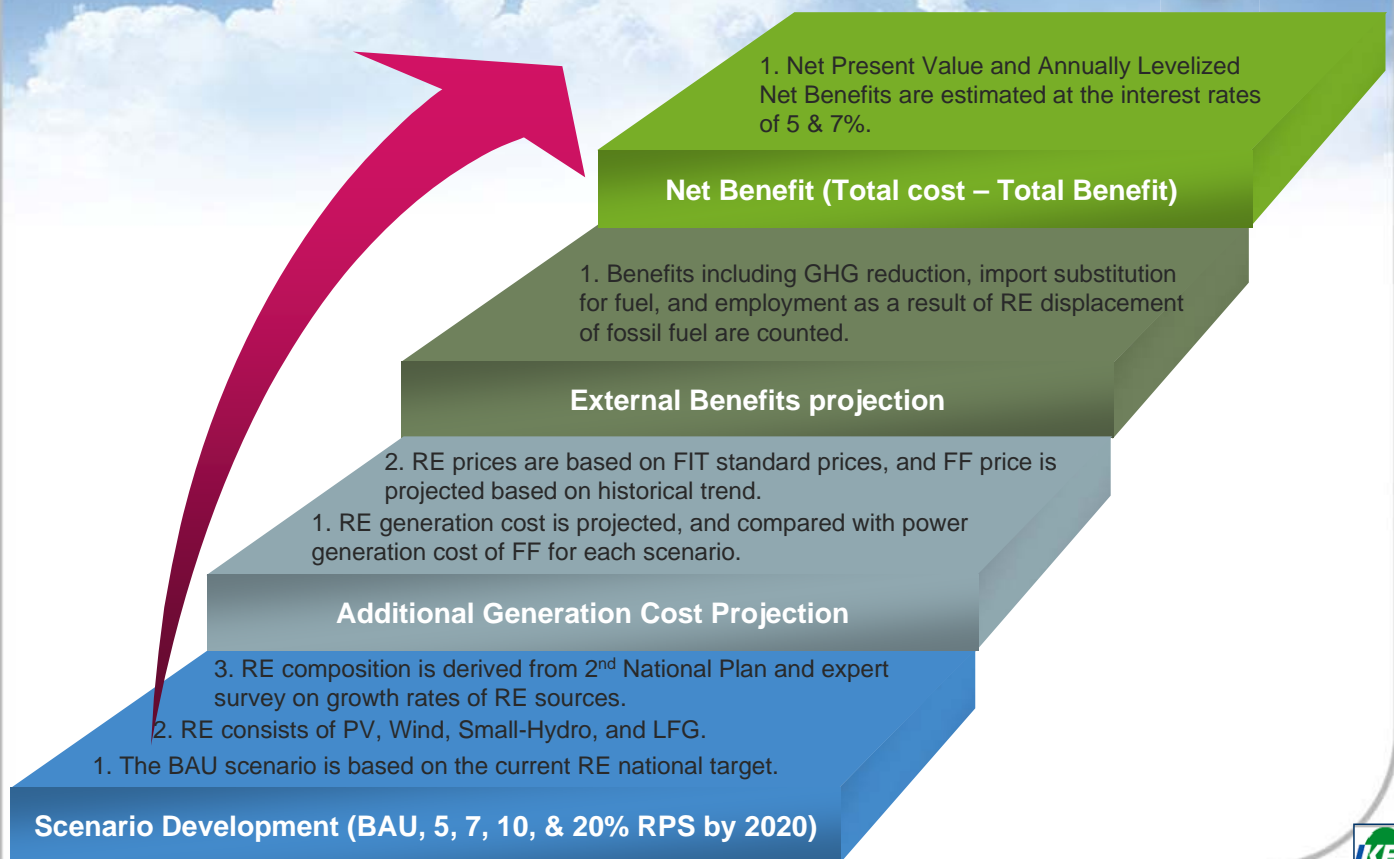
- ❖ RPS requires power companies to include a certain percentage of RE in their power mix.
- ❖ RPS helps to mitigate the financial burden weighted on the government by practicing FIT.
- ❖ It is important to set the feasible level of standard, and gradually adjust the target level in consideration of market conditions.

RESCO

- ❖ RESCO targets to substitute energy source from fossil fuel to RE.
- ❖ O&M by RESCO will increase economic efficiency and reliability of RE technology.
- ❖ Governmental supports such as providing financial incentives and tax benefits to RESCO should be provided with regard to relatively long period of cost recovery in the case of RE.



Policy Analysis: RPS



1. Interim Process: Power Generation Projection



RE Allocation Projection

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LFG	41%	34%	30%	29%	27%	25%	24%	22%	21%	20%	18%
PV	8%	11%	12%	12%	14%	15%	16%	17%	18%	19%	20%
Wind	36%	41%	44%	45%	45%	47%	47%	48%	48%	49%	50%
Small Hydro	15%	14%	14%	14%	14%	13%	13%	13%	13%	12%	12%

Power Generation by RE under different RPS Scheme

Unit: Twh

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU (=Current Target)	9.76	12.71	15.19	16.48	17.92	19.53	21.32	23.32	25.55	28.05	30.85
RPS Target 7% by 2020	9.76	13.25	15.89	18.09	19.56	22.27	24.99	27.77	30.58	33.41	36.28
RPS Target 10% by 2020	9.76	13.71	16.60	19.29	22.01	24.74	29.98	35.35	40.77	46.26	51.83
RPS Target 15% by 2020	9.76	15.11	17.78	22.91	29.35	37.11	44.97	53.02	61.15	69.39	77.75
RPS Target 20% by 2020	9.76	16.27	18.97	28.94	39.13	49.48	59.96	70.70	81.54	92.52	103.66



2. Interim Process: Costs



Standard Price

Unit: Cents/kWh

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Wind	10.77	10.55	10.34	10.13	9.93	9.73	9.54	9.35	9.16	8.98	8.80
PV	66.87	64.19	61.63	59.16	56.79	54.52	52.34	50.25	48.24	46.31	44.46
Small Hydro	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44
LFG	7.47	7.47	7.47	7.47	7.47	7.47	7.47	7.47	7.47	7.47	7.47
Fossil Fuel	6.58	6.78	6.99	7.21	7.44	7.67	7.91	8.16	8.41	8.68	8.95

Generation Senarios Cost Comparison

Unit: Billion USD

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU	1.34	1.94	2.36	2.50	2.82	3.10	3.38	3.71	4.05	4.44	4.87
RPS 7%	1.34	2.02	2.47	2.74	3.08	3.54	3.96	4.42	4.85	5.29	5.72
RPS 10%	1.34	2.09	2.58	2.92	3.47	3.93	4.76	5.63	6.47	7.32	8.18
RPS 15%	1.34	2.30	2.76	3.47	4.63	5.89	7.13	8.44	9.70	10.98	12.27
RPS 20%	1.34	2.48	2.95	4.38	6.17	7.86	9.51	11.26	12.93	14.64	16.35



3. Interim Process

: Benefits (coefficient & assumptions)



1

Unit: Million USD	
Scenario	2020
BAU	1,040.26
RPS Target 7% by 2020	1,223.40
RPS Target 10% by 2020	1,747.71
RPS Target 15% by 2020	2,621.56
RPS Target 20% by 2020	3,495.42

Environmental Benefit
: GHG Reduction

2

Unit: Million USD	
Scenario	2020
BAU	2,108
RPS Target 7% by 2020	2,479
RPS Target 10% by 2020	3,541
RPS Target 15% by 2020	5,312
RPS Target 20% by 2020	7,082

Fuel Import Substitution

3

Unit: Million USD	
Scenario	2020
BAU	583
RPS Target 7% by 2020	685
RPS Target 10% by 2020	979
RPS Target 15% by 2020	1,469
RPS Target 20% by 2020	1,958

Employment Benefit



4. CBA Result



Unit: Million USD @ current price

Scenario	Discount rate: 5%		Discount rate: 7%	
	Net Present Value	Annually leveled Net Benefits	Net Present Value	Annually leveled Net Benefits
BAU	5376.46	647.27	4679.21	624.00
RPS with 7% target by 2020	6177.05	743.65	5361.75	715.03
RPS with 10% target by 2020	7755.90	933.72	6690.08	892.17
RPS with 15% target by 2020	11093.38	1335.52	9522.90	1269.94
RPS with 20% target by 2020	14527.91	1749.00	12444.76	1659.59

Currently, Korea announced Energy Vision 2030, targeting 9% of RE share of primary energy consumption by year 2030. Based on this, I have made a rough conclusion that the most optimal and feasible scenario is to be:

➡ RPS with 10% target by 2020

Alternative: To avoid the possible partial development of certain RE technologies, the separate RPS target on each RE technology can be imposed. For example, if target RPS by 2020 is 10%, 5% RPS to wind, 2% RPS to PV, 1.8% RPS to LFG, and 1.2% RPS to Small Hydro can be applied.



Conclusion



- ❖ The regulatory and institutional structure of Korea should be consolidated to improve policy implementation.
- ❖ Externalities such as environmental and social benefits of RE should be taken into account (for CBA).
- ❖ Korea can implement the RPS (at the target ratio of 10% by 2020).
- ❖ Both government intervention and market-driven instruments should be applied.
- ❖ The role of RESCO should be enhanced to improve technical reliability and economic efficiency of RE.
- ❖ In addition to the implementation of new policies, the improvement of existing policies should be attained.



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Thank You !