Renewable Energy Characteristics on Korea Electricity Market

KOREA POWER EXCHANGE

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Renewable Energy Status

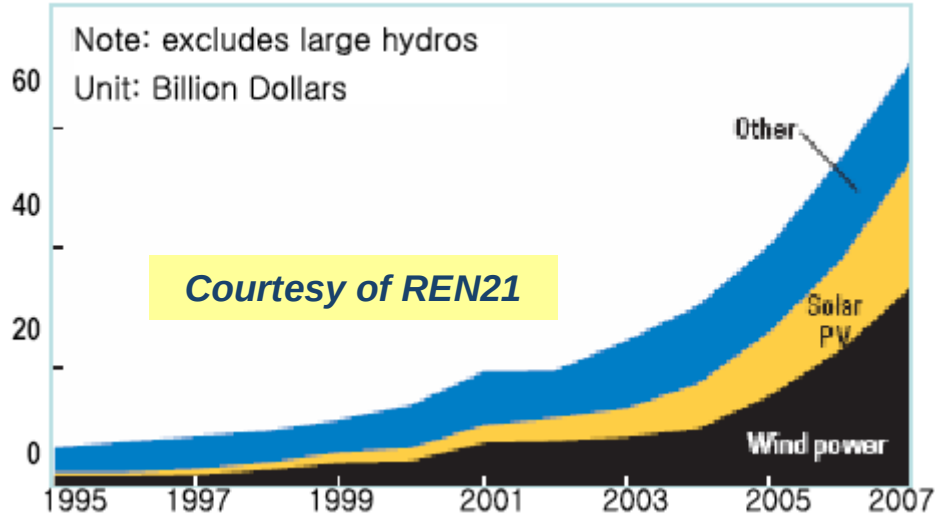
Renewable Energy Status

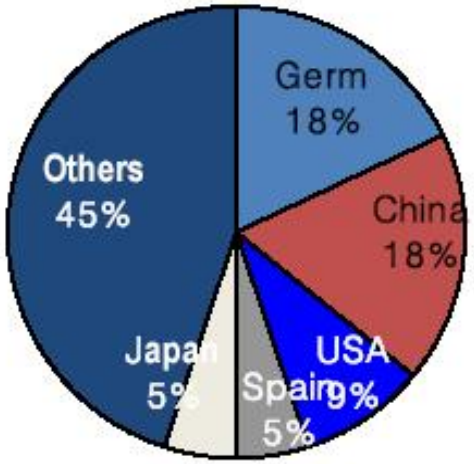
- Renewable Energy offers a chance to
  - reduce carbon emission
  - put our civilization on a more sustainable footing
  - improve energy security
  - spur economic development

- More than 65 Countries
  - have goals for their own renewable energy futures
  - are enacting a far-reaching array of policies to meet these goals

Renewable Energy Status

- In 2007, more than $100 billion was invested in
  - new renewable energy capacity,
  - manufacturing plants,
  - and research & Development
- Largest country shares of RE investment were in Germany, China, U.S., Spain, Japan and India



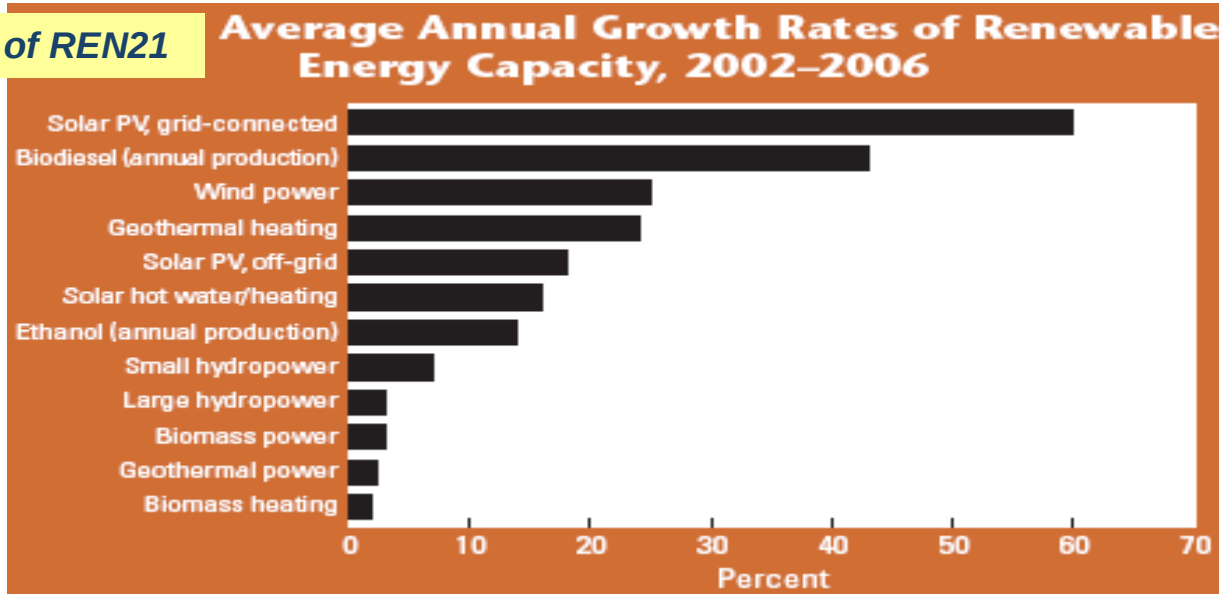


Renewable Energy Status

- Renewable electricity generation capacity
  - reached an estimated 240GW worldwide in 2007
  - an increase of 50% over 2004
  - 5% of global power capacity
  - 3.4% of global power generation

    - exclude large hydro power(15% of power generation)

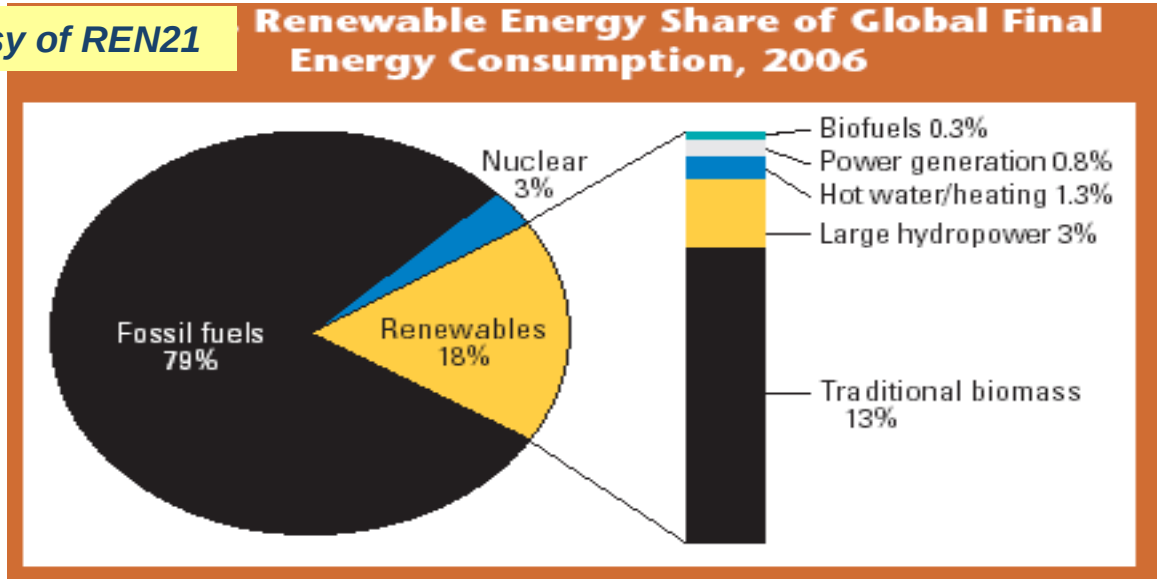
Courtesy of REN21



Renewable Energy Status

- **Renewable Energy Share of Global Final Energy Consumption, 2004 vs. 2006**
  - Renewable energy supplies 13% -> 18% of the world's final energy consumption
  - Traditional biomass (81->72%), Large hydropower (15%), Others (Solar, Wind, Biofuels..) (0.5 -> 1.2%)

Courtesy of REN21



Renewable Energy Status

- Selected indicators and top 5 Countries

Selected Indicators	2005	2006	2007 (estimated)
Investment in new renewable capacity (annual)	$40	55	71 billion
Renewables power capacity (existing, excl. large hydro)	182	207	240 GW
Renewables power capacity (existing, incl. large hydro)	930	970	1,010 GW
Wind power capacity (existing)	59	74	95 GW
Grid-connected solar PV capacity (existing)	3.5	5.1	7.8 GW
Solar PV production (annual)	1.8	2.5	3.8 GW
Solar hot water capacity (existing)	88	105	128 GWth
Ethanol production (annual)	33	39	46 billion liters
Biodiesel production (annual)	3.9	6	8 billion liters
Countries with policy targets	52		66
States/provinces/countries with feed-in policies	41		46
States/provinces/countries with RPS policies	38		44
States/provinces/countries with biofuels mandates	38		53

Courtesy of REN21

Renewable Energy Status

❒ Selected indicators and top 5 Countries

Top Five Countries	#1	#2	#3	#4	#5
Annual amounts for 2006					
New capacity investment	Germany	China	United States	Spain	Japan
Wind power added	United States	Germany	India	Spain	China
Solar PV added (grid-tied)	Germany	Japan	United States	Spain	South Korea
Solar hot water added	China	Germany	Turkey	India	Austria
Ethanol production	United States	Brazil	China	Germany	Spain
Biodiesel production	Germany	United States	France	Italy	Czech Republic
Existing capacity as of 2006					
Renewables power capacity	China	Germany	United States	Spain	India
Small hydro	China	Japan	United States	Italy	Brazil
Wind power	Germany	Spain/United States		India	Denmark
Biomass power	United States	Brazil	Philippines	Germany/Sweden/Finland	
Geothermal power	United States	Philippines	Mexico	Indonesia/Italy	
Solar PV (grid-connected)	Germany	Japan	United States	Spain	Netherlands/Italy
Solar hot water	China	Turkey	Germany	Japan	Israel

Courtesy of REN21


Current Status of
Korea Renewable Energy

Current Status of Korea RE

❒ Domestic RE supply status

- ❖ Renewable Energy Supplies : 1.4% of the domestic final energy consumption (318 Mtoe, IEA)
- ❖ RE supply increased 8.3% per annum (’95-’07)
- ❖ Share of RE supplies increased 0.6%

(’95 : 0.8% -> ’07 : 1.4%, final energy consumption)

(Mtoe, %)

Coal	Oil	LNG	Nuke	Renewables	Fianl energy Consumption
57.6 (25.3)	97.9 (43.1)	31.2 (13.7)	37.3 (16.4)	3.2 (1.4)	227.1 (100.0)

Current Status of Korea RE

❒ Domestic RE power generation status

❖ 1.0% of domestic power generation **(4,227GWh, IEA)**

- Hydro : 84.9% of renewable power generation

(TWh, %)

Coal	Oil	LNG	Nuke	Renew-ables	Heat	Total
194.9 (44.6)	22.7 (5.2)	72.5 (16.6)	142.9 (32.7)	4.3 (1.0)	0.1 (0.0)	437.4 (100.0)

❒ Domestic RE generation capacity (as of Jun 08)

❖ **2,076MW : 3% of total generation capacity**

	Hydro		Wind	PV	Bio	Waste	Fuel Cell	Total
	Large	Small						
Capacity (MW)	1527.6	73.0	194.1	159.4	113.4	8.0	0.6	2,076.0

Current Status of Korea RE

❒ RE capacity additions outlook : 5,898.6MW

	Hydro	Wind	Solar PV	Bio	Tidal	Fuel Cell	IGCC /CCT	Waste	Total
Capacity(MW)	78.7	626.3	886.2	906.2	2,827	21.4	600.0	6.3	5,898.6

❒ Domestic RE Investment Status

❖ Governmental RE investment : 435 billion Won (’07)

- an increase of 8.9 times over ‘01 (49 billion Won)

❖ ’08 budget : 533 billion Won

- Soalr PV : 33.3%, Wind : 13.5%, Fuel Cell : 7.9%

Current Status of Korea RE

❒ Feed-in Tariffs

- ❖ Set preferential rates or pay premiums to electricity generated from renewable energy sources
- ❖ Supported by public funds for 15 years
- ❖ Cover seven technologies including solar photovoltaic, wind power, small hydro power, bio energy, tidal power, fuel cell and waste gas

(Premium can't be offered if capital investment subsidies by the government is over 30%)

Current Status of Korea RE

❖ Tariffs for renewable generators stations (Won/kWh)

Renewable energy sources			Tariff
Solar photovoltaic		3 – 30kw	677.38
		Above 30kw	711.25
Wind		Above 10kw	107.29
Small Hydro		1 – 5MW	86.04
		Up to 1MW	94.64
RDF		Above 20MW	SMP+5
Bio	LFG	Up to 20MW	74.99
		20 - 50MW	68.07
	BIO GAS	150kW-50MW	72.73
		Up to 150kW	85.71
	BIO MASS	Up to 50MW	68.99
Tidal power		Above 50MW	90.50
Fuel Cell		Above 200kW	234.53

- 1 USD = 1,100 Won

Current Status of Korea RE

- Limitations of RE as distributed resources
  - Solar PVs : Most popular resources in these days
    (100,000 Solar House Supply Plan launched)
    -> high land value around load pocket
    Feed-in tariff will be lowered from Oct. '08
  - Wind Power : Construction at the shore or mountain area
    -> far away from the load pocket
  - Fuel Cell : Development of 3kW and 250kW fuel cells for buildings and residential use, respectively
    -> narrowing tech. gaps from developed countries

Current Status of Korea RE

- Development and deployment targets set for selected RE
  - “Selection and Concentration Strategy”
    - Concentrate limited resources on selected RE
      : Fuel cell, wind and PVs
  - Implementing consortium-typed projects to integrate all stages of development, evaluation, verification and deployment of RE techs

Current Status of Korea RE

❒ Future of Korea RE

- ❖ **Solar PVs : Development of 3kW system for residential application**
  - **Creating a solar PVs industry based on the domestic hi-tech semiconductor industries**
- ❖ **Wind Power : Development of 750kW and 1MW wind turbines**
  - **Indigenizing advanced technologies to promote alternative power sources**

● Can be distributed resources in the near future


Capacity Credit of
Korea Renewable Energy

Capacity Credit of Korea RE

- Electricity has two different units of value
  - Electric generation facilities provide energy value,
  - but they also deliver capacity value
  - Capacity credit represents the value of a generator's contribution to the reliability of the overall electrical supply system
- Renewable energy sources have operational characteristics
  - intermittent production output
    - Analytical methods for evaluating the capacity value of intermittent resources

Capacity Credit of Korea RE

BPE : Basic Plan for Long-term Electricity Supply & Demand

- Legal Background
  - Minister of Commerce, Industry and Energy establish the BPE Plan to secure electricity supply & demand (electricity business law article 23)
- BPE contains ;
  - Electricity policy direction, long term outlook, facilities construction plan, demand side management etc.
- Establishment Interval and review process
  - Every 2 years or if necessary
  - Electricity policy review committee (electricity business law article 27)

Capacity Credit of Korea RE

- **Uncertain Factor on BPE**
  - Contribution at peak : Renewables
- **Effective Installed reserve margin concept**
  - Considering stochastically Peak contribution

✦Effective capacity= Apparent– uncertain capacity

✓ Apparent capacity : Whole plant's nominal rating
✓ Uncertain capacity : Uncertain peak contribution capacity

● Need to consider Capacity Credit!!

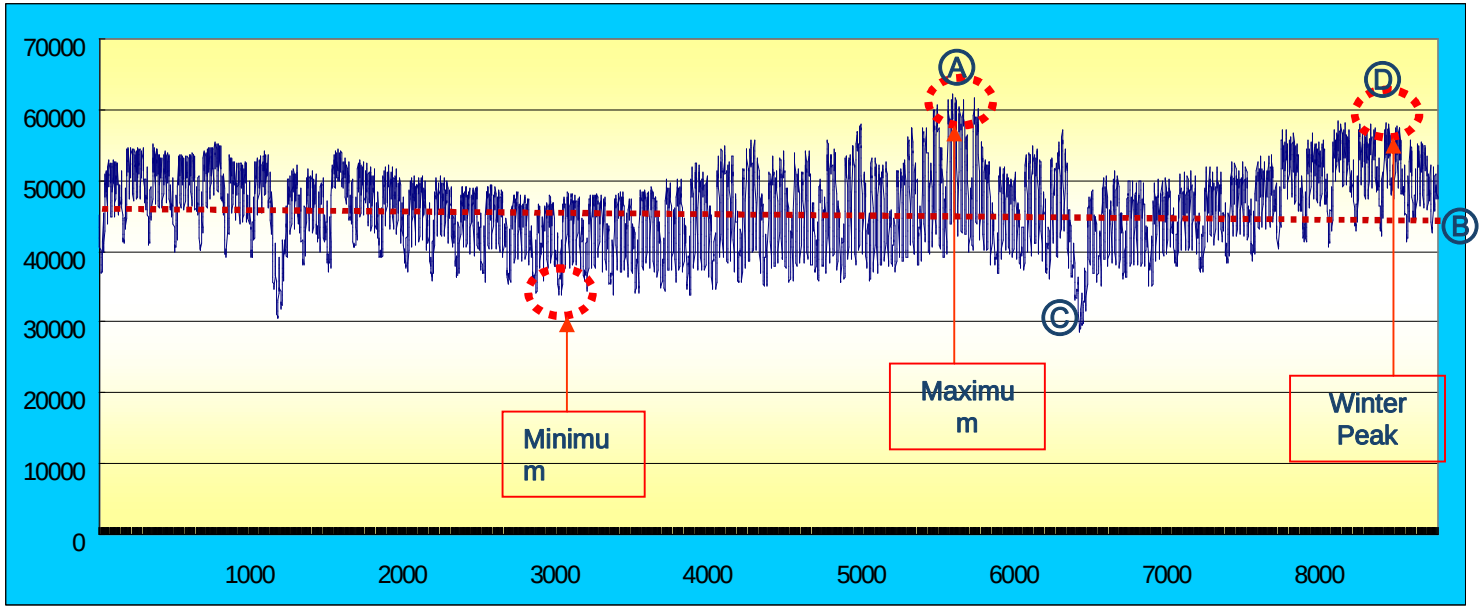
Capacity Credit of Korea RE

❒ Capacity credit

- ❖ Installed Capacity x Load Factor

❒ Annual Load Duration Curve (2007)

- ❖ Load Factor : 74%
- ❖ Max. vs. Min. : 46% (ⓒ/ⓐ)



Capacity Credit of Korea RE

❒ Capacity credit of RE

(Unit : %)

Classification		Small Hydro	Wind	Solar PV	LFG
Capacity Credit	① 14:00– 15:00	62.2	21.9	42.8	40.9
	② 14:00– 17:00	62.6	21.8	33.7	41.6

- ❖ Coefficient of utilization of RE facilities (Jul and Aug from ’05 to ‘07)
- ❖ Consider MOR and FOR

Thank You!

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