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# Power System Performance Report 2011

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April 2012



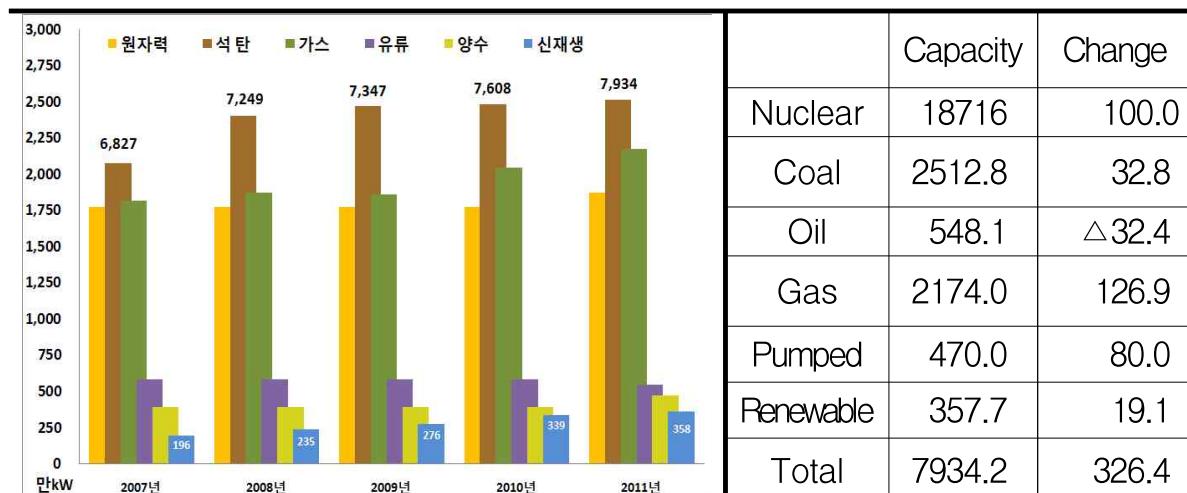
# I The Present State of Power Infrastructure

## 1. Generating Unit

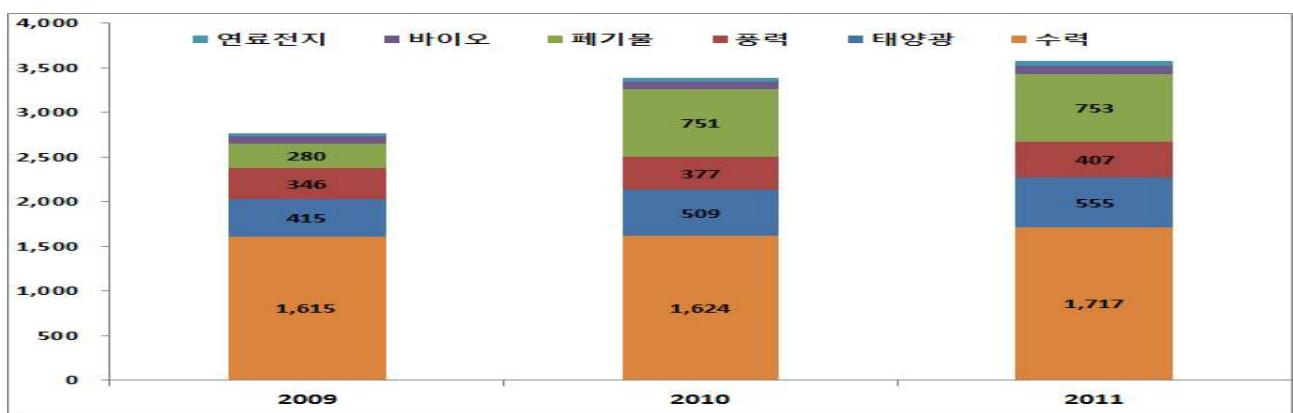
- Installed capacity is 79,342MW, a yearly increase of 3,264MW(4.3%).
- Nuclear, coal, gas, and pumped storage plants gained 1,000MW, 328MW, 1,269MW, and 800MW respectively, Oil plants were reduced by 324MW(App.2).
- 191MW of renewable energy capacity have been added, a 5.6% increase over last year.
- Details : Hydro, solar, wind, and others gained 94MW, 45MW, 30MW, and 22MW respectively

**<The Trend of Installed Capacity by Fuel \*>**

(Unit : 10,000kW)



**<The Trend of Installed Capacity for Renewable Plants>**



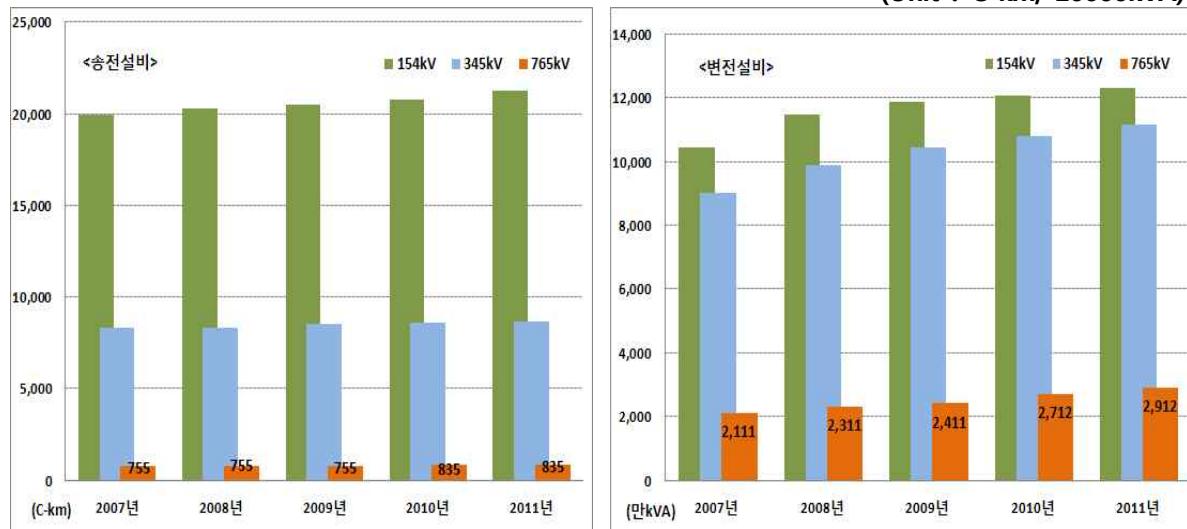
\* Hydro power plants are included in the renewable plants. Anthracite (domestic) coal plants are included in the coal plants. Statistics are based on the year-end capacity.

## 2. Transmission Infrastructure and Phase Modifying Equipments

- Transmission, transformation, and phase modifying equipments have increased by 575C-km, 8040MVA, and 948MVar respectively from last year.
- The major extensions(Appendix 2) are as follows:

**<Transmission Infrastructure Extension>**

(Unit : C-km, 10000kVA)



Class (kV)	Transmission(Length)			Transformation(Capacity)		
	2010	2011	Change	2010	2011	Change
765	835	835	0	2,712	2,912	200
345	8,580	8,653	73	10,810	11,160	350
154	20,777	21,280	503	12,068	12,323	254
Total	30,192	30,767	575	25,589	26,394	804

**<Phase Modifying Equipment Extension>**

(Unit : 10000kVar)

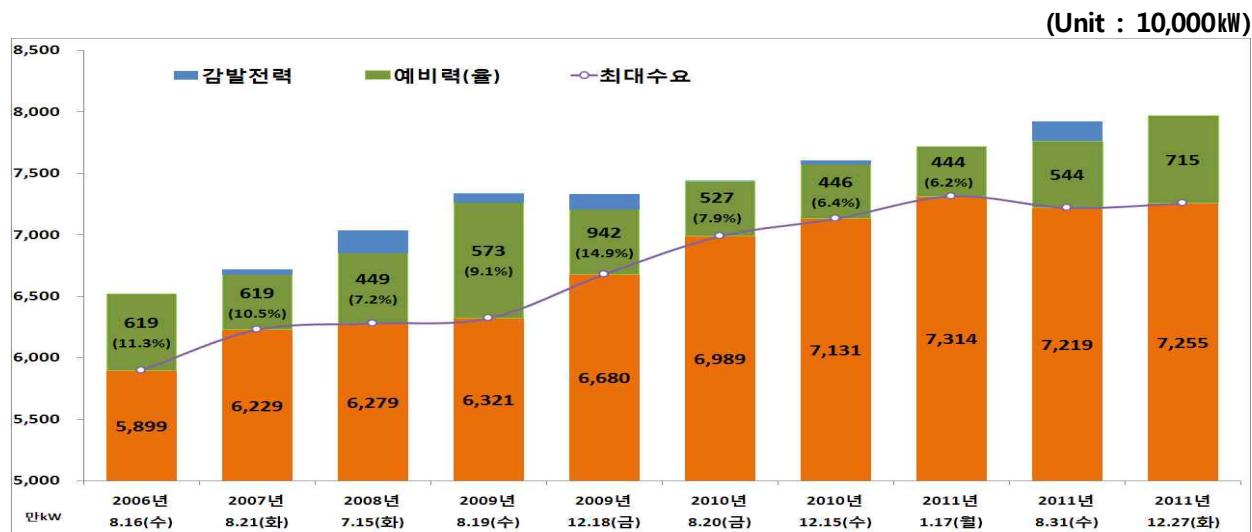
Class (kV)	Static Condenser(S.C)			Shunt Reactor(Sh.R)		
	2010	2011	Change	2010	2011	Change
345	40	40	-	760	810	50
154	1,297	1,342	45	4	14	10
66	-	-	-	-	-	-
22.9	776	776	-	424	414	△10
Total	2,113	2,158	45	1,188	1,238	50

## II Power Supply and Demand

### 1. Peak Demand

- Peak Demand was 73,140MW, a yearly increase of 1,830MW(2.6%).
- This was 2.9%p smaller than the average rate (5.5%) between 2006 and 2010.

<Peak Demand Trend>



### 2. Summer Power Supply and Demand

- Maximum demand was 72,194MW, a yearly increase of 2,308MW (3.3%).
  - Air conditioning power demand was estimated to be 15,320MW, a yearly decrease of 67MW (0.4%).
- \* 2009: 12,777MW (-2.8%), 2010: 15,388MW (20.4%), 2011: 15,321MW (-0.4%)

- Available capacity was 77,644MW, a yearly increase of 3,292MW(4.4%).

Reserve power was 5,442MW (reserve rate of 7.5%) maintaining stable supply.

\* we secure 4,000MW of reserve power according to the reliability standard (Ministry of Knowledge Economy Public Notice 2011-254)

<Summer Power Demand and Supply>

(Unit : 10,000kW, %)

Classification	2010	2011	Change
Installed Capacity	7,440.7	7,924.6	483.9
Available Capacity	7,434.4	7,763.6	329.2
Peak Demand	6,988.6	7,219.4	230.8
Reserve (Rate)	445.8 (6.4)	544.2 (7.5)	98.4

## <Peak Day's Temperature and Tropical Night Records for the Last 5 Years>

(Unit : 10,000kW, °C)

Classification	2007 (Tue.Aug.21)	2008 (Tue.Jul.15)	2009 (Wed.Aug.19)	2010 (Fri.Aug.20)	2011 (Wed.Aug.31)
Peak Demand	6,229	6,279	6,321	6,989	7,219
Maximum Temp.	31.2	31.2	32.0	33.0	32.2
Average Temp.	28.0	27.6	28.1	28.8	27.3
Minimum Temp.	25.7	24.8	24.8	25.3	23.4
Continuous High Temp. Days*	4	3	4	4	4
Number of Tropical Nights**	1	0	0	1	0

### Demand Management

- Designated demand management period: 10 days (August 10 to 12, 16 to 19, and 23 to 25) / 11 AM to 12 PM, 1 PM to 5 PM.
  - Although we operated summer demand management on August, peak demand occurred after demand management period due to the late summer heat.
  - Daily peak curtailment was 1,649MW on average, which was 649MW more than planned (1,000MW)

\* 2009: 1,709MW, 2010 : 1,648MW, 2011 : 1,649MW

### Seoul Metropolitan Area

- Peak demand was 28,341MW, a yearly increase of 255MW.
- Available capacity was 30,526MW, a yearly increase of 1,382MW.

## <Power Supply and Demand in Seoul Metro. Area on August>

(Unit : 10,000kW, %, %p)

Classification	Peak Demand	Available Capacity			Reserve	Reserve Rate
		Generation	Interchange	Total		
2010	2,808.6	1,654.4	1,260.0	2,914.4	105.8	3.8
2011	2,834.1	1,832.6	1,220.0	3,052.6	218.5	7.7
Change	25.5	178.2	-40	138.2	112.7	3.9

\* The number of days that the temperature is over 30°C consecutively during 4 days up until peak day

\*\* The number of days that the temperature is over 25°C consecutively during 4 days up until peak day

Jeju Island

- Peak Demand was 624MW, a yearly decrease of 1MW.
- Available capacity was 793MW, a yearly decrease of 8MW.
  - The change stems from the revision of the renewable energy contribution ratio standard (8MW decrease)

**<Power Supply and Demand in Jeju Island on August>**

<b>(Unit : 10,000kW, %, %p)</b>						
Classification	Peak Demand	Available Capacity			Reserve	Reserve Rate
		Generation	HVDC	Total		
2010	62.5	65.1	15.0	80.1	17.6	28.2
2011	62.4	64.3	15.0	79.3	16.9	27.1
Change	△0.1	△0.8	0.0	△0.8	△0.7	△1.1

### 3. Winter (December) Power Supply and Demand

- Peak demand was 72,554MW, an increase of 360MW compared to summer, and 1,246MW year-over-year.
- Available capacity was 79,705MW, an increase of 3,958MW year-over-year.
- Installed capacity had increased by 3,264MW due to the reduction of generation overhaul capacity and improvement of generation output by 700MW.

**<Power Supply and Demand on December>**

<b>(Unit : 10,000kW, %, %p)</b>			
Classification	2010	2011	Change
Installed Capacity	7,607.8	7,934.2	326.4
Available Capacity	7,574.7	7,970.5	395.8
Peak Demand	7,130.8	7,255.4	124.6
Reserve (Rate)	443.9 (6.2)	715.1 (9.9)	271.2 (3.7)

Seoul Metropolitan Area

- Peak demand was 28,024MW, a yearly decrease of 344MW.  
Available capacity was 31,722MW, a yearly increase of 1,798MW.

**<Power Supply and Demand in Seoul Metro. Area in December>**

(Unit : 10,000kW, %, %p)

Classification	Peak Demand (Share)	Available Capacity			Reserve (Rate)
		Generation	Interchange	Total	
2010	2,836.8 (39.3)	1,742.4	1,250.0	2,992.4	155.6 (5.5)
	2,802.4 (38.6)				
Change	△34.4	209.8	△30.0	179.8	214.2 (7.7)

Jeju Island

- Peak demand was 597MW, a yearly decrease of 13MW. Available capacity was 819MW, a yearly decrease of 1MW.
- The change stems from the revision of the renewable energy contribution ratio standard (1MW decrease)

**<Power Supply and Demand in Jeju island on December>**

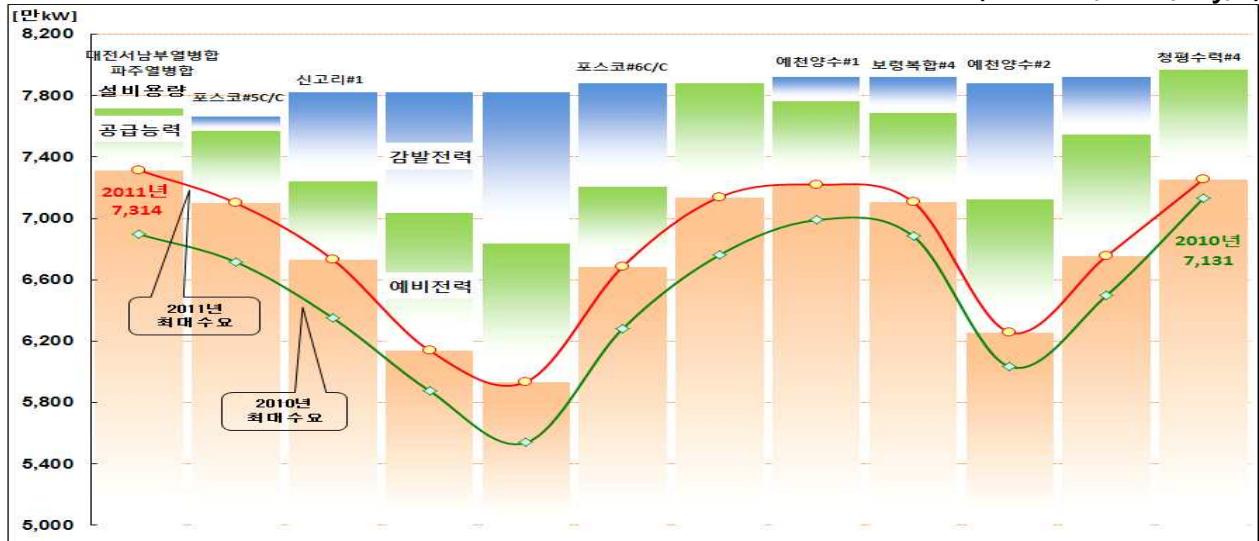
(Unit : 10,000kW, %, %p)

Classification	Peak Demand	Available Capacity			Reserve Power	Reserve Rate
		Generation	HVDC	Total		
2010	58.4	66.8	15.0	81.8	23.4	40.1
2011	59.7	66.9	15.0	81.9	22.2	37.2
Change	1.3	0.1	0	0.1	△1.2	△2.9

## 4. Monthly Demand and Supply Results

<Monthly Demand and Supply Results for 2011\*>

(Unit : 10,000kW/day, %)



Classification	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Installed Capacity	7,613	7,665	7,824	7,824	7,824	7,881	7,881	7,925	7,925	7,881	7,921	7,934
Available Capacity	7,718	7,573	7,243	7,037	6,836	7,209	7,884	7,764	7,689	7,126	7,546	7,971
Peak Demand	7,314	7,100	6,732	6,140	5,936	6,687	7,139	7,219	7,106	6,258	6,755	7,255
(Change %)	(6.1)	(5.7)	(6.0)	(4.5)	(7.2)	(6.4)	(5.6)	(3.3)	(3.2)	(3.7)	(4.0)	(1.7)
Reserve	404.2	472.7	511.2	897.1	900.6	521.9	744.5	544.2	582.4	868.6	790.6	715.1
(Reserve Rate %)	(5.5)	(6.7)	(7.6)	(14.6)	(15.2)	(7.8)	(10.4)	(7.5)	(8.2)	(13.9)	(11.7)	(9.9)

\* Installed and available capacities are for monthly peak days, while change rates are year-over-year for each month

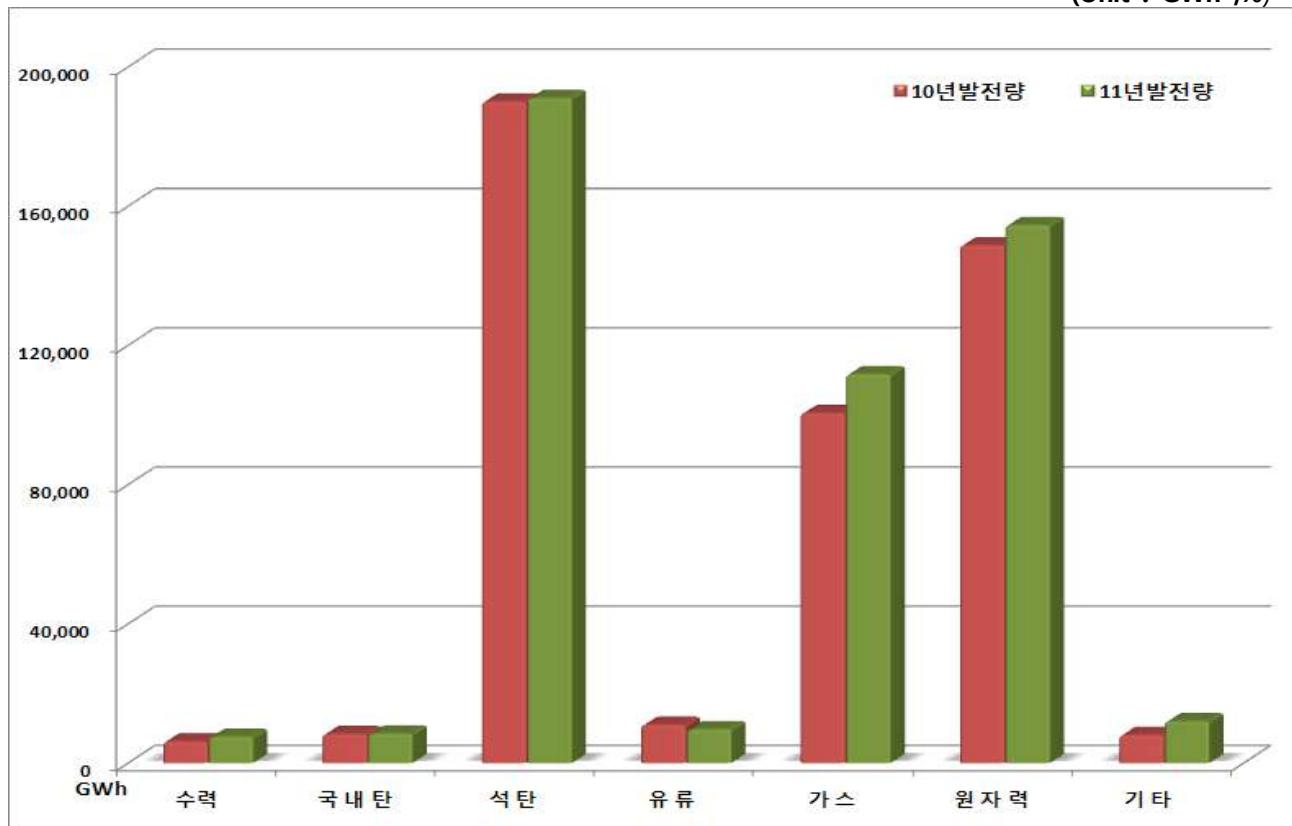
### III Generation Output

#### 1. Generation Output by Fuel Type

- Annual generation increased by 4.7%, while industrial power sales increased by 8.1% compared to last year.

**<Generation Output by Fuel Type>**

(Unit : GWh ,%)



Classification	Hydro	Anthracite Coal	Bituminous Coal	Oil	Gas	Nuclear	Others	Total
Generation	7,571	8,483	191,069	9,728	111,721	154,572	12,024	495,168
Change	21.6	1.6	0.5	-11.5	11.1	3.9	49.4	4.7
Share	1.5	1.7	38.6	2.0	22.6	31.2	2.4	100

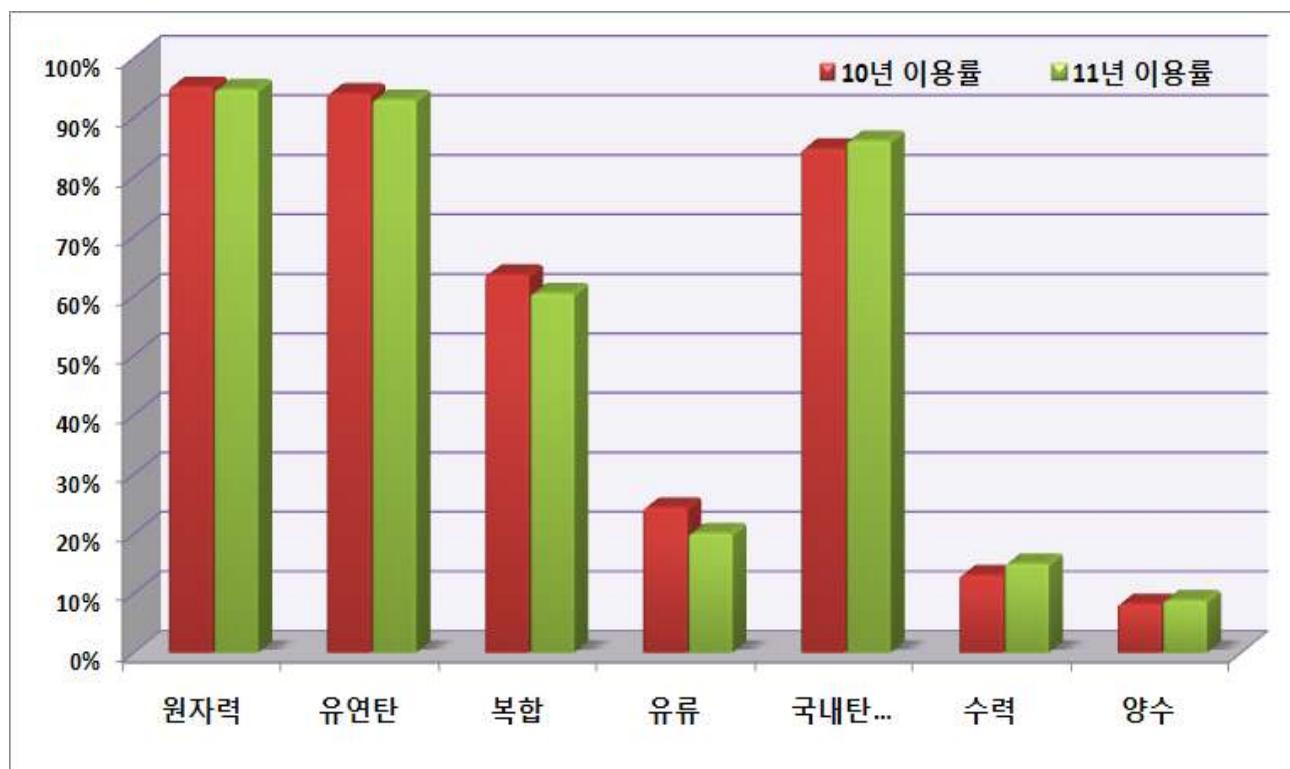
## 2. Capacity Factor

- The annual capacity factor for the power generation facilities has decreased by 1.2%p to 72% compared to last year.

**<Capacity Factor\* by Fuel Type>**

(Unit : %,%p)

Classification	2010	2011	Change
Hydro Power (Pumped Storage)	13.0 (8.2)	15.0 (8.8)	2.0 (0.6)
Anthracite Coal	84.7	86.1	1.4
Bituminous Coal	94.0	93.0	△1.0
Oil	24.4	20.1	△4.3
Combined Cycle	63.5	60.4	△3.1
Nuclear	95.1	94.7	△0.4
Total	73.2	72.0	△1.2



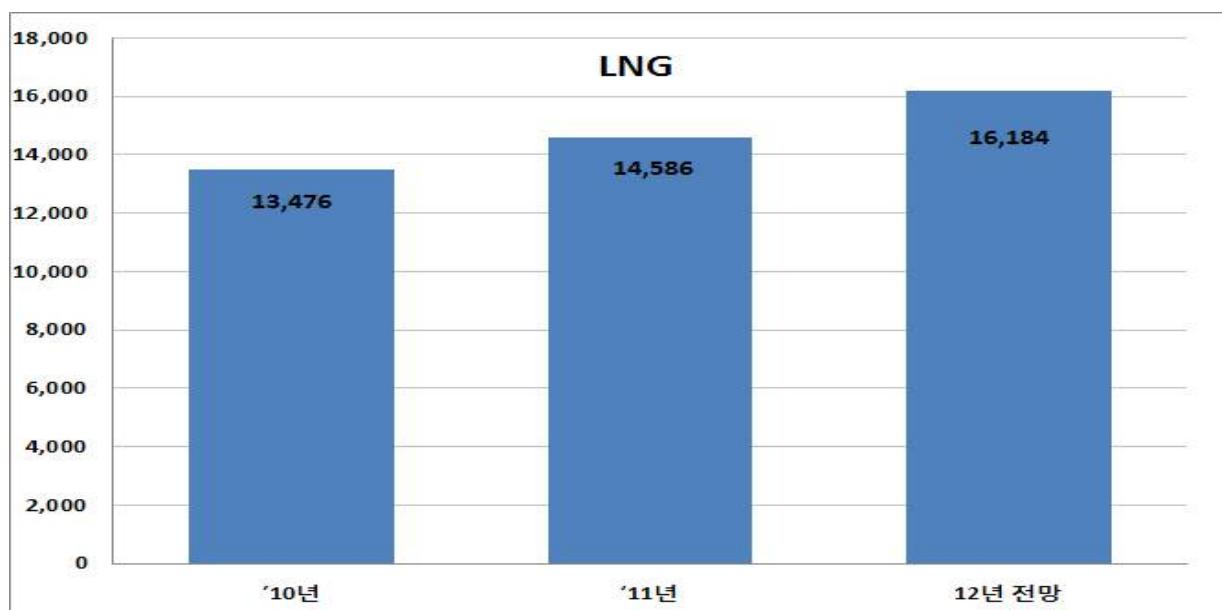
\* Excludes trial generation

### 3. Fuel Usage

- LNG usage increased by 8.2% compared to last year.
- This is caused by the capacity factor improvements due to soaring power demand and addition of combined cycle power plants.

**<Fuel Usage Trend>**

(Unit : 1,000 Ton, %)



### 4. Generator Overhauls

- The average annual overhaul capacity was 5.23 million kW/day which was lower than that of 2010.

**<Overhauls by Generator Type>**

(Unit : 10,000kW/day)

Classification	2010	2011	Change
	Overhaul Rate	Overhaul Rate	
Coal	158	133	△25
Nuclear	168	156	△12
Oil	52	51	△1
Combined Cycle	92	109	17
Others	66	148	82
Total	536	523	△13

## IV Error Rate in Demand Forecast

### 1. Error Rate by Forecast Range

- Daily Forecast: Annual target is 1.317%, and cumulative total exceeds the target by 0.011%.
- On average, error rate in the daily forecast is highest in February and September.

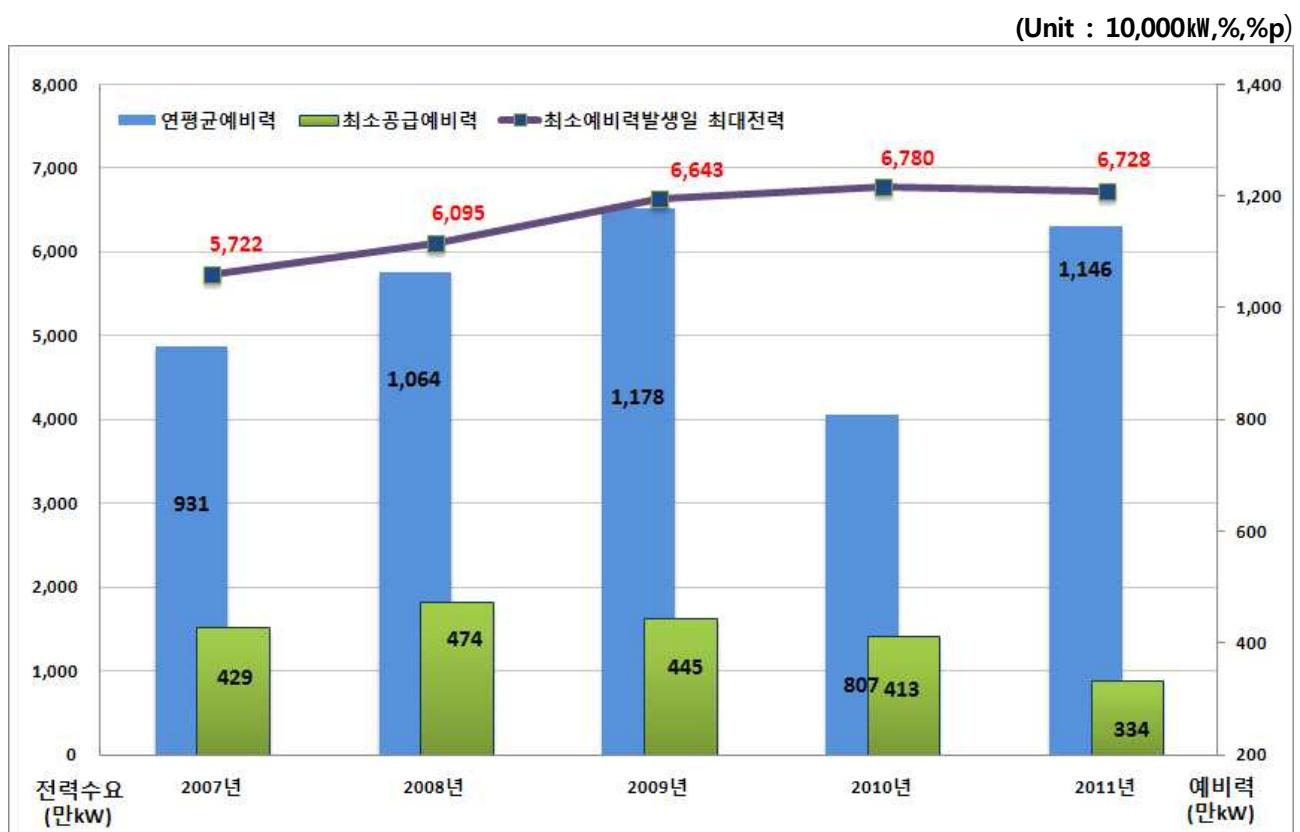
Classification	2010	2011		Difference		2012 Target
		Target	Actual	From Target	Year-Ov er-Year	
Daily Forecast	1.328	1.317	1.306	△0.011	△0.022	1.295

## V Supply Reserve Capacity and Rate

### 1. Lowest Supply Capacity

- The lowest supply capacity during the year was 3,341MW on September 15, with the reserve rate of 5.0%.

<Annual Lowest Supply Capacity Trend>



Classification	Annual Average	On Lowest Supply Capacity Day		On Peak Demand Day	
		Demand	Reserve (Rate)	Demand	Reserve (Rate)
2010	806.7	6,780.2	413.4 (6.1)	7,130.8	443.9 (6.2)
2011	1146.1	6728.1	334.1 (5.0)	7313.7	404.2 (5.5)

## VI Transmission Network Operation

### 1. Transmission Line Outage

- Annual planned outage of transmission lines increased by 326 cases, while non-planned decreased by 96 cases.
- The reasons for outages include facility inspection for stable power system operation, maintenance of deteriorating power facility, and system reinforcement for increased power demand.

**<Annual Outages>**

(Unit : Cases)

Classification	Planned Outages		Non-Planned Outages		Total
	Planned	Actual	Temporary	Emergency	
765kV	44	38	9	3	50
345kV	1,149	868	126	131	1,125
154kV	1,918	1,479	172	113	1,764
2011 Total	3,111	2,385	307	247	2,939
2010 Total	2,648	2,059	430	220	2,709

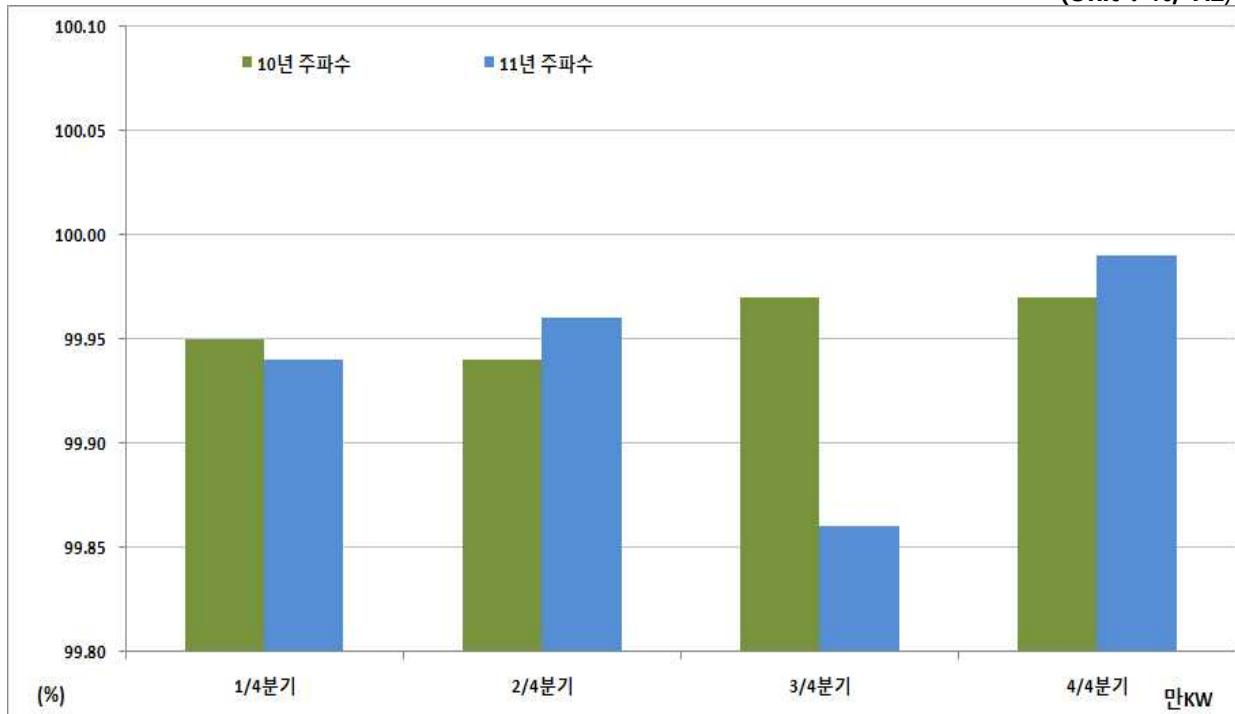
## VII Quality Control

### 1. Frequency Maintenance

- Annual performance decreased by 0.02% to 99.94% from last year.
- The quarterly performance of frequency maintenance was at its lowest in the third quarter.

**<Quarterly Performance of Frequency Maintenance>**

(Unit : %, Hz)



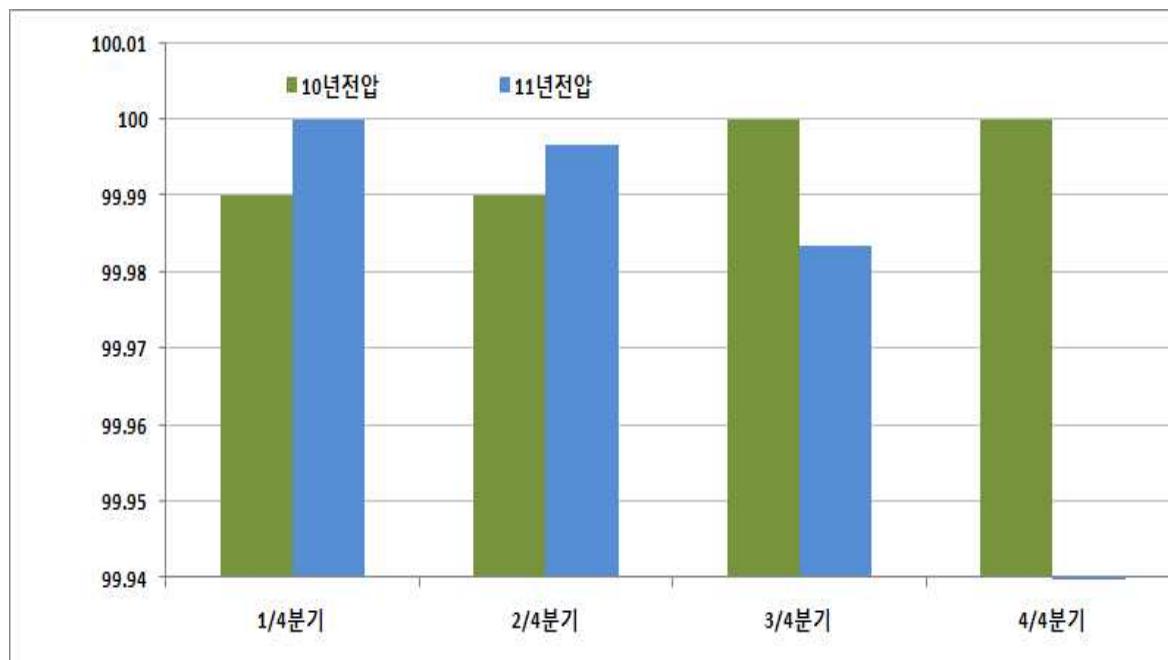
Classification		1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter
Frequency Maintenance Rate (60±0.1Hz)	2009	99.98	99.92	99.93	99.94
	2010	99.95	99.94	99.97	99.97
	2011	99.94	99.96	99.86	99.99

## 2. Voltage Maintenance

- Annual performance decreased by 0.02% to 99.97% from last year.

### <Quarterly Performance of Voltage Maintenance>

(Unit : %, kV)



Classification	Standard	High	Low	Average
Light Load	$156 \pm 4\text{kV}$	163	152	158
Transient	$157 \pm 4\text{kV}$	162	153	158
Heavy Load	$160 \pm 4\text{kV}$	164	155	159
Standard	High	Low	Average	
353kV(336 ~ 360kV)	366	336	352	

### <Annual Quality Control Maintenance Results>

(Unit : %)

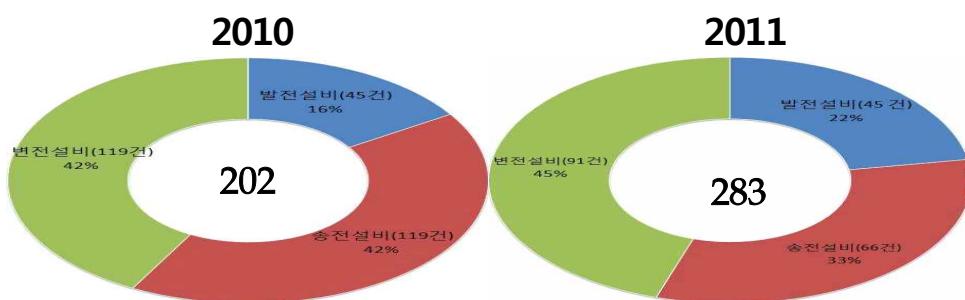
Classification	Maintenance Target	2007	2008	2009	2010	2011		2012 Target
						Target	Actual	
Frequency Maintenance Rate (%)	$60 \pm 0.1\text{Hz}$	99.87	99.92	99.94	99.96	99.96	99.94	99.96
Voltage Maintenance Rate (%)	Standard Operating Voltage $\pm 4\text{kV}$	99.99	99.98	99.99	99.99	99.95	99.97	99.95

## VIII Power Facility Failures

### 1. Failures by Facility

- There were 45 cases of generator failure, which was the same as last year. Transmission and transformation facility failures decreased by 53 cases and 28 cases, respectively.

**<Yearly Comparison of Failures by Facilities>**



[Unit : Cases]

Classification	2010	2011	Change
Generator*	45	45	0
Transmission	119	66	-53
Transformation	119	91	-28
Total	283	202	-81

### 2. Failures by Cause

- The causes of failures included 41 cases (20.3%) of natural disaster, 62 cases (31.0%) of faulty facility, 66 cases (32.5%) of poor maintenance, 19 cases (9.3%) of external contact, and 14 cases (6.9%) of other causes.

**<Failures by cause>**

(Unit : Cases)

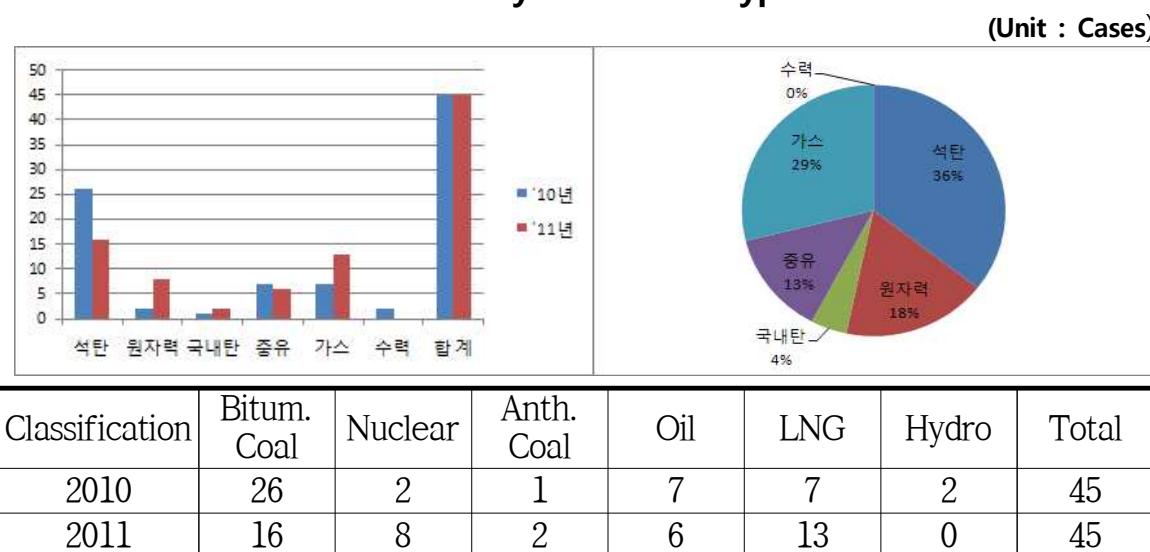
Classification		Natural Disaster	Faulty Facility	Poor Maint.	External Contact	Others	Total
Generator	2010	1	26	17	0	1	45
	2011	0	11	32	0	2	45
Transmission	2010	78	9	3	22	7	119
	2011	41	6	3	14	2	66
Transformation	2010	0	39	58	8	14	119
	2011	0	45	31	5	10	91
total	2010	79	74	78	30	22	283
	2011	41	62	66	19	14	202

\* Includes non-scheduled failures from six KEPCO subsidiaries (i.e. excludes private generation companies)

### 3. Failures by Generator Type

- There fore 45 cases of generator failures, which was the same as last year.
- Compared with last year, bituminous coal, oil, and hydro generators saw decrease of 10, 1, and 2 cases, respectively. Meanwhile, nuclear, anthracite coal, and LNG generators saw increase of 6, 1, and 5 cases, respectively.

**<Failures by Generator Type>**



### 4. Transmission and Transformation Facility Failures by Voltage

- Transmission and transformation facility failures totalled 157 cases, a decrease of 81 cases from last year.
- Compared to last year, transmission facility failures decreased by 53 cases to 66 cases, and transformation facility failures decreased by 28 cases to 66 cases.
- For 345kV or higher facilities, transmission and transformation facility failures decreased by 7 and 2 cases, respectively.

**<Transmission and Transformation Facility Failures by Voltage\*>**

Classification	(Unit : kV, Cases)									
	Transmission Line			Transformation Facilities						Total
				Bus			M.TR			
	765kV	345kV	154kV	765kV	345kV	154kV	765kV	345kV	154kV	
2010	0	22	97	0	3	11	3	20	82	238
2011	1	15	50	1	3	13	9	18	47	157
Change	+1	-7	-47	+1	-	+2	+6	-2	-35	-81

\* Excludes successful reclosing