



## Present Energy Status

### Unbalanced energy supply and demand ( high overseas dependency rate)

- Basic shortage in energy resources (96% overseas dependency rate , financial burdens)
  - Energy consumption rate continuously increase
  - ( Ranking Korea as the 10<sup>th</sup> energy consuming nation , 8<sup>th</sup> Kerosene )
- Energy price 172,5 Bil USD (2011), 32.9 % of total amount of imports

### Energy imports ( vs total imports)



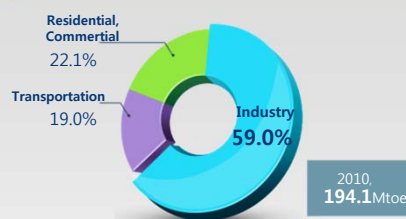
\*Source: International Monetary Fund - 2011 World Economic Outlook

## Energy consumption status (1)

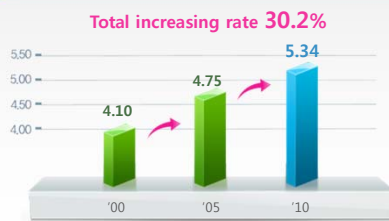
### Energy consumption status by sector



### Energy consumption rate by sector



### Energy demand per person (toe)



### Total Energy Demand (Mtoe)



\*source : Annual Energy Statistics

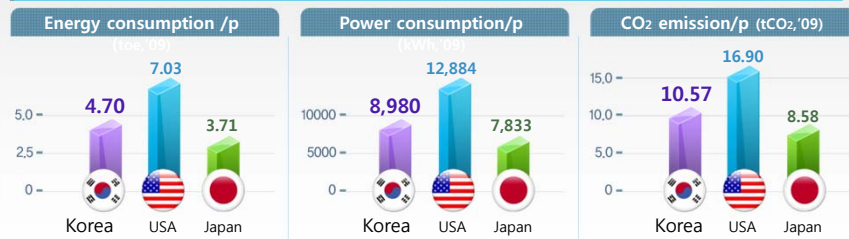
## Energy consumption status (2)

### Annual energy consumption increasing rate ('00~'09)



\*Source: Energy Balances of OECD countries 2011(IEA)

### Comparison of national energy consumption rate per person



\*source: key statistics 2011(IEA)

## II. NRE Status

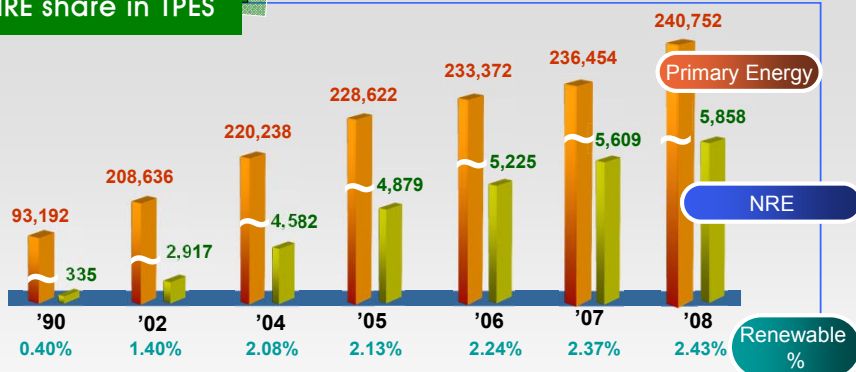
## NRE classification

	New				Renewable Energy							
Heat source	Fuel cell	coal liquefaction gas	hydrogen energy		Solar PV	Solar heating	Bio-energy	Wind Turbines	hydraulic power	Ocean power	Scrapped material	Geo thermal
	New				Renewable							
(Korea)	●-----●				●-----●							
(EU)	●-----●				●-----●							

- 3 New energy, 8 Renewable energy
- Heat Pump is NOT included.

## Status of Primary energy & NRE deployment

### NRE share in TPES



	'90	'02	'04	'05	'06	'07	'08
Primary Energy	93,192	208,636	220,236	228,622	233,372	236,454	240,752
NRE	335.3	2,917.3	4,582.4	4,879.2	5,225	5,609	5,858
Percentage(%)	0.40	1.40	2.08	2.13	2.24	2.37	2.43

❖ Unit : 1000 X TOE, : Hydraulic power included since 2003

## Capacity of Renewable facilities/ (based on service area)

Source	Numbers (unit)		Capacity [MW]
Land Fill Gas	생곡 LFG 등	33	82.407
Wind Power	강원풍력 등	190	298.645
BPG (By-Product Gas)	여천 카본블랙 등	3	30.0
Fuel Cell	분당 연료전지 등	7	7.75
Waste	전주소각장 등	2	8.0
PV	영광 솔라파크 등	892	290.209374
IPP small Hydraulic Power (소수력)	산내소수력 등	11	4.42
(small) Hydraulic Power (소수력)	산청양수소수력 등	119	68.9872
Sub-Sum	1,262 대		803.639574

\* source : Korea Power Exchange as of 2009. 1. 1

- Total power capacity : 72,480MW ( Renewable : 1.1% of total capacity)

## Representative NRE power generating facilities



[SiHWA Tidal : 254MW]



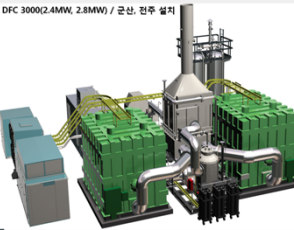
[KangWon Wind : 98MW]



[YoungDuk : 40MW]



[JiDo Solar PV : 15MW]



[JeonJu FuelCell : 2.4MW]

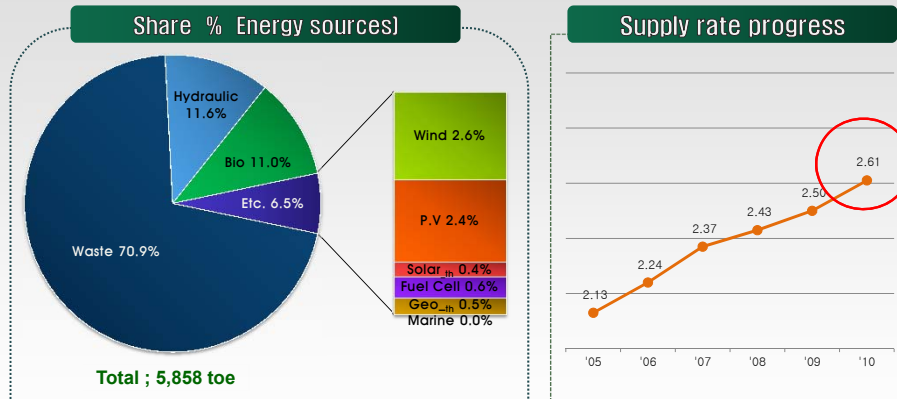


[KimPo LFG : 50MW]



## Status of NRE supply

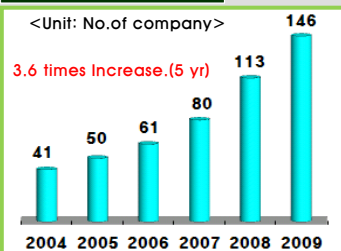
In 2010, **NRE Share portion 2.61%**  
NRE average increase rate : 7.0% ('05~'10)



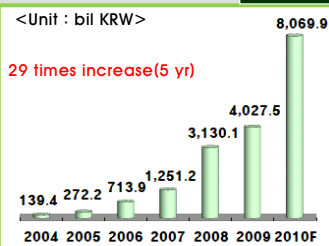
**“In 2030, goal of NRE supply rate : 11%”**

## Domestic NRE development state

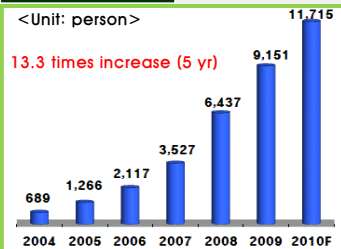
### No. of company



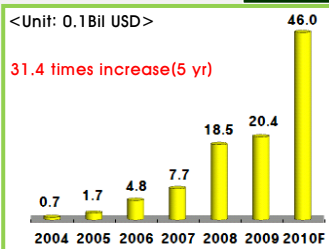
### Sale



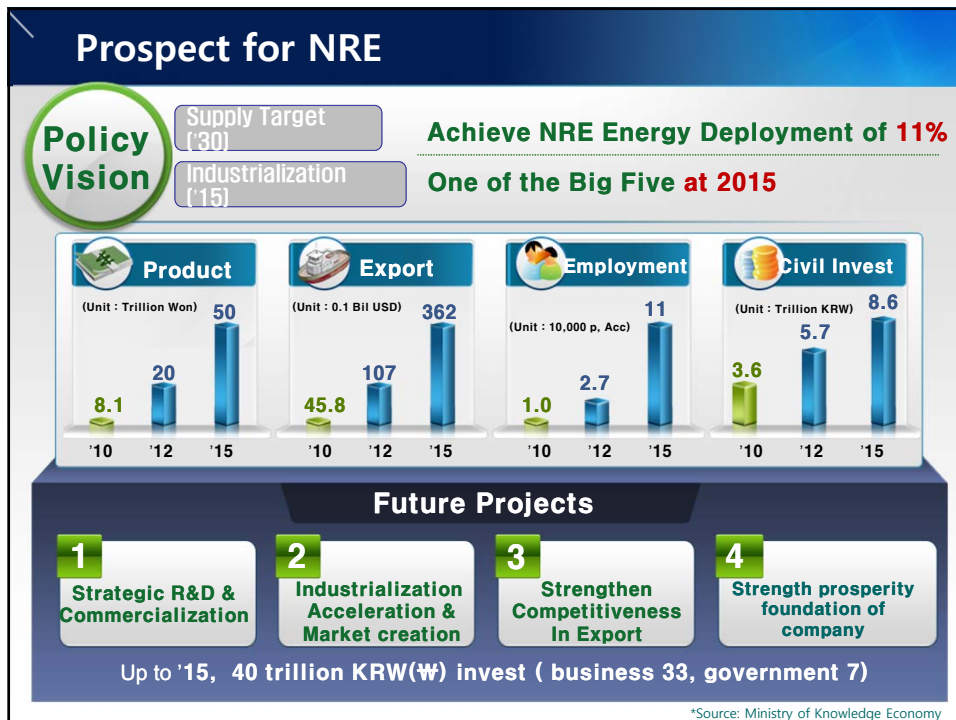
### Employment



### Export



\*Source: Korea Energy Management Corporation



## Support Structure of NRE



### R&D

- Research Plan
- Policy development
- Performance evaluation
- Demonstration



### Dissemination

- General provision
- 1 mil . Green homes
- Provinces provision
- Support Finance
- Tax Exemption



### Infra-structure Development

- Certification
- FIT
- RPS

## Budget of NRE business



(Unit : 0.1 Bil KRW(₩))

	2007	2008	2009	2010
Infra (Certification)	32	37	41	37
Diffusion Aid	1,401	3,081	1,801	1,802
FIT(Feed in Tariff)	270	1,266	2,392	2,636
Finance	1,214	1,803	1,303	913
SUM	2,917	6,187	5,537	<b>5,388</b>

\*Source: Korea Energy Management Corporation



## Future Policy Trend

### NRE mandatory use for Public Buildings

- 2004~
- New & Reconstruction : Above 3,000 m<sup>2</sup>: above 5% of construction cost, investing in new & renewable energy
- 2011~
- More than 10% of total energy usage, install new & renewable energy res.
- New & Reconstruction : Above 1,000m<sup>2</sup> (From '12, Enforcing Plan)

### FIT

- 2002~
- Gov. Support (Diff. with SMP)

### RPS

- 2012~
- Total Electric Power Gen. Amount : '12(2%), '22(10%)

### RFS

- 2012~
- Mandatory use for bio-diesel with transportation

### Certification of buildings using NRE

- 2011~
- Private buildings above 1,000m<sup>2</sup>, amounts used by NRE / total energy usage

## Renewable Portfolio Standard (RPS)

### Concepts

- RPS is a system that enforces power producers to supply a certain amount of the total power generation by NRE (Replacing FITs from 2012)

### Applicable area in RPS

- PV, Wind power, hydro power, fuel cell, ocean energy, bio energy and other energy prescribed in the ordinance of the Korean Government

### Obligators

- Companies generating "500,000kW" (NRE power plants excluded)
  - 6 Power Gen. Com.(KHNP, KSEPC, KMPC, KWPC, KSPW, KEWPC), KDHC, KWRC, Posco Power, SK E&S, GS EPS, GS Power, MPC Uulchon

### Obligatory supply rate by suppliers

- Starting (2012) 2%, rate increase 10% in 2022

Year	' 12	' 13	' 14	' 15	' 16	' 17	' 18	' 19	' 20	' 21	' 22
(%)	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0



Strategic Products	2008	2009	2010	2011	2012	2013
<b>VRF</b>	<p>High-efficient 20HP-level VRF heat pump and dissemination. Evaluation technology development (capacity : 20HP-level, -15℃ standard COP 2.6( 2<sup>nd</sup> stage), delay rate of HW frost formation time : 150%( 2<sup>nd</sup> stage)</p>					
<b>Hot and chilled water Gen.</b>	<p>Hybrid HP technology development by utilization of waste heat (System Design, Tech. of 30 kW class cap. , Max. output temp. : Above 90℃</p> <p>Development of high-efficient adsorptive hot and chilled water gen. (COP 1.4, 210 RT-lv adsorptive hot and chilled water gen, cooling water inlet/outlet temperature: 32 ℃ /3, 75 ℃ )</p> <p>Technology development of high-efficient HP hot and chilled water gen. (home capacity : under 16kW, Max output Temp. : 80℃, industrial capacity : over 29kW, Max. output temp. : 65℃)</p> <p>High temperature HP system development by using exhaust gas as heat sources (30RT-lv design technology, 70℃ hot water production, COPH=3.5, thermal efficiency improvement : 8%)</p>					
<b>Latent heat storage HP</b>	<p>Ultra high efficient HW development for air cooling of district and HVAC system of skyscrapers (General heat transfer rate 6,000kcal/high voltage durability 30 bar)</p>					
<b>Products of Gas Engine &amp; HP tech. applied</b>	<p>GHP system development of R410A (air cooling / heating : 85/95 kW, thermal efficiency : 35%@30HP)</p> <p>High-temperature generating HP development with Box-type Dryer for Commercialization (Dryer output amount: over 190kW, rage of temperature : 60~80℃, COP over 3.0, efficiency rate over 70%)</p>					

\*Source: Korea Institute of Energy Technology Evaluation and Planning

National R&D status in heat pump



## Current market & technology status

### ✓ Why VRF high-efficient heat pump is chosen?

- ❖ **Refrigerant flow variable multi air-conditioner system**, consisting of many compressors and indoor units (vaporizer or condenser), and connecting to refrigerant pipe.
- ❖ Advantageous system for construction, extension & reconstruction and remodeling due to standardized system, easy design and installation.
- ❖ **Customer-oriented heating and cooling system** due to elaborate heating and cooling control from individual and central.
- ❖ **The most economic heating and cooling system** in respect of initial investment, operating cost, and maintenance fee.
- ❖ Needed a technology which can control various capacity indoor units elaborately (oil or refrigerant dissemination and etc.)
- ❖ **Energy saving effect, greenhouse gas reduction effect, and export and employment development effect**



\* VRF(Variable Refrigerant Flow)



## Current market & technology status

### Through developing high-efficient heat pump, increasing exports and reducing CO<sub>2</sub> emission.

- ❖ Present 4.7 billion USD (Market share 7.5%)  
Enlarge by 8.0 billion USD(Market share 12%, 2012)
- ❖ Through Eco-friendly product design, reducing CO<sub>2</sub> emission.
- ❖ Through high-efficiency energy products, reducing CO<sub>2</sub> emission.
- ❖ Through products applied by natural refrigerants, reducing CO<sub>2</sub> emission.





## Current market & technology status

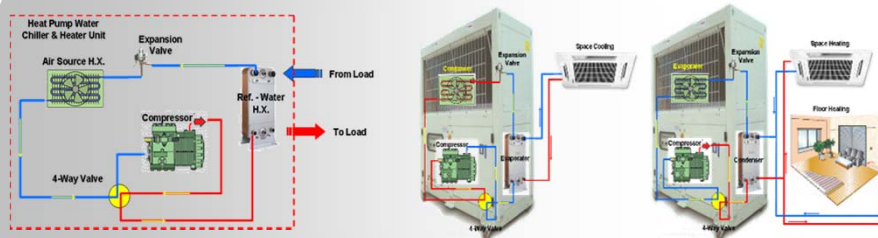
### ✓ Hot and Chilled-water Generator

- ❖ As a heating and cooling, hot water supply available system, expected to form a huge market and grow continuously.
  - Residential hot water supply and heat market size which can be targeted with ATW(Air-to-Water) heat pump products is about 45.1 billion USD
  - Global market size around Japan, Europe, and China has show rapid growth from 0.43 million units in 2006 to 1 million units in 2008, it is predicted over 11% high growth rate in 2014.
  - In 2012, it is expected domestic 3000 units (over 270 billion KRW(**₩**)) market
- ❖ As the technology which can counteract the Climatic Change Convention, its R&D and dissemination is under heavy investment around developed countries.
- ❖ Needed to secure international competitiveness of technology for exports expansion.



## Current market & technology status

### ✓ Hot and Chilled-water Generator



- ❖ As KIMM(Korea Institute of Machinery & Materials) arranged, companies such as Samsung Electronics and LG Electronics consist of consortium and are progressing on the project of developing high-efficiency heat pump hot and chilled-water Gen.
- ❖ On this project, government is supposed to support 14 Million USD for 5 years and separately participated companies on the project are planning to invest 14 Million USD .

\*Source: Korea Institute of Machinery & Materials



## Current market & technology status

### Heat Pump Market Size

- ❖ Domestic and World market share increasing (Strategic Trend)
  - \* Overseas market : 4.7 Billion USD (2008) → 8.0 Billion USD(2012)
  - \* Market share of overseas market : 7.5%(2008) → 12%(2012), 20%(2030)
  - \* Domestic market : 1.18 Bil USD(2008) → 1.55 bil USD (2012)
- ❖ Replacing boiler by high efficient hot and chilled-water generator, above 10% Global CO<sub>2</sub> emission control, HP market share increase (IEA HPC-BR6 report)
  - \* Domestic market : 11 Mil USD (2007) → Above 5 times growth(2012)
  - \* By High efficiency (3%) and Replacement boiler (7%), 10 % reduction of domestic CO<sub>2</sub> emission amount ( 50 million ton of CO<sub>2</sub>)
- ❖ Geo-thermal HP is almost taken by small & medium sized businesses and about 70% of total heat pump market but most of main components such as compressor, heat exchanger is imported
  - \* Domestic market share in : Geo-thermal (70%), ASHP(20%), etc.(seawater, sewage)(10%)
  - \* Dispersion : Small and medium sized businesses (77%), Large company(23%)



## Current market & technology status

### Industrial Heat Pump status for replacement of boiler

- ❖ Excessive energy consumption on air conditioning & heating and water heat
  - It is urgent to save the energy in this age of high oil price.
- ❖ It is expected that alternative energy technology-based products around the world will increase rapidly.
  - In Korea, alternative technology supply objectives : 10% at 2020
- ❖ Currently heating and cooling equipment is focused on the GHP type.

(unit)					
Year	2005	2006	2007	2008	2009
Industrial	14,437	14,208	14,066	16,330	17,111
Heating	22,331	21,654	21,429	23,486	24,106

\*Source: Small & Medium Business Administration of Korea

## Current market & technology status

### Global supporting system and policy (high efficiency fields)

Country	Support system	Technology standard	Support information
France	Product Purchase subsidiary	• Heating COP $\geq 3.0$ above Heat Pump	• 50% Cash Back (Excepting Indoor unit & piping)
Benelux		• Heating COP $\geq 3.5$ above Heat Pump	• 44% Cash Back (Excepting Indoor unit & piping)
UK	Enhanced Capital Allowance	• Heating COP $\geq 3.2$ above Heat Pump	• About 30% tax exemption of total purchasing price.

Support system	Technology standard	Support information
Subsidy for high efficient HVAC	• Heating and cooling COP $\geq 3.9$ Heat Pump (averaged COP)	50% supporting of Max. and Min. efficiency (Fund-Gov.)

Support system	Technology standard	Support information
High efficiency energy device certification	(Real Value base) • Cooling COP $\geq 3.8$ • Heating COP $\geq 4.0$ • Cold Temp. COP $\geq 2.6$ (Standard Base Heat Pump)	• Installation - cheap capital and tax exemption (variable interest rate 3.5%, 80% support of buying) • tax exemption for energy efficient facilities • Priority purchasing of high efficient device in public organization • Priority purchasing in "Public Procurement Service" • Obligation for using high efficiency devices - New building above 50 household - Educational building above 3,000m <sup>2</sup> floor )

Support system	Technology standard	Support information
High Efficiency for Energy Star PGM	• SEER $\geq 13$ Heat Pump	• \$ 300 tax exemption

\*COP : Coefficient Of Performance



## Opportunities for the industry

### ❖ Strategic Products of Small and Medium-sized companies

- **Geothermal heat pump** : High efficiency heat exchanger development ( 30% increase compared to existing borehole)
- **CO2 heat pump** : Customized medium & large HP system & components development
- **Hot and chilled water Gen.** : HP system with hot water supply function by variable compressors for capacity control and tech. for delay of frost formation
- **Seawater heat pump** : High efficient, low-cost and self-cleaning Titanium-based heat exchangers with seawater corrosion resistance
- **Sewage heat pump** : 1) Heat exchangers for sewage 2) removing contaminant pollutant
- **Adsorption heat pump** : Heat pump system using adsorbents based on Nano-powder manufacturing technology.





## Opportunities for the industry

- ❖ Promising green technology of small and medium-sized companies
  - Manufacturing tech. for high efficient bore hole HX for Geo-thermal system
  - Compressor manufacturing tech. for CO<sub>2</sub> HP with durability and high efficiency
  - HX manufacturing tech. for high capacity of CO<sub>2</sub> HP
  - Components (valves etc.) manufacturing tech. for high efficient CO<sub>2</sub> HP
  - High efficient variable compressor manufacturing tech. for preventing high discharging temp.
  - Air-cooled HX manufacturing tech. for delay of frost formation
  - High efficient water-cooled HX manufacturing tech.
  - High efficient and corrosion resistance HX manufacturing tech. for sea water HP system.
  - High efficient HX manufacturing tech. for sewage water HP system
  - High performance cycle simulation technology for adsorption HP system.
  - High efficient adsorbents manufacturing tech. with durability for adsorption HP system.
  - High efficient "Activated Carbon Tower" module manufacturing tech. for adsorption HP system.



## Future prospect

- ❖ Possibility of including NRE on air source heat pump
  - The MKE is planning to secure basis of future policy making by measuring heating and cooling efficiency(COP) in order to include air-source as NRE resource.
  - After installing air-source heat pump in field, its efficiency will be investigated under various temperature change for 1 year.
  - As EHP is designated a renewable energy source in Europe and Japan, it should be designated a NRE source after analyzing the effectiveness.
  - After 2012, it will be decided depending on EHP performance testing results.

