



**Governance on Green Energy  
and Carbon Reduction**

**RE Industry as a New Growth Engine  
Current Status and the Future**

**Chung Hua Institution for Economic Research**

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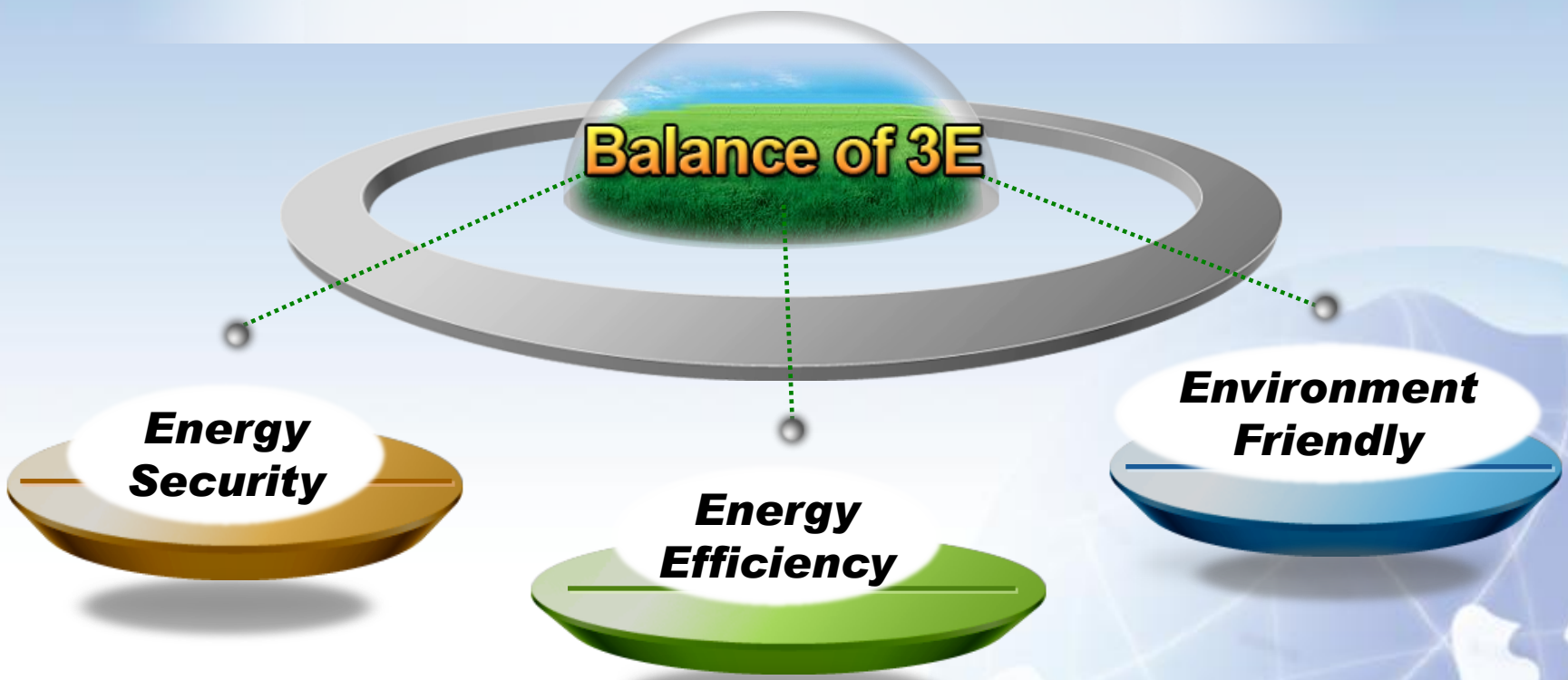


# DEVELOPMENT STRATEGY OF GREEN ENERGY INDUSTRY

# LONG-TERM NAT'L ENERGY POLICY DIRECTIONS



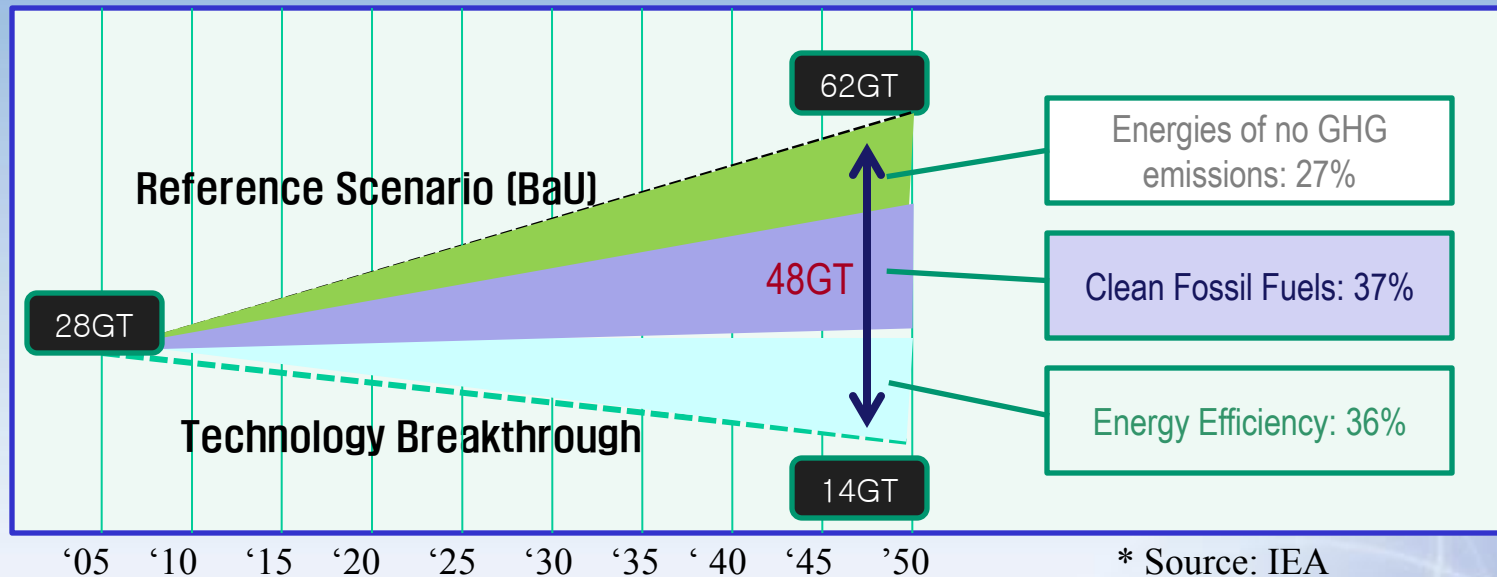
## Low Carbon GreenGrowth



# CONCEPT OF GREEN ENERGY INDUSTRY



## New Industries to reduce GHG emissions



	Technologies
Renewable Energy	Solar PVs, Wind, H2/Fuel Cells, IGCC
Clean Fuels	GTL, CTL, CCS
Energy Efficiency	LED, Electricity IT, Energy Storage, Small-cogeneration, Heat Pumps, Super Conductivity

# VISION & STRATEGY OF GREEN E INDUSTRY



Becoming a Global Leader in Green Energy Industry

Narrow Gap from Developed Countries via Selection & Concentration  
Full-Cycle Supporting System from R&D to Export Industries

## Strategy 1

Strategic Selection  
Of 9 Promising Techs

- marketability technology, urgency
- Classifying early growth engine and next one

## Strategy 2

Market-oriented  
Tech. Development

- Tech development target & roadmap
- Diversification of technology gain
- Combination of R&D and validation

## Strategy 3

Market Creation  
Export Industry

- Leading demand in the public sector
- Support business entities in developing foreign market

## Strategy 4

Infrastructure  
Building

- Gov. & private joint implementation system
- Securing stable funding sources
- Training experts

# CATEGORY AND APPROACH



Category	Approach	Technology	Cool Earth (Japan)	SET-Plan (EU)	CCTP (USA)
Early Growth Engine (9)	Market Pull	Solar PVs	√	√	√
		Wind		√	√
		LED	√		√
		Electricity IT		√	√
	Technology Push	H2/FC	√	√	√
		Clean Fossil Fuel	√	√	√
		Coal IGCC	√	√	√
		CCS	√	√	√
		Energy Storage	√		√
Next Growth Engine (6)	Corporate-led	Heat Pump	√		√
		Micro Cogen		√	√
		HT Nuke Reactor	√	√	√
		E Effic. Bldg	√		√
		Green Car	√		√
	Univ./ R&D Ctr	Super Conductor	√		

# INFRASTRUCTURE FOR GREEN GROWTH



## Nation-wide implementation

- Establishment of “Green Growth Committee” as a control tower (Chair: Prime Minister and Private)
- National Green Growth Strategy : 5 year Roadmap for Green Growth (June 2009)

## Stable Source Of Funding

- Green Energy Investment Fund: raising 100 billion Won
- Matching Fund : Policy Fund 50%, Bank Loan 50

## Improved System of RED Implementation

- Expansion of Korea Energy Technology Evaluation & Policy (KETEP )as Core Organization for Green Growth
- Integration & Coordination of Green Energy Technologies and Improvement of R&D Efficiency

## Human Resources Education & Training

- Training Green Energy-related 150,000 experts of Master and PhD
- Special Graduate School for Climate Change, NREs, Natural Resource Development
  - \* Producing 344(Climate Change0, 334(NREs), 1658(Natural Resources Development between 2008 and 2012



# LARGE SCALE DEPLOYMENT OF NRES



- Govn't-driven → Encouraging the private sector's initiative
- Mandatory use of NREs in the public sector
- A wide uptake of a variety of NREs

## Million Green Home 2020

	2004-7	2008-12	2012-20	Total
Goal (unit)	17,400	94,150	913,000	1,024,550
Budget (10 <sup>9</sup> ₩)	2,280	13,300	137,530	153,080

- Village-based, local autonomy, “Green Village” Award (2010)
- Unit: village, site: NRE mix to be decided based on village & sites

# INSTITUTIONAL ARRANGEMENTS-1



Supply	GenCos	<ul style="list-style-type: none"> <li>• Voluntary NRE investment (RPA)→RPS (2012)</li> <li>• Share of total power generation to be estimated</li> </ul>
	Petro	<ul style="list-style-type: none"> <li>• recommending biodiesel mix →RFS (2012) available feedstock</li> <li>• 3% by 2012, 7% by 2020</li> </ul>

❖ RPA: Renewable Portfolio Agreement, RPS: Renewable Portfolio Standards, RFS: Renewable Fuel Standards

Design	New Town	<ul style="list-style-type: none"> <li>• NRE integrated design of government complexes, innovative cities, new towns: gov't complexes (10%)</li> </ul>
	Public Building	<ul style="list-style-type: none"> <li>• Over 5% of total energy load with NRE, scale up annually (2012)</li> <li>❖ (current) 5% of construction costs with NRE facilities</li> </ul>
	Private Building	<ul style="list-style-type: none"> <li>• Introduction of NREs certificates (2010)</li> <li>❖ NRE use over 5% of total energy load eligible for incentives</li> </ul>

# INSTITUTIONAL ARRANGEMENTS-2



## Administrative System

<b>Inter-ministerial Cooperation</b>	<ul style="list-style-type: none"> <li>• Voluntary NRE investment (RPA) → RPS (2012)</li> <li>• Recommendation of biodiesel mix → mandatory: RFS (2012)</li> </ul>
<b>Enhanced Role of Local Autonomy</b>	<ul style="list-style-type: none"> <li>• NREs in conjunction with Local industry/energy clustering</li> <li>• Local autonomy's ordinance</li> </ul>

## Regulation Reform

- Identify barriers to be removed for a wider uptake of NREs

<b>Allow rooftop PVs installation within zones of limited development</b>	<b>M of Land, Transp, Maritime Affairs</b>
<b>Offshore wind, tidal power: occupation &amp; use of public water surface to be extended</b>	<b>M of Land, Transp, Maritime Affairs</b>
<b>Organic waste biogas to get access to city gas pipeline</b>	<b>MKE, ME</b>
<b>Permit wind turbine installation above top areas of mountains</b>	<b>M of Forest</b>



# **CURRENT STATUS & FUTURE OF NRE IN KOREA**

# POLICY EVOLUTION IN KOREA



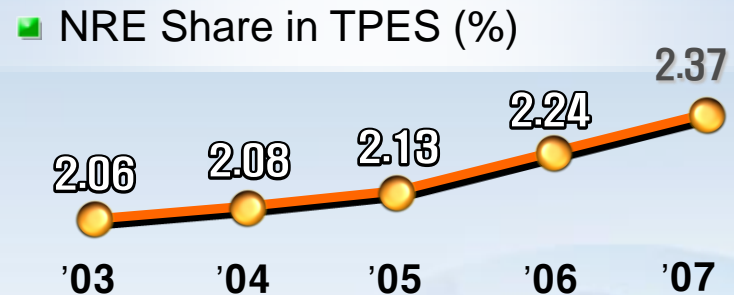
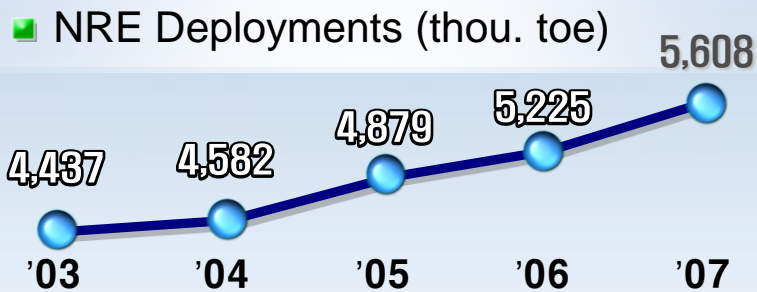
Year	Legislation	Notes
1987	Promulgation of The Promotional Act of NRE Development	Legal basis for NRE R&D activities
1997	Promotional Act of NRE Development, Utilization&Deployment(1 <sup>st</sup> Amendment)	Amendment for legal basis for NRE dissem.
2002	Promotional Act of NRE Development, Utilization&Deploymnt (2 <sup>nd</sup> Amendment)	Incl. obligation on pub. bldg, cert. FIT,
2003	The 2 <sup>nd</sup> National Basic Plan for NRE Technology Development & Deployment	10 yr plan, target: 3%(2006), 5%(2011)
2004	Promotional Act of NRE Development, Utilizat'n&Deploymnt(3 <sup>rd</sup> Amendment)	Incl. standardizat'n, RESCOs. etc.
2008	The 3 <sup>rd</sup> National Basic Plan for NRE Technology Development & Deployment	Target yr 2018(mid), 2030 (long), RE industry promotion

# STATUS OF NRES IN KOREA

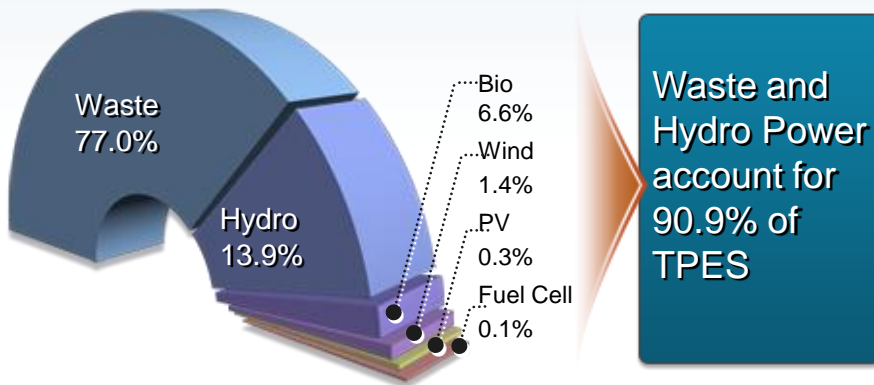


## Definition of NRE Sources

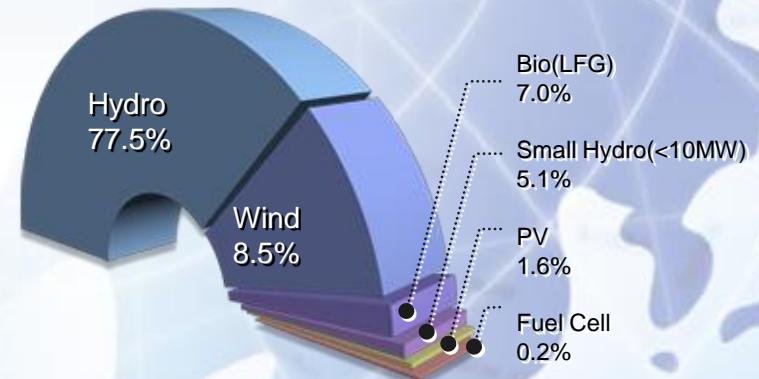
- 11 Categories : Solar PVs, Solar Thermal, Wastes, Bio(LFG, Bio-diesel), Hydro, Geothermal, Marine, Wind, Hydrogen, Fuel Cell, Coal Liquefaction /Gasification



< Composition of NREs ('07p) >



< Power Generation from NRE ('07p) >



# GOALS AND STRATEGIES



## Sustainable Energy Development via New & Renewable Energy

Goal I : NRE Deployment 11% by 2030  
Goal II : Fostering NREs as Green Growth Industry

### Strategy 1

#### Industrialization

- TRM/PRM
- Validation/Demonstration Complex
- Codes & Standards
- Export Industry

### Strategy 2

#### Larger Deployment

- Million Green Home
- NRE Design in Bldg & New Towns
- Larger Role of Local Autonomies
- Tech. Fusion

### Strategy 3

#### Infrastructure

- Industrial Codes
- Finance mechanism & funding
- Removing barriers
- Statistics & DB

### Strategy 4

#### Market Mechanism

- RPS/RFS
- Integrated Policy
- Green Pricing
- Tradable RECs

# LONG-TERM DEPLOYMENT OF NRES



## ■ Business As Usual: BaU

- Continuation and Maintaining of the Current Policy: Annual growth Rate similar to that between 2003 and 2007
- Way higher as compared to those growth rate of 1.3% and 0.9% in the primary energy consumption during the same period

## ■ Strengthened Policy

- Strengthening R&D and Deployment Policy
- Annual growth rate: much higher than those of BaU

		2008	2010	2015	2020	2030	~2020	~2030
BaU	Share(%)	2.6	2.9	3.6	4.2	5.7	6.3%	5.3%
	Thou.TOE	6,360	7,390	10,323	13,233	19,558		
Policy	Share(%)	2.6	3.0	4.3	6.1	11.0	8.8%	7.8%
	Thou.TOE	6,360	7,566	11,731	17,520	33,027		



# LARGE SCALE DEPLOYMENT OF NRES

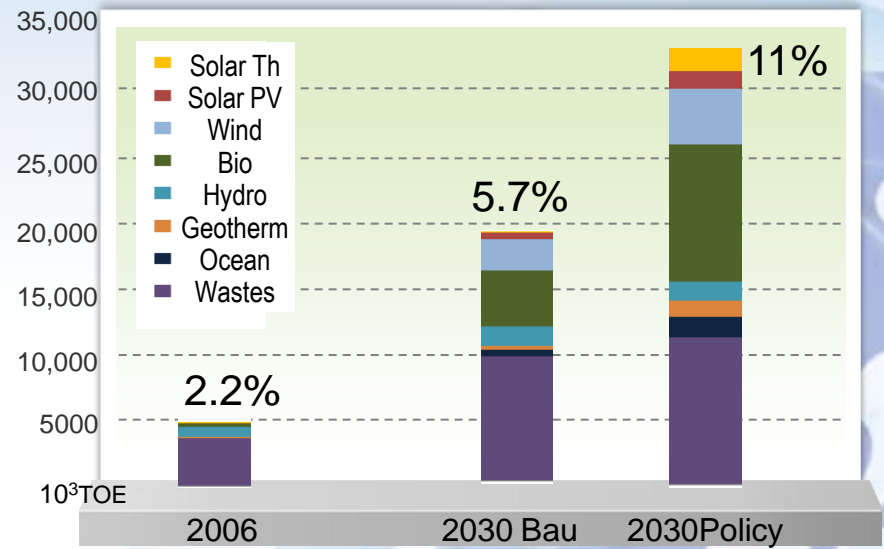
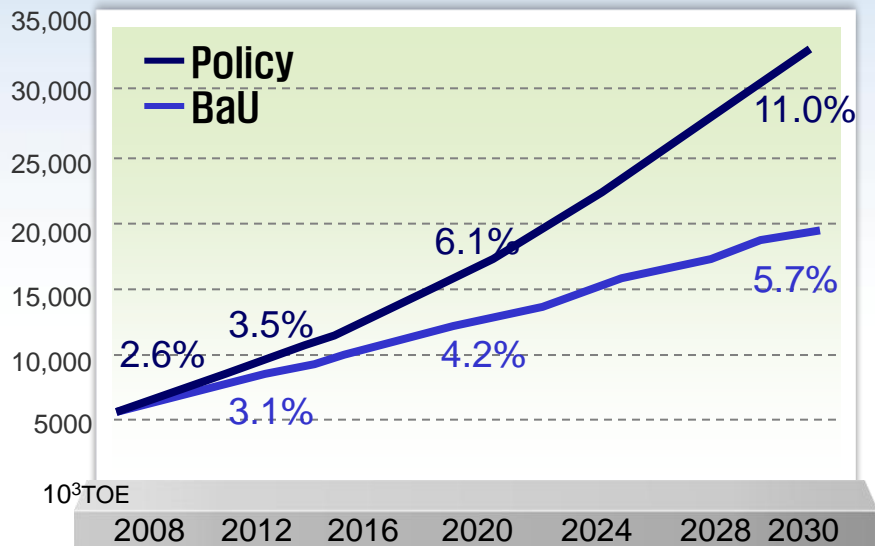


- Deployment of NREs based on Cost-effectiveness
  - Biofuels, Ligneous Biomass, Tidal Power, etc.
- Expansion of resource-recycled energy system based on wastes-to-energy
- Strategic R&D and deployment: wind, solar PVs, H2/Fuel Cells
- As a result, energy mix in NRE consumption shifted into a balanced one

**Wastes** 75% → 33%

**Bio E** 8.1% → 31%

**PV/Wind** 3.1% → 22.4%



# DEPLOYMENT TARGET BY NRE TYPE



(Unit: 1,000 toe)

	2010	2015	2020	2030	Avg. annual growth rate (%)
<b>Solar</b>	40 (0.5)	63 (0.5)	342 (2.0)	1,882 (5.7)	<b>20.2</b>
PVs	138 (1.8)	313 (2.7)	552 (3.2)	1,364 (4.1)	15.3
Wind	220 (2.9)	1,084 (9.2)	2,035 (11.6)	4,155 (12.6)	18.1
Bio	987 (13.0)	2,210 (18.8)	4,211 (24.0)	10,357 (31.4)	14.6
Hydro	972 (12.8)	1,071 (9.1)	1,165 (6.6)	1,447 (4.4)	1.9
<b>Geothermal</b>	43 (0.6)	280 (2.4)	544 (3.1)	1,261 (3.8)	<b>25.5</b>
<b>Tidal</b>	70 (0.9)	393 (3.3)	907 (5.2)	1,540 (4.7)	<b>49.6</b>
Wastes	5,097 (67.4)	6,316 (53.8)	7,764 (44.3)	11,021 (33.4)	4.0
Total	7,566	11,731	17,520	33,027	7.8
Primary E (10 <sup>6</sup> TOE)	253	270	287	300	0.9
<b>Share</b>	<b>2.98%</b>	<b>4.33%</b>	<b>6.08%</b>	<b>11.0%</b>	



# NEW & RENEWABLE ENERGY STATUS & POLICIES BY TYPE

# SOLAR PVs



## Building Industrial Foundation for Solar PVs

### ■ Expansion of Domestic Market

#### – Cost down based on a wide uptake of solar PV systems

- Solar roofs program: 100 roofs in 2003 → 8,000 in 2007 → 10,000 in 2012
- Installation cost: \$15,000/kW in 2003 → \$9,400 in 2006 → \$84,000 in 2007

### ■ Promoting Solar PVs as an export industry through aggressive investment

#### – Integrated mass production

- Poly-silicon, etc

#### – Emergence of PV export companies

- Hyundai Heavy Industry and KPE, etc
- Over 20,000 thousand dollars per year



# WIND POWER



## Expanding Onshore Wind and Developing Offshore Wind

- **Wide uptake of Onshore Wind via Strategic Approach**
  - Governmental support such as subsidies, financial supports, Feed-In Tariffs
  - Deployment of indigenized wind turbines in conjunction with local NRE dissemination (Kangwon : 98MW)
- **Indigenization of Onshore Wind Power Generation**
  - Technical validation of onshore wind technology
  - Indigenization of 3MW onshore wind turbine
- **Mass Production of Wind Power System**
  - Investment in facilities for mass production of indigenized wind turbines and blades
    - 750kW turbines indigenized



# HYDROGEN & FUEL CELLS



## Building Infrastructure in transition to H2 Economy

- **A Long-Term Master Plan for a H2 Economy** was established and being implemented
  - Basic strategies and phased action plan were developed to realize a H2 economy by 2040
  - Institutional arrangements underway as a follow up to the master plan
- **Development and Deployment of Fuel Cells in Energy Sectors**
  - **Transportation:** Expanded R&D, monitoring projects, building infrastructure including H2 stations
  - **Residential:** R&D and monitoring for RPG
  - **Power generation:** grid-connected fuel cell power plants, micro fuel cells for notebooks



# BIOENERGY



## Developing Bioenergy as the Next Major NRE Source

### ■ A wide uptake of Biodiesel

- Commercialization and deployment of BD5 since July 2006
- “Mid- and long-term plan for Biodiesel dissemination”
  - Demonstration: Seoul Metros ('02-'05)→nation-wide (BD5) since 2006

### ■ Technology Validation of Ethanol

- Replacing MTBE with ethanol as oxygenator
- A study on market development for ethanol



### ■ Ligneous Biomass and Biogas, etc

- Energy utilization of ligneous biomass
  - wood chips and pellets as feedstocks for cogeneration
- Livestock manure to be used for biogas generation in conjunction with local NRE deployment

# GEOTHERMAL/SOLAR THERMAL



## Securing a Industrial Foundation via Wide Uptake

### ■ Geothermal: Development of Core Technologies and Expansion of Deployment Base

- Consistent implementation of subsidization, local NRE dissemination projects
- Reform in electricity rate structure to allow for a wide-spread use of heat pumps



### ■ Solar Thermal: Securing a Stable Market

- Operation of A/S centers to resolve complaints from customers
  - 8 regions for 2,999 units
- Technology development and validation





# WASTE-TO-ENERGY



## Building an Environment-Friendly Resource Recycling System

### ■ Environment-Friendly Use of Wastes

- Combustible Renewable Wastes → RDF, RPF, etc.
- A greater number of RDF production plants using combustible municipal wastes in urban areas

### ■ Cogeneration based on RDF

- Technology validation of 10MW RDF cogeneration plant



# IGCC/TIDAL POWER



## Incremental Expansion in consideration of Economics

### ■ IGCC as the Next Generation of Coal-Fired Power Generation Technology

- Technology validation of a 300MW plant underway (2006-2014)
- Participation in USDOE's FutureGen Project (2006-2011)



### ■ Tidal Power

- Commercial tidal power plants underway
  - Tidal Power Plant (254MW) in Sihwa Lake by Korea Water Resources Corporation (KWRC)
- New 2-3 major projects under consideration
  - Kanghwa Island, Garorim & Cheonsoo Bays, etc.



# HYDRO POWER



## Development of Various Types of Hydro Power

### ■ Large Hydro Power

- Environmental regulations: major barriers to development of a large hydro power and small ones as well

### ■ Small Hydro Power

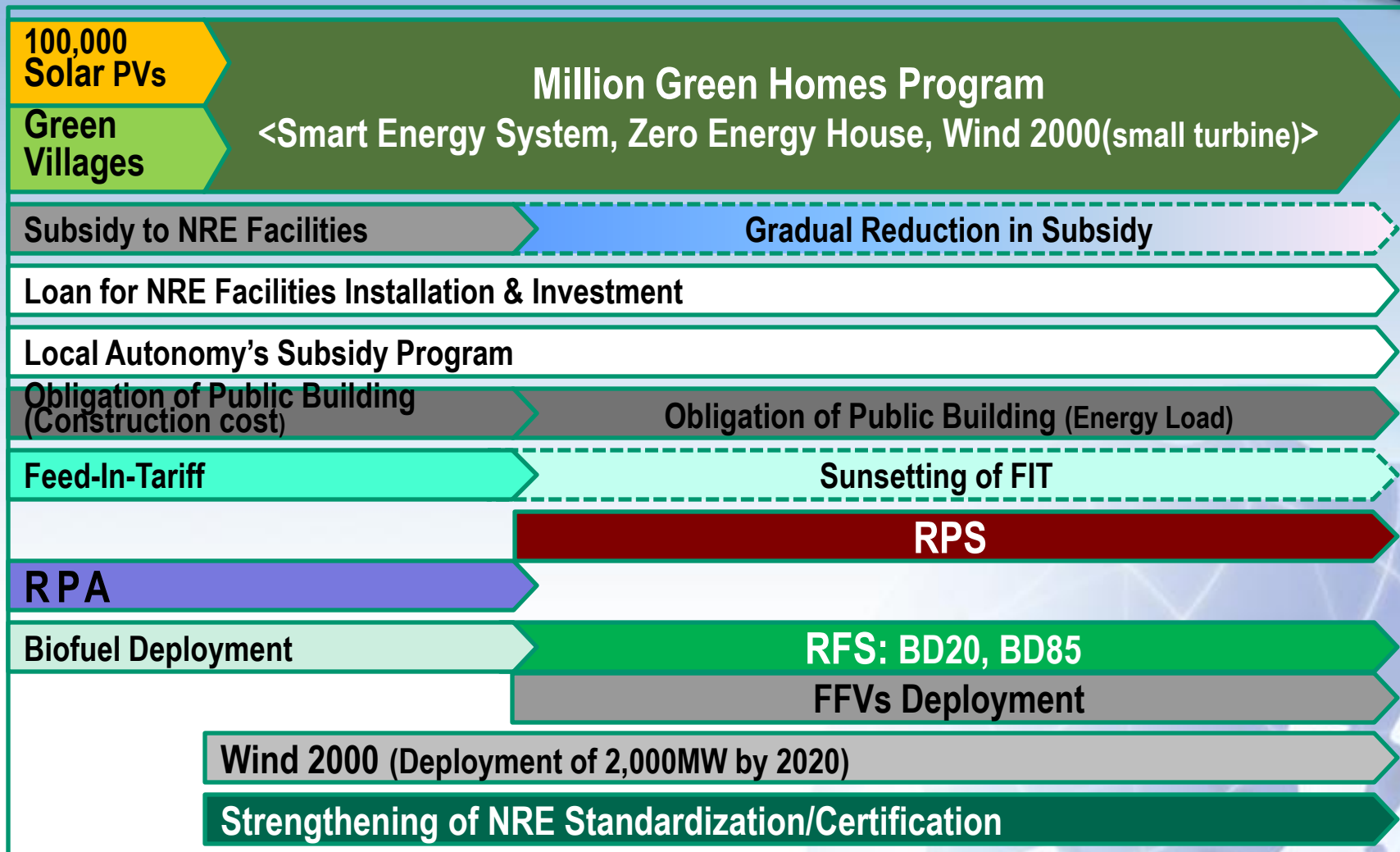
- Development potential: 1,500MW, Installed capacity: 62MW
- Kaplan, Francis types were indigenized and development of micro-system underway
- Feed-In Tariff to be improved to induce a wider uptake of small hydros
- Developing a variety of small hydro power sources
  - Cooling towers of power plants, water reservoir for agriculture, etc.



# ROADMAP FOR NRE DEPLOYMENT



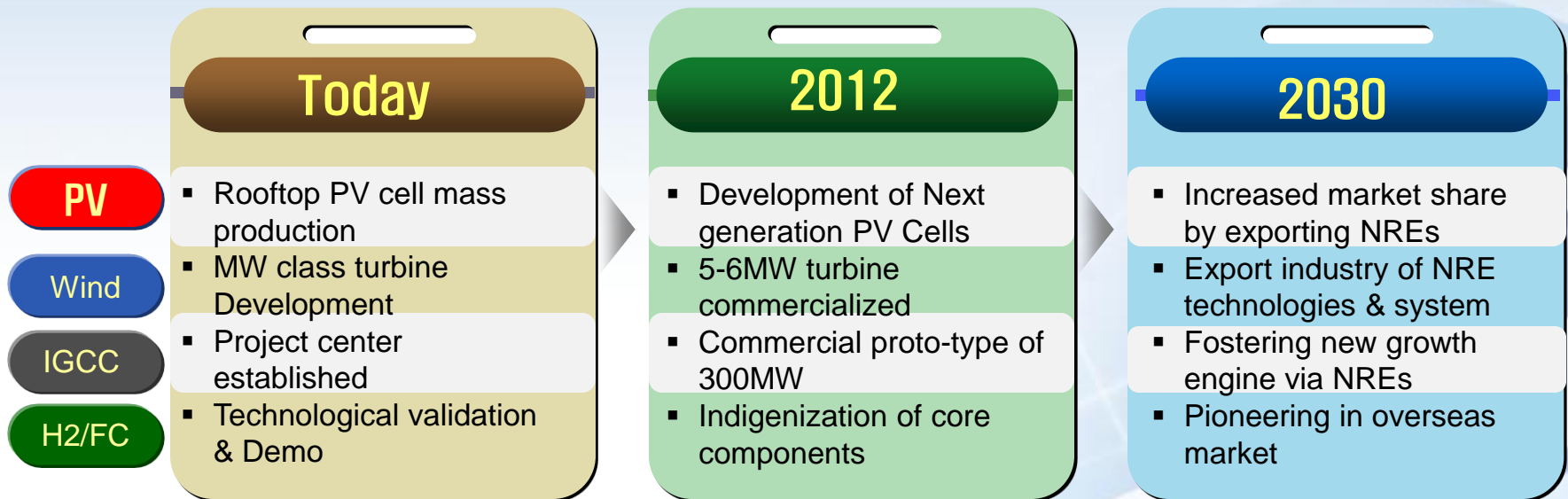
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020



# LONG-TERM VISION OF NRES



- **Fostering Domestic NRE industry via indigenization of core technologies**
  - Cooperation b/w large enterprises and SMEs → industry cluster of systems, components, and materials
- **Domestic NRE industry → export industry → global business entities**
  - Solar PVs: semi-conductor, display industry
  - Wind: construction and heavy industry
  - H2/Fuel Cells: leading companies, components → large scale technical validation and demonstration projects



# Thank You

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