

# National Program of Hydrogen and Fuel Cells in Korea

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on behalf of  
Ministry of Knowledge Economy

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# Hydrogen and Fuel Cell

## - Hydrogen and Fuel Cell Program since 1988

Background: Urgent Energy and Environmental Challenges

Programs: Research, Development, Validation, Demonstration,  
and Commercialization

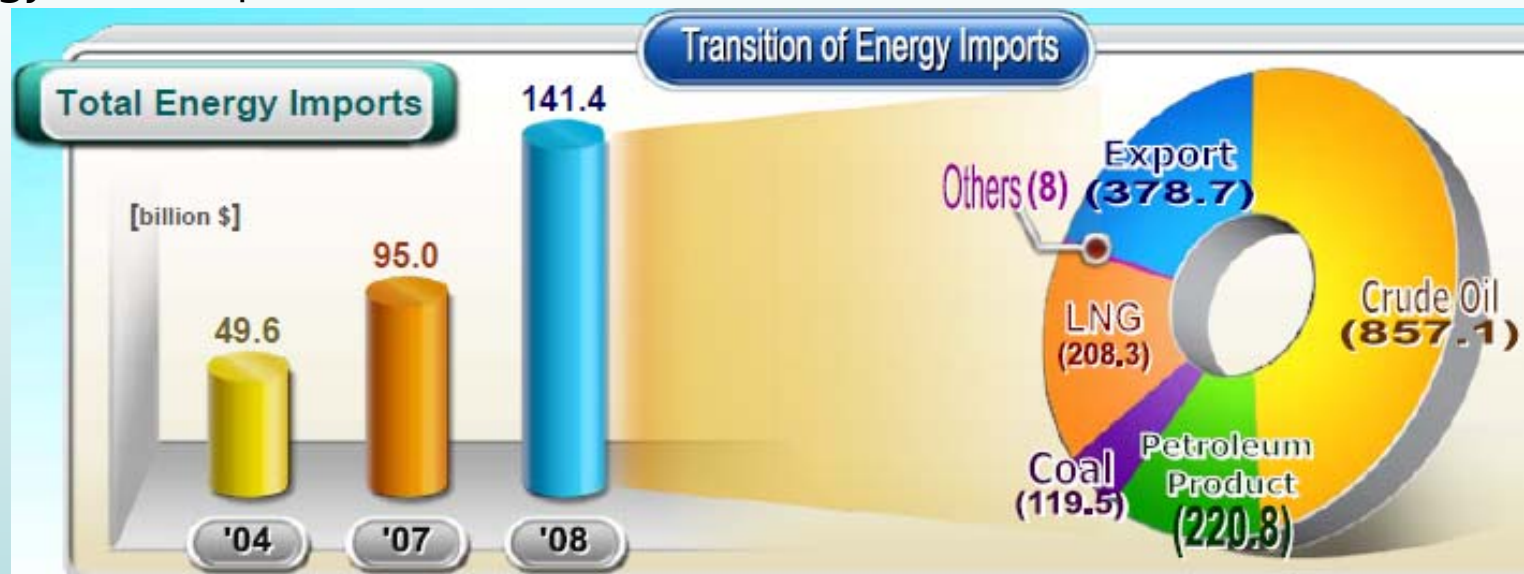
## - Energy Situations in Korea

Population: ~50 million

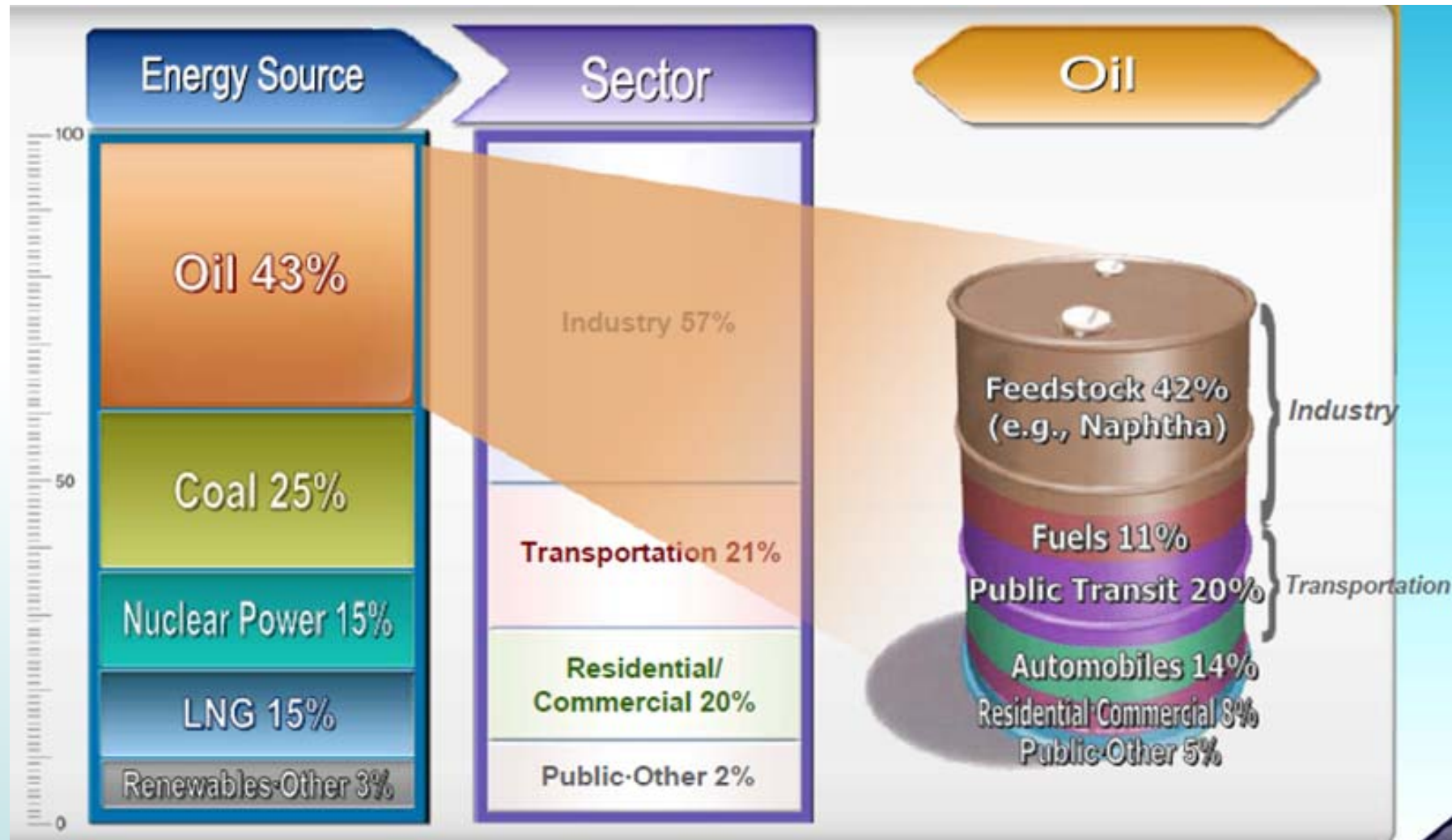
Energy Import (97%)

5<sup>th</sup> largest Oil importer, 2<sup>nd</sup> largest LNG importer

Energy consumption (10<sup>th</sup>)

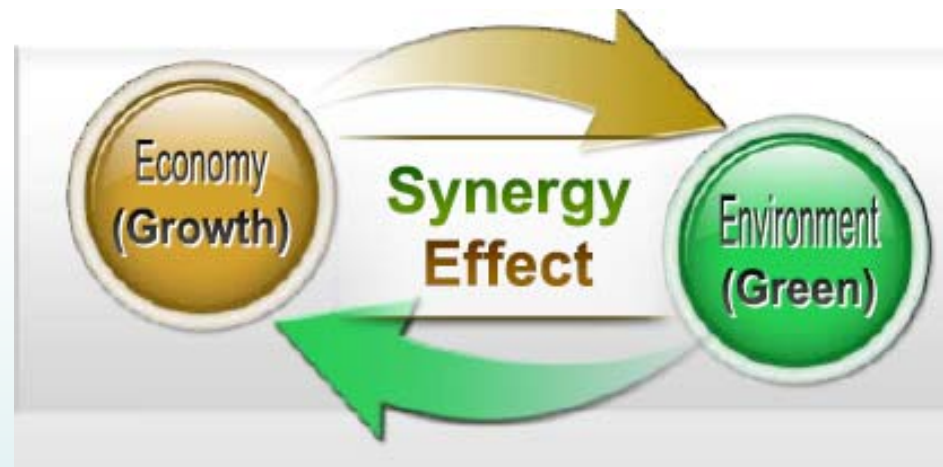


- Energy-intensive, Manufacturing-based Economy



# Declaration of "Low Carbon, Green Growth"

- "Low Carbon, Green Growth" as the new national vision



- "Low Carbon, Green Growth"  
as a means to change the structure of our economy and  
create a new growth engine

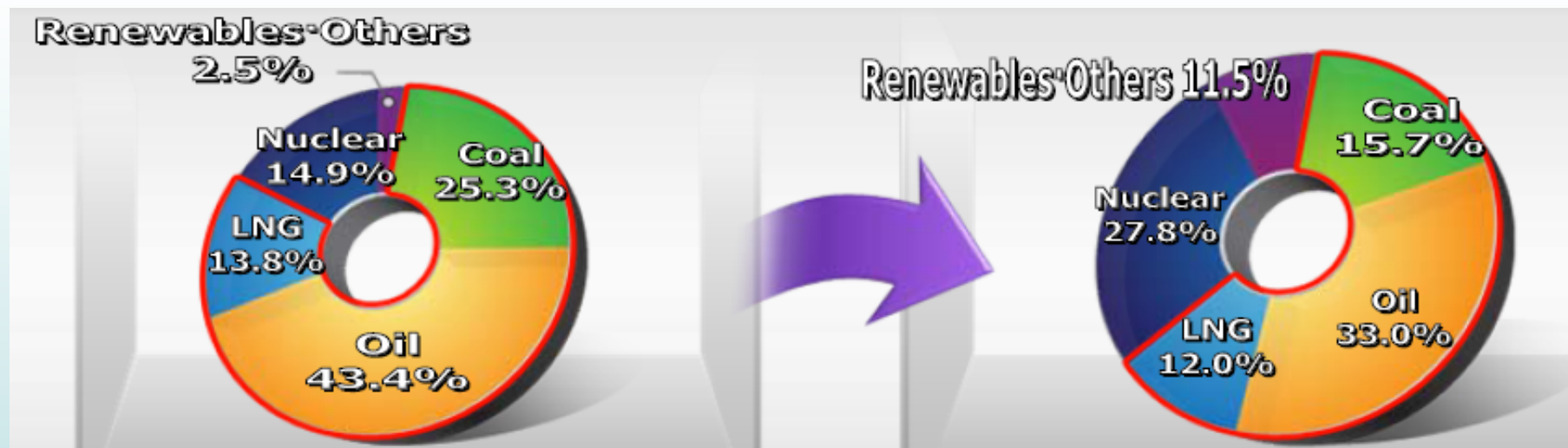
## Fostering New and Renewable Energy(NRE) Industry

- Increased renewable energy share: 2.24%('06) → 11%('30) → +20%('50)
- Initial market creation & reinforced promotion programs
- \* 1 Million Green Homes' project, Strengthen mandatory NRE use in public buildings, etc.

## Proportions by Energy Source

2007

2030



# Strategic Choice of 9 Potential Sectors

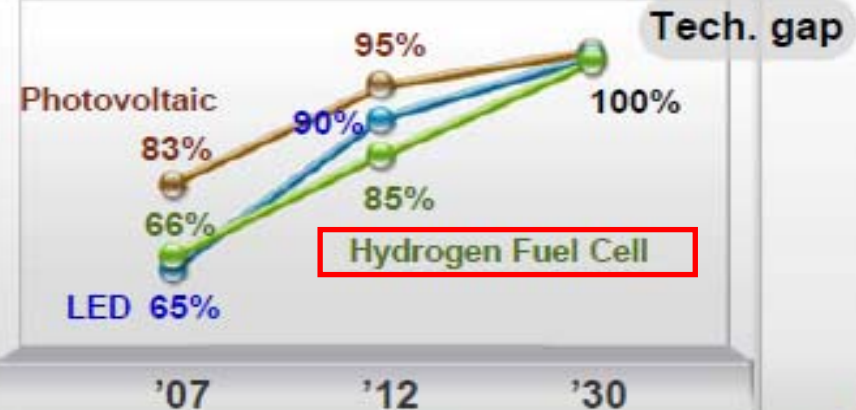
## Foster 9 sectors considering Marketability, Technical Ability, Urgency

	9 Sectors	World Market Size	Domestic Production	Technology level (Advanced Nations-2009)
<p>Rapid Development of World Market Development of related Domestic Industries</p> <p><b>Early Growth Engine</b></p>	Photovoltaic	20.0 bil. \$	140 mil. \$	83%
	Wind	37.5 bil. \$	400 mil. \$	79%
	LED	14.0 bil. \$	1,160 mil \$	65%
	Electrical IT	13.0 bil. \$	70 mil. \$	85%
<p>Huge Potential World Market Urgent Need for Technological Advance</p> <p><b>Next-Generation Growth Engine</b></p>	Hydrogen Fuel Cell	3.2 bil. \$	-	66%
	<b>IGCC</b> (Integrated Gasification Combined Cycle)	8.6 bil. \$	-	56%
	<b>CTL / GTL</b> (Coal-to-Liquids/Gas-to-Liquids)	28.5 bil. \$	-	50%
	Energy Storage	0.5 bil. \$	-	60%
	<b>CCS</b> (CO2 Capture & Storage)	-	-	65%

# Market-Oriented Technology Development

Invest 3 trillion won for 5 years ('08 ~ '12), Close the technology gap by '12

## Investment



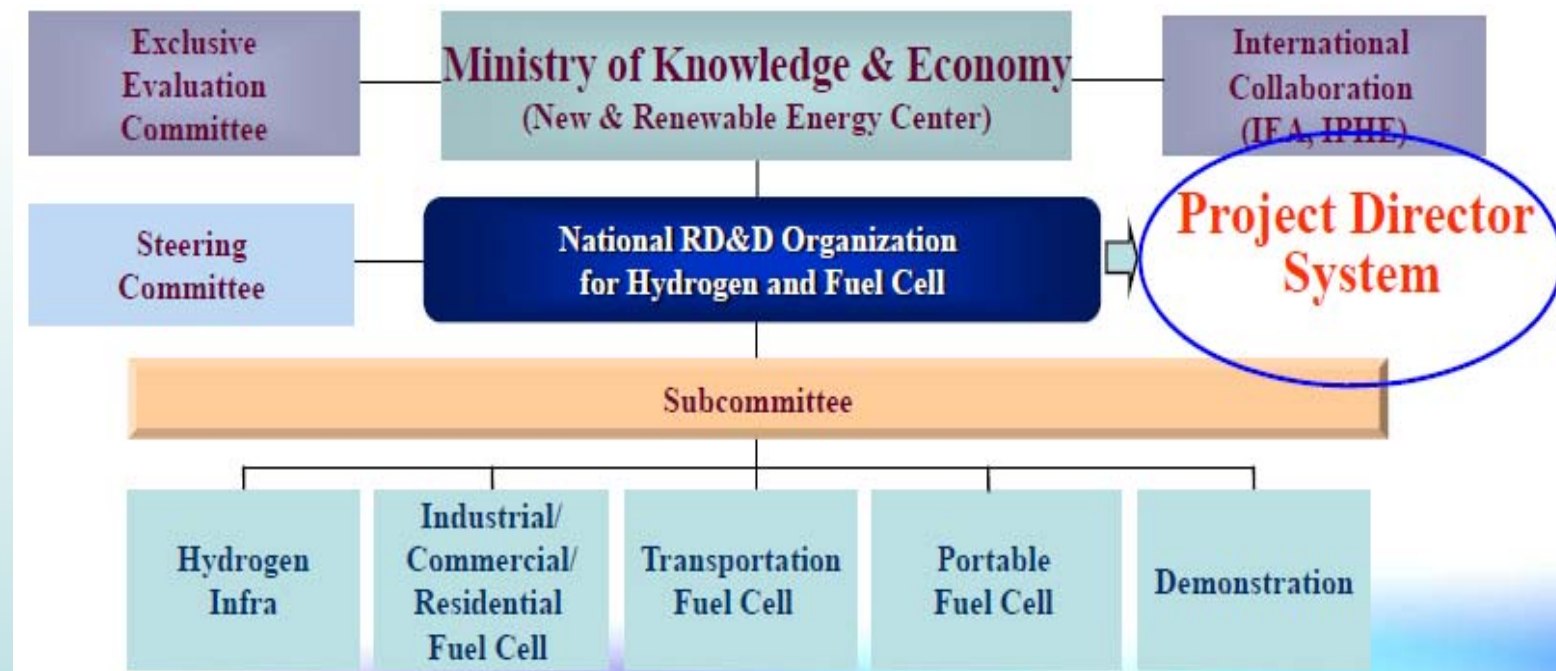
Trillion won = 10 billion dollars

## Target Setting and Establishment of Technology Development Roadmap

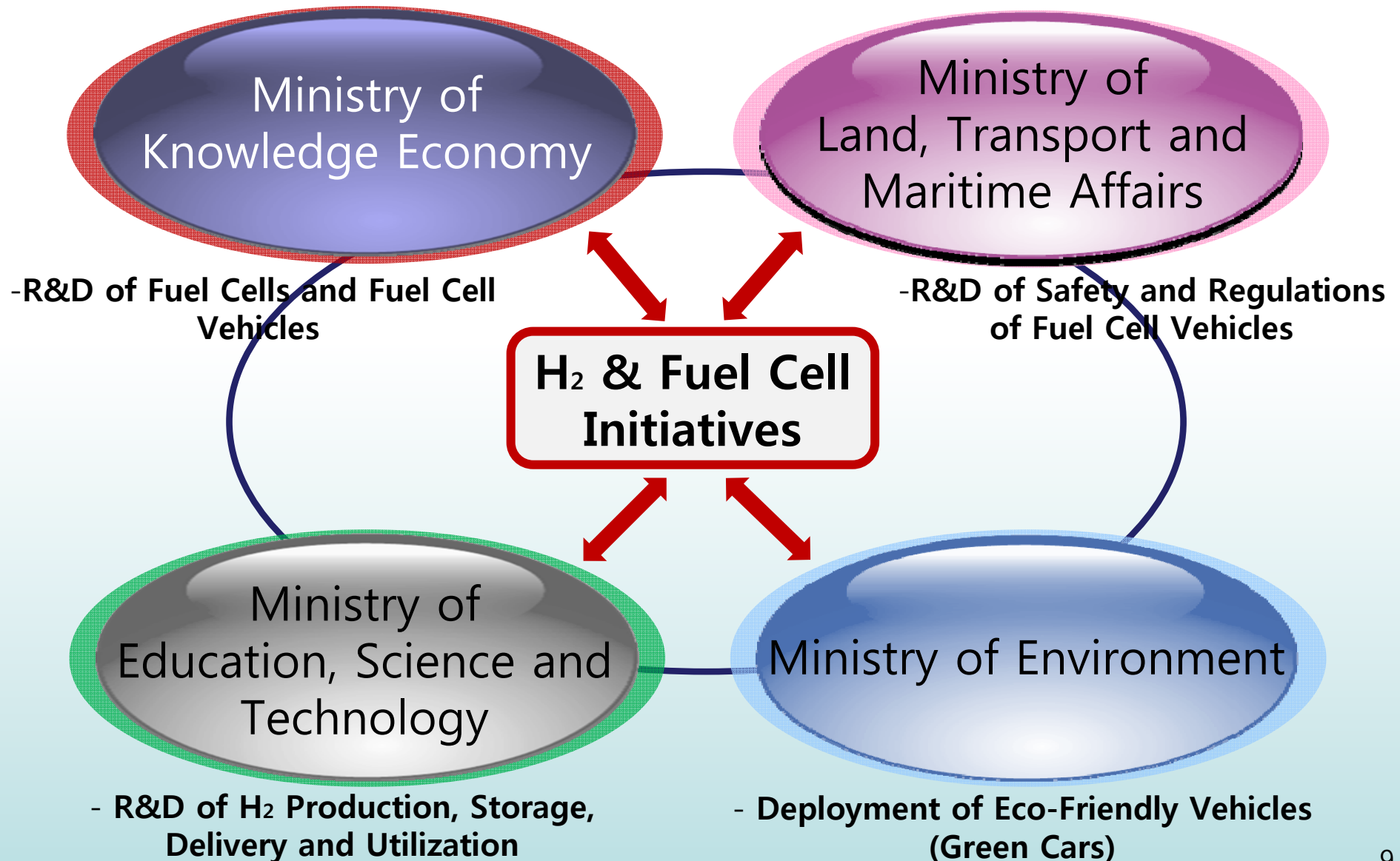
	Technology Development Target (Example)	World Market Share('07)	
		2012	2030
Photovoltaic	'20, Profitability of Fossil Fuels(Generation Cost 150 won/kWh)	5	15
Hydrogen Fuel Cell	'15, kW unit household battery (Cost : '08, 70mil. won → '15, 5mil. won)	6	15
IGCC	'12, 300MW unit design technology	1	10
LED	'15, 100 lm/W unit key original LED technology	16	20

# National RD&D Organization for H<sub>2</sub> & Fuel Cell

- Established in 2003 to expedite the commercialization of **Hydrogen and Fuel Cell**
- Propose the Vision for Hydrogen economy in Korea
- Develop a **national plan, road maps** to create a new industry
- Set up a detailed action plan to meet nation's dissemination target
- **Coordinate and allocate R&D programs supported by government**



# Roles & Activities of the Ministries



# R&D Activities of The MKE (Knowledge Economy)

## R&D Programs for Renewable Energy (11 types)

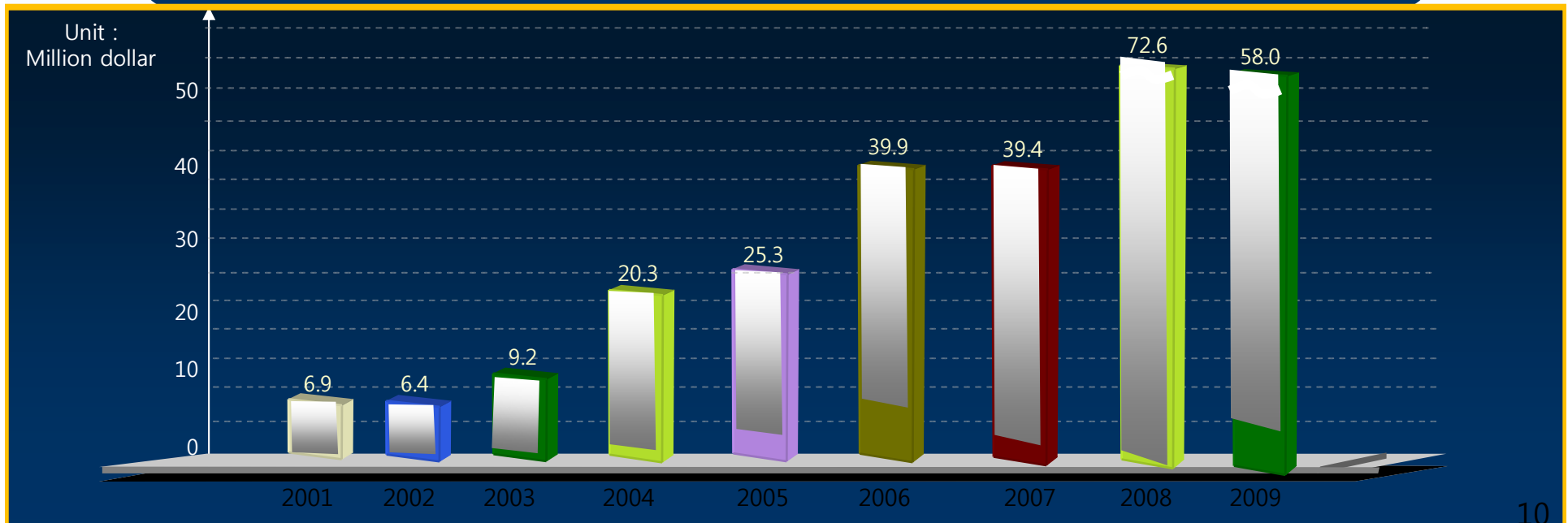
-Hydrogen, Fuel Cell, Photovoltaic, Solar, Thermal, Wind, Bio, Waste, Geothermal, Marine Energy, Hydro, Synthetic Fuel

## R&D Programs for Eco-Friendly Vehicles

-. FCEV, EV, HEV, PHEV, Clean Diesel

Budget for FCEV: \$ 7 M/year (50/50 cost share)

### Development of Hydrogen and Fuel cell (~'09 Budget : \$ 300million, 30% of Renewable energy program)



## 21st Century Frontier R&D programs: '03 ~ '12

(Budget: \$100 million (Government \$86M, Industry \$14M))

### - **Hydrogen Production**

Biological, Photocatalytic, and Photochemical Production,  
Water Electrolysis, etc

### - **Hydrogen Storage**

Metal Hydrides, Nano-Structured Materials, Chemical Hydrides, etc.

### - **Hydrogen Utilization and Policies**

# Vision of Hydrogen Economy (MKE 2003, revised in 2008)

2003 ~ 2012
R&D and Demonstration
<ul style="list-style-type: none"> <li>. Demonstration and Supply under Government Support</li> <li>. Hydrogen Energy Market Share                             <ul style="list-style-type: none"> <li>▶ 0.03%</li> </ul> </li> </ul>

2013 ~ 2020	2021 ~ 2030	2031 ~ 2040
Market Formation	Market Expansion	Initial Phase of Hydrogen Economy
<ul style="list-style-type: none"> <li>. Accomplishment of Technical Development</li> <li>. Expansion of Hydrogen Infra.</li> <li>. Self-Growing Market</li> </ul>		

'03-'05	'06-'08	'09-'12
R&D	▶ Demo	▶ Market Intrusion
<ul style="list-style-type: none"> <li>● Decentralized (250-1000kW)</li> <li>● Industrial (10-50kW)</li> <li>● Residential (under 3kW)</li> </ul>		<ul style="list-style-type: none"> <li>400 MW</li> <li>80 units</li> <li>10,000 units</li> </ul>
<ul style="list-style-type: none"> <li>● Hydrogen Station</li> <li>● Fuel Cell Vehicle</li> <li>● Fuel Cell Bus</li> </ul>		<ul style="list-style-type: none"> <li>10 units</li> <li>500 units</li> <li>20 units</li> </ul>



Fuel Cell System Market Share		
<ul style="list-style-type: none"> <li>● Decentralized 1,000 MW</li> <li>● Industrial 2,000 units</li> <li>● Residential 100,000 units</li> </ul>	10%	15%
Fuel Cell Vehicle Market Share		
<ul style="list-style-type: none"> <li>● Hydrogen Station 500 units</li> <li>● Fuel Cell Vehicle 50,000 units</li> </ul>	15%	50%

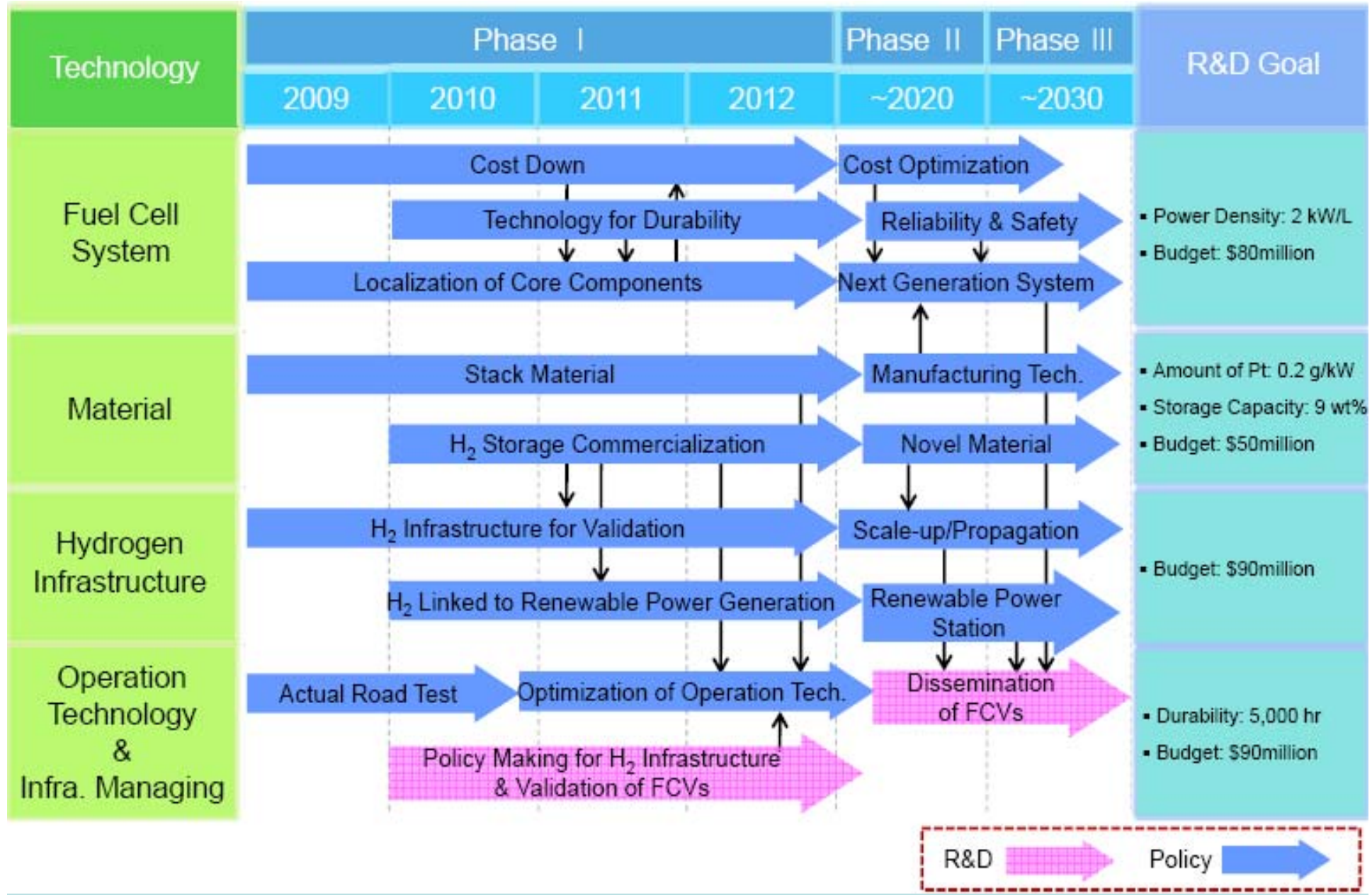
# Dissemination of Target by 2012

Fuel Cell Classification	Fuel Cell Type	Capacity	Phase I (03~05)	Phase II (06~08)	Phase III (09~12)
			R & D	Validation Demonstration	Dissemination
Hydrogen Fueling Station	-	-	1	10	50
Industrial Power Generation	MCFC	250~1,000 kW	Cumulative 300 units		
Vehicle Transportation	PEMFC	200 kW	Bus: -	Bus: 10	Bus: 200
		80 kW	Passenger Car: 10	Passenger Car: 300	Passenger Car: 3,200
Commercial Power Generation	PEMFC/SOFC	5~50kW	Cumulative 2,000 units		
Residential Power Generation	PEMFC/SOFC	Less than 3kW	Cumulative 10,000 units		
Portables	DMFC/PEMFC	2W, 50W, 100W	R & D	Commercialization	

Source: National RD&D Organization for Hydrogen and Fuel Cells (2008).

Note: DMFC = direct methanol fuel cell; MCFC = molten carbonate fuel cell; PEMFC = proton exchange membrane fuel cell; R&D = research and development; SOFC = solid oxide fuel cell.

# FCEV Roadmap of Korea (MKE, 2009)



# Domestic Fleet Program

1. Period: 2006. 8 ~ 2010. 7 (4 years)

2. Vehicles: 30 passenger cars, 4 Buses

Year	SUV	Bus	Station
1st	4	1	2
2nd	8	1	2
3rd	18	2	1



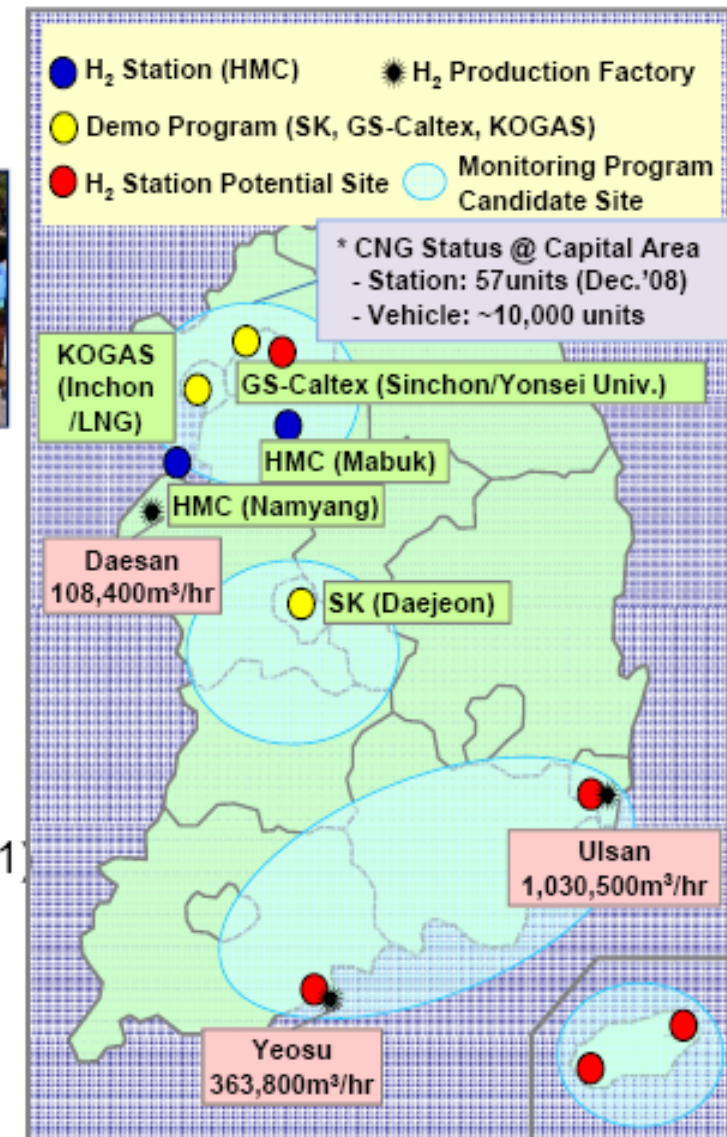
3. Budget: \$46.6 million (Government 50%)

4. Hydrogen Fueling Station: 10 (5 new stations)

- Hyundai · Kia: 2 stations (Mabuk, Namyang)
- Demo. Program: 3 stations (SK, GS-Caltex, KOGAS)
- 5 new stations (Seoul1, Cheju2, Kyungnam1, Chunnam1)

5. Results (as of Dec. '09)

- Total: 743,500km (including Bus)
- Average fuel economy: 19.2 km/l (SUV, gasoline eq.)



# FCEV Status & Near-Term Plans

- Domestic Fleet Program Phase 2: 80 FCEVs, \$17.6 M (HMC: \$12.3 M, Gov't: \$5.3 M)

- 1st Handling-over to opinion-leaders ('09.12.01)

: Demonstration Service  
(Borrego FCEV: 10 units)

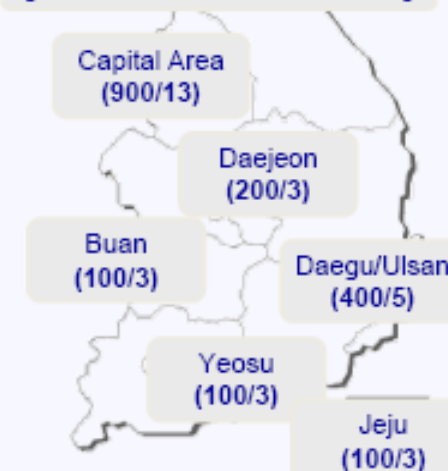


- Eco-friendly Vehicle Town: MOU with Ulsan local government

- Fueling station infrastructure & distribution of FCEVs

: Link to major cities ('12.03 ~ '15.02, \$60 M\*)

[FCEV/Station Plan ~'2015]



		1st Year (‘09.12~‘10.11)	2nd Year (‘10.12~‘11.11)	3rd Year (‘12.03~‘13.02)	4th Year (‘13.03~‘14.02)	5th Year (‘14.03~‘15.02)
FCV	Units	▪ >50 (SUV)	▪ >100 (SUV)	▪ 500 (SUV)	▪ 500 (SUV + Sedan)	▪ 1,000 (SUV + Sedan)
	Target	▪ Government Organization, HMC Group, DOE, Opinion Leaders ▪ Lease Program				
H <sub>2</sub> Station		▪ 700 bar H <sub>2</sub> Station: 2 units ▪ 350 bar H <sub>2</sub> Station Upgrade		▪ 20 units	▪ 25 units	▪ 30 units
Budget		▪ ~\$7 million	▪ ~\$10 million	▪ \$ 15 million*	▪ \$ 15 million*	▪ 30 million*

\* Assumption: Government Subsidy (50% of extra cost)

# Demonstration Project for RPG

## Targets:

- 2006.8 – 2009.8
- 40unit(1<sup>st</sup> year) → 70unit(2<sup>nd</sup> year) → 100unit(3<sup>rd</sup> year) = 210units(total)



③한진도시가스(상계)



⑭가스공사(송리공관)



①대한도시가스(시청)



⑫대한도시가스(시립대)



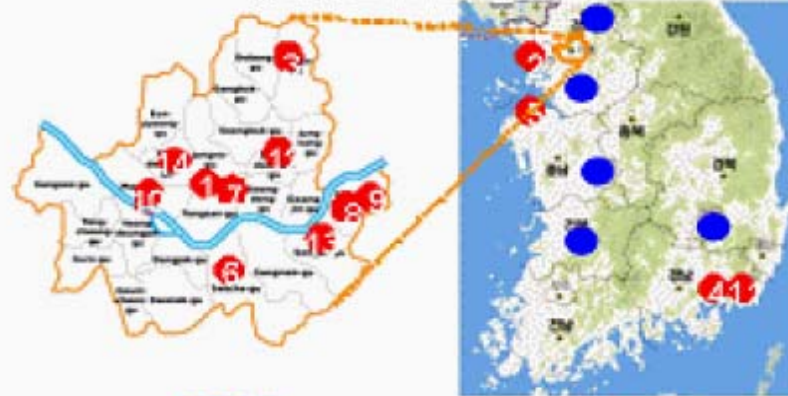
②인천도시가스(인천)



⑥대한도시가스(서초)



⑦에스코(남산빌관)



SEOUL

KOREA

● 설치 26기

● 예정 9기



④경남에너지(창원)



⑤서해도시가스(웅진)



⑧대한도시가스(암사)



⑬대한도시가스(장실)



⑨대한도시가스(교막)

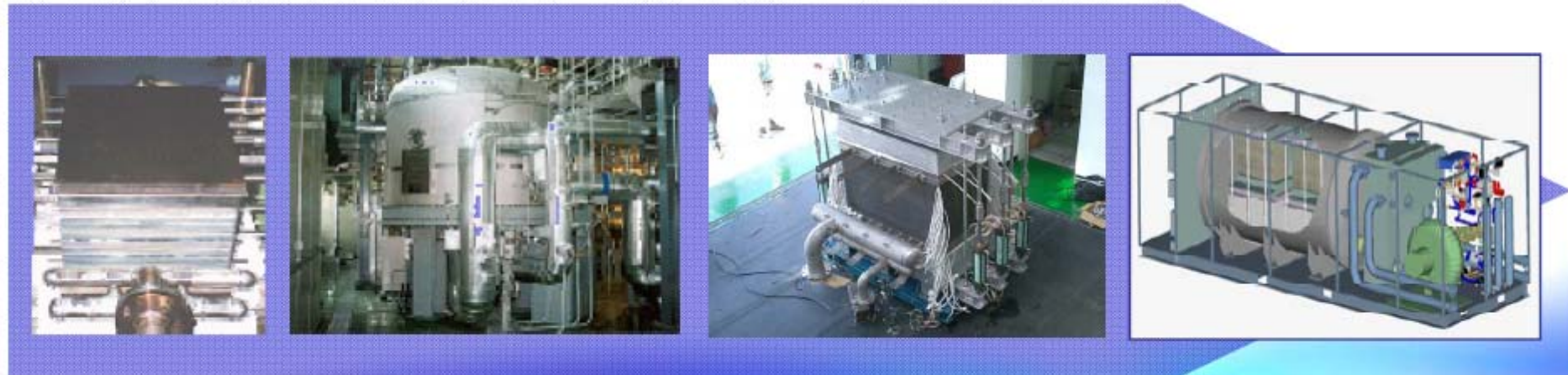
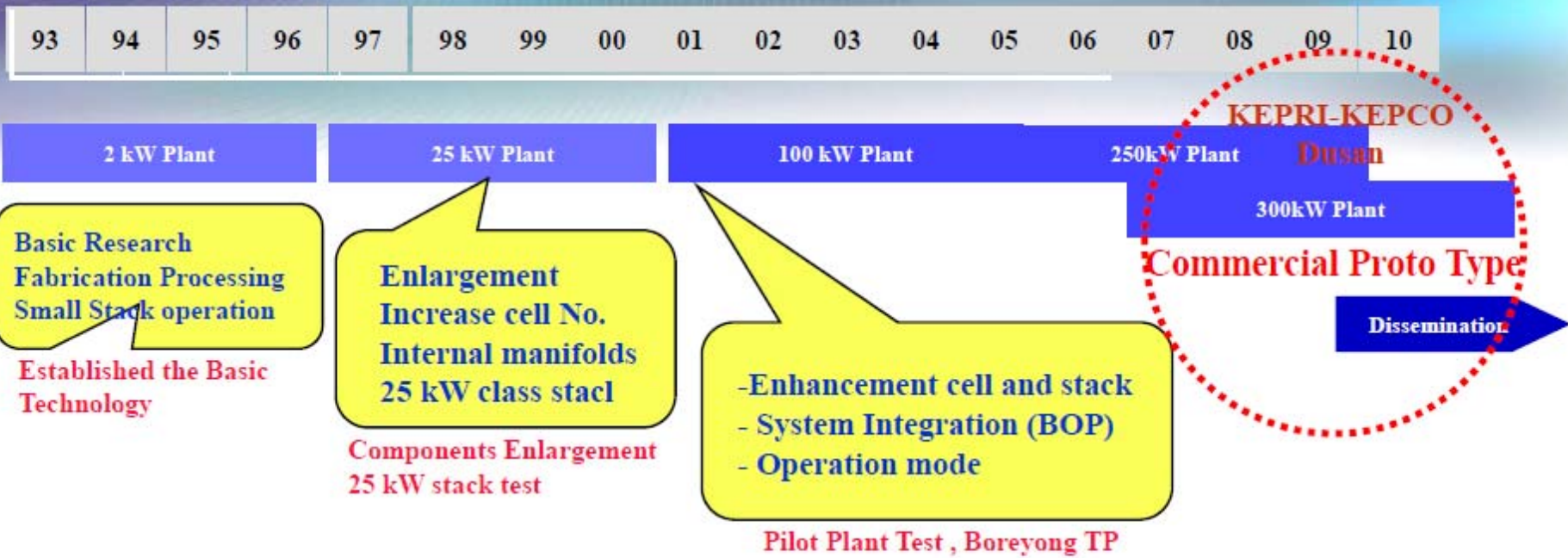


⑩에스코(마포)



⑪경남에너지(창원)

# History of MCFC Development for Power Generation Application



# Thank you

## The Creation of the New Industry

