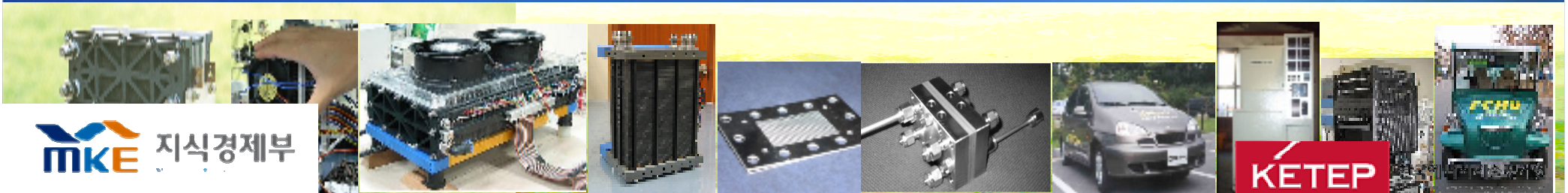


Activities of Hydrogen Fuel Cells in Korea

November 9, 2010

Won-Yong Lee

**Fuel Cell R&D Program Director
Ministry of Knowledge Economy of the Rep. Korea**



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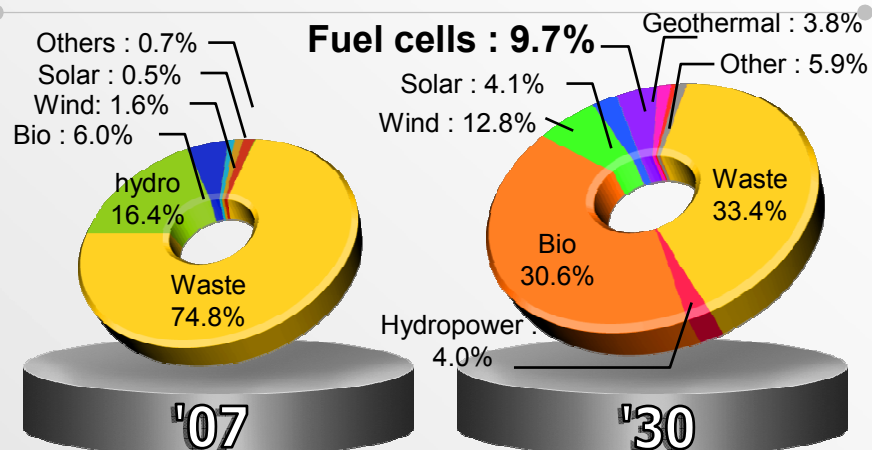
I. Introduction

Expansion of New and Renewable Energy

Based on the 10-Year basic plan for the deployment of New and Renewable Energy

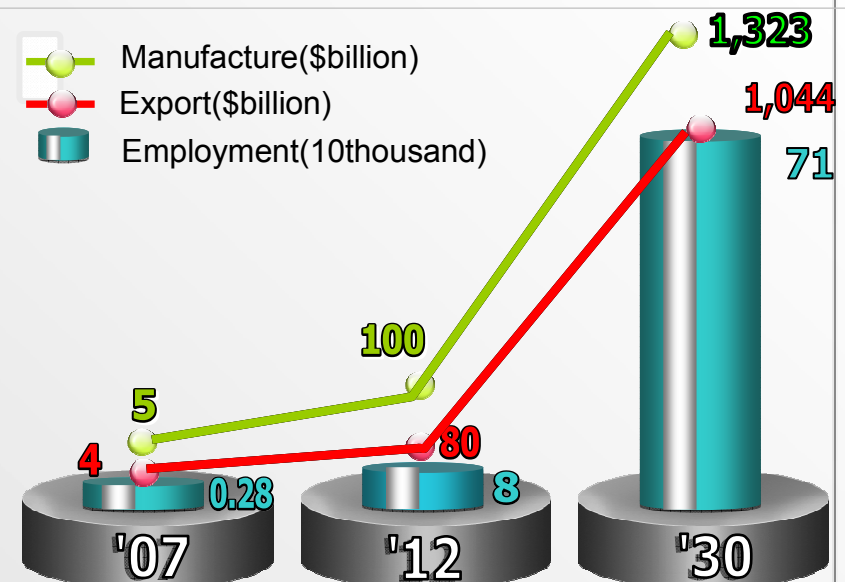
Dissemination rate of 11%

- Reach a dissemination rate comparable to Japan and the United States by 2030
- Promote Renewable Energy dissemination through regulations and policy schemes



Growth Engine

- Focus on Photovoltaics, Wind Power, and **Fuel cells** as growth engine



I. Introduction

Current State

Fuel Cells	State
PEFC: Residential Power Generation	<ul style="list-style-type: none">- At the stage of field test and Demonstration, preparing large scale deployment for the Green Home Program by 2020.- 210 Units were installed from 2006 to 2010 under demonstration program- 200 Units will be installed by end of 2010 under the Green home program
MCFC: Distributed Power	<ul style="list-style-type: none">- 300kW(from 2007) and MW Plants(from 2008) are being Developed by Doo-San- POSCO Power is manufacturing MCFC systems by technical alliance with FCE.- about 50MW will be cumulatively installed by the end of 2011
SOFC	<ul style="list-style-type: none">- At the stage of R&D-1kW, 5kW, 25kW, 100kW, Stacks and systems are being developed by KEPRI, SamSumg, and POSCO Power.

I. Introduction

Government Support System

- R&D
- Field test
- Innovative research
- Global Cooperation



- Certification
- Fostering specialists
- A/S center

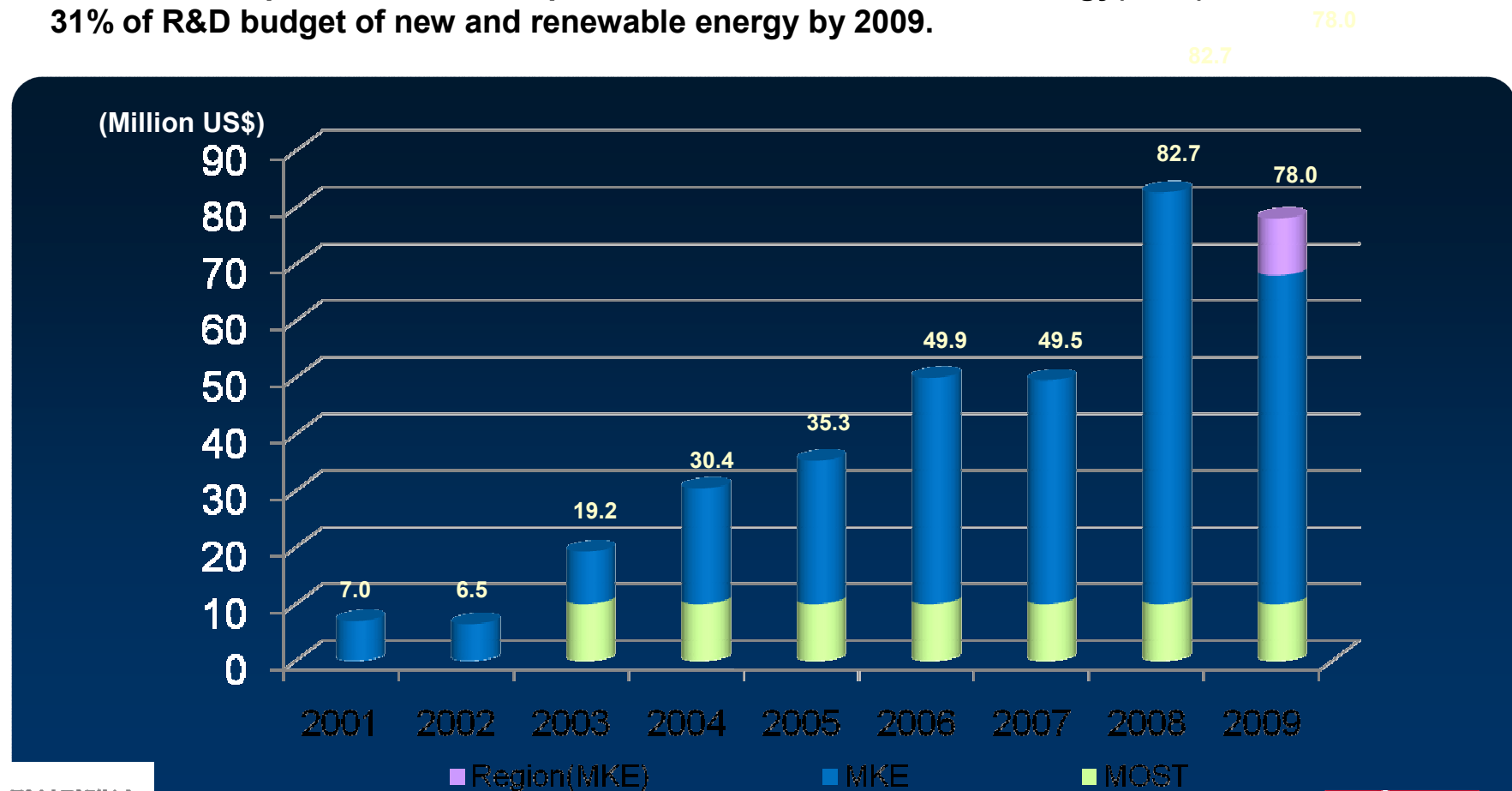


- Subsidy
- FIT
- Regulations in public sector
- RPS
- Loan
- Tax credit

I. Introduction

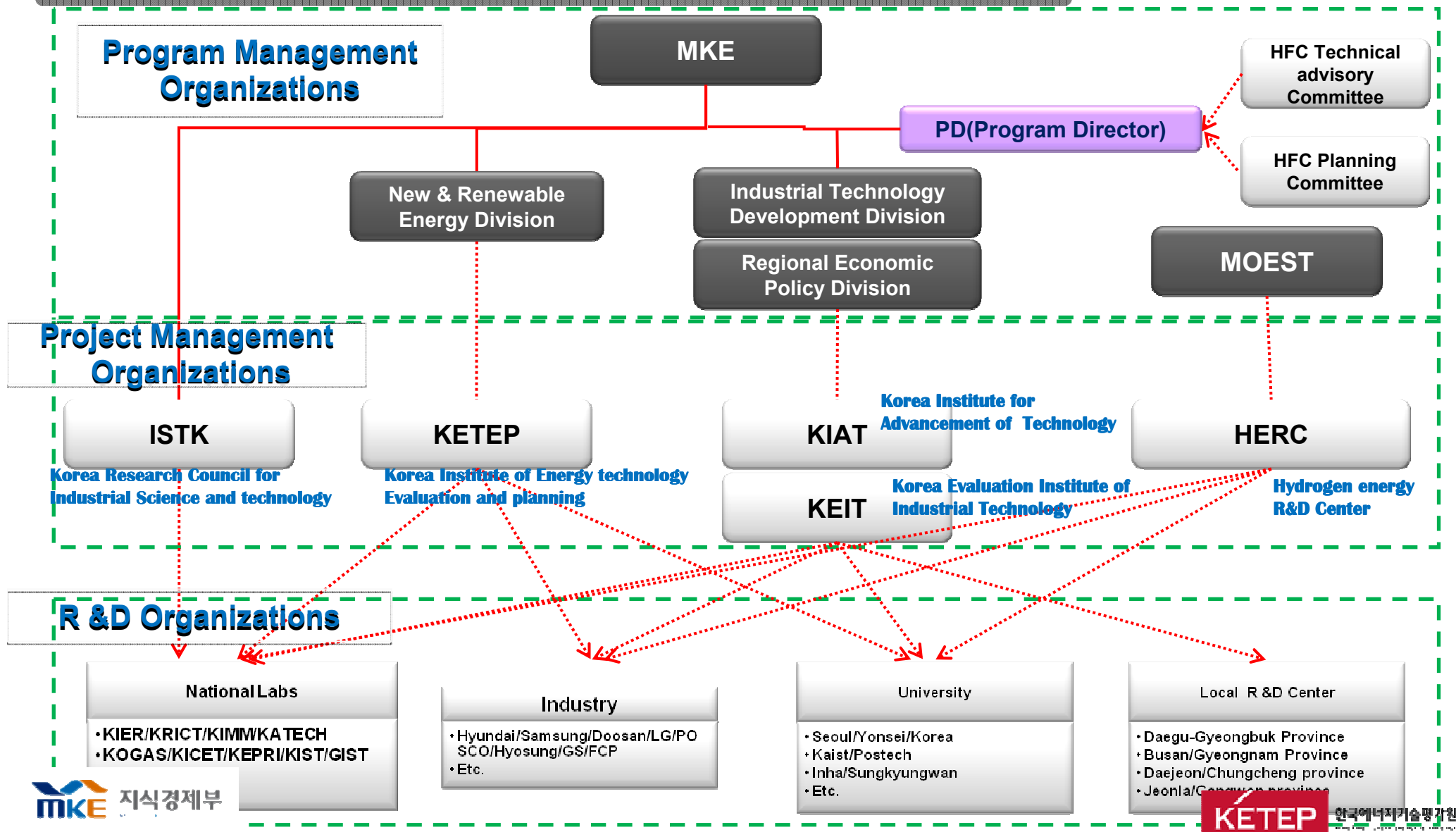
Budget

- ◆ 1988 ~ 2003 : about 80 Million USD
Promotion Act for the Development of Alternative Energy(1987)
- ◆ 2004~2008: about 360 Million USD
10-Year basic plan for the development of New and Renewable Energy(2003)
31% of R&D budget of new and renewable energy by 2009.



I. Introduction

RD & D Planning and execution Structure



I. Introduction

List of Major Projects(about \$100M/year for RD&D)

Type		Status		\$M/y
MOST(MOEST)		Hydrogen	Basic study of Hydrogen production, storage and utilization('03-'13)	10
MKE	PEFC	Common	MEA('08~'13, low temp.), ('09~'14, high temp.) low cost , high durable PEFC System('08~'13) Production Technology of Bipolar plates	58
		Vehicle	80 kW FC module development for cars('04~'09) 200 kW FC module development for buses ('05~'10) Demonstration program I('06-'09), II('09~'11)	
		RPG	Development of BOPs('09~'12) Demonstration program('06~'09)	
	MCFC		300kW MCFC system ('07~'11) Multi MW class MCFC system development for hybrid plant('08 ~'13)	
	SOFC		100kW SOFC system development('08~'13) Development of SOFC components ('09~ '13)	
	Local R& D		Green Energy Technology – R&D hub of Hydrogen and Fuel cells in KyongBuk Province('09 ~'14)	10
	Stack materials		Core technology development for PEFC, DMFC and SOFC ('04~'11)	5
	Support of Nat. Lab.		Basic study on Fuel cells and Hydrogen	15

I. Introduction

Subsidy

◆ Feed-in-Tariff

- By 2011 FC plants will have feed-in-tariff about USD 0.25 for 15 years

Total amount will be 50MW

Fiscal Year	Allowable capacity
~2008	8MW
2009	12MW
2010	14MW
2011	16MW
Total	50MW

◆ Renewable Portfolio Standard (RPS)

- After providing FIT by 2011, RPS will be implemented from 2012.
- Utility companies with more than 500MW should generate a certain percent of power using new and renewable energy systems by RPS regulation

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

I. Introduction

Subsidy

◆ Green Home Program:

- Deployment of green energy for 1,000,000 Green homes by 2020
- The subsidy program offers up to 80% of the green energy system cost this year.
- Subsidy budget of 1kW FC systems in 2010: USD10M

◆ Regulation for new and reconstructed Public Buildings

- More than 5% of the building cost should be used to the new and renewable energy systems for public buildings with more than 3,000m² total floor area.
- From 2012 this regulation will be applied to buildings with more than 1,000 m² total floor area.

The rate will be gradually increase from 10% at 2011 to 20% at 2020.

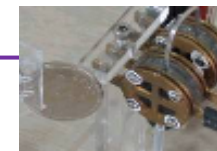
II. RD&D Activities

History of PEFC Development at KIER

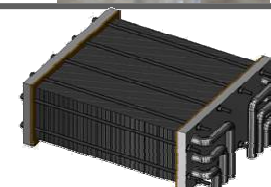
Key Player	Name
Research Inst.	KIER, KIST
Academia	ChonBuk Nat. Univ., Hanyang Univ., KAIST, Korea Univ., POSTECH, Seoul National Univ. and Yonsei Univ.
Private Company	Samsung, Hyundai, FCP, GS FC, Hyosung, SK, KEPCO, KOGAS, POSCO Power

e

Small(~'03)



Submarine(~'08)



Portable('99~'07)



Golf Cart(~'04)



Vehicle
(~'98~'10)



RPG('96 ~'10)



(~'85-'02) PAFC



II. RD&D Activities

History of RPG Development



1996 ~ 2001
Development of
5kW RPG
(Korea Institute of Energy
Research)



2004~ 2006
Development of
3kW RPG
(CETI)



2004~ 2006
Initial Field Test
of 1kW RPG
(Fuel Cell Power,
GS Fuel Cell,
Daegu City Gas)



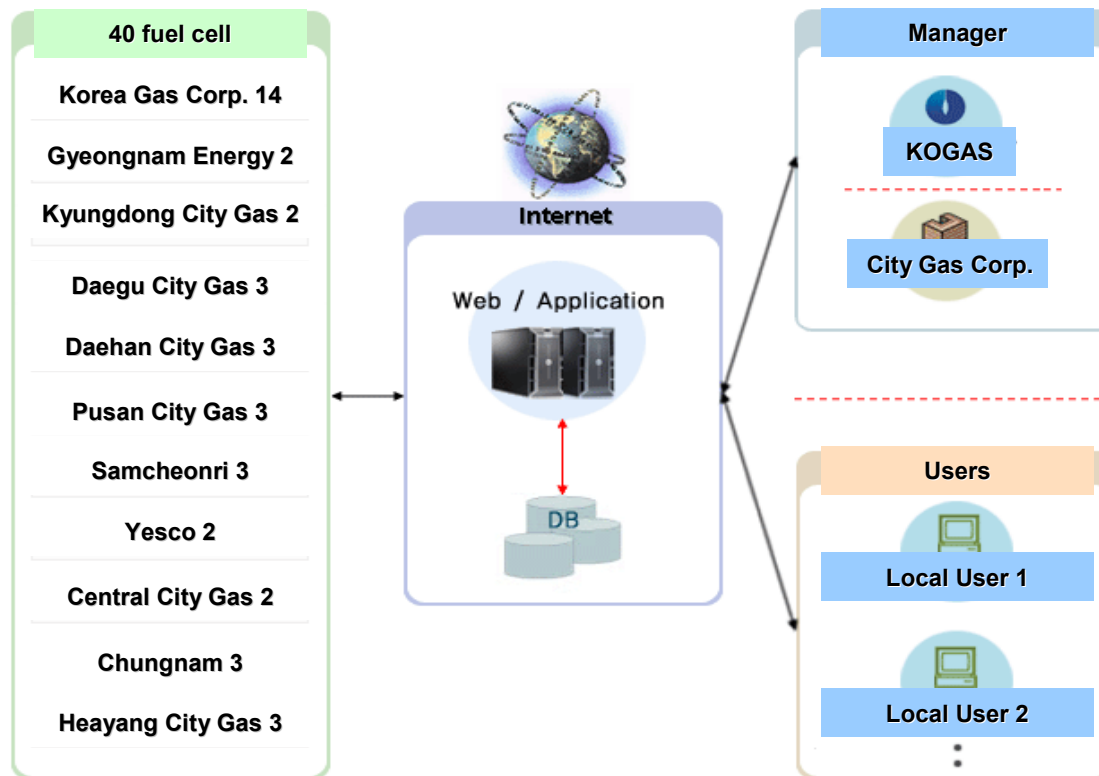
2006~ 2009
Field Monitoring
of 1kW RPG
(KOGAS, Gas Companies,
Regional Government, Fuel
Cell Power, GS Fuel Cell)

II. RD&D Activities

Residential Fuel Cell Demonstration Program

- Provide Feedback on Various Operation and Fault Data for Future Research and Development
- Improving Public Acceptance

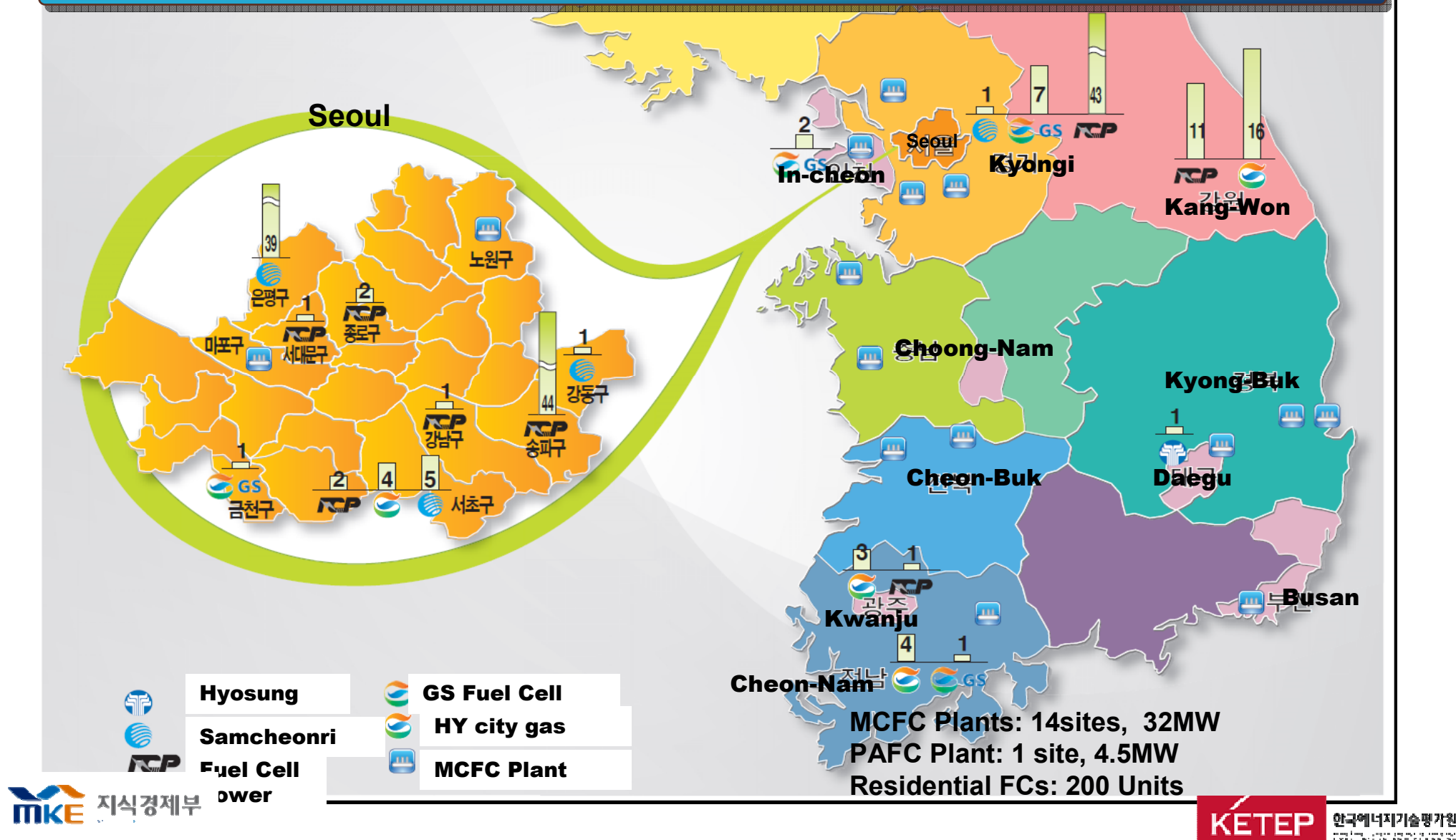
Configuration



	2006	2007	2008	Total
No. of units	40	70	100	210
Localization ratio of main components	55%	70%	80%	
Site	Gas co.	Local Gov.		

II. RD&D Activities

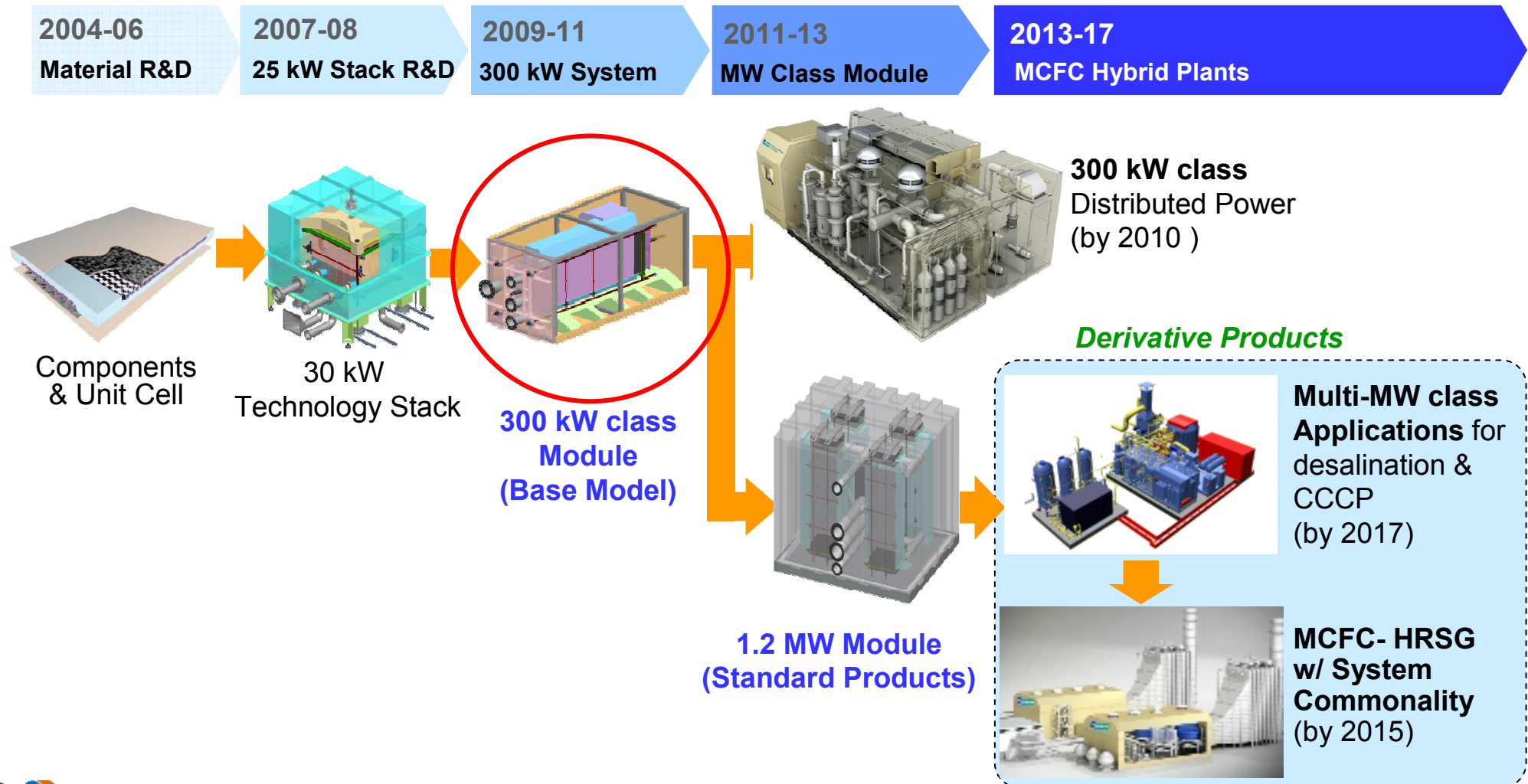
Map of FC installation sites



II. RD&D Activities

MCFC Progresses and Product Plan

- Develop core technology by 2008, and diversify product portfolio from 2013.



II. RD&D Activities

MCFC Progresses

Target

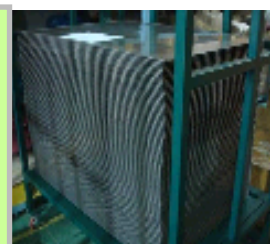
- MW MCFC module((BPPs, Stacks), Integration Technology of FC and Power plants and/or Desalination plants

Capacity	1.2MW
Electric Effic.	48%
Total Effic.	82%
Durability	>40,000

MOLD



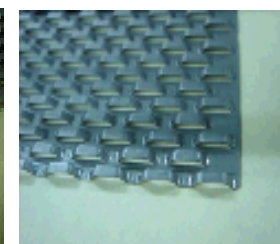
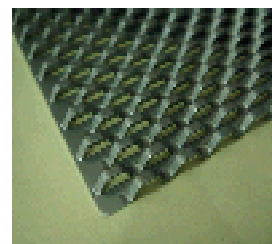
Proto Type



Center Plate

Anode & IIR Slot Plate

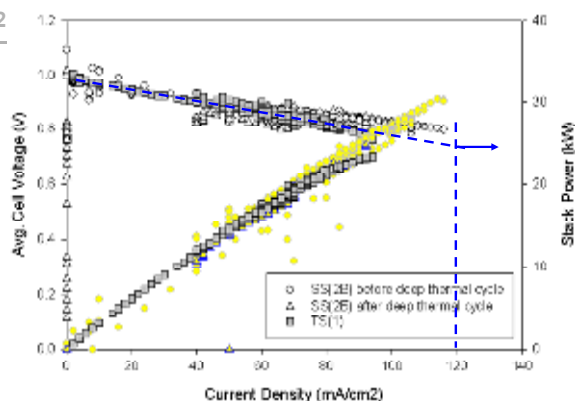
Cathode Slot Plate



- Active area : >8,000cm²

1.Tech. Stack

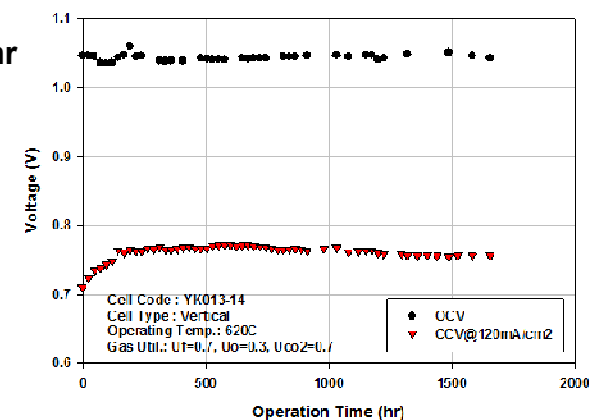
- 0.77V@120mA/cm²
- Operation :1,100hr



• SS(2B) : Short Stack의 약자로 300kW 내부개질형 정부과제 평가 스택임

2. Durability

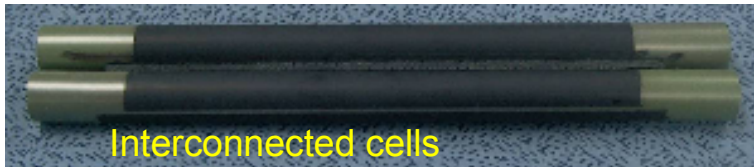
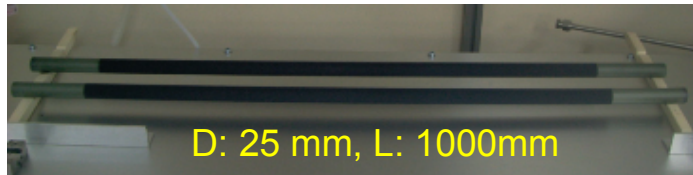
- Decay Rate : 8.45mV/1,000hr
- Estimation after 10,000hr : 0.688V



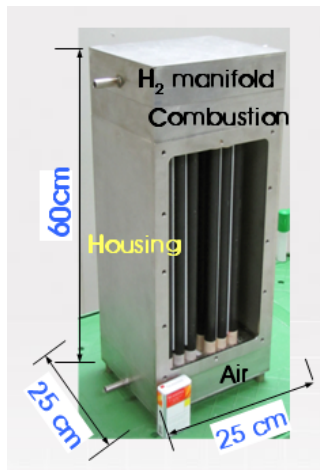
II. RD&D Activities

SOFC Progress

1. Sample of 1m unit cell



2. Integration of a sub-stack



I/C type
Module

1Kw sub stack

◆ 1st phase Target (2008~2011):

- Development of 25 kW Stack Module
- Current density : $0.3\text{W}/\text{cm}^2$
- Durability: 2%/1,000h

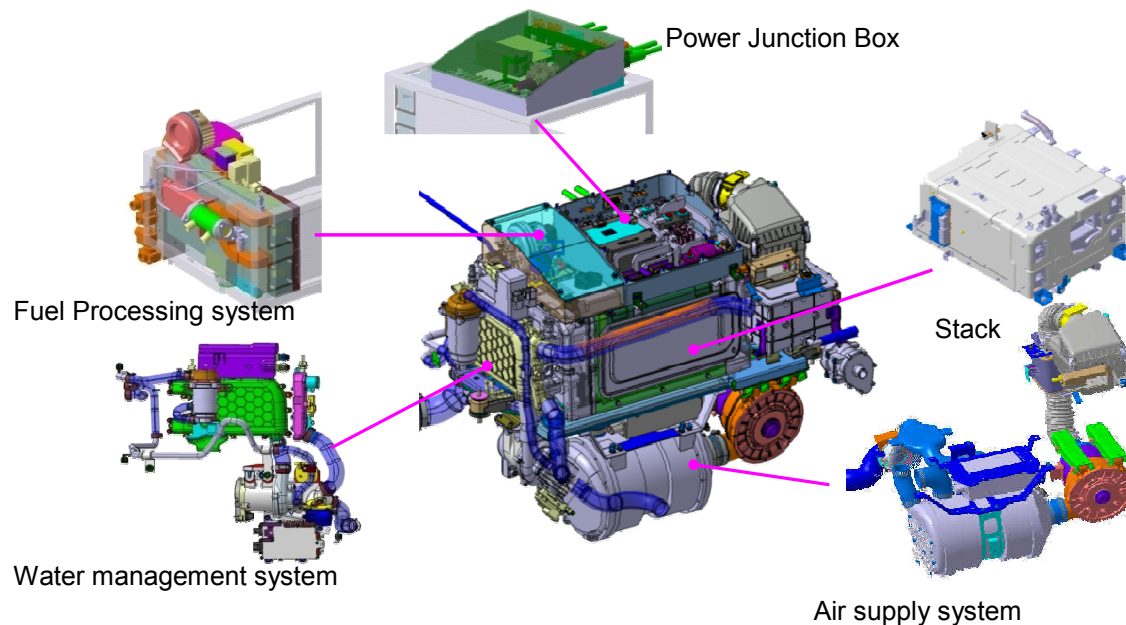
◆ 2010 achievements

- Under integration of the 6kW stack module
- Current density : $0.23\text{W}/\text{cm}^2$
- Durability: 4.5%/1,000h, 300hr

II. RD&D Activities

Progress of FCs for Transportation Applications

- improve power density and durability, and reduce cost



■ 1st phase Target (2008~2011):

- System power density : 550 W/L
- System cost : \$0.2M
- Durability: 3,000hr
- Stack power density: 1.4 kW/L

■ 2010 achievements

- Design and integration of the 1st Prototype
- System power density : 490 W/L
- System cost : \$0.20M
- Durability : 500hr
- Stack power density : 1.47 kW/L

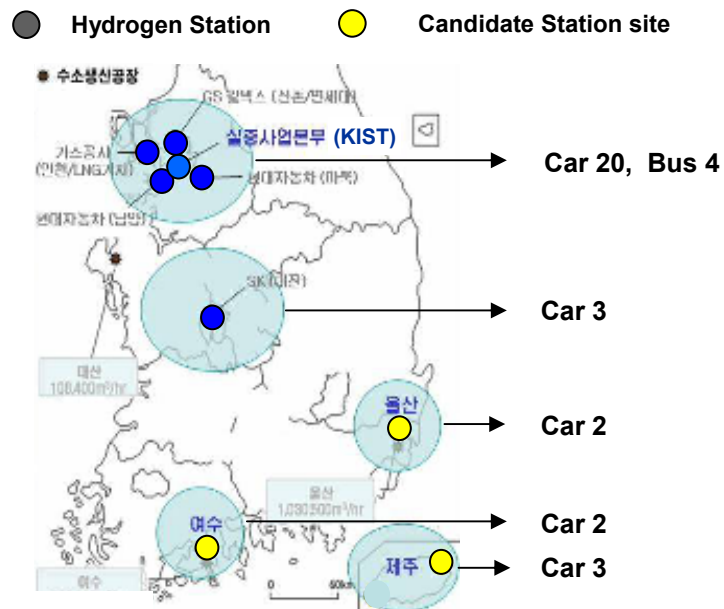
II. RD&D Activities

Demonstration of FCEV

- ❖ Purpose: operate for improving safety/performance and standards /regulation
- ❖ 66 Vehicles - 32 cars in USA, 34 Vehicles in Korea → total distance travelled : about 1M km
(0.4 Mkm in Korea , 0.6M km) in USA, Cars in USA: UTC FC system, Vehicles in Korea : Domestic FC system

1st Phase

- Period : '06. 8 ~ '10. 7 (4 year)
- 34 vehicles with 7 stations



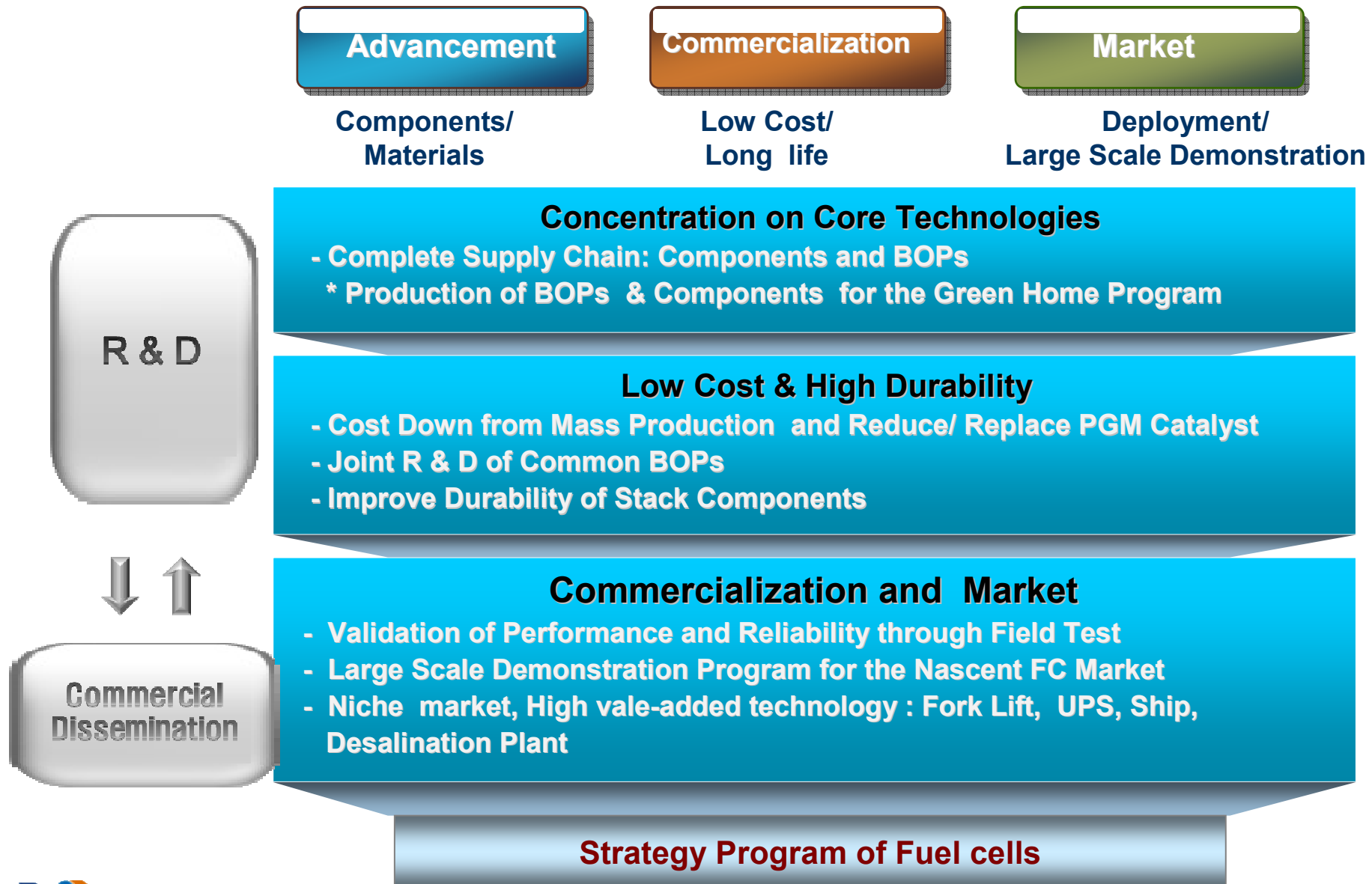
2nd Phase

- Period : '09. 12 ~
- 80 vehicles with 15 stations (plan)



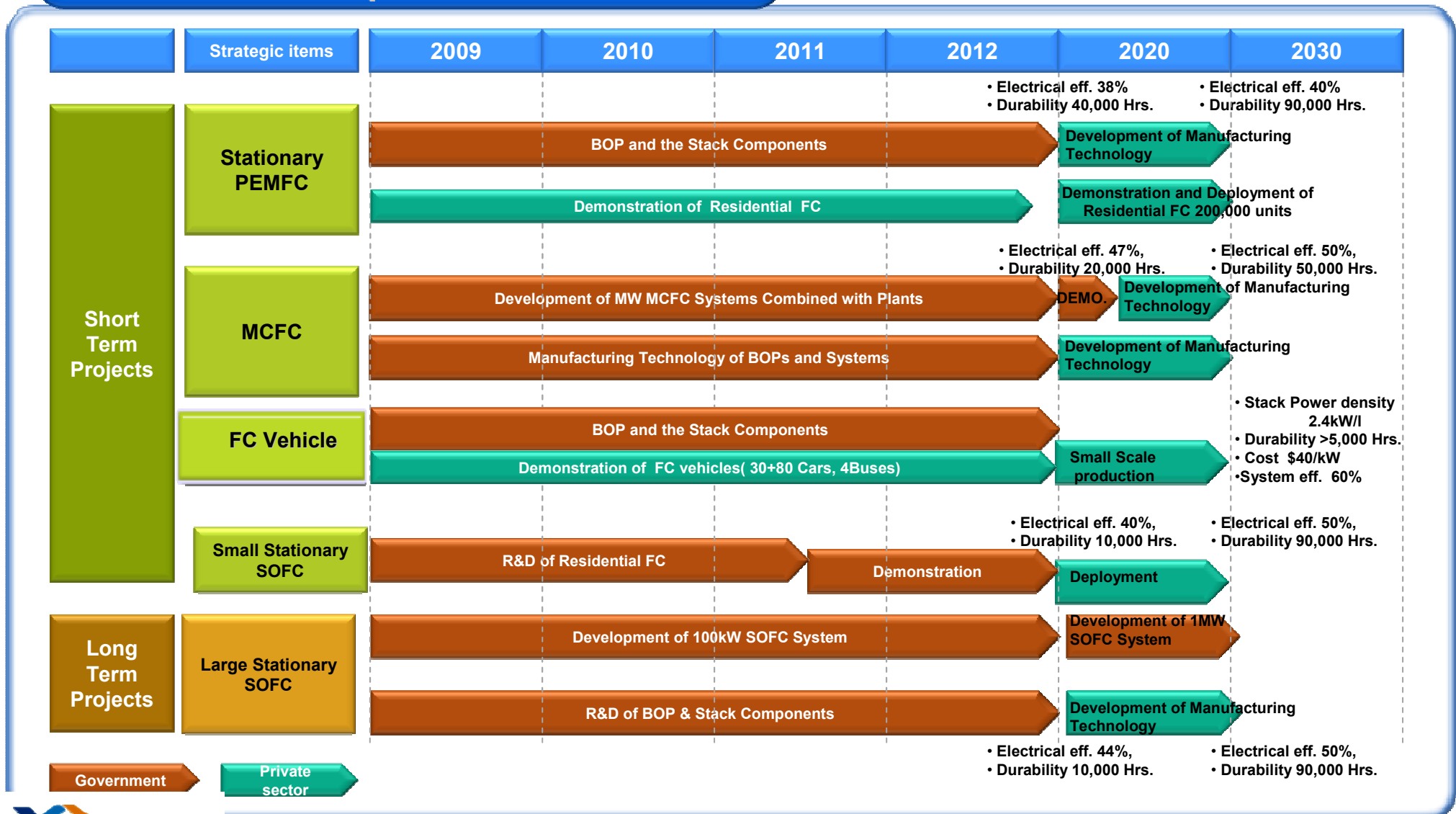
Fuel cell	115 kW
Motor	110 kW
Hydrogen Cylinder	350, 700 bar

III. RD&D Plan



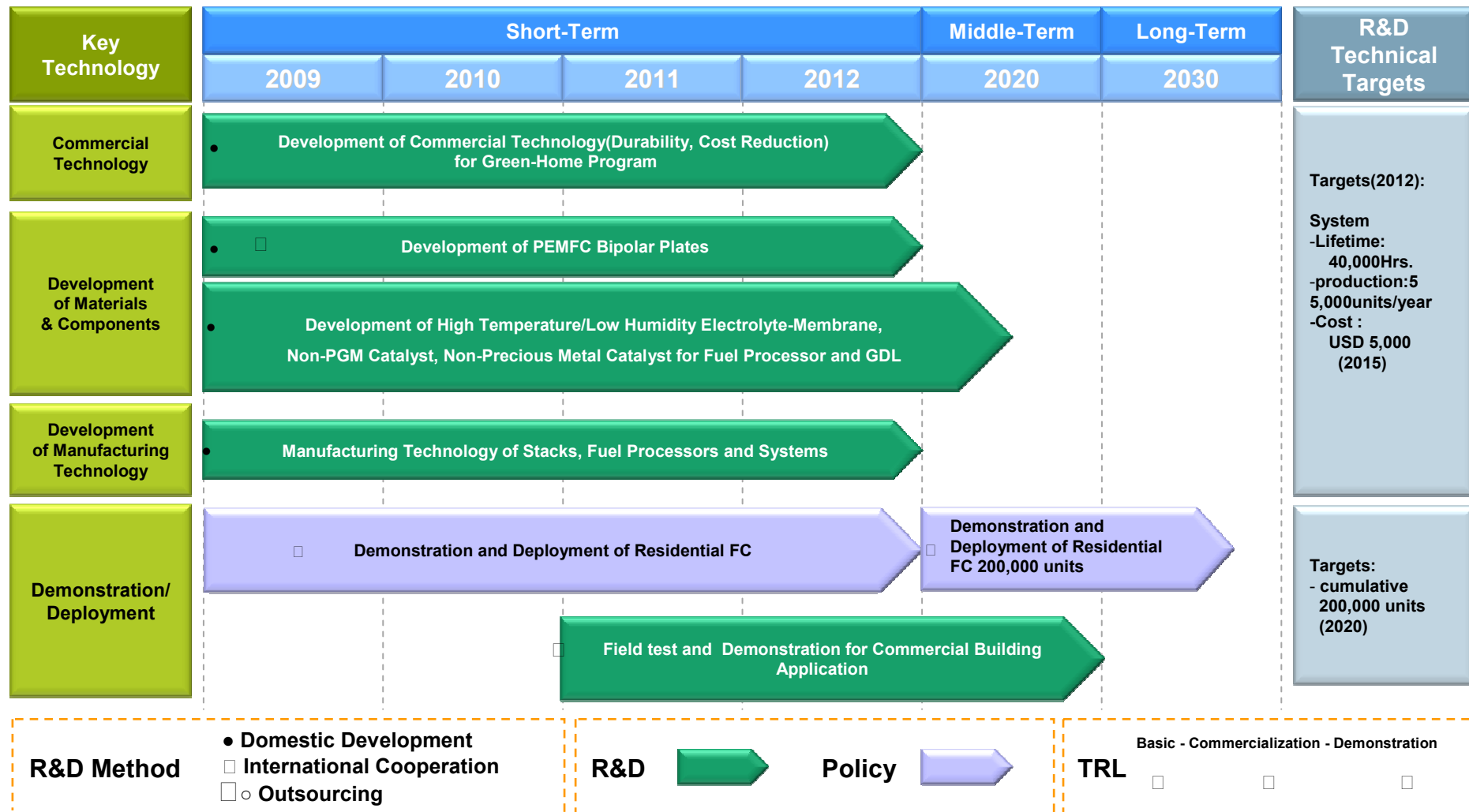
III. RD&D Plan

Roadmap : Fuel Cells

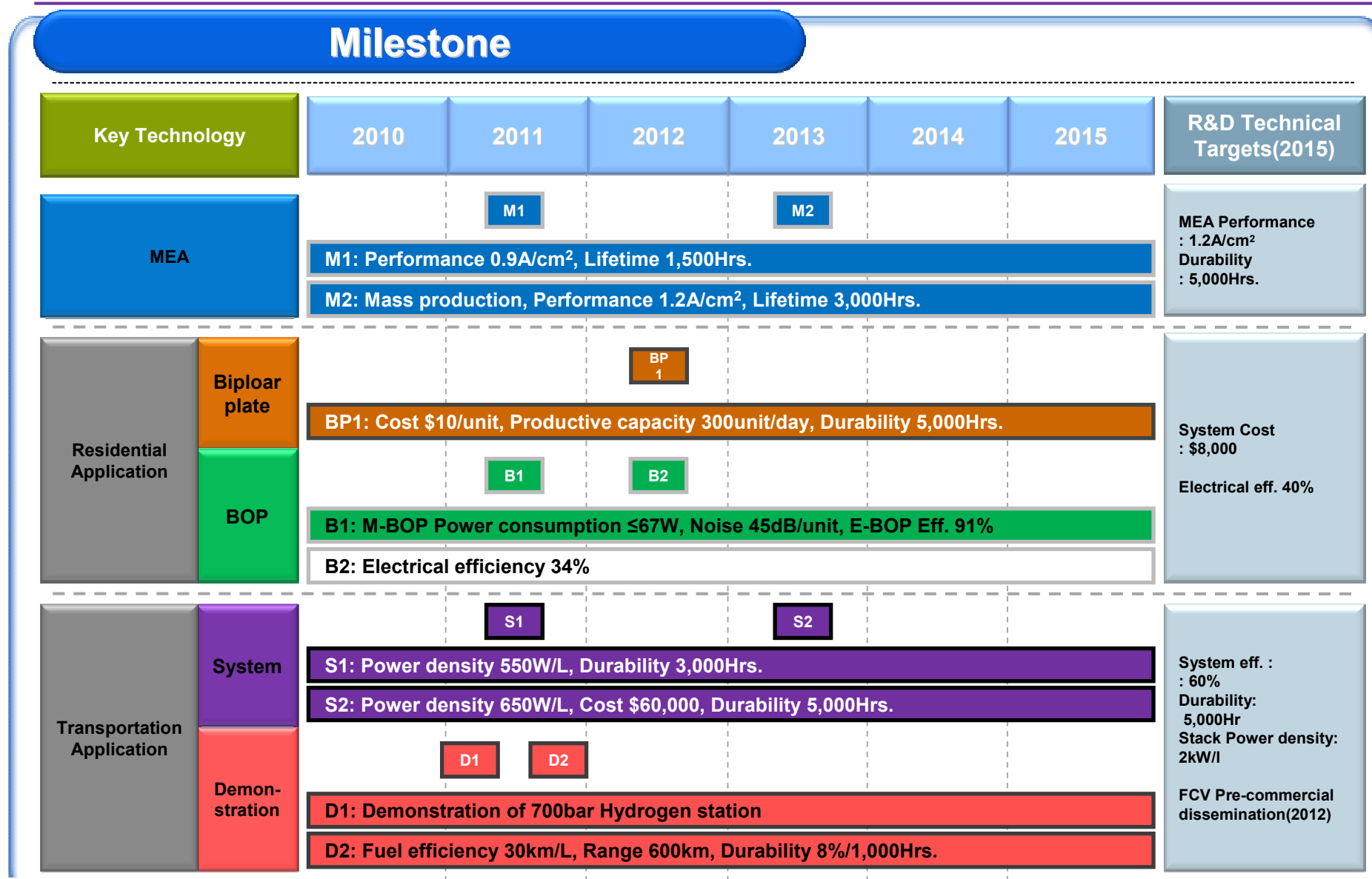


III. RD&D Plan

Roadmap : Small Stationary PEFC

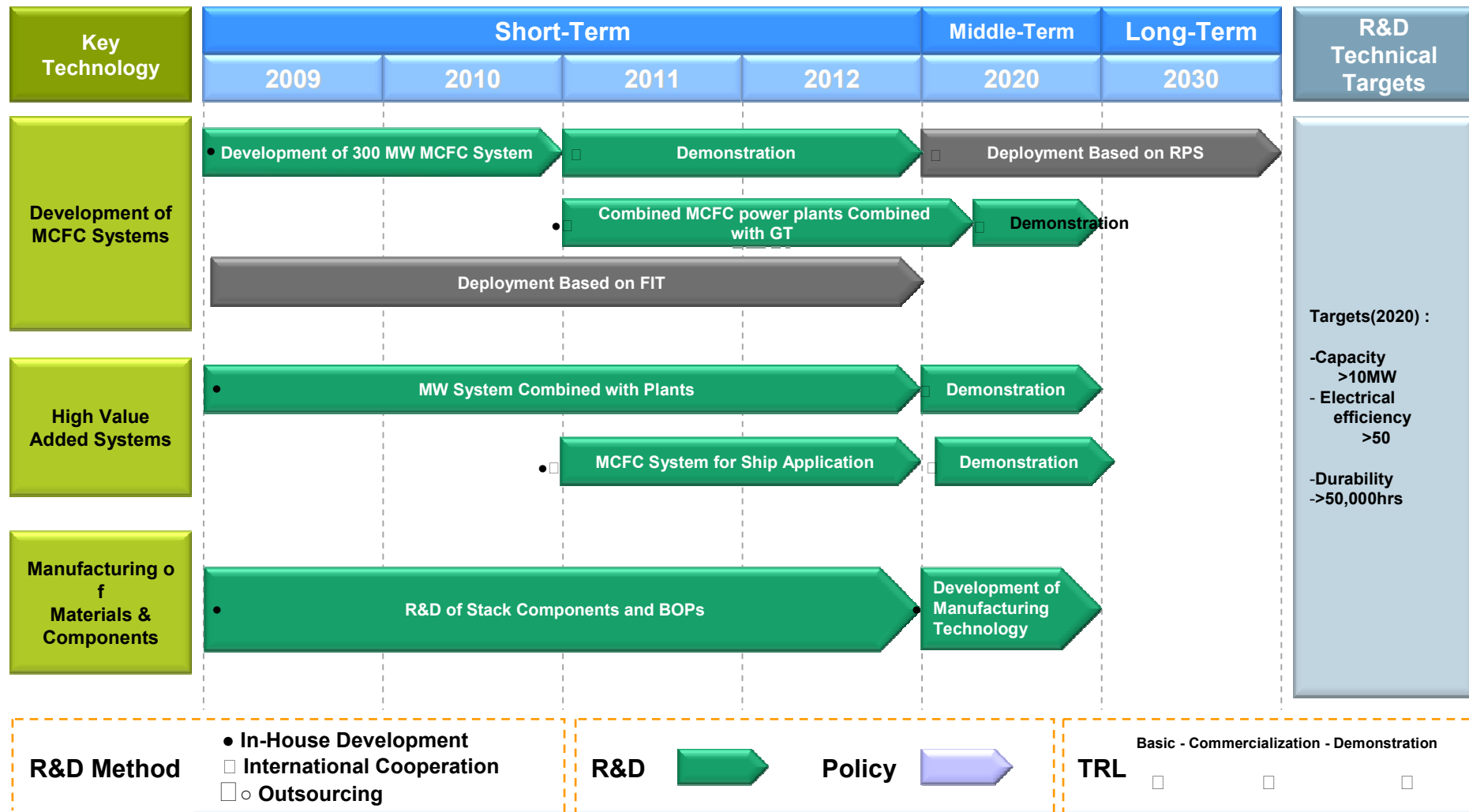


III. R&D Plan



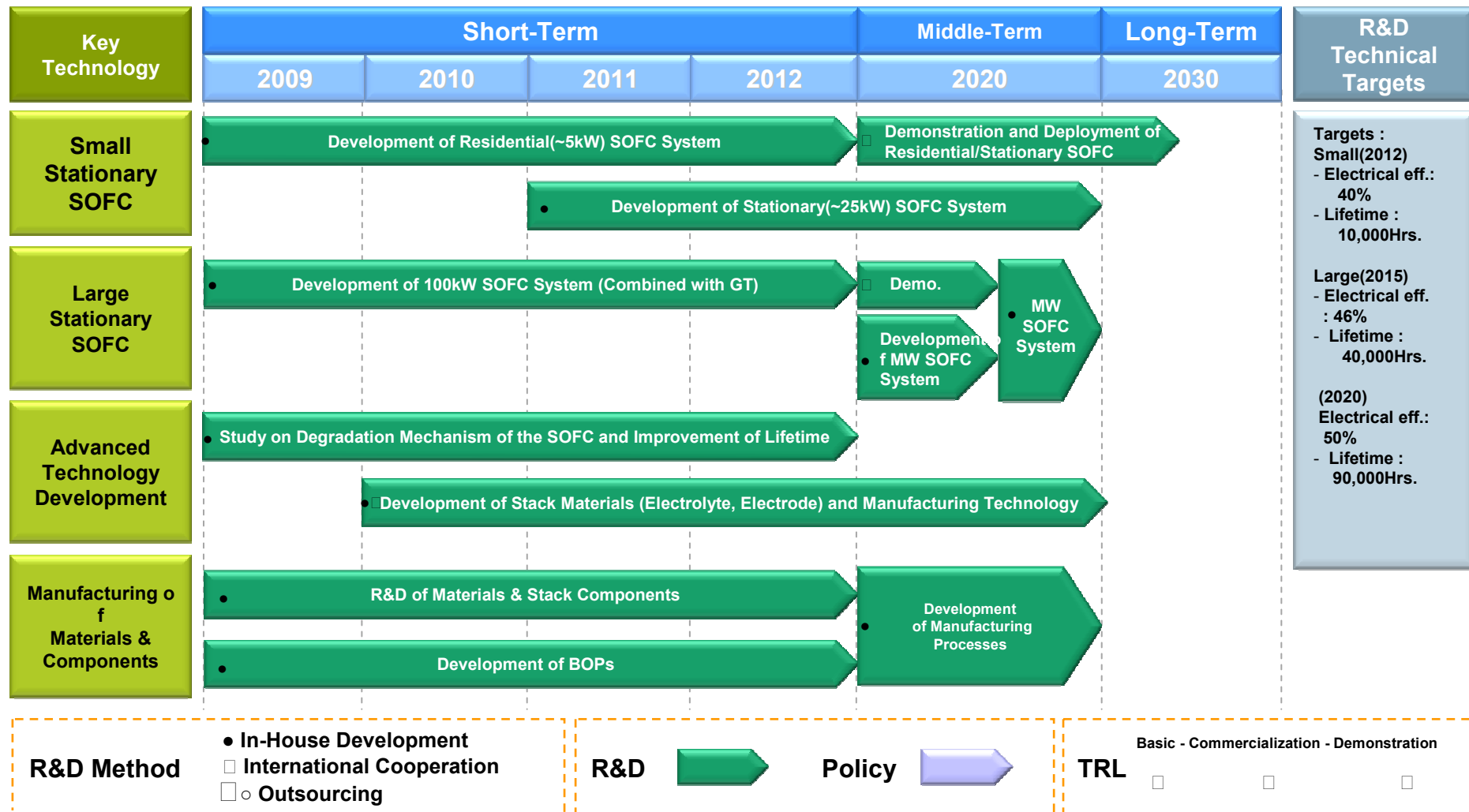
III. RD&D Plan

Roadmap : MCFC



III. RD&D Plan

Roadmap : SOFC



IV. SUMMARY

1

Korea plans to utilize new and renewable energy for new growth engine.

2

Fuel cells are one of the most promising new and renewable energy.

3

The National Plans and technology roadmap are established for Fuel Cells .

4

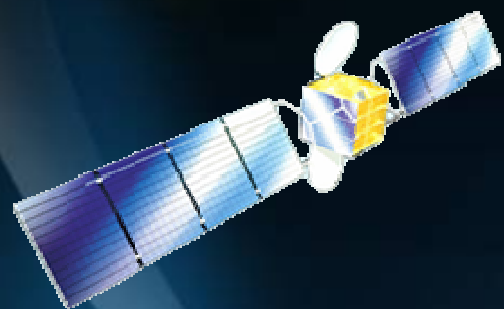
The commercialization of fuel cells is in a process.

5

Open innovation and domestic/International alliances are effective for product development and market generation.

6

The goals of the national plan can be achieved by the continuous investment of the government .



Thank You !

