Deployment Policy of FCEVs & Hydrogen Refueling Stations in Korea

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KETEP

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Results of the 2nd Master Plan for the Development and Supply of Eco-Friendly Cars

	EV	PHEV	HEV	FCEV	HRS
Target (2015)	85,700	44,000	151,500	10,100	43
Status	4,900	60	157,500	40	10
%	5.7	1.4	104	0.4	23.3

Eco-Friendly Cars : EV, PHEV, HEV, FCEV

The 3rd Master Plan for the Development and Supply of Eco-Friendly Cars (Dec. 2015)

	2015	2020	2025	2030	2050
Total No. of FCEV	71	10,000	100,000	630,000	7,000,000
Price (k ₩)	85,000	50,000	38,000		
(US $)	77,200	45,500	34,500		
HRS Capacity (kg/day)		250	500	1,000	1,500
No. of HRS	10	100	210	520	1,500
Type of HRS	Off-site	Off-site On-site	Off-site On-site	Off-site On-site	

($1= ₩ 1100)

Vision and Strategy

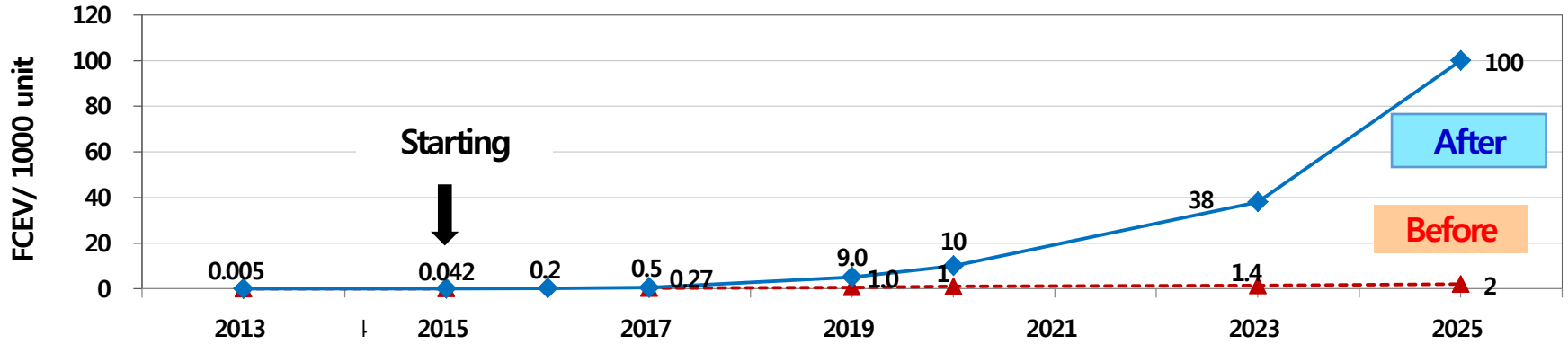
Vision

◈Number of FCEV will reach to be 10% of New Vehicles in 2030

- R&D, Infrastructure, Regulation, Certification and so on

Target

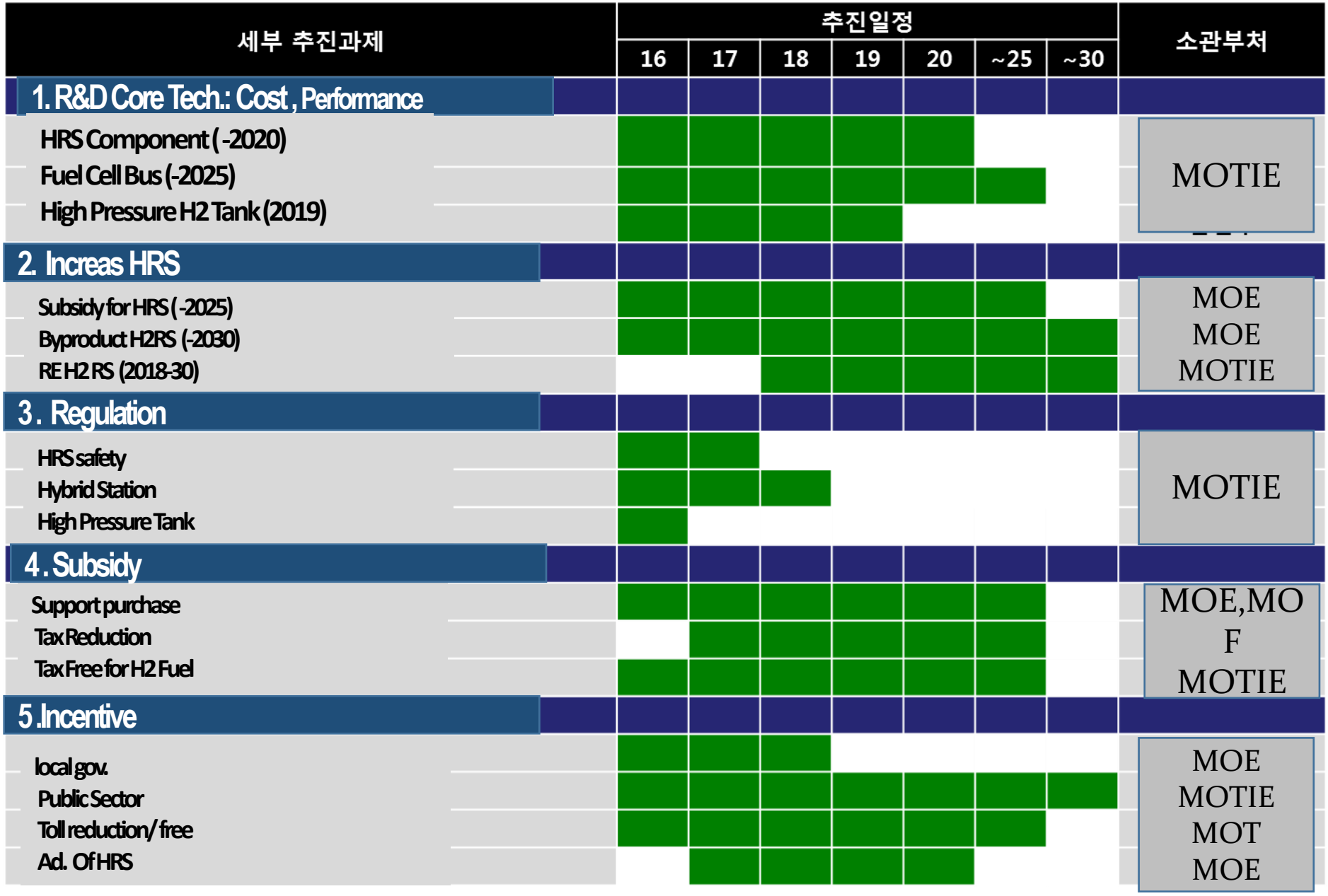
	~'16	'17	'18	'19	'20	~'25	~'30	~'50
FCEV (1000 units)	0.2 (0.1)	0.5 (0.3)	2.5 (2.0)	5.1 (2.6)	10 (4.9)	100 (91)	630 (530)	7,000 (6,370)
HRS	13 (3)	20 (7)	30 (10)	50 (20)	100 (50)	210 (130)	520 (310)	1,500 (980)



Project

Core Tech.	HRS	Regulation	Subsidy	Incentive
① Cost reduction of HRS ② Fuel Cell Bus ③ High Pressure Tank	① Increase number of HRS ② Fuel Diversity - Byproduct H2 - CNG reforming - RE H2	① Safety ② Hybrid Station ③ High Pressure regulation	① Support purchase ② Tax Reduction ③ Tax Free for H2 Fuel	① local gov. ② Public Sector ③ Toll reduction/ free ④ Ad.

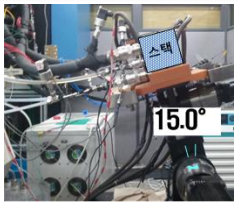
Time Plan


세부 추진과제
추진일정
16
17
18
19
20
~25
~30
소관부처
1. R&D Core Tech.: Cost , Performance
HRS Component (-2020)
Fuel Cell Bus (-2025)
High Pressure H2 Tank (2019)
MOTIE
2. Increas HRS
Subsidy for HRS (-2025)
Byproduct H2RS (-2030)
RE H2 RS (2018-30)
MOE
MOE
MOTIE
3 . Regulation
HRS safety
Hybrid Station
High Pressure Tank
MOTIE
4 . Subsidy
Support purchase
Tax Reduction
Tax Free for H2 Fuel
MOE,MO
F
MOTIE
5 .Incentive
local gov.
Public Sector
Toll reduction/ free
Ad. Of HRS
MOE
MOTIE
MOT
MOE

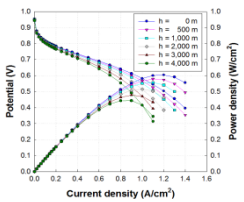
Status of FCEV Development (Govn't Support)

- Technology secure(2013) for FC vehicle of mass production type by verification of real world driving and durability on environmental conditions
- Continue to develop the technology for reducing manufacturing time by optimal process of mass production

Simulation of Driving Condition



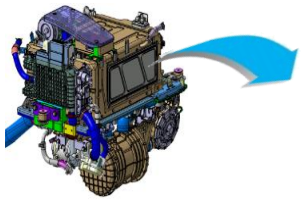
Tilting test



Altitude test

Hyundai	Fuel cell system test
KATECH	Driving environment test
KIST	MEA durability test
WIA	

Minimization of FC System

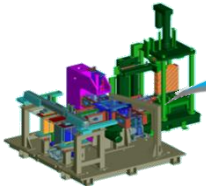


Fuel cell system

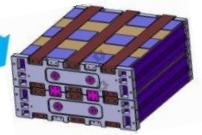
2~2.2 L급 엔진

Hyundai	Fuel cell system
Mobis	Fuel supply system
Halla	Air supply system

Reduction of manufacturing time for Stack



Auto stacking

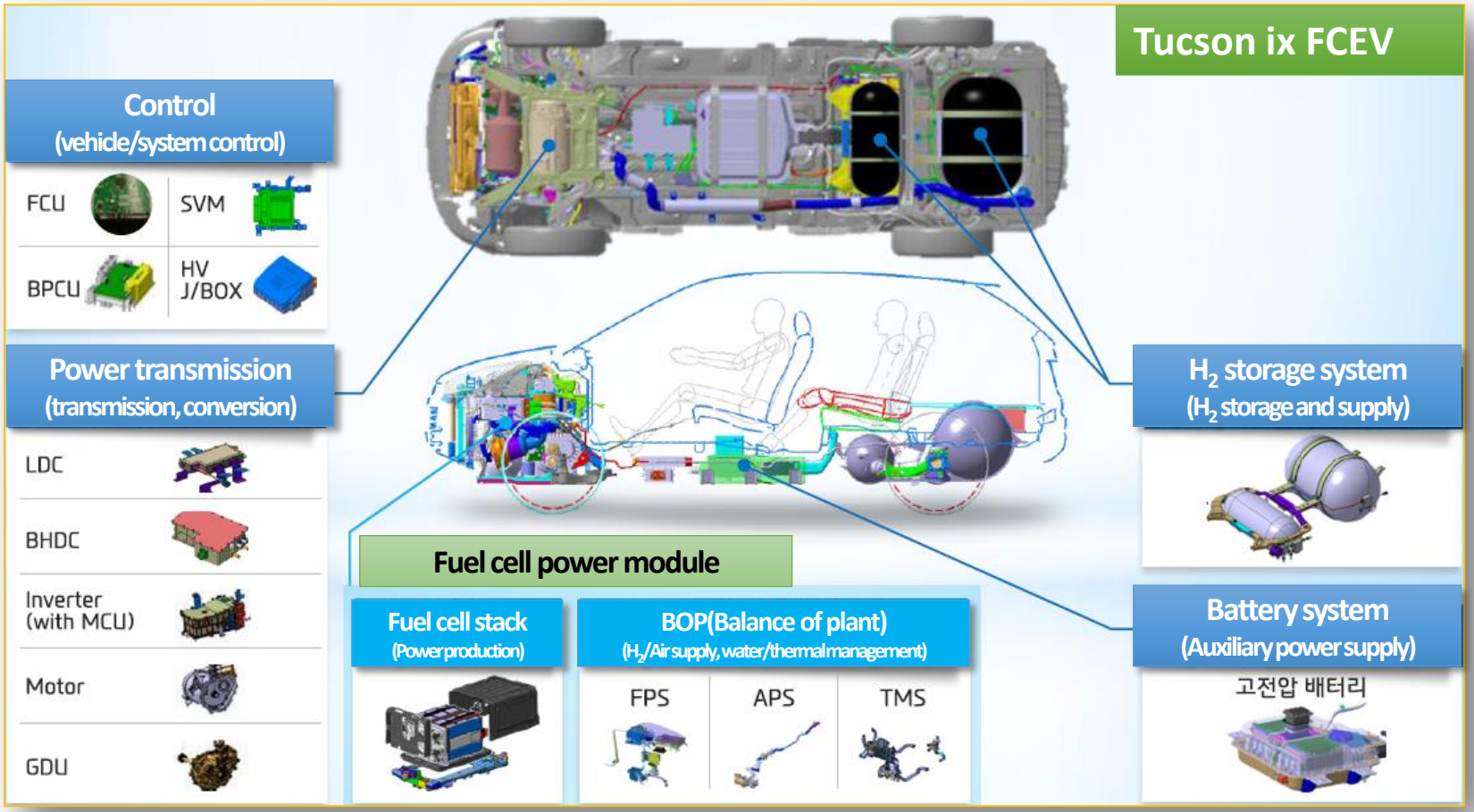


Fuel cell stack

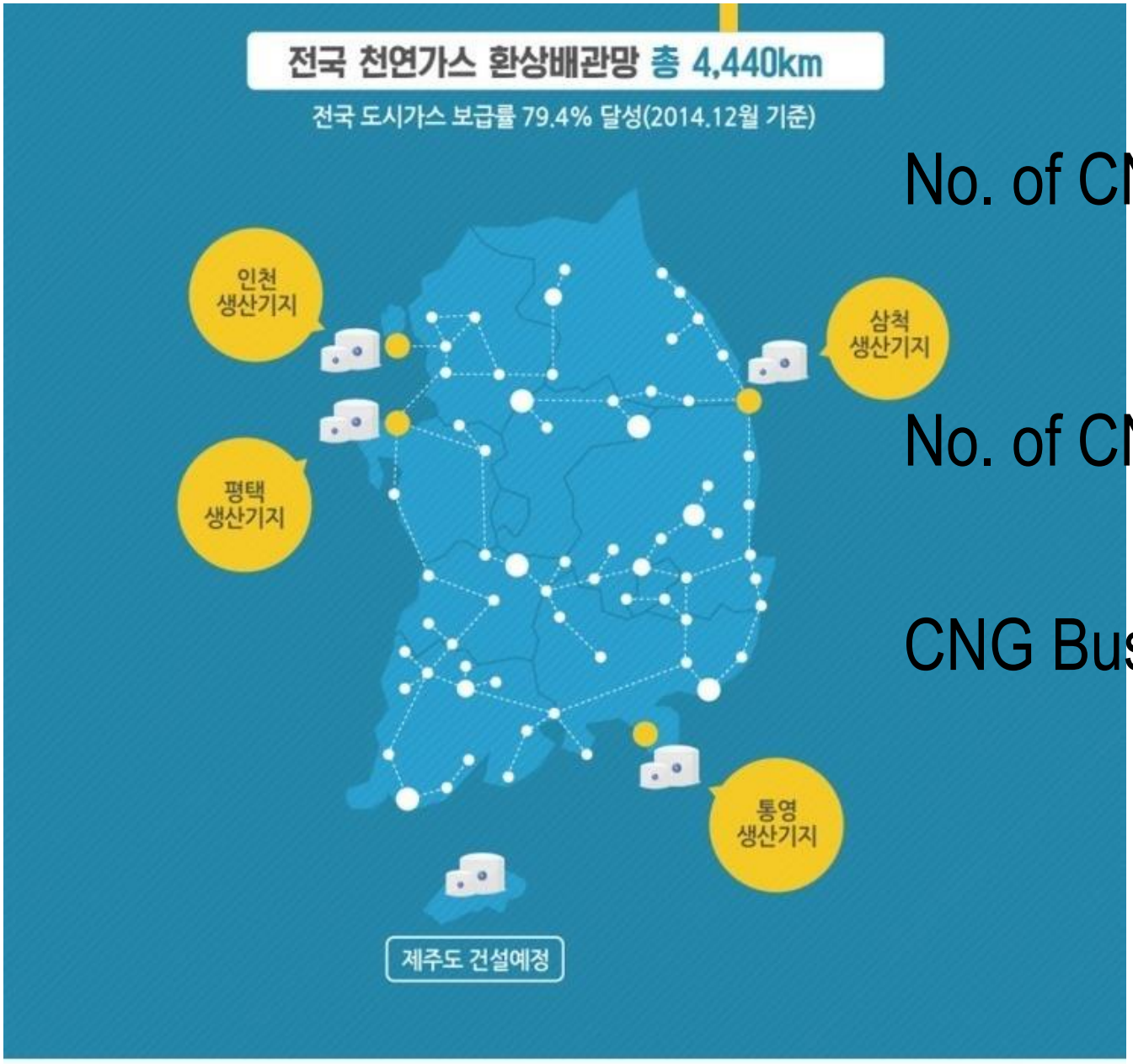
JNL	Bipolar plate coating
Hysco	Bipolar plate
오크론	Voltage sensor
Yura	High voltage connector

Status of FCEV Development (Govn't Support)

- 120 companies are producing the fuel cell parts of Tucsun ix(Localization ratio : 95%)
- Imported Parts : MEA(membrane and Electrode Assembly), GDL(Gas diffusion layer)
  → Continue to study the technology for High-temperature MEA, Thin layer GDL



NG Infrastructure in Korea



No. of CNG Bus: 26,000

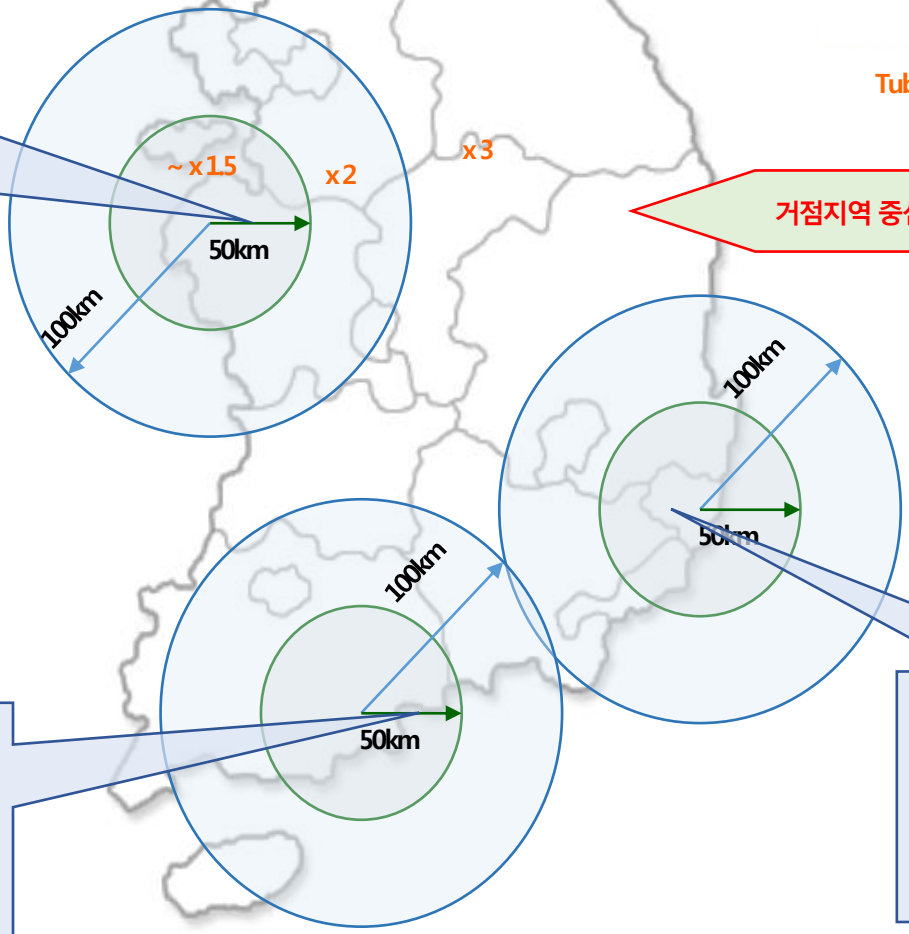
No. of CNG RS : 195

CNG Bus/CNG RS =133

H2 Price

Tube Trailer

충남(대산, 당진)
Production : 585 kt/yr
Consumption : 566 kt/yr(97%)
Retail : 19 kt/yr (3%)

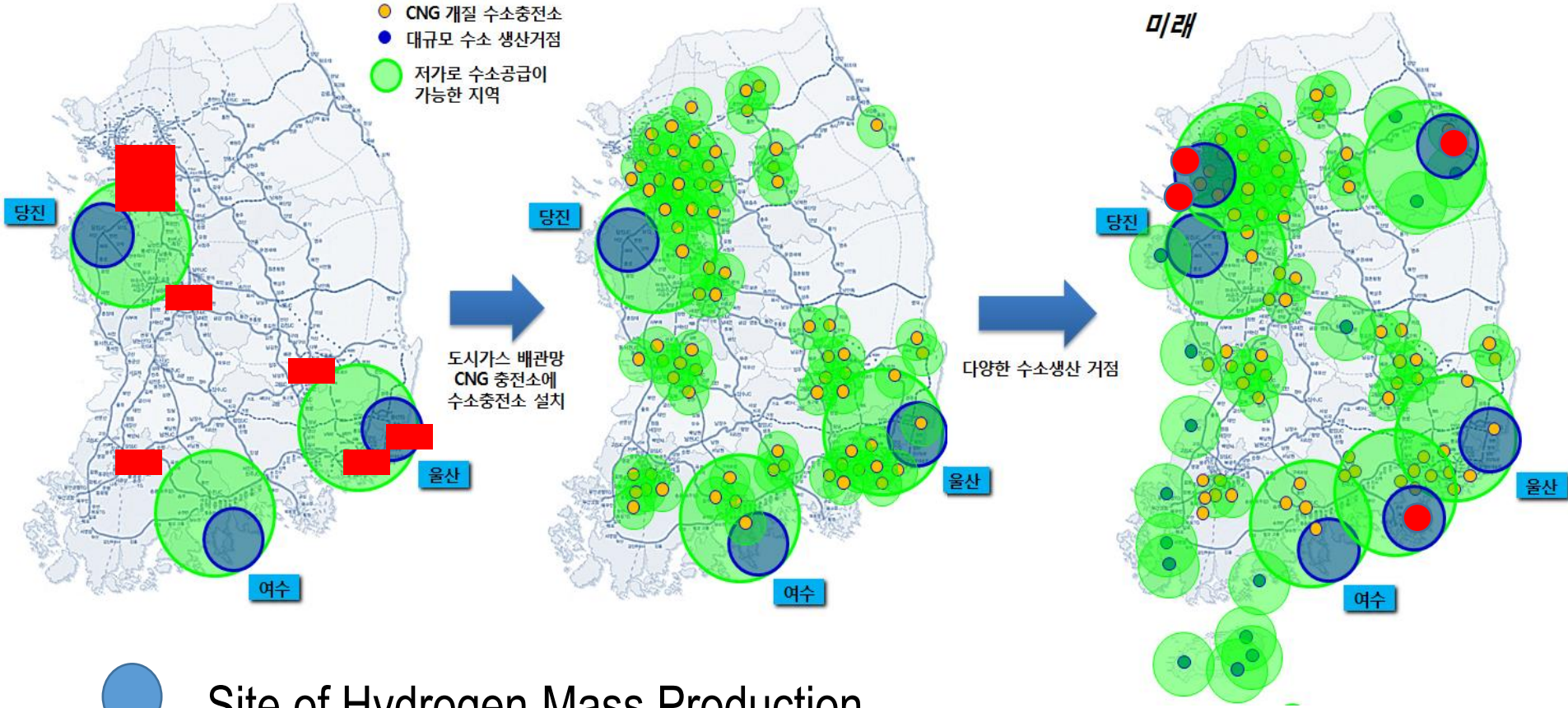


거점지역 중심의 보급 불가피

전남(여수)
Production : 371 k t/yr
Consumption : 221 k t/yr (60%)
Retail : 150 k t/yr (40%)

울산(온산)
Production : 899 k t/yr
Consumption : 820 k t/yr (92%)
Retail : 79 k t/yr (8%)

HRS Deployment Plan



- Site of Hydrogen Mass Production
- Hydrogen and CNG Refueling Station
- Renewable HRS
- LNG Storage Sites

HRS Using Coke Oven Gas from Hyundai Steel

공장 배치도

공장 개요

○ 수소 공장 전체 면적 : 7,600m² (2,300평)

○ 생산 개요

- 생산능력 : 4,000 Nm³/h (34백만 Nm³/년)
- 제품사양 : 순도 99.999 %, 압력 16.0 kgf/cm²

○ 설비 개요

전처리 설비	압축 설비 (컴프레서)	수소추출 설비
- 전기 집진기 (2 Sets) - 흡착탑 (2 Sets) - TSA (3 Sets)	- 용량 : 6천 Nm³/h (3 Sets) - 압력 : (1차) 5kgf/cm² (2차) 17.5kgf/cm²	- PSA (8 Sets) · 용량 : 4천 Nm³/h

공정 흐름도

사용처

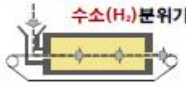
냉연 공장

· 소둔로

· 아연도금

· 표면 산화방지 및 열전달 가속화

철분말 공장



· 연속 수소환원로

· 철분말

· 환원공정 : 산화 피막 제거

수소 자동차

· 수소충전소

· 차량용 연료전지

· 수소 충전소를 통한 수소

Subsides

◈ Support subsides of FCEV and HRS installation from 2013

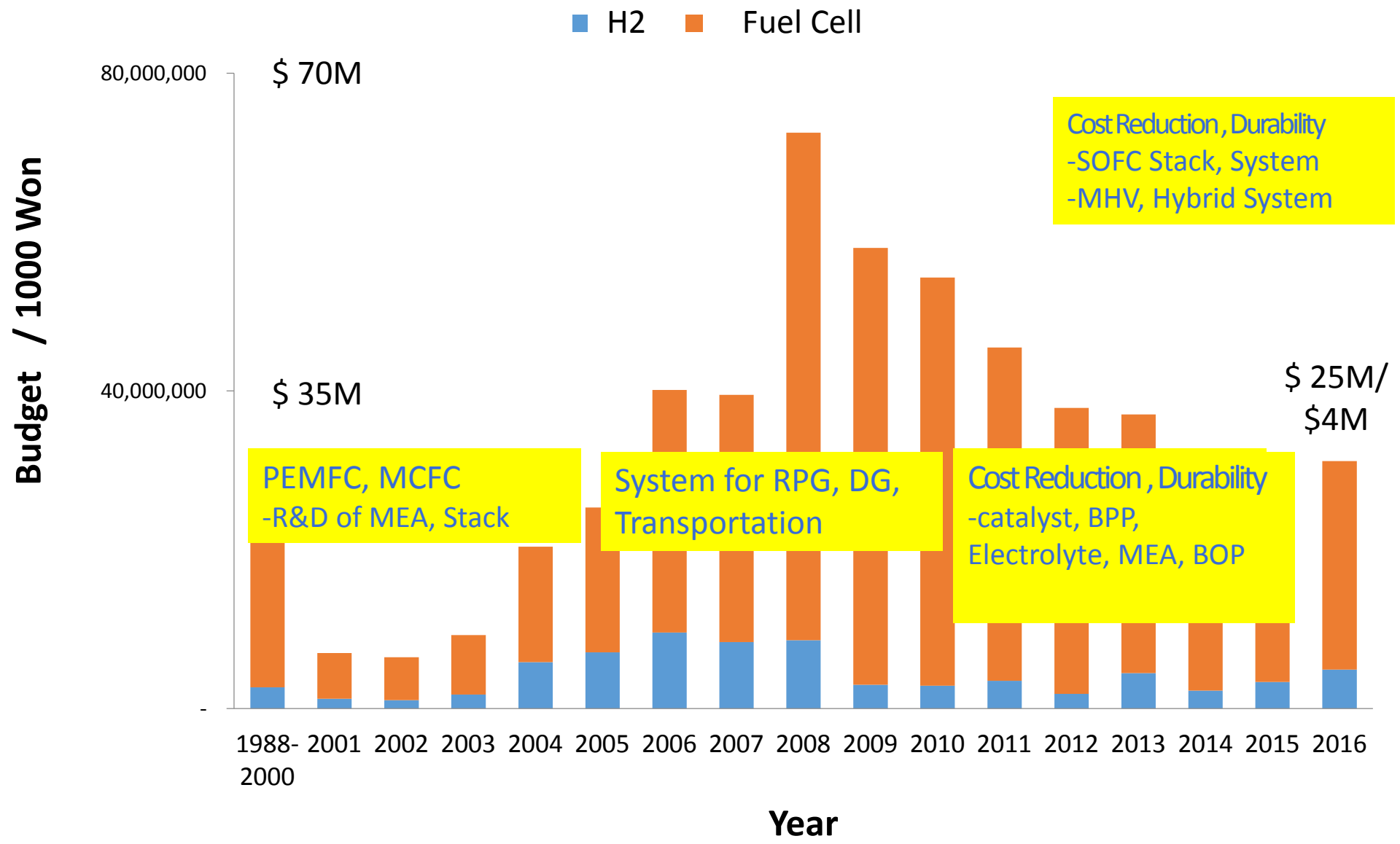
▷ **(FCEV) 50% of price gap between ICE and FCEV**

* 2013~2014 : ₩ 60 M (FCEV ₩ 150 M)

2015~ : ₩ 27.5M (FCEV ₩ 55 M)

▷ **(HRS) ₩ 1.5 B/HRS**

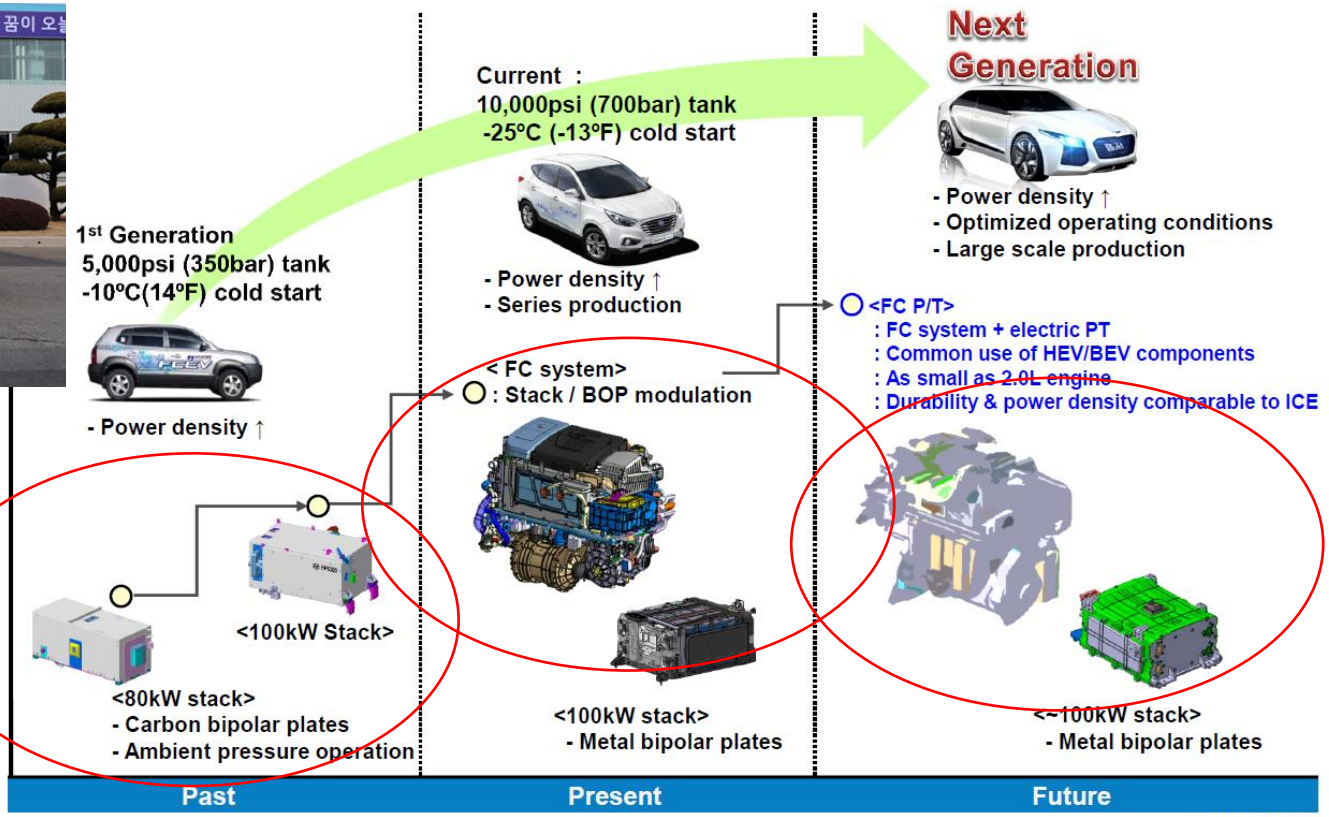
MOTIE Budget for R&D of Hydrogen and Fuel Cell



Achievement (transportation)

현대차 세계최초 연료전지 상용차 출시

- 100㎾ Class Stack , 700bar H2 Tank
- Driving Range : 594㎞
- Fuel economy :27.8㎞/
- Price : USD 100,000 (production 500 unit/y



$ 135,000 $77,000 $35,000

Achievement (RPG)

Doosan PEMFC

	단위	600W	1kW	5kW	10kW
System Power		600W급	1kW급		
Fuel		NG	NG, H2	NG	NG
Dim. (W x D x H)	mm	500 x 400 x 900	500 x 700 x 1,550	1,400 x 650 x 1,520 1,120 x 550 x 850	1,500 x 1.600 x 1,520
Monthly Power	kWh/ Month	**430**	**720**	**3,600**	**7,200**
Heat Production	kcal/h	720	1,200	6,000	12,000
Gas Consumption	Nm^3	0.16	0.26	1.3	2.6
Electric efficiency	%(LHV)	35	35.2	36.6	34.4
Thermal efficiency	%(LHV)	50	51.7	49.1	49.5
Total efficiency	%(LHV)	**85**	**86.9**	**85.7**	**83.9**
Grid Connection		o	o	o	o
AC Power		220V ,2p	220V , 2p	220V, 2p	380V , 3p
Start-Up Time		1h	1h	1.5h	2h

2014-2016: 1139 units

Doosan : PEMFC (10kW$_e$ ~ 20kW$_e$) using Biogas from Waste Food

혐기성 소화
(CH_4, CO_2, 수분, H_2S, NH_3, 실록산 등

바이오가스 전처리
(H_2S, NH_3, 수분, 실록산 제거]

보일러 및 열병합 발전
연료(전기/열) 활용

20KW 연료전지 용

바이오가스 고질화
(CH_4와 CO_2분리기술)

CH_4 분리

CO_2 분리

연료전기, 공업용 가스 및
자동차 연료(CNG) 활용

Achievement (RPG)

S-Fuelcell 에스퓨얼셀

모델명	ecogener NG5K	ecogener NG1K	ecogener HG1K~10K
	3D view 보기 		
Fuel	LNG, LPG	LNG, LPG	H2
Power	5kW, 220V AC (단상) / 7㎾	1kW, 220V AC (단상) / 1.4㎾	1~10kW, 220V AC (단상) / 1.4~14㎾
Efficiency	E 35%,, Total E 85%	E 35%, Total E 85%	E 50%
Operation Mode	웹모니터링(24시간) 부하운전(50~100%)	웹모니터링(24시간) 부하운전(50~100%)	웹모니터링(24시간) 기동시간(5분이하)
Application	중대형 건물	가정, 소형 빌딩	백업용, 가정용
	2009년 GS건설, 가스공사, 제주도	2007 전국	2006 제주도, 연세대, 울산시

2014-2016: 590kW

Achievement (SOFC)

▶ 1kW SOFC System (2016)

	구 분	Target	Current Status	Future Target
System Performance	Power(AC)	1 kW	1.2kW	1kW
	Efficiency(AC)	40%	47.3%	50%

2012.04
η : 30% (AC)

2014.04
η : 35% (AC)

2016.04
η : 47% (AC)

Achievement–H2 Town in Ulsan (195kW, 150 units)

세계 최대 규모 수소타운

국내 현황-경기그린에너지의 연료전지발전소:58.8MW

세계 최대 규모 연료전지발전단지

- Site: Hwaseong Balan Industrial Complex
- Capacity: 58.8MW
- Annual Electricity Generation: 464 GWh (covers 70% of households)
- Annual Heat Output: 195,000 Gcal (covers 20% of households)
- Installation Area: 20,000 m²
- Consortium: Posco Energy, Samchully, Korea Hydro & Nuclear Power (RPS obligator)

Achievement (component)

Iljin H2 Tank

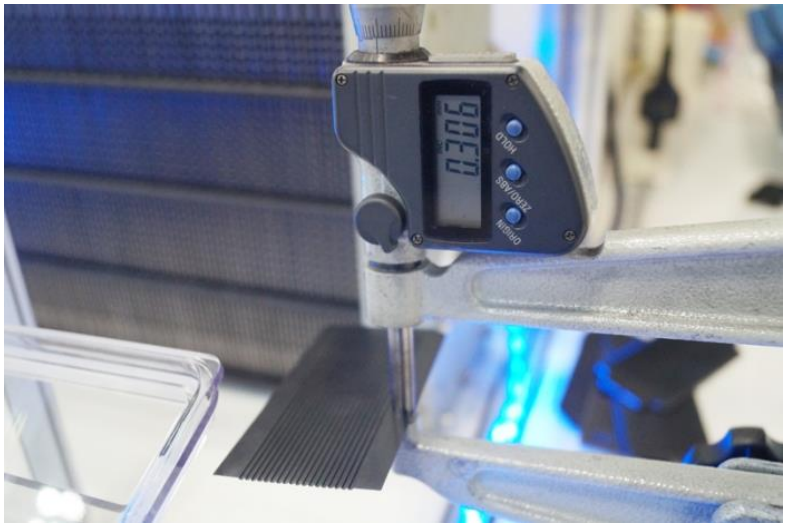
JNTG GDL

Hyundai Steel, Metallic BPP

GS Caltex

Hankook Tire, Carbon composite BPP

Achievement (component)



ACC, Thin Carbon composite BPP

H&Power, Gasoline & Diesel Reformer

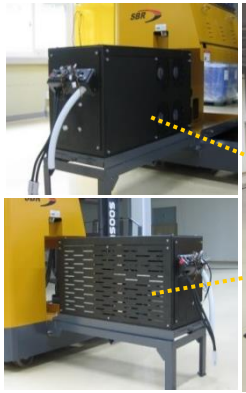
Achievement (MHVs)

MHV [PRO-POWER]

2010

2011

2013~



MHV_Class1

Fuel Cell	5 kW PEMFC
Fuel Storage	1.2kg (700bar)
Fuel Type	Hydrogen
Battery Type	Lithium Polymer
Battery Capacity	7.2 kWh (48V, 150Ah)
Driving Time	8 hrs

MHV_Class2

Fuel Cell	1.5 kW DMFC
Fuel Storage	12 L (100 % MeOH)
Fuel Type	Methanol
Battery Type	Lithium Polymer
Battery Capacity	3.6 kWh (48V, 75Ah)
Driving Time	8 hrs

Thank you
for your attention