Development of Fuel Cell Electric Vehicle in Hyundai Motor

Byung Ki Ahn, Ph.D.

Principal Engineer & General Manager
Fuel Cell Group
Hyundai Motor Group

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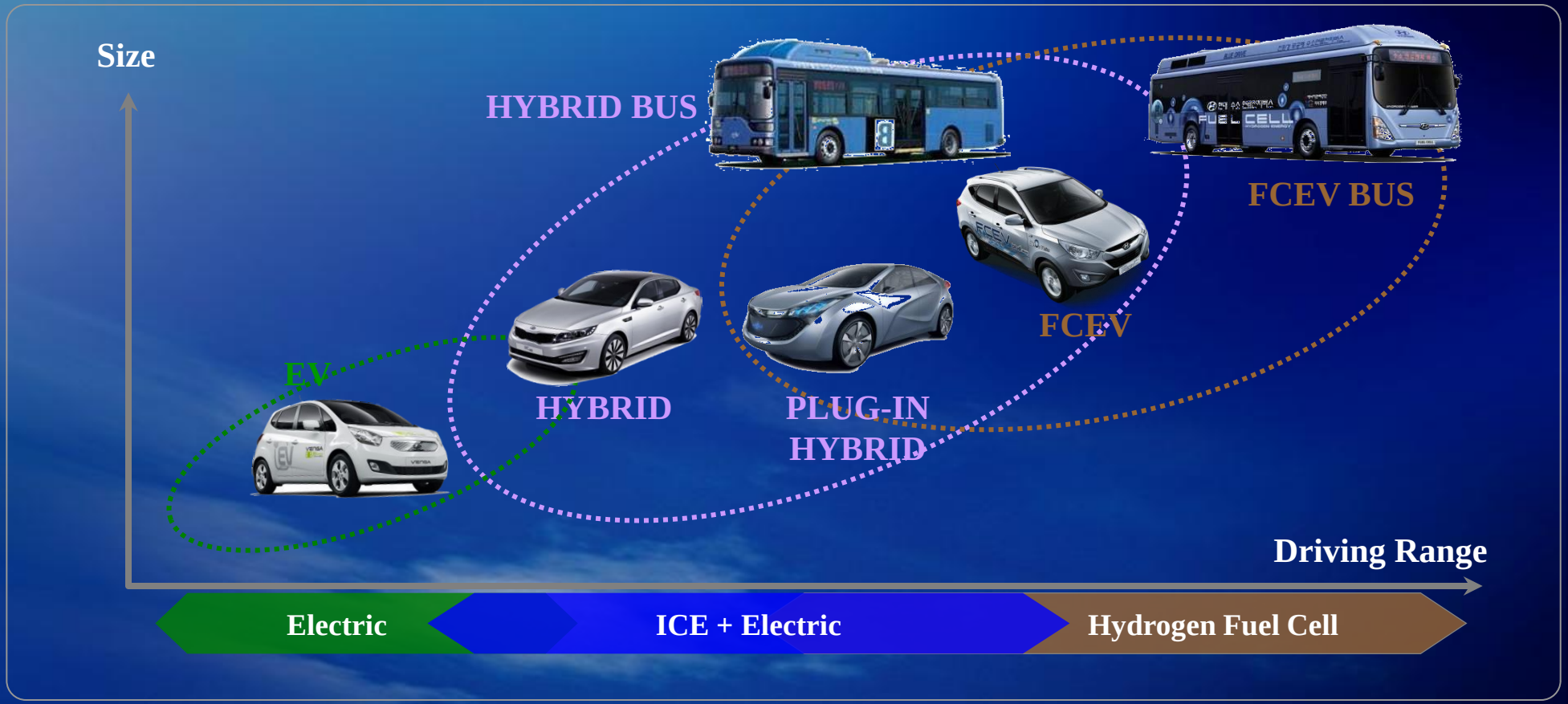
Eco-friendly Vehicle Strategies of Hyundai-Kia

- Small vehicles for short driving range → EV
- Large vehicles for long driving range → Hydrogen FCEV



Fuel Cell Electric Vehicle Development

Small Scale Production

• 2012 ~

- Tucson *ix35* FCEV (100kW)

Validation Program
(2009.12 ~ 2011.11)

• 2008 ~ 2009

- Borrego FCEV (115 kW)
- FC-BUS Gen II (200kW)

Domestic Monitoring Program
(2006.08 ~ 2010.07)

• 2007

i-Blue Concept car

- Tucson FCEV-II (100 kW)
- FC-BUS II (200 kW)

US DOE Fleet Program
(2004.09 ~ 2009.12)

• 2006

- Tucson FCEV (80 kW In-house Stack)
- FC-BUS (160 kW In-house Stack)

Member of CaFCP
(2000.11 ~ Present)

• 2004 ~ 2005

- Tucson FCEV (80 kW)
- Sportage FCEV (80 kW)

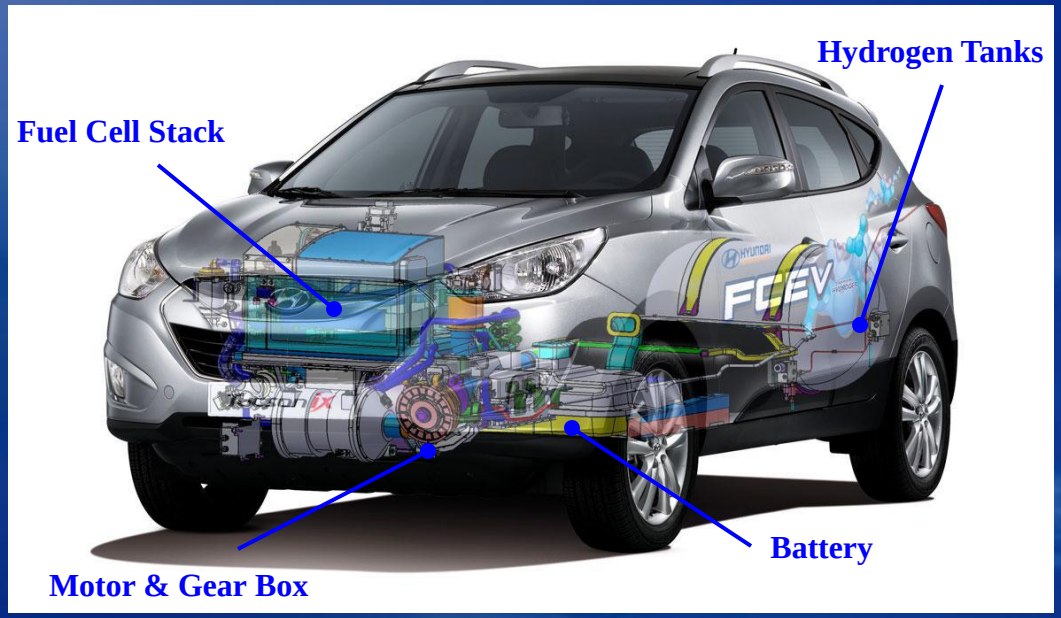
• 2000 ~ 2002

- SantaFe FCEV (75 kW)
- Sportage (10kW)

Fuel Cell Electric Vehicle Development

Tucson *ix35* FCEV (2010)

- Vehicle model for 2,000 unit production (2012~2014)
- Cost reduction through automatic production technology
- Compact design of fuel cell system by modularization
- Tests at T-Car level have been completed
- Power density of FC system: >650W/L



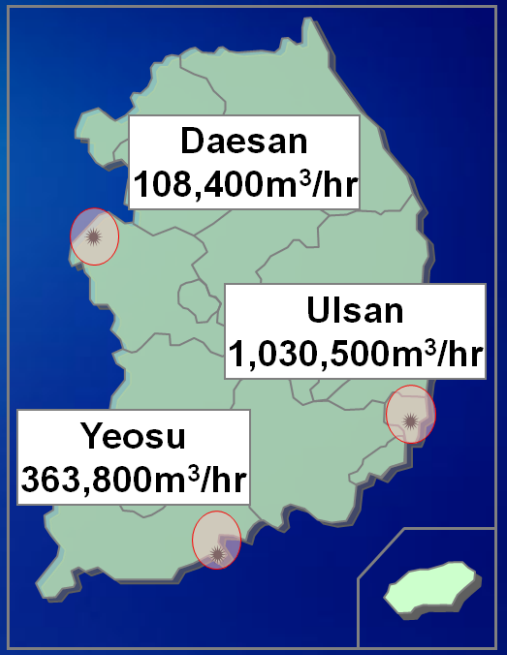
Fuel Cell Power	100 kW
Battery	21 kW
Motor System	AC Induction/100 kW
H_2 Tank	700 bar (10.2 ksi)
Fuel Economy	30 km/l (71 mpg)
Driving Range	650 km (404 miles)
Acceleration (0 → 100kph)	14.1 sec
Max. Speed	160 kph (100mph)

Hydrogen Production in Korea

- Most H_2 from chemical process
- Annual capacity: 1.171 million ton
- By-product H_2: 100k ton

20% of By-product H_2 ☞ 100k FCEV/year

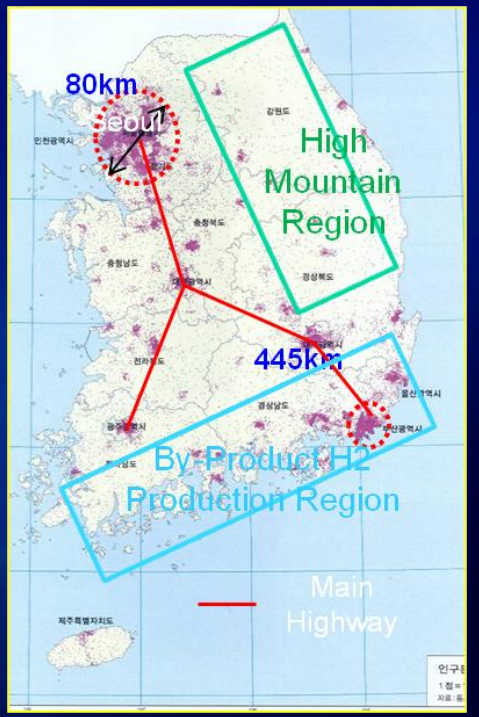
No additional investment for H_2 production for early market introduction



H_2 supply strategy in Korea:

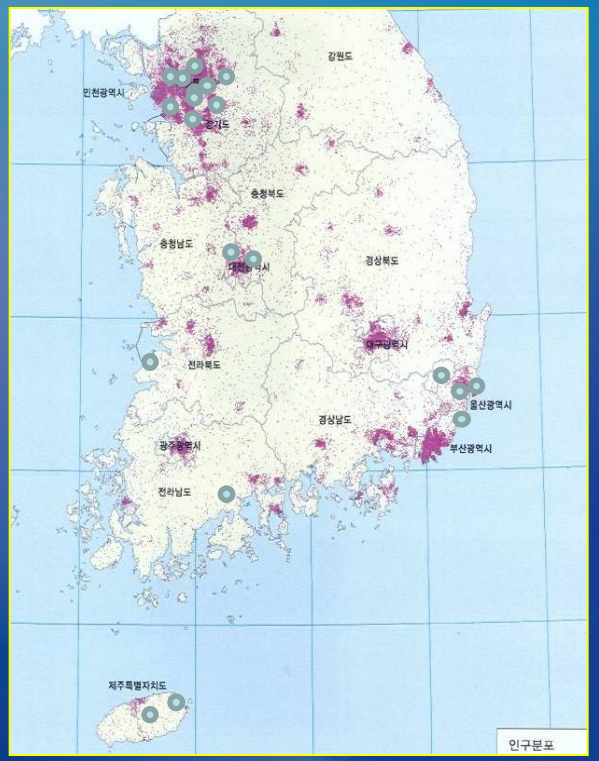
By-Product H_2 (~ '25)

Nuclear H_2 + By-product H_2 ('25~)



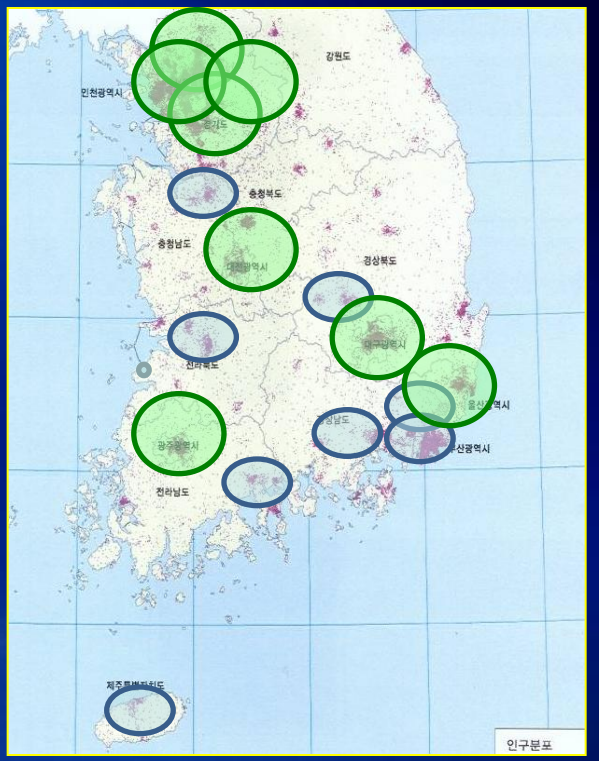
H2 Infrastructure Building Scenario

Phase 1 (~'14)
20 stations



Phase 2 (~'20)
100 stations

Phase 3 (~'30)
500 stations



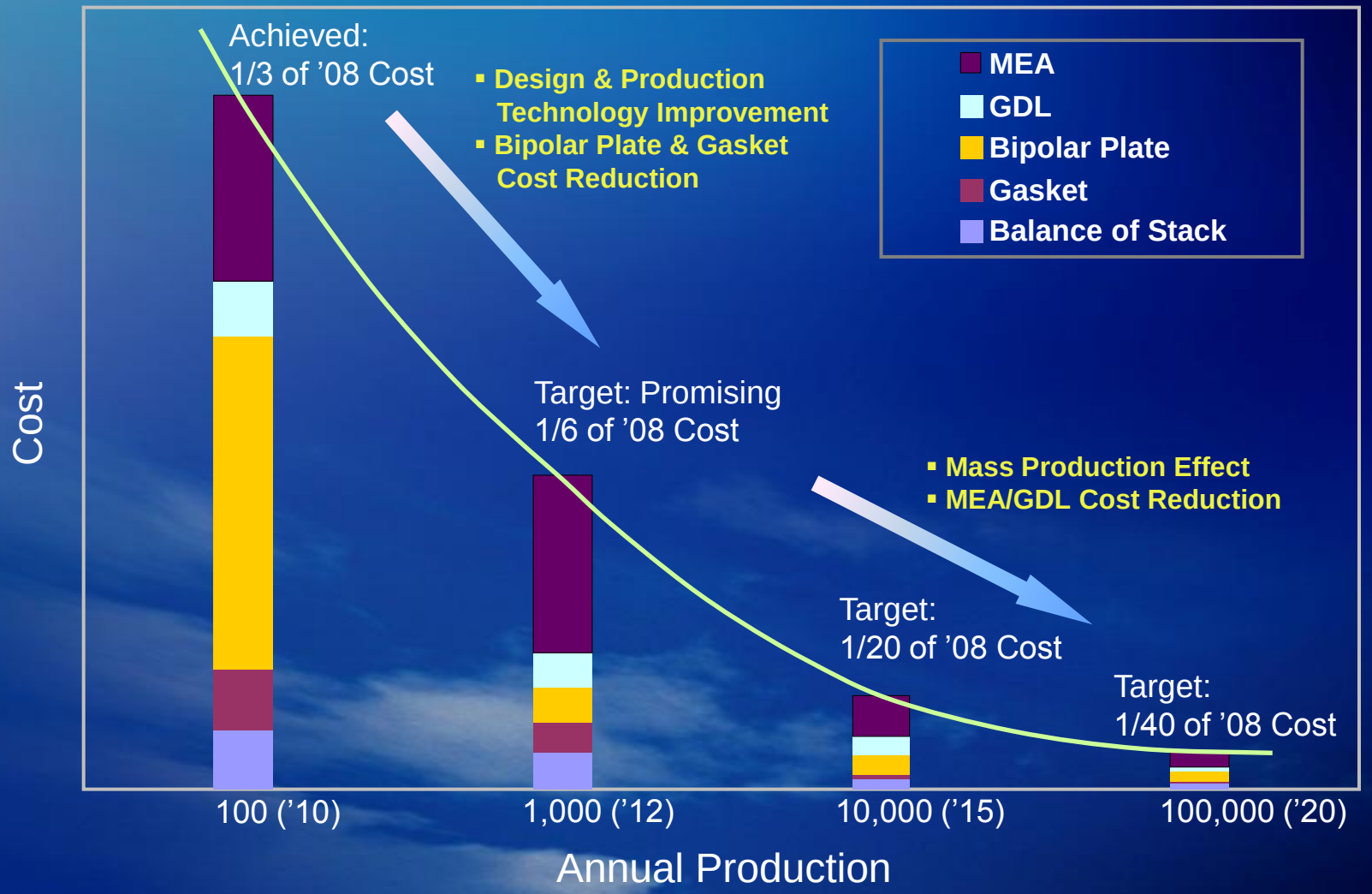
- Phase 1: Focusing on densely-populated area + H_2 production sites
- Phase 2: Spreading out to large cities
- Phase 3: Networking the large cities

: 10 stations

: 50 stations

Cost Estimation

- Cost Target of an FCEV is less than $ 50,000.



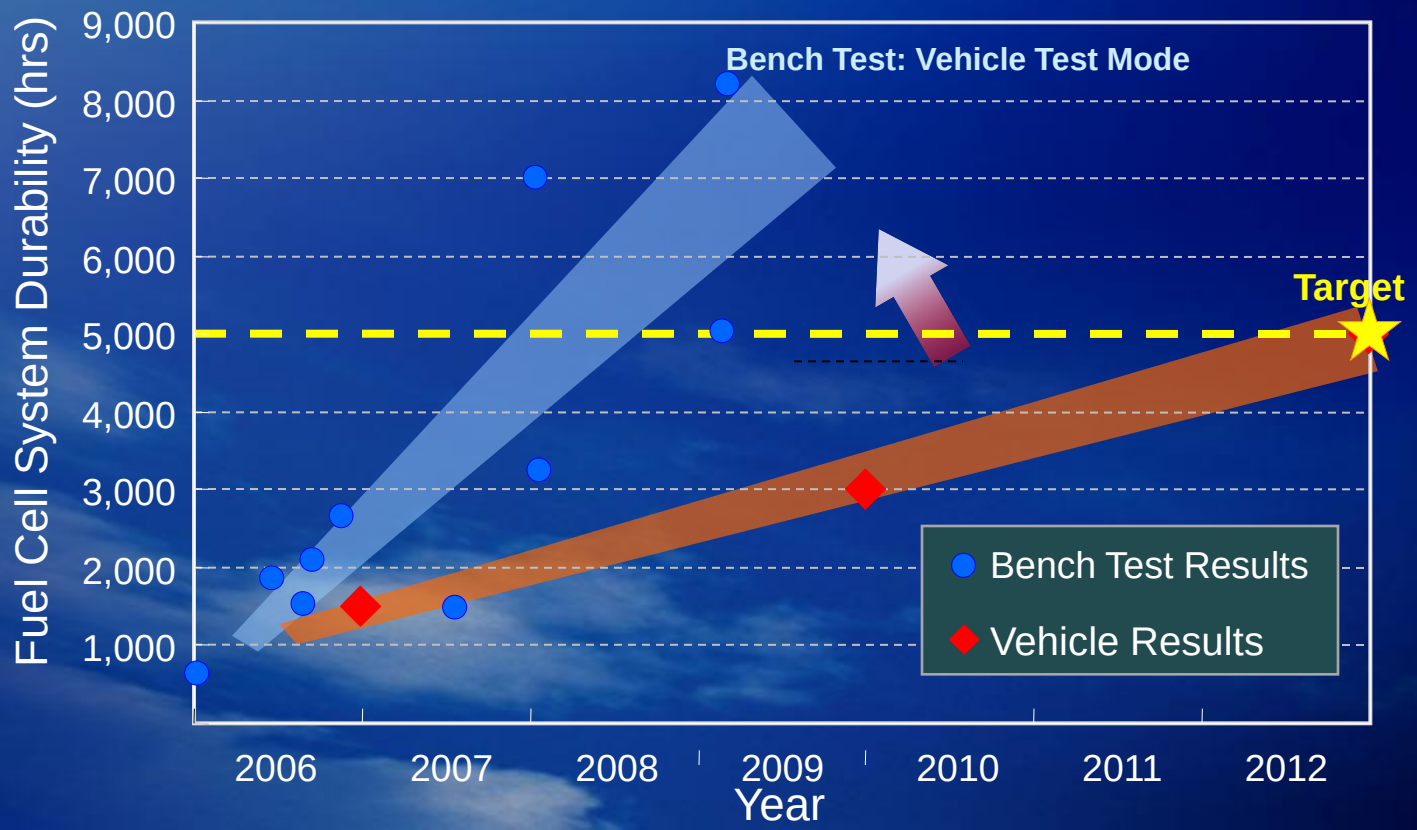
Durability

Durability = f(operation parameters, driving mode, environmental effects)

- **Verification of Degradation Mechanism**

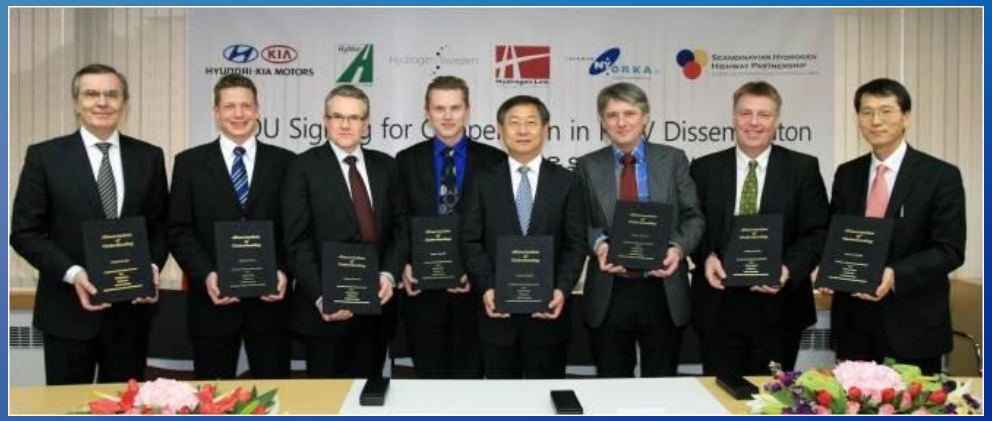
  (Start Up / Shut Down / Cold Start Up / High Temperature Operation)

- **Development of New Material** (Catalyst / Membrane) **& Optimum Operating Conditions**



Activities in Europe

MOU	**3 MOU's (SHHP, CEP, City of Copenhagen)**
EU Project	**- H2MOVES (4 FCEVs: Copenhagen and Oslo)** **- EU Parliament Testing Drive (1 FCEV)**



■ MOU with SHHP (Jan. 31, 2011)

■ EU Parliament Testing Drive (6 months)

■ Crossing Denmark: 340km on single H_2 charge (May)

■ Zero Rally in Norway (June,)

Activities with EU Government

EU Government Supported Projects

1. H2MOVES

- Budget: Total 2.43M € (0.97M € by EU).
- Period: ’09. 11~ ’12. 12 (3 years)
- Participated in the events (Germany (HME), UK (Ecovelocity), Italy (EcoDolomites) and Denmark (COTY Jury events, Copenhagen))

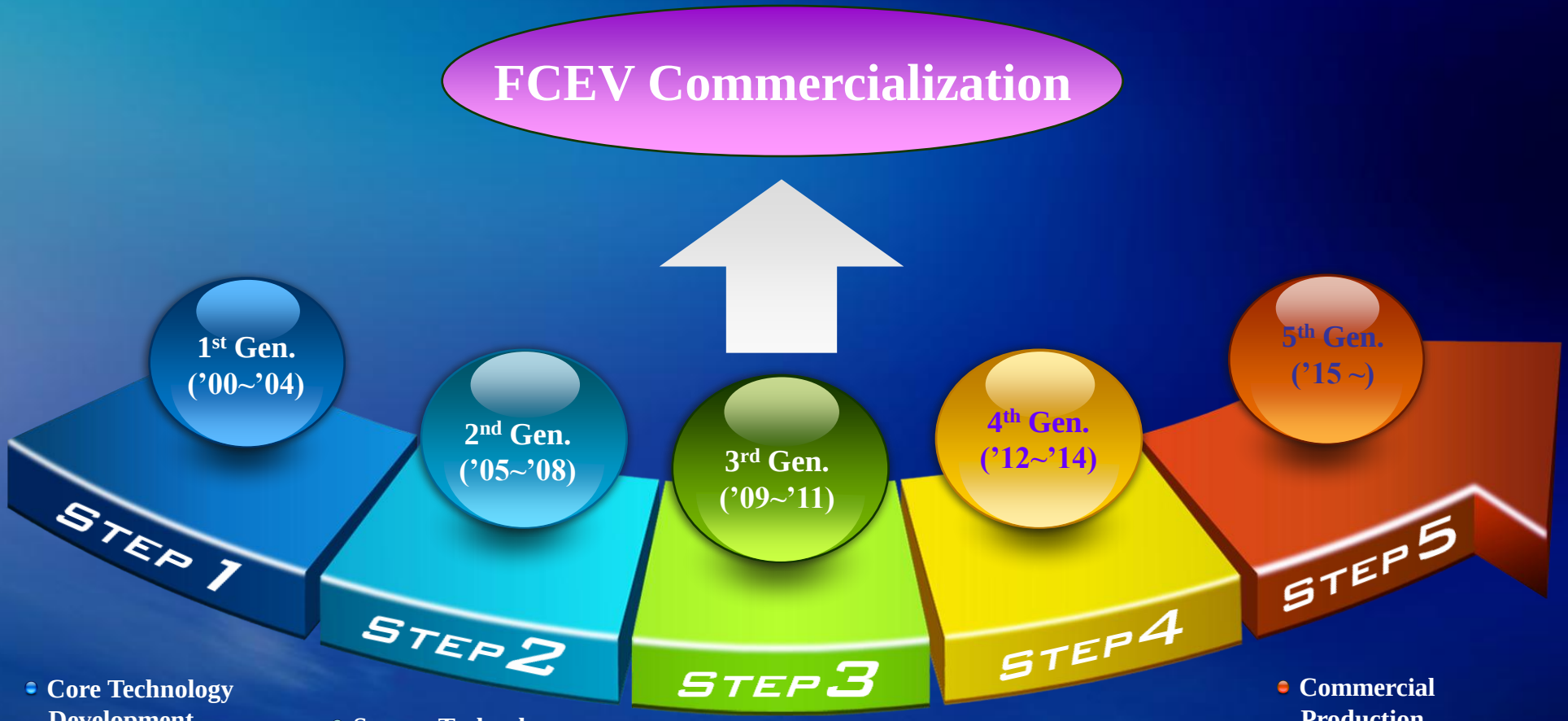
2. H2CONNECT

- Budget: Total 9.77M € (3.39M € by EU).
- Period: ’12. 9~ ’15. 8 (3 years)
- 25 Vehicles will be deployed in Germany (10 vehicles), Italy (10 vehicles) and Sweden (5 vehicles).

3. EU Parliament Officials Test Driving

- Being testdriven by members of European Parliament, Commissioners, EU officials and other policy makers.
- Period: ~ Mar. 2012 (6 months).

Roadmap of FCEV Commercialization



- Core Technology Development
- Outsourced Stack - 1st FCEV
- Several FCEVs/year

- System Technology Development & Fleet Operation
- Stack Bipolar Plate - Graphite
- Tens of FCEVs/year

- Semi-Automatic Production
- Stack Bipolar Plate - Metal
- Hundreds of FCEVs/year

- Pre-commercial Production (Pilot-scale)
- 1,000 FCEVs/year

- Commercial Production - Initial Market
- Full Automation
- 10,000 FCEVs/year SUV/Sedan


Thank you !