Chinese Hydrogen Update

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Ministry of Science and Technology
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International Partnership for the Hydrogen Economy
Joint SC / ILC Meeting
Washington, DC, USA
1-3 December 2009

Outline

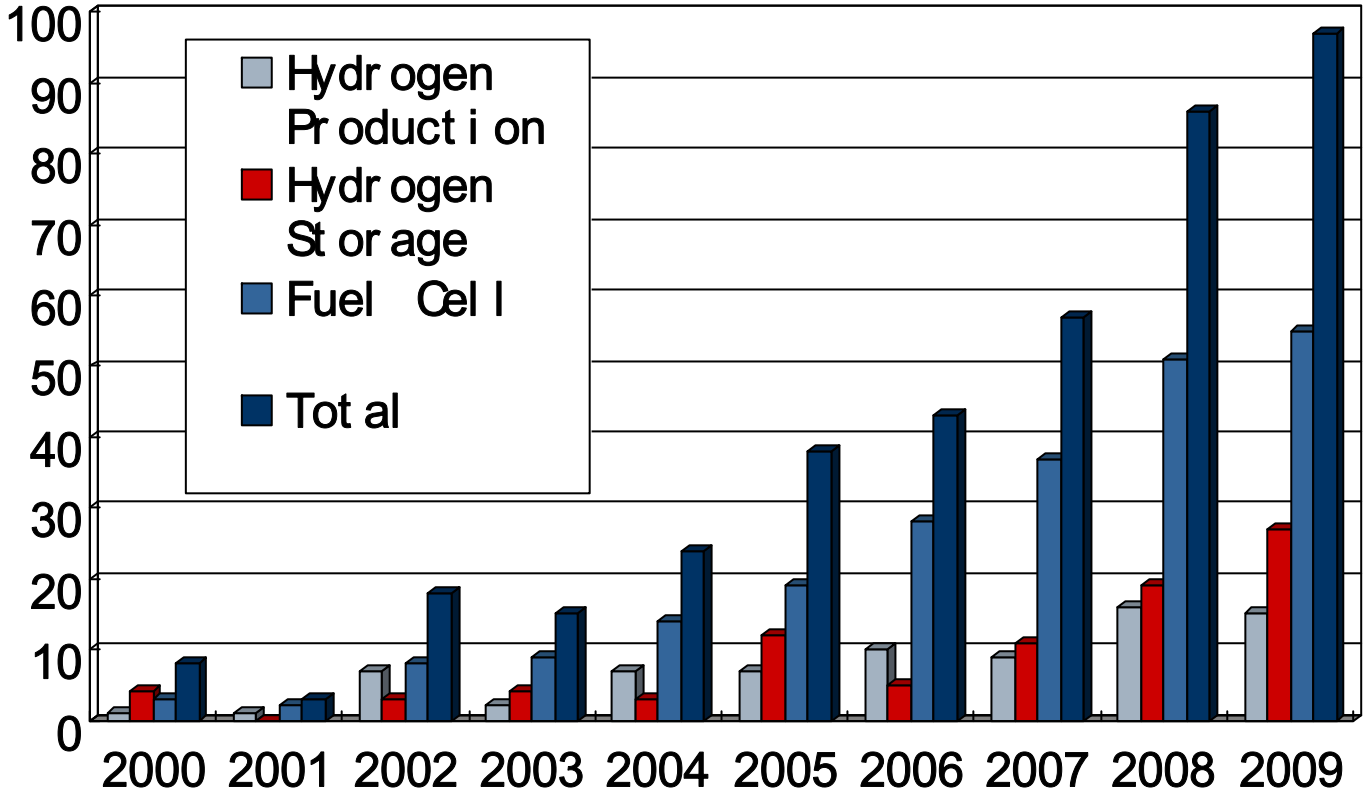
- State police
- R&D and Demonstrations of FCVs
- R&D and Demonstrations of Hydrogen station
- Development of Codes & Standards

National Mid-to-long Term Sci-Tech Plan（2006-2020）

In the Plan（2006-2020）, seven key areas were given top priority for innovation in energy area.

- **Technologies for energy saving and efficiency improvement;**
- **Reasonable, efficient, economic and clean utilization of coal;**
- **Technological supporting system for oil supply security;**
- **Advanced nuclear technologies;**
- **Advanced and reliable electricity transport and distribution system;**
- **Technologies for large-scale utilization of renewable energies;**
- **Hydrogen and fuel cell technologies.**

National Natural Science Foundation of China



Basic research projects on hydrogen founded by NSFC.

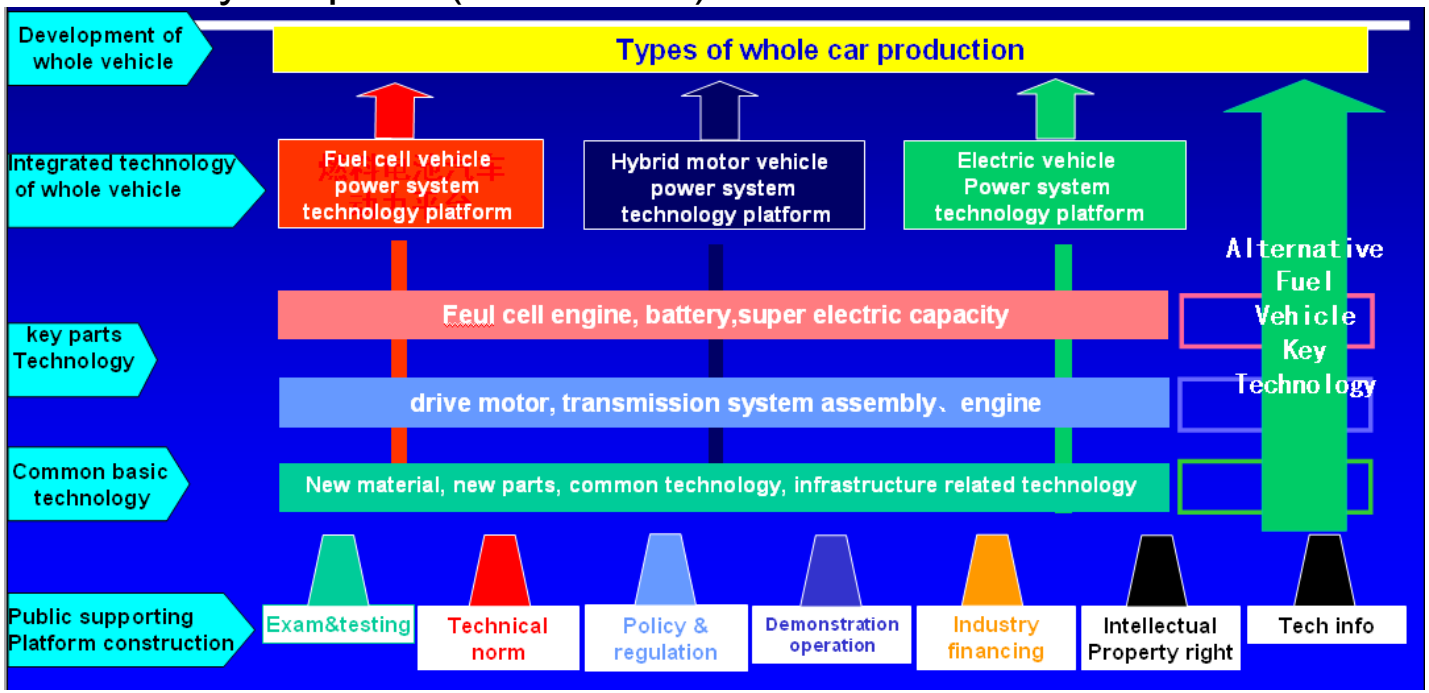
National High-tech R&D Program (863 Program)

During the 11th Five-year (2006–2010) Economic Development Plan, China's Ministry of Science and Technology (MOST) has approved RMB 634.3 million (approx USD 93 million) R&D program in the field of advanced energy technology. Within which, Hydrogen and Fuel Cell technology has been granted a total investment of approximately RMB 182.5 million (approx USD 27 million).

Budget/ RMB, million	2006	2007	2008	Total
Hydrogen and Fuel Cell Technology	**73.1**	**77.4**	**32.0**	**182.5**
Energy-saving and Distributed Energy Technology	**75.5**	**85.8**	**32.0**	**193.3**
Clean Coal Technology	**31.0**	**58.6**	**32.0**	**121.6**
Renewable Energy Technology	**35.0**	**37.9**	**64.0**	**136.9**

National High-tech R&D Program (863 Program)

R&D deployment of Energy-saving & New Energy Vehicle in "11th five-year-plan" (2006-2010)



In 2008, within total governmental support of **RMB 413 million**, FCV got **150 million**.

“1,000+ Green Vehicles in 10+ Cities”

- In Feb. 2009, a pilot demonstration project for energy-saving and new-energy vehicles have been launched in 13 cities.
- The government will provide a one-off subsidy for the purchase of hybrid, electric, and fuel cell vehicles in these cities.
- By 2012, over 60,000 clean buses and cars are expected to be running in China.

“1,000+ Green Vehicles in 10+ Cities”

Government subsidy standards

Vehicle type	Subsidy per unit
Passenger cars and light commercial vehicles	Hybrid Vehicle, maximum RMB 50,000
	Electric Vehicle, RMB 60,000
	Fuel Cell Vehicle, RMB 250,000 (approx USD 36,600)
Buses with a length of ten meters or above	Hybrid Bus, maximum RMB 420,000
	Electric Bus, RMB 500,000
	Fuel Cell Bus, RMB 600,000 (approx. USD 87,800)

The subsidies will be provided mainly to vehicles for public benefit in the 13 cities, such as taxis, buses, post vans, cars for public services, not for private purchase yet.

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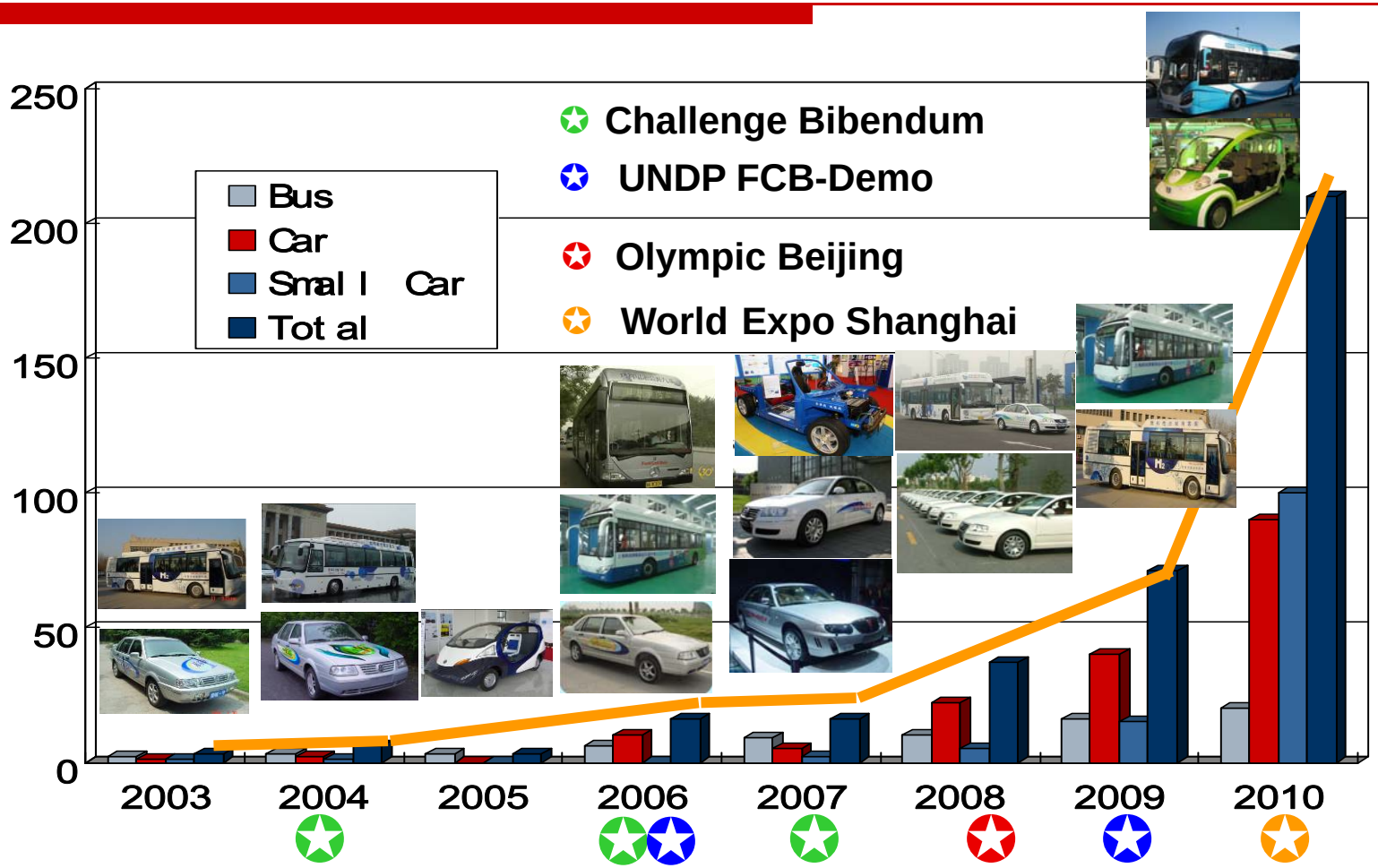
R&D and Demonstration of FCVs



GEF-UNDP-China FCB Demonstration

As Phase I of the GEF-UNDP-China FCB project, three FCBs purchased from Daimler-Chrysler started formal operation for public in Beijing on June 20th, 2006, and finished their demonstration in Oct. 2007.

GEF-UNDP-China FCB Demonstration

Demonstration statistics of Phase I

By Oct.24, 2007

Total operation mileage	92,116 km
Total operation hours	5,699 h
Total amount of H2 filled	16,621 kg
Average hydrogen consumption	18 kg/100km
Average bus availability	89%
Passengers	56,841

GEF-UNDP-China FCB Demonstration

- The Phase II of the GEF-UNDP-China FCB project was launched in Shanghai on November 15, 2007.
- In Phase II, FCB will be demonstrated in Shanghai for two years or 4000 operation hours, including in World Expo 2010 in Shanghai.

GEF-UNDP-China FCB Demonstration

- The specification and bidding tender document had been released in July 2008. Main requirements:
  - Large (overall length 12m), low floor or low entrance
  - passenger seat ≥ 30
  - curb/gross weight ≤ 14000/18000 kg
  - Max speed ≥ 70 km/h (with air conditioning)
  - Acceleration 0 to 50 km/h ≤ 25 sec
  - Gradability ≥ 15%
  - Range per fully fueling ≥ 220 km (with air conditioning)

- Shanghai Automotive Industry Corporation won the bidding in October 2008. SAIC will supply six large hybrid FCBs, in which three FCBs will install Ballard FC stacks and others will install homemade FC stacks.

Fuel-cell Vehicles in 2008 Beijing Olympics

◆During Beijing Olympics, nearly 600 hybrid vehicles, pure electric vehicles and fuel cell vehicles were used. Beijing has realized "zero-emission" in Olympic central districts and fulfilled the promise of "low emission“.

◆To ensure the smooth operation of the fuel cell vehicles during the Olympic Games, a base that is responsible for the operation, dispatch and maintenance of the vehicles had been established in Beijing Hydrogen Park.

Fuel-cell Vehicles in 2008 Beijing Olympics

Passat Lingyu fuel cell cars escort Olympic marathons.

Fuel-cell Vehicles in 2008 Beijing Olympics

The cars were developed by Shanghai Volkswagen , Shanghai Fuel Cell Vehicle Powertrain Co. and Tongji University.

	Contents	Unit	Parameter
1	Overall dimension L-W-H	mm	4789 X 1765 X 1470
2	Gross /Max weight	kg	1804/2179
3	Fuel Cell engine	kw	55
4	Li Battery		376V, 8Ah
5	Max speed	km/h	140
6	Acceleration		≤15s (0-100km/h)
7	Gradeability		20%
8	Range per fueling	km	250 (Chinese City Drive Cycle)
9	Hydrogen consumption	Kg/100km	1.4 (Chinese City Drive Cycle)

Fuel-cell Vehicles in 2008 Beijing Olympics

In addition to the marathons, the cars also provide transport for special guests, the press and Olympics organizing committee officials.

Fuel-cell Vehicles in 2008 Beijing Olympics

Fuel cell buses pick up marathon runners in Beijing Olympics and Paralympics.

Fuel-cell Vehicles in 2008 Beijing Olympics

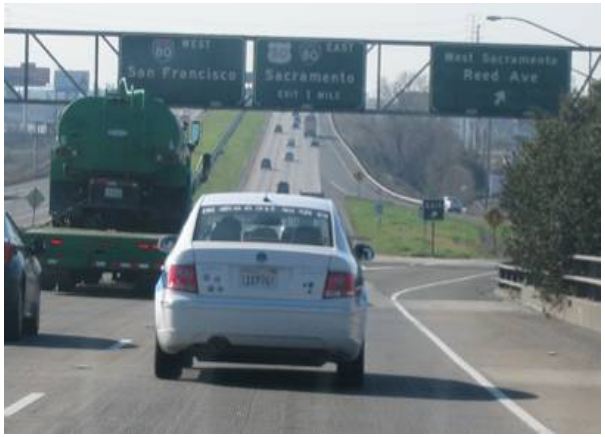
The buses were developed by Beiqi Foton Motor Co. and Tsinghua University.

1	overall dimension L-W-H	mm	11950-2550-3450
2	curb/ gross weight	kg	14200/17400
3	max. speed	km/h	⩾80
4	acceleration	⩽25 Sec.	0 to 50 kph
5	g radeability	%	18
6	.range per fueling	km	⩾200
7	PEM fuel cell system rated/max output energy efficiency at rated output max energy efficiency	 Kw % %	 80/100 ⩾40 ⩾50
8	.AC inductive motor rated/max power output rated/max torque output rated RPM	 Kw Nm	 100/185 531/1100 1800
9	battery NiMH		336 V, 80 AH
10	hydrogen storage		10tanks, 140L/tank.200 bar
11	hydrogen consumption (without air conditioning) (Chinese typical bus cycle)	kg/100km	8.5

After 2008 Beijing Olympics

After debuted at the 2008 Olympic Games, 16 Passat Lingyu vehicles participate in fleet demonstrations at the California Fuel Cell Partnership in Sacramento, Calif.

Feb.6 – Jun.30, 2009	Fleet	Single car
Mileage in Calif.	37,000km	4,111 km (Max.) 519 km (Min.)



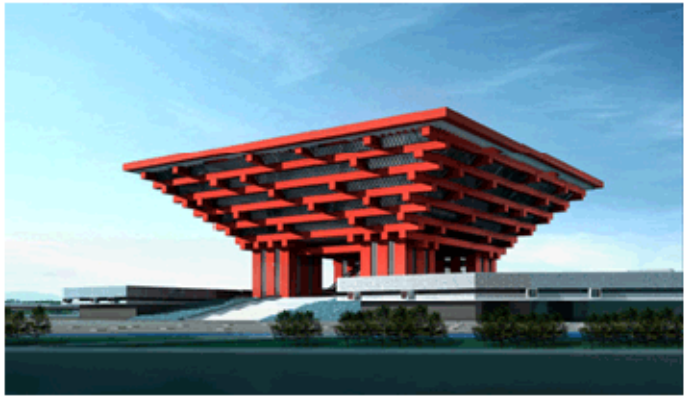
After 2008 Beijing Olympics

Aug.1, 2008 – July.31, 2009

Total mileage	75,460 km
FC work time	3,646 hr
Hydrogen consumption	9.5 kg/100km
Passenger	39,995

In addition to the Olympics, 3 FC buses initiated one year formal demonstration as city buses since Aug.1,2008. The operation route is same as DC buses in UNDP/GEF/China project phase I.

2010 World EXPO Shanghai



Duration:
May 1 to Oct 31, 2010
Expected Visitors:
70 million
Expected Participants:
200
Theme:
Better city, better life.

More information on
http://www.expo2010.cn

2010 World EXPO Shanghai

Over 1,000 environmentally friendly buses and cars will be used to transport visitors in and around the Expo Site during the 2010 World Expo.

Bus in Expo Site	Puming Line: 36 Super-capacitor Buses + **6 Fuel Cell Buses**; Yuejiang Line: 120 Electric Buses
Bus & Taxi around Expo Site	150 Hybrid Buses, 350 Hybrid Taxis
VIP passenger car and Sight-seeing car (small car)	**90 Fuel Cell passenger cars, 100 Fuel Cell sight-seeing cars**
Service vehicle in Expo site	150 Electric vehicles (Security, transport, etc.)

Welcome to everyone to visit 2010 World EXPO Shanghai !
Propose to hold the IPHE meeting in Oct. 2010 in Shanghai.

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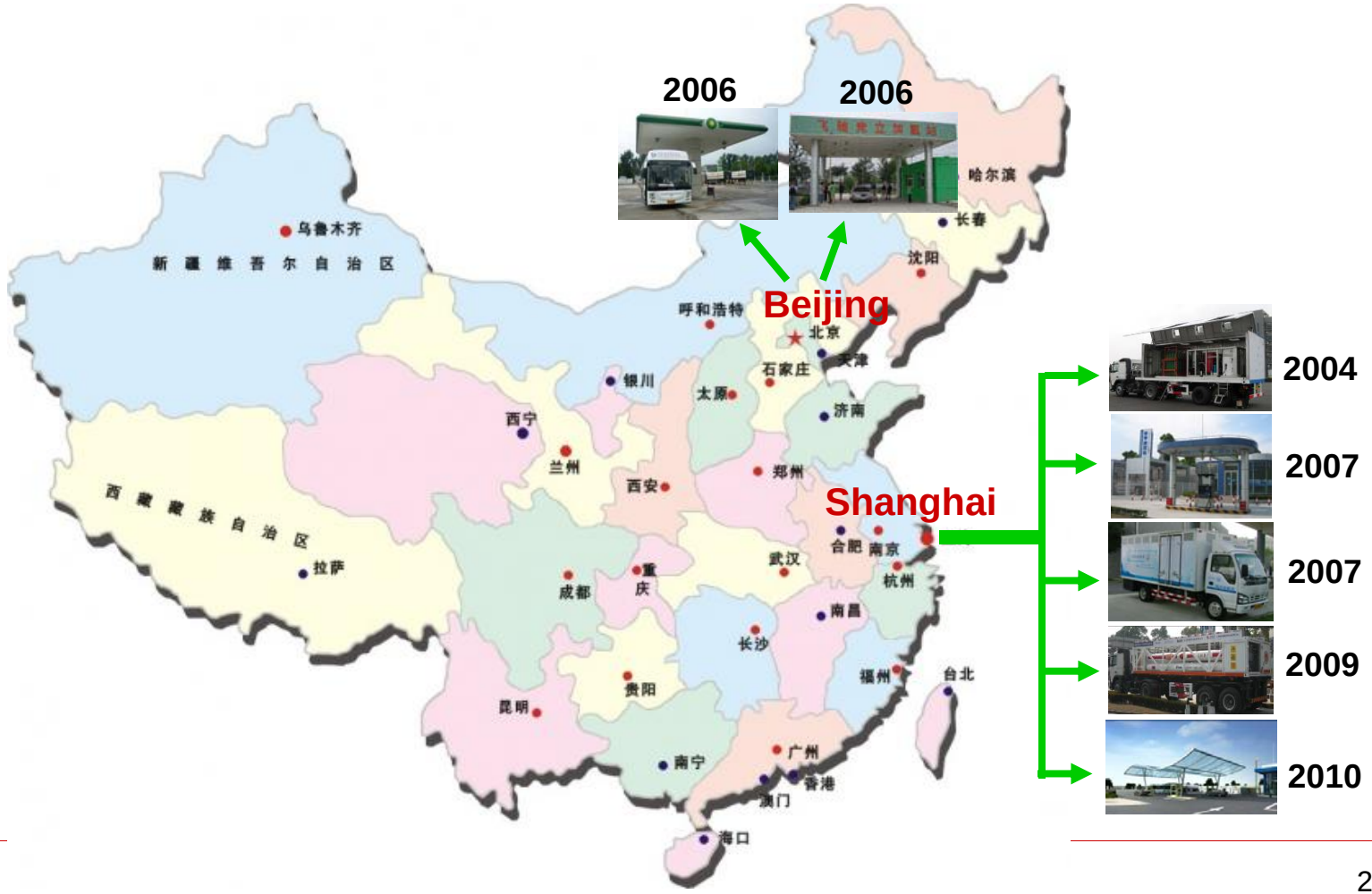
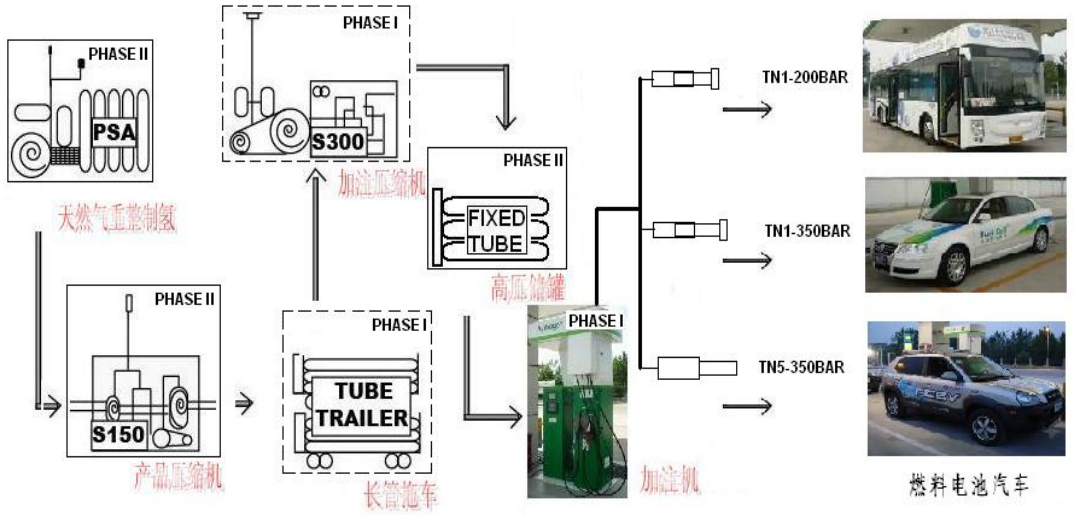
R&D and Demonstration of HRS in China



Beijing Hydrogen Park

Opened in November 2006, the Beijing Hydrogen Park was the first hydrogen refueling station in China.



Phase Ⅰ: Trucked in H2 supply, 2000Nm^3/day, finished in 2006
Phase Ⅱ: On site NG reforming, 50Nm^3/h, finished in 2008
Phase Ⅲ: On site H2 production from renewable energy, in planning

Beijing Hydrogen Park

DaimlerChrysler FCB Demonstrate in UNDP/GEF/China project Phase Ⅰ

Olympics FCV demonstration

Beijing LN Power Sources Hydrogen Station

◆Located only 1 km from Beijing Hydrogen Park, the station complex was built in 2006.

◆On-site hydrogen production from water electrolysis (300 Nm3/hour). H2 stored in one vertical cylindrical steel vessel of 5 m3 with 40 MPa, also the produced oxygen is stored onsite. H2 can be dispensed at 35MPa; both H2 and O2 are also filled in steel bottles and sold to clients.

Anting Hydrogen Refueling Station

◆Officially opened on Nov. 15, 2007, together with the inception of UNDP/GEF/China FCB project (Phase II).

◆Co-built by Tongji University, Shanghai Aerospace Energy Co. and Shanghai Sunwise Energy System Co. Shell Hydrogen cooperates with Tongji University as technical consultant and funds part of the station demonstration. Linde provides engineering services for the construction of the station.

◆Hydrogen source : Trucked-in by-product H2
Filling pressure: 350bar
Storage pressure: 424bar
Storage capacity: 800kg(Max)

Anting Hydrogen Refueling Station

Start 3
(Tongji Univ.)

PASSAT FCV
(Shanghai VW)

EASTER FCV
(Chery)

PASSAT FCV
(Shanghai VW)

Roewe plug-in FCV
(SAIC)

Shanghai FCV
(SAIC)

Mobile hydrogen refueling station

- Since 2004, Tongji Univ. and Shanghai Sunwise Energy System Co. had developed three generations of mobile hydrogen fueler, which greatly supported the development of FCV in Shanghai.
- Two new mobile hydrogen fuelers (3rd generation) are under installing now, and will provide hydrogen refueling service for FCV fleet in 2010 EXPO.

2009

2007

2004

2010 World EXPO HRS

To support FCV demonstration in 2010 World Expo, a bigger hydrogen station is under construction.

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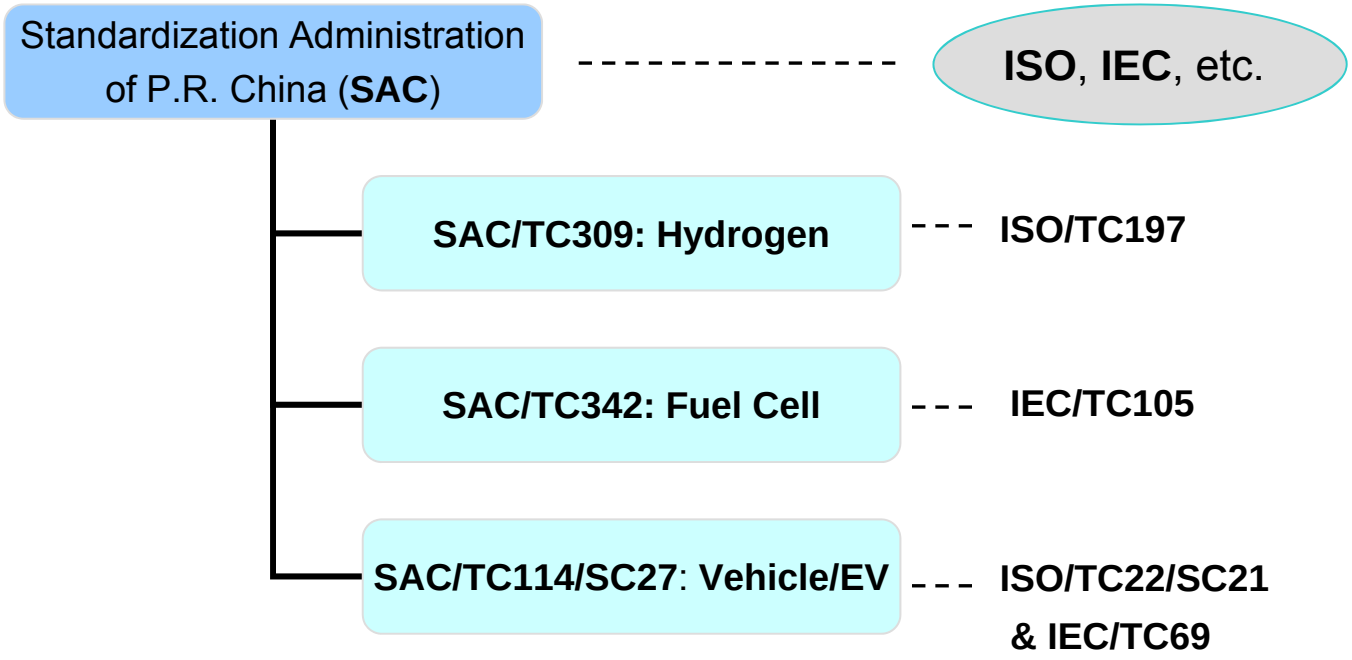
Three main Hydrogen related CDOs in China



*Codes and standards were stipulated by **SAC**, approved and promulgated by **AQSIQ** (the General Administration of Quality Supervision, Inspection and Quarantine of PRC).*

SAC/TC309

Issued standards

- GB 3634-1995, ”Industry Hydrogen”
- GB/T 7445-1995, “Pure Hydrogen, High Purity Hydrogen, Ultra Pure Hydrogen”
- GB 4962-1985, “Technical Safety Regulation for Gaseous Hydrogen Use”
- GB 50177-2005, “Design Code for Hydrogen Station”
- GB/T 19774-2005, “Specification of Water Electrolyte System for Producing Hydrogen, Specification of Hydrogen Purification System on Pressure Swing Adsorption”
- GB/T 24499-2009, “Technologies glossary for gaseous hydrogen, hydrogen energy and hydrogen energy system”
- DGJ08-2055-2009 / J11330-2009, “Technical specification of hydrogen refueling stations for fuel cell vehicles” (Shanghai Local Code)

Documents under official approval

- “Technical Code for Hydrogen Fuelling Station”
- “Terminology of Hydrogen Energy”
- “Technical Safety Regulation for Gaseous Hydrogen”

SAC/TC342

Issued standards

- GB/T 20042.1-2005, “Proton exchange membrane fuel cell – Part 1:Terminology”
- GB/Z 21742-2008, “Portable proton exchange membrane fuel cell power systems”
- GB/Z 21743-2008, “Stationary proton exchange membrane fuel cell power system (separate)- Tests methods for the performance”
- GB/T 20042.2-2008, “Proton exchange membrane fuel cell – Part 2: General technical specification of fuel cell stacks”
- GB/T 20042.3-2009, “Proton exchange membrane fuel cell – Part 3: Test method for proton exchange membrane”
- GB/T 20042.4-2009, “Proton exchange membrane fuel cell – Part 4: Test method for electrocatalysts”
- GB/T 20042.5-2009, “Proton exchange membrane fuel cell – Part 5: Test method for membrane electrode assembly”
- GB/T 23645-2009, “Test methods of fuel cell power system for passenger cars”
- GB/T 23751.1-2009, “Micro fuel cell power systems- Part 1: Safety”
- GB/T 23751.2-2009 / IEC 62282-6-200:2007, “Micro fuel cell power systems- Part 2: Performance test methods”

SAC/TC114 /SC27

Issued standards

- GB/T 24548-2009, “Fuel cell electric vehicles terminology”
- GB/T 24549-2009, “Fuel cell electric vehicles safety requirements”
- GB/T 24554-2009, “Performance test methods for fuel cell engines”

Documents under official approval

- Specification of mobile hydrogen refueling vehicles
- Technical specification of vehicle fueling connection device
- Technical specification of hydrogen system of FCV
- Maximum speed test methods of FCV
- Energy consumption measurement of FCV

Thanks for your attention