Overview of Scenario, Roadmap and R&D projects of Hydrogen and FCV in Japan

SATO, Yoshiteru

Department Director
Fuel Cell and Hydrogen Technologies Development Department
New Energy and Industrial Technology Development Organization (NEDO)

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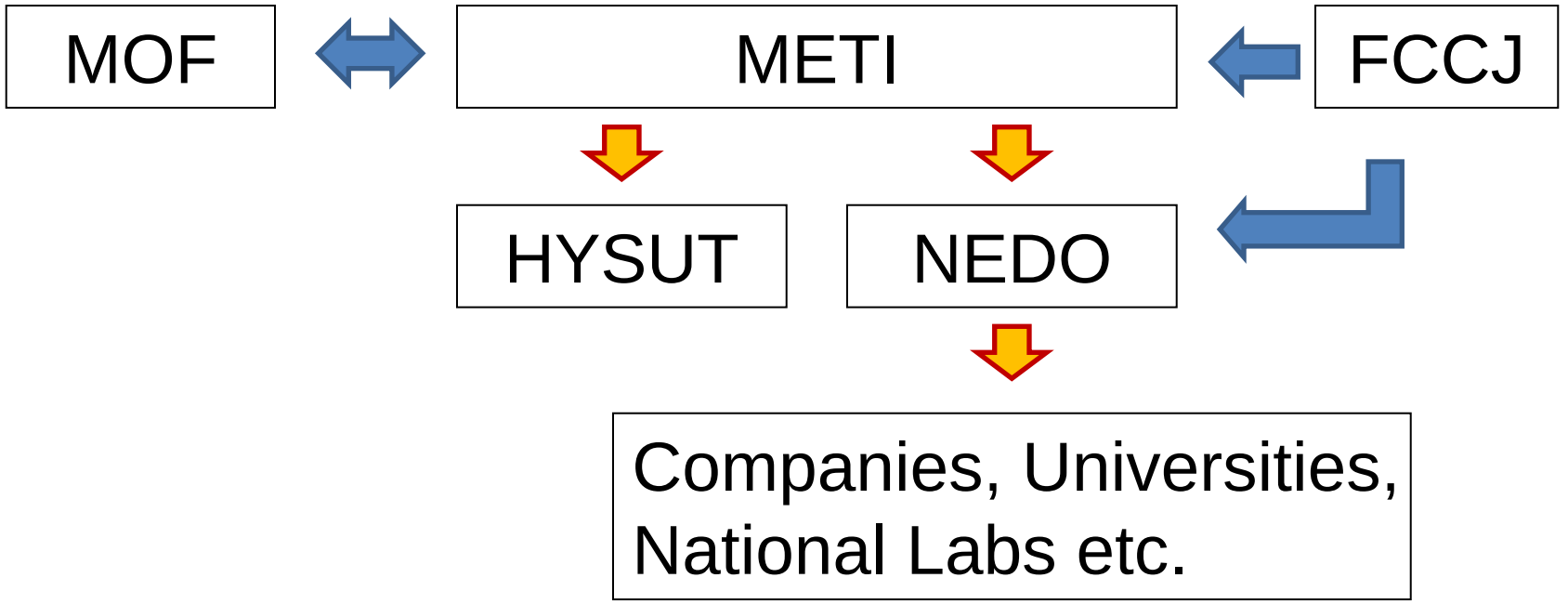
Contents

Framework for R&D of Hydrogen and Fuel Cells under METI & NEDO in Japan

Policy planning
Hydrogen and Fuel Cell Promotion Office
METI (Ministry of Economy, Trade and Industry)

R&D program planning, funding and managing
Fuel Cell and Hydrogen Tech. Devel. Depart.
NEDO

R&D Project
Companies, Universities, National Labs etc.



FCCJ : Fuel Cell Commercialization Conference of Japan
FCCJ was established on March 19, 2001 as a conference to study and discuss at a nongovernmental level the commercialization and commercialization of fuel cells. FCCJ's major activities include making proposals regarding verification tests for fuel cell vehicles, hydrogen infrastructure and stationary fuel cells; identifying technological development issues for fuel cells and creating and proposing roadmaps; discussing fuel cell introduction scenarios and making proposals to the ministries concerned regarding standardization and review of regulations.

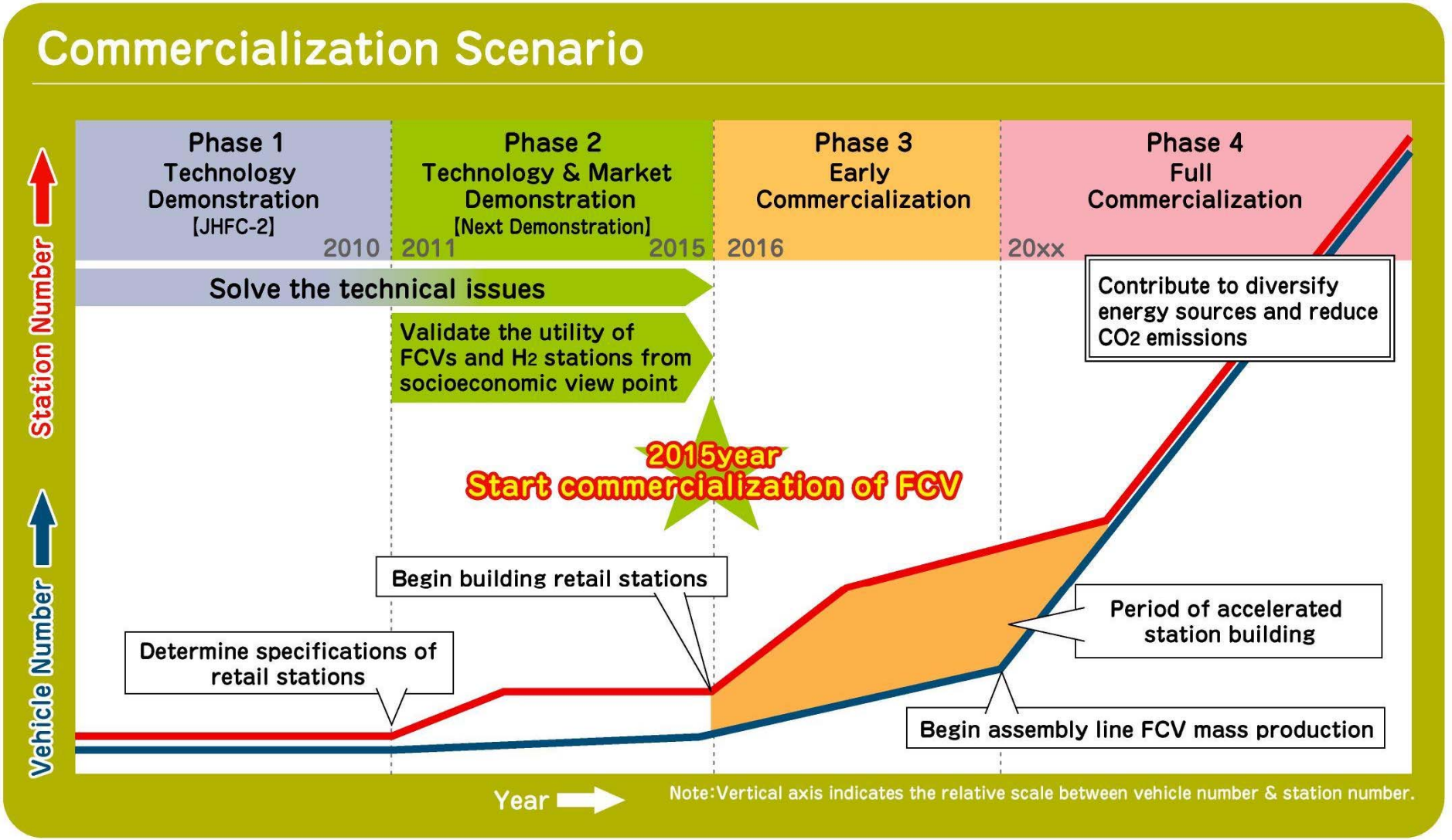
FCCJ press release on July 4, 2008

Leading automakers in and outside Japan and Japanese energy companies have agreed on a scenario which sees commercialization of fuel cell vehicles (FCVs) and hydrogen stations beginning in 2015.

They have also identified the challengers facing future energy diversification and post-Kyoto Protocol talks.

Under METI (Ministry of Economy, Trade and Industry), activities for overcoming the challenges are being accelerated through the Japan Hydrogen & Fuel Cell Demonstration Project, through promotion of technology development programs led by NEDO (New Energy and Industrial Technology Development Organization), through investigations into a large scale pilot project, and through other unique initiatives by individual energy automobile companies.

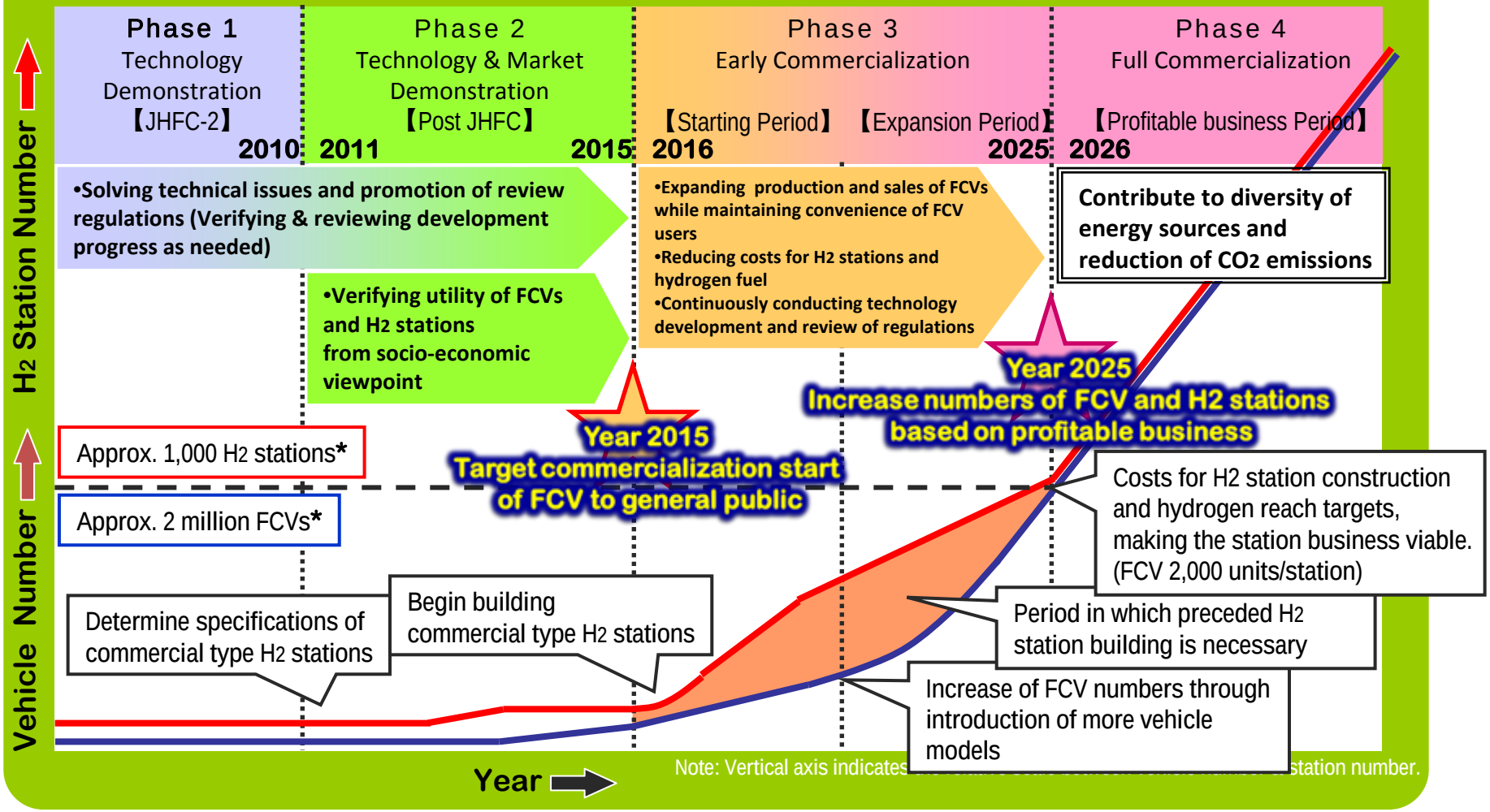
Commercialization of fuel cell vehicles and hydrogen stations to commence in 2015



Major member companies of the FCCJ board

Toyota Motor, Honda Motor, Nissan Motor, General Motors Asia Pacific (Japan), Mercedes-Benz Japan, Nippon Oil, Tokyo Gas, Osaka Gas, Idemitsu Kosan, Cosmo Oil, Japan Energy, Showa Shell Sekiyu

Commercialization Scenario for FCVs and H_2 Stations



* **Precondition: Benefit for FCV users (price/convenience etc.) are secured, and FCVs are widely and smoothly deployed**

NEDO's Mission and Approach

Mission

As Japan's largest funding agency promoting research and development as well as the diffusion of energy, environmental, and industrial technologies, NEDO has a crucial mission to carry out.

- Addressing energy and global environmental challenges
- Enhancement of industrial competitiveness

Approach

Based on the goals of outcome oriented and user friendly operation, NEDO, a professional research and development management organization, employs a Plan-Do-See (PDS) approach.

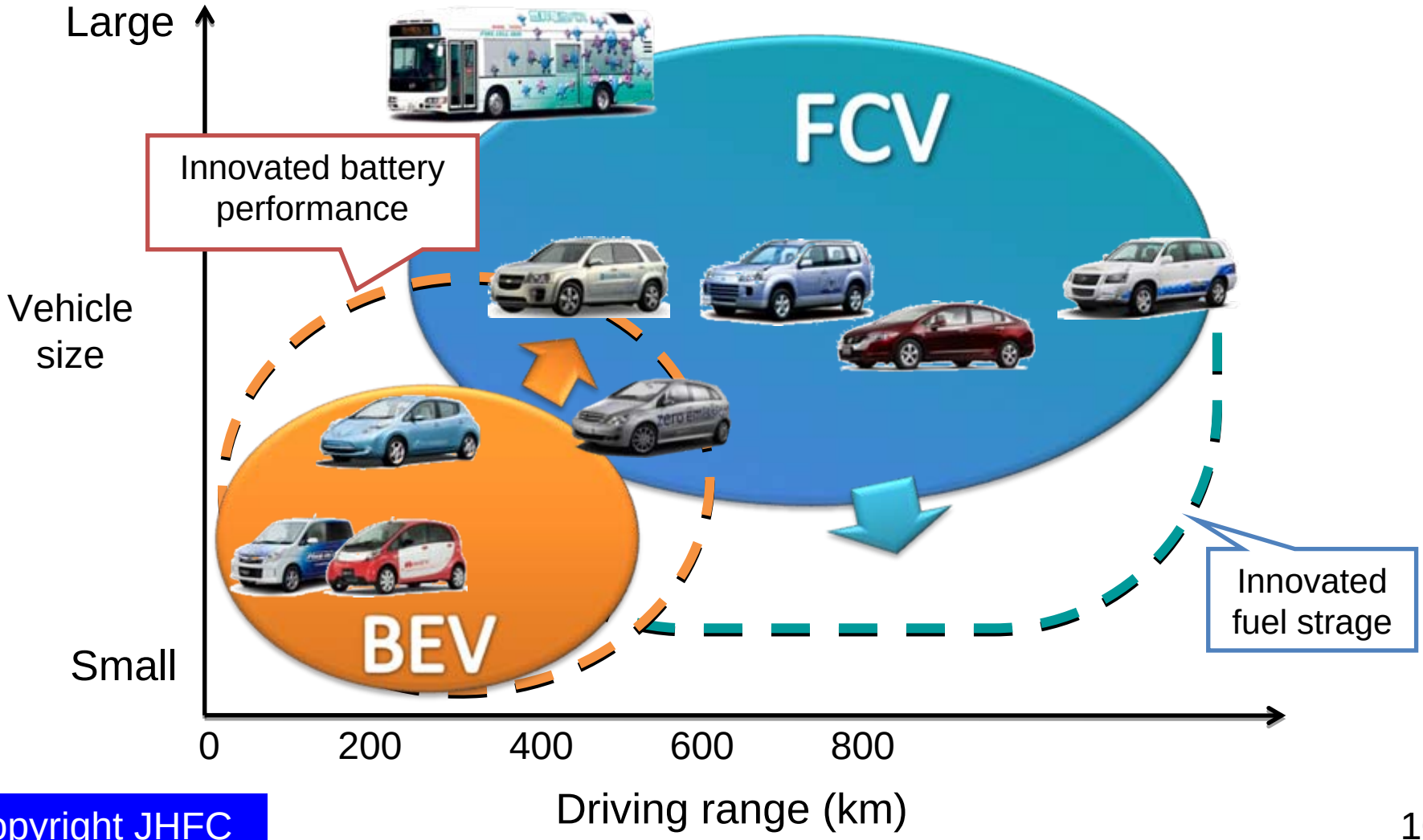
- Promotion of R&D through "Selecting and Focusing"
- Flexible and agile project management through rigorous evaluations

FY2010 Budget for R&Ds of Hydrogen and Fuel Cells managed by NEDO (in million Yen)

R&D program of PEFC	FY2010-FY2014	5,100
R&D program of hydrogen production, delivery, storage and refueling system	FY2008-FY2012	1,350
R&D of hydrogen storage material (HYDROSTAR project, Leader : Dr. Akiba)	FY2007-FY2011	900
R&D of hydrogen embrittlement and tribology (HYDROGENIUS project, Leader : Prof. Murakami)	FY2006-FY2012	1,000
D of FCV and refueling station (JHFC project, Chair of Steering Comm.: Dr. Ishitani)	FY2006-FY2010	870
R&D program of SOFC	FY2008-FY2012	800
D of residential SOFC	FY2007-FY2010	662
Total		10,682

Segmentation of FCV and BEV

- FCV can replace existing gasoline vehicle in aspects of vehicle size and driving range.
- For small and short-distance applications, BEV and FCV can coexist to spread more widely.



Objectives of JHFC Phase 2

1. To clarify remaining issues under the actual using conditions.
2. To collect data to develop regulations, codes and standards.
3. To formulate and implement public relations and educations for dissemination and promotion.
4. To verify the energy savings (fuel economy) and environmental impact
5. To identify technology and policy trends of FCV's, fuel cell powered small vehicles and hydrogen ICV's as well as hydrogen infrastructures

Features of JHFC Phase 2

Fleet tests by third parties

Increase of hydrogen users (not limited to FCV's but small FC carriers and hydrogen ICV's)

Area extension (metropolitan Tokyo, Nagoya and Osaka)

Operation of FC buses and hydrogen station in Centrair Airport region

Operation of FC wheel chairs, FC carts and FC-assisted bicycles and operation of hydrogen stations for them in Osaka region

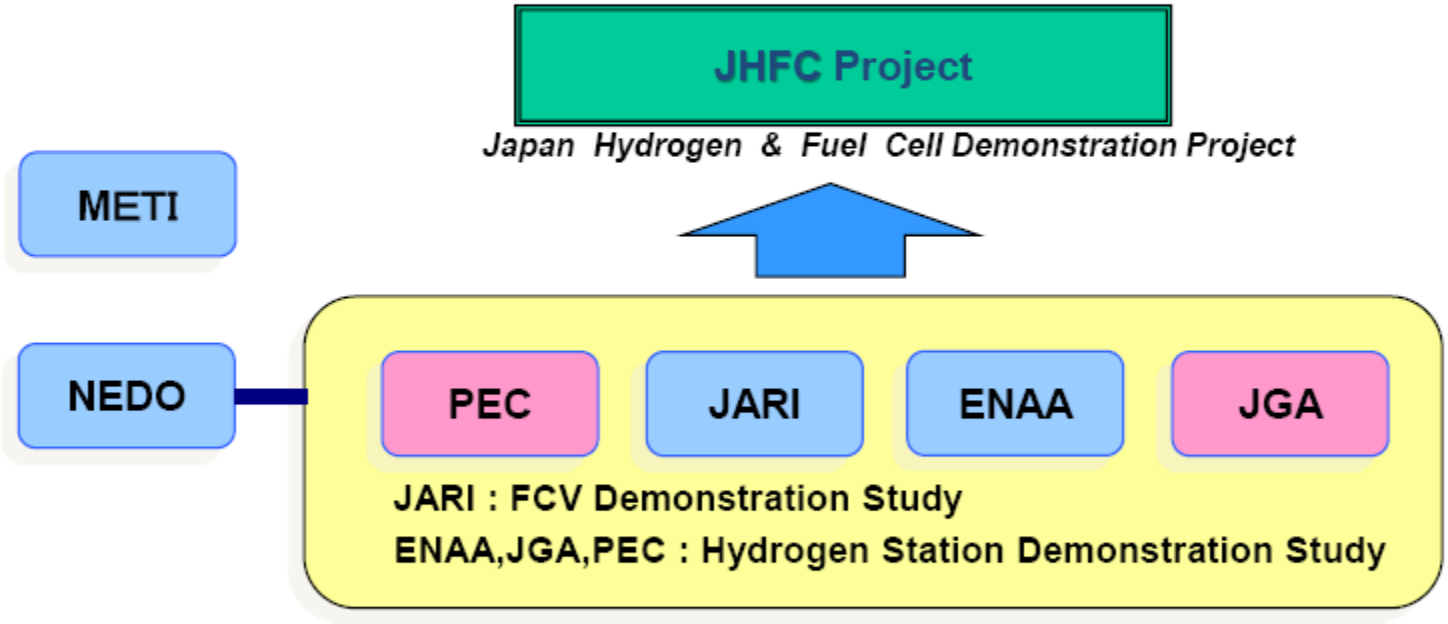
Important points

- Progress
  - 8-year operation without serious accidents
  - Various outreach activities
  - Demonstrating technical advances
- Challenges
  - 70 MPa infrastructure technologies
  - Cost reduction (vehicles and stations)
  - Codes and standards

Organizational Framework of JHFC

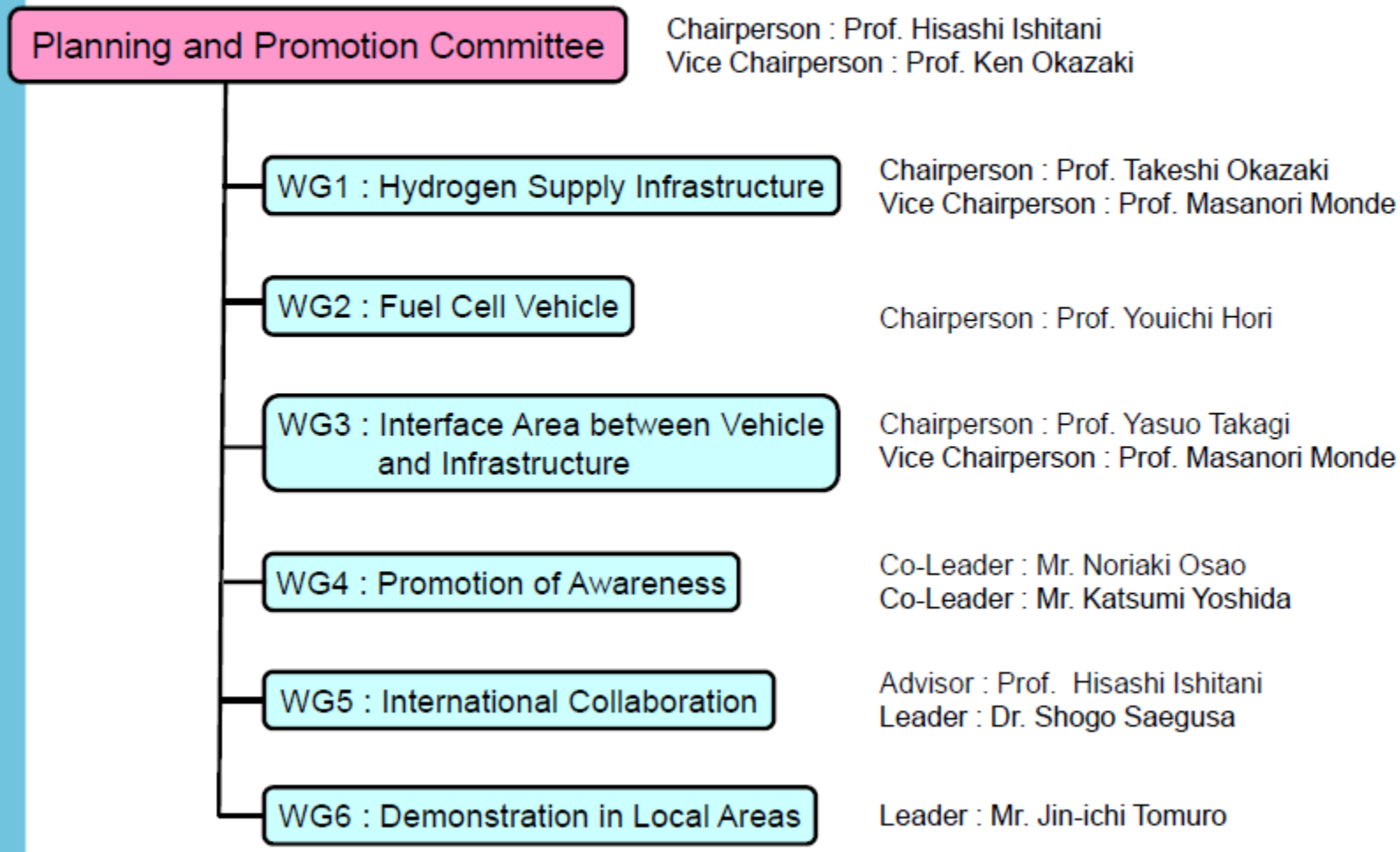
JHFC consists of demonstrations of FCVs and hydrogen stations financially supported by NEDO & METI.

From FY2009 on, PEC and JGA, representing oil industries and city gas industries respectively, have been involved in JHFC.



METI : Ministry of Economy, Trade and Industry
NEDO : New Energy and Industrial Technology Development Organization
PEC : Japan Petroleum Energy Center
JARI : Japan Automotive Research Institute
ENAA : Engineering Advancement Association of Japan
JGA : The Japan Gas Association

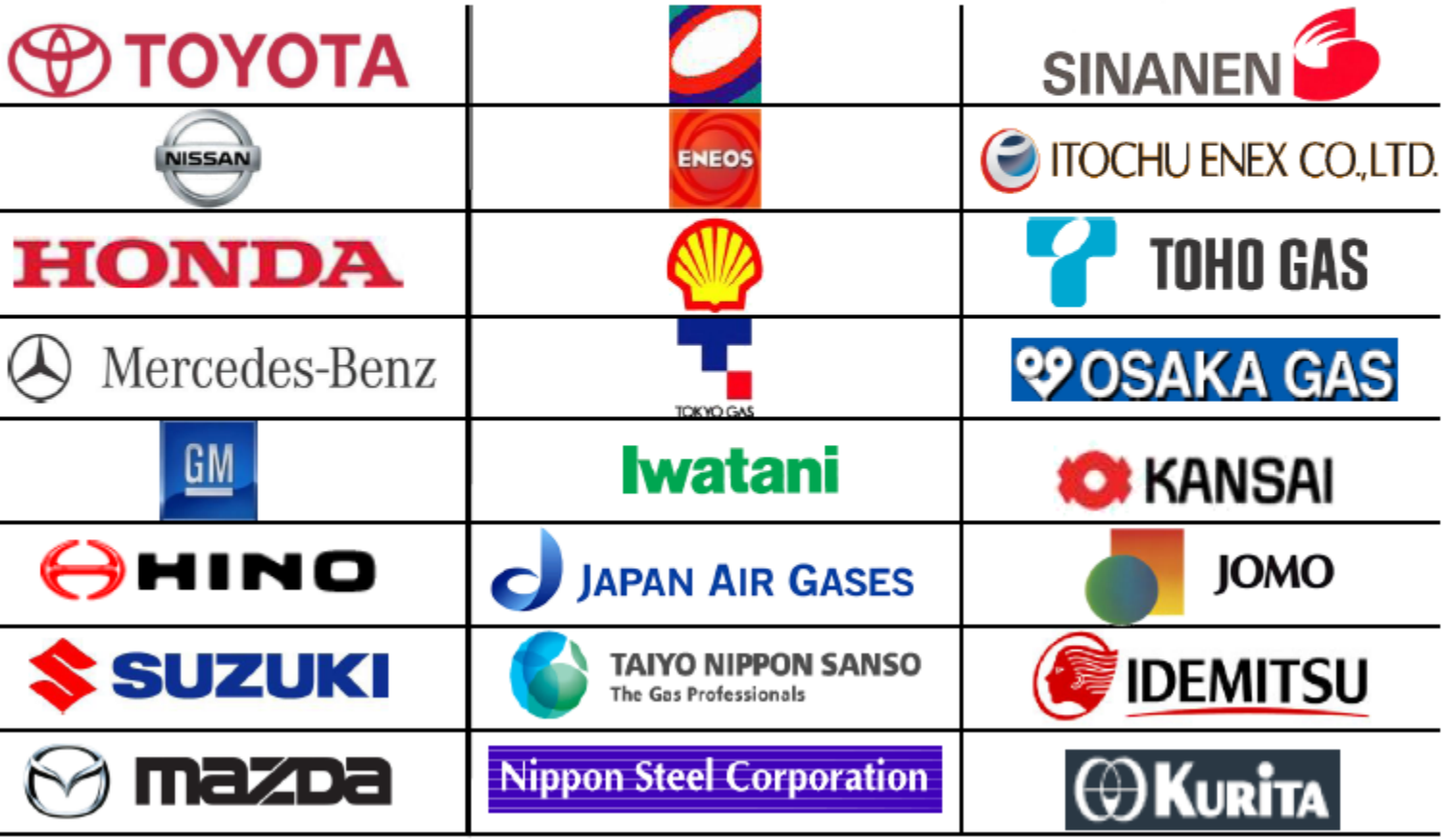
Steering of Current JHFC Phase 2



JHFC Participating Companies

Auto manufacturers: 8

Energy & Infra. Related companies : 16



JHFC Participating Vehicles

6 FCVs, FC Bus and Hydrogen ICV have been participating

Toyota FCHV-adv

Nissan X-TRAIL FCV

Honda FCX Clarity

Mercedes Benz
A-Class F-Cell

GM HydroGen3

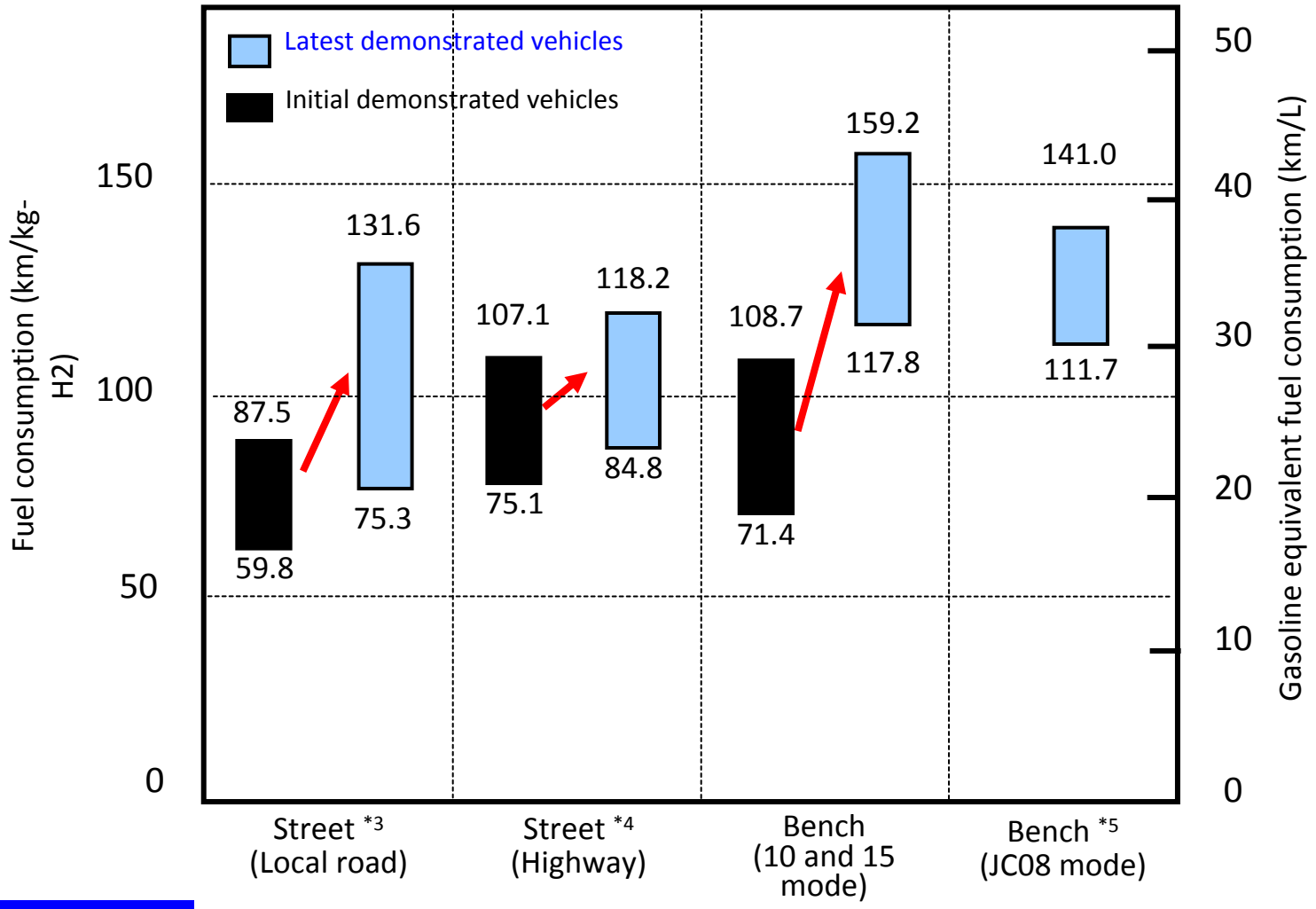
Suzuki SX4-FCV

Mazda RX-8 Hydrogen RE

Toyota/Hino FCHV-BUS

Result of Street Fuel Economy Test

- Latest demonstrated vehicles have improved fuel economy steadily in both local road and highway.



Current cost of Major Components

	Current cost (million yen)	Parameter*) dependence
Reformer	150 – 186	No
Compressor	50 – 110	Yes (strong)
High-pressure storage cylinders	39 -	Yes (very strong)
Dispenser	15 -	Yes (fairly strong)
Pre-cooler	17 -	Yes (fairly strong)
total	roundly 300 -	Yes (250 million yen difference between 35 MPa and 70 MPa stations)

Construction, piping and wiring costs are extra.

*)parameter : filling pressure, filling period, filling method

Results cannot be directly compared with those previously disclosed in the JHFC product.

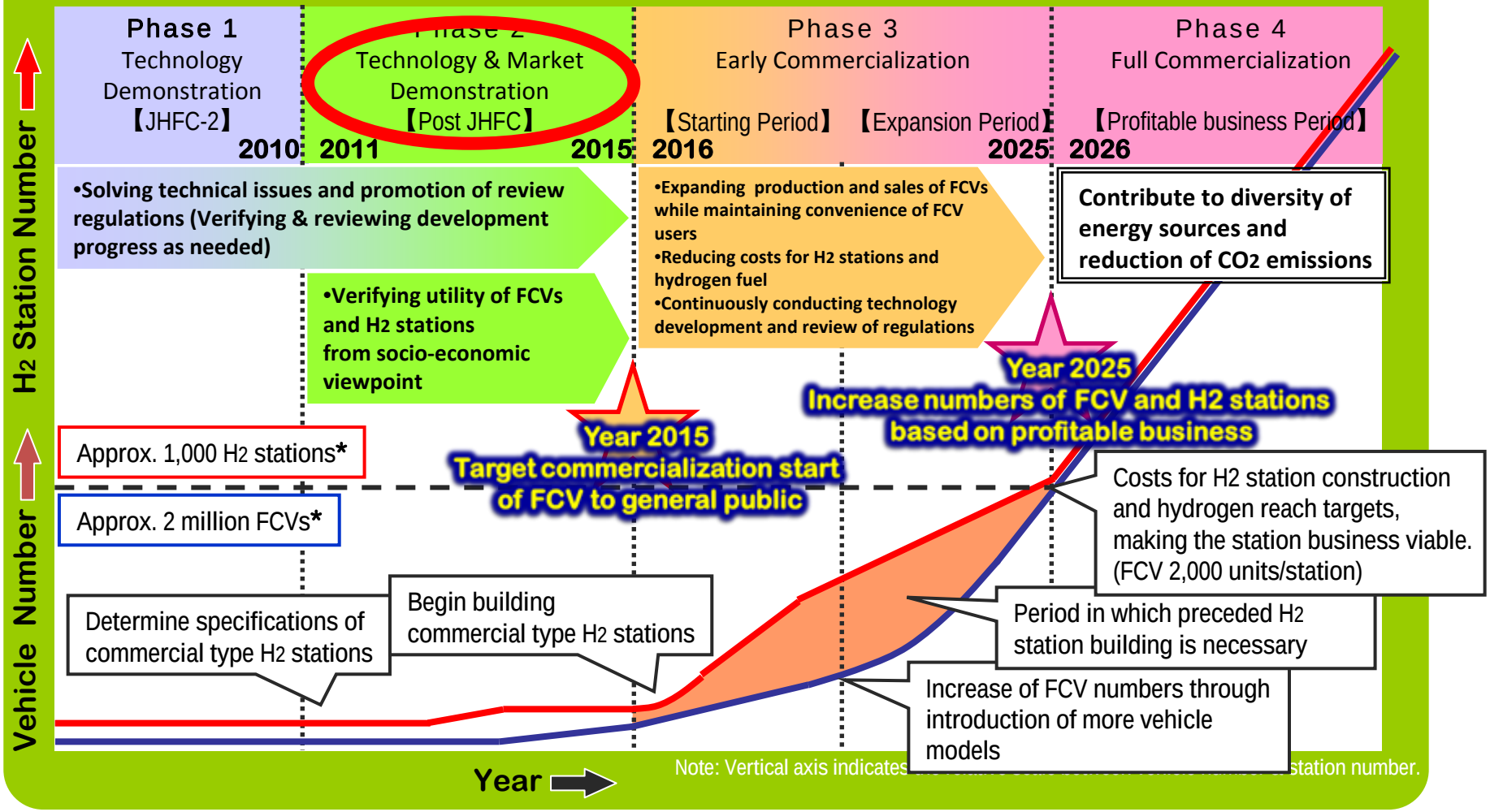
Further cost reduction is definitely necessary.

Cost Reduction Feasibility

Reformer	Simplified system, reduction of parts Target is 50% of current cost.
Electrolizer	Key components (electrode, separator), power supply, rectifier
Compressor	Cylinder type, oil-driven booster, &c.
High-pressure storage cylinders	Large-scale cylinder, mass production through standardization, cost reduction using material other than steel, number reduction through the combination of cascade and compressor-drive filling.
Dispenser	Target is 50% of current cost.
Common (parts & equipments)	Imported parts, similar equipment widely used
Others	Layout optimization, cost reduction of general installation at the site.

Investigation to be continued.

Commercialization Scenario for FCVs and H_2 Stations



* **Precondition: Benefit for FCV users (price/convenience etc.) are secured, and FCVs are widely and smoothly deployed**

Milestones in NEDO Roadmap, unfixed

FCV

year	2010	2015	2020	2030
vehicle efficiency % (HHV / LHV)	45 / 55	51 / 60	51 / 60	more than 51 / 60
durability (hour)	2,000	5,000	5,000	5,000
FC system cost (million. Yen)	more than 10	1	0.8	0.5

Cost estimated on the assumption that annual production of FCV is 0.5 million.

Hydrogen Station

year	2010	2015	2020	2030
station cost (M yen) (300 Nm^3/h)	1,000 (70MPa) 500 (35MPa)	400 (70MPa) 300 (35MPa)	200-300	150
hydrogen cost (yen/Nm^3)	120	90	70	60