Research and Development of Fuel Cells Vehicle and Hydrogen in Japan

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Ministry of Economy, Trade and Industry (METI)

Contents

Fuel Cell/Hydrogen Technology in Government Policies

- **Science and Technology Basic Plan (Mar. 2006)**
- **New National Energy Strategy (May 2006)**
- **Basic Energy Plan (Mar. 2007)**
  - **Cool Earth – Innovative Energy Technology (Mar. 2008)**
    Selection of 21 technologies as innovative technologies that should be given higher priority

  => approved June 2010
- **Next-Generation Automobile Fuel Initiative (May 2007)**
- **New Growth Strategy (June 2010)**

“Basic Energy Plan”

Energy security

A stable supply of resources and energy.

Basic Energy Plan

point of view: 3E

Environment

Powerful countermeasures to environmental issues: global warming.

Economic efficiency

An efficient energy supply based on the proper function of the market.

- Energy is the foundation of citizens’ lives and economic activities.
- The basis of energy policy is to aim at the realization of the three Es –energy security and environmental suitability, as well as economic efficiency that takes advantage of market functions while giving sufficient consideration to such security and suitability.

The New Growth strategy

“Cool Earth – Innovative Energy Technology”

Cool Earth 21 Key Innovative Energy Technologies

Efficiency improvement *Low carbonization*

Supply side

Demand side

Cross sectoral

Power Generation

2. Efficient coal-fired power plant

3. CCS

4.Innovative solar power

1. Efficient LNG-fired power plants

5. Advanced nuclear power

6. Superconducting power transmission

Transport

7. ITS

8. FCV

9. PHEV/EV

10. Biofuel

It has been revised!!

Industry

11. Innovative materials/ manufacturing process

12. Steel making process with Hydrogen

Residences/Buildings

13. Efficient houses/buildings

14. Efficient lighting

15. Fuel Cell for residential use

16. Efficient Heat pumps

17. Efficient IT devices/networks

18. HEMS/BEMS/Regional EMS

19. Power storage

20. Power electronics

21. Hydrogen production/storage/transport

3. CCS (restated)

“The New Growth Strategy”

“The New Growth Strategy” was issued last June.

Focusing on truly essential fields	Prioritizing policies and programs in each field	Avoiding duplication of similar programs (including cross-ministerial programs) in terms of “selection and focus”

aimed at settling on the subject surrounding Japan **at 2020.**

- We will spread and promote top-level environmental technologies in Japan by advancing “green innovation” (innovation in the environment and energy sectors) and with a comprehensive policy package.
- We will also aim at making Japan the foremost global environment and energy power.

Policy package: Action Plan

(by Council for science and technology policy)

“green innovation”	“life innovation”

“Action Plan” in green innovation

Toward becoming the world’s top environment and energy power through a comprehensive policy package. The climate change problem has already exceeded the range that can be addressed by individual element technologies. It is now essential to promote the creation of a low-carbon society through a comprehensive policy package including new systems design, systems changes, new regulations, and regulatory reform, and to support the rapid spread and expansion of environmental technologies and products.

Vision	Action	Policy Package
Aim at making Japan the world’s top environment and energy power through overcoming the climate change.	Transformation into renewable energy	①Promotion of transformation into renewable energy through photovoltaic power
		②Promotion of transformation into renewable energy through biomass.
	Low-carbon society	③Low carbon society through atomic power generation
		④Efficient use of fossil fuel
	Energy-conserving	**⑤Low-carbonization in the transportation through spreading next-generation vehicles.**
		⑥Energy conserving in office/residence
		⑦Low carbonization through utilization of information and communication technology
	Green cities	⑧Creation a lush greenery environment and natural circulation
		⑨Advance homes, transportation and environment of local areas

Policy package ⑤: Development of dramatic growth and reducing cost of Battery /Fuel Cell

1. **Development of High-performance Battery System for Next-generation Vehicles**
2. **Advanced Science Research of Innovative Battery**
3. **Development of PEFC Technologies for Commercialization Promotion**
4. **Fundamental Research Project on Advanced Hydrogen Science**
5. **Advanced Research on Hydrogen Storage Materials**
6. **Development of Technologies for Hydrogen Production, Delivery and Storage Systems**

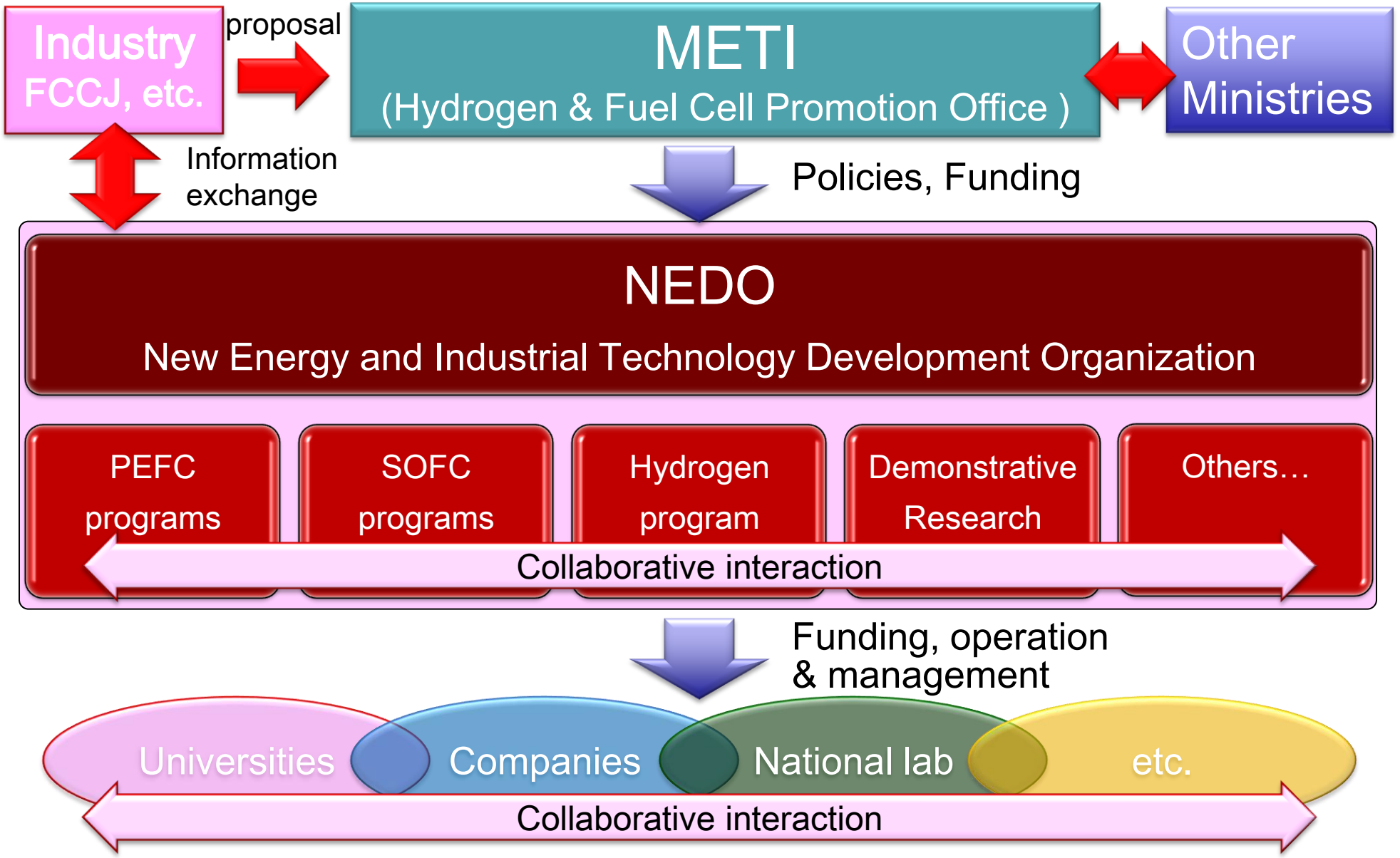
Contents

Budget for New Energy

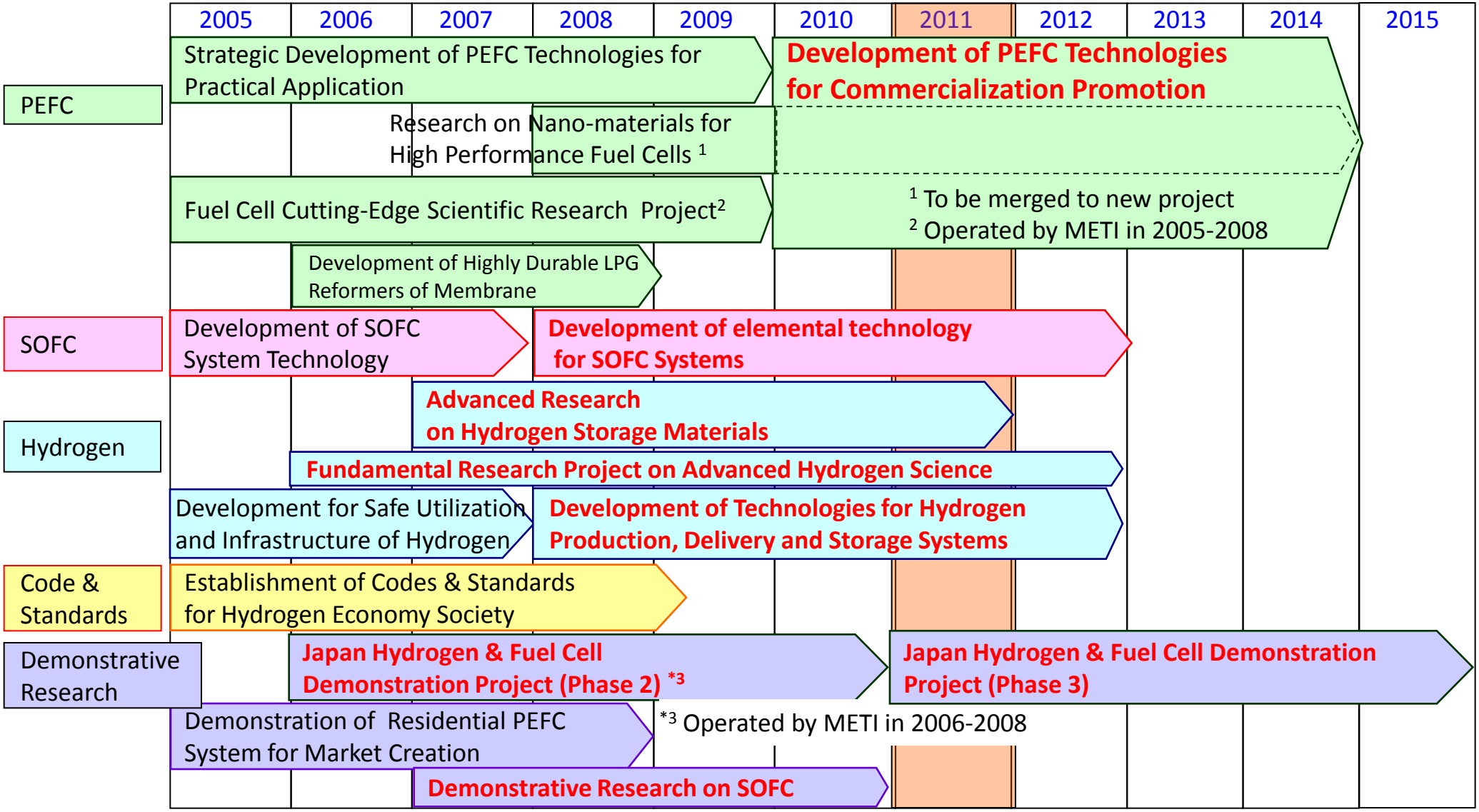
FY 2011:128.3 Billion Yen（FY2010:129.5 Billion Yen）

Budget (unit: Billion Yen)	FY 2011	FY 2010	FY 2010	FY 2009
Subsidy	89.9	15.3	95.8	45.9
Subsidy for Installation of Residential Photovoltaic System	34.9	14.5	40.1	22.0
Subsidy for Purchasing of Clean Energy Vehicle	29.2	0.8	13.7	
Subsidy for Installation of Residential Fuel Cell	8.7		6.8	2.0
Subsidy for Installation of New Energy (non-residence)	13.0		34.5	16.1
Subsidy for Installation Renewable heat energy	3.5			
R&D	38.4	0	33.7	1.4
Photovoltaic	8.1		6.4	0.9
Innovative Photovoltaic Cells	2.1		1.9	0.9
R&D on Next Generation High Efficiency Solar Cell	6.0		4.1	
Wind Power	4.5		2.6	0.2
Bio Energy	6.7		6.2	
R&D on Ocean Energy	1.0			
Storage Battery	7.5		6.3	
R&D for Scientific Innovation on New Generation Batteries	2.0			
Research on Storage Batteries with Various Appliances	3.0		3.0	
Fuel Cell	8.1		10.7	0.3
Support for Start-up Business on New Energy	1.6		1.6	

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



R&D on Fuel Cell and Hydrogen Technologies by NEDO



Commercialization of Residential Fuel Cells

Residential fuel cell systems commercialized in 2009.
- 0.7–1.0 kW PEFC + heat recovery (CHP)
- Three manufactures
- Subsidization program initiated

1/2 of users' costs (system + installation): up to 1.3M JPY in 2010

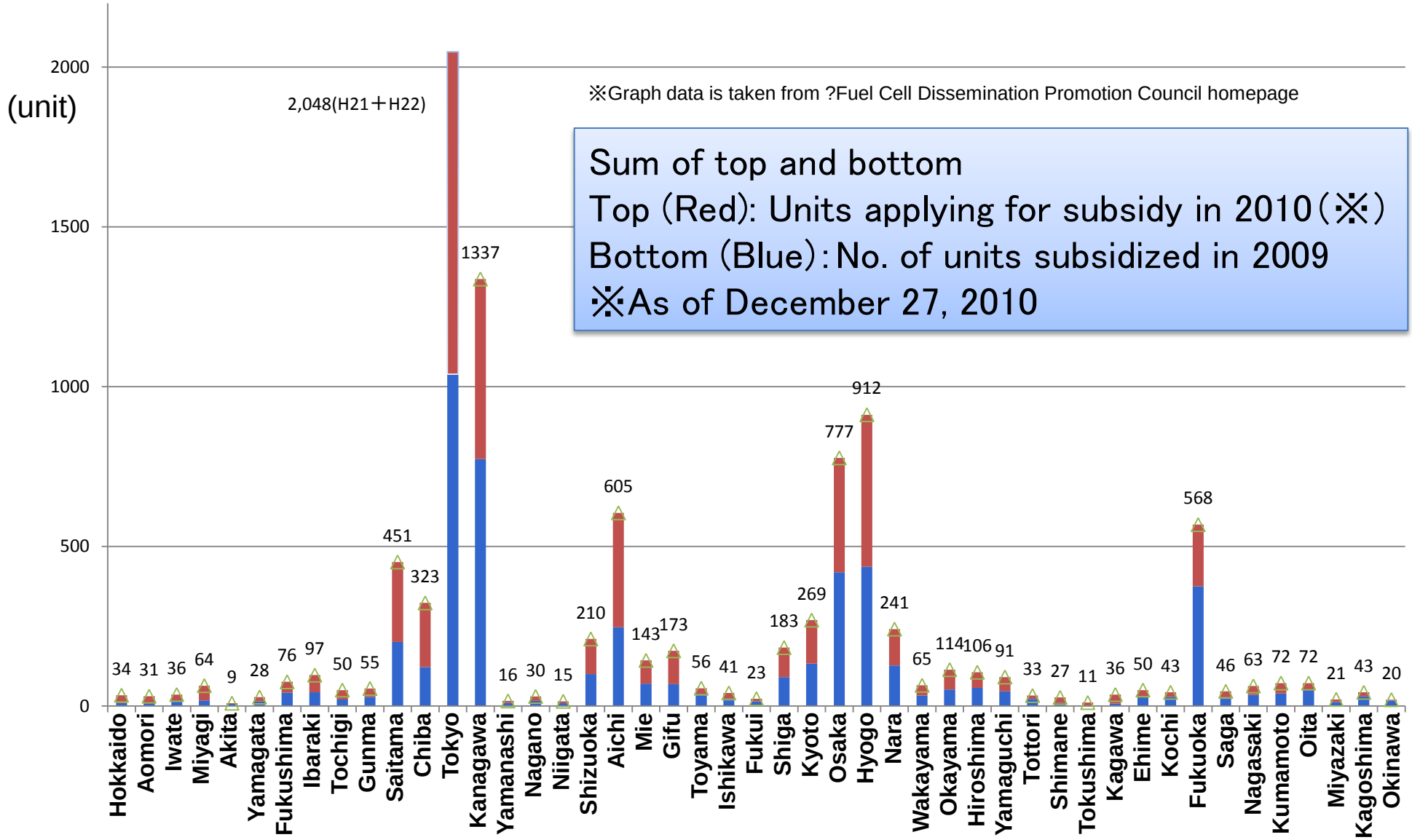
Nearly 10,000 units were offered (as of Mar. 2011)

(3,307 by demonstration project in 2004-2008)

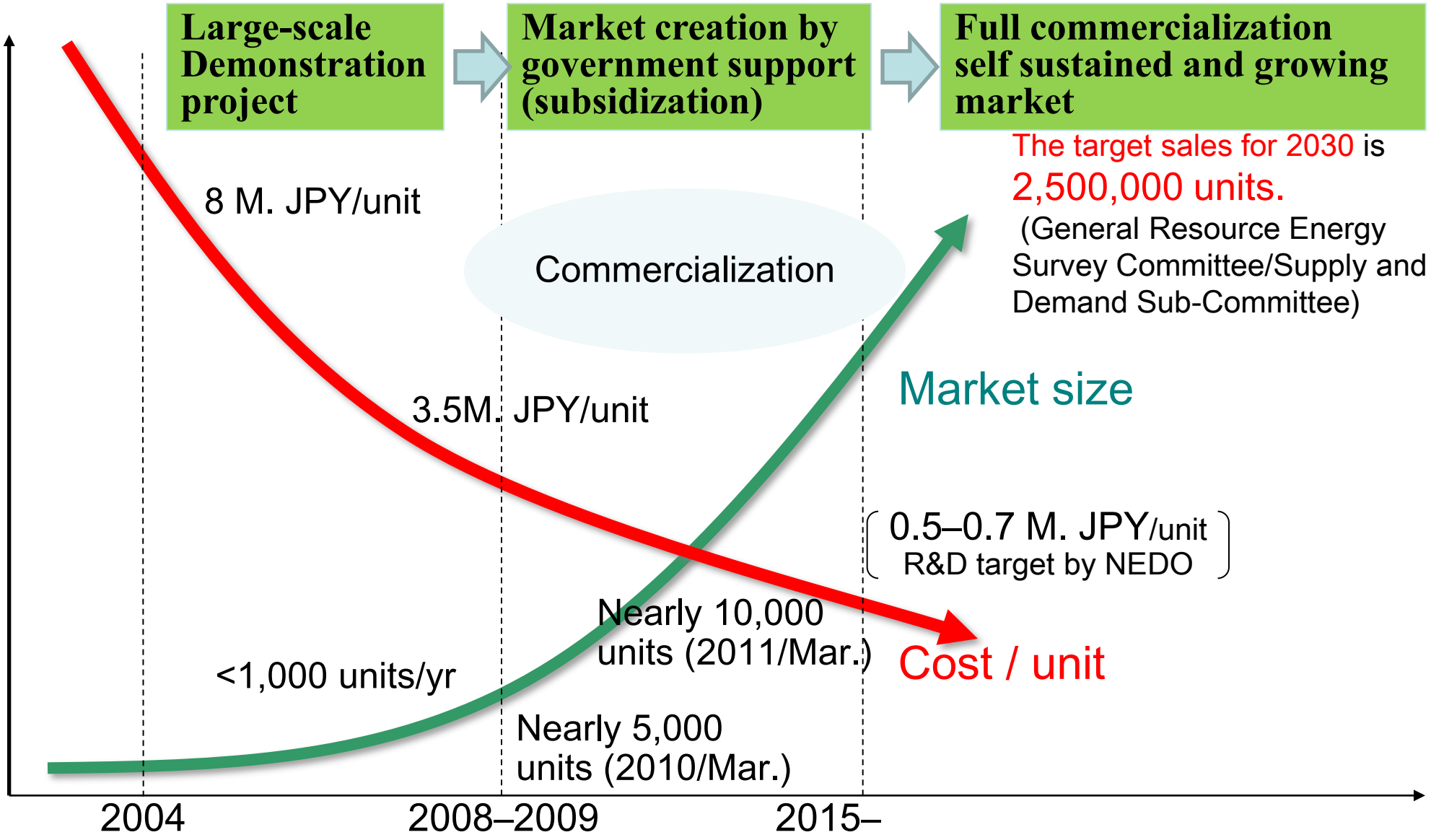
家庭用燃料電池コージェネレーションシステム
ENE·FARM
エネファーム

"ENE-FARM" - The unified logo for Residential Fuel Cells

Residential Fuel Cells for Public Use (2009 to 2010)



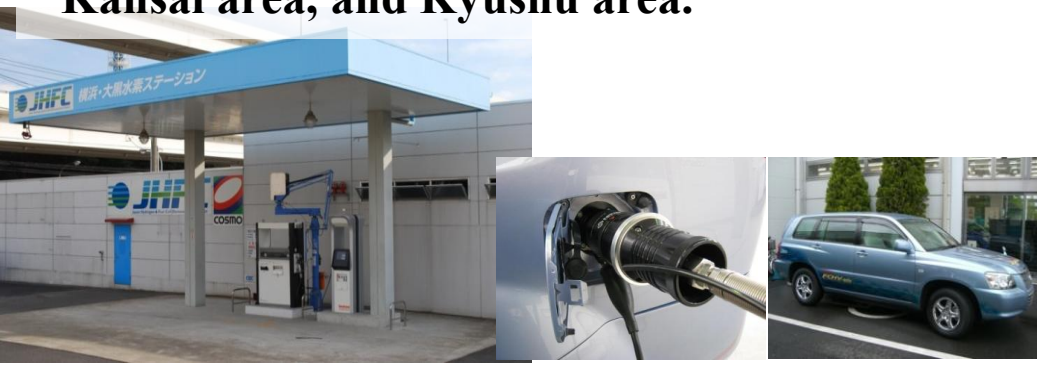
Scenario of Market Creation for Residential Fuel Cell



Japan Hydrogen & Fuel Cell Demonstration Project (JHFC Phase II)

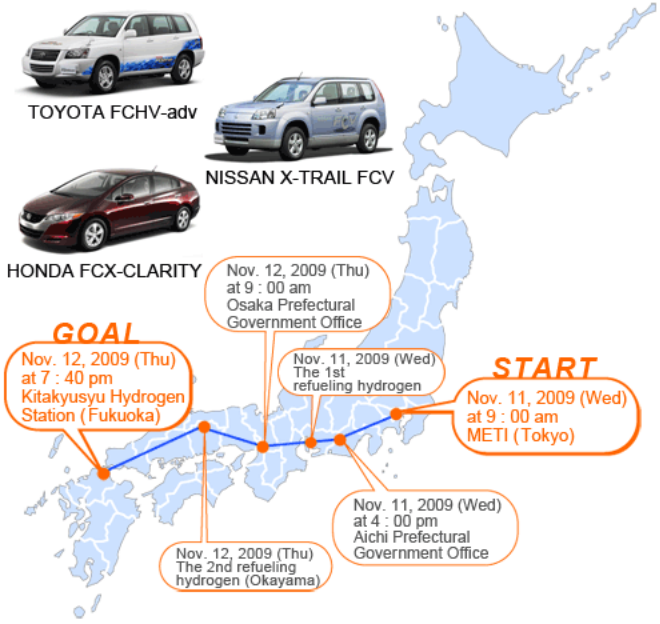
- To clearly show energy-saving effect and environmental impact
- To collect data for codes & standards development and certification practices
- Project Year: 2006–2010

- Demonstration of FCV under actual circumstances
- Hydrogen stations: upgraded to 70 MPa
- Demonstrative operation of various means of H_2 production and supply and its verification
- Awareness & education: To raise public awareness regarding FCVs and H_2 Stations
- Currently operating 14 hydrogen fuelling stations and one hydrogen liquefaction facility in the Tokyo metropolitan area, Chubu area, Kansai area, and Kyushu area.



Report on the Long Distance Demonstration Drive of 1,100km (approx. 684 miles) by Three Fuel Cell Vehicles

- The top-ranked vehicle in the project has recorded an efficiency of 61.3 percent and a mileage of 159 km/kg of hydrogen (Japan's 10-15 mode).



Japan Hydrogen & Fuel Cell Demonstration Project

Survey on Locations which can Implement Future Hydrogen Supply Infrastructures（new as of 2011） (JHFC Phase III)

Regional Hydrogen Supply Infrastructure Technological and Social Demonstrations

Objective of study

Aim to carry out technological demonstration on FCVs and hydrogen supply infrastructures under conditions close to actual use as well as social demonstration verifying user-friendliness, business launchability, and social receptivity, etc. towards the start of dissemination of FCVs to general users in 2015.

Project scale

○R&D period

2011 to 2016 (5 years)

Posit on technological strategy map

Positioned as important task in technological strategy map “Energy Field”.

Outline of study

○R&D tasks (Technical tasks for achieving objectives）

R&D Item A Technological and social demonstrations

Carry out demonstrations of technologies required for starting dissemination to general users in 2015 in cities playing a core role in the initial stage of dissemination (Tokyo area, Nagoya, Osaka).

R&D Item B Regional demonstration research

Carry out technological demonstrations mainly in regions around major cities, using their infrastructure, resource, and technologies.

R&D Item C Regional cooperation survey

Carry out surveys on potentials of implementing future hydrogen supply infrastructures and locations in addition to areas around major cities.

R&D Item D Joint International Research

Carry out joint international research on hydrogen supply infrastructures leading to epoch making low costs and enhanced reliability through information exchange based on NEDO-NOW’s MOU.

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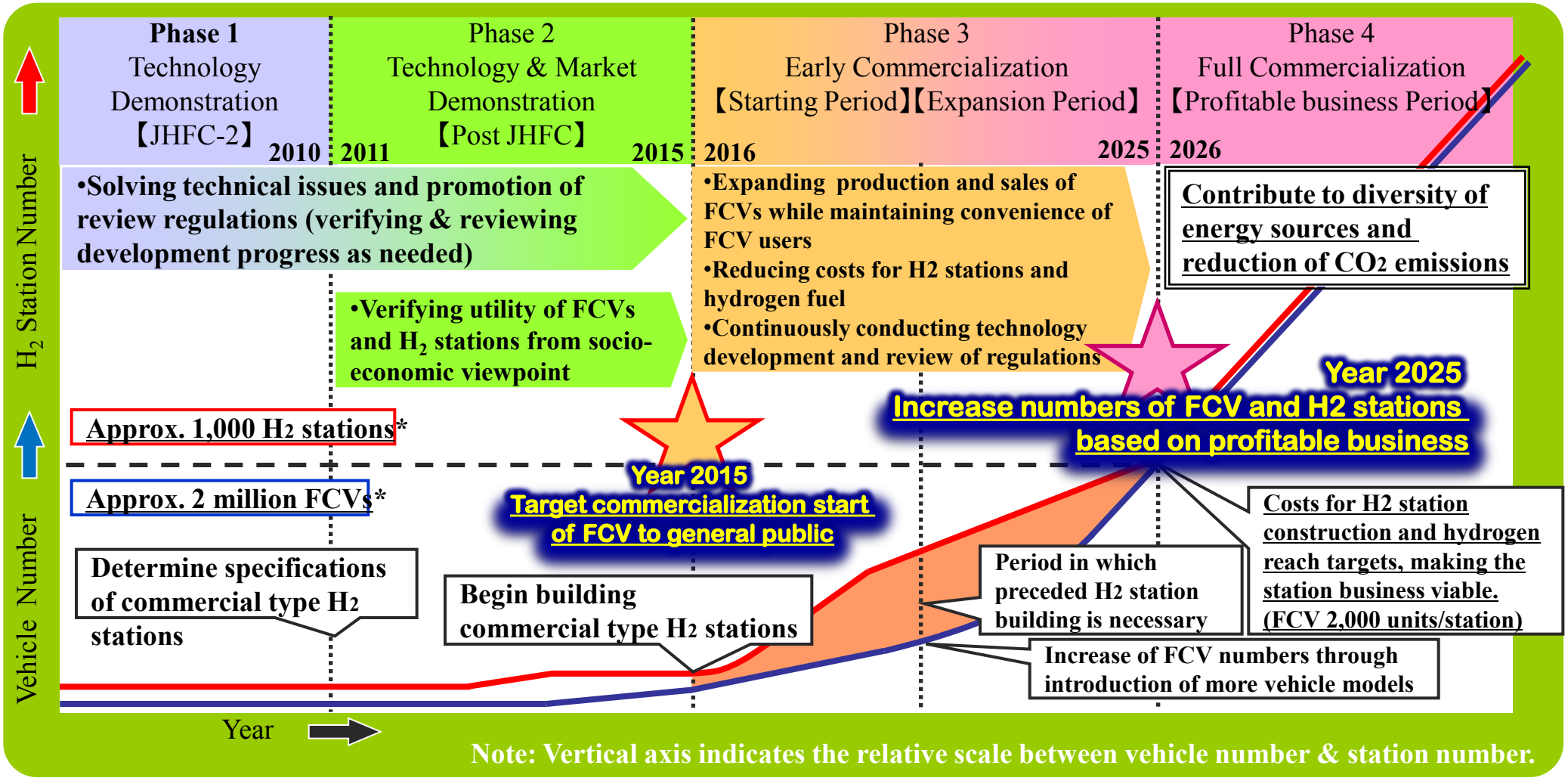
FCCJ approved Commercialization scenario



2nd milestone is set in 2025 to contribute to reduction of CO_2 emissions.

Approximately 1,000 H_2 stations and approximately 2 milliion FCVs are set as common perspective.

Source : FCCJ

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

Announcement of Developments related to FCVs during Toyota Environment Technology Press Conference

Announced Toyota's future plans for environment technologies (November 18, 2010)

- Develop sedan type fuel cell hybrid vehicles (FCHVs), and release them in areas with hydrogen supply infrastructures in Japan, U.S., and Europe.
- At this point, prices in Japan are expected to be less than 10 million yen. However, efforts will be made to further reduce costs to realize prices that are reasonable to customers in preparation for market release.

Source : TOYOTA homepage

TOYOTA Vice President Uchiyamada
During Toyota Environment Technology Press Conference

Joint Declaration on Domestic Market Release of FCVs and Establishment of Hydrogen Supply Infrastructure

Three automobile manufacturers and 10 energy companies have announced a joint statement on releasing FCVs on the market from 2015.(January 13, 2011).

＜13 companies＞

Automobile manufacturers：Toyota, Nissan, Honda

Petroleum companies：JX Nikko Nisseki Energy, Idemitsu Kosan, Showa Shell, Cosmo

City gas companies：Tokyo Gas, Osaka Gas, Toho Gas, Seibu Gas

Industrial gas companies：Iwatani Sangyo, Taiyo Nissan

Joint statement

The statement declares that in 2015 when market release of FCVs will start on a full-scale, automobile companies will start selling mass produced FCVs (*), and prior to this, energy companies will aim to establish the first hydrogen stations of the required scale according to the prospects on the number of mass produced FCVs that will be sold (about 100 locations), centering around the four major cities Tokyo, Aichi, Osaka, and Fukuoka.

※Mass produced cars are generally cars which can be sold according to user needs by establishing quality assurance and after-care service systems. It is expected that when FCVs are first released, they will sell about a thousand to several thousand vehicles should the trends be the same as the initial sales performance of next generation cars sold until now, although it will also depend on the progress of technology development in the future and market trends.

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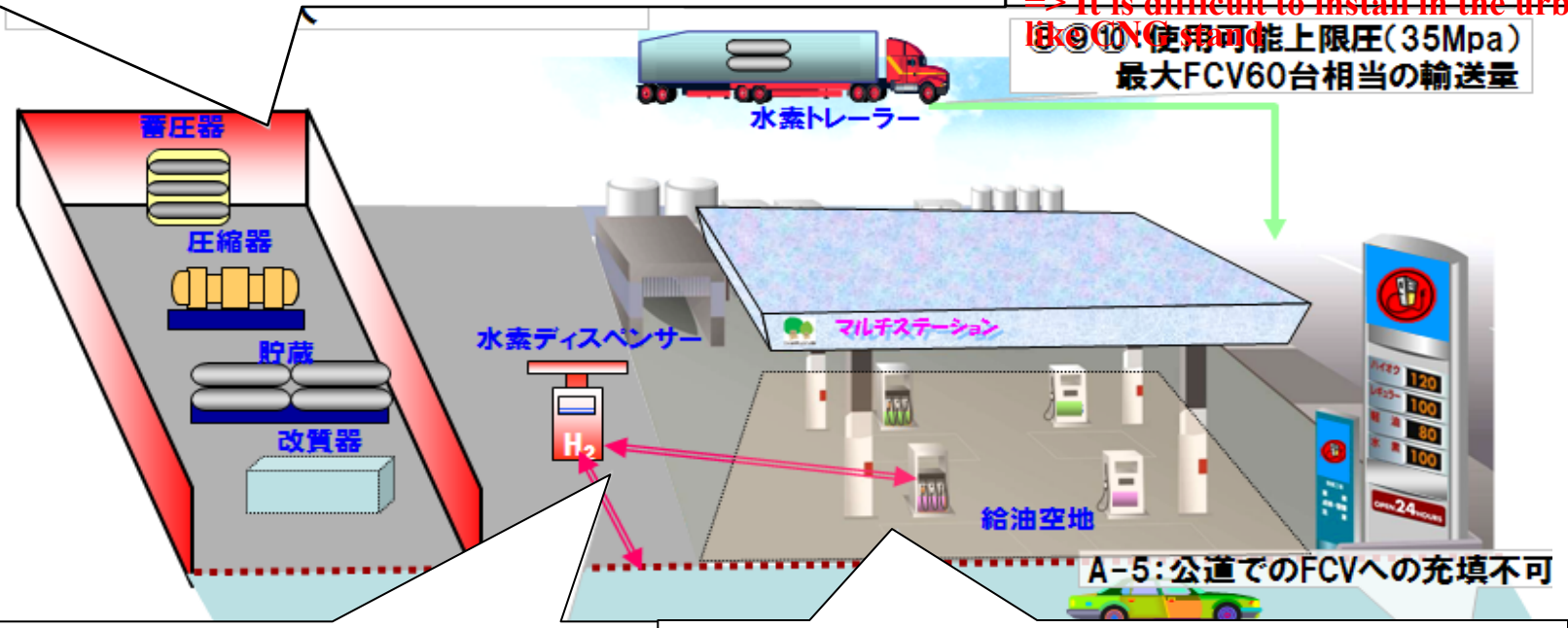
Image of the cost down of the H_2 fueling station by reviewing regulation: Before the review, Construction Cost > 600 million yen

5 Simplify the application of Technical Standards Adaptation for specific facilities and pluming of low design coefficient
6 Enhance of usable steal stock mentioned in Exemplified Basis
10 Simplify the application of Technical Standards Adaptation of compound vessel usage for hydrogen stand accumulator
16 Change maximum refueling pressure for Full-refueling and revise Exemplified Basis (container related) Change maximum refueling pressure for Full-refueling and revise Exemplified Basis (general related) **=> Building Cost Up**
3 Formulate Safety Inspection Regulation to simplify process of safety inspection and assign at the Safety Inspection Announcement
11 Rationalize regulations of fueling stations related to the setting of the hydrogen stations
13 Allow hydrogen refueling to those who are not permitted of high pressure gas manufacturing, set forth to realizing self-refueling hydrogen stands **=> Running Cost Up**

1 Maintain Technical Basis and Exemplified Basis compliant to 70MPa hydrogen stand
2 Alleviate the distance regulation that facilitate of building CNG stands
4 Increase of hydrogen holdings in the urban area
semi-industrial area 3,500 Nm3
commercial area 700 Nm3 (FCV 20 units)
semi-residential area 350 Nm3 (FCV 10 units)
*more than 200 units at CNG stands
=> It is difficult to install in the urban area as like CNG stand.



14 Clearly articulate the explosion protection zone basis related to hydrogen dispensers
Distance from fire road: >6m(35MPa), >8m(70MPa)
*4m (like gasoline stations)
Difficult to find location

11 Rationalize regulations of fueling stations related to the setting of the hydrogen stations
14 **Distance from fire source**: >6m(35MPa), >8m(70MPa)
*4m (like gasoline stations),
Difficult to find location

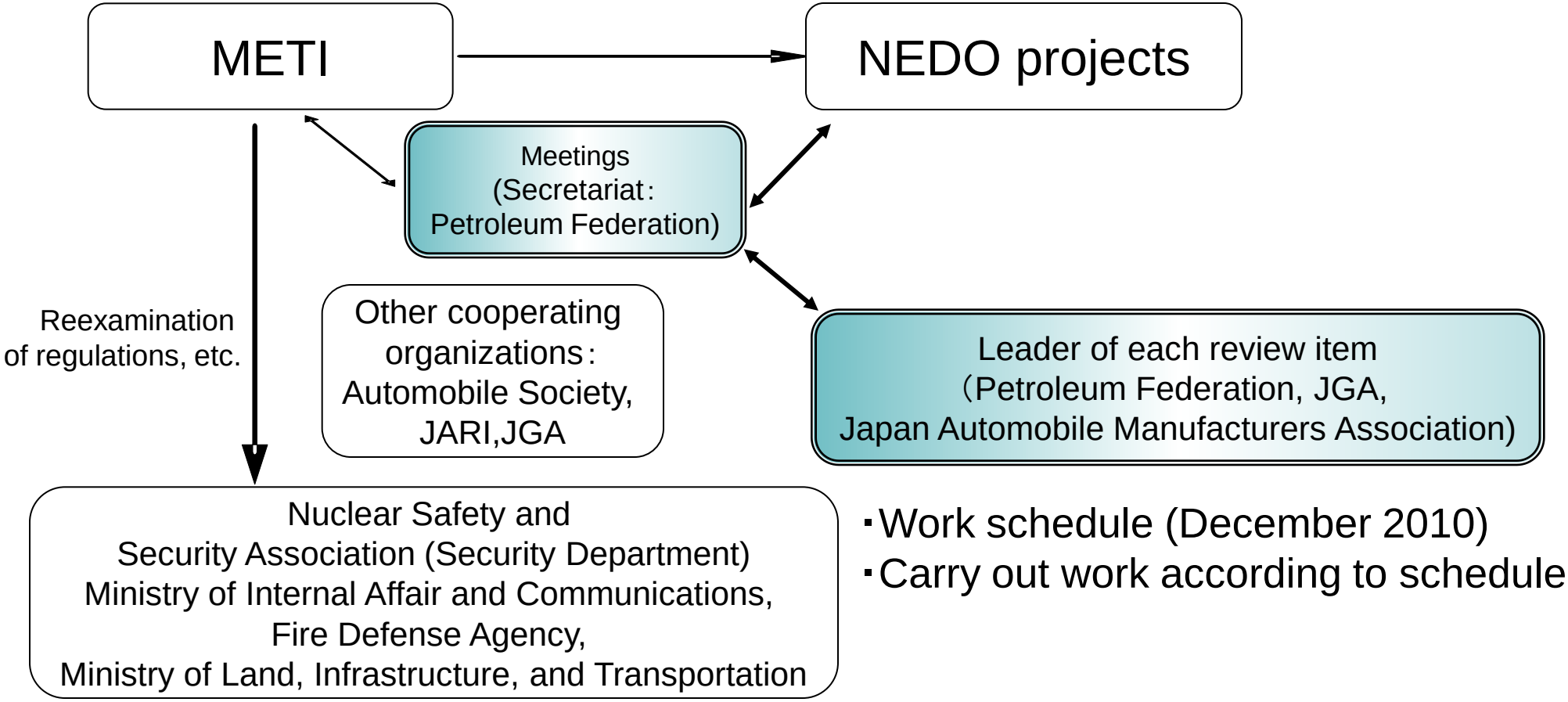
Reference: PAJ

16 Priority Issues For Policy Reforms

1	Maintain Technical Basis and Exemplified Basis compliant to 70MPa hydrogen stand	High Pressure Gas Safety Act
2	Alleviate the distance regulation that facilitate of building CNG stands	High Pressure Gas Safety Act
3	Formulate Safety Inspection Regulation to simplify process of safety inspection and assign at the Safety Inspection Announcement	High Pressure Gas Safety Act
4	Increase of hydrogen holdings in the urban area	Building Standard Law
5	Simplify the application of Technical Standards Adaptation for specific facilities and pluming of low design coefficient	High Pressure Gas Safety Act
6	Enhance of usable steal stock mentioned in Exemplified Bas	High Pressure Gas Safety Act
7	Revise the Exemplified Basis in order to raise the maximum refueling pressure (35MPa to 45MPa) of the compound vessels for compressed hydrogen vehicles	High Pressure Gas Safety Act
8	Revise the Exemplified Basis of accessories to add thermal actuation safety valve (glass bulb) to the compound vessels for compressed hydrogen vehicles	High Pressure Gas Safety Act
9	Establish exception for stamping compound vessels and accessories for compressed hydrogen vehicles	High Pressure Gas Safety Act
10	Simplify the application of Technical Standards Adaptation of compound vessel usage for hydrogen stand accumulator	High Pressure Gas Safety Act
11	Rationalize regulations of fueling stations related to the setting of the hydrogen stations	Fire Service Law
12	Establish alternative measures for barriers related to the distance between public roads and dispensers	High Pressure Gas Safety Act
13	Allow hydrogen refueling to those who are not permitted of high pressure gas manufacturing, set forth to realizing self-refueling hydrogen stands	High Pressure Gas Safety Act
14	Clearly articulate the explosion protection zone basis related to hydrogen dispensers	High Pressure Gas Safety Act
15	Ensure refueling stands to accommodate out of gas vehicles on public roads	High Pressure Gas Safety Act
16	Change maximum refueling pressure for Full-refueling and revise Exemplified Basis (container related) Change maximum refueling pressure for Full-refueling and revise Exemplified Basis (general related)	High Pressure Gas Safety Act

System for Reexamining Regulations

● Based on advise from the relevant authorities, acquire, analyze, and evaluate data for the concerned entities to review regulations in NEDO projects, and prepare draft of technical standards.
● The Petroleum Federation reexamines the regulations and organizes meetings for all those related to the establishment of standards, and centrally controls implementation plans and progress （PDCA).
The actual work shall be led by the leader for each review item.

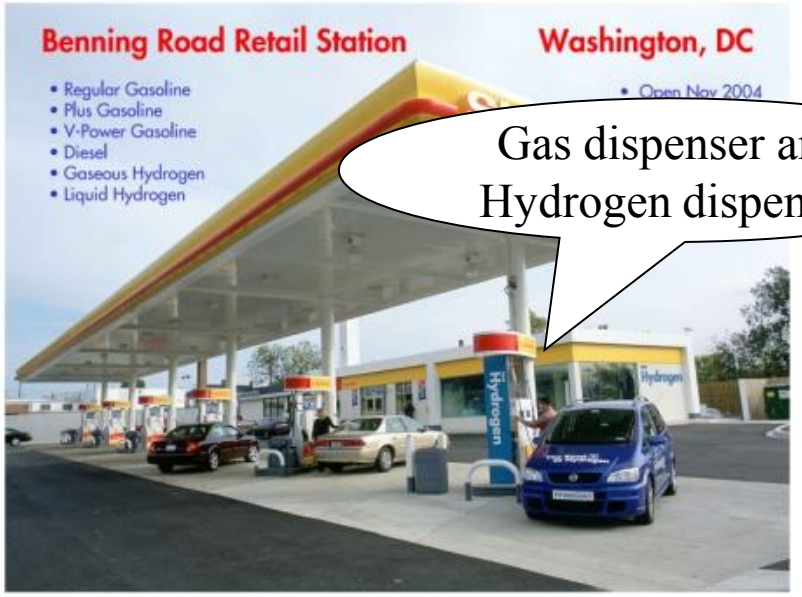


- Work schedule (December 2010)
- Carry out work according to schedule

Examples of expected outcome

Hydrogen fueling station at Ichihara

Hydrogen fueling station in US

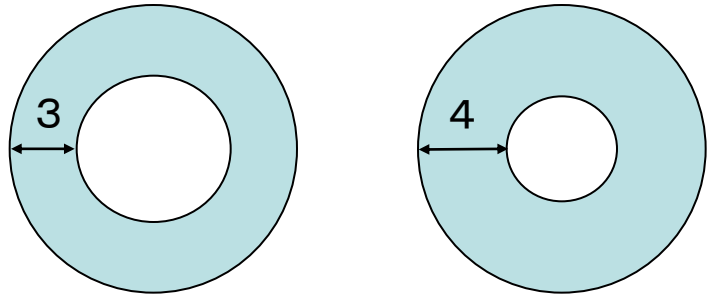


- In the U.S. and Europe, design coefficients *) smaller than Japanese standards are used

	Storage cylinder	Pipe
Domestic	**3.5 ~ 4**	**4**
U.S./Europe	**2.4 ~ 3.5**	**3**

*) The greater the value, thicker the pipe

・Cross-section view of Storage cylinder



Overseas product　　Domestic product

Source : JX Nikko Nisseki Energy

Image of the cost down of the H_2 fueling station by reviewing regulation:
After the review, Construction Cost < 200 million yen

5 Simplify the application of Technical Standards Adaptation for specific facilities and pluming of low design coefficient
6 Enhance of usable steal stock mentioned in Exemplified Basis
10 Simplify the application of Technical Standards Adaptation of compound vessel usage for hydrogen stand accumulator
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3 Formulate Safety Inspection Regulation to simplify process of safety inspection and assign at the Safety Inspection Announcement
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=> Running Cost down

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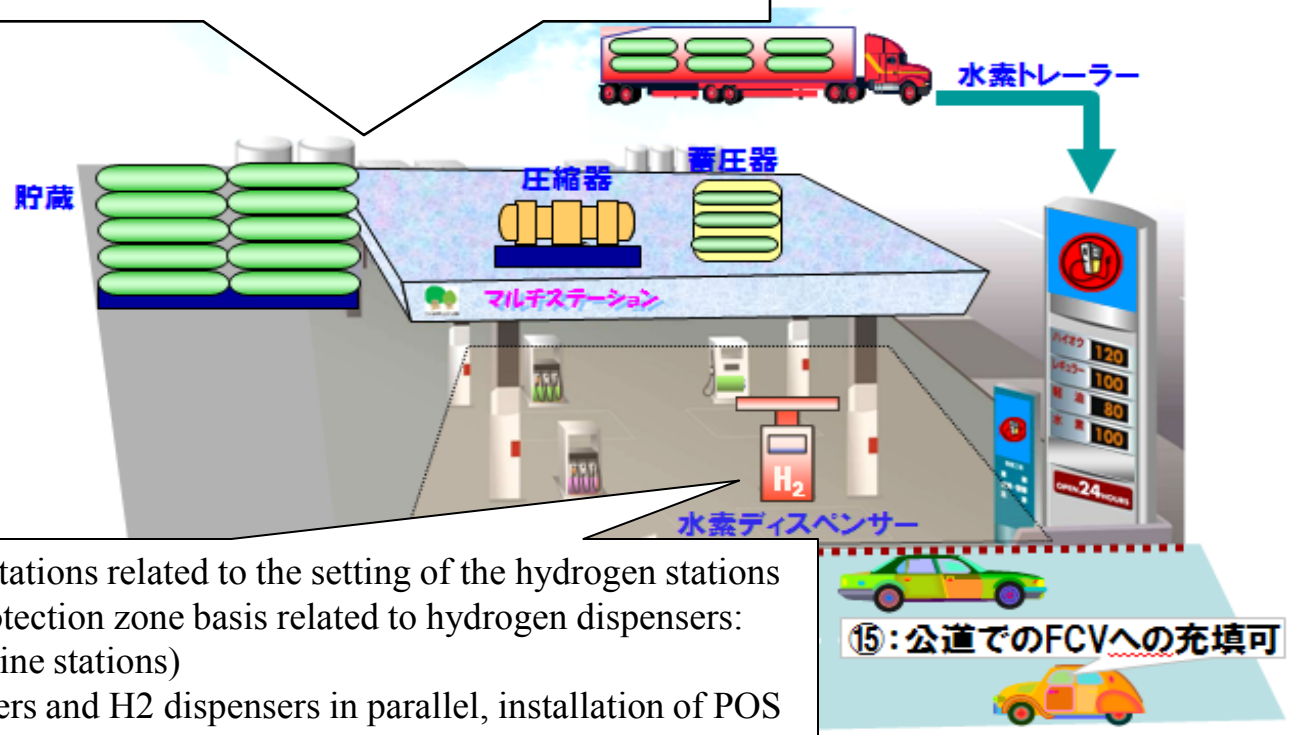


11 Rationalize regulations of fueling stations related to the setting of the hydrogen stations
14 Clearly articulate the explosion protection zone basis related to hydrogen dispensers: distance from road ~ 4m (like gasoline stations)
Easier installation of gasoline dispensers and H2 dispensers in parallel, installation of POS system
Reduce the area required for Hydrogen station. Facilitate procuring of site for ST.

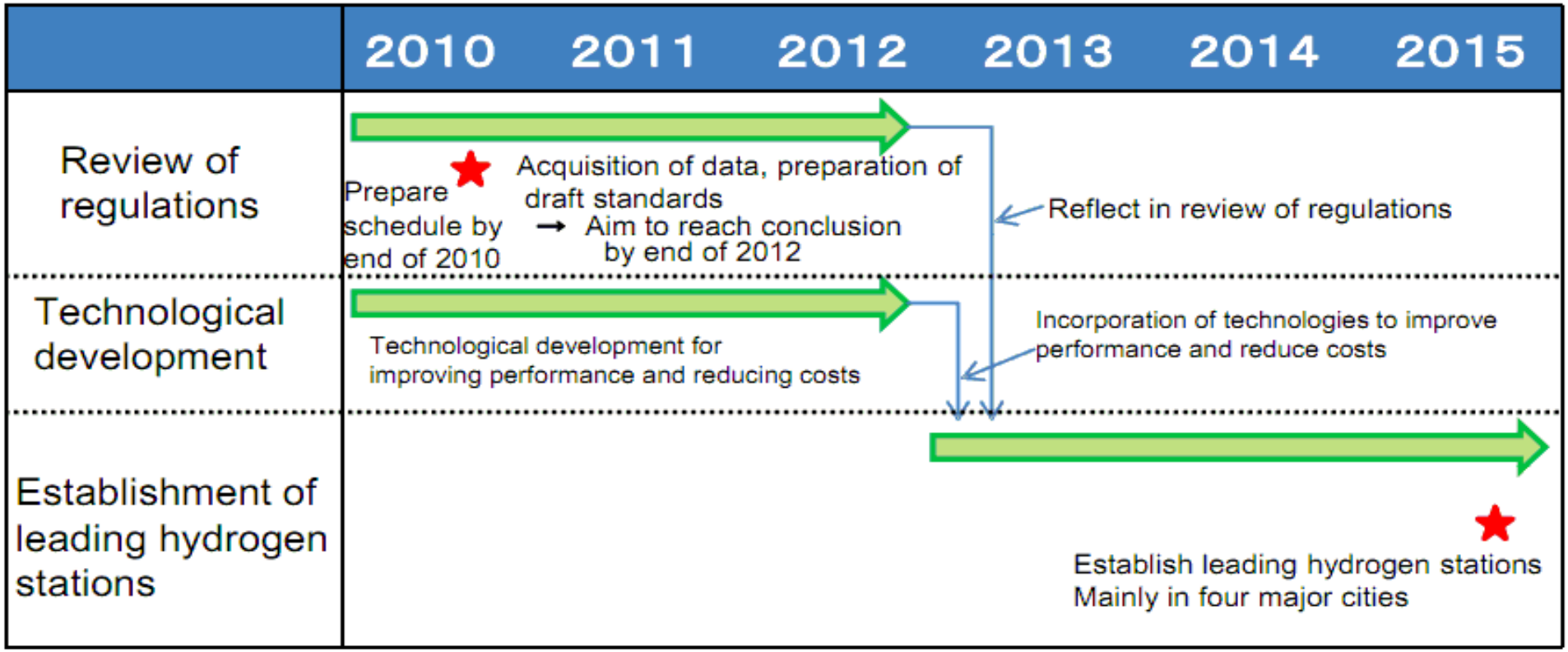
Reference: PAJ

Schedule for Starting Introduction of FCVs in 2015

Towards starting introduction in 2015

By 2012, reach a conclusion on the reexamination of principal regulations, and implement technical development to enhance performance of dispensers and accumulators, and reduce costs.

From 2013, start building leading hydrogen stations reflecting the above results.



Concluding Remarks

1. **The development of FCV and Hydrogen technology are important for the government policies of Japan.**
2. **Residential fuel cell systems successfully started to be commercialized in 2009. Nearly 10,000 units were offered as of Mar. 2011.**
3. **New JHFC project started this April (JHFC phase III)**
4. **Joint Declaration on Domestic Market Release of FCVs and Establishment of Hydrogen Supply Infrastructure: Three automobile manufacturers and 10 energy companies have announced a joint statement on releasing FCVs on the market from 2015 (January 13, 2011).**
5. **Reviewing safety, code and standard: 16 Priority Issues For Policy Reforms.**

Thank you

for your attention !!

Policy Reforms Related To The Regulatory System by the Government Reform Congress（Cabinet Decision, June 18, 2010）

■ **Regulation Reform：“Review standards related to Fuel Cell Vehicles and Hydrogen Stations”**

＜Basic Vision (Excerpt)＞

・Adjust cost reduce by reviewing the current regulations meeting the technical progress based on security for 2015 commercializing projects.

・Adjust global harmonization as much as possible for regulations that has much severe restrictions compared to the international standards, by showing clearer evidence and collecting established data.

・It is possible to warrant good safety by verifying it with scientific data. To verify the safety, both public and private entities should store knowledge together. In such situation, they should verify the possibility of using special zone institution.

＜Revised Policy＞

・Draw up and notify the “Exemplified Basis” which shows specifications related to hydrogen stations based on the revision of High Pressure Gas Safety Act of 2005 (Midterm measure of 2010)

・Give technical advise related to the permission of rational Hydrogen Store Basis, after the Exemplified Basis is set forth.

・Review regulations impeding commercializing projects for dissemination at 2015 and by confirming the technical progress and ensuring global harmonization, give advise to establish the performance that enables technical progress. Compose future specific schedule of the review after coordinating each relevant ministry (METI, MLIT, and FDMA) (Midterm measure of 2010)

Composition of Regulation Review Related Operation Sheet for Dissemination of Fuel Cell Vehicles and Hydrogen Stations

In December 2010, together with MLIT and FDMA, METI announced the operation sheet consisting 16 items related to the regulation review for 2015 dissemination of fuel cell vehicles and hydrogen stations .

■ Objective

In order to achieve a full-scale dissemination of fuel cell vehicles, a vast amount of consolidating cost cutting of hydrogen supply infrastructure such as hydrogen stations for fuel cell vehicles.
To achieve the cost cutting, the correspondence to regulations restricting design basis of pressure container and usable steel stock defined in the High Pressure Gas Safety Act

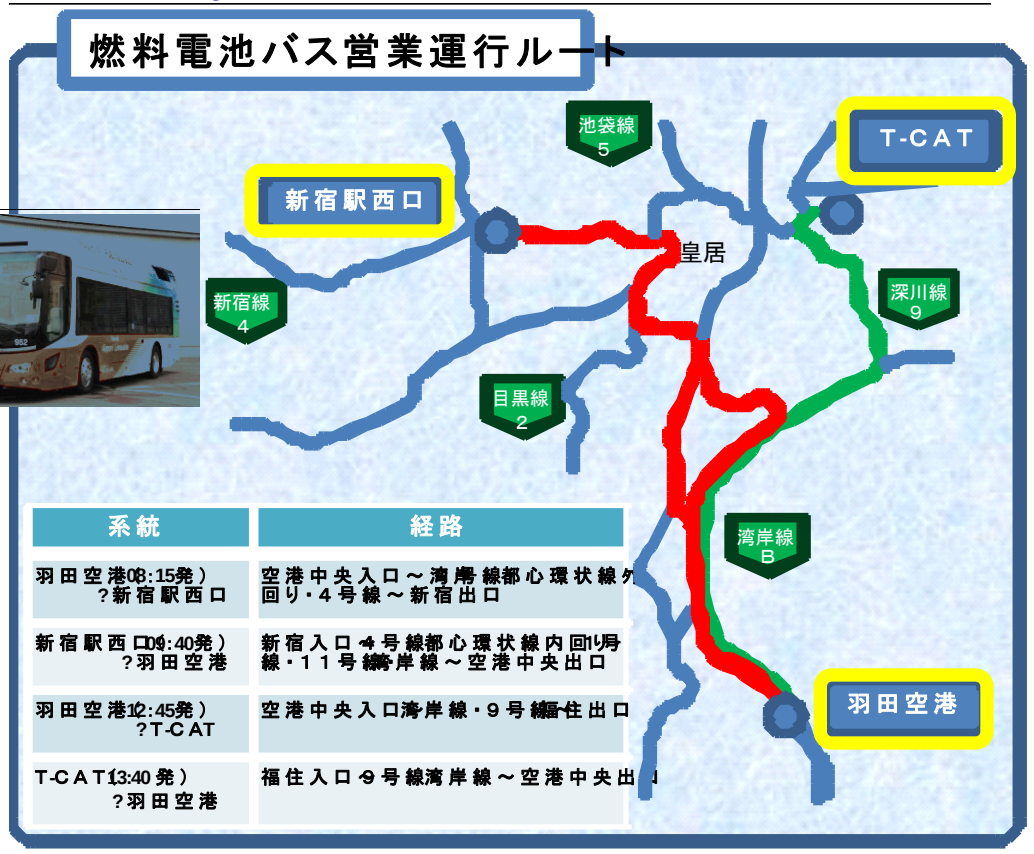
Hydrogen Highway Project

■ Outline

Construct and operate the three hydrogen stations “Tokyo Suginami Hydrogen Station”, “Haneda Hydrogen Station”, and “Narita Hydrogen Station”, and carry out regular operations of the first fuel cell buses and vehicles in Japan via highways.

■ Fuel cell buses started operating on December 16, 2010

Route：Shinjuku Station West Exit～Haneda Airport, Tokyo City Air Terminal～Haneda Airport, to and from once a day.



Tokyo Suginami hydrogen station

Haneda hydrogen station

December 15, 2010 Opening ceremony at Haneda Airport

Hydrogen Town Project

■ Outline

Laid the pipeline from the Kita-Kyushu Hydrogen Station (Hachiman-Higashi-Ku, Kita-Kyushu-shi, Fukuoka Prefecture) which uses hydrogen manufactured by Nippon Steel to nearby housing complexes, houses, commercial facilities, and public facilities. Verify through demonstrations odorizing and deodorizing techniques for the safe use of hydrogen, hydrogen gas measurement systems required for charging hydrogen in the future, and operability of pure hydrogen fuel cells.

■ Demonstrations started January 15, 2011

January 15, 2011 Opening ceremony at Kita-Kyushu City, Inochi-no-Tabi Museum

The Research Association of Hydrogen Supply/Utilization Technology (HySUT)

Association of private companies on H_2 supply & utilization

- Verify hydrogen supply business by demonstrative research in societies
- Installations and operations of hydrogen infrastructures
- Operations and maintenance of hydrogen utilization such as fuel cell vehicles

Members: 13 companies

Oil Utilities: Nippon Oil, Idemitsu Kosan, Cosmo Oil, Japan Energy, Showa Shell Sekiyu

Gas Utilities: Tokyo Gas, Osaka Gas, Toho Gas, Saibu Gas

Other companies (Industrial gas suppliers, hydrogen stations): Iwatani, Taiyo Nippon Sanso, Air Liquid Japan, Mitsubishi Kakoki Kaisha

- Established on July 31, 2009
- FY2009–2015

Basic Research Programs for Innovation in Science of Hydrogen & Fuel cell Technologies

Back to the basic

Basic research programs for innovation and breakthrough

Polymer Electrolyte Fuel Cell Cutting-Edge Research Center

Project period: FY2005–2009

Head: AIST (FC-Cubic)

Research Center for Hydrogen Industrial Use and Storage

Project period: FY2006–2012

Head: Kyushu Univ. and AIST Kyushu

Advanced Fundamental Research on Hydrogen Storage Materials

Project period: FY2007–2011

Head: AIST

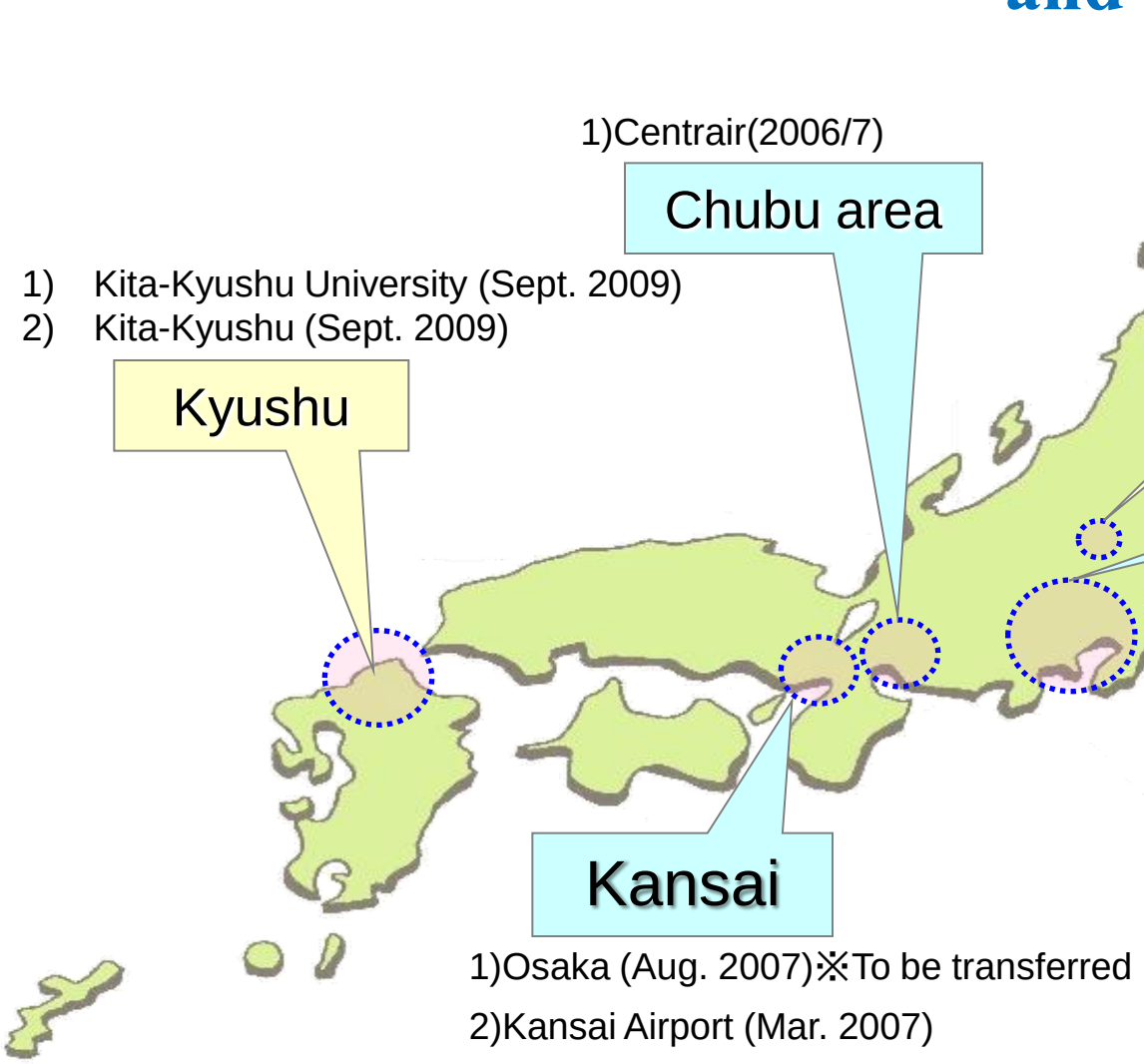
Basic materials research for High Performance Fuel Cell

Project period: FY2008–2014

Head: Yamanashi Univ.

Hiper-FC

Hydrogen Stations Operating in JHFC and Hydrogen Highways Project



1) Nikko (Sept. 2009)

Nikko

1)Centrair(2006/7)

Chubu area

1) Kita-Kyushu University (Sept. 2009)
2) Kita-Kyushu (Sept. 2009)

Kyushu

Metropolitan Tokyo

Kansai

1)Osaka (Aug. 2007)※To be transferred
2)Kansai Airport (Mar. 2007)

1)Yokohama, Daikoku (Mar. 2003, 70MPa:Dec. 2008))
2)Yokohama, Asahi (Apr. 2003,70MPa:Feb 2009)
3)Senju(May 2003,70MPa:Sept. 2008)
4)Kawasaki(Aug. 2003)
*Demonstrations to end in Mar. 2011
5)Sagamihara(Apr. 2004)
*Demonstrations to end Nov. 2010
6)Kasumigaseki (Dec. 2002,70MPa:Feb. 2009)
7)Funabashi(Jun. 2007)
*Demonstrations to end Dec. 2010
8)Ariake(May 2003)
9)Haneda(Dec.2010)
10)Narita (To start operating from Feb. 2011)
11)Suginami(Feb. 2010)

Established in hydrogen society system-building demonstration project

1) （ ）shows year operations started
2) ▭ are JHFC-sponsored stations.

Review of Building of Leading Hydrogen Stations

＜Concept of the building of leading hydrogen stations＞

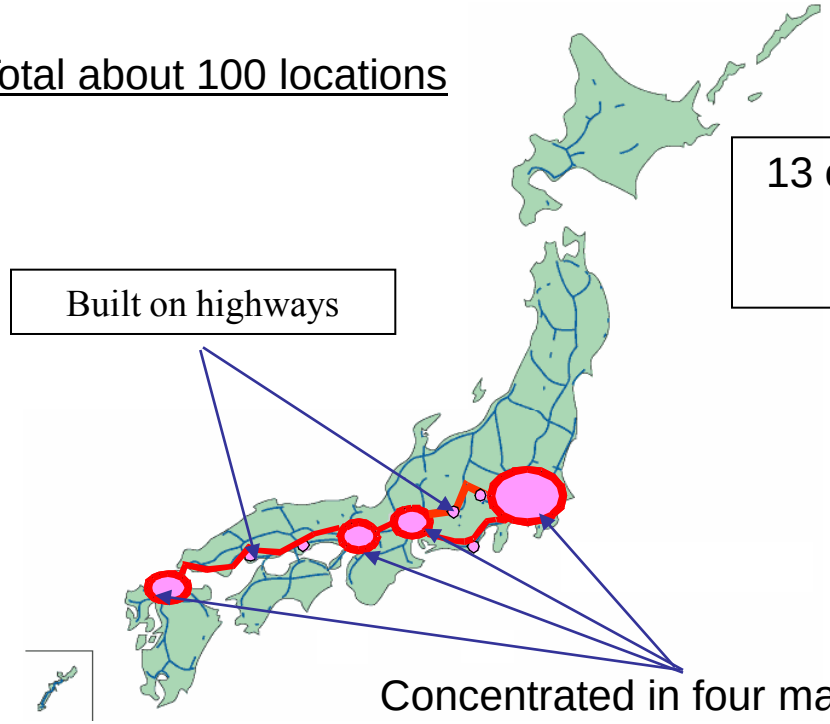
Built leading hydrogen stations in four major cities prior to the start of FCV sales in 2015

Concentrate the hydrogen stations in areas concentrated with potential FCV customers.

Also built STs on highways linking the four major cities, to enable travel between the cities

Ensure user-friendliness in the above areas concentrated with hydrogen stations, to create initial demands from potential FCV customers.

Total about 100 locations



13 companies in the private sector (automobile, infrastructure) have started reviewing strategies to create initial demands in four major cities

Discussions started in meetings and reviews run by local governments and municipals are the Secretariat in Kansai, Chukyo, and Fukuoka.

Source: JX Nikko Nisseki Energy