Country Update of Japan

Current Status of H2 and Fuel Cell Programs of Japan

IPHE 20th SC, Fukuoka

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Ministry of Economy, Trade and Industry
(METI)

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1. Policies / Current Topics

Dissemination of H_2 Refueling Stations

- New subsidy program for the installation of H2 Refueling Stations
  FY2013: 4.6 bil yen, FY2014: 8.25 bil yen (requested)
- Streamlining regulations on H_2 Refueling Stations and FCVs
  Council for Regulatory Reform was launched in June, 2013

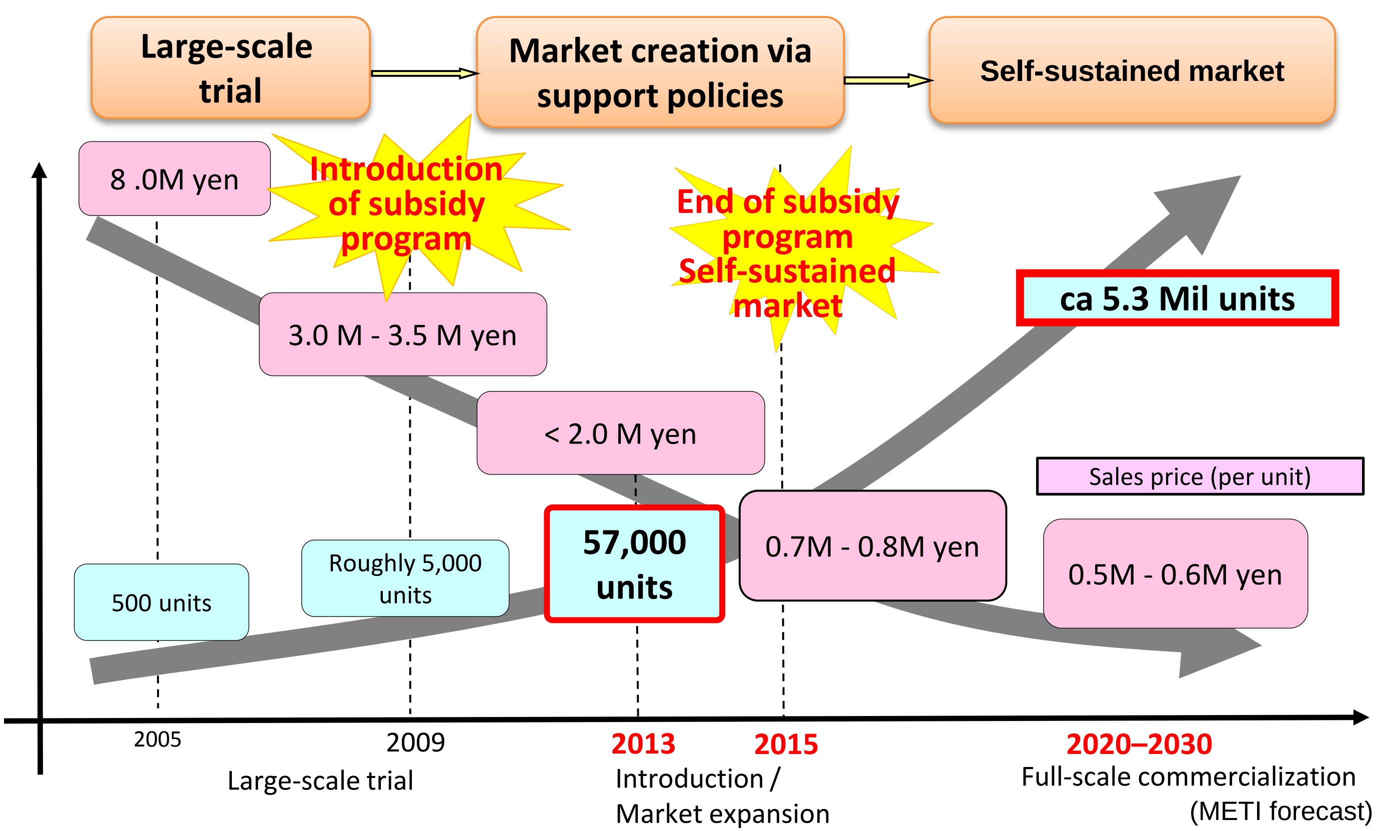
Promotion of RD&D on Fuel Cells

- RD&D on cost-reduction of FCs and new applications
  Small-FCs / Middle & Large-scale FC power generators
- Methods to estimate SOFC lifetime / durability
  e.g. acceleration tests

2. Stationary FCs – Dissemination for ENE-FARM (1) -

* ENE-FARM sale price has been steadily decreasing from 3.5 mil yen in 2009 to <2mi yen today through subsidy.
* To date - 57,000 units in operation (as of Oct 2013) , targeting 5.3 mil unites in 2030.
* SOFC-based ENE-FARM has been commercialized since 2011.

ENE-FARM Dissemination Scenario



ENE·FARM

* 0.7kW-1.0kW per unit

2. Stationary FCs – Dissemination for ENE-FARM(2) -

Toward self-sustained market in 2016, the system cost has to be reduced to 700,000 - 800,000 yen, at which the cost can be competitive with other energy efficient boilers. Therefore, further cost reduction is needed and the following measures have been taken.

(1) Creation of early market

- Toward self-sustained market of ENE-FARM, subsidy plays important role both for cost reduction and dissemination. (450,000 yen/unit (FY2013))
- “ENE-FARM Partners” has been established (May 2013)

ENE-FARM

(2) Market expansion to Europe

- ENE-FARM will be introduced in Germany in April 2014
- Targeting oversea market with high heat demand, e.g. Europe.

ENE-FARM fro European market

(3) Further Cost reduction of FCs

- R&D to reduce Pt-loading at electrodes, further improvement of efficiency and durability (NEDO)

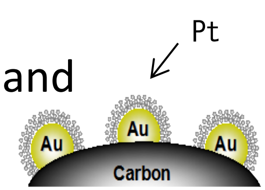
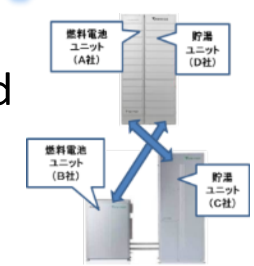


Image of electrode

(4) Cost-reduction of BoP components

- Standardization of connection protocol between FC-Unit and Hot Water Tank -Unit
- Further cost reduction of BoP, e.g. pumps, blowers (NEDO)



Standardization of connector (between FC and hot water tank), and protocal

2. Stationary FCs– Larger FCs -

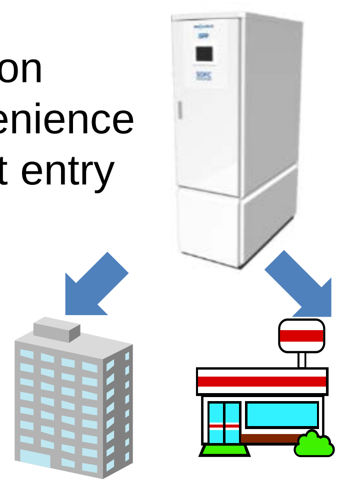
- For the development of larger FCs for commercial-use applications, e.g. shops, hospitals, buildings, factories, RD&D on durability and reliability for SOFC systems is conducted.
- How to make the most use of generated heat through larger SOFC systems is a key. However SOFC systems without heat usage can be also an option considering its fairly high power generation efficiency.

(1) Basic Research

- Development of diagnosis method on SOFC durability and reliability (e.g. acceleration test) (NEDO)

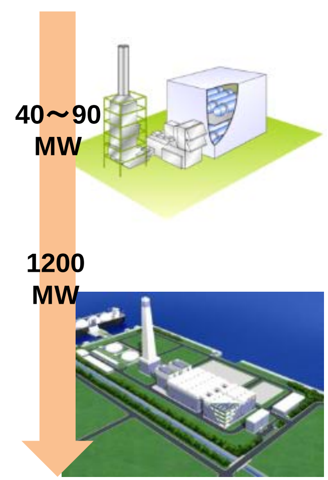
(2) Demonstration

- A SOFC-demo project on small offices and convenience stores focusing market entry (NEDO)



(3) "Triple Combined Cycle Generator"

- Technology development on "Triple Combined Cycle" (using SOFC with gas combined cycle engine) (NEDO)
- This technology can be applied to IGFC, too.



3. FCVs and Hydrogen Refueling Stations

- joint announcement by 13 companies including automakers and energy companies (Jan 13, 2011)
  (1) introduction of FCV in 2015,
  (2) installation of 100 hydrogen refueling stations in four major metropolitan areas
- "Japan Revitalization Strategy" (June 14, 2013)
  (1) installation of 100 hydrogen refueling stations in four major metropolitan areas
  (2) the world's fastest dissemination of FCVs

Automakers' Worldwide Cooperation

Toyota = BMW	Nissan = Daimler = Ford	Honda = GM
(announced on Jan 24, 2013) - Agreed on joint development of FCVs - Launch of FCVs in 2015	(announced on Jan 28, 2013) - Agreed on joint development of FCVs - Launch of mass-production FCVs in 2017	(announced on July 2, 2013) - Agreed on joint development of FCVs - Launch of FCVs in 2015

Source: news release from automakers

3. FCVs and HRSs – Initial Efforts

- Continuous improvement of performance and safety of FCVs as well as cost reduction of vehicles, proper H2 infrastructure development - following measures have been taken
  (HRS cost: 100-200 mil yen(US/Europe), 500-600 mil yen(Japan))

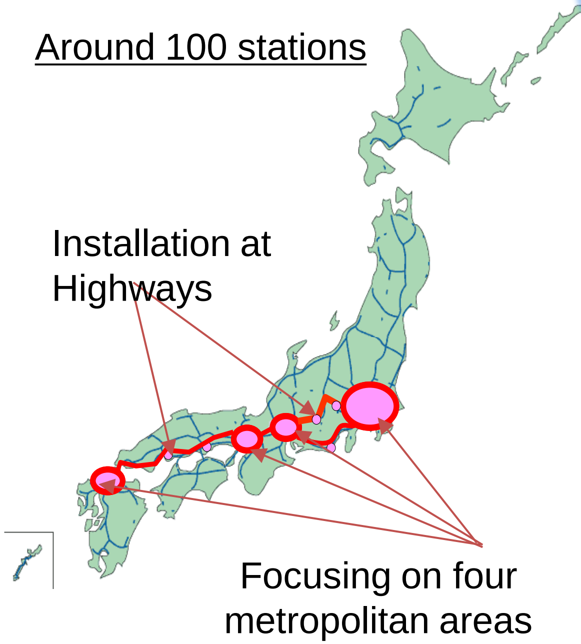
- Other issues
  - low profitability, difficulty of secure appropriate locations in/near high H2 demand areas
  - demand creation by introduction at fleet, emergency vehicles, taxis and buses,
  - establish strong cooperation (government, local governments, automakers and energy companies)

(1) Early Dissemination of HRS

- Subsidy for early dissemination of HRSs prior to FCV commercialization

(2) Streamlining Regulations

- "Regulation Reform Plan" (Cabinet approved in June 2013)
  - 24 priority items were identified as priority (e.g. streamlining regulations for pressure vessels and material standards)



(3) RD&D for further cost reduction

- RD&D on HRS components, e.g. H2 production unit, compressor, and pressure vessels

(4) Creation of early H2 demand

- Develop strong cooperation with local governments and private companies in terms of creation of early demand for FCVs (e.g. public fleet, taxis and buses)

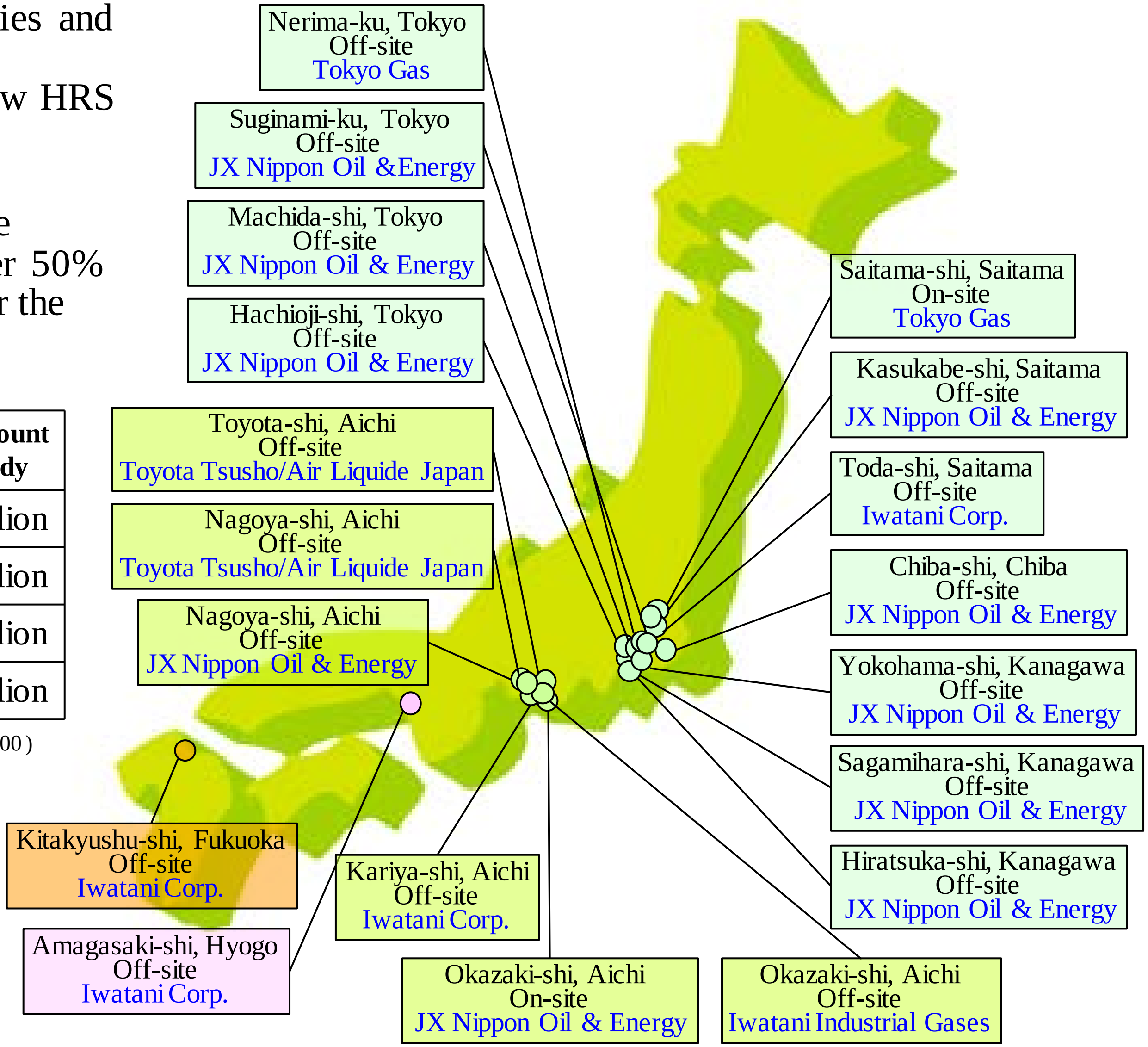
3. FCVs and HRS - Planned HRSs -

- 19 applications by 5 companies and groups were adopted of governmental subsidy for new HRS construction.
- The government subsides the smaller amount money, either 50% of capital expense of HRS or the amount in the table below.

Hydrogen Supply (Nm3/h)	Type	Max. Amount of Subsidy
≥300	On-site	$2.5 million
	Off-site	$1.9 million
≥100 and <300	On-site	$1.6 million
	Off-site	$1.3 million

(Exchange rate: ¥100 = $1.00)

- This map is made by HySUT.
- Each point on the map does not show the exact site of HRS.
- Hydrogen supply capacities of 19 HRSs are 300 Nm^3/h or more.

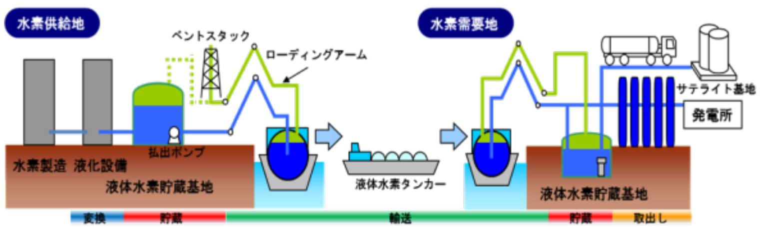


4. Hydrogen Transportation and Storage

- For the large transportation of hydrogen (H2 as energy carrier), liquefied hydrogen transportation and chemical hydride (hydrogen reacted with toluene) transportation are considered as feasible.
- For these technologies, cost-reduction and network-building are issues to be addressed. Further evaluations are needed.

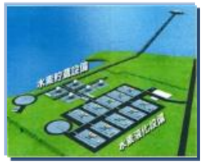
Hydrogen delivery by liquefaction

H_2 is cooled down to -253 C for LH_2



- H_2 transportation efficiency is 12 times higher than compressed H_2.
- LH_2 storage tanks are using on-grand tank technology, and LH_2 tankers are using LNG tanker technology.

Gasification / H2 production



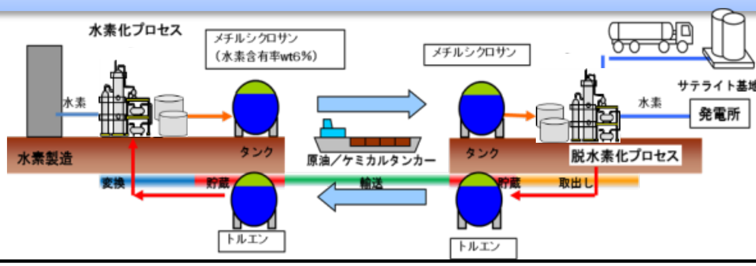
Liquefaction plant

LH2 Carrier

Source: Kawasaki Heavy Industries

Hydrogen delivery using chemical

H_2 is reacted with Toluene, making methylcyclohexane



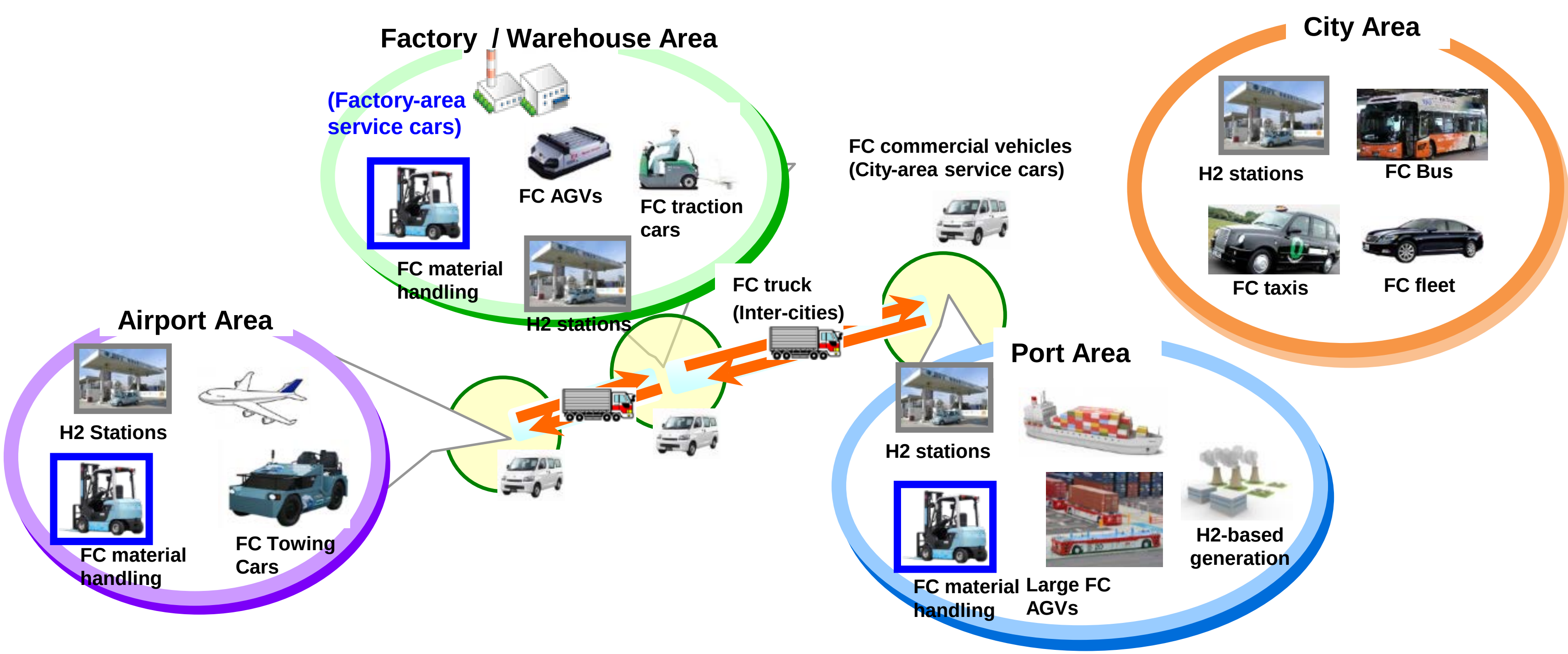
- H2 transportation efficiency is 8 times higher than compressed H_2.
- These chemicals are easy to handle at ambient temp / atmospheric conduction
- Toluene and MCH are parts of gasoline, and large volume storage technology is already established.

Demonstration plant

Source: Chiyoda Corporation

5. Road Map / H_2 supply chain

- Toward "Hydrogen-Applied- Society", detailed roadmap for whole hydrogen chain (production, storage / transport and application) with clear timelines will be developed, showing tasks/roles for public and private for common understandings.
- Demonstration of Hydrogen supply chain can be conducted in areas with enough hydrogen demand, e.g. factory / warehouse areas, airport, port areas and city areas, in order to make models applicable to other areas.



- Kita-Kyushu Hydrogen Town (Northern Kyushu):	**Hydrogen pipeline**
- Hydrogen Energy Frontier Vision (City of Kawasaki)	**H2-based generation, petrochemical complex**
- Hydrogen Grid Project (Kansai int'l Airport)	**Renewables, material-handling**

6. Budget for Hydrogen and Fuel Cell (summary)

Million JPY

		FY 2013	FY 2014 request
R&D Activities (NEDO)			
	Development of PEFC technologies	**3,190**	**3,440**
	Development of SOFC technologies	**1,240**	**1,500**
	Hydrogen Utilization Technology Development	**2,000**	**3,850**
	FCV and HRS demonstration project	**750**	**---**
	R&D for the technologies on H2 storage and H2 transport considering H2 produced by renewable energy source, etc.	**1,130**	**2,200**
	Promotion of safety Infrastructure on next generation hydrogen supply system	**---**	**270**
Installation Support (METI)			
	Subsidy for HRS	**4,600**	**8,250**
	Subsidy for ENE-FARM	**25,050**	**22,400**

Thank you for your attention !!