

Research and Development for Safety Improvement of Hydrogen Refueling Stations in Japan

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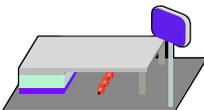
1. Introduction 1-1. About HySUT*

*The Research Association of **H**ydrogen **S**upply / **U**tilization **T**echnology

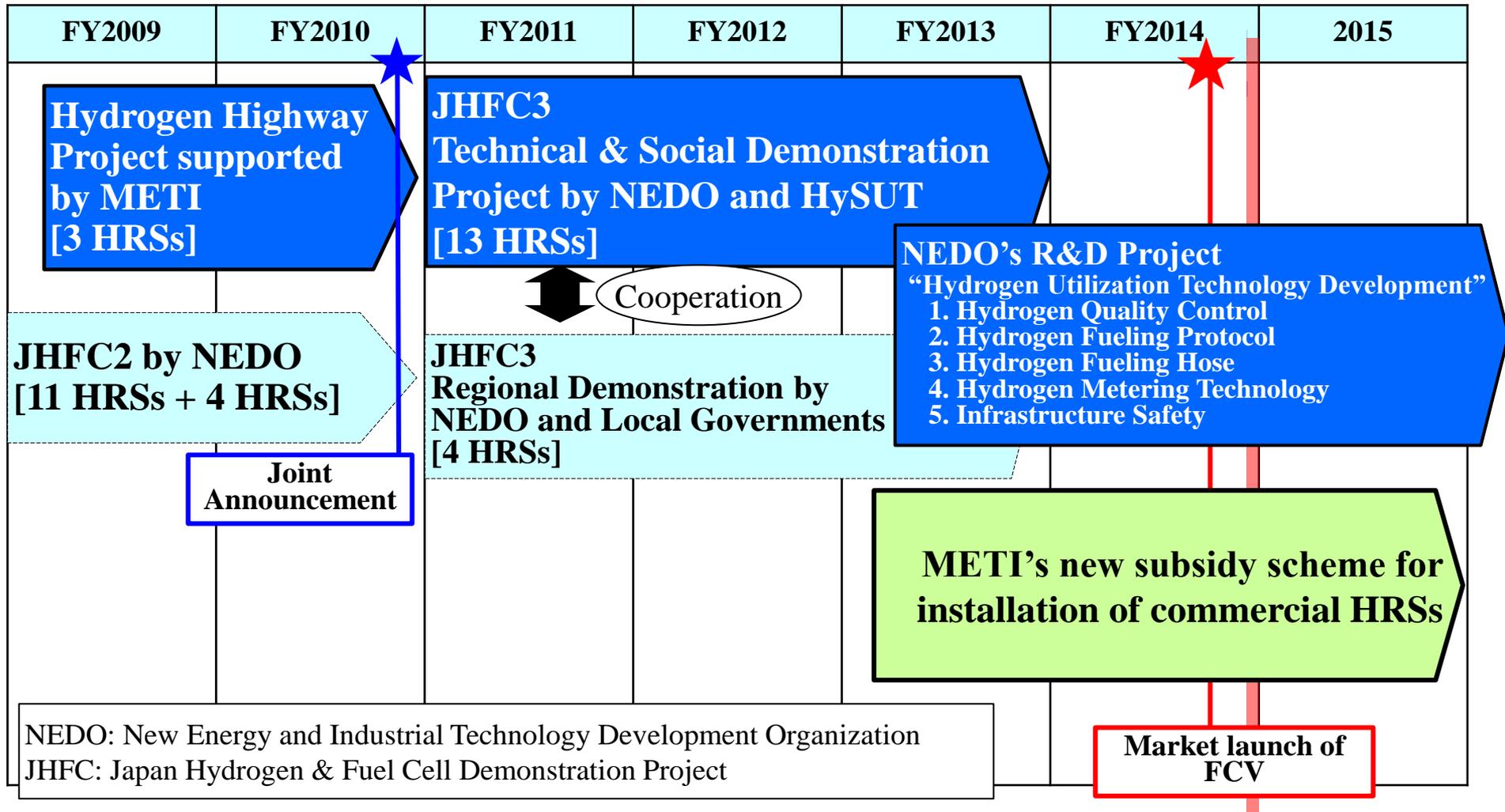
Goals and Objectives

- ✓ Our goal is to **develop hydrogen supply business and promote the commercialization of FCVs** by private companies.
- ✓ Our objective is to **solve the issues of technology, consumer awareness, and social acceptance, and to assist businesses to become viable** through our demonstration programs.

Established on: July 31st, 2009

Members	19 companies and organizations
4 	JX Nippon Oil & Energy Corporation; Idemitsu Kosan Co., Ltd.; Cosmo Oil Co., Ltd.; Showa Shell Sekiyu K.K.
4 	Tokyo Gas Co., Ltd.; Osaka Gas Co., Ltd.; Toho Gas Co., Ltd.; Saibu Gas Co., Ltd.
6 	Iwatani Corporation; Air Liquide Japan Ltd.; Kawasaki Heavy Industries, Ltd.; Mitsubishi Kakoki Kaisha, Ltd.; Taiyo Nippon Sanso Corporation; The Japan Steel Works, Ltd.
3 	Toyota Motor Corporation; Nissan Motor Co., Ltd.; Honda R&D Co., Ltd.
2 	Engineering Advancement Association of Japan (ENAA), Japan Petroleum Energy Center (JPEC)

1-2. Current status of national projects in Japan



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2. Japan's activities for commercialization

2-1. Joint announcement by 13 Japanese companies

Automotive: Toyota Motor Corporation; Nissan Motor Co., Ltd.; Honda R&D Co., Ltd.
Petroleum: JX Nippon Oil & Energy Corporation; Idemitsu Kosan Co., Ltd.; Cosmo Oil Co., Ltd.; Showa Shell Sekiyu K.K.
City Gas: Tokyo Gas Co., Ltd.; Osaka Gas Co., Ltd.; Toho Gas Co., Ltd.; Saibu Gas Co., Ltd.
Industrial Gas: Iwatani Corporation, Taiyo Nippon Sanso Corporation

On January 13, 2011, 13 Japanese companies (automakers and hydrogen fuel suppliers) jointly announced the launch of FCVs in the Japanese market by 2015 and the development of hydrogen supply infrastructure.

1. Automakers are aiming to **launch FCVs in the Japanese market**—mainly in the country's four major metropolitan areas—in 2015.
2. Hydrogen fuel suppliers are aiming to **build approximately 100 hydrogen refueling stations by the end of 2015**.
3. Automakers and hydrogen fuel suppliers will work together to increase the number of FCVs and develop a hydrogen supply network throughout Japan.



2-2. Introduction of commercial HRSs

NeV: Next Generation Vehicle Promotion Center
Total 81 HRSs approved (23 opened) as of July 1st 2015
“Blue” shows mobile stations (total 26)

North Kyushu Area (12)

	Fukuoka Pref. Kitakyushu-shi Iwatani 10/2014
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Under Construction:
 Fukuoka Pref. / Fukuoka-shi (3) (1)
 Kitakyushu-shi
 Onojo-shi
 Koga-shi
 Shime-cho
 Yamaguchi Pref. / Shunan-shi
 Saga Pref. / Saga-shi
 Oita Pref. / [Oita-shi](#)

Kansai Area (12)

	Hyogo Pref. Amagasaki-shi Iwatani 7/2014
	Osaka Pref. Ibaraki-shi Osaka Gas 4/2015

Under Construction:
 Shiga Pref. / Otsu-shi
 Kyoto Pref. / Kyoto-shi(1)(1)
 Osaka Pref. / Osaka-shi (3) (1)
 Ibaraki-shi
 Sennan-gun
 Tokushima Pref. / [Tokushima-shi](#)

Under Construction:
 Aichi Pref. / Nagoya-shi (2) (2)
 Kariya-shi (2)
 Anjo-shi
[Kiyosu-shi](#)
[Toyohashi-shi](#)
 Shizuoka Pref./[Hamamatshu-shi](#)
 Mie Pref./[Yokkaichi-shi](#), [Tsu-shi](#)
 Gifu Pref./[Hashima-gun](#)



Metropolitan Area (37)

	Tokyo, Hachioji-shi JX 2/2015
	Tokyo, Chiyoda-ku Nippon Mobile Hydrogen 3/2015
	Tokyo, Suginami-ku JX 3/2015
	Tokyo, Minato-ku Iwatani 4/2015

	Kanagawa Pref. Ebina-shi JX 12/2014
	Kanagawa Pref. Yokohama-shi JX 2/2015
	Kanagawa Pref. Yokohama-shi JX 2/2015
	Saitama Pref. Saitama-shi JX 2/2015
	Saitama Pref. Kasukabe-shi JX 3/2015
	Saitama Pref. Sayama-shi JX 4/2015
	Saitama Pref. Toda-shi Iwatani 5/2015
	Chiba Pref. Chiba-shi JX 3/2015
	Tokyo, Nerima-ku Tokyo Gas 12/2014

Chukyo Area (20)

	Aichi Pref. Miyoshi-shi JX 2/2015
	Aichi Pref. Okazaki-shi JX 3/2015
	Aichi Pref. Nagoya-shi Toyota-Tsusho/Air Liquide 3/2015
	Aichi Pref. Nagoya-shi JX 3/2015
	Aichi Pref. Toyota-shi Toyota-Tsusho/Air Liquide 4/2015
	Aichi Pref. Nissin-shi Toho Gas 4/2015
	Aichi Pref. Toyota-shi Iwatani / Toho Gas 5/2015

Under Construction:
 Tokyo / Koto-ku (2), Meguro-ku, Ota-ku (1) (1)
 Arakawa-ku, [Itabashi-ku](#)
 Kanagawa Pref. / Yokohama-shi (2) (2), [Sagamihara-shi](#)
[Fujisawa-shi](#), [Isehara-shi](#)
 Saitama Pref. / Saitama-shi (1) (2)
[Kawagoe-shi](#), [Koshigaya-shi](#)
 Chiba Pref. / Matsudo-shi, Narita-shi
 Yachiyo-shi, [Inba-gun](#)
 Yamanashi Pref. / Kofu-shi

Source: <http://fccj.jp/hystation/index.html>

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3. Safety and reliability technology for HRS

3-1. Basic concept of the program

- ✓ Incident/trouble data collection and construction of reliability database
- ✓ Training and education for HRS operators
- ✓ Development of safety and reliability improvement technology for future
- ✓ Enhancement of social acceptance

Construction of reliability database



No.	種別	発生年月	発生場所	発生原因	対策	備考	発生日
1	故障	2014.10	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2014.10.25
2	故障	2014.11	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2014.11.10
3	故障	2014.12	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2014.12.15
4	故障	2015.01	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.01.20
5	故障	2015.02	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.02.25
6	故障	2015.03	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.03.30
7	故障	2015.04	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.04.05
8	故障	2015.05	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.05.10
9	故障	2015.06	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.06.15
10	故障	2015.07	東京都	燃料供給装置の故障	燃料供給装置の点検	燃料供給装置の故障	2015.07.20

Hydrogen Refueling Station

Training & education



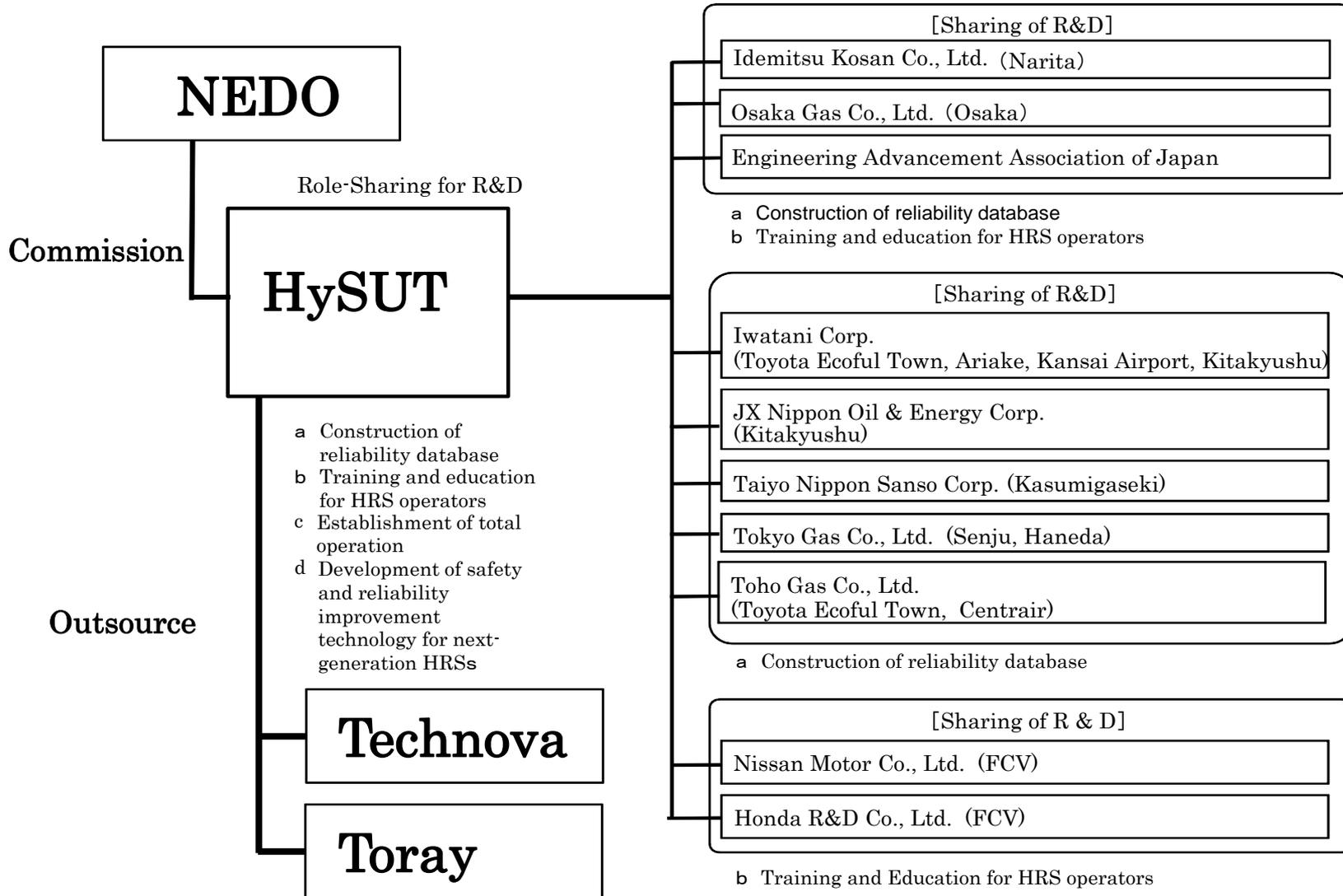
May 21 @Narita HRS July 8 @Osaka HRS

Enhancement of social acceptance



48,414 visitors @FC Expo 2015

3-2. Organizational structure for the project (FY2015)



3-3. Organizational structure of HySUT

Hydrogen Infrastructure Safety Steering Committee

→ Guidance and coordination of the project as a whole as well as supervision of progress of each WG.

Reliability Database Working Group *

→ Collection of accident/incident data and study for compiling a database

Education & Training Working Group *

→ Drafting a guideline document for education facilities and training programs for hydrogen stations

Next-generation Technology Working Group

→ Discussion of next-generation concepts for stations and development of fuel services based on them; scoping study of related development items; activities for improved social acceptance

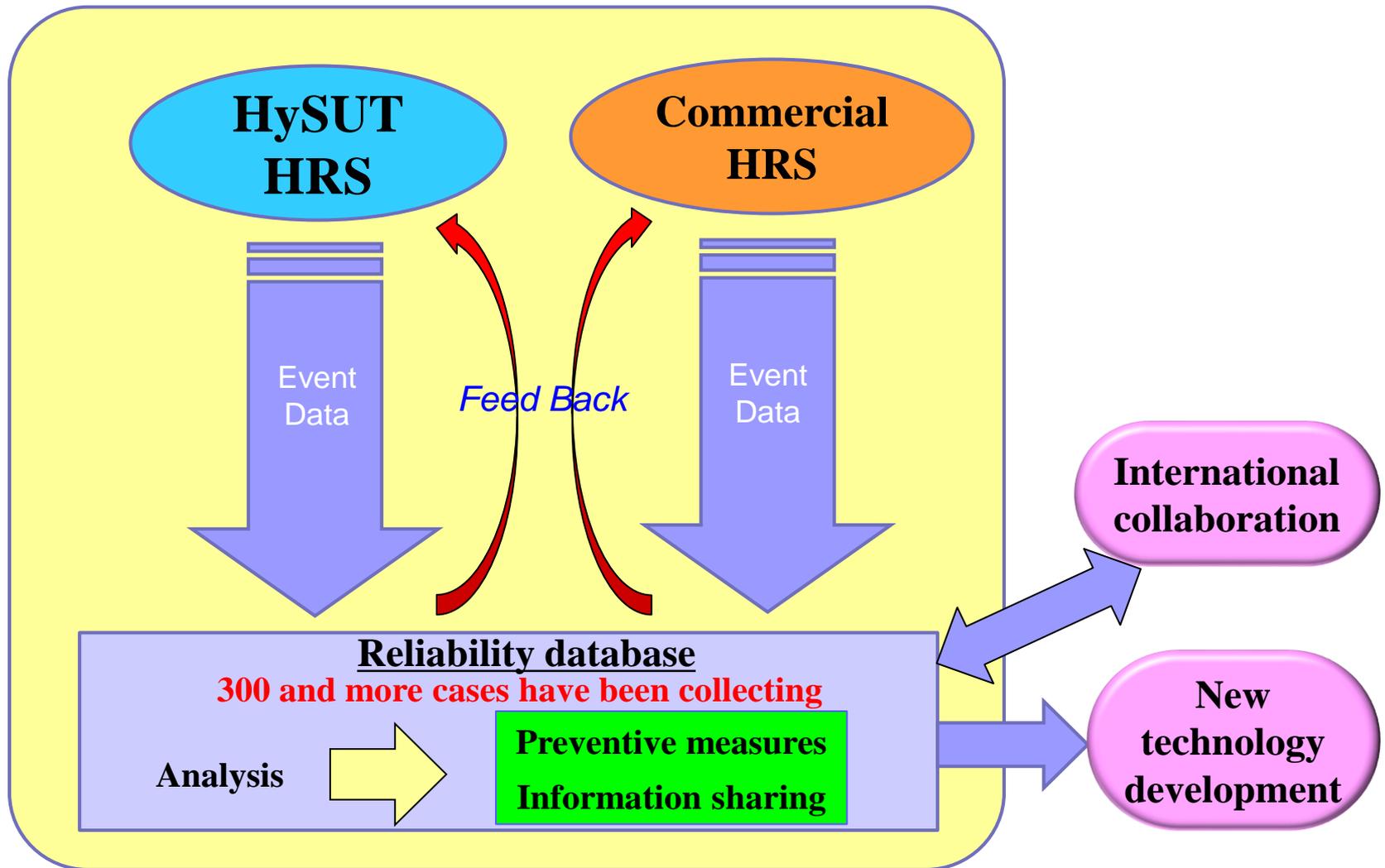
Next-generation HRS Sub Working Group

→ Producing original ideas for the above through brainstorming and other activities

* Sub-groups under each WG as needed

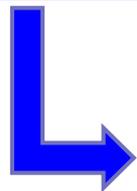
3-4. Reliability Database Working Group

3-4-1. Collection and compilation of incident/trouble data



3-4-2. Reliability database template

No.	Category	Hydrogen leakage	Death & injuries	Physical damage	Facility	Place	Occurrence	Causes	Measures taken
1									
2									
3									
-									
N									



A: Incident class A (number of casualties: 5 or more)		<i>High Pressure Gas Safety Act</i>
B: Incident class B (number of casualties: 1 - 4)		
C: Incident class C		
D:	D1: Operation hindrance	<i>HySUT</i>
	D2: Minor hydrogen equipment issue	
	D3: Minor non-hydrogen equipment issue	
E: Near-miss		

3-5. Education & Training Working Group

3-5-1. Education & training for HRS operators

The WG is drafting the Guidelines for HRS Education Facilities and Training Programs (provisional name) as the basis for operational guidelines for commercial HRS. A list of safety management parameters, emergency training, and employee education manuals is being prepared for this.

Wide deployment of FCV



Directing vehicles



H₂ fueling



Inspection



Maintenance



Narita HRS

Study of simulation training



Osaka HRS

Draft guidelines

3-5-2. Draft Guidelines for HRS Education Facilities and Training Programs (provisional name)

Contents (draft)

- 1. Purpose and definitions**
- 2. Physical properties and characteristics of hydrogen**
- 3. Basic knowledge of high-pressure gas – Standards related to compressed H₂ stations**
- 4. Hazard prevention – Explanation of hazard prevention requirements**
- 5. Safety manuals – Equipment and task-oriented manuals**
- 6. Fuel cell vehicles – What every H₂ station operator should know about FCVs**
- 7. Simulation training for HRS – Hydrogen compression, pressure accumulation, guiding and fueling FCVs, routine inspections**
- 8. Emergency training – What to do in combustion, fire fighting, or gas leaks**
- 9. Case study of incidents – From hydrogen stations in and out of Japan
(Reliability database and others)**

3-5-3. Preliminary experiments with training & education for HRS operators (@Narita HRS & Osaka HRS)



Explaining fueling equipment



Directing an FCV



Directing waiting vehicles



Checking the tank's expiration date



Filling hydrogen



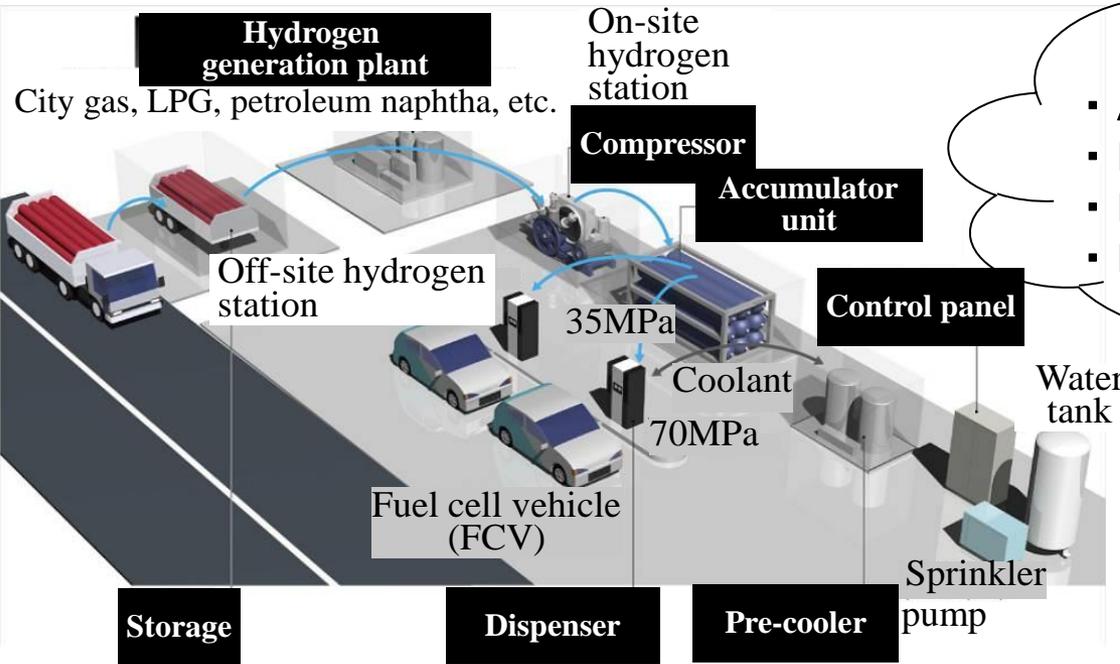
Explaining FCV

3-6. Next-generation Technology WG

Current status of Next-generation Technology WG

Typical HRS at present

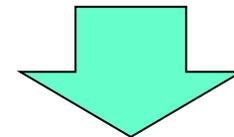
Next-generation HRS



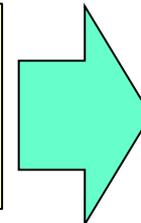
Keywords

- Around 2025
- Further enhancement of safety
- Less labor
- Lower cost

Identified issues (via backcasting)
 Postulated an ideal hydrogen station for the next generation and identified the technology needs for development.



Identified issues (via forecasting)
 Analyzed the incident data collected so far and identified the technology needs for the next generation of hydrogen stations.



List of development items for the next gen. H₂ station

3-7. Example of activities for better social acceptance

One-stop portal site for hydrogen aiming to gain better recognition for hydrogen (out-sourced to Technova)

The front page of the Hydrogen Energy Navi that has been published from May 25 is seen below:

<http://hydrogen-navi.jp/>

The screenshot shows the homepage of the Hydrogen Energy Navi website. At the top left is the logo for '水素エネルギーナビ' (Hydrogen Energy Navi) with 'HYDROGEN' written below it. To the right of the logo is a search bar with a '検索' (Search) button. Below the search bar are five navigation tabs: '水素とは' (What is hydrogen), '水素エネルギー技術' (Hydrogen energy technology), '水素の意義とビジョン' (Significance and vision of hydrogen), '燃料電池自動車(FCV)' (Fuel cell vehicle (FCV)), and '水素ステーション' (Hydrogen station). The main content area is divided into three sections. The top section features a photograph of a 'JHFC セントレア 水素ステーション' (JHFC Sentria Hydrogen Station) and a blue background with the heading 'What is Hydrogen Refueling Station' and a paragraph explaining that while gas stations are needed for gas cars, hydrogen stations are needed for FCVs. The bottom left section has an orange background with the heading 'Hydrogen energy in 5 minutes' and text stating that hydrogen has been used in private life and that users should check Q&A and feel the hydrogen nearby. The bottom right section has a green background with the heading 'Commercial stations' and text explaining that it provides information on commercial hydrogen stations for FCVs. A small icon of a hydrogen station is shown in the bottom right corner.

水素エネルギーナビ

水素とは | 水素エネルギー技術 | 水素の意義とビジョン | 燃料電池自動車(FCV) | 水素ステーション

➔ What is Hydrogen Refueling Station
ガソリン自動車にガソリンを補給するためにガソリンスタンドが必要なように、燃料電池自動車(FCV)に水素を充填するためには水素ステーションが必要です。水素ステーションとはどのようなものでしょうか。

➔ Hydrogen energy in 5 minutes
水素は以前から私達の生活で利用されています。水素エネルギーに関するQ&Aをご覧ください。いただき、身近にある水素を感じてください。

➔ Commercial stations
燃料電池自動車(FCV)の燃料水素を供給する全国の商用水素ステーションを一覧でご覧いただけます。※FCCJサイトに移動します

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4. Summary

1. Since FY2013, HySUT has been working under NEDO's Hydrogen Utilization Technology Development Project to develop the technology for:
 1. hydrogen quality management; 2. hydrogen fueling; 3. hydrogen fueling hoses; 4. hydrogen metering.
2. In FY2014, development of technology for high-level safety and reliability of hydrogen stations started, with the following results:
 - A reliability database using Microsoft Excel is up and running for the parties involved.
 - A proposal for a training center to train and educate hydrogen station operators and a draft for the Guidelines for Hydrogen Station Education Facilities and Training Programs.
 - A list of new technologies for development projected to be required by next-generation stations around 2025.
 - A one-stop portal site under operation for wider social acceptance.

Thank you very much for your attention!



Masanori Hirose, Tetsufumi Ikeda, Yoichi Sone, Tadashi Abe, Ayumu Okamoto, Yusuke Nagai, Fuminori Yamanashi, Yoshitaka Konishi, Shoichi Kaneko, Kazuhito Matsuda, Tomonari Komiyama, Hisatoshi Ito, Mikihiko Shibata,

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