

# Demonstration of Hydrogen Stations Integrated with Gas Stations Targeting the Commercial Start of Fuel Cell Vehicles(FCV)

3<sup>rd</sup> Mar, 2014

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R&D Planning Division

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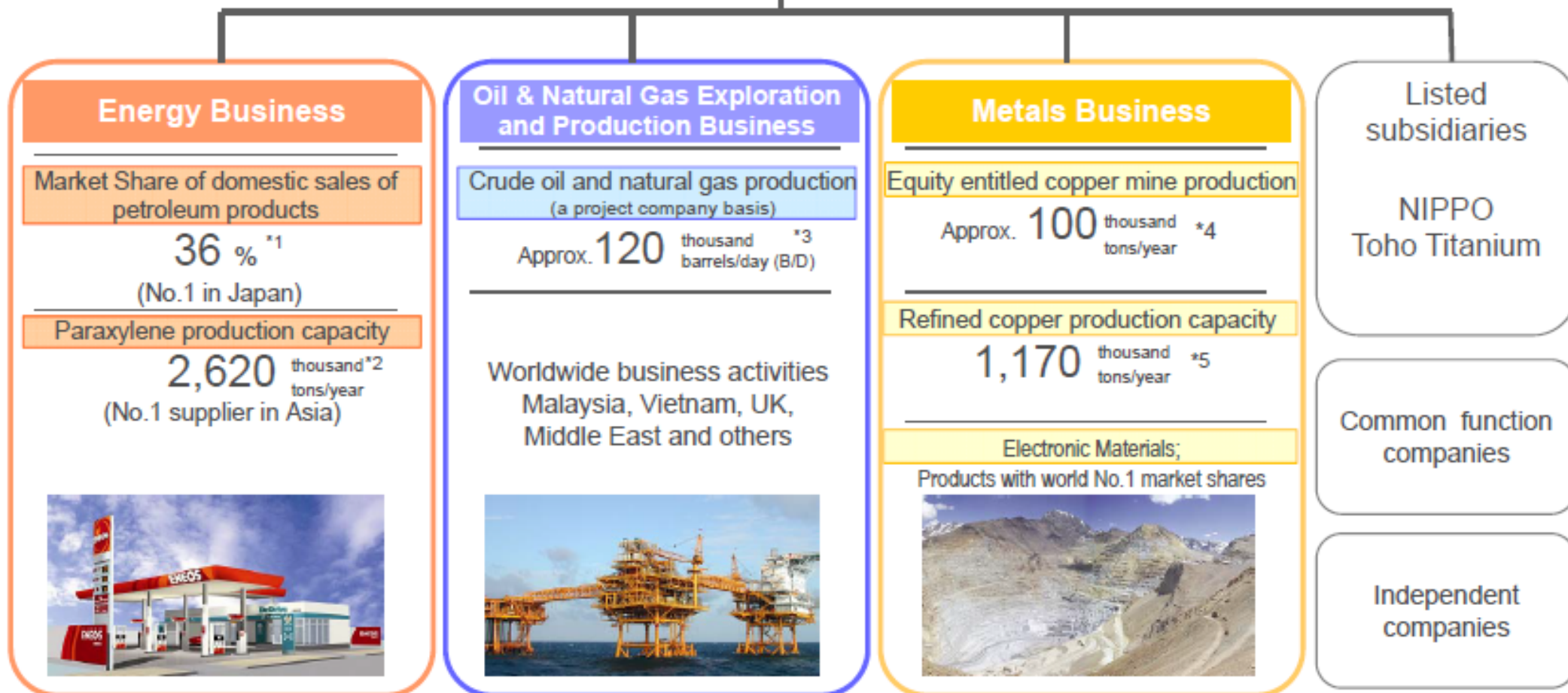
The Future of Energy, Resources and Materials

**JX Nippon Oil & Energy Corporation**

# Businesses Summary of JX Group



## JX JX Holdings, Inc.



\*1 FY 2011 actual

\*2 As of Mar. 2013

\*3 Crude Oil Equivalent (Estimated average daily production from Jan. to Dec. 2012)

\*4 Equity entitled copper production contained in copper concentrate (Estimated production from Jan. to Dec 2012)

\*5 Pan Pacific Copper(88.0% equity stake) ; 610 thousand tons/year + LS-Nikko Copper(39.9% equity stake) ;580 thousand tons/year (As of Mar. 2013)

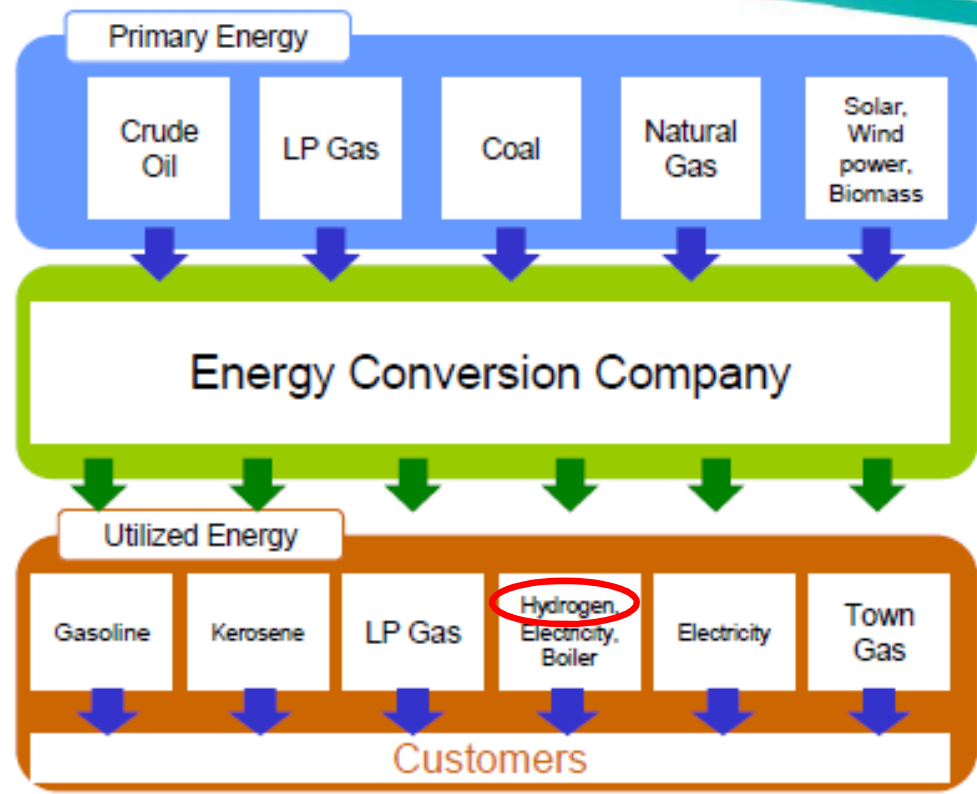


# Petroleum Refining & Marketing/Energy Conversion

<b>Business Environment</b>	Domestic petroleum demand decline and competition with import products continue
<b>Basic Strategy</b>	<b>Strengthening profitability of refining &amp; marketing</b>
<ul style="list-style-type: none"> <li>➤ Strengthening global competitiveness of refineries                             <ul style="list-style-type: none"> <li>• Safe and Stable operation</li> <li>• Cost reduction (Energy saving, Utilizing for bottom oil)</li> <li>• Conversion to chemical factory</li> </ul> </li> <li>➤ Establishing strong supply chain                             <ul style="list-style-type: none"> <li>• Building strong sales network</li> <li>• Improving brand value (Introduce new Dr. Drive brand, Card strategy, etc.)</li> </ul> </li> </ul>	

<b>Business Environment</b>	Reformation of energy policy by Japanese government progress
<b>Basic Strategy</b>	<b>Enhancing business as an energy conversion company</b>

- Electricity : Business expansion corresponding to electric system reformation by Japanese government
- Gas : Construction of LNG terminal (Hachinohe & Kushiro) starting operation in 2015 (Enhancing providing base, Acquiring new demand )
- Coal : Development of coking coal in Canada , Increasing domestic sales
- Solar, Fuel Cell : Mega solar project, fuel cell business (Challenge for realizing a society with independent and distributed energy system)
- Hydrogen : Bring forward demonstration test of providing infrastructure



# Agenda

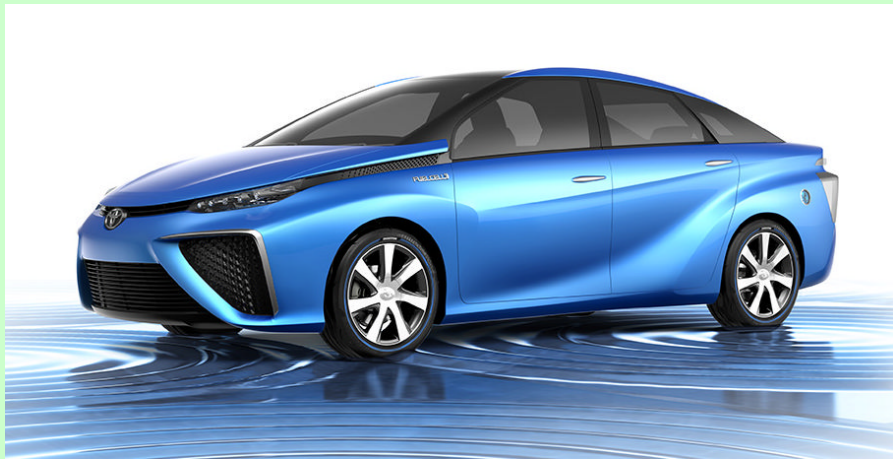
1. Government & Private Activities
2. Business Model Development
3. Issues & Activities

# Market Launch announcements of Japanese Carmakers

## 【TOYOTA】

“We will launch mass produced sedan type FCV for Japan, US and EU market in 2015.” “Affordable Market Price”  
“Alliance partnership with BMW”

### *TOYOTA FCV Concept* Launched in Tokyo Motor Show 2013



## 【HONDA】

“Market Entry is 2015”  
“Alliance partnership with GM”

### *HONDA FCEV Concept* Launched in Los Angeles Auto Show 2013



## 【NISSAN】

NISSAN Green program 2016 “Next wave of ZEV is FCV”  
“Alliance for Commercial FCV with Daimler and Ford”  
“FCV Market Entry is 2017”

### *Concept Car “TeRRA”*



# Joint Announcement for aiming Launch of mass-produced FCVs in 2015

–Construction of 100 Hydrogen Supply Station in advance–

January 13 2011



1. As development of fuel-cell systems progresses, Japanese automakers are continuing to drastically reduce the cost of manufacturing such systems and are aiming to **launch FCVs** in the Japanese market—mainly in the country's **four largest cities—in 2015**. The automobile industry hopes to popularize the use of FCVs after their initial introduction as a way of tackling energy and environmental issues.

2. Hydrogen fuel suppliers are aiming to construct **approximately 100 hydrogen fueling stations** by 2015, based on the number of FCVs expected to initially enter the market, to ensure a smooth launch and to create initial market.

3. With an aim to significantly reduce the amount of CO<sub>2</sub> emitted by the transportation sector, automakers and hydrogen fuel suppliers will work together to expand the introduction of FCVs and develop the hydrogen supply network throughout Japan. The two groups are looking to the **government to join** them in forming **various strategies** to support their joint efforts and to gain greater public acceptance of the technology.

## The Research Association of Hydrogen Supply/Utilization Technology

HySUT was established by private companies who share the purpose to popularize hydrogen supply business and FCVs from 2015. The objective of HySUT is to solve issues on technology, consumer awareness, social acceptance and also to assist business establishment through their demonstration program.

### (1) Members: 19 Companies

#### Energy Supplier:

JX Nippon Oil & Energy , IDEMITSU KOSAN ,COSMO OIL ,Showa Shell Sekiyu. K.K., TOKYO GAS, OSAKA GAS, TOHO GAS, Saibu Gas, IWATANI CORPORATION

#### Engineering Company, Device Company:

Air Liquid Japan, KAWASAKI HEAVY INDUSTRIES, MITSUBISHI KAKOKI, TAIYO NIPPON SANZO, Japan Steel Works

#### Automakers:

TOYOTA, Nissan, HONDA

#### Related organization:

Japan petroleum energy center,

Engineering Advancement Association of Japan

### (2) Establishment: 2009.7.31

### (3) Term of the existence: 2009 to 2015FY



# **“Towards Hydrogen Economy Society” described in the Basic Energy Plan approved by the Cabinet in June 20<sup>th</sup> , 2010.**

## **【Views to be Realized】**

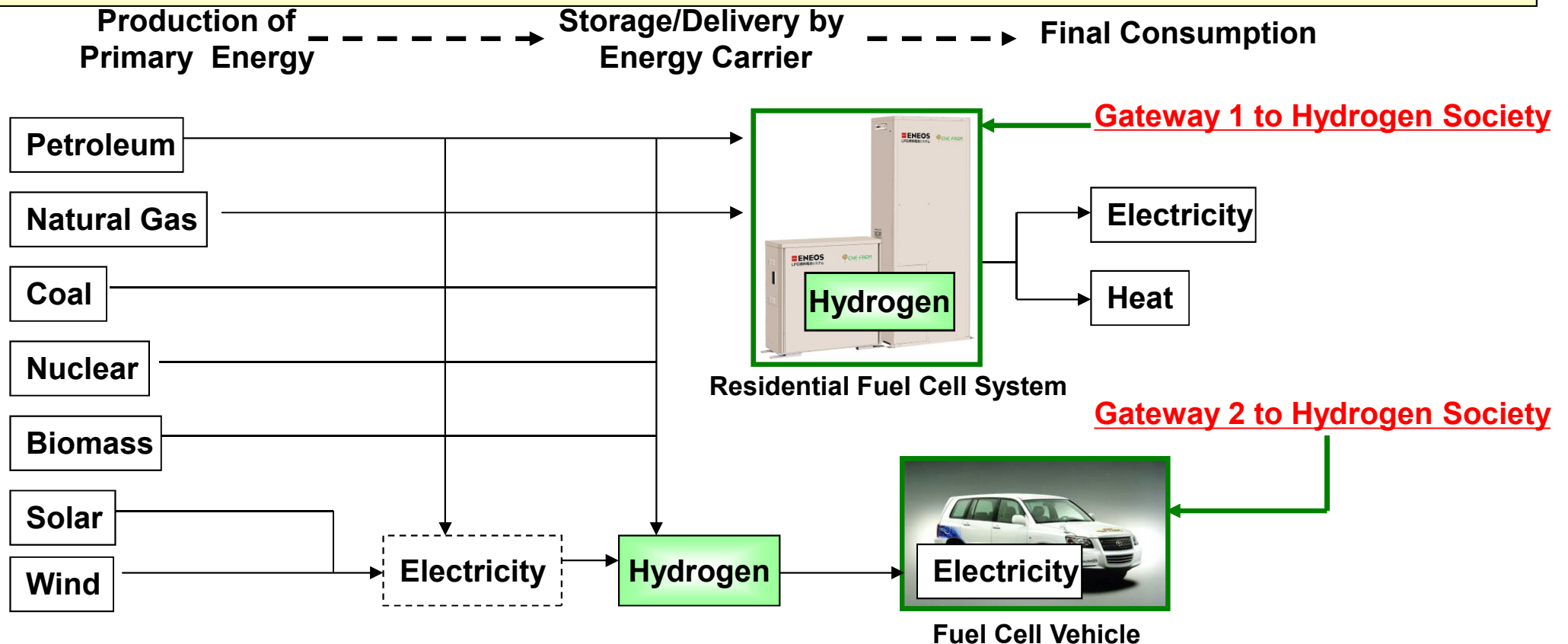
- To establish hydrogen utilization social system which does not emit carbon dioxide in middle and long term**
- To utilize fossil derived Hydrogen and/or bi-product Hydrogen from Iron Mills etc. for the moment. And in the future production technologies of fossil derived Hydrogen combined with CCS and non-fossil oriented Hydrogen to be established**
- To accelerate the market expansion of residential fuel cell “Enefarm” which had been put into commercial use for the first time in the world. From now, the expanded usage of fuel cells as dispersed-type power source and also as business use will improve energy utilization efficiency. Moreover, building support of supply infrastructures, such as hydrogen stations will be promoted towards the introduction of fuel cell vehicles planned in 2015.**
- Activities of internationally expanding the market including international standardization will be accelerated**



# Hydrogen is a “Smart Energy Carrier”

## <Merits of Hydrogen as an energy carrier>

- Hydrogen can be produced from **various primary energies**. → Contribution to energy source **diversification**
- Hydrogen can generate electricity and heat efficiently when used in a **fuel cell**, therefore hydrogen is **a kind of battery** which can store electricity generated from **unstable renewable energies**.  
→ Contribution to energy **security** and energy **conservation**
- Hydrogen emits no CO2 during consumption. → Contribution to **CO2 reduction**

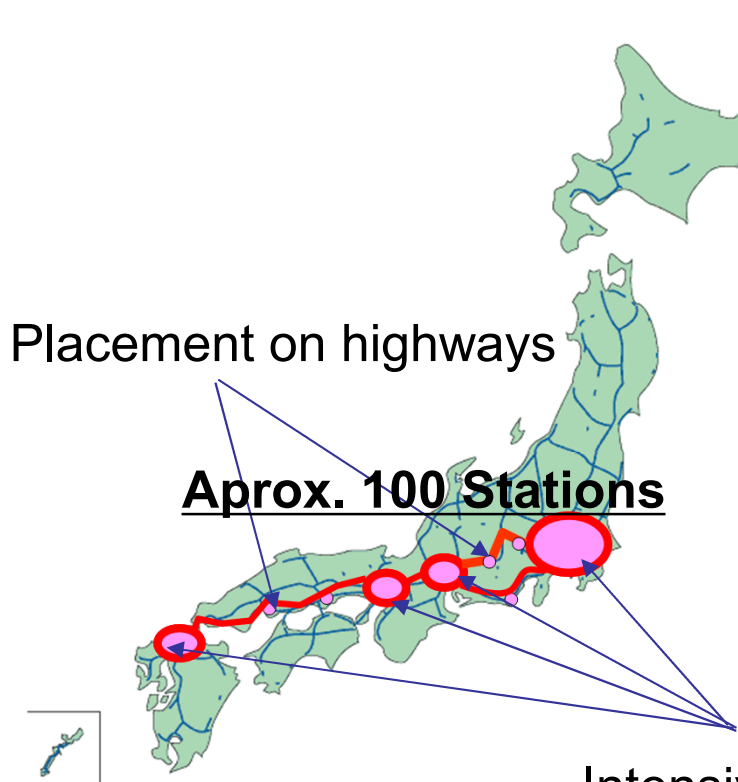


# Joint Study on Preceded H2 Infrastructure Preparation

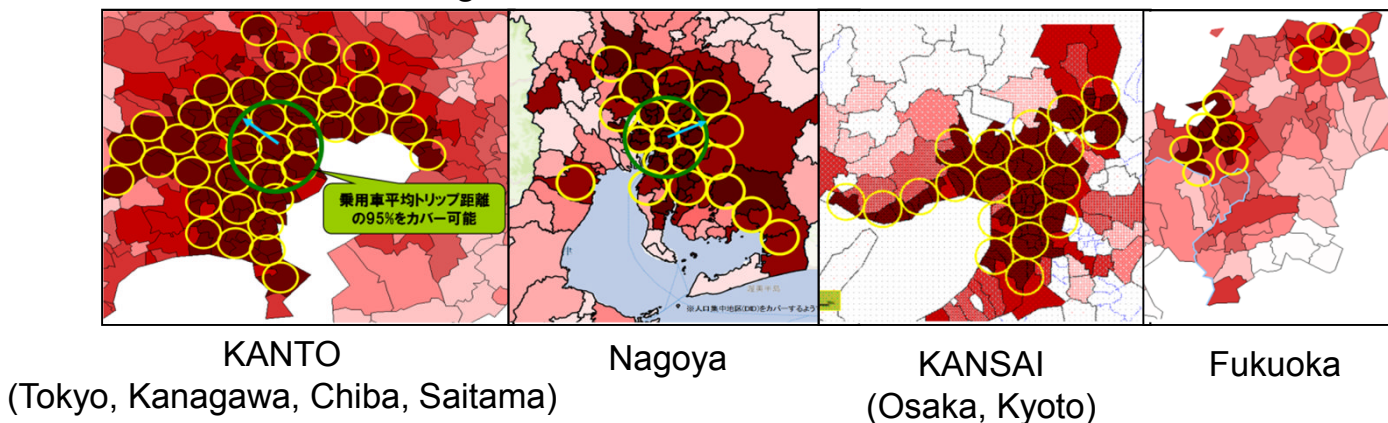
## <The concept of preceded H2 infrastructure preparation>

- Preparation of hydrogen station before 2015 FCV commercialization
- Intensive placement in Kanto, Nagoya, Kansai and Fukuoka city area which may have big FCV market.
- Placement on highways between 4 city areas.
- Placement has to satisfy convenience of FCV users for FCV deployment.

Early adopter market of FCV might be held in these areas, because about 50% of passenger car are held and early HV market were formed there.



## <H2 Stations Coverage>



Intensive placement at Kanto, Nagoya, Kansai and Fukuoka areas

# Gov. subsidies program for H2 Supply facilities

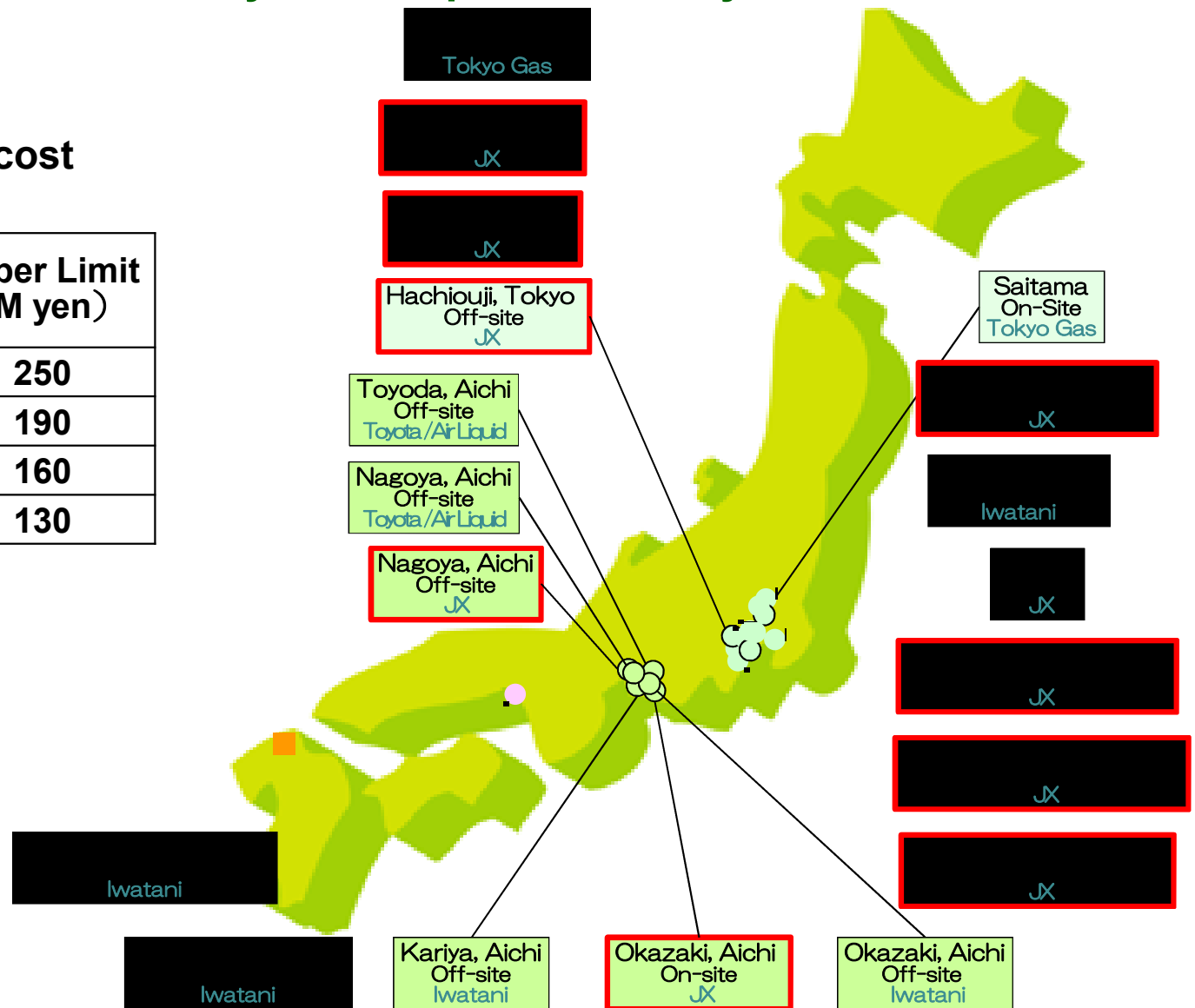
The total budget is 4.6B yen and the next year's request is 8.9B yen

- Amount of subsidies  
: 50% of the total construction cost

H2 supply capacity (Nm3/h)	type	Upper Limit (M yen)
300 >	On-site	250
	Off-site	190
100-300	On-site	160
	Off-site	130

## Adoption destination

JX	: 10
Iwatani	: 5
Tokyo Gas	: 2
Air Liquid Japan	
/Toyota Tsusho	: 2
<b>Total</b>	<b>: 19</b>



([http://www.cev-pc.or.jp/hojo/suiso\\_index.html](http://www.cev-pc.or.jp/hojo/suiso_index.html))

# Agenda

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- 2. Business Model Development**
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# Key Concept of Business Model

- Supply chain by the refinery H2 production and Gas Station Network is our core competency for hydrogen business.

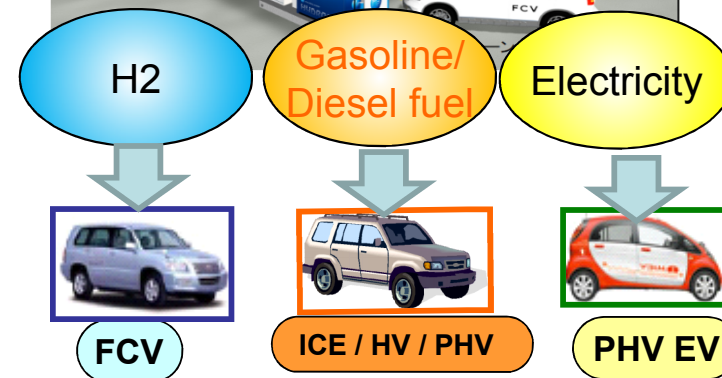
Surplus Capacity of 4.7B m3-H2\*  
(applicable to 5 M FCV)  
\*as a whole domestic Refinery

**Hydrogen production Plant**  
(Refinery existing facility)



SS Network : 11,000  
Domestic Market Share : 36%

**Gas Station network**  
(Multiple Fuel Businesses)

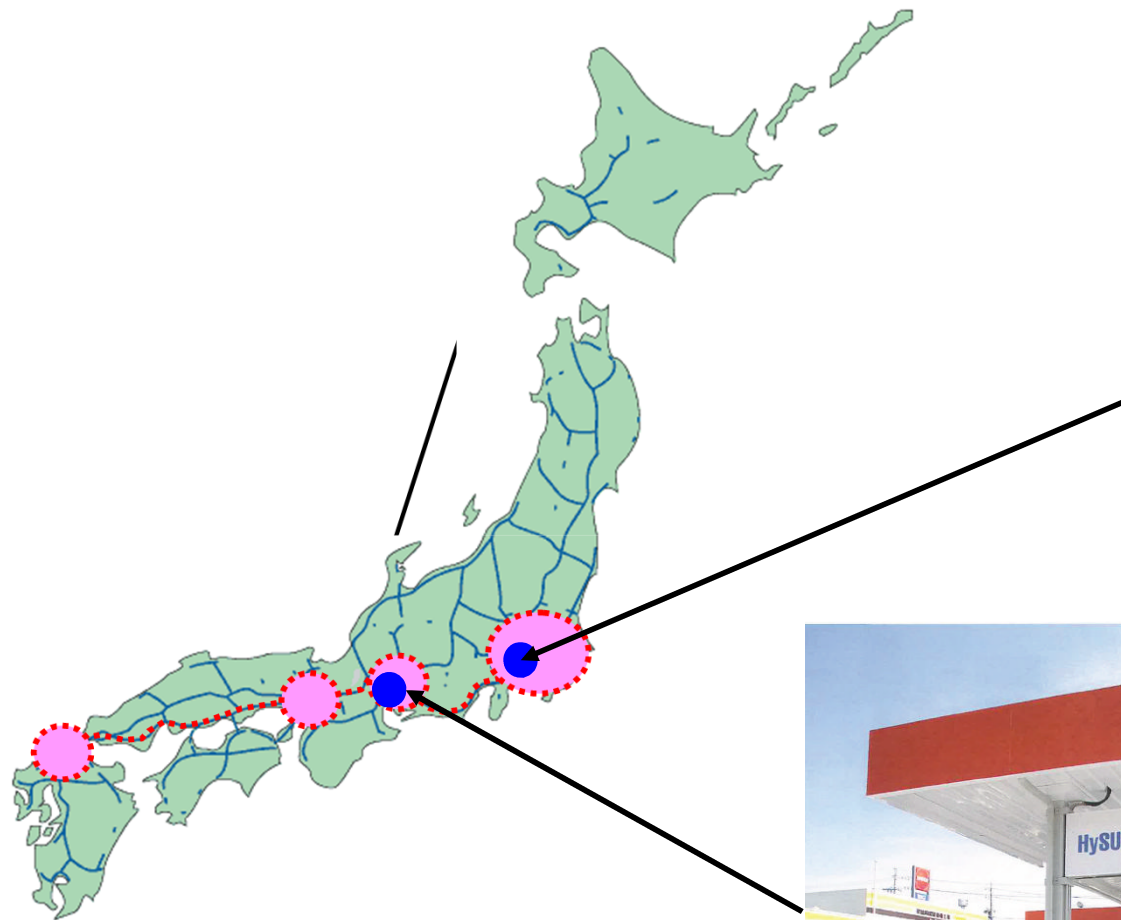


We are willing to strengthen these capabilities for H2 business

# Comprehensive demonstration of the commercial-type H2 station

First integral-type SS of gasoline and hydrogen in Japan opens two places in March, 2013.

Ebina Chuo Hydrogen Station  
(Ebina city, Kanagawa)



Kaminokura Hydrogen Station  
(Nagoya city, Aichi)



# Commercial Specifications of Hydrogen Station

The specification is compatible with the world unified standard, which can realize safety full tank filling in 3 minutes, equal to ICE, for any countries' FCV.

	Kaminokura	Ebina Chuo
Location	Nagoya-City, Aichi	Ebina-City, Kanagawa
Building Standards Law	Quasi-residential	urbanization control area
Site area	3,125m <sup>2</sup>	3,300m <sup>2</sup>
Type	On-Site	Off-Site
Feed	LPG	Compressed Hydrogen
Capacity	100Nm <sup>3</sup> /h	300Nm <sup>3</sup> /h
<b>Protocol</b>	<b>SAE J2601</b>	<b>SAE J2601</b>
Pressure	70MPa	70MPa
Storage Vessel	82MPa CFRP(Type3)	82MPa CFRP(Type3)
Security Regulation for General High-Pressure Gas	Article 7-3	Article 7-3

# Appearance of Ebina Chuo H<sub>2</sub> Station, first integrated into Gas Station

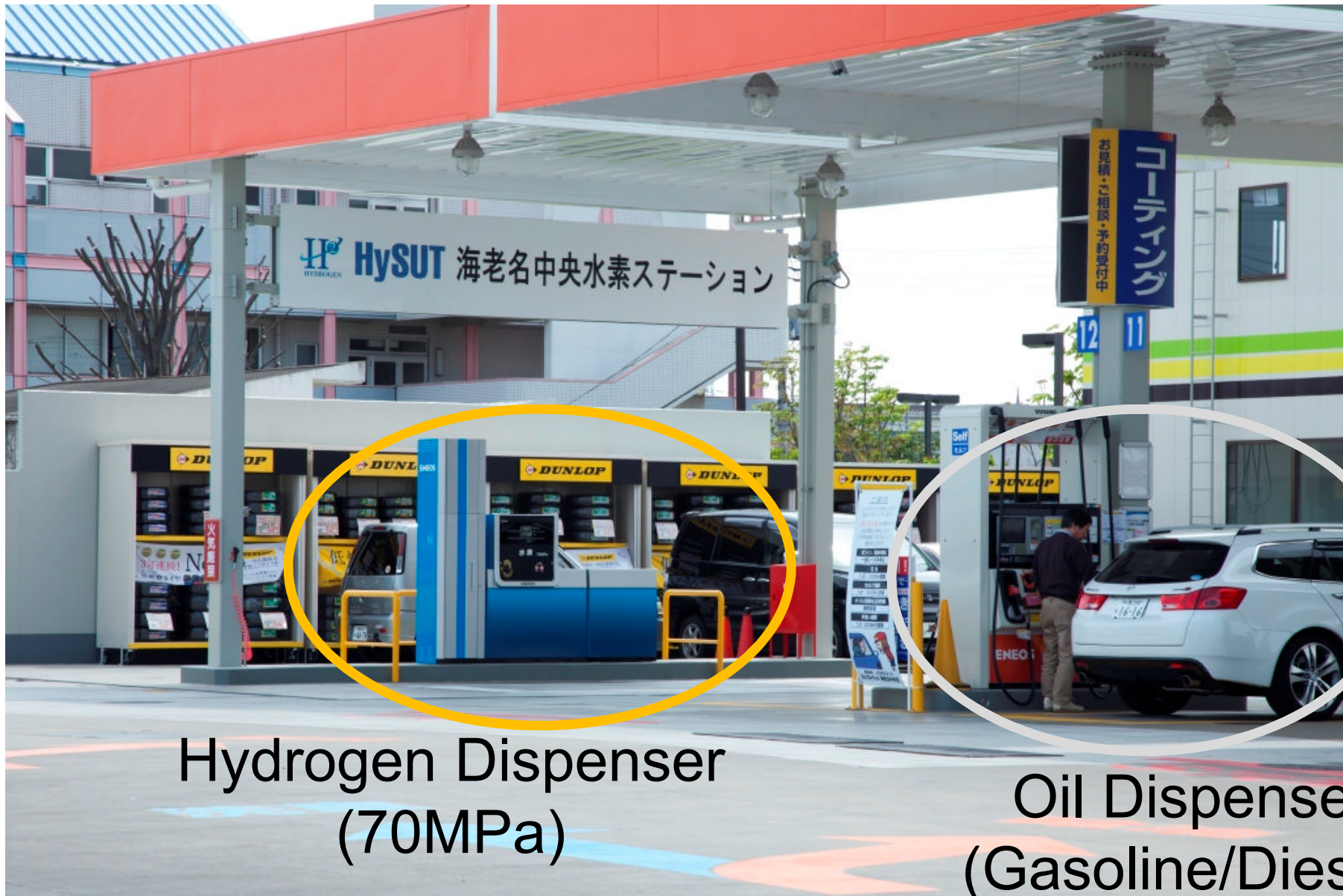
Hydrogen  
(70MPa)

Gasoline Diesel





# H<sub>2</sub> supply Lane



Hydrogen Dispenser  
(70MPa)

Oil Dispenser  
(Gasoline/Diesel)

# Hydrogen Supply Facilities and Layout of Ebina Chuo H2 Station

**Kawasaki Heavy Industries**



水素トレーラー  
Hydrogen trailer

**KOBELCO**



水素圧縮機  
Hydrogen Compressor

**Samtech**



蓄圧器  
Storage unit

**Maekawa Manufacturing Co.**



冷凍機  
Chiller



水素出荷実証設備  
Hydrogen shipment demonstration

**Hitachi Ltd.**



水素充填機  
Hydrogen dispenser

**Tatsuno Co.**

# H<sub>2</sub> Filling Operation by High Pressure Gas Production Chief Licensees



# 70MPa H<sub>2</sub> Filling Nozzle

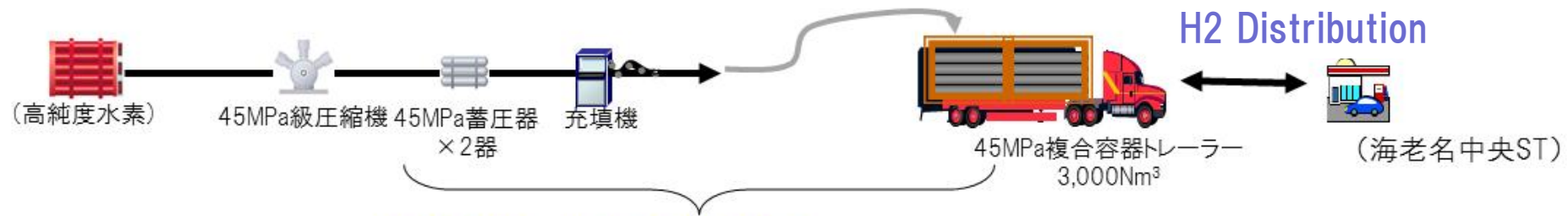


# Demonstration of the 45MPa Hydrogen distribution System

High-pressure filling facility can realize a short-time loading of large amount of H2 to Trailer.

The following technical demonstrations are on going as part of HySUT (NEDO) project

- ① To demonstrate transportation, storage and filling to a trailer technology
- ② To optimize the station mode of operation by trailer employment
- ③ To show high frequency operation of the hydrogen production equipment of a station



**High-Pressure H2 Filling Facility**

**45MPa H2 Tube Trailer**



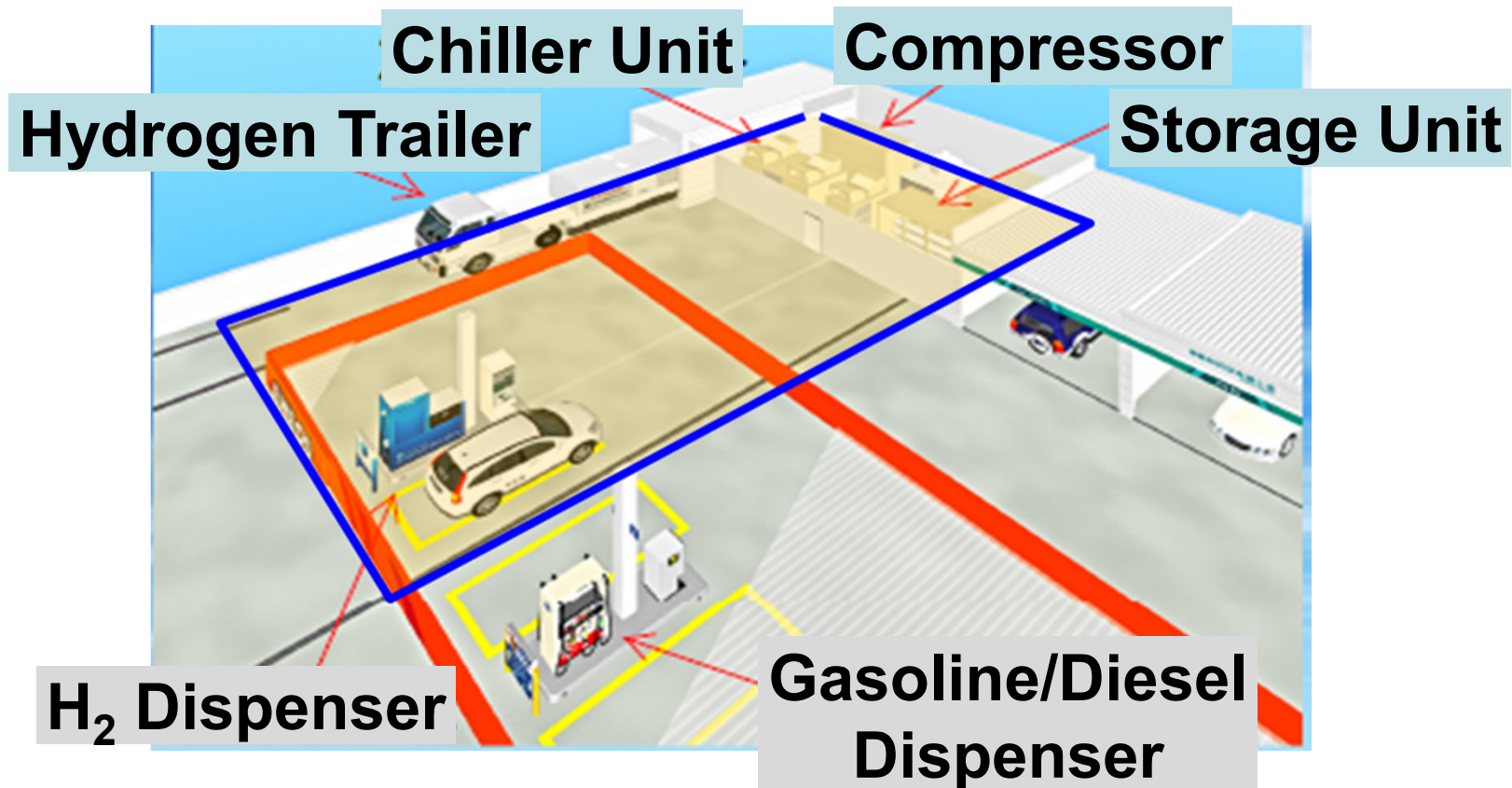
Developer	Kawasaki Heavy Industry
Load Capacity	260kg-H2
Load Pressure	45MPa

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# Issues in H2 Station construction

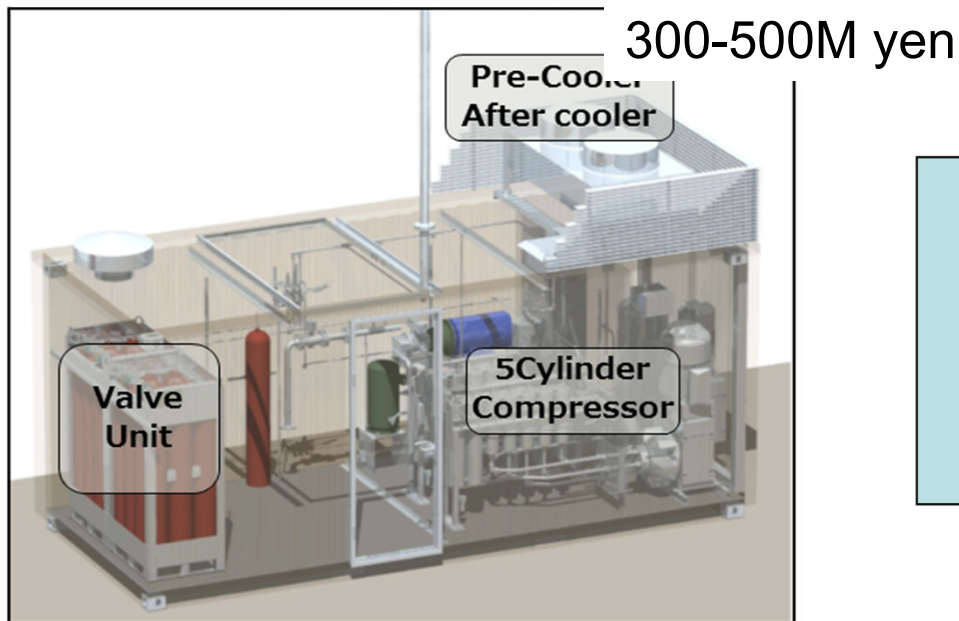
- Downsizing and construction cost savings required
- Technological developments and optimization of regulation can contribute the cost down
- Downsizing can provide the easily finding of suitable sites in the urban areas which can contribute the improvement of business profitability.



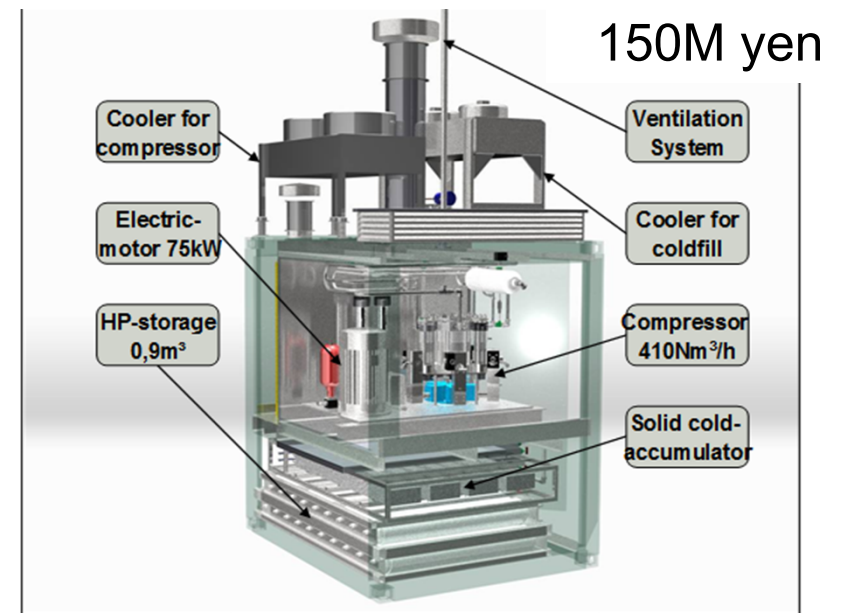
# Issues in Regulatory Optimization

- Japanese safety standards are very strict in comparison with overseas.
- Examples of deregulation necessary future
  - Steel that can be used is limited to that of a special composition, not commercially available.
  - Welding is prohibited
  - H<sub>2</sub> storage capacity is severely limited in urban zone
- In the products of the same manufacturer, the cost and volume are doubled overseas in Japan. To optimize the regulation to an appropriate level without sacrificing safety must be needed.

Japanese Specification : 20-30ft



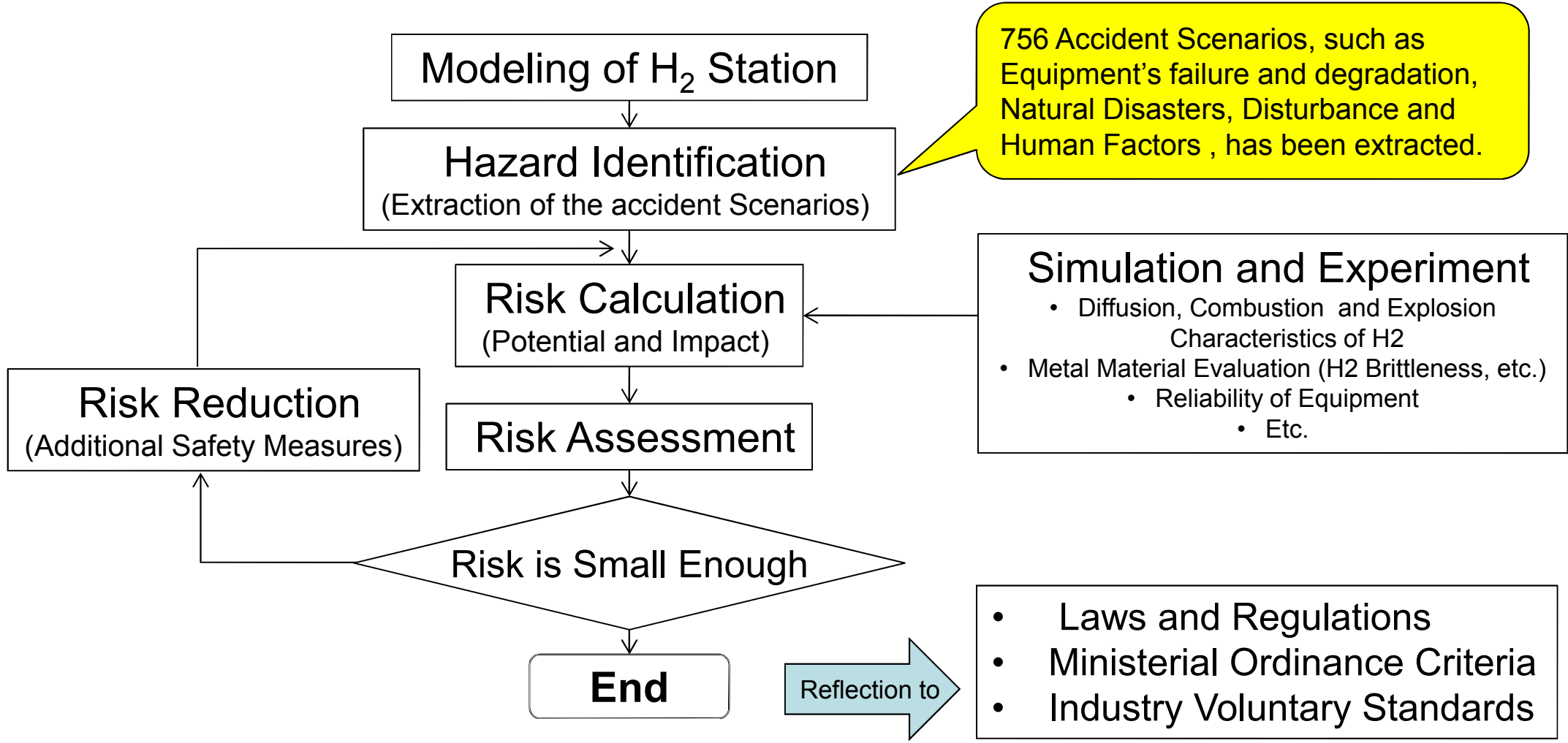
Overseas Specification : 10ft





# Safety Engineering Methodology for H2 Station

Safety Criteria, set out in the ministerial ordinance, prescribed on the basis of the risk scenario analysis methods, HAZOP(Hazard and Operability Analysis) and FEMA(Failure Mode and Effect Analysis).



756 Accident Scenarios, such as Equipment's failure and degradation, Natural Disasters, Disturbance and Human Factors, has been extracted.

**Simulation and Experiment**

- Diffusion, Combustion and Explosion Characteristics of H2
- Metal Material Evaluation (H2 Brittleness, etc.)
  - Reliability of Equipment
  - Etc.

**Reflection to**

- Laws and Regulations
- Ministerial Ordinance Criteria
- Industry Voluntary Standards

Source : NEDO H<sub>2</sub> Production Transportation Storage Technology Development Project (2010-2012)

# Issues for Public Acceptance

So-Called “NIMBY” Problem exists in the H2 station construction.  
To improve public acceptance, it is necessary to spread awareness about the social significance and sense of familiarity for FCV and Hydrogen station.

(A) To deepen consumers' understanding of convenience of FCV such as environment nature, is important to popularize FCV.

(B) To deepen understanding of the local residents for the safety of hydrogen station, is important to popularize hydrogen station.

How do we work for citizen to make them feel FCVs & hydrogen stations familiar?

- To prove safety through construction and operation of hydrogen stations under actual operating condition
- To promote the activity to educate a local resident (Right knowledge and information are disseminated.)

For transparently disclosure of objective safety data, we have continued to steady activity, such as parent-child learning experience at our hydrogen stations.

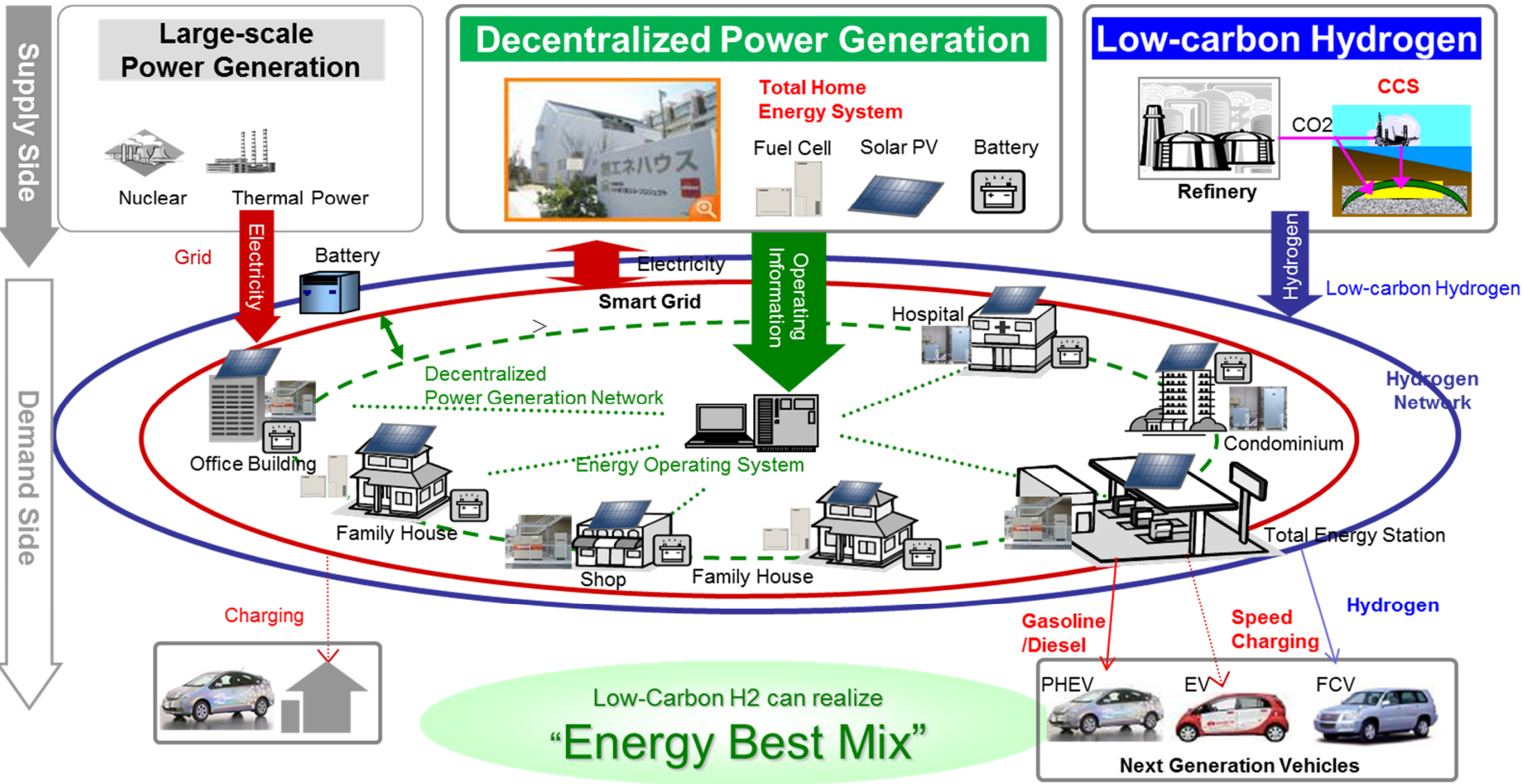
**Ebina H2 Station**



**Kaminokura H2 Station**



# Energy Network for Low Carbon Society



Thank you for your attention.