

26th World Gas Conference

1 – 5 June 2015, Paris, France



Development of New Model Residential Fuel Cell Systems

Hisataka YAKABE
Residential Fuel Cell Business Development Dept.
Tokyo Gas Co., Ltd.



Outline

1. Introduction

- What is “ENE-FARM” ?

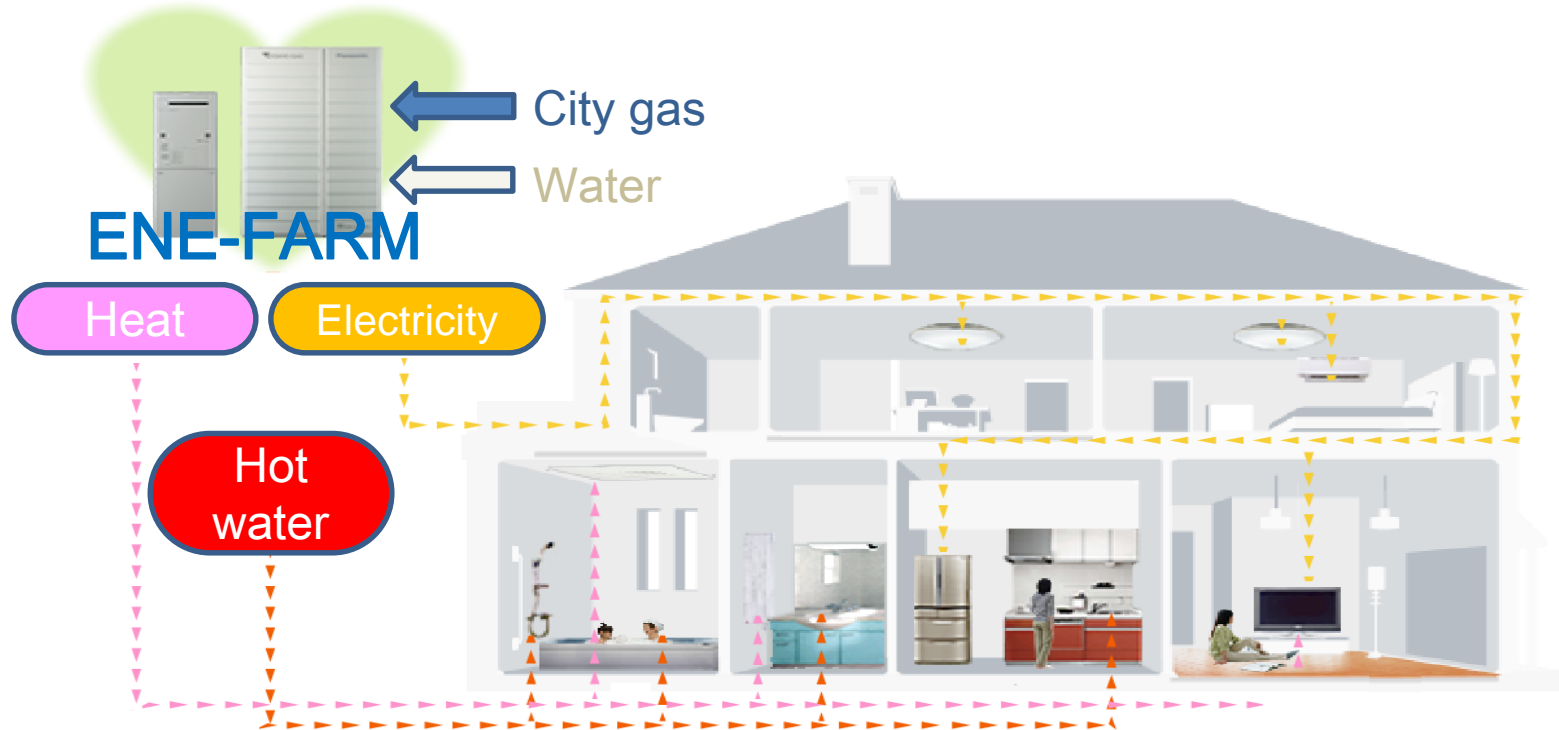
2. Recent development topics

- New apartment house model
 - Operating function during power outage

3 . Future vision

What is “ENE-FARM”?

“ENE-FARM” is a residential micro-CHP system using FC and provides electric power, hot water and heat to each home



Benefits of ENE-FARM

“ENE-FARM” can provide benefits for customers, society and related market.

For Customers

- Enables power generation at home (covers 50% of electricity consumption)
- Lowers the total energy bill (reduces by € 480 /yr)

For Society

- Lowers carbon emission (reduces by 1.3 t-CO₂/yr)

For Industry

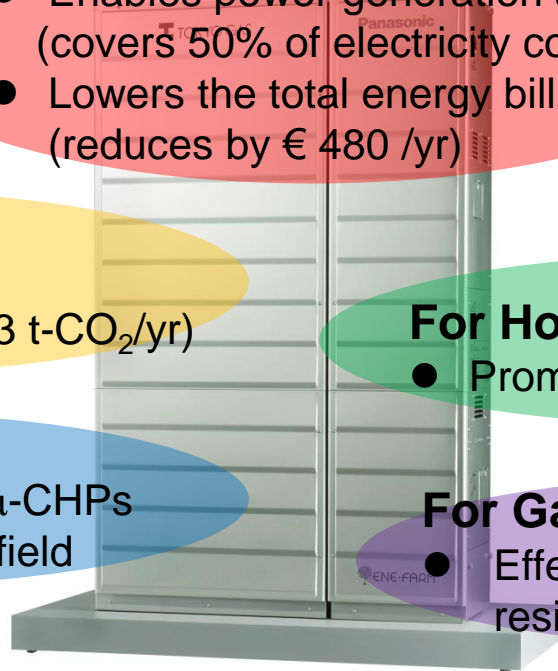
- A pioneer for residential μ -CHPs
- Creates a new industrial field

For Home builders

- Promotes Eco-Friendly House

For Gas companies

- Effective tool to expand the residential gas sales



Types of residential FCs in Japanese market

①



②



③



	① Panasonic (PEMFC)	② Toshiba (PEMFC)	③ Aisin (SOFC)
Fuel	natural gas: NG (city gas)	LPG/ NG (city gas)	NG (city gas)
Rated output power	700 W	700 W	700 W
Power generation Efficiency(LHV)	39 %	38 % (39 %)	46.5 %
Heat recovery Efficiency (LHV)	56 %	56 %	43.5 %
Size of FC unit	400W × 1750H × 400D	780W × 1000H × 300D	600W × 935H × 335D
Capacity of Hot water tank	140 L	200 L	90 L

Evolution of “ENE-FARM”

1st model
(2009~10)



2nd model
(2011~12)



3rd model
(2013~14)

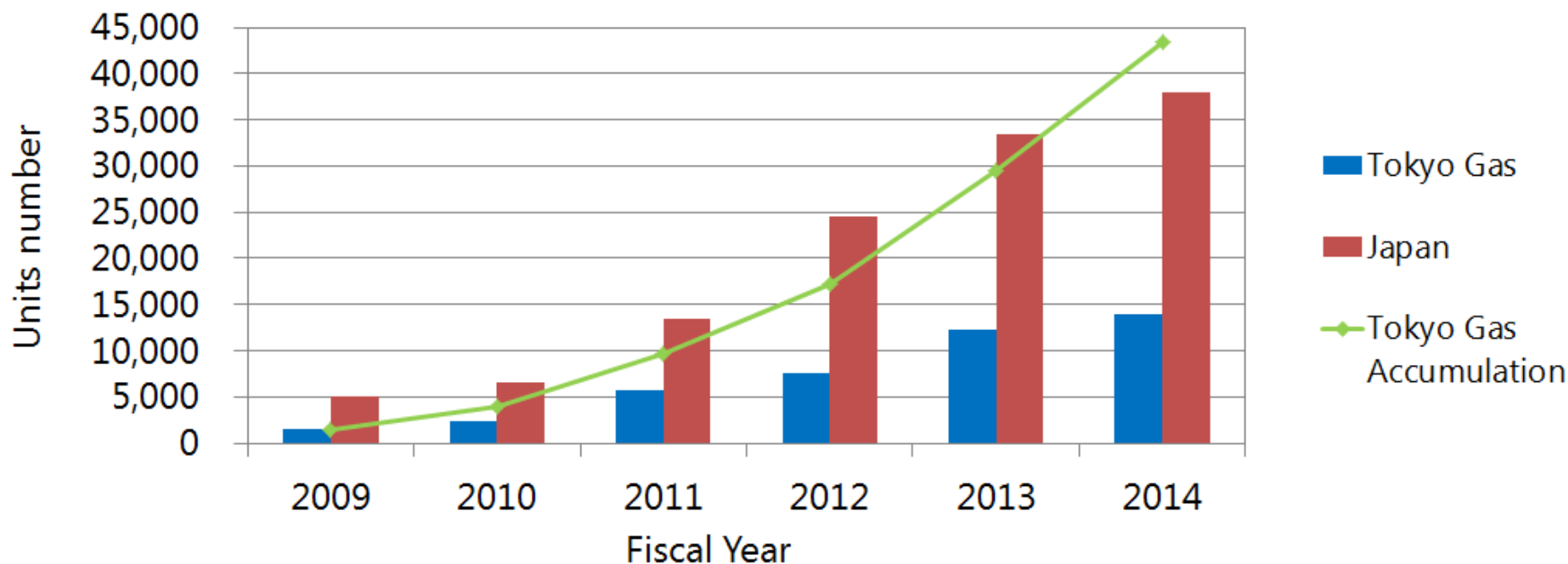


4th model
(2015~)
Newest



Total efficiency (LHV)	89%	90%	95%	95%
Installation space (depth)	3.9 m ² (1100 mm)	2.0 m ² (900 mm)	2.0 m ² (750 mm)	1.7 m ² (750 mm)
Life time (Start and Stop)	40000 h 4000 times	50000 h 4000 times	60000 h 4000 times	70000 h 4000 times
Price (tax excluded)	€ 24,500	€ 19,500	€ 14,000	€ 11,800

The yearly increase of the sales of ENE-FARM



- ◆ From 2009 to 2014, ENE-FARM was sold over 40,000 by Tokyo Gas and this number accounts for over one third of the units in Japan.
- ◆ Tokyo Gas aims to increase the number of stocks to 300,000 until 2020.

To increase the sales of ENE-FARM more

Cost Reduction

- Technology development
 - > Reduction of device cost
 - > Reduction of number of components
- Mass-production

Expansion of the market potential

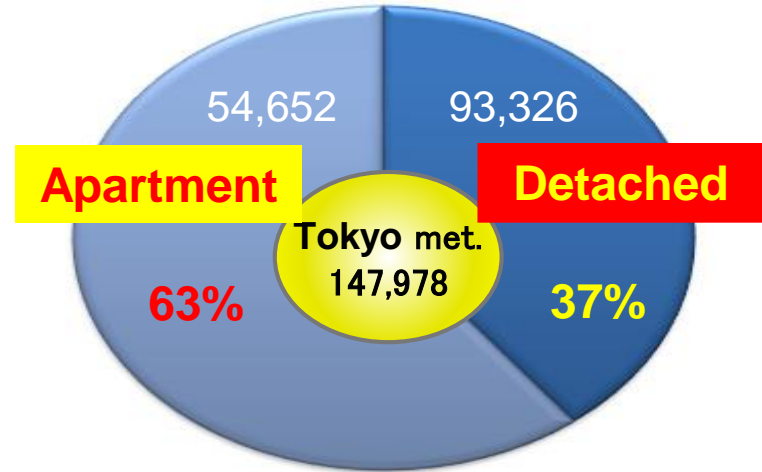
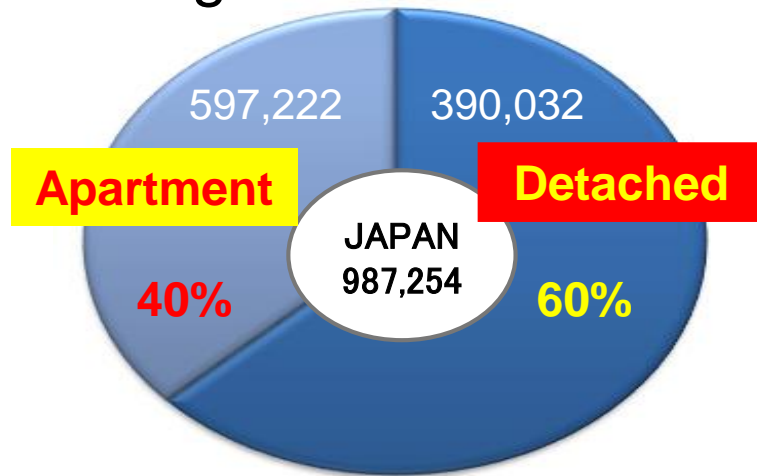
- Installation to apartment buildings

Product Appeal

- Attractive user interface
- Meets users' preference
 - > Power supply function during power outage

High percentage of apartment residences in Tokyo

Percentage of new houses in 2013

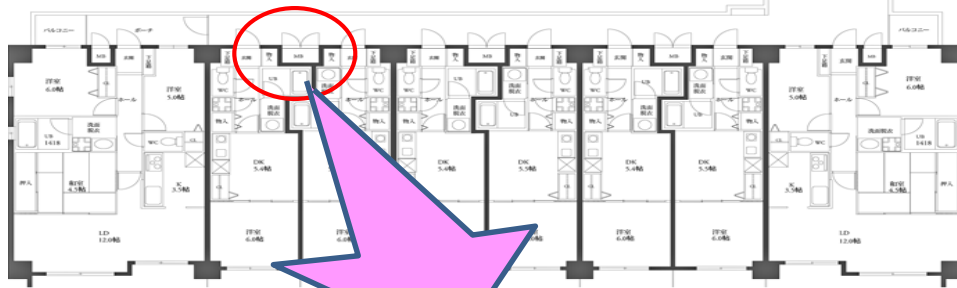


* Calculated using residence statistic report by the Ministry of Land, Infrastructure, Transport and Tourism, Japan

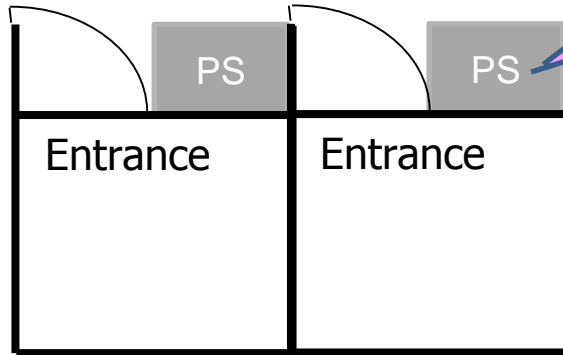
Apartment model is important for market expansion in Tokyo

Image of an apartment building in JAPAN

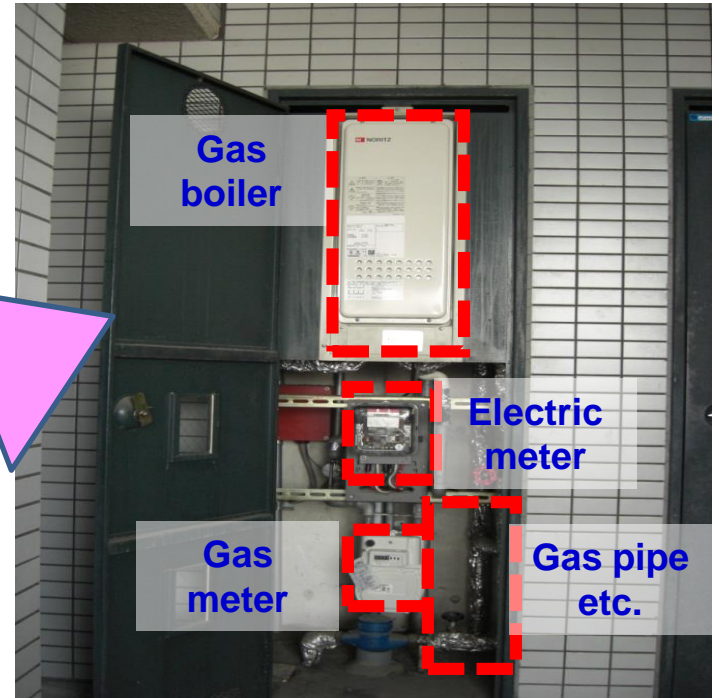
Example of a floor in an apartment building



Corridor



Example of a pipe shaft

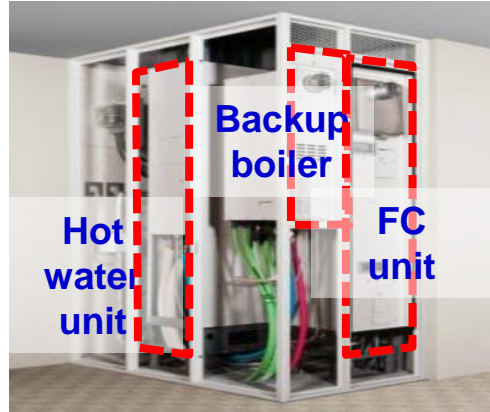


Overview of the apartment model

- Based on the detached model (3rd generation)
- Modified to meet the requirements for the apartment installation
 - ✓ Air tightness (necessary to install in a pipe shaft)
 - ✓ Appropriate structures of intake and exhaust
 - ✓ Earthquake resistance (apartment:1.0G, detached:0.4G)
 - ✓ Wind resistance (apartment:30m/s, detached:15m/s)



Apartment model



Detached model

Market entry of the apartment model

- Apartment model was released in April 2014
- Around 1000 systems have been adapted



BRANZ CITY SHINAGAWA-KATSUSHIMA

Completion : July 2015
Households :356



THE PREMIER SKY SHINAGAWA-NAKANOBU

Completion : August 2015
Households :100

Demand for power supply during power outage

Normally

- ENE-FARM is designed to stop its operation in case of power failure because it needs to detect the right frequency and voltage of the commercial power grids while in operation.

However

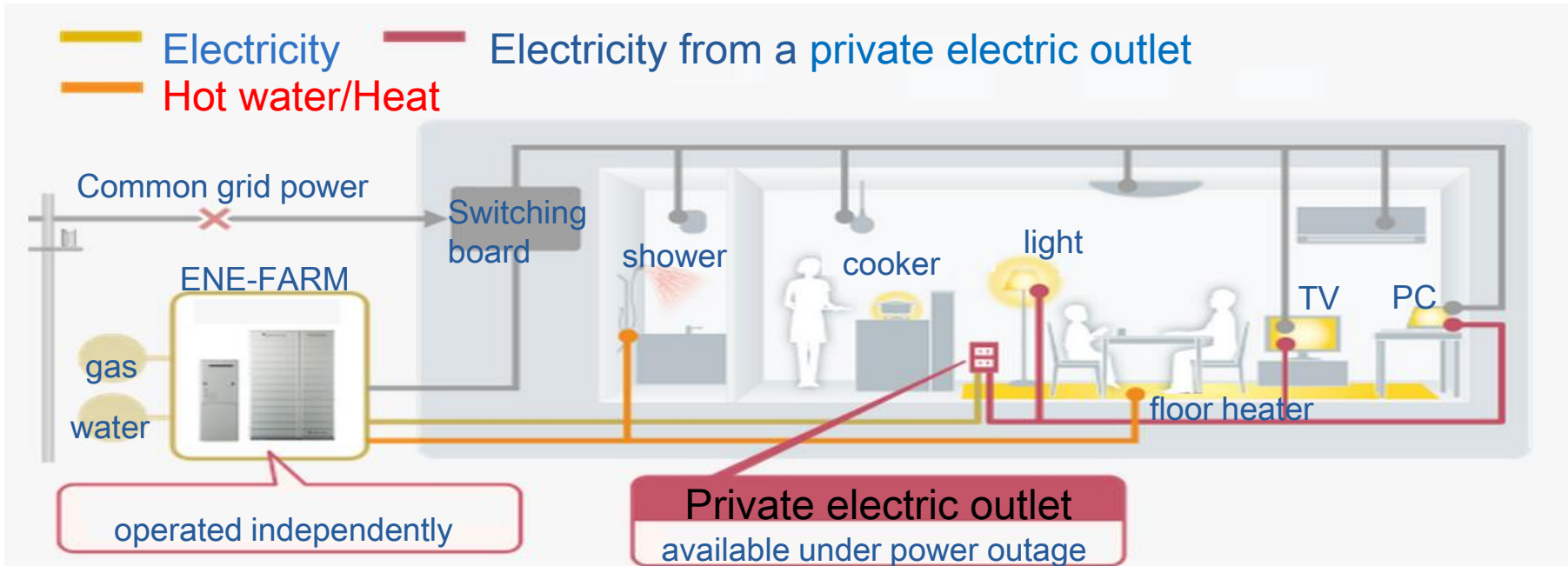
- After the Great East Japan Earthquake, user demand for operating ENE-FARM during power outage becomes a necessity.

Thus

- The latest model (4th model) is improved to provide power even during a blackout.

Continuing power supply during power outage

- In April 2015, a new detached model that ensures continuous power supply during power outage was released.
- A maximum power of 500 W is available for 4 days even during a blackout

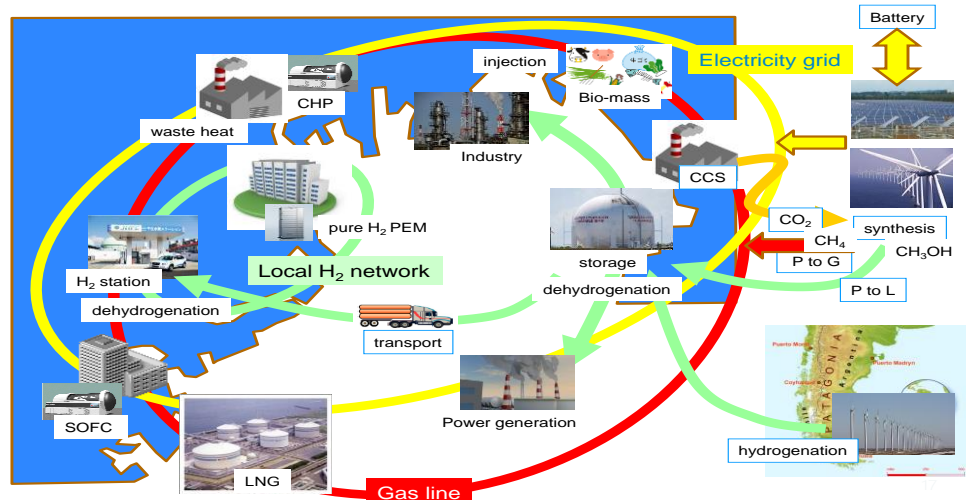


Heading for hydrogen society

- Highly efficient FC such as SOFC
- Reverse power flow
- Smart energy network
- Local hydrogen network
- Pure hydrogen FC



Hydrogen refueling station



Energy network with renewable energy

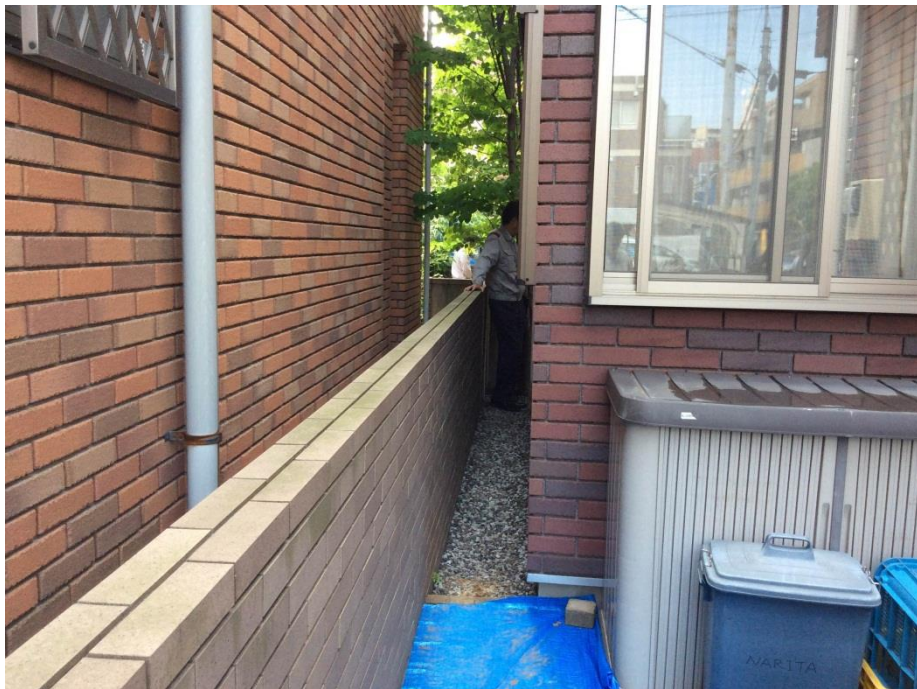
In Tokyo Olympics, we will demonstrate the new technologies toward hydrogen society.



Thank you for your kind attention



Image of an installation site



Earthquake resistance

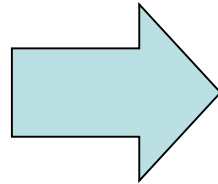
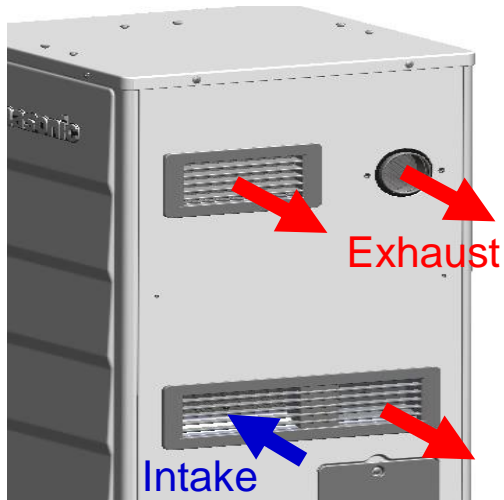
- To strengthen the anchor legs against seismic load, larger anchor bolts are used and it meets building installation regulation in Japan
- Confirmation of no toppling at 1.0G



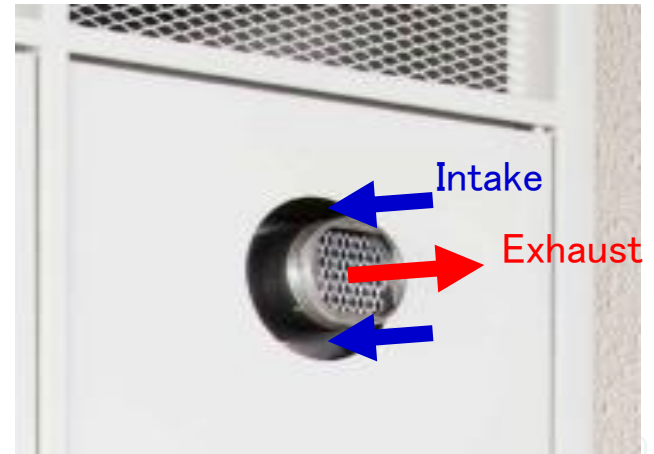
Wind resistance

- Confirmation of stable operation under 30 m/s wind (necessary for buildings over 100 m in height)
 - (a) Improving composition of intake and exhaust
 - (b) Mitigating the effects of wind pressure on the internal components

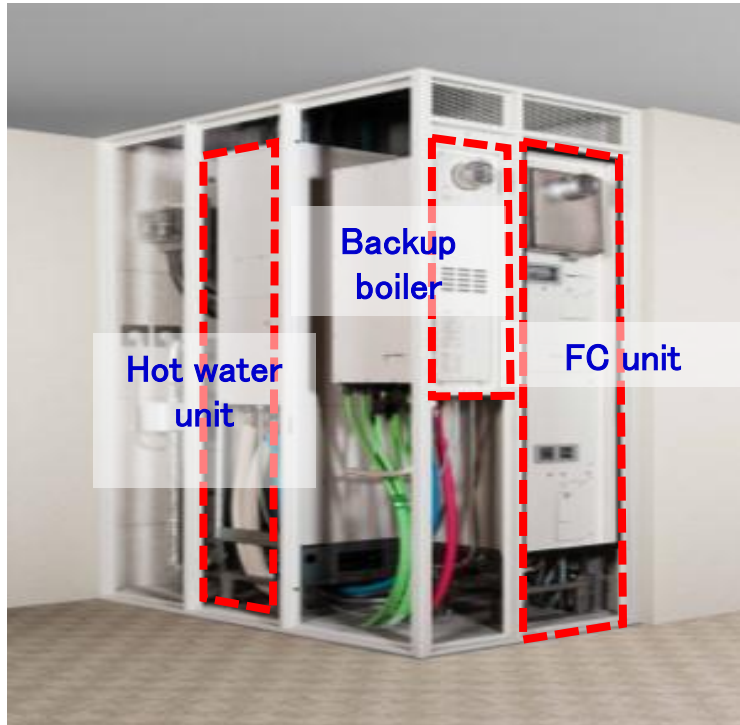
【Detached house model】



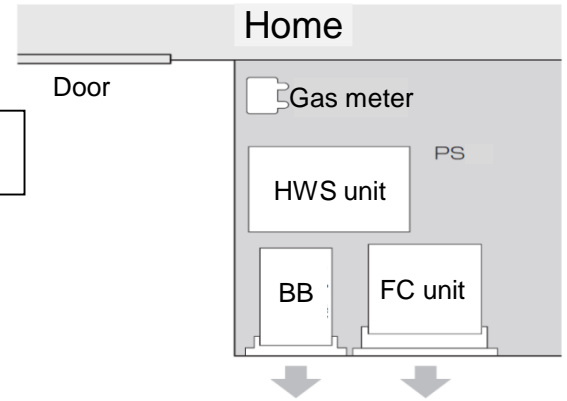
【apartment buildings model】



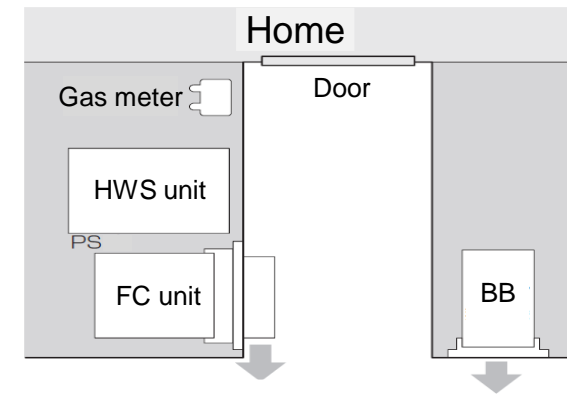
Examples of the installation in a pipe shaft



System installed in one space



System installed in separated space



Subsidies of Japanese government

2014:JPY 380,000

2013:JPY 450,000

2012:JPY 700,000

2011:JPY 1,050,000

2010:JPY 1,300,000

2009:JPY 1,400,000

History of “Enefarm” Development

1999

Japanese Government started PEM development and diffusion project named “Millennium Project”

2002

Prime Minister Koizumi declared commercialization of residential fuel cell in 3 years

2005

Large Scale Demo project started

FY 2005 - 2008 (3,300 systems installed at actual homes)

2007

Stationary fuel cell chosen as part of “Cool Earth 50 (emissions reduction target)” by Prime Minister Abe

2008

Fuel cell becomes part of “Fukuda Vision” by Prime Minister Fukuda

2009

Commercial sale of residential fuel cells begins in Japan

2012

Japanese Government set the target for the diffusion of residential fuel cells (accumulated installation of 1.4 million units by 2020 and 5.3 million units by 2030).

2014

The above target reconfirmed in Hydrogen and Fuel Cell Road Map

