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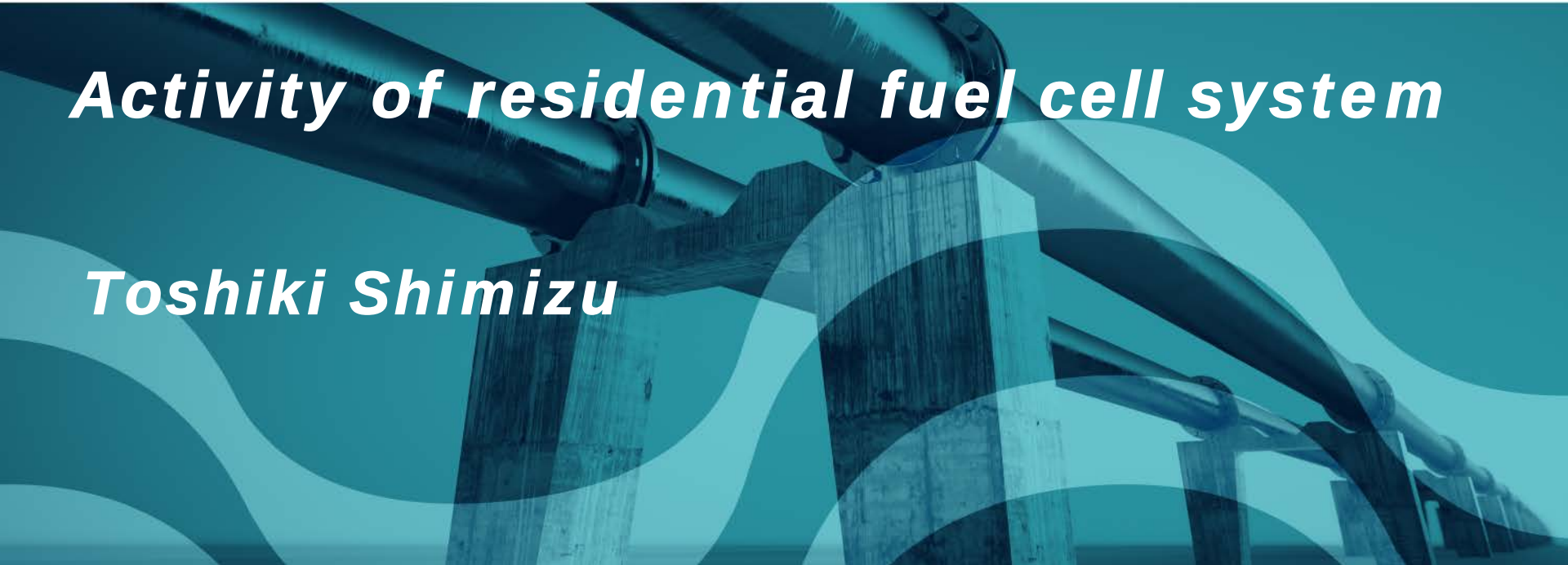

Activity of residential fuel cell system

Toshiki Shimizu

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2. Latest Development

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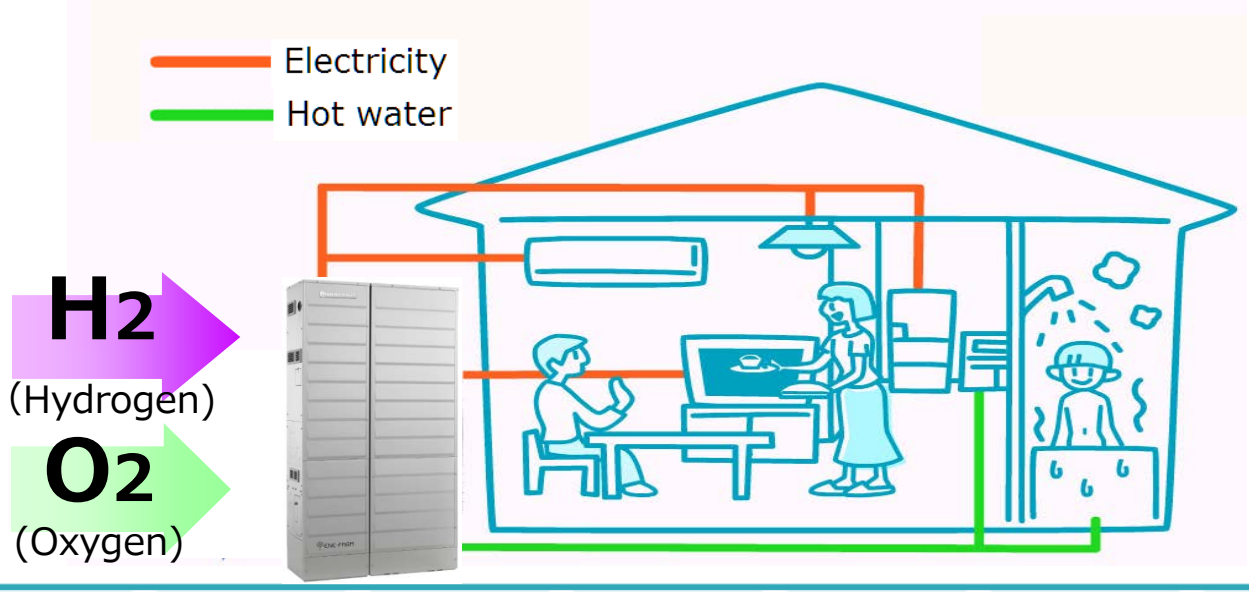
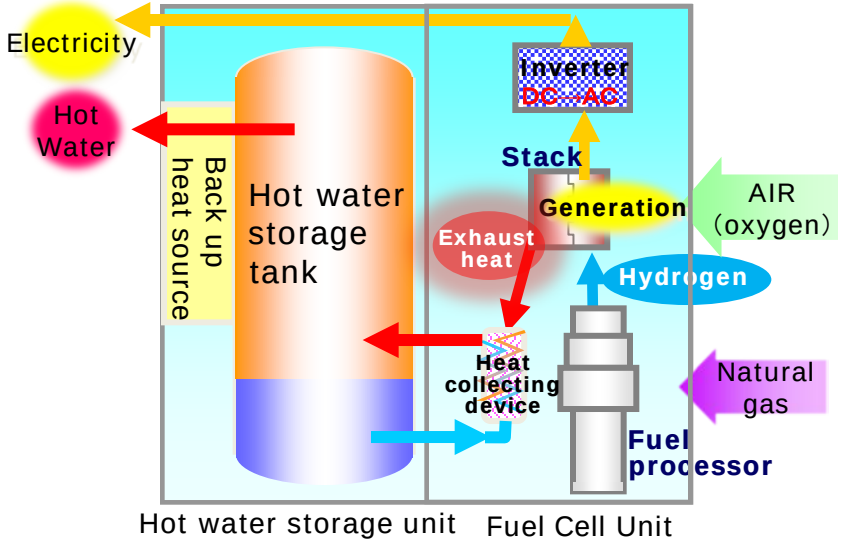
Residential Fuel cell

Fuel cell system generates electricity and hot water by chemical reaction with hydrogen and oxygen



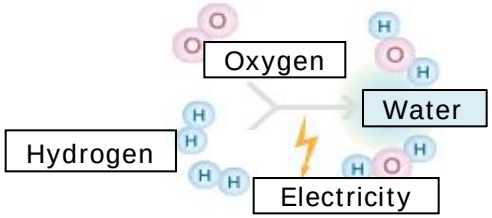
Mechanism of Fuel cell

Hydrogen is transformed from natural gas in the fuel processor
Electricity is generated by hydrogen and oxygen in the stack
Heat energy by chemical reaction is transformed to hot water



■Power generation by chemical reaction

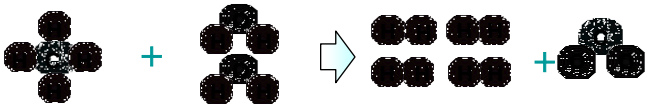
$2H_2 + O_2 \rightarrow 2H_2O + 4e^-$



■Forming of hydrogen at Fuel processor

(methane)

$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$



Residential Fuel cell

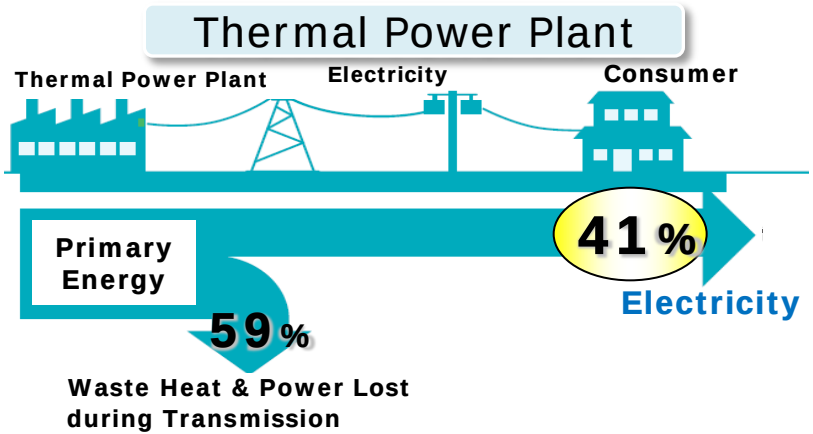
Installtion example in Japan and Europe

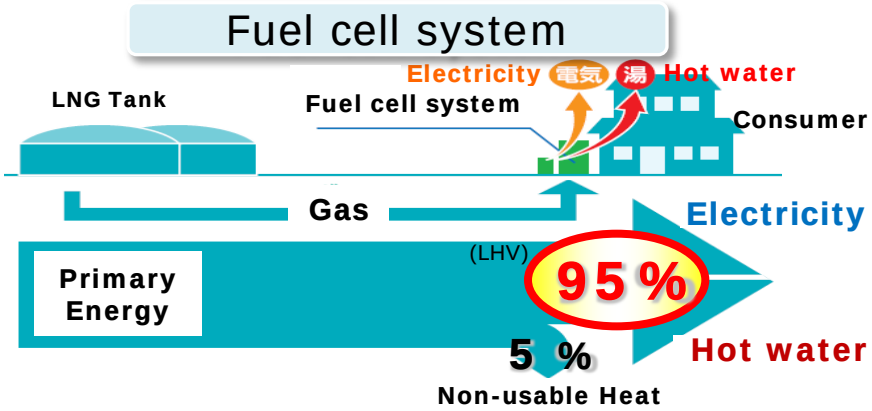
A. Installation at house

B. Fuel Cell+PV,
Combined Generation

C. Installation at basement
(European model)

Advantage of Fuel cell



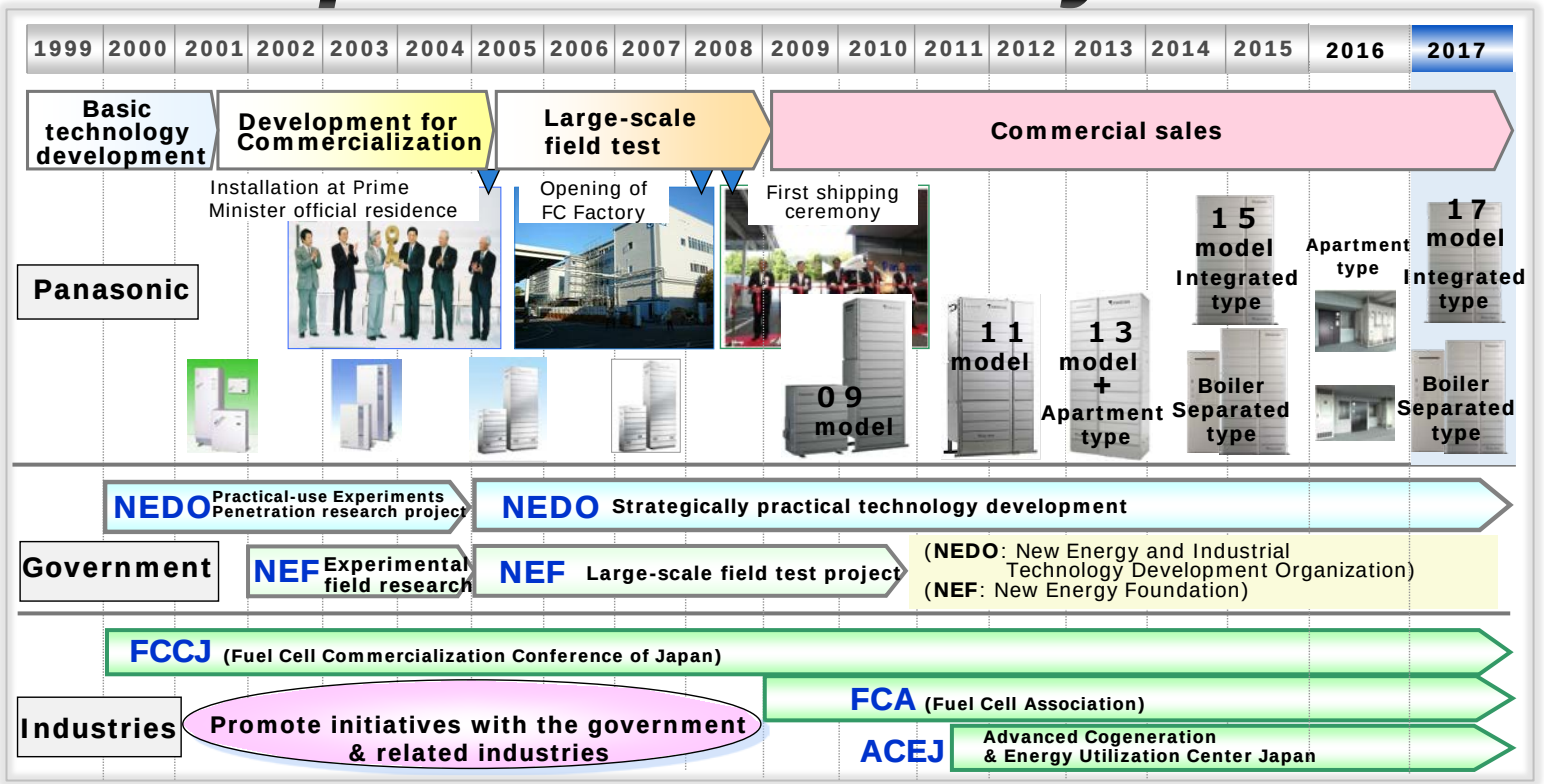


Reduction of CO2 emissions
: 1.3t / year

Energy cost saving
: 600～900 US$ / year

*1US$=110JPY,Data by Panasonic

Development History



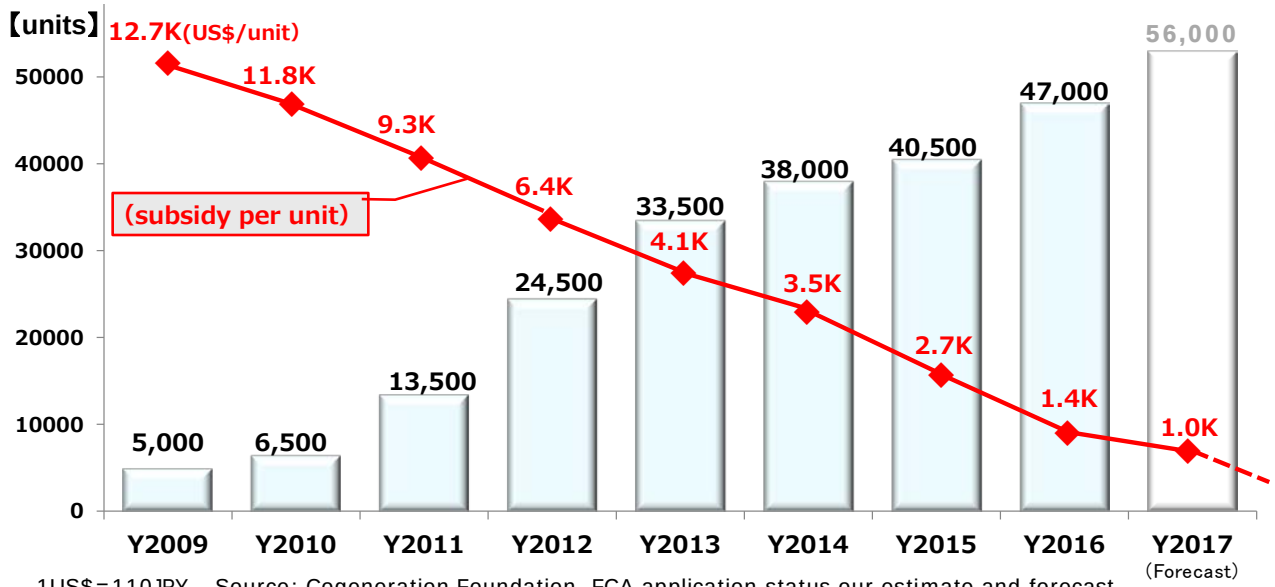
Progress of Panasonic Fuel cell

Since 2009, Panasonic has developed new model every 2 years to get more acceptance from the market.

	1st Gen.	2nd Gen.	3rd Gen.	4th Gen.	5th Gen.
Year	2009	2011	2013	2015	2017
			 World Highest efficiency 95% (LHV)	 Slim & Compact design	 ・Long life ・Network connection ・Remote Maintenance ・LPG model
Power	1000 – 300W	750 – 250W	750 – 200W	700 – 200W	700 – 200W
Durability	40,000h	50,000h	60,000h	70,000h	90,000h
Footprint	3.9㎡	2.0㎡	2.0㎡	1.7㎡	1.7㎡
Weight (FU unit)	125kg	100kg	90kg	77kg	65kg

Market expansion in Japan

Market is growing rapidly since 2009, Panasonic's accumulated quantity achieved 100,000 units in March 2017



1US$=110JPY Source: Cogeneration Foundation, FCA application status our estimate and forecast

Panasonic
100,000 units
(March 2017)

Industry
200,000 units
(May 2017)

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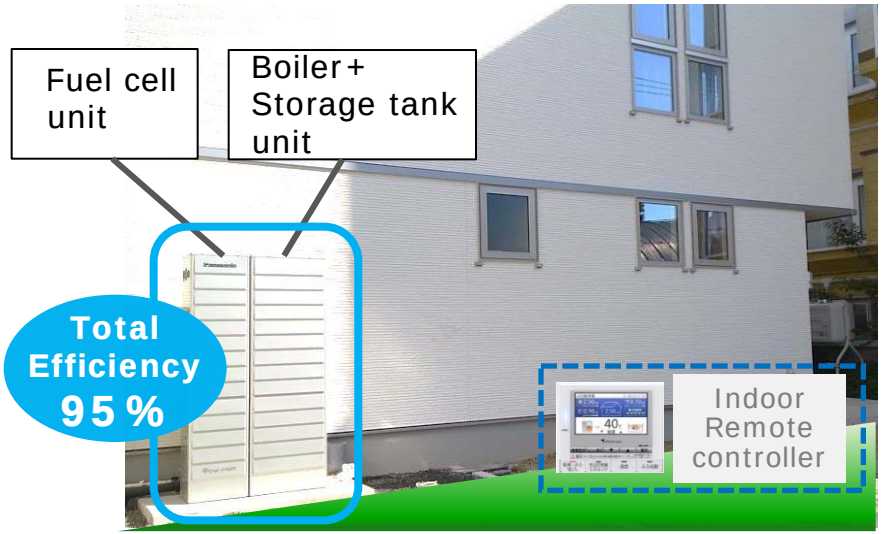
Latest model

Model for detached house : launched in April 2017

Installed example for detached house



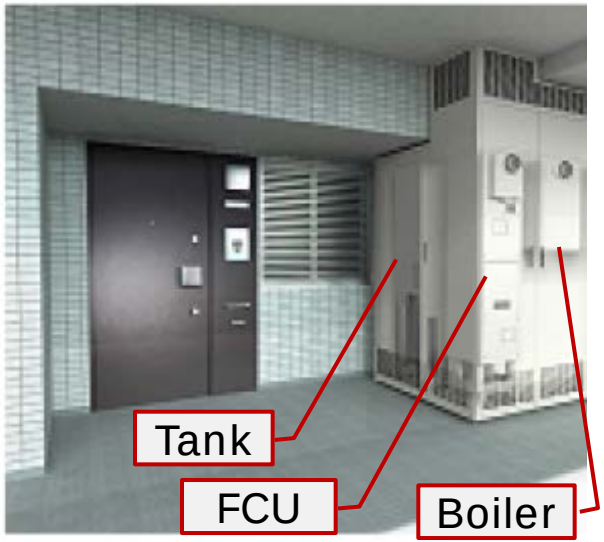
Key Features

- 90,000 hrs. lifetime
- Remote maintenance by network connection
- Continuous power supply up to 8 days at the blackout
- Introduction to LPG market

Latest model

Model for apartment house: launched in July 2016

Installed example for apartment house



Features

Installation in pipe shaft space

- Improvement of airtightness
- Integration of several exhaust vent

Specialization for apartment

- Resistance to earthquake
- Resistance to strong wind

Wide variation of installation

- Exhaust variations
- Compact size boiler
- Installation into separated pipe shaft

Network connection

Possibility to create for new business solution by network connection

Current ➡ **Future**

Individual operation

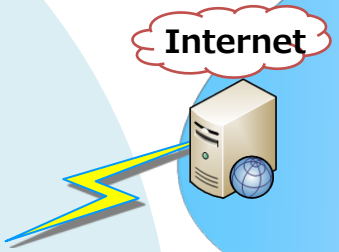
Connected information

Electricity

Water

gas

Internet



HEMS

Visualization of energy

Plural connection
Connection to the other appliances

VPP (Virtual power plant)
DR (Demand response)

Utilization of Big Data

Expansion of New business solution

Remote Maintenance

Software down load
Remote analysis

Factory IoT

Analysis of failure
Product and process Innovation

Connection to subcontractor

HEMS: Home Energy Management System

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European Environment

There are variety of gas composition in Europe
Heating system is different from Japan

■Gas composition

Japan ： Liquefied Natural Gas (LNG)

- Removed the impurity substances by liquefaction

Germany： Gas Pipe line Network

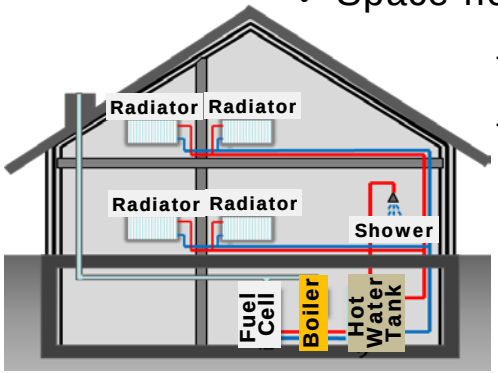
- It contains some impurity substances without liquefaction
- Mixing the gas at the each area
- Gas composition is changed by the political reason and the cost factor

Source :SYSTEM DEVELOPMENT MAP 2011 Gas Infrastructure Europe Web site

■Heating system

Japan ： Outside installation
： Domestic hot water demand

Germany ： Inside installation
： Space heating demand



-Requirement for the safety of the “CO” density
-Large heating demand (approx. 4 times of Japan)
-Adaptation of the local heating circuit
-Secure the performance against various flue pipe

European PEFC fuel cell

Joint Development with VIESSMANN who is major heating company in Europe. Fuel cell system is supplied through VIESSMANN

■Features

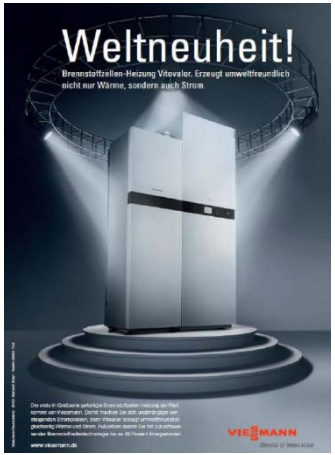
1. High efficiency
   Achieved 90% (LHV) for overall Efficiency
2. Simple construction
   Suitable for utility room such as basement
3. Easy to Use
   Monitoring of power generation and maintenance information by mobile device

Subsidy 9,300 Euro/unit

■Specification

【POWER GENERATION】750w（constant）
【OVERALL EFFIENCY】90%(LHV)（Electricity 37%/heat 53%）
【DURABILITY】 70,000 hours（10 years）, Start/Stop 4,000 times

Panasonic VIESMANN



Left：Fuel cell（PANASONIC）　Right：Hot water tank and Back up boiler（VIESSMANN）

Sumarry *for further expantion*

- Further Cost reduction
  Payback time 10 years – 7 years – 5 years
- Extension of Product life time
  Life time 10 years – 12 years – 15 years
- Improve Robustness of Key devices (Cell stack, Fuel processor)
  For global expansion
- Improve Connectivity to network
  For quality improvement and new business chance

Panasonic will contribute comfortable life

for the customer and the global environment

by the spread and expansion of Fuel Cell

A Better Life,
A Better World