01_w841×1189

THE JAPAN GAS ASSOCIATION

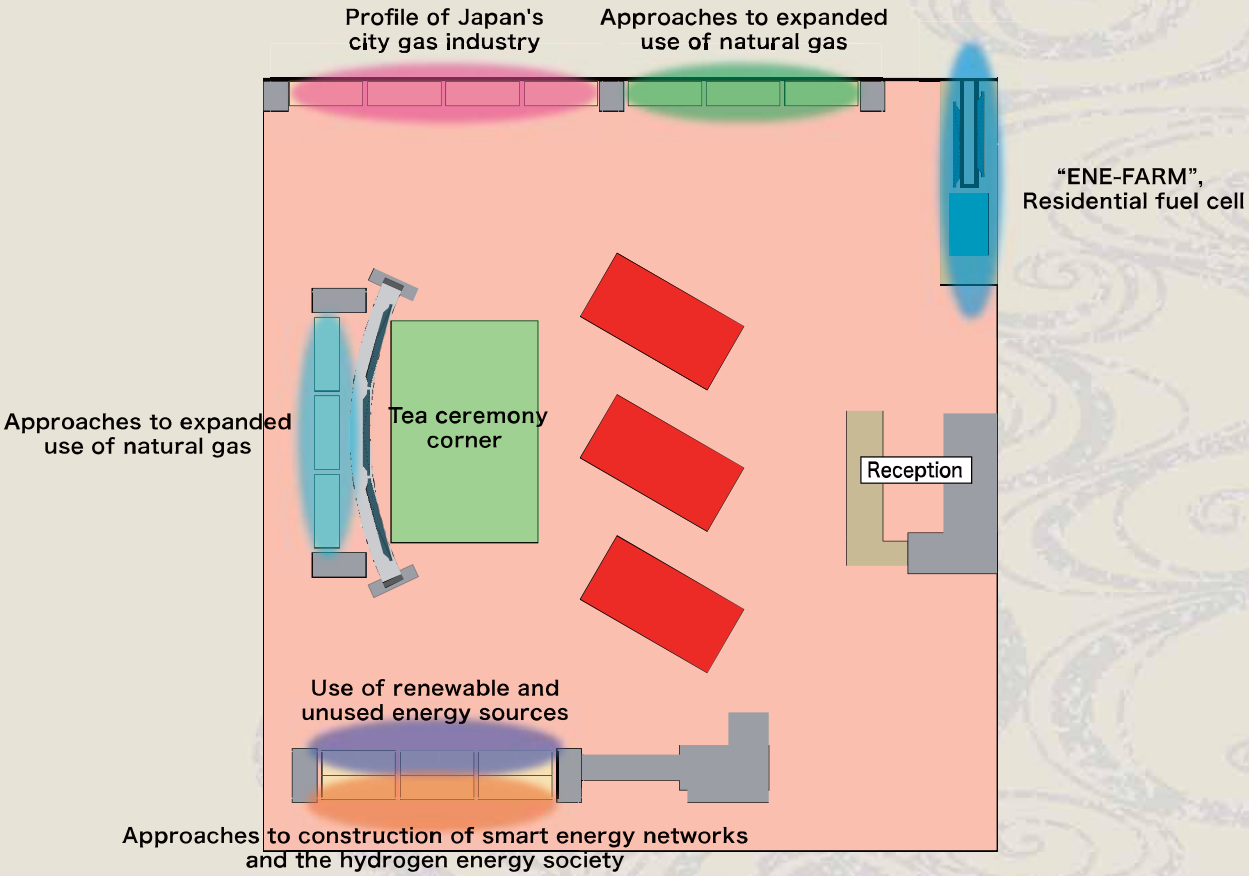
# Welcome to the Japan Gas Association Booth!

## Profile of the Japan Gas Association

The Japan Gas Association (JGA) has a regular membership of 209 city gas utilities and about 270 associate members consisting of firms whose activities are deeply tied to the city gas business. Besides providing for the sound development of the city gas industry, its mission is to contribute to the improvement of Japan's economic activities and lives of its citizens through assurance of energy supply stability and security, and response to environmental challenges.

As an organization of city gas utilities, the JGA is taking active approaches to a variety of issues, including expanded use of natural gas, the spread of appliances and systems for highly-efficient gas use, the diffusion of gas-fueled air conditioning systems and natural gas vehicles, more advanced city gas utilization technology, higher levels of gas safety, publicity about the city gas industry, and international cooperation.

## Map of the JGA booth



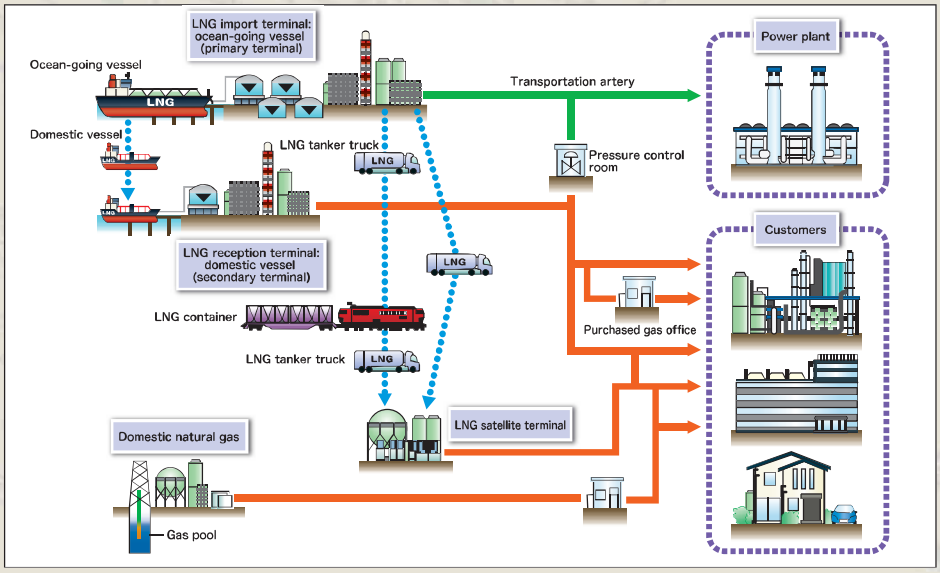
02_w841×1189

THE JAPAN GAS ASSOCIATION

# City Gas Business in Japan

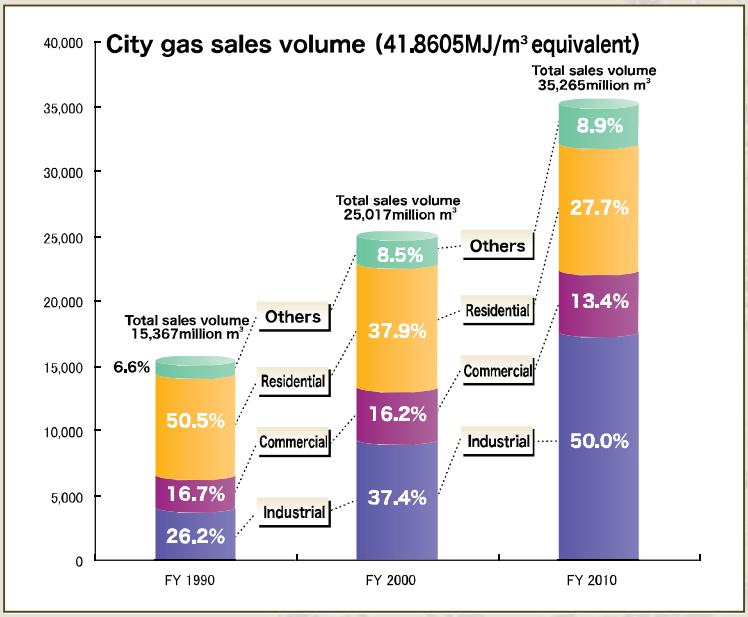
## Flow of city gas business in Japan

**In Japan, the same enterprise is engaged in the all phases of the city gas business, from production to supply and sales.**




## City gas sales in Japan

**The volume of city gas sales in Japan has been steadily rising. Growth has been strongest in the industrial sector, which has good prospects for continued increase.**



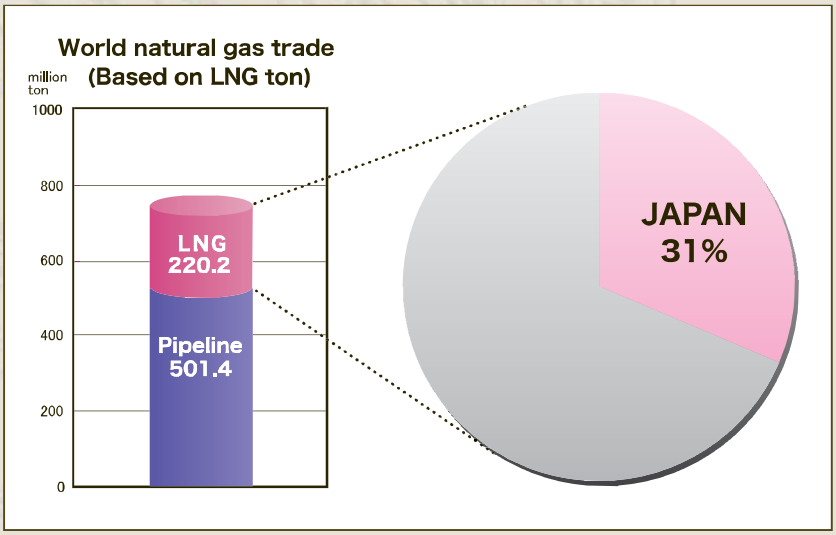

03_w841×1189

THE JAPAN GAS ASSOCIATION

# Japan's Import of LNG

## Japan's position in world LNG trade

Japan is the world's largest importer of LNG. It accounts for about one-third of the world LNG trade.




Source: BP Statistical Review of World Energy 2011

## Japan's LNG import projects (long-term contracts)

As of June 2011, Japan was importing about 66 million tons of LNG per year from eight countries around the world in accordance with long-term contracts alone. Furthermore, Japan has diversified its LNG sources through spot market.


Source: BP Statistical Review of World Energy 2011, The Japan Gas Association

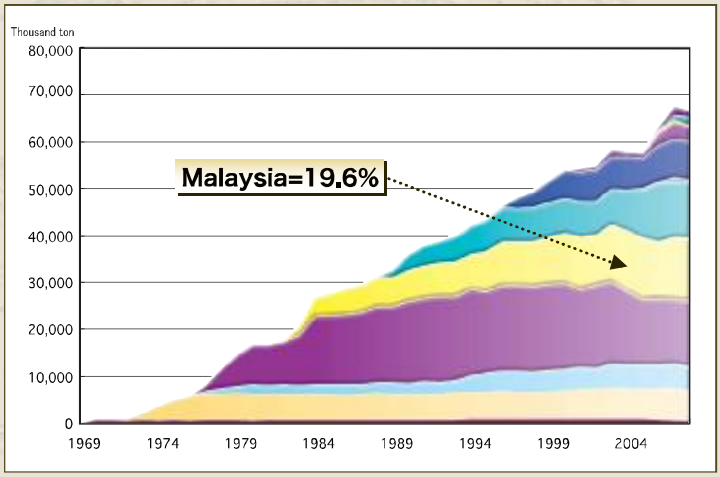
04_w841×1189

THE JAPAN GAS ASSOCIATION

# Japan's Gas Industry and Malaysia

## LNG trade

- Ever since it introduced LNG in 1969, Japan has been promoting a diversification of its import sources. It has been importing LNG from Malaysia since 1982.
- Malaysian LNG accounts for 19.6 percent of Japan's total LNG import (including LNG for power generation).




Source: Japan Exports & Imports, Ministry of Finance

## Approaches to diffusion of gas use in Malaysia - Gas Malaysia Berhad

Tokyo Gas Co., Ltd. joined with Mitsui & Co., Ltd. in making outlays for the establishment of Gas Malaysia Berhad, Malaysia's supplier of natural gas and LPG. It is working for the spread and expansion of gas use in Malaysia through both human and technical exchanges.

05_w841×1189

THE JAPAN GAS ASSOCIATION

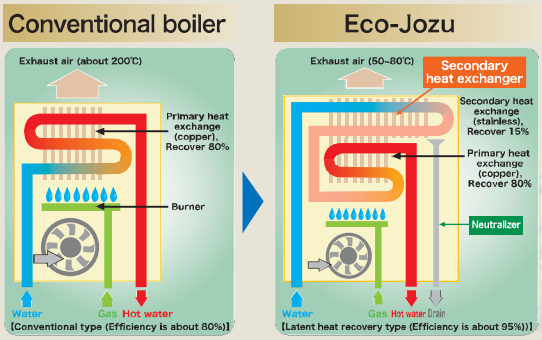
# The Latest Residential-use Gas Appliances

## Outline

Japanese companies are commercializing residential-use gas products aimed at higher levels of energy efficiency, safety, and convenience.

## Eco-Jozu - latent heat recovery highly-efficient water heater

- Eco-Jozu is a milestone product that dramatically increased thermal efficiency in water heating from 80 percent to a remarkable 95 percent. This was made possible by recycling the heat left over from water heating.
- The industry is hoping to make Eco-Jozu the de facto standard (meaning that almost all newly installed gas water heaters are Eco-Jozu) by March 2013 and targeting cumulative sales of some 20 million units by 2020.




Source: The Japan Gas Association

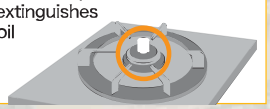
## Gas cooking stove with Si* sensor

- This gas cooking stove is installed with a device for prevention of oil overheating and other safety features as standard equipment. It features an outstanding level of safety.
- Gas cooking stoves produced since April 2008 are all equipped with Si* sensors. As of October 2011, some 13 million had been installed.

### Safety devices of gas cooking stoves with Si* sensors

**Safety function** Device to prevent overheating of cooking oil (Tempura oil etc.)

Upon detection of a temperature in excess of about 250 degrees on the bottom of the pan, the device automatically extinguishes the flame to prevent the oil from catching fire.

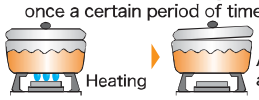


**Safety function** Safety device for flame failure

It automatically shuts off gas when the flame goes out due to the pan boiling over or to strong wind.


**Safety function** Device for extinguishing burners (and grills) carelessly left on

Even if users forget to turn off the burner or grill, this device automatically extinguishes the flame once a certain period of time has passed after ignition.




*"Si" is composed of four words: Safety, Support, Smile and Inteligent

Source: The Japan Gas Association etc.

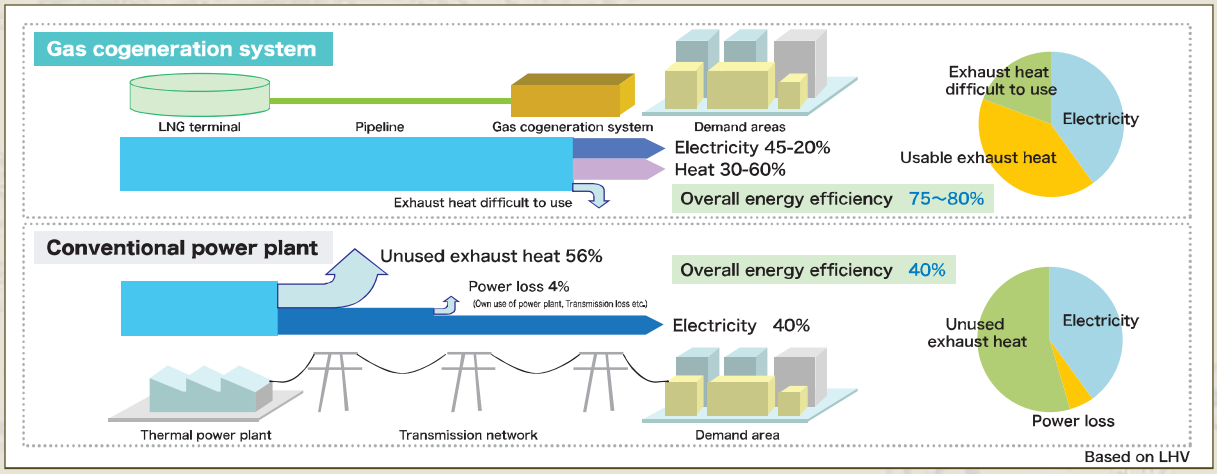
06_w841×1189

THE JAPAN GAS ASSOCIATION

# Benefits of Natural Gas Cogeneration Systems

## Gas cogeneration systems

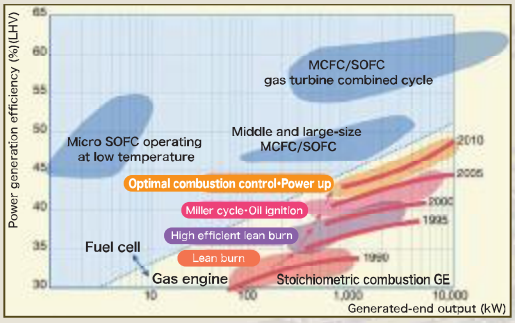
Gas cogeneration systems use gas to produce electricity and heat for utilization. The installation of cogeneration yields a high generation efficiency on a par with or higher than that of commercial systems. Because they also use waste heat, the systems make a vital contribution to conservation of energy and reduction of $CO_2$ emissions in Japan.



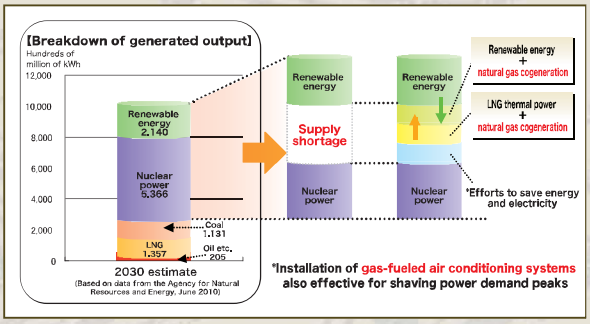

## Efficiency of gas cogeneration systems

Because they produce energy only at the necessary times and places, the systems eliminate the need to transport energy over long distances and, by extension, the related energy loss in transportation. Furthermore, they recover waste heat from exhaust gas and cooling water, and use it for water heating and air conditioning. As such, they make effective use of 70 - 90 percent of the primary energy input. They are being looked to for satisfaction of the demand for power long into the future.

### Efficiency of gas cogeneration system




### Power supply mix in 2030





Small-size gas engine


Mid-size gas engine


Large-size gas engine

THE JAPAN GAS ASSOCIATION

# "ENE-FARM", Residential Fuel Cell

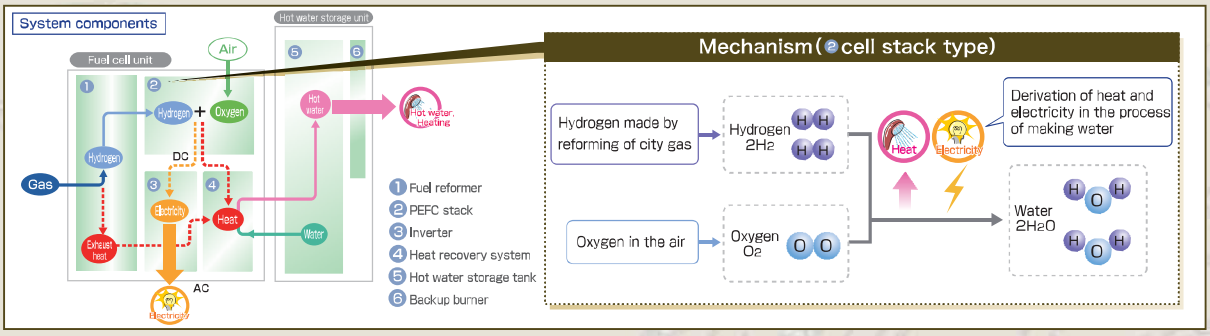
## Outline

- Fuel cell is a new form of natural gas utilization technology. It produces electricity through an electrochemical reaction between hydrogen extracted from natural gas and oxygen in the air.
- In FY 2009, Japan became the first country in the world to commercialize a residential-use model. The industry is targeting a diffusion on the order of 5 million units (including LPG models) by 2030.

## Feature of fuel cell

- Fuel cell attains a high generation efficiency because it converts the chemical energy of the fuel directly into electrical energy.
- Fuel cell also enables use of the heat derived in power generation to heat water. Its efficient use of energy brings a reduction in utilities costs and $CO_2$ emissions without lowering comfort and convenience in modern living.

### Structure




Source: Osaka Gas

## Fuel cell types and specifications

| Items | Polymer electrolyte fuel cell (PEFC) | Solid oxide fuel cell (SOFC) |
|---|---|---|
| Characteristics | Low operating temperature, easy start-up and shutdown | High operating temperature, high generation efficiency |
| Development status | Commercialized in FY2009. Commercialization of a new model with higher efficiency and more compact size in certain classes in FY2011. | Commercialized in FY2012. |
| Electrolyte | Fluorine resin | Ceramic |
| Generated output | 700W~750W | 700W |
| Operating temperature | 70℃~80℃ | 700℃~1,000℃ |
| Generation efficiency | LHV35%~45% | LHV45%~55% |
| Heat recovery efficiency | About 50% | About 40% |
| Appearance |  Panasonic Corporation  Toshiba Fuel Cell Power System Corporation  ENEOS CELLTECH Co., Ltd. |  TOYOTA MOTOR CORPORATION / AISHIN SEIKI Co., Ltd. / KYOCERA Corporation |

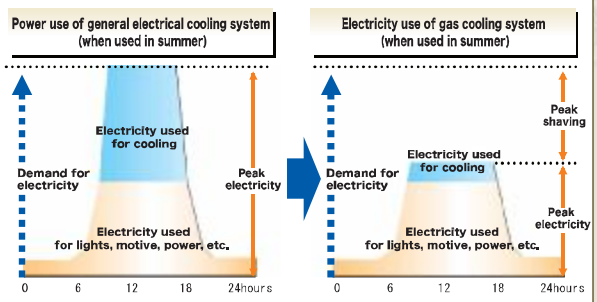
08_w841×1189

THE JAPAN GAS ASSOCIATION

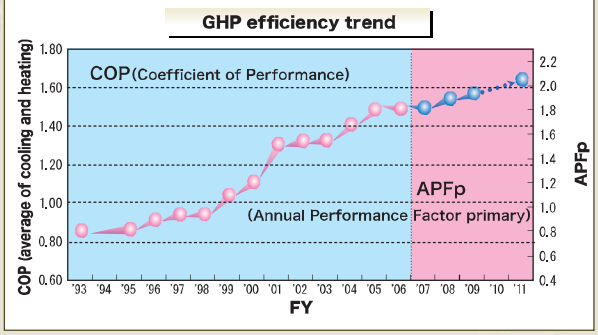
# Gas Air Conditioning

## Benefits of introduction of GHPs (Gas engine driven Heat Pumps)

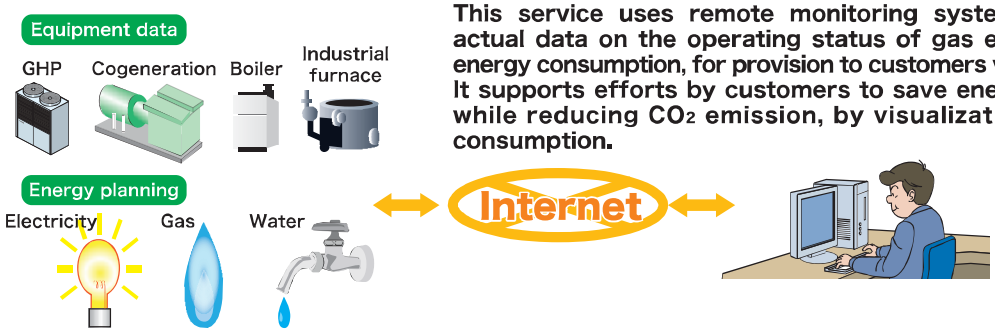
Gas air conditioning systems play a vital role for shaving of the summertime power peak.




The APFp of GHPs is dramatically rising, and indicates their outstanding energy-saving characteristics. Even higher levels of energy conservation will be expected.



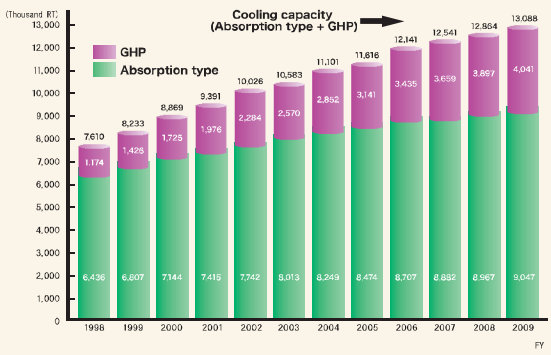

## Remote-monitoring and energy conservation service




This service uses remote monitoring systems to collect actual data on the operating status of gas equipment and energy consumption, for provision to customers via the Internet. It supports efforts by customers to save energy and costs while reducing $CO_2$ emission, by visualization of energy consumption.

## Diffusion of gas air conditioning systems in Japan (installed capacity)

The total capacity of gas air conditioning systems installed in Japan reaches 13 million RT. The systems have been increasing their share in the total air conditioning market.



09_w841×1189

THE JAPAN GAS ASSOCIATION

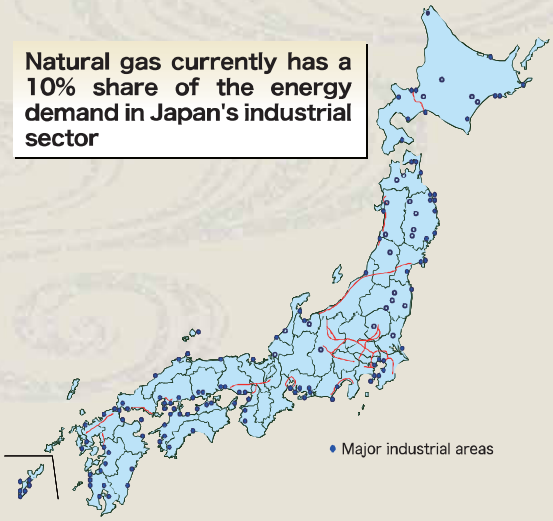
# Fuel Switching in the Industrial Sector

## Distribution of the industrial demand in Japan

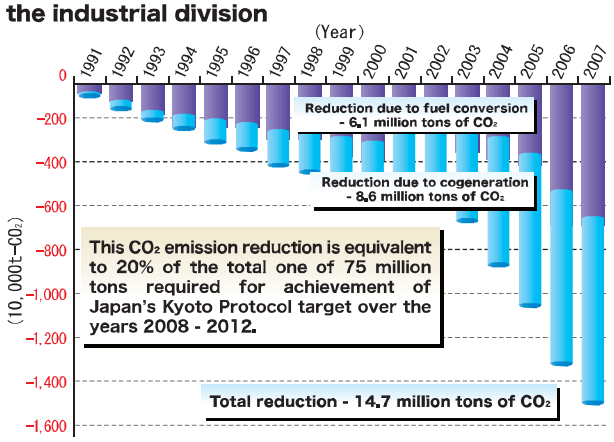
**In Japan's industrial sector, the switching to natural gas for fuel and installation of cogeneration systems has brought a significant reduction of $CO_2$ emissions. The gas industry is going to continue promoting the introduction of natural gas.**

- Fuel switching (share occupied by natural gas)
  Up 50% by 2020
  Up 100% by 2030
- Cogeneration (installed capacity)
  Up 50% by 2020 (to 8 million kW)
  Up 100% by 2030 (to 11 million kW)

Natural gas currently has a 10% share of the energy demand in Japan's industrial sector



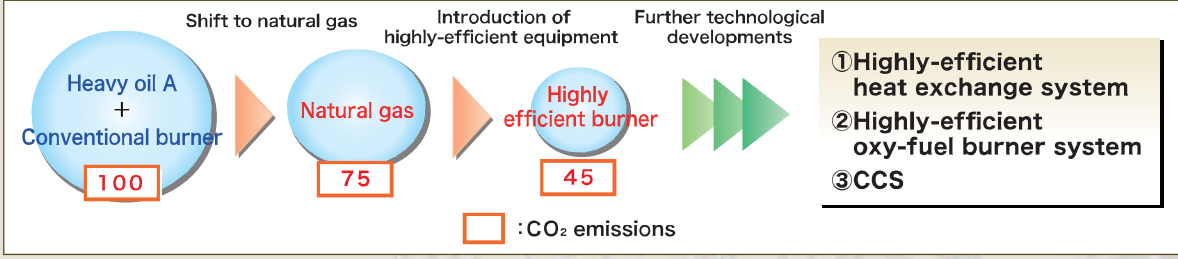

**Reduction of $CO_2$ emissions due to fuel conversion and cogeneration to meet the demand for heat in the industrial division**




*Trial calculations based on EDMC Handbook of Energy & Economic Statistics in Japan 2009

## Demand for heat - energy conservation and carbon reduction

**There is a shift under way from heavy oil to natural gas as an energy source for the industrial heat demand. In addition, the installation of highly-efficient gas equipment reduced the $CO_2$ emissions from gas equipment by half. The gas industry is going to continue reducing carbon levels through further programs of technology development.**




①Highly-efficient heat exchange system
②Highly-efficient oxy-fuel burner system
③CCS

10_w841×1189

THE JAPAN GAS ASSOCIATION

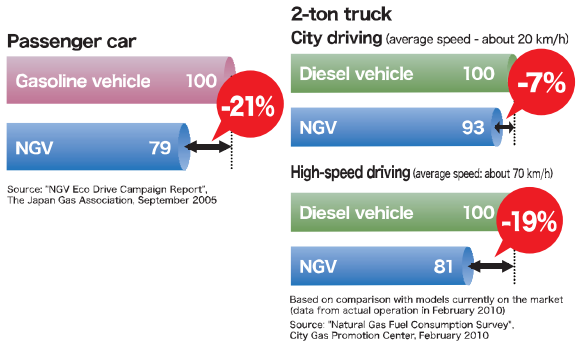
# Energy Diversification in the Transportation Sector

## Expanded diffusion of NGVs

**Natural gas vehicles (NGVs) entail less $CO_2$ and NOx emissions than ordinary gasoline and diesel vehicles, and feature excellent environmental characteristics.**

**NGVs have 20 - 30% less $CO_2$ emissions than conventional gasoline vehicles.**

■Comparison of conventional and NGVs in respect of $CO_2$ emissions
(indicators when conventional vehicles = 100)

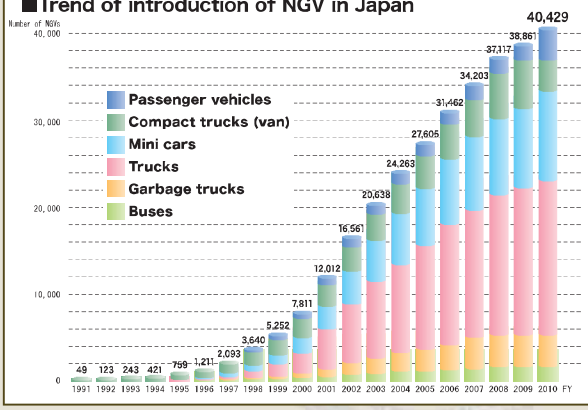



Source: "NGV Eco Drive Campaign Report", The Japan Gas Association, September 2005

Based on comparison with models currently on the market (data from actual operation in February 2010)
Source: "Natural Gas Fuel Consumption Survey", City Gas Promotion Center, February 2010

**In Japan, there were about 40,000 NGVs on the road as of March 31, 2011. The JGA is engaged in promotional efforts aimed at increasing the total to 500,000 vehicles by 2030.**
**A particular focus for the futures is the spread of large CNG trucks for transport between cities or between key industrial sites.**

■Trend of introduction of NGV in Japan




## A rich varieties of NGV types


## Approaches for the spread of fuel cell vehicles

**City gas utilities are also promoting the diffusion of fuel cell vehicles, which do not produce any $CO_2$ emissions while driving. In this connection, the industry is building hydrogen stations to refuel such vehicles with hydrogen.**

11_w841×1189

THE JAPAN GAS ASSOCIATION

# Utilization of Solar Heat

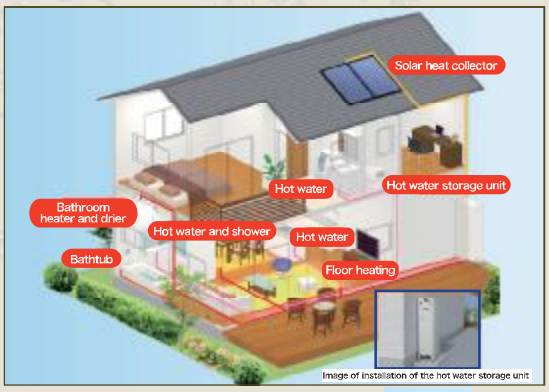
## Outline

■ The combination of solar heat and gas equipment brings a substantial reduction in utilities costs and $CO_2$ emissions without lowering comfort in lifestyles. The gas equipment complements the solar heat, which varies greatly with the weather.

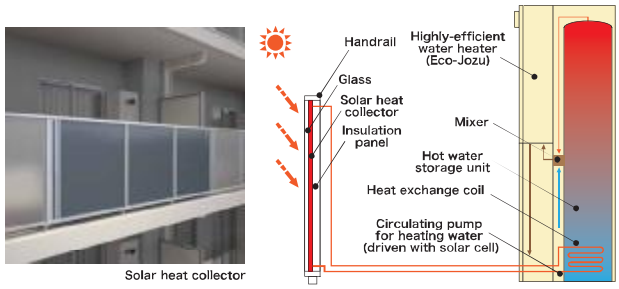
## Use to heat water: SOLAMO

■ SOLAMO combines solar heat with a gas water heater.
■ The solar panels collect solar heat, and a gas water heater that instantaneously makes hot water is activated for any shortage of the former. The system makes hot water available at any time.

### System installed on the roof




### System installed on the balcony

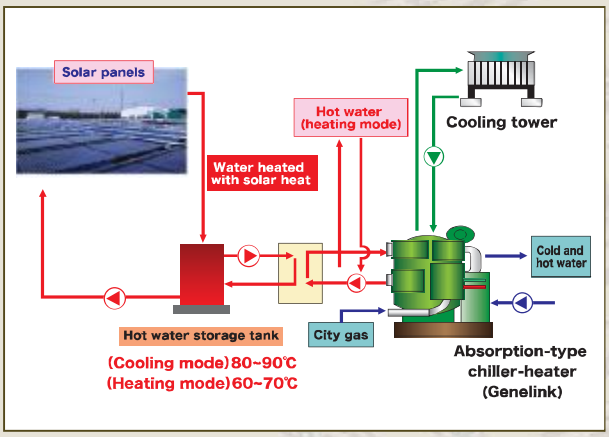



Source: Tokyo Gas

## Use for air conditioning: Solar Cooling

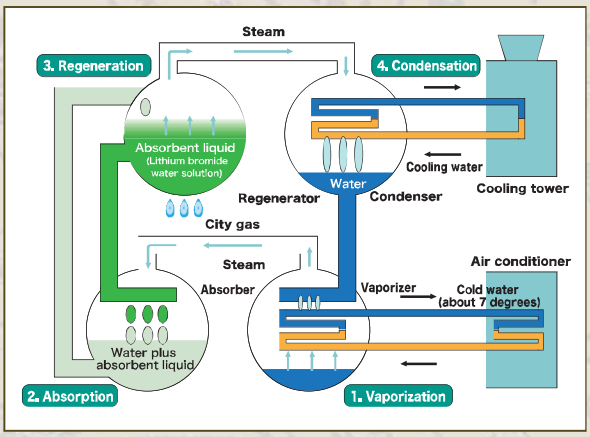
■ Solar Cooling is a product adapted to air conditioning in commercial facilities. It combines solar heat with an absorption-type chiller-heater.
■ It utilizes solar heat on a priority basis and compensates for any shortage due to the weather with gas as the back-up system. This enables it to deliver an air conditioning capability on a stable basis.

### Solar Cooling System




Source: Osaka Gas

### Absorption-type chiller-heater system




Source: Toho Gas

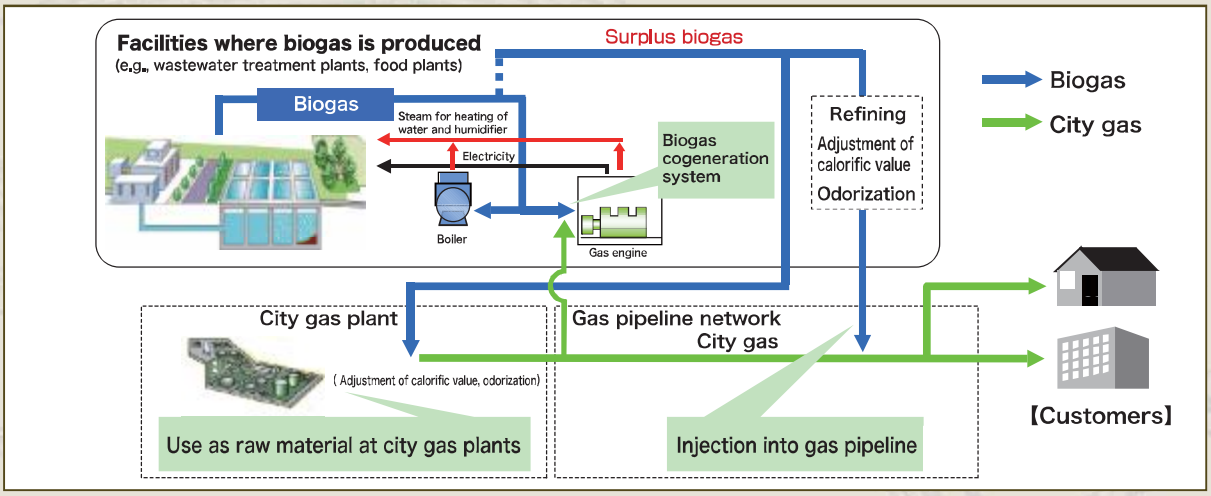
12_w841×1189

THE JAPAN GAS ASSOCIATION

# Use of Biogas

## Approaches to biogas

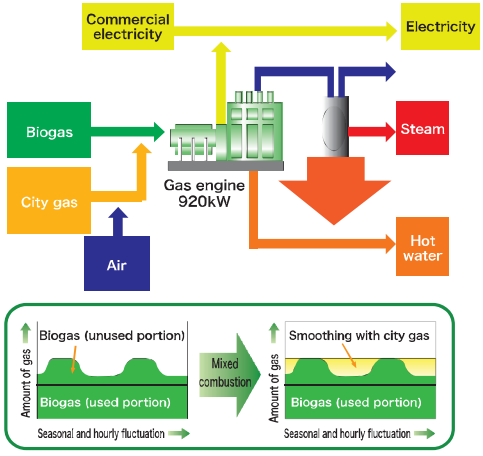
**Applying the gas utilization technology accumulated through their activities to date, Japan's city gas utilities are supporting effective use of biogas produced customer sites.**
**Biogas is produced from sewage sludge, raw garbage, food waste, industrial wastewater and other sources.**




## Biogas utilization system

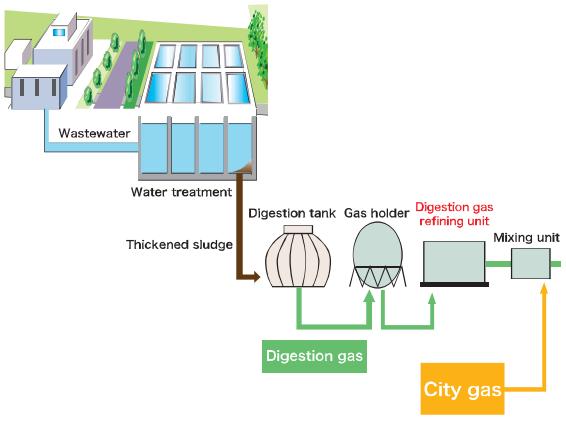
### Biogas cogeneration system

**The system performs multi-fuel combustion of biogas, which fluctuates in produced volume and calorific value, and city gas, which is stable in both these respects. It enables stable and continuous operation of cogeneration.**
**This system heightens effects for energy conservation and economic merit.**




### Injection into city gas pipelines

**City gas utilities are conducting demonstration projects of injecting biogas for its effective use as city gas.**
**The impurities contained in methane fermentation gas can cause damage to and deterioration of gas utilization facilities. To eliminate this adverse influence, they are removed by refining.**



13_w841×1189

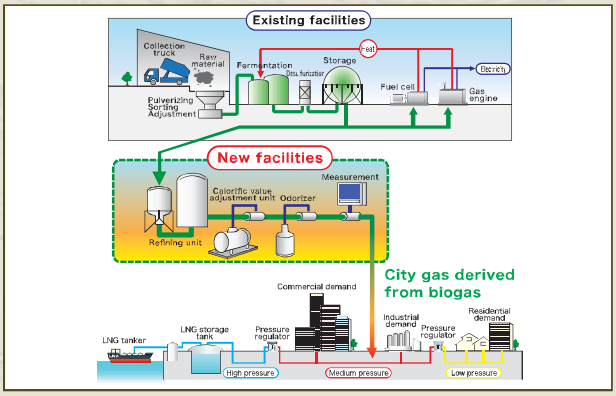
THE JAPAN GAS ASSOCIATION

# Specific Cases of Biomass Energy Use: Proving through Injection of Biogas into City Gas Pipelines

## Biogas derived from food waste

- Tokyo Gas Co., Ltd. and Bio Energy Corporation have begun accepting biogas from food waste and injecting it into city gas pipelines.
- The injection of biogas into city gas pipelines amounts to about 800,000 cubic meters per year, enough to fill the annual city gas demands 2,000 homes. This translates into a $CO_2$ emission reduction of 1,360 tons per year.

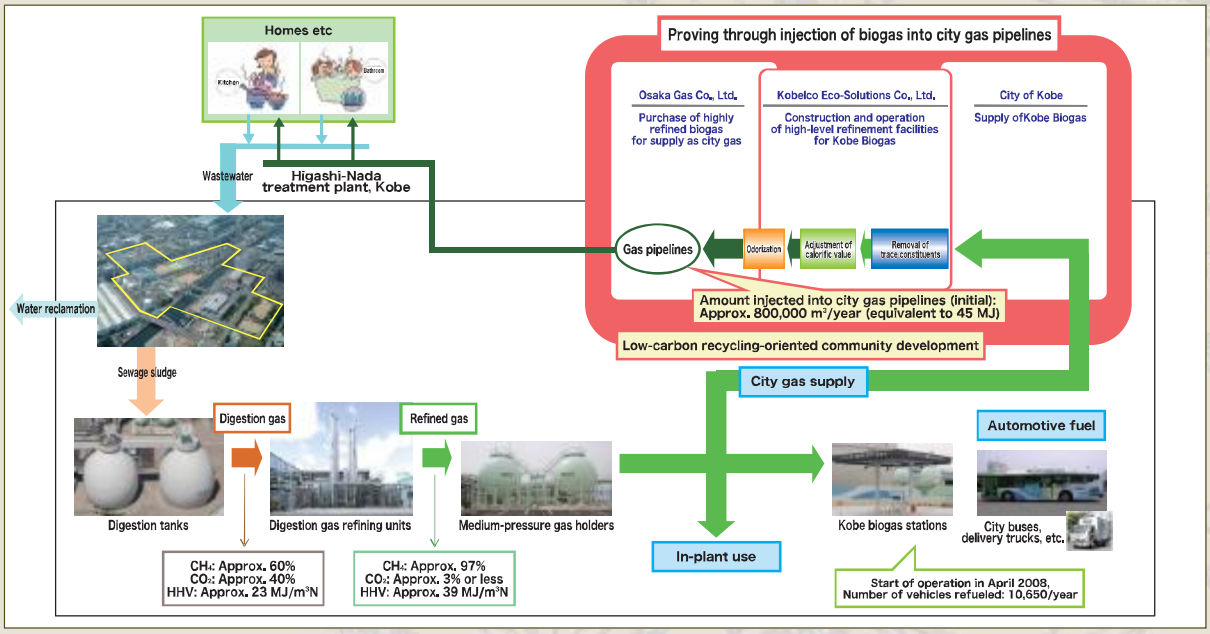
### Schematic flow of biogas injection project




### Facilities for intake and injection of biogas into city gas pipelines

## Biogas derived from sewage sludge

- Osaka Gas Co., Ltd., Kobelco Eco-Solution Co., Ltd., and The City of Kobe. have begun intake of biogas derived from sewage sludge and its injection into city gas pipelines.
- The injection of biogas into city gas pipelines amounts to about 800,000 cubic meters per year, enough to fill the annual city gas demands of 2,000 homes. This translates into a $CO_2$ emission reduction of 1,200 tons per year.

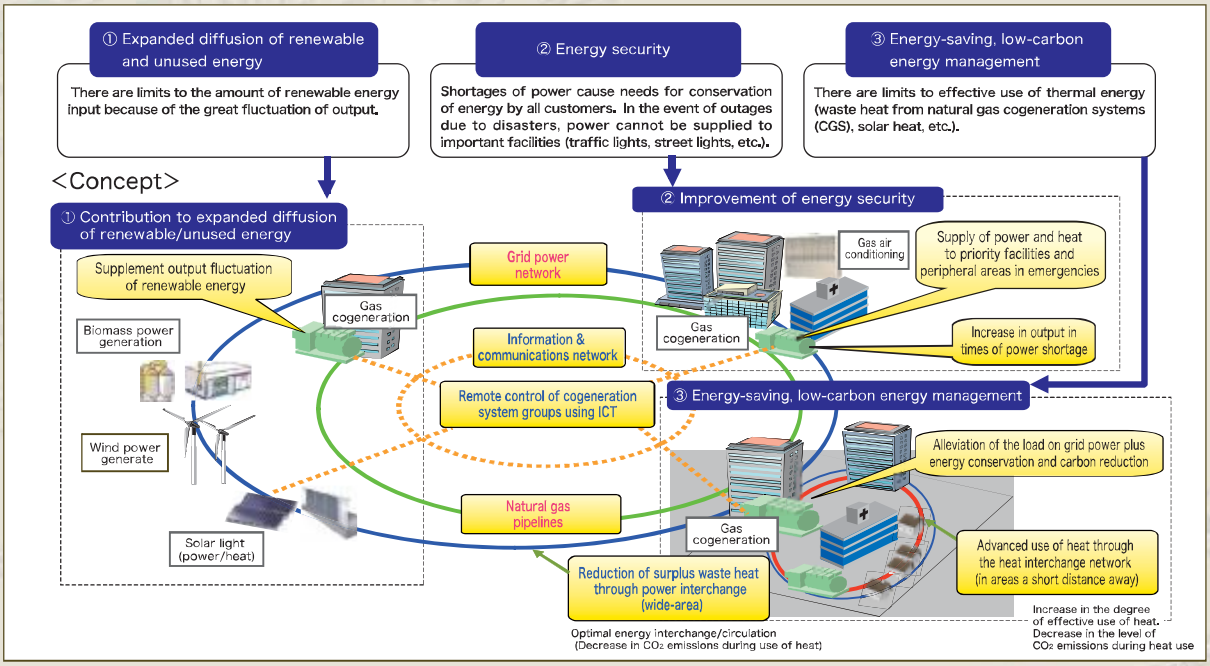


14_w841×1189

THE JAPAN GAS ASSOCIATION

# Smart Energy Networks

## Issues in energy use in today's urban areas

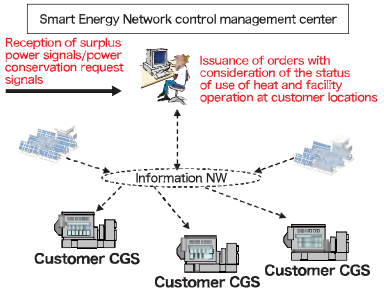



## Approaches to realization (proving tests)

### Remote control of CGS groups using ICT

Examinations are currently being made of the following effects based on remote control of CGS groups installed in a distributed manner over a wide area.

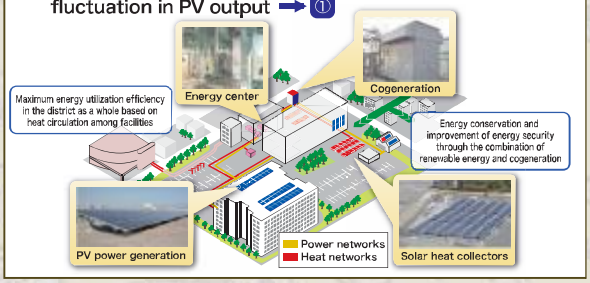
- Optimal energy circulation: circulation of power generated by CGS at sites with a demand mainly for heat to sites with a low heat demand, to reduce heat waste → ③
- Supplement of PV output fluctuation: compensation for PV output fluctuation by adjustment of the CGS group output → ①
- Adjustment of power supply and demand: supply of the output adjustment capacity of the CGS groups as a means of power supply-demand adjustment → ②




### Advanced use of heat by heat circulation networks

Examinations are currently being made of the following effects based on energy networks centered around heat circulation networks built in specified areas.

- Area-wise heat circulation: circulation of CGS waste heat and solar heat among a plural number of buildings, to increase the degree of effective use of heat → ③
- Integrated heat source control: reduction of $CO_2$ emissions during heat use through control based on maximum use of fluctuating solar heat and CGS waste heat, and compensation for any shortages with power and gas heat sources → ③
- Supplement of PV output fluctuation: adjustment of the output of CGS and turbo chillers to compensate for fluctuation in PV output → ①



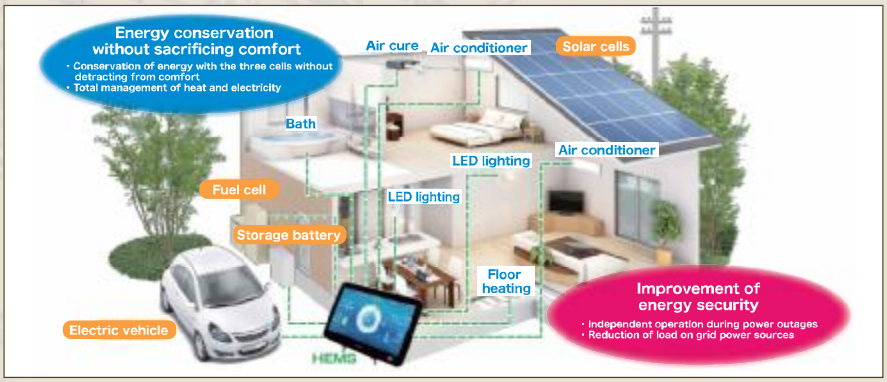
15_w841×1189

THE JAPAN GAS ASSOCIATION

# Smart Energy Houses

## Concept

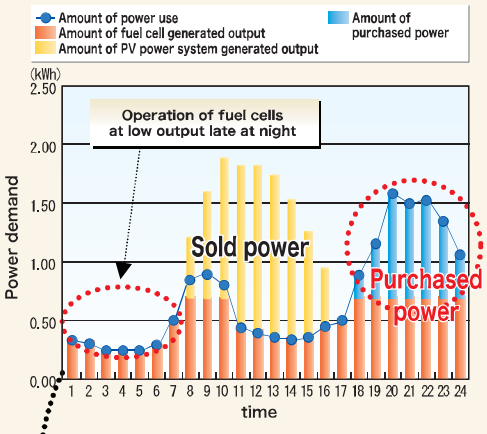
**Realization of the following effects by proper control of three cells (fuel cell, solar cells, and storage battery) and housing appliances using IT**



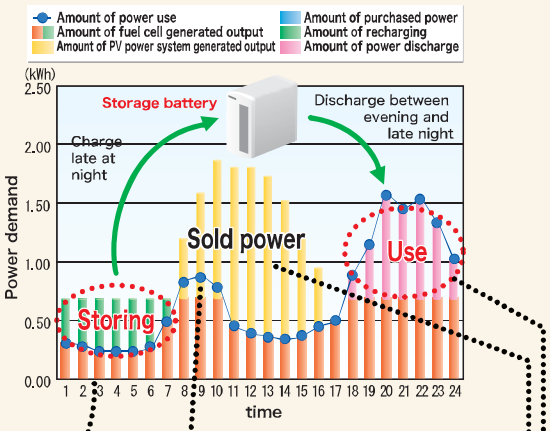

## Energy-saving effects based on optimal control of three cells

**City gas utilities are currently conducting proving tests of optimization of the methods of controlling three cells and resulted energy-saving effects, using test housing.**

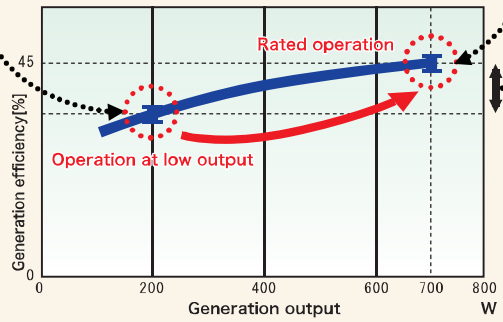
■Fuel cell + solar cells




■Fuel cell + solar cells + storage battery




■Increase in the generation efficiency of fuel cell




Achievement of energy saving without a decrease in the amount of power use (energy conservation without sacrificing comfort)

Contribution to grid power peak shaving (improvement of energy security in society as a whole)

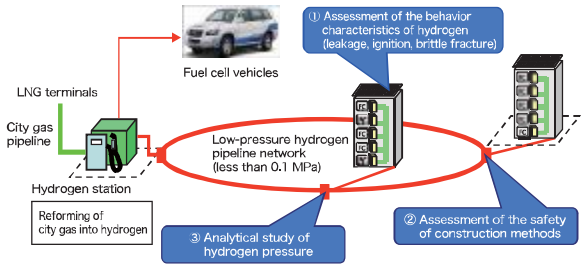
16_w841×1189

THE JAPAN GAS ASSOCIATION

# Approaches to the Hydrogen Energy Society

## Research on safety technology for hydrogen pipeline

**Hydrogen stations are scheduled for construction to serve fuel cell vehicles, which are to enter diffusion in FY 2015. The industry plans to build local hydrogen networks for supply of hydrogen to homes through pipelines leading from these stations. City gas utilities are engaged in technical studies to assure safety.**




### Technical study items

① Assessment of the behavior characteristics of hydrogen (leakage, ignition, brittle fracture)
The study will investigate hydrogen's diffusion behavior in the event of leakage and the impact at time of ignition, in order to identify the safety requirements during the process of pipeline installation and repair work. It will also examine the influence of the addition of odorant agent as regards hydrogen embrittlement of the pipe materials.

② Assessment of the safety of construction methods
The study will check safety in the event of application of construction methods used in existing city gas construction projects (e.g., hot tapping and repair methods) to hydrogen pipelines.

③ Analytical study of hydrogen pressure
In the interest of more efficient construction of hydrogen supply networks, the study will ascertain the relationship between the flow rate and pressure loss in the flow of the hydrogen in the pipeline. This will provide practical (provisional) formulas enabling simplified pressure analysis.

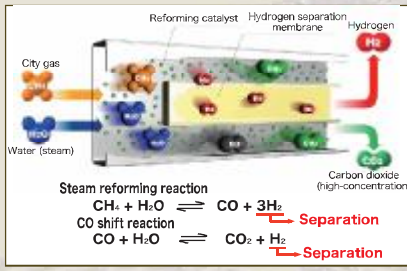
## Development of on-site compact hydrogen manufacturing units

**Compact hydrogen manufacturing units can produce highly pure (at least 99.999%) hydrogen from city gas on the site, by means of high-performance reforming catalysts (the $CO_2$ by-product is also recovered on-site). City gas utilities are also pursuing development of hydrogen separation reformers for even more efficient production of hydrogen.**

### Specifications of compact hydrogen manufacturing units

| Model | HYSERVE | HyGeia |
|---|---|---|
| Hydrogen production capacity | 30 Nm³/h<br>100 Nm³/h | 50 Nm³/h<br>100 Nm³/h<br>200 Nm³/h |
| Hydrogen purity | At least 99.999% by vol. | At least 99.999% by vol. |
| Dew point | No more than -70℃ | No more than -70℃ |
| Product hydrogenpressure | No more than 0.70 MPaG | No more than 0.70 MPaG |
| Installation space | [Main unit only]<br>W2.5m×D2.0m×H2.5m(30m³/h)<br>W3.8m×D2.6m×H2.8m(100m³/h) | [Including the feedstock compressor and off-gas holder]<br>About 9m²(50m³/h) |

### Hydrogen separation reformer - mechanism and unit





Hydrogen production capacity:40 m³/h
Hydrogen production efficiency:81.4 %
Purity of the hydrogen produced:99.999 vol%

## Proving test of hydrogen stations

- Construction of stationary hydrogen stations using city gas as feedstock (raw material) in Tokyo, Osaka and Nagoya (construction in 20 places nationwide so far when types using different feedstock are included)
- Adoption of technology for hydrogen production units based on city gas reforming
- Refueling of fuel cell vehicles used in testing on public roads with hydrogen (35/70 MPa)

Hydrogen station in Senju, Tokyo

## Other approaches

- Proving of applicability for supply of hydrogen through existing pipelines (currently being conducted in the Kita-Kyushu Hydrogen Town Project)
- Examination of the prospects for use of non-sulfur odorant agent to curtail decline in fuel cell performance