# Frontrunner in

Since the Great East Japan Earthquake in March 2011, increasing public attention has been given to energy issues including security of supply and diversity of supply sources. In order to ensure the stable supply of gas, the Osaka Gas Group has a number of ongoing initiatives in its gas business, including the safeguarding of its facilities against disasters, and securing the steady procurement of natural gas. In its electric power business, the Group plays a role in bolstering the supply of electricity in Japan through its large-scale natural gas power plant and its initiatives to promote and broaden the use of dispersed power generation systems.* We will fulfill our responsibilities as an energy supplier in three ways. First, and foremost, we will work to enhance the stable supply of not only natural gas, but also energy in general. Second, we will promote and support local energy supply and consumption through on-site energy systems. Thirdly, we will be in the forefront of diversifying our energy sources. This feature showcases the Group's engagement in ensuring gas supply and broadening the use of dispersed power systems among its many initiatives.

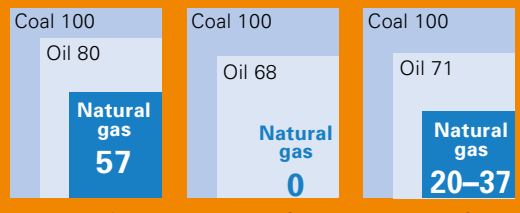
* Dispersed power consists of small-scale systems to generate electric power, installed in close proximity to where the power is consumed.

## The Environment Surrounding Natural Gas

### Natural Gas as Clean Energy

Natural gas is widely available throughout the world at numerous locations. It is not concentrated in a specific region and the reserves are plentiful. Emissions of carbon dioxide, a cause of global warming, and emissions of nitrogen oxides, a cause of photochemical smog, are low. Sulfur oxides, which cause atmospheric pollution and acid rain, are not emitted. Natural gas is, therefore, the most environmentally friendly fossil fuel. As environmental awareness has increased, natural gas has drawn increasing interest, and demand is only expected to grow.

**Emission Levels for Fossil Fuels (Coal = 100)**




$CO_2$*1 (Carbon dioxide) | $SO_x$*2 (Sulfur oxides) | $NO_x$*2 (Nitrogen oxides)

*1: Institute of Applied Energy (IAE) Report on Thermal Power Plant Atmospheric Impact Assessment Technology Demonstration Survey (1990/3)

*2: International Energy Agency (IEA) "Natural Gas Prospects (1986)"

# Social Change

**Initiatives Aimed at Stable Supply of Natural Gas**

Supply

**Initiatives to Optimize Energy**

Optimize

**Initiatives to Expand the Use of Natural Gas for Dispersed Power**

Expand


## Position of Natural Gas in Japan's Energy Policy

Environmentally friendly natural gas is positioned as an important energy source in Japan's energy policy. The Basic Energy Plan endorsed by the Japanese government in June 2010, calls for promoting a shift to natural gas to help speed the realization of a low-carbon society. Specific policy objectives include enhancing natural gas in industrial fuel consumption, promoting cogeneration, and encouraging widespread use of high-efficiency water heaters among households. In the years to come, in line with these policies and objectives, it is expected that positive steps will be made for conversion from petroleum and other fuels to natural gas as well as for advanced use of natural gas.

**Natural gas is a key factor in the realization of a low-carbon society**

Supply

# Initiatives Aimed at Stable Supply of Natural Gas

## Stable Procurement of Natural Gas

At present, the Group procures all of its LNG from overseas sources. To avoid exposure to political and economic risks in any one particular country, Osaka Gas has a well established framework for stable procurement of natural gas, comprised of two parts. One is to diversify the source of LNG, currently to six countries; namely Indonesia, Brunei, Malaysia, Australia, Qatar, and Oman. The other is to base the majority of LNG Osaka Gas imports on long-term contracts.

Refer to page 37 for relevant information.

## Infrastructure Redundancy

Osaka Gas has two bases for receiving LNG; one in Semboku along the southern coast of Osaka Prefecture, and the other, in Himeji in Hyogo Prefecture. These two bases form the backbone of the dispersal and redundancy of the Group's gas supply infrastructure. In addition, Osaka Gas is working together with Chubu Electric Power Co., Inc. to construct the Mie-Shiga Line, a pipeline approximately 60 kilometers long between Taga Town in Shiga Prefecture and Yokkaichi City in Mie Prefecture, scheduled for completion in 2014. The pipeline linking Osaka Gas with a major utility in a separate region further enhances the stability of gas supply.

## Safeguarding Facilities against Natural Disasters

Based on our experience following the Kobe (Hanshin-Awaji) Earthquake in 1995, we have actively promoted measures enhancing our preparedness against natural disasters in three major aspects: preventive, emergency, and post-disaster restoration. In light of the extent of damage the Great East Japan Earthquake wrought, the Central Disaster Management Council and the government are reexamining their predictive assumptions for earthquakes and tsunami, and we will implement any necessary countermeasures based on the government's revisions and recommendations.

### 1 Preventive Measures

#### Bolstering the Earthquake Resistance of Facilities

Our gas facilities can be roughly divided into LNG-related and gas supply facilities. Our major LNG facilities are earthquake-proofed to withstand earthquakes as strong as level 7 on the seismic intensity scale, as well as against tsunami far higher than in the Central Disaster Management Council's worst case scenario. As a matter of fact, none of the Group's LNG facilities were damaged in the Kobe earthquake.

For supply facilities, we continue to install earthquake-resistant polyethylene and other pipes on a scheduled basis, and now over 80% of our pipeline network has been earthquake-proofed. Highly earthquake-resistant pipelines have demonstrated their effectiveness in earthquakes that have occurred since the Kobe earthquake. We intend to continue efforts to earthquake-proof even more of our network.

# 2 Emergency Disaster Measures

## Preventing Secondary Disasters

We have increased the installation of seismographs and remote monitoring devices for gas pressure governors to enable us to quickly collect information in the event of a disaster. We have also built a framework for preventing secondary disasters that includes further subdividing our supply area, the installation of automated seismic shutoff systems and new remote shutoff systems on our supply network, and establishing a central command sub-center as a backup to the monitoring and control functions.

For individual households we have been promoting widespread use of microcomputer-controlled meters, which automatically shut off the gas supply with a preset level of seismic intensity, and now 100% of households in our supply area are equipped with the meters.

| | | Before Kobe earthquake (January 1995) | March 31, 2011 |
|---|---|---|---|
| Strengthen information collection | Install seismographs | 34 locations | 241 locations |
| | Remote monitoring devices for gas pressure governors | — | 3,494 locations |
| Build supply shutoff system | Further subdivide supply area | 55 blocks | 148 blocks |
| | Install gas pressure governors and shutoff equipment | — | Remote shutoff in 704 locations<br>Seismic shutoff in 2,954 locations |

# 3 Restoration Measures

## Post-Disaster Restoration Measures

If a disaster occurs and the gas supply is temporarily shut off to prevent secondary disasters, working on each subdivided block in our supply area will make it possible to restore service promptly while ensuring safety. To this end we are engaged in technological development including equipment for removing water or sand that has infiltrated gas pipes and an in-pipe video camera system that can find pipe damage. We also have a system ready for temporarily supplying gas to important public facilities such as hospitals and disaster response centers.

Technology for restoration work →

←Water extraction equipment

Equipment for removing water infiltration from gas pipes

In-pipe video camera system →

A video camera for examining the insides of gas pipes without having to shut off the gas

# Initiatives to Expand the Use of Natural Gas for Dispersed Power

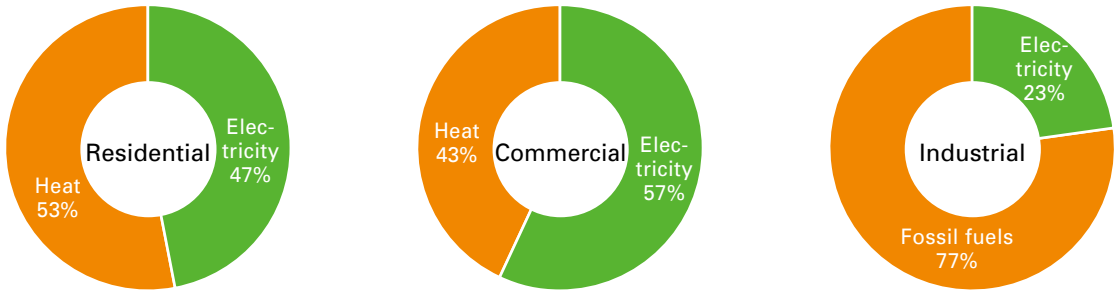
The Great East Japan Earthquake and the consequent shortage in electricity have increased the public's interest in the importance of power supplies. We think the position of dispersed power can only rise in importance as it helps enhance the stability of electric power supplies when combined with large-scale sources of power. Osaka Gas is promoting initiatives to extend the market penetration of dispersed power by making active use of gas cogeneration systems.

## Gas Cogeneration Systems

Households and factories use two types of energy: thermal energy (fuel) and electricity. About half of the energy households and commercial businesses consume and three-quarters of the energy factories and industrial businesses consume is thermal energy. An important part of achieving a low-carbon society is the implementation of measures that take the efficient use of both thermal energy and electricity into consideration.

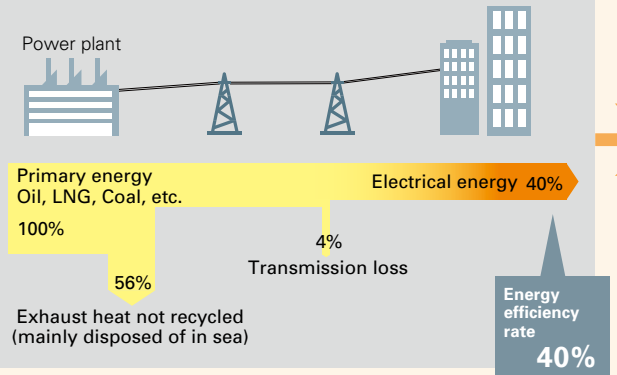
A gas cogeneration system is a system that uses gas to generate power at the customer site while simultaneously utilizing the heat recovered for air conditioning and water heating. As the power is generated at the customer site, little is lost in energy transmission, and both heat and electricity are used efficiently, raising energy efficiency to around 70–90%.

**Ratio of Heat (or Fossil Fuels) and Electricity as Percentage of Energy Consumption**

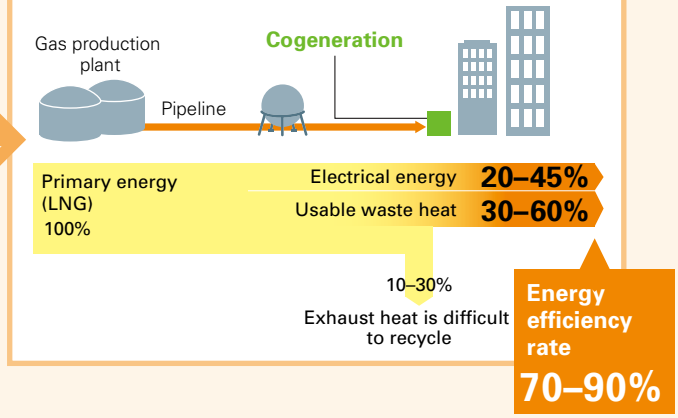



* Ratio of heat (or fossil fuels) and electricity as percentage of final energy consumption
Source: Energy Data Modeling Center "Handbook of Energy & Economics Statistics in Japan, 2011"

**Power Generation System Using Conventional Methods***




**Cogeneration System**



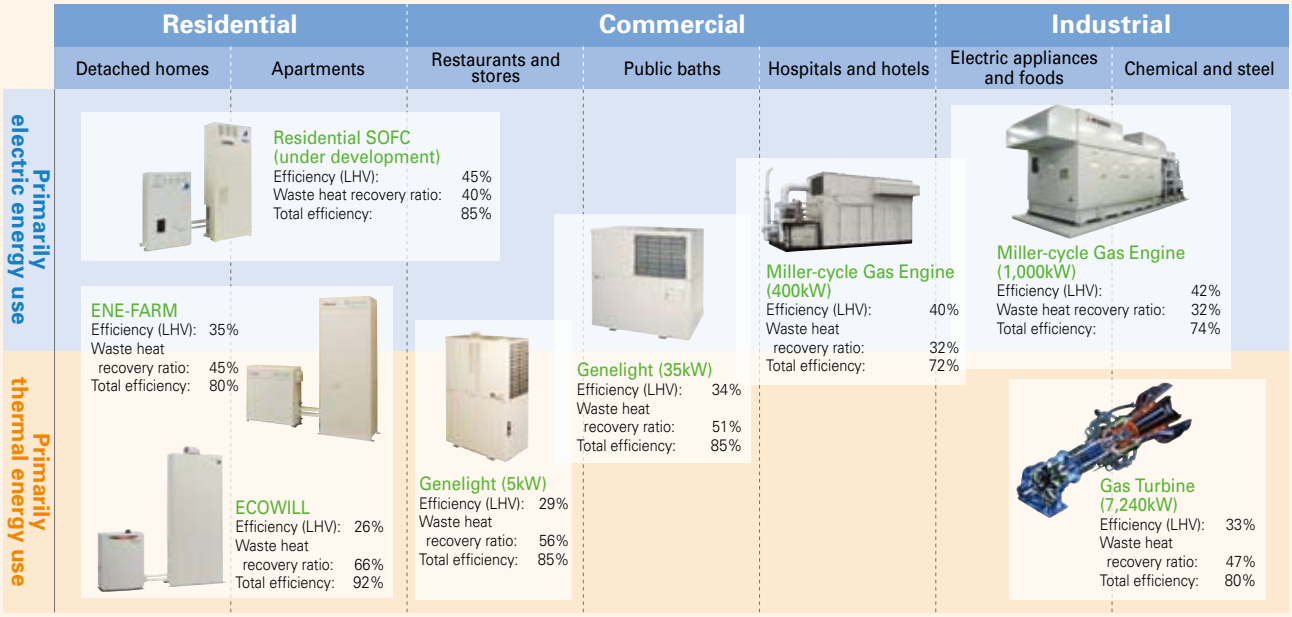

* Average for 10 power companies (fiscal 2005)
Source: Japan Gas Association "Cogeneration System"

## Gas Cogeneration Systems in Various Domains

When gas cogeneration systems were first introduced in the 1980s, they were primarily used at large facilities, but subsequent technical advances have made the systems more compact and efficient. We now have a broad product lineup, and the systems are utilized by customers of various sizes, from factories and large-scale commercial developments to hospitals, hotels and smaller retail establishments.

The need for power security has increased at hospitals and other facilities in the aftermath of the Great East Japan Earthquake, so the importance of cogeneration systems with power outage response capability is also increasing.

In addition to this, Osaka Gas markets cogeneration systems for use among households including "ECOWILL," a gas engine cogeneration system, and "ENE-FARM," a fuel cell cogeneration system. Sales of both systems have been increasing steadily.




Note: Description of representative examples

## Cogeneration systems for household use

The fuel cell cogeneration system "ENE-FARM" for household use produces electrical energy through a chemical reaction between hydrogen reformed from natural gas and oxygen in the air while the heat generated in the process is simultaneously used for water heating. Compared to conventional means, "ENE-FARM" reduces primary energy consumption by approximately 27% and $CO_2$ emissions by roughly 40%. There are growing expectations for the product as an ideal way to reduce household $CO_2$ emissions.

Osaka Gas is also currently developing a solid oxide fuel cell (SOFC) for households with higher electrical efficiency. The Company is working toward practical application of household SOFC sometime before 2015. The addition of this system alongside "ECO WILL" and "ENE-FARM" will enable us to present customers with cogeneration systems optimized for their specific lifestyles. The market for residential cogeneration systems is therefore expected to enjoy more growth in the years ahead.

Refer to page 40 for details on SOFC for households.

Residential gas engine cogeneration system "ECOWILL"

Residential fuel cell cogeneration system "ENE-FARM"

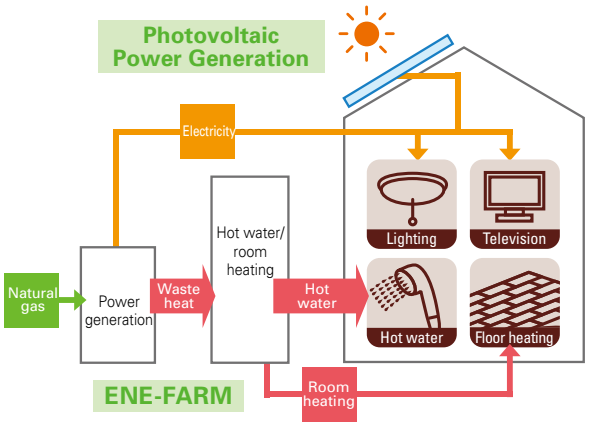
# Initiatives to Optimize Energy

## Hybrid Power with Photovoltaic Systems

Osaka Gas is promoting the concept of hybrid power for even higher environmental performance. Hybrid power combines the gas engine cogeneration system "ECOWILL" or the fuel cell cogeneration system "ENE-FARM" with a photovoltaic power system.

Photovoltaic power systems are affected by the weather, so power output is not stable, but "ECOWILL" and "ENE-FARM" are capable of generating electricity in a stable manner regardless of the weather. With a hybrid power system, households can not only reduce their electric and heating bill substantially, but conceivably sell their surplus electricity. The system has been very well received for its original outstanding environmental performance as well as these economic benefits. Approximately 40% of customers who have installed "ENE-FARM" use this hybrid power system.

**Energy Efficiency of Residential Fuel Cell Cogeneration System"ENE-FARM" and Hybrid Power Generation**




"ENE-FARM" Alone Reduces:

- Primary energy use by approx. 27%
- $CO_2$ emissions by approx. 40%

**Hybrid with "ENE-FARM" Reduces:**

- Primary energy use by approx. **45%**
- $CO_2$ emissions by approx. **70%**

## Smart Energy Houses

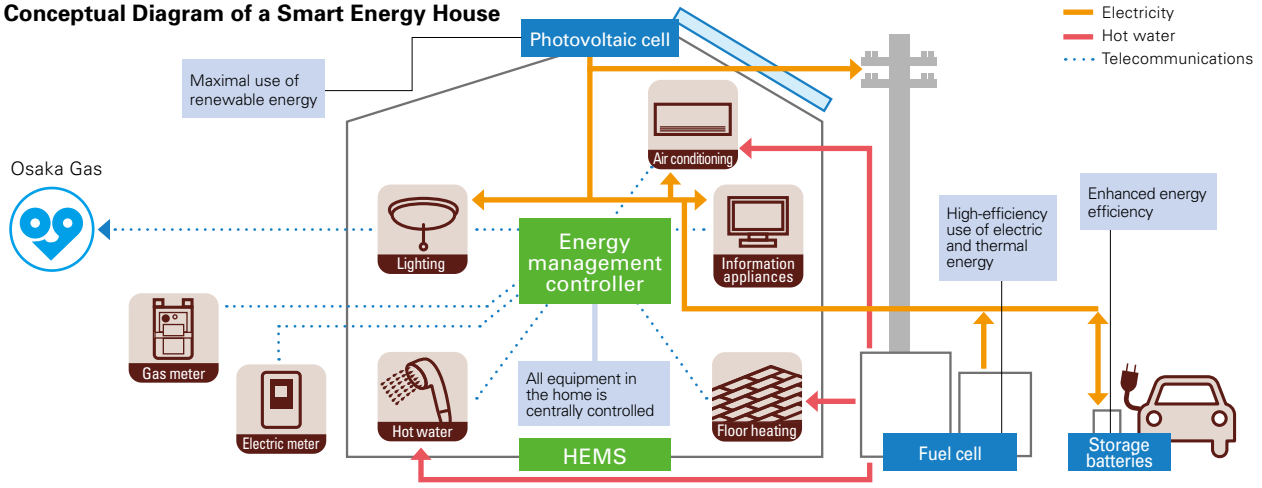
Osaka Gas is involved in the development of "smart energy houses," which provide comfortable, environmentally friendly living. The houses utilize information technology and a combination of three types of batteries—residential fuel cells, solar cells and rechargeable batteries—to smartly and efficiently produce, store and utilize electricity and heat. To accelerate development and eventual commercialization, we constructed two new residences, one for technical assessment and one as an experimental dwelling, and initiated verification testing in February 2011.

House for technical assessment
(located onsite at Osaka Gas in Osaka)

House used as an experimental dwelling
(Kitakatsuragi District, Nara Prefecture)

At the house for technical assessment, we are using a load simulator to assess and verify basic technologies at the development stage, including control technologies to optimize use of the three types of batteries and automated control technologies for conserving the energy appliances consume. These basic technologies will be installed in stages in the house used as an experimental dwelling as their technical assessments reach completion, to verify their effectiveness in actual day-to-day living. The goal of this test house is to completely offset its $CO_2$ emissions, including energy for the electric car used by the occupant, with $CO_2$ reductions provided by the photovoltaic cells.

**Conceptual Diagram of a Smart Energy House**




## Smart Energy Network

A "smart energy network" is a next-generation energy system that optimizes the energy supply and demand balance by combining gas cogeneration systems, photovoltaic units and other devices to effect the exchange of heat and electricity that is produced among multiple energy consumers. Specifically, the adjustability of gas cogeneration is utilized to accommodate fluctuations in photovoltaic power output. Coordinated control of the systems enables renewable energies to be actively utilized to significantly reduce energy consumption and carbon dioxide emissions. Osaka Gas is partnering with Tokyo Gas in a project to optimize and test multiple dispersed energies and verify the feasibility of a smart energy network linking an energy community in the Kansai region created with the cooperation of nine customers.

**Overview of Smart Energy Network Pilot Project**