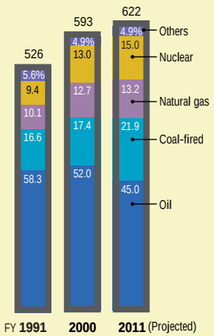
Adapting to Deregulation

Japan's Energy Demand by Type
(Millions of Kiloliters)



Source: The Advisory Committee for Resources and Energy

The Ongoing Deregulation Process

Japan has been working in earnest to open up its markets and introduce competition into the public utility industries since the 1980s. These efforts have brought dramatic changes in the business environment for the energy sector as well.

Changes affecting the gas industry include the March 1995 amendments to the Gas Utility Industry Law, which eased restrictions on rates and market entry in the area of gas supplies to large users (over 2,000,000 m^3 annually). Changes to pricing systems include yardstick system and the fuel-cost adjustment system, which were fully implemented in January 1996. The Gas Utility Industry Law was again amended in November 1999.

The new amendments to the Law further eased restrictions, and the market subject to liberalization was expanded to include customers using in excess of 1,000,000 m^3 of gas annually. Also, to facilitate the supply of gas to large users by suppliers without their own pipelines, the four major gas utilities (Tokyo Gas, Osaka Gas, Toho Gas, Saibu Gas) became subject to reporting and publishing requirements concerning their transportation services.

The electric power, petroleum and LPG industries are making similar moves toward deregulation and liberalization. These changes are reflected in accelerating competition among companies in the energy sector. Yet there are also increased opportunities to move into other energy markets.

The Strengths of the Osaka Gas Group

The Osaka Gas Group has a number of strengths that will help it to adapt successfully to these changes in the business environment. These strengths can be broadly categorized into the following three areas.

① **Excellent Financial Structure and Ample Cash Flows**

Compared with other companies in the Japanese energy sector, Osaka Gas combines low reliance on interest-bearing debt with a high shareholders' equity ratio. In addition, the cash flows are expected to remain ample in the medium-term future, allowing the Company to undertake forward investment in such areas as the electric power business and overseas energy projects.

② **Strong Customer Confidence, Ability to Respond Precisely to Customer Needs through Proposal Marketing**

Osaka Gas is able to respond to customer needs precisely, thanks to its advanced proposal, engineering and maintenance capabilities. In addition, a tradition of reliability has enabled the Osaka Gas Group to build a strong foundation of customer confidence.

Deregulation in the Electricity and Gas Industries

		Phase 1 (1995–)	Phase 2 (2000–)	Phase 3 (2003–)
Entry restrictions	Gas	Liberalization for customers using over 2 million m^3 per annum	Expansion of liberalization to include customers using over 1 million m^3 per annum	Further expansion of scope of liberalization
	Electricity	Introduction of IPPs and restricted power supply business	Liberalization of special high-voltage (over 2,000kW and 20,000V)	Equal footing for third party access
Transmission	Gas/ Electricity	Allowing third party access to transmission lines	Establishing connecting rules	Separate accounting for network operations (pipelines)
Rate regulations	Gas/ Electricity	Introduction of yardstick system and fuel-cost adjustment system	From approval to notification (price reductions), diversification of billing options	Facilitation of third-party use of LNG terminals

Press meeting announcing the establishment of a new subsidiary, Ennet Corporation.

LPG terminated facilities in Yokkaichi (Nissho Iwai Petroleum Gas Group)

The Torishima Energy Center, an IPP under construction in Osaka.

③ **Group Companies in Growth Phase**

Companies in the Osaka Gas Group have achieved net sales of ¥380 billion and income before income tax of ¥13 billion, and they are still achieving sustained growth. Initially the Group expanded into areas that offered significant synergies with the gas business. Today, more and more group companies are demonstrating their core competencies in a variety of industrial sectors. Osaka Gas has achieved greater diversification than any other utility company in Japan. During its 20-year history of diversification, it has also accumulated immense resources of knowledge and expertise. Another important strength is the Group's human resources. Group members, especially the core companies, will continue to raise their profiles in their respective areas. At the same time, the Group will follow a strategy of selection and concentration.

Osaka Gas aims to use these strengths to attract both customers and investors in the increasingly competitive energy sector of the future.

Energy Business Activities

The Osaka Gas Group sees this new era of deregulation as a time of business opportunities. It is aggressively expanding into the LPG and electric power businesses under a strategy designed to turn the Group into a "one-stop" energy supply service capable of meeting all of its customers' energy needs.

In the area of LPG, Osaka Gas acquired 70% of the shares of Nissho Iwai Petroleum Gas Corporation in September 2000, making it a part of the Osaka Gas Group. The Nissho Iwai Petroleum Gas Group handles 540,000 tons of LPG annually. It imports LPG as a wholesaler and sells it to LPG dealers throughout Japan. Its group consists of 16 companies, including LPG retailers, throughout Japan. Group annual sales amount to ¥65 billion.

The LPG chain expertise developed by the Nissho Iwai Petroleum Gas Group has been added to the marketing and gas facility expertise of the Osaka Gas Group in its gas operations. The Nissho Iwai Petroleum Gas Group will develop the LPG business on a national scale in cooperation with the Liquid Gas Group's existing LPG retailing business in the Kansai region.

The Osaka Gas Group has moved into the electric power business as an operator of its own generation facilities. It also aggregates surplus power from in-house generation facilities belonging to major power users. One of the Group's strengths in this field is its proposal marketing expertise, which will be used to discover demand and build a presence in the electricity retailing business.

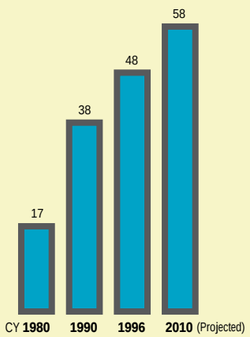
Osaka Gas is currently building a 150MW generator at Torishima in Osaka City. The plant will supply electric power to Kansai Electric Power Co., Inc. as an independent power producer (IPP). The plant is scheduled to come on line in April 2002. In April 2001, Ennet Corporation, a power retailing company established jointly by Osaka Gas, NTT Facilities Co., Ltd. and Tokyo Gas Co., Ltd., began to supply power to the Osaka Prefectural Government and nine office buildings. Ennet aims to secure resources of around 500MW within three years. In addition to the special high-voltage market, which has already been liberalized, the Osaka Gas Group is awaiting the liberalization of high-voltage supplies. It aims to attract demand equivalent to 3.5 GW, or 10% of all commercial contracts in the Kanto and Kansai regions. Plans for the electric power business also call for the networking of existing Osaka Gas customers so that surplus power can be sourced from their cogeneration facilities for sale.

In addition, the Osaka Gas Group is developing its energy service company (ESCO) business in conjunction with on-site generation. In January 2001 it began to provide services to a major shopping center in Ibaraki City, Osaka.

Expanding Demand for Natural Gas

The Bontang LNG Base in East Kalimantan, Indonesia

Future Natural Gas Demand in Japan
(Millions of Metric Tons)



Source: Ministry of Economy, Trade and Industry

Natural Gas Demand Forecast

Natural gas is seen as a principal energy source having potential for greatest growth in Japan's energy mix in the future. The three basic requirements for an energy supply system are the ability to cope with economic growth, consideration for the environmental protection and energy security. In particular, global warming is now recognized as a major issue throughout the entire world, and there is growing demand for clean energy.

Natural gas is an abundant resource, with reserves estimated to be sufficient for 63 years. It is also environment-friendly, since it contains no SOx and emits far smaller amounts of CO_2, NOx and other substances than coal or oil. The environmental impacts imposed by natural gas is the smallest of any fossil fuel.

In July 2001, the Advisory Committee for Resources and Energy, which advises the Minister of Economy, Trade and Industry, formulated a new long-term energy supply and demand outlook calling for the increased contribution of LNG to Japan's energy mix from 12.7% in fiscal year 2000 to 14.0% by fiscal 2011. Natural gas can be expected to play an increasingly significant role in meeting Japan's energy needs.

The gas sales of Osaka Gas have increased by an average of 4.3% annually in volume terms over the past decade and expected to increase by an average of 3.4% per annum until 2010.

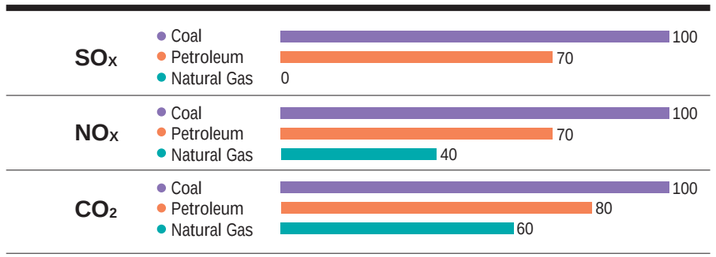
Developing New Uses

Residential Cogeneration System to Debut in 2002

The cumulative capacity of gas cogeneration systems supplied by Osaka Gas, primarily for commercial and industrial uses, is now in excess of 1GW. These systems form a highly efficient distributed energy network with an output equivalent to that of a major power station.

Osaka Gas aims to introduce cogeneration systems into the residential sector. In the fall of 2002, it plans to market a cogeneration system with a compact 1kW gas engine. Based on field tests, the new system can be expected to reduce residential energy consumption by 10% and CO_2 emissions by 15%.

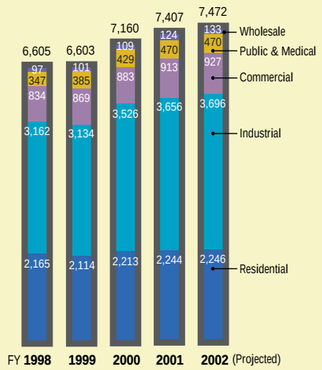
Environmental Advantages of Natural Gas



Note: All values are in relation to coal emissions, which are set at 100 for comparative purposes.
Source: "IEA Natural Gas Prospects to 2010," 1986

Fuel reformer for PEFCs

Projected Gas Sales Growth by Sector
(Millions of m^3)



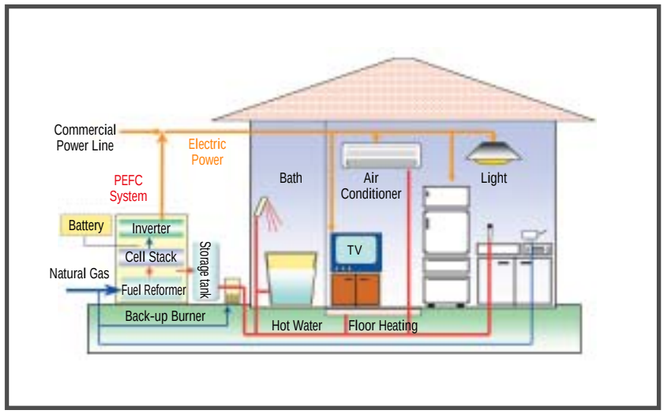
Development of Residential Fuel Cells Continuing

Polymer electrolyte fuel cells (PEFCs) have been described as a revolution in energy technology. Osaka Gas aims to have PEFCs for use as residential cogeneration systems on the market by 2005. The target of the commercial development program is to produce 500W and 1kW PEFC cogeneration systems. These next-generation cogeneration systems will have an extremely high generation efficiency rating of 35% (LHV). Since waste heat will also be utilized, total energy efficiency will reach 65~70% (LHV). This new technology will allow residential energy consumption to be reduced by about 10%, and CO_2 emissions by 20%. These systems are extremely environment-friendly. Emissions of nitrous oxides (NOx) will be almost zero, and there will be negligible vibration or noise.

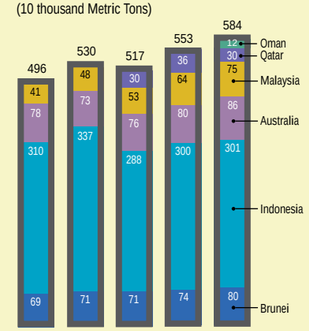
The keys to the development of the new systems are catalyst technology developed over many years, and a compact fuel reformer that will be used to extract hydrogen from natural gas. In addition to its compact design, the fuel reformer also features a unique structure that provides dramatic improvements in thermal efficiency. Because the device is easy to produce, it will be possible to reduce costs substantially through mass-production. The technology embodied in this fuel reformer is at the leading edge of international developments in this field and is being supplied to manufacturers in Japan and overseas.

A prototype 500W PEFC cogeneration system developed by Osaka Gas underwent field tests under actual living conditions between January and April 2000 in Next21, an experimental multi-family housing unit occupied by Osaka Gas employees and their families. This trial, the first in the world, yielded useful information about crucial technical issues. Osaka Gas plans to resolve these issues in the first half of fiscal year 2002 and to resume trials in an actual household environment, using modified equipment.

PEFC Cogeneration System for Residential Application



LNG Purchase by Volume
(10 thousand Metric Tons)



LNG *Jamal* transports LNG to Osaka Gas.

Natural Gas Value Chain

Natural Gas Value Chain

The Osaka Gas Group has a number of strengths in the natural gas business, including its infrastructure and expertise, and its powerful market development capabilities. One of its management strategies is to seek business opportunities at all levels from upstream to downstream, and to link all of its business operations to form a value chain. Areas of business in which the Group is already involved range from upstream activities, such as gas field development and LNG transportation, to diverse gas transportation and supply.

Upstream Natural Gas Activities

The Osaka Gas Group sees an involvement in the upstream end of the value chain as a way of ensuring stable supply of low-cost gas. At the same time, the upstream undertaking is expected to contribute to earnings as an independent business within the Group.

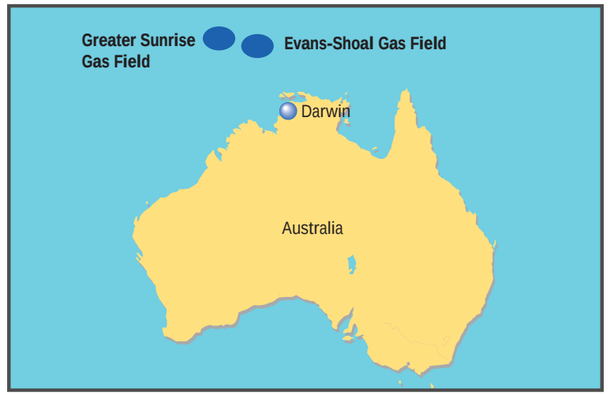
Osaka Gas first became involved in overseas gas field development in 1990, when it acquired a shareholding in Universal Gas and Oil (UGO). UGO explores and produces natural gas and other resources in Indonesia. In July 2000, Osaka Gas signed a contract under which it owns a 10% share of the offshore gas of Northern Australian Gas Venture (NAGV).

Following the ownership of two LNG tankers, LNG *Flora* and LNG *Vesta*, the third vessel of Osaka Gas, LNG *Jamal*, went into service in October 2000. Recently surplus capacity on these vessels has been used to deliver LNG to other countries.

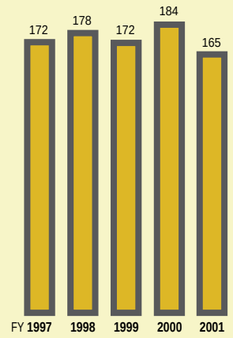
Domestic Gas Transportation and Supply

Osaka Gas has put considerable effort into the development of the supply network to other gas companies in Japan. Its efficient supply system which originates from Himeji Terminal and Senboku Terminal is based on the combination of pipeline network, coastal tankers (planned) and an overland lorry fleet. These various methods are used for wholesaling of natural gas to 11 other gas companies (as of March 2001). A total of 124 million cubic meters of gas is supplied by pipeline to four companies, while the LNG equivalent of 170,000 tons is delivered to seven companies by lorries.

The Northern Australian Gas Venture (NAGV).



R&D Expenditures
(Billions of Yen)



Osaka Gas achieved advanced R&D results in the area of PEFCs.

Valuation test of PEFC for residential use.

Advanced micro-gas turbine.

Research and Development

Perspectives on Technology Development

Competition is intensifying in the energy sector. The Osaka Gas Group uses a strategy of "selection and concentration" to maximize the cost effectiveness of its R&D activities. Management also recognizes the need to accelerate development so that new advances can be brought to the market as quickly as possible. Osaka Gas has created a highly efficient R&D structure that takes full advantage of the Company's own core areas of expertise while building alliances with outside companies and institutions. This approach is helping to enhance the competitiveness of the Osaka Gas Group.

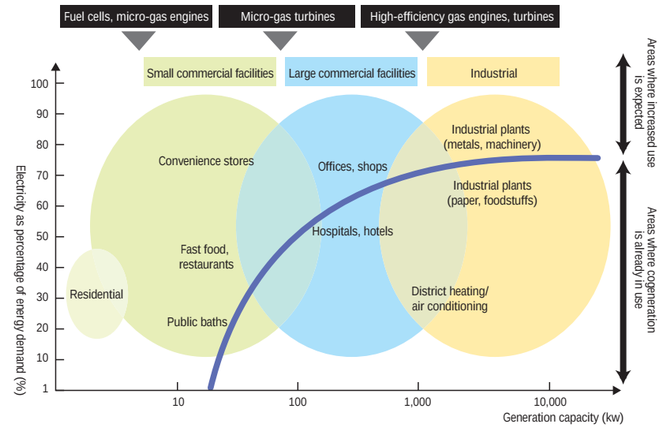
Activities in Fiscal 2001

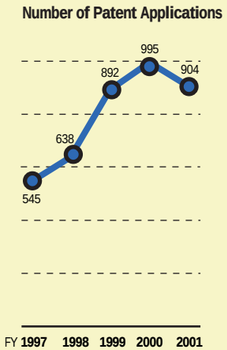
In fiscal year 2001, consolidated expenditure on research and development, including labor costs, expenses and depreciation, amounted to ¥16.5 billion. Some of the important achievements during the year are outlined below.

Cogeneration Technology

There is growing interest in cogeneration systems as distributed energy systems that impose a reduced load on the environment. There is enormous potential for the increased use of this technology in the future. Osaka Gas has sold more cogeneration capacity than any other gas companies in Japan. In addition to its efforts to

New Technologies to Meet Demand for Gas Cogeneration






Built-in cooker with a heat-resistant ceramic glass surface.


The No. 18 LNG tank at the Senboku Terminal.

improve generating efficiency through the refinement of combustion methods and cycles, it also aims to expand the market for new systems by developing compact cogeneration systems, including micro-gas turbines, polymer electrolyte fuel cells (PEFCs) and micro-gas engines.

Osaka Gas plans to commercialize a residential cogeneration system with a 1kW gas engine on the market in 2002, followed in 2005 by 1kW and 0.5kW PEFC systems. Fuel reformers developed by Osaka Gas incorporate the most advanced catalyst technology in the world. It has supplied this technology to a number of fuel cell manufacturers, including H Power Corporation of the United States.

Gas Air Conditioning Technology

There are two gas air conditioning technologies: absorption chiller/heater and gas engine heat pump. Because of its excellent energy efficiency, gas accounts for a substantial share in the air-conditioning market for large buildings. Osaka Gas aims to make gas air conditioning more competitive against electrical systems by developing technology to further improve system efficiency and reduce prices.

Osaka Gas has developed a super-efficient gas heat pump which has achieved the industry's highest coefficient of performance (COP) of 1.3. It plans to launch the new system in fiscal year 2002 for use in stand-alone air conditioning systems in commercial buildings.

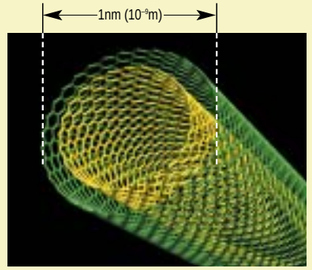
Residential Appliances

The aim of development activities in this area is to enhance and expand the existing range of gas home appliances while developing new products with improved levels of energy performance, safety and comfort. Kitchen appliances developed by Osaka Gas include a popular built-in cooker, which features a heat-resistant ceramic glass top, which combines an attractive design with ease of cleaning. The range also includes central heating terminal devices, such as floor heaters, bathroom heater-driers and dishwashers. In addition, Osaka Gas has developed the PRIOR ECO, a water heater that uses condensing technology to recover latent heat from steam exhaust gases. The most efficient system of its type in Japan, it won an energy conservation award from the Minister of Economy, Trade and Industry.

LNG Transportation and Distribution Technology

Another focus of technology development is the maintenance of safety in LNG operations. Osaka Gas has been involved in the development of pre-stressed concrete (PC) LNG tanks for many years. The latest technology resulted in construction of an 180,000kl LNG tank at the Semboku Terminal, with substantial savings in cost and construction time.

Technologies to enhance the durability, earthquake resistance and safety of transportation and distribution systems are also among the agenda of R&D. Trenchless pipe replacement systems which can reduce installation costs have also been introduced.



High-grade carbon nanotube used for nanotechnology applications.

Information Technology, Materials Technology

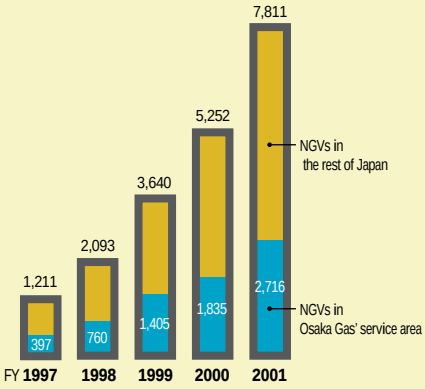
Osaka Gas has responded to the rapid spread of the Internet by establishing electronic commerce systems. It is also developing technology for remote meter reading systems based on wireless communications jointly with other utilities.

In the past Osaka Gas manufactured gas from coal and oil. It has maintained and expanded expertise accumulated during that period, which has formed the basis of new technologies in carbon materials and catalysts. This knowledge and expertise has further developed into natural gas reformers for fuel cells, natural gas adsorption materials, lithium secondary power cells and other energy storage materials, as well as environmental purification catalysts to remove toxic substances from exhaust gases and waste water. The development of the mass-production method for high-grade carbon nanotubes is another product of our accumulated technologies and applications for this nanotechnology-based product is now under development as a hydrogen storage material and electron discharge material.

R&D Achievements

Field	Achievement
Cogeneration	• Development of cogeneration system based on 290kW micro-gas turbine • Development of lean-burn mirror cycle gas engine • Transfer of high-performance fuel reformer technology for polymer electrolyte fuel cell (PEFC) to H Power
Air conditioning	• Reduction of NOx emissions from GHP • Development of gas air conditioner with new refrigerant
Residential	• Development of "PRIOR ECO" condensing hot water and heating system • Development of table-top dish washer-drier • Development of wall-mounted, gas-fired bathroom heater-drier • Development of high-power cooker with multiple internal burners for Chinese cooking • Development of "Glass-Top Built-in Cooker" with heat-resistant ceramic glass top • Development of bath with pulse detector
LNG	• 18th LNG tank at Senboku Terminal • Development of simultaneous two-way transmission system for moving pictures via PHS) • Development of methane hydrate exploration and production technology
Gas transmission and distribution	• Trenchless pipe replacement method • Development of in-pipe camera system with water extraction functions • Development of "G-Setter" governor pressure adjustment system for gas regulator • Development of software for 3-D gas visualization system
Information technology	• Field testing of shared remote metering system for electricity and gas • Development of rice cooker controlled via Internet
Materials, etc.	• Development of carbon nanotubes • Development of LNG polymer materials • Development of mass-production technology for high-grade polysilane • Development of new low-NOx combustion system based on fluid elements • Development of new "Aqua Loop System" wet-catalyst oxidation process • Development of world's smallest dioxin recovery filter (capable of high-speed extraction)

Number of Natural Gas Vehicles
(Units)



Osaka Gas encourages the use of natural-gas-powered buses.

The Gas Science Museum at Senboku Terminal attracts many visitors.

Osaka Gas achieved ISO 14001 accreditation at all corporate facilities.

Contributing to the Environment and Society

The Environment

Osaka Gas is working to enhance its value to the shareholders, customers and society. In its efforts to enhance its social value, the Company has focused in particular on environmental protection. In June 2000 it adopted Long-term Environmental Targets for the period to fiscal year 2011. It is working to reduce CO_2 emissions resulting from its business activities, and to reduce and recycle wastes. Other efforts to reduce the environmental load include the reduction of the volume of soil requiring final disposal during gas pipeline construction work, the promotion of "Green Procurement," the development of highly efficient products, and recycling of used appliances. In addition, the Osaka Gas Group has established a corporate environmental behavior promotion system. It has also included environmental items in its internal performance assessment systems and achieved ISO14001 accreditation at all corporate facilities. Through these and other activities, Osaka Gas is helping to conserve energy and resources and reduce the burden on the environment.

Since 2000 Osaka Gas has calculated and disclosed its environment costs based on uniform environmental accounting standards adopted by the entire gas industry. Details of the Company's environmental behavior can be found in its Environmental Action Report.

Contributing to Society

All corporate activities of the Osaka Gas Group are linked to local communities. The companies and employees who make up the Group, are involved in a wide range of community activities through the Osaka Gas Small Light Campaign, which has now been running for 20 years. Activities range from charity concerts to fund-raising for disaster relief, sign language and braille courses and local clean-up projects.

The Osaka Gas Group Welfare Foundation provides grants for welfare activities, and for research and surveys relating to the welfare of the elderly. It also supports health improvement activities for the aged. The Osaka Gas Foundation of International Cultural Exchange provides assistance for classroom materials for use in elementary schools and junior and senior high schools in natural gas-producing countries, including Indonesia and Malaysia. It also provides research grants and scholarships to universities.

As part of its public relations activities for enhancing community understanding about natural gas, Osaka Gas established facilities at its Senboku and Himeji LNG Terminals. The Gas Science Museum at Senboku and the Gas Energy Hall in Himeji receive around 94,000 visitors per year, most of whom are elementary school children.