Cover Story

The cover page illustration shows "KEISO LIME," a building interior finishing material utilizing diatomaceous earth, developed by Osaka Gas Chemicals Co., Ltd. Diatomaceous earth is a kind of soil created by the accumulation over several million years of the dead bodies of phytoplankton that thrived in ancient seas and lakes.

Consisting of highly porous particles, the moisture content of KEISO LIME changes just as if it were breathing, thus providing excellent heat retention and insulation. It is also effective in deodorizing and in preventing dew condensation and furthermore produces no harmful substances during production and disposal.

By combining this diatomaceous earth with carbon fiber, a new material, Osaka Gas has succeeded in developing the world's first finishing material with high resistance to cracking.

In recent years, finishing material utilizing diatomaceous earth has drawn attention as naturalistic surface materials gentle to humans and the earth.

2002 Environmental Report

The Environmental Report is posted on our web site. For more extensive data, see the "Additional Data" on the Osaka Gas Environmental Home Page at the following address:

http://www.osakagas.co.jp/kankyo/index.htm

Osaka Gas Environmental Report 2002
The Committee on Energy and the Global Environment, Osaka Gas Co., Ltd.
4-1-2, Hiranomachi, Chuo-ku, Osaka 541-0046, Japan
Published in September 2002 (first edition)
For inquiries, contact the Environment Department at +81-6-6205-4605.

GPN Green Purchasing Network
Osaka Gas promotes green purchasing

PRINTED WITH SOY INK

This brochure is printed on recycled paper with highly biodegradable soy ink that allows easy recycling of printed matter.

OSAKA GAS

ENVIRONMENTAL REPORT
CONTENTS

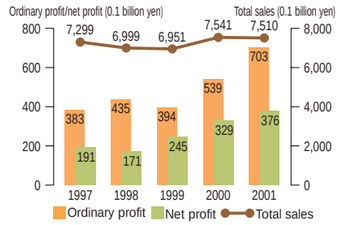
Corporate Profile (as of 31 March 2002)

Head office	4-1-2, Hiranomachi, Chuo-ku, Osaka 541-0046, Japan Tel: +81-6-6202- 2221
Capital	132,166 million yen
Major fields of business	1. Manufacture, supply and marketing of gas 2. Marketing of gas equipment and related construction work 3. Contracted pipe installment, etc.
Number of customers	6,484,000 (number of gas meters installed)
Amount of gas sold	7,309 million m³ (FY 2001)
Number of employees	8,810 (including directors and part-time employees and excluding employees being loaned to other companies)

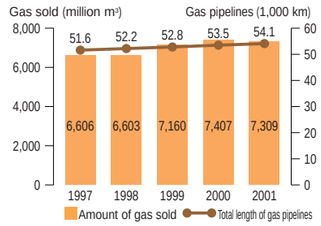
Affiliates

Number of affiliates	120 (including 43 consolidated subsidiaries)
Total sales	383.6 billion yen (as of FY 2001)
Number of employees	8,827

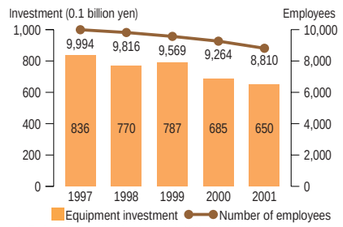
Total Sales, Ordinary Profit and Net Profit



Amount of Gas Sold and Total Length of Gas Pipelines



Equipment Investment and Number of Employees



Note: The figures for the number of employees for FY 1999 and before include employees on loan.

Osaka Gas Service Areas

Editorial Objective The "Osaka Gas Environmental Report 2002" was prepared with reference to "Environmental Reporting Guidelines" by Japan's Ministry of the Environment, and "Sustainability Reporting Guidelines" by the Global Reporting Initiative (GRI)*. The "Osaka Gas Environmental Report 2002" describes environmental activities carried out in FY 2001 (from April 1, 2001 to March 31, 2002).

In this report, more extensive data on our environmental performance, etc., are provided as compared to previous reports. The terminology and descriptions of technological developments have been improved in order to make the report more understandable. New items include information concerning social performance, including anti-disaster measures, labor safety and health, legal compliance, and local philanthropic activities. In response to the opinions of scientists, consumer organizations, NPOs, NGOs, and other parties, we have improved the accuracy of the report.

The scope of this report covers the environmental activities of Osaka Gas Co., Ltd. and its major affiliates. More details are available on our web site (for the address, see the back cover). The next report will be issued in September 2003.

*Global Reporting Initiative (GRI): An international organization established in 1997 to facilitate the drafting of globally applicable guidelines for sustainability reports by companies. The GRI Guidelines aim at sustainability focusing on the mutual association of "Environment," "Society," and "Economics."

Osaka Gas Business Management Strategy and Environmental Management

The 21st century has been called "the Century of the Environment." A major challenge for the energy sector today is to balance sustainable economic growth with energy security and environmental conservation. We call this the "3-E" challenge. Osaka Gas provides a "one-stop service" as a supplier of various forms of energy, including city gas, heat, electricity and LPG. With the belief that "environmental actions are business activities for energy utility companies," we want to be a leading company that takes the initiative in environmental action, as well as in energy costs, efficiency and supply stability, so as to attract the approval of customers and the public.

"Value Creation Management" — Osaka Gas's Business Strategy —

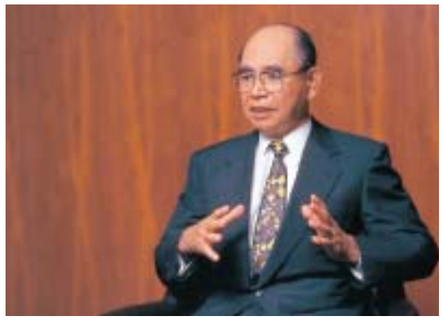
In 1999, Osaka Gas formulated its "2010 Vision" as the basis for its group's long-term business activities to meet the requirements of the new era. The "2010 Vision" advocates a corporate philosophy described as "Value Creation Management," aiming at maximizing the corporate value of our group as a whole by increasing "Values for Customers," "Values for Shareholders," and "Values for Society." Osaka Gas and its group companies are making efforts to accomplish specific goals for increasing these values.

Environmental Action — The Key to "Value Creation" —

In the "2010 Vision," environmental actions are given priority as the key to "increasing values for society." Specifically, we are actively involved in a broad spectrum of environmental activities including environmental improvement through promoting the use of natural gas, a clean energy source, efficient use of energy and resources at our own plants and offices, development and diffusion of energy-saving and environment-improving technologies at our customers' homes and businesses, and local and overseas environmental conservation activities. Through these activities, which we think of as our duty, Osaka Gas is making constant efforts to strengthen its "environmental management," with the aim of realizing the concept "Value Creation."

Future Environmental Management — Further Innovation —

Business circumstances for the energy industry are changing dramatically due to various factors, including rapidly advancing trends toward deregulation of the electric power and city gas markets, as well as the persistent economic recession. Against this background, we cannot be thought highly of by our customers, shareholders or society unless we are able to continue to create new corporate values through constant innovation. In implementing "environmental management," we must strive to further improve the global environment and local environments by developing new technologies and reforming business procedures, and moreover by making further innovations in all areas including our corporate systems and every employee's awareness of environmental conservation. We would like to enhance our "environmental management" through such innovations and hence to expand our business operations.



This year's "Environmental Report" provides a sophisticated description focusing on improving environmental accountability by presenting quantitative data on the environmental impacts imposed by our own plants and offices and at our customers' homes and businesses. Aiming at further qualitative improvement of our environmental actions, we have also begun to positively exchange mutual opinions with the relevant stakeholders and to reflect their valuable opinions in our future environmental actions. We would be happy if this report helps deepen your understanding of Osaka Gas's environmental efforts, and we would most sincerely welcome your frank opinions, which will be of great value to our future activities.

Akio Nomura

Akio Nomura
President
September 2002

Osaka Gas's Environmental Activities

Environmental Philosophy and System — Companywide Environmental Activities —

Osaka Gas carries out environmental activities based on the "Osaka Gas Environmental Philosophy" and the three guidelines advocated in the "Osaka Gas Environmental Action Guidelines," which provide specific guidance concerning the Philosophy. We have established the "Committee on Energy and the Global Environment" as an internal organization for examining and reviewing environmental issues, supported by an associate deliberative council. To ensure the effectiveness of our environmental activities, we have also organized the "Environmental Conservation Promotion Secretariat Representatives' Council." Also, an environmental conservation promotion secretariat has been organized in each department. This internal system enables our individual employees to fully understand the Philosophy, the Guidelines and other corporate codes, and motivates them to be involved positively in environmental activities.

The Three Guidelines — Environmental Actions for Definite Objectives —

Focusing on environment impact reduction in business operations, Guideline 1 covers the activities to improve the environment in the phase of business leading up to supplying gas to our customers. For example, we have been engaged in reducing CO_2 emissions through energy-saving activities and promoting the use of untapped energy at our plants and offices. In FY 2001, we reduced CO_2 emissions per m^3 of gas sold by about 19% as compared to FY 1997. Other efforts include reduction of resource consumption, promotion of resource recycling, and improvement of environmental management.

Guideline 2 concerns contributions to reducing the environmental impacts through our products and services. Major efforts include the technological development and widespread application of energy-saving equipment and systems using natural gas. In FY 2001, we made significant contributions to energy-saving and reduction of CO_2; for example, the cumulative capacity of gas co-generation systems installed in Osaka Gas's service areas amounted 1.13 million kW, accounting for about 50% of the national total. Other efforts include control of air pollutant emissions through widespread application of low-NOx equipment and natural gas vehicles (NGVs), and recovery and recycling of used gas equipment. One of our important missions is to make positive efforts to increase awareness of the importance of improving the environment in situations where our customers are actually using city gas.

Guideline 3 advocates contribution to local, national and international environmental improvement. For people in local communities and throughout the world, we are conducting a broad spectrum of philanthropic activities, including the "Everyone's Environmental Effort Campaign" and "Better Citizenship Activities," carried out together with people living around our plants and offices, as well as development of environmental conservation technologies, and technology transfer to domestic and overseas sectors.

In FY 2001, the final year of the three-year mid-term environmental plan, quantitative targets were met in all categories, and we are now confident that these remarkable achievements will be greatly appreciated by our customers and by society.

Environmental Goals for FY 2010 — In the Long Term —

In 2000, we established the "Environmental Goals for FY 2010" as criteria for long-term actions to realize the "2010 Vision." For each of the three Action Guidelines, quantitative targets have been established, including "25% reduction of CO_2 emissions per unit of gas sold associated with our business activities as compared to FY 1998," "toward zero emissions on a companywide basis;" and "development of a gas air-conditioner greater than 50% more efficient than current models." There are other various environmental goals, 11 items in all, including companywide acquisition of ISO 14001 certification and promotion of philanthropic activities that contribute to environmental conservation in local communities. Because we view all these goals as commitments to our customers and society, we are carrying out a wide variety of environmental conservation activities in order to fulfill them.

Specific Action Plan — Toward Further Environmental Action —

As a step towards the accomplishment of our long-term goals, we formulated the "Mid-term Environmental Plan for FY 2005" at the end of FY 2001. In this Mid-term Plan, we established 34 action targets based on our long-term goals. Additionally, expectations for goal accomplishment were moved forward for some long-term goals, including zero emissions. We realize that it is a key business strategy to accomplish the Environmental Goals for FY 2010 as early as possible and to become actively involved in further environmental actions by aggressively utilizing our business management resources to resolve environmental issues.

As a leading company highly appraised by our customers and the public for our emphasis on environmental conservation, Osaka Gas will continue to make efforts to meet our Environmental Goals in all our business activities and to be positive in information disclosure.

Yuji Matsumura

Yuji Matsumura
Vice-President
Chairperson of the Committee on
Energy and the Global Environment
September 2002

2010 Vision

Value Creation Management

Corporate Values

Values for Customers

1) Gas rates and rate menus
We make efforts to reduce gas rates and to broaden the menu variety.

2) Service standards
We endeavor to increase our customers' satisfaction by providing new customer centers with wide regional coverage.

3) Safety standards
We strive to maintain the "zero serious accidents" status at our major facilities and to further improve the safety of our customers' equipment.

Values for Shareholders

1) Ordinary profit
Osaka Gas: Not less than 65 billion yen
Consolidated: Not less than 75 billion yen

2) Net profit
Osaka Gas: Not less than 35 billion yen
Consolidated: Not less than 40 billion yen

3) Return on equity (ROE)
Not less than 9.0%

4) Return on assets (ROA)
Not less than 3.5%

5) Free cash flow
To go into the black in FY 2000 and to increase profits thereafter.

*Consolidated figures include 25 companies. Quantitative targets are based on the assumption that there will be no major changes in business circumstances.

Values for Society

1) Environmental actions
We contribute to society through our business activities and our activities to improve the environment at our customers' homes and businesses.

2) Philanthropic activities
We carry out philanthropic activities mainly in the areas of welfare, regional cooperation, environmental conservation, and international exchanges.

3) Information disclosure and legal compliance (abiding by laws and regulations)
We promote information disclosure and legal compliance by improving our internal regulations and strengthening our internal awareness-raising activities.

Environmental Philosophy and Environmental Action Guidelines

Environmental Philosophy

Environmental conservation at both the local and global levels is an extremely important mission for energy utility companies. Bearing in mind that all of its business activities are closely related to the natural environment, the Osaka Gas Group pursues harmony with the environment and realizes the efficient use of energy and resources through its business operations.

Action Guidelines

Action Guideline 1 Reduction of the Environmental Impacts of Our Business Activities

We aim to reduce the environmental impacts of our business activities. To this end, Osaka Gas will strengthen its environmental management system and promote internal activities aimed at saving energy and resources.

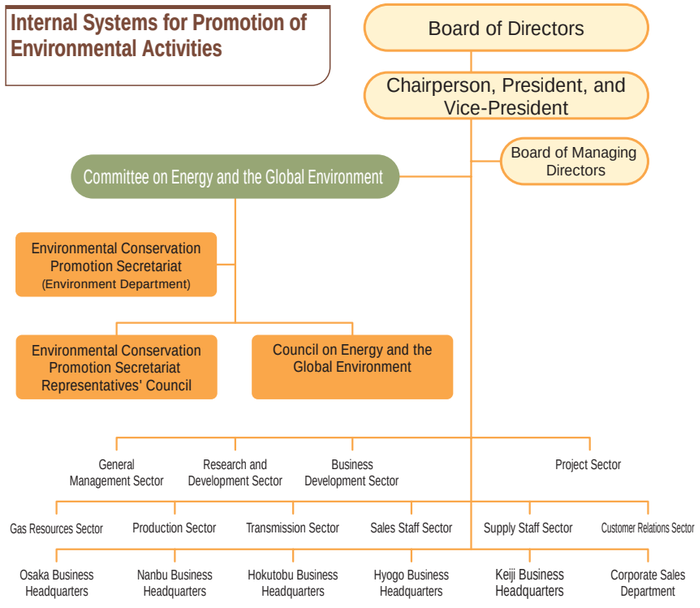
Action Guideline 2 Contribution to Environmental Impact Reduction through Our Products and Services

We aim at environmental conservation through promoting the widespread use of natural gas and will make efforts together with our customers towards reducing the environmental impacts through our products (natural gas, heat supply, and our equipment and systems). To this end, we will strive to develop and implement energy-saving and environmental conservation technologies and to promote recycling of resources.

Action Guideline 3 Contribution to Environmental Improvement Locally, Nationally and Overseas

We aim to take an active part in environmental improvement activities in areas wherever we conduct business, both in and outside Japan.

Internal Systems for Promotion of Environmental Activities



● Departmental Environmental Action Promotion System

Environmental Management Supervisor (General manager of each department)

Environment Committee
- Chairperson : General manager of each department
- Members : General managers of sections under each department, and others
- Roles : Review and evaluate environmental action plans, actual results, etc. of individual management units

Environmental Conservation Promotion Secretariat

Environmental Manager (for each section under each department)

Environmental Conservation Promotion Secretariat Representative (for each team)

● Committee on Energy and the Global Environment

Chairperson	Vice-President
Vice-Chairperson	Director in charge of environmental activities
Members	Relevant executive officers and general managers of relevant departments
Secretariat	Environment Department
Roles	Examination and review of basic policies and measures for companywide environmental activities. Examination and review of efforts to resolve problems concerning energy and the global environment, data publication, etc.

● Environmental Conservation Promotion Secretariat Representatives' Council

Chairperson	General Manager of the Environment Department
Members	Environmental Conservation Promotion Secretariat representatives of individual departments
Secretariat	Environment Department
Roles	Deliberation on policies for integrated company-wide communication and exchanges of opinion, and on information, reviews, and instructions regarding management units' progress in environmental action.

● Council on Energy and the Global Environment

Chairperson	General Manager of the Environment Department
Members	Assistant managers of relevant departments
Secretariat	Environment Department
Roles	Preliminary examination of subjects for review by the Committee on Energy and the Global Environment, and examination and discussion on various environmental conservation measures.

Environmental Goals for FY 2010 and Mid-term Environmental Plan for FY 2005

Since FY 1999, Osaka Gas has promoted companywide environmental activities aimed at the Mid-term Plan for FY 2001. As a result, we achieved all quantitative targets set for FY 2001 (see pages 11 and 12). At the end of FY2001, we formulated the new Mid-term Environmental Plan for FY 2005, which provides more specific targets based on the Environmental Goals for FY 2010, established in 2000. The goals specified in the Mid-term Plan for FY 2001 were revised to double the number of quantitative targets, from 12 to 24, the total number of target items being 34.

	Key measures	Target items	Mid-term Environmental Plan for FY 2005	Environmental Goals for FY 2010	Page
Action Guideline 1 Reduction of the Environmental Impacts of Our Business Activities	1) Control of CO_2 emissions associated with city gas operations	CO_2 emissions per m^3 of gas sold (*1)	25g-CO_2/m^3 (FY 1998) → not more than 20g-CO_2/m^3 (20% reduction)	25g-CO_2/m^3 (FY 1998) → not more than 19g-CO_2/m^3 (25% reduction)	16-17
	2) Introduction of Natural Gas Vehicles (NGVs) at our plants and offices	NGV introduction rate (= number of NGVs introduced/number of vehicles owned)	19% (FY 1998) → not less than 50%	To increase the number of NGVs from 562 (as of the end of FY 1998) to 1,760 (80%*2)	18
	3) Gas pipe work				19-20
	●Reduction of the amount of excavated soil ultimately disposed of	Amount of excavated soil disposed	380,000 t (FY 1998) → not more than 100,000t (about 75% reduction)	380,000 t (FY 1998) → not more than 100,000t (about 75% reduction)	
	●Promotion of excavated soil recycling	Recycling rate of excavated soil (*3)	42% (FY 1998) → not less than 65%	――	
	●Improvement of recycling rate of polyethylene pipe waste	Recycling rate of used polyethylene pipes	To maintain a recycling rate of 100% and to improve the internal use rate of products recycled from polyethylene pipe	――	
	4) Promotion of green procurement				23
	●Expansion of green purchasing	Monetary ratio of environmentally friendly office supplies purchased	52% (FY 2000) → not less than 70% (ratio to all unit price purchases)	●To preferentially purchase environmentally friendly office supplies ●To require fulfillment of specified environmental criteria for suppliers of materials and machines and in construction work for Osaka Gas business partners ●To use 100% recycled paper	
	●Promotion of green distribution	Promotion of green distribution	To request business partners to shift from conventional vehicles to low-pollution vehicles for logistic, service and sales activities	――	
	5) Waste reduction and improvement of recycling rate				21-22
	●Plants Toward zero emissions at plants	Amount of waste disposal (industrial and general) generated by plants	230t (FY 1998) → not more than 25t (*4) (about 90% reduction)	230t (FY 1998) → not more than 25t (*4) (about 90% reduction)	
	●Non-manufacturing sites Toward zero emissions of general waste	Amount of final general waste disposal	1,000 t (FY 1998) → not more than 500 t (50% reduction)	1,000 t (FY 1998) → not more than 100 t (about 90% reduction)	
		Recycling rate of general waste	43% (FY 1998) → not less than 75%	――	
	Toward industrial waste reduction and improvement of recycling rate	Amount of industrial waste disposal	4,400t (FY 1998) → not more than 1,760 t (*5) (60% reduction)	――	
		Recycling rate of industrial waste	55% (FY 1998) → not less than 80%	――	
	6) Strengthening of environmental management	Acquisition of ISO 14001 certification	To accelerate companywide acquisition of ISO 14001 certification	To acquire ISO 14001 certification in all departments	24-26
	7) Improvement of environmental accountability	Enhancement of environmental accounting	――	Full-scale introduction (starting in FY 2000)	13-14
Action Guideline 2 Contribution to Environmental Impact Reduction through Our Products and Services	1) Contribution to the control of CO_2 emissions and energy efficiency at our customers	CO_2 emissions control	To reduce by 20% the CO_2 emission increment corresponding to the increase in the amount of city gas sold through the promotion of gas co-generation systems, gas air-conditioning systems, etc. in FY 2005 as compared to FY 1998	To reduce by 20% the CO_2 emission increment corresponding to the increase in the amount of city gas sold through the promotion of gas co-generation systems, gas air-conditioning systems, etc. in FY 2010 as compared to FY 1998	31-32
		Energy consumption control	To reduce by 6% the energy consumption corresponding to the increase in the amount of city gas sold through the promotion of gas co-generation systems, gas air-conditioning systems, etc. in FY 2005 as compared to FY 1998	To reduce by 6% the energy consumption corresponding to the increase in the amount of city gas sold through the promotion of gas co-generation systems, gas air-conditioning systems, etc. in FY 2010 as compared to FY 1998	
	2) Development of technologies for increased efficiency of gas equipment and systems	Improvement of gas engine co-generation efficiency	To commercialize large-scale power generators (6,000 kW) with efficiency improved by 13% (compared to FY 1998) (power generation efficiency 38% → not less than 43%)	To develop power generators with efficiency improved by not less than 20% as compared to FY 1998	36-39
			To commercialize high-efficiency Miller cycle gas engine co-generation systems (380-1,000 kW) with power generation efficiency improved by 20% (compared to FY 1998) (power generation efficiency 35% → not less than 42%)		
		Improvement of air-conditioning equipment efficiency	To commercialize gas absorption refrigerator (100-500 RT) and GHP with efficiency improved by not less than 50% (compared to FY 1998) (COP 1.0 → 1.5 for both equipment) (*6)	To develop equipment with efficiency improved by not less than 50% and NOx emissions reduced by 40% as compared to FY 1998	
		Improvement of efficiency of water heaters for household use	To commercialize condensing equipment with thermal efficiency improved by not less than 16% (compared to FY 1998) (thermal efficiency 80% → 93%) and to commercialize 3 or more models of hot water heaters equipped with such condensing equipment	To develop models with thermal efficiency improved by not less than 10% as compared to FY 1998	
			To commercialize compact water heaters with thermal efficiency improved by 7% (compared to FY 1998)		
		Gas co-generation systems for household use	To commercialize a gas co-generation system for household use	To develop a highly efficient low-NOx fuel cell co-generation system	
	3) Development of technologies for reduction of NOx emissions and promotion of low-NOx products	Low-NOx dryers	To commercialize an ultralow-NOx (not more than 15 ppm) directly fired clothes dryer for commercial use	――	33
		Low-NOx boilers	To commercialize hot water boilers (200,000-500,000 kcal) with NOx emissions reduced by 33% (60 ppm in FY 1998 → not more than 40 ppm)	――	37
	4) Promotion of NGVs	Number of filling stations installed	24 stations (FY 1998) → 80 stations	――	33
	5) Promotion of ecological design in gas equipment etc.	Gas equipment for household use	To reduce the size and weight of ceiling installation type bathroom heater/dryer (40% reduction as compared to FY 2000, commercialized in FY 2003) and to expand the use of shrink packaging	Promotion of ecological design	40
	6) Recovery and recycling of gas equipment and systems	Recovery rate	To improve and maintain a recovery rate of not less than 90% for major used gas equipment at Osaka Gas and its service chain shops	To improve and maintain a recovery rate of not less than 90%	35
		Recycling rate	To improve the recycling rate for major equipment recovered by Osaka Gas's recovery system to not less than 80%	――	
Action Guideline 3 Contribution to Environmental Improvement Locally, Nationally and Overseas	1) Contribution to domestic and overseas environmental improvement	Widespread application of environmental technologies	To promote use of wet catalyst oxidation process technology and waste hydrochloric acid recycling system technology	To encourage and to provide technical support for energy-saving and environmental projects	28
			To diffuse tree planting technology using VAM fungi and to develop and commercialize antibiotic microbial materials	――	
		Contribution to environmental impact reduction at public facilities etc.	To promote use of sewage sludge fusion systems and garbage incineration systems	――	42-45
	2) Development of new environmental technologies	Harmful substance treatment technologies	To develop and commercialize dioxin treatment technologies	――	
	3) Contribution to environmental conservation in local communities	"Everyone's Environmental Effort Campaign"	To maintain and expand environmental activities at each plant and office location in cooperation with local communities	To maintain and expand environmental activities at each plant and office location in cooperation with local communities	46
		Environmental awareness-raising activities	To sponsor environmental learning programs and environmental awareness-raising events using our facilities, and support environmental education	――	50

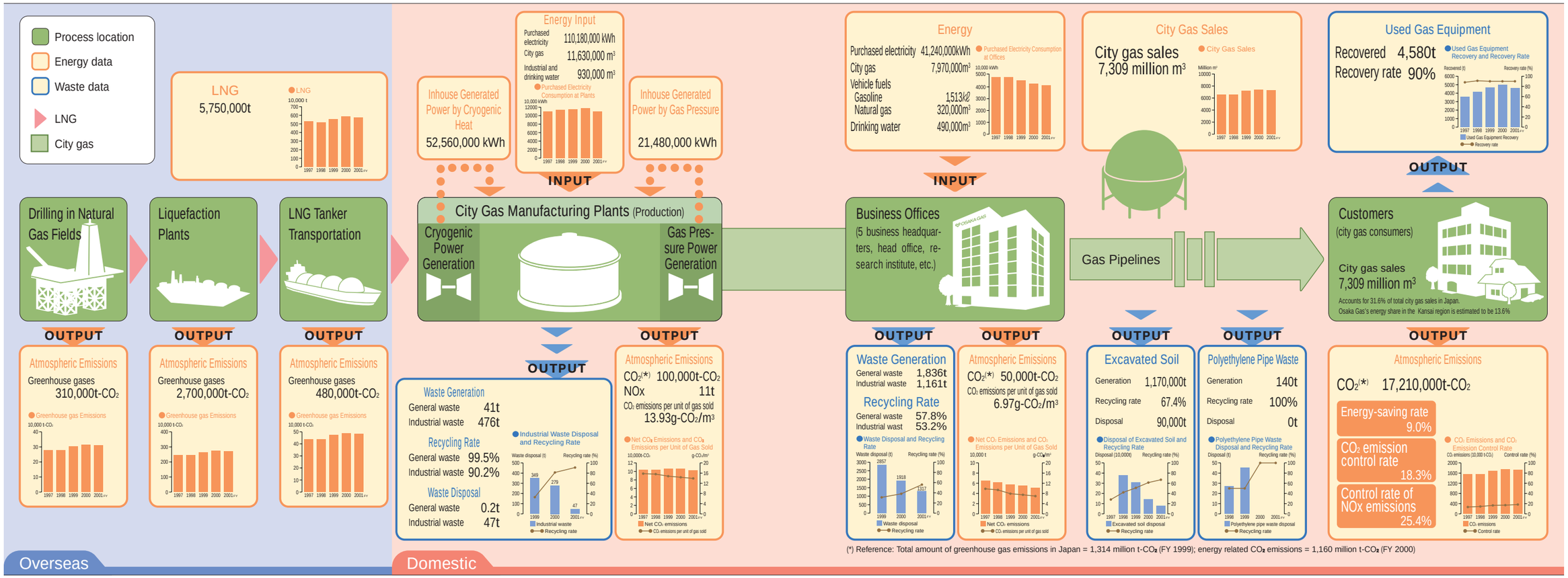
(*1) CO_2 emissions associated with purchased electricity are calculated using the average thermal power coefficient. For details, see page 18. See page 16 for values calculated using the average coefficient for all power sources. (*2) All vehicles, excluding emergency vehicles etc., should be replaced with NGVs wherever possible. (*3) Excavated soil recycling rate = amount of recycled soil used for gas pipe work /amount of excavated soil resulting from gas pipe work (*4) Less than 2.4%, as compared to 1,027 tons, the amount of final disposal in FY 1993, the year with the greatest amount of final disposal in the 1990s. The quantitative target for final disposal includes the residue from recycling. If it is excluded, the amount of final disposal is nearly 0 tons. (*5) Including 500 tons of waste gas appliances etc. (*6) COP: An index of energy efficiency (coefficient of performance)

Environmental Impact of Our City Gas Operations

The schematic diagram below illustrates the flow of resources and energy consumption, starting from the drilling of natural gas to its consumption by our customers, the resulting atmospheric emissions of greenhouse gases, and the amounts of waste generated and discarded.

The major raw material of city gas supplied by Osaka Gas is natural gas. Natural gas is drilled in natural gas fields in Indonesia, Australia, Brunei, Malaysia and elsewhere. At those countries, natural gas is liquefied by cooling it to an ultralow temperature of -160ºC. This liquefied natural gas (LNG) is transported to Osaka Gas's manufacturing plants by specialized LNG tankers.

On reaching each manufacturing plant, LNG is vaporized and a small amount of LPG is added to adjust its caloric value. During this process, we strive for efficient energy use, including cryogenic power generation using the cold energy of LNG, and gas pressure power generation using the pressure of natural gas. The city gas thus manufactured is sent from the plants to our customers through gas pipelines.



(*) Reference: Total amount of greenhouse gas emissions in Japan = 1,314 million t-CO_2 (FY 1999); energy related CO_2 emissions = 1,160 million t-CO_2 (FY 2000)

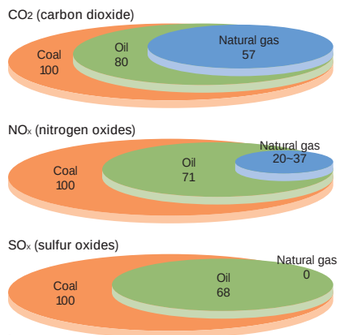
Natural Gas - A Clean Energy Source

Global Environmental Conservation and Natural Gas

During our society's progress, the demand for energy has increased steadily, reflecting our desire for a more affluent lifestyle. At the same time, global environmental concerns such as global warming, ozone layer depletion and acid rain, have posed increasingly serious problems demanding resolution through our own actions. Because the city gas supplied by Osaka Gas is comprised mainly of methane (CH_4), it has the lowest ratio of carbon to hydrogen of all fossil fuels and hence its combustion produces the least amount of CO_2. In addition, because impurities such as sulfur are removed in the liquefaction process in the countries where it is drilled, natural gas combustion produces almost no sulfur oxides (SOx) - a major cause of air pollution and acid rain - and produces relatively small amounts of nitrogen compounds (NOx), a cause of photochemical smog. For these reasons, natural gas is highly acclaimed as a source of energy that contributes to global environmental conservation.

Additionally, in its report on future national energy policies, the "Advisory Committee on Resources and Energy," a body that advises the Minister of Economy, Trade and Industry, counsels the expanded use of natural gas in order to take advantage of its merits in terms of environmental conservation and low environment impacts.

●Comparison of Fossil Fuel Combustion Emissions (Coal: 100)



Sources:
(1) "Natural Gas Prospects to 2010" International Energy Agency (IEA) (1986).
(2) "Report on Thermal Power Plant Atmospheric Impact Assessment Technology Demonstration Surveys, March 1990," Energy Engineering Research Center.

Properties of City Gas

● Ingredients and Composition

Ingredients		Composition	
Ingredient name	Chemical formula	Percent by volume	Percent by weight
Methane	CH_4	88	74
Ethane	C_2H_6	6	10
Propane	C_3H_8	3	7
Butane	C_4H_{10}	3	9

(Note) As gas composition is variable, the figures indicate a representative case.

● Physio-chemical Properties

Appearance etc.: A colorless gas having a characteristic odor.
Specific gravity: 0.65 (air = 1.0)
Combustion range: 5-15 vol%

● Effects on the Human Body

If the gas is inhaled at high concentrations for an extended period of time, it can have adverse effects on the human body, such as suffocation due to a lack of oxygen supply.

Comparison of Greenhouse Gas Emissions Associated with Combustion of Fossil Fuels as Determined by LCA

The table below compares total greenhouse gas emissions, from drilling to combustion, for various fossil fuels as determined by the life cycle assessment (LCA*1) method.

(Unit: g-CO_2/1000 kcal)

	Coal	Oil	LPG	LNG	City gas	
Production	19.18	17.01	21.60	40.77	38.43	Drilling 3.85
						Liquefaction 33.55
						Manufacturing 1.03
Transportation	7.15	3.30	7.52	7.77	6.01	
Equipment	0.48	0.33	0.48	0.51	2.16 (*2)	
Unit at time of fuel combustion	370.59	286.04	250.54	206.76	214.10	
Total	397.40	306.68	280.14	255.81	260.70	
Ratio	152	118	107	98	100	

(Note) Converted from g-C/Mcal to g-CO_2/Mcal, based on a report of the Institute of Energy Economics, Japan (August 1999).
(*1) LCA (Life Cycle Assessment): A method of survey, analysis and evaluation, that is as quantitative and comprehensive as possible, of the amount of resource and energy consumption and environmental impacts throughout all processes, from resource collection to manufacturing, transportation, use, recycling, and waste disposal of products and services.
(*2) The figures for city gas equipment include all equipment from the overseas production phase to gas pipeline construction.

Environmental Activity Topics in FY 2001

Major topics selected from among the environmental activities carried out by Osaka Gas in FY 2001 are summarized below.

p.11 ▼ p.12 FY 2001 Goals Accomplished

In FY 2001, the final year of the three-year mid-term environmental plan, all ten quantitative targets were achieved. Representative examples include CO_2 emissions per m^3 of gas sold in city gas operations, amounts of LNG cryogenic heat used, recycling rate of excavated soil resulting from gas pipe work, energy-saving and CO_2 emission control rates related to gas equipment, and recovery rate of used gas equipment.

p.5 ▼ p.6 Mid-term Environmental Plan for FY 2005 Formulated

To accelerate the achievement of the "Environmental Goals for FY 2010" within the framework of the long-term environmental plan, we formulated the "Mid-term Environmental Plan for FY 2005," with 34 targets. The number of quantitative targets was doubled from 12 in the Mid-term Environmental Plan for FY 2001 to 24 in the 2005 plan.

p.13 ▼ p.14 Monetary Value of the Environmental Conservation Benefits Evaluated

The results of reducing environmental impacts through environmental conservation activities produce benefits to society (external benefits). Although these benefits are difficult to evaluate in monetary terms because they are not priced in the market, we attempted to convert them into monetary terms.

Environmental Conservation Costs
Investments: 0.4 billion yen
Expenses: 7 billion yen

Environmental Conservation Benefits
CO_2 emission reduction: 64,000 t-CO_2
Excavated soil disposal reduction: 78,000 t

Monetary conversion

Internal Economic Benefits
6.5 billion yen
(Savings through energy-saving investments etc.)

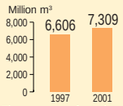
Social Benefits
About 2 billion yen

Action Guideline 1 Reduction of the Environmental Impacts of Our Business Activities

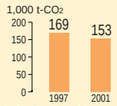
p.16 Goal for Reduction of CO_2 Emissions per m^3 of Gas Sold Achieved

With the aim of achieving a 10% reduction of CO_2 emissions per unit of gas sold in FY 2001 compared to FY 1997, a yearly target was established by each department. With this target incorporated as a business performance evaluation item, as a result of companywide efforts, we achieved a 19% reduction of CO_2 emissions per m^3 of gas sold, a level nearly double the original quantitative target.

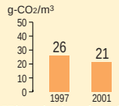
Amount of Gas Sold Increased by 11%



Net CO_2 Emissions Reduced by 10%



CO_2 Emissions per m^3 of Gas Sold Reduced by 19%



The gas manufacturing plants scored significant achievements, with a 57% reduction of net CO_2 emissions and a 74% reduction of CO_2 emissions per unit of gas sold as compared to FY 1990. The level of CO_2 emissions per m^3 for our gas manufacturing plants is the lowest among the figures reported for gas companies.

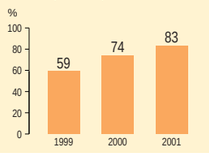
CO_2 emissions associated with purchased electricity are calculated using the average thermal power coefficient. For details, see page 18. See page 16 for values calculated using the average coefficient for all power sources.

p.19 Progress in Shallow Gas Pipe Laying Work

(Osaka Gas ranks No. 1 in the total length of shallow gas pipelines in the gas industry)

Traditionally, Japan's Road Law required gas pipes to be laid at 1.2 meters below the surface. On March 31,1999, the Ministry of Construction (currently the Ministry of Land, Infrastructure and Transport) announced that the regulations would be modified to enable gas pipe to be laid at shallower depths. As of FY 2001, Osaka Gas gained permission to lay pipe at shallow depths from approximately 97% of the administrative authorities in its service areas. The length of pipelines laid at depths shallower than 1.2 meters in FY 2001 was 755 km, accounting for 83% of the total length of pipelines laid in that year. Significant reductions in amounts of excavated soil generated, mountain sand used, vehicle fuel consumption, etc. were thus achieved.

●Ratio of Pipe Laid at Depths of Less than 1.2 Meters



p.23 Green Distribution Policy Formulated

Within the framework of the project for environment impact reduction in the transportation sector, "Green Distribution" efforts are being promoted by local governments in the Kansai region. Against this background, Osaka Gas formulated in December 2001 the "Osaka Gas Green Distribution Policy," which requests its distributors to preferentially use low-pollution vehicles in logistic, service and sales activities. This is the first green distribution policy formulated by a private corporation in the Kansai region.

●Examples of Low-Pollution Vehicles


Natural gas-powered vehicle


Hybrid vehicle


Methanol-powered vehicle

p.24 Activities toward Companywide Acquisition of ISO 14001 Certification Ongoing

Following ISO 14001 certification acquired by the Production Department, the Engineering Department (construction work section) and other departments, the Transmission Department also acquired ISO 14001 certification in June 2001, the Head Office Gas Building in September 2001, and the Osaka Business Headquarters in March 2002. This was the first certification by a head office among private electricity or gas companies. In the Mid-term Environmental Plan for FY 2005, Osaka Gas aims at the acquisition of ISO 14001 certification for its all departments, including the Production, Transmission, and all Business Headquarters responsible for marketing.


Efforts to Reduce Power Consumption in Elevators (Osaka Business Headquarters)

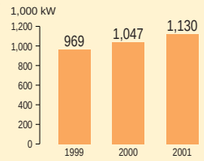
Action Guideline 2 Contribution to Environmental Impact Reduction through Our Products and Services

p.31 ▼ p.32 Cumulative Capacity of Gas Co-generation Installation Increased

Osaka Gas's Share Rises to About 50% of the Japanese Market

The cumulative capacity of gas co-generation systems installed in the Osaka Gas service areas reached 1.13 million kW (1,220 units) as of the end of FY 2001 (equivalent to one large-scale thermal power generation plant). The corresponding CO_2 emissions reduction is estimated at 1.81 million t-CO_2.

●Cumulative Capacity of Gas Co-generation System Installation



p.33 Number of NGVs in Use in the Kansai Region Exceeds 3,000

As a countermeasure against air pollution in urban regions, Osaka Gas promotes the widespread use of natural gas vehicles, as they are environmentally friendly with clean exhaust gas. Since their first introduction in the Kansai Region in 1989, Osaka Gas has been promoting the use of NGVs. In 2001, the number of NGVs in use in the Kansai Region exceeded 3,000.


Bentencho Eco-Station Opened In March 2002

p.36 ▼ p.39 Energy-saving Systems and Equipment Developed

Aiming at efficient use of natural gas, the fossil fuel that produces the least CO_2 emissions, and of maximizing its performance, Osaka Gas has promoted the development of various energy-saving systems and equipment, thus contributing to energy-saving and CO_2 emission reduction at our customers' homes and businesses (see table at right).

●Examples of Major Recent Developments

Category	
Gas co-generation for commercial use	Miller cycle gas engine co-generation, micro-gas engine co-generation
Gas co-generation for household use	Gas engine co-generation for household use (will be launched in FY 2002) Fuel cell for household use (will be launched in FY 2005)
Air-conditioners for commercial use	Improvement of gas absorption refrigerator efficiency and improvement of GHP efficiency
Boilers for commercial use and industrial furnaces	Low-NOx burners for boilers and regenerative burners
Water heaters	Latent heat recovery type hot water heaters "PRIOR ECO"
Kitchen equipment	High efficiency cooking stoves and built-in cooking stove "PRO-FLAT"

Action Guideline 3 Contribution to Environmental Improvement Locally, Nationally and Overseas

p.45 Japan's First Full-scale Hydrogen Supply Station Completed

Making use of its catalyst modification technology for separating hydrogen from natural gas, together with fuel cell technology, Osaka Gas participated in the national project "Development of an International Clean Energy System Using Hydrogen Conversion," conducted by the New Energy and Industrial Technology Development Organization (NEDO), and constructed Japan's first vehicle hydrogen supply station using natural gas as the raw material.


Hydrogen supply station

p.44 Osaka Gas Participates in the North Taiwan LNG Station Project

Osaka Gas, along with Kansai Electric Power Co., Inc., decided to participate in the North Taiwan LNG Station Project by Tung Ting Gas Corporation to promote the construction of LNG stations under private initiative. This was the first time the two companies participated cooperatively in an overseas energy business.


Planned construction site

p.45 Osaka Gas Develops "MARICOM," a New Resin Prepared from Waste PE from Gas Pipes

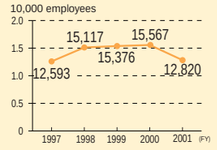
Osaka Gas developed a new recycled resin made from waste PET bottle material and waste polyethylene from gas pipes combined at the nanometer level. This technology combines a number of low-quality waste resins so as to take advantage of their remaining useful qualities. We designated this resin "MARICOM" and will pursue the project toward commercialization and expanded use.


A tray made from MARICOM

p.49 The 20th Anniversary of the "Little Lanterns" Program

In 1981 (International Year of Disabled Persons), Osaka Gas started the "Little Lanterns" program, a campaign for corporate voluntary activities. In 2001 (International Year of Volunteers), we cerebrated its 20th anniversary. Through this program, Osaka Gas has expanded its network with NPOs and volunteer organizations and has been involved in a broad spectrum of voluntary activities both inside and outside the company.

●Number of Employees Participating in Voluntary Activities



Environmental Action Guidelines - Key Measures, Quantitative Targets and Results for FY 2001

In the last triennium period, we formulated the "Mid-term Environmental Plan for FY 2001" and have been promoting environmental activities by setting forth annual quantitative targets for individual plants and offices, including reductions in CO_2 emissions and copy paper consumption (see page 24).

As shown in the table below, all ten quantitative targets were achieved successfully in FY 2001, the final year of the three-year mid-term environmental plan.

	Key measures	Quantitative targets	Item		Unit	FY 1998	FY 1999	FY 2000	FY 2001	FY 2001 targets	Achieved	Page
Action Guideline 1 Reduction of the Environmental Impacts of Our Business Activities	Control of Greenhouse Gases and NOx Emissions 1) Promotion of energy-saving measures to control CO_2 emissions 2) Promotion of untapped energy use 3) Control of HFC and SF6 emissions 4) Control of NOx emissions	● FY 2001: To reduce CO_2 emissions per unit of gas sold by 10% (compared to FY 1997) ● FY 2001: To increase LNG for cryogenic use by 35% (compared to FY 1995) ● FY 2000: To introduce 1,030 NGVs at Osaka Gas	Net CO_2 emissions (*1)		t-CO_2	165,077	162,774	161,751	152,742	———		16
			CO_2 emissions (*1) per unit of gas sold		g-CO_2/m^3	25.01	22.73	21.84	20.90	less than 23.10	✓	16
			LNG for cryogenic use		10,000 t/year	401	410	459	460	more than 426	✓	17
			Unit of NOx emissions from plants		mg/m^3	1.7	1.6	1.5	1.5	———		18
			Number of NGVs used at Osaka Gas		———	562	660	788(*2)	885(*3)	———		18
	Reduction of Resource Consumption and Promotion of Recycled Material Use 1) Reduction and recycling of soil excavated during gas pipe work 2) Recycling gas pipe materials 3) Reduction of paper consumption and promotion of paper recycling 4) Efficient use of water resources 5) Green purchase (preferential purchase of environmentally friendly products) 6) Improvement of resource recycling rate by promoting sorted collection of garbage	● FY 2001: To achieve a recycling rate of 50% or higher for excavated soil ● FY 2001: To reduce the amount of paper consumed (copy paper, computer output paper, business cards, letter pads) by 50% (by weight, compared to FY 1992) (1,097 tons consumed in FY 1992) ● FY 2001: To maintain a recycling rate of 80% or higher for copy paper, computer output paper, business cards, and letter pads (by weight)	Soil excavated from gas pipe works	Amount recycled	10,000 t/year	67	80	71	79	———		20
				Amount reduced	10,000 t/year	26	30	62	77	———		20
				Recycling rate	%	42.2	51.0	61.4	67.4	more than 50	✓	20
			Recycling rate of used polyethylene pipes		%	50	50	100	100	———		20
			Total paper consumption		t/year	641	548	426	421	less than 548	✓	22
			Recycled paper use rate		%	100.0	100.0	100.0	100.0	more than 80	✓	22
	Improvements in Environmental Management 1) Establishment and improvement of environmental management systems 2) Improvement of environmental education and awareness-raising programs for employees											
Action Guideline 2 Contribution to Environmental Impact Reduction through Our Products and Services	Contribution to CO_2 Emission Reduction 1) Promotion of the use of natural gas and energy-saving systems and equipment 2) Technological development of energy-saving systems and equipment	● FY 2001: To achieve an energy-saving rate of 7.0% or higher (compared to FY 1990) ● FY 2001: To achieve a CO_2 emissions control rate of 16% or higher (compared to FY 1990)	Energy-saving rate (compared to FY 1990)		%	6.0	7.1	8.0	9.0	more than 7	✓	31
			Gas equivalent of energy saved (compared to FY 1990)		million m^3/year	416	547	650	725	———		31
			CO_2 emissions control rate (compared to FY 1990)		%	14.4	16.6	17.1	18.3	more than 16	✓	31
			Amount of CO_2 emissions controlled (compared to FY 1990)		10,000 t-CO_2/year	250	325	361	386	———		31
			Co-generation	Number of units installed (cumulative)	———	758	919	1,082	1,220	———		32
				Capacity installed (cumulative)	1,000 kW	872	969	1,047	1,130	———		32
			Introduction of untapped energy use		Sites	5	5	5	5	———		32
	Contribution to Reduction of NOx and Other Air Pollutant Emissions 1) Development of NOx reduction technologies and promotion of the use of low-NOx equipment 2) Promotion of NGV use	● FY 2001: To achieve an NOx emission concentration control rate of 21% or higher for in-place gas equipment (compared to FY 1990) ● FY 2001: To achieve an NOx emission concentration control rate of 40% or higher for gas equipment sold within the current fiscal year (compared to FY 1990) ● FY 2000: To install 30 natural gas filling stations in our service areas	NOx emission concentration control rate (compared to FY 1990)		%	15.9	18.8	21.4	25.4	more than 21	✓	33
			NOx emission concentration control rate for gas equipment sold in current fiscal year		%	28.4	29.8	34.6	42.3	more than 40	✓	33
			Numbers of NGVs in use		———	1,405	1,835	2,752	3,770	———		33
			Number of natural gas filling stations		———	24	33	36(*4)	41	———		33
	Contribution to Chlorofluorocarbon Control Measures 1) Development and promotion of the use of gas absorption type chiller/heaters 2) Control of HFC emissions		Cumulative capacity of gas absorption type chiller/heaters		10,000 RT	182	191	201	211	———		34
	Promotion of Resource Recycling 1) Improvement of recovery and recycling rates for used gas equipment	● To achieve a recovery rate of 90% or higher (Osaka Gas and service chain shops)	Used gas equipment recovery rate	Osaka Gas only	%	68	79	85	87	———		35
				Osaka Gas and service chain shops	%	91	90	90	90	more than 90	✓	35
Action Guideline 3 Contribution to Environmental Improvement Locally, Nationally and Overseas	Domestic and Overseas Environmental Contributions 1) Promotion of the use of natural gas-related technologies both domestically and overseas 2) Transfer of energy-saving technologies to foreign countries 3) Promotion of the use of environmental technologies domestically 4) Transfer of environmental technologies to foreign countries 5) Financial and personnel support, technological guidance, and other overseas contributions related to environmental conservation		● District heating and cooling/ESCO operations ● Development of VAM fungi application technologies ● Development of antibiotic microbial materials ● Promotion of widespread use of wet catalytic oxidation process ● Transfer of wet catalyst oxidation process technology to Yunnan Province, China ● Participation in the North Taiwan LNG Station Project ● Preparation of report on estimates of natural gas supply and demand in Thailand and neighboring countries ● Tree planting								
	Development of New Environmental Technologies 1) Development of CO_2 recovery and other technologies 2) Waste treatment technologies 3) Resource recycling technologies 4) Water treatment technologies		● New technology for natural gas storage using adsorbent material ● Technology for fusing sewage sludge incineration ash ● Recycling technology for waste plastics ● Development of technology for methane production from waste using supercritical water ● Development of hydrogen fuel supply stations for automobiles ● Development of "MARICOM," a new resin prepared from waste polyethylene from gas pipes								
	Environmental Contributions to the Local Community ● Promotion of "Everyone's Environmental Effort Campaign"		Major Activities in FY 2001 ● "Cleanup Osaka" campaign ● Ecological cooking ● Local environmental activities pursued with the participation of each plant and office ● Sponsoring events in the natural environment								
	Social Performance		Anti-disaster Measures, Labor Safety, Health, Legal Compliance, Human Rights Local Philanthropic Activities ● Activities in cooperation with local communities ● "Better Citizenship Activities"								

(*1) CO_2 emissions associated with purchased electricity are calculated using the average thermal power coefficient. For details, see page 18. See page 16 for values calculated using the average coefficient for all power sources. (*2) The quantitative target for FY 2000 was 1,030 NGVs. Since the total number of vehicles owned was reduced by 300, substantial gains were made towards this target. (*3) The total number of vehicles owned by Osaka Gas was reduced by 400. (*4) The quantitative target for FY 2000 was 30 stations.

Environmental Accounting

●Environmental Conservation Costs

(Unit: million yen)

Items		Contents	Investments FY 2000	Investments FY 2001	Expenses FY 2000	Expenses FY 2001
Internal Efforts	Global Environment	Equipment investment and maintenance, personnel, etc. for energy-saving etc.	186	147	754	655
	Pollution Prevention	Equipment investment and maintenance, personnel, etc. for prevention of air pollution etc.	21	4	189	129
	Recycling Resources	Equipment investment and maintenance, personnel, etc. for excavated soil reduction and recycling etc.	73	71	336	540
	Environmental Management	Green procurement, environmental education, EMS construction, etc.	0	0	341	276
	Others	Tree planting at plants, soil surveys and countermeasures, environmental conservation subsidies, etc.	11	61	539	2,529(*1)
Environmental Impact Reduction at Customers	Environmental R&D	R&D of environmental impact reduction technologies, environmentally friendly products, etc.	194	91	1,824	2,017
	Recycling of Used Gas Equipment	Recovery and recycling of used gas equipment, containers, packages, etc.	0	0	209	166
Philanthropic activities (voluntary tree planting, environmental advertising, environmental information disclosure, etc.)			1,485(*2)	56	547	725
Total			1,970	430	4,739	7,037(*3)

(*1) Includes about 2.3 billion yen for soil surveys and countermeasures on land owned by Osaka Gas and elsewhere. (*2) Includes about 1.45 billion yen for investment for the Tsuruga LNG Terminal Biotope. (*3) Includes 593 million yen for depreciation.

●Internal Economic Benefits

(Unit: million yen)

Economic Benefits	FY 2000	FY 2001
Savings through reduction of excavated soil disposal (*1)	4,439	5,480
Savings through energy-saving investments	738	738
Savings through efforts to save energy and resources (*2)	52	87
Sales of marketable articles (LNG cryogenic energy)	267	240
Total	5,496	6,545

(*1) Includes new data on reductions resulting from shallow laying of service pipes and preliminary reinstatement work, in addition to gas pipeline construction in urban districts.
(*2) Savings compared to FY 1999.

Introduction of Environmental Accounting

Osaka Gas has been operating an extensive environmental accounting system since FY 1999. We believe that environmental accounting is of great significance in allowing our stakeholders to deepen their understanding of our environmental activities, and as a tool for efficiently promoting our own environmental activities and constantly improving our environmental conservation performance by quantitatively assessing the balance between environmental costs and benefits.

Environmental Accounting Calculations

(1) Governing Standards

Costs and benefits were calculated in accordance with the "Guidelines for Implementing Environmental Accounting in the City Gas Industries, FY 2000 Version" (published by the Japan Gas Association). These guidelines were prepared on the basis of "Developing an Environmental Accounting System (Year 2000 Report)" by Japan's Ministry of the Environment, and reflect the unique characteristics of the city gas industry.

(2) Scope: Osaka Gas Co., Ltd.

(3) Period under review: April 1, 2001 - March 31, 2002

In FY 2000, we developed a computer-aided environmental accounting system, which has improved the accuracy of our environmental accounting and reduced calculation work loads.

Item Classification and Content

(1) Cost Items

Calculations are limited to the costs concerning environmental purposes wherever possible (calculation of differences).

For items in which proportions for environmental purposes are difficult to determine, such as R & D and personnel expenses, proportional calculations were made using an "environmental ratio" established for the purpose of determining the degree of association with environmental actions.

Investments: Calculations include this year's acquired fixed assets that contribute to environmental improvement.

Expenses: Calculations include depreciation, personnel and other expenses incurred for environmental purposes.

Depreciation expenses were calculated for fixed assets acquired after FY 1997 (with the exception of previously acquired fixed assets consisting of large-scale equipment at manufacturing plants, etc.) using the fixed percentage method for equipment life expectancy. Personnel expenses were calculated using standard unit costs.

(2) Benefit Items

Both environmental conservation benefits (physical benefits) and internal economic benefits (cost-saving benefits) as a result of energy consumption reduction, etc. were calculated.

1) Environmental conservation benefits

Three kinds of environmental conservation benefits were calculated:

i) Levels of environmental impact per unit of gas sold

ii) Total environmental impact

iii) Reduction in environmental impact

•Environmental impact reduction in Osaka Gas business operations

Reductions in environmental impacts for the current fiscal year through the installation of environmental equipment and environmental impact reduction activities by Osaka Gas.

•Environmental impact reduction at customers

The amount of environmental impact reduction for the current fiscal year by promotion of the widespread use of natural gas and energy-saving systems and devices.

(2) Internal economic benefits

Cost-saving benefits that could be determined accurately from actual figures for our own operations were calculated.

Results for FY 2001

In the environmental accounts for FY 2001, figures for investments, expenses, and internal economic benefits were calculated as 0.4 billion yen, 7 billion yen, and 6.5 billion yen, respectively. Environmental investments decreased from the previous fiscal year by about 1.5 billion yen, equivalent to the FY 2000 investments for the Tsuruga LNG Terminal Biotope. Environmental expenses increased by 2.3 billion yen compared to FY 2000, due to the soil surveys and countermeasures on land owned by Osaka Gas and elsewhere. Internal economic benefits increased by 1 billion yen compared to FY 2000 as a result of accelerated reductions in excavated soil disposal.

●Environmental Conservation Benefits (Physical Benefits)

Item		Level of Environmental Impact Unit	Level of Environmental Impact FY 2000	Level of Environmental Impact FY 2001	Total Environmental Impact Unit	Total Environmental Impact FY 2000	Total Environmental Impact FY 2001	Reductions in Environmental Impacts (*2) Unit	Reductions in Environmental Impacts (*2) FY 2000	Reductions in Environmental Impacts (*2) FY 2001
Osaka Gas	NOx (plants)	mg/m³	1.5	1.5	t	11.1	11.1	t	18.4	17.4
	COD (plants)	mg/m³	0.25	0.19	t	1.9	1.4	t	6.7	6.2
	CO_2 (plants) (*1)	g-CO_2/m³	14.37	13.93	1,000 t-CO_2	106	102	1,000 t-CO_2	58	58
	CO_2 (other sites) (*1)	g-CO_2/m³	7.48	6.97	1,000 t-CO_2	55	51	1,000 t-CO_2	1	6
	Final disposal of excavated soil	t/km	165	90	1,000 t	140	80	1,000 t	67	78
	Disposal of industrial waste	g/m³	0.71	0.65	t	5,243	4,782	t	806	1,267
	Disposal of general waste	g/m³	0.14	0.11	t	1,038	774	t	222	486
Customers	CO_2 emission reduction	——	——	——	——	——	——	1,000 t-CO_2	3,612	3,857
	CO_2 emission reduction through gas equipment recycling using LCA	——	——	——	——	——	——	t-CO_2	3,234	3,165
	Gas equipment recovery rate	——	——	——	——	——	——	%	90	90

(Note) The amount of gas sold in FY 2001 was 7,309 million m³ (7,407 million m³ for FY 2000). The total length of gas pipeline laid was 913 km in FY 2001 (850 km for FY 2000).
(*1) CO_2 emissions associated with purchased electricity are calculated using the average thermal power coefficient. For details, see page 18. See page 16 for values calculated using the average coefficient for all power sources.
(*2) Calculation of Environmental Impact Reductions
• For NOx and COD, the amounts reduced were calculated compared to legal emission levels.
• For CO_2, the benefits of environmental equipment investment in plants were calculated. For other sites, the relevant fiscal year's CO_2 emission reduction was calculated using FY 1999 as the base year.
• For excavated soil disposal, reductions in the amount of landfill disposed were calculated from the amounts of excavated soil generated and recycled.
• For industrial and general waste, the relevant fiscal year's reductions in the amount disposed were calculated using FY 1999 as the base year.

Future Efforts

1) Environmental conservation benefits were converted to monetary values (social contribution benefits) for the first time in FY 2001 (see Topics below). We will make use of the figures calculated as a basis for evaluation of our future environmental activities.

2) We will investigate the possibility of an integrated index combining financial data, with environmental conservation benefits.

3) We will investigate the possibilities for a consolidated environmental accounting system for Osaka Gas and its affiliates.

Topics

Monetary Evaluation of Environmental Conservation Benefits — FY 2001 Environmental Conservation Benefits Estimated as Two Billion Yen —

Environmental conservation activities produce social benefits (external benefits involving the preservation of natural/ecological systems, human health, environmental amenities, etc.), as well as internal economic benefits for the entity undertaking these conservation activities. The former is difficult to evaluate on a monetary basis because such social benefits are not priced in the market. With this situation in mind, we attempted to evaluate the monetary value of social benefits (physical benefits) of our environmental conservation activities using the Contingent Valuation Method (CVM): a method of converting the value of environmental conservation to monetary value based on surveys of the amount of money that relevant inhabitants would be willing to pay for environmental conservation. The resulting benefits were calculated to be about two billion yen per year (FY 2001).

Calculation Method and Estimated Results

Among the environmental impacts imposed by our business operations, excavated soil resulting from gas pipe work was expected to be an area in which reductions would have relatively great monetary value. So we attempted to develop a method for its evaluation based on CVM.

A survey was conducted on the amount of money local inhabitants (7.38 million households) would be willing to pay in the case of a scenario in which water pollution and resulting environmental impacts would be avoided by postponing the construction of a marine landfill disposal facility scheduled to be constructed in Osaka Bay. A total of 1,656 questionnaires were distributed and 610 replies were received. Based on analysis of 212 cases of viable responses, the average willingness to pay by local inhabitants was estimated at 11,902 yen/year/household. Subsequently, with reference to the current amount of waste disposed of in Osaka Bay and the marine landfill disposal ratio of excavated soil work in the Kansai region, the monetary value of environmental conservation to be gained by the reduction of disposal of 1 ton of excavated soil was calculated at 22,128 yen/ton. This figure was multiplied by the reduction amount of the excavated soil disposal resulting from our business operations. The total monetary value of our environmental conservation in the area was thus calculated to be about 1.7 billion yen. The validity of this method of evaluation was confirmed by Assistant Professor Kuriyama of Waseda University and Assistant Professor Takeuchi of Kobe University.

Regarding environmental impact items other than excavated soil, we reviewed domestic and overseas literature on environmental damage costs and values of the natural environment and applied useful data to achieve monetary evaluation of our environmental conservation activities. Combining these, the total social benefits of environmental conservation activities in our business operations were calculated to be about two billion yen (FY 2001).

● Monetary Evaluation of Social Benefits of Environmental Conservation by Osaka Gas Business Activities

(Unit: 0.1 billion yen)

Environmental impact reduced	FY 2000	FY 2001
Excavated soil disposal	14.7	17.2
CO_2	2.1	2.2
Other (Note)	0.4	0.6
Total	17.2	20.0

(Note) Monetary evaluation for other items

(Unit: 0.1 billion yen)

	NOx	COD	Industrial waste	General waste
FY 2000	0.066	0.101	0.247	0.007
FY 2001	0.063	0.093	0.388	0.015

CO_2 and NOx: Based on environmental damage cost data prepared by the European Commission (*1).

COD: Based on environmental value conversion factors per ton of COD calculated from the levels of willingness to pay for improvement of water quality in Osaka Bay and the amount of COD coming into Osaka Bay, survey by Osaka University (*2).

Industrial waste: Based on environmental value conversion factors per ton of waste calculated from the present CVM for avoidance of marine landfill disposal.

General waste: Based on the above European Commission environmental damage cost applied to estimated CO_2 emissions for incineration of general waste.

(*1) ExternE Externalities of Energy, Vol. 7: Methodology 1998 Update (1999).

(*2) An attempt to assess the economic value of the water environment in the coastal area of Osaka Bay, Proceedings of the Japan Society of Civil Engineers, No. 518/IV-28 (1995).

Action Guideline 1

Reduction of the Environmental Impacts of Our Business Activities

Realizing the importance of the environmental impacts of corporate activities, Osaka Gas places emphasis on minimizing environmental impacts imposed by its own business activities, and makes constant efforts to meet our environmental goals.

We are pursuing energy- and resource-saving activities on a companywide basis, by promoting better environmental management systems and by integrating environmental goal achievement levels into our performance evaluation system.

P.20 Waste polyethylene pipe recycling rate
100%

P.20 Excavated soil from gas pipe works
Amount generated: 1.17 million t
Recycling rate: 67.4%
Amount disposed: 90,000 t

P.18 Number of NGVs used at Osaka Gas
885

P.18 NOx emissions from plants 11 t
NOx emissions per unit of gas sold
1.5mg/m³

P.18 COD emissions from plants 1.4 t
COD emissions per unit of gas sold
0.19mg/m³

P.17 LNG for cryogenic use
4.60 million t

P.16 CO_2 emissions
153,000 t-CO_2

P.16 CO_2 emissions per unit of gas sold
20.9 g-CO_2/m³

P.22 Recycled paper use rate
100%
Total paper consumption
421 t

Dust emissions from plants
0 t*

SOx emissions from plants
0 t*

*0 t means that the amount is less than 0.4 t.

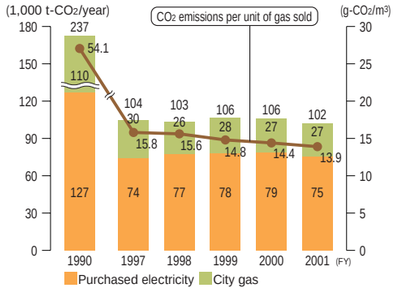
1. Control of Emissions of Greenhouse Gas and NOx

Points and Future Prospects

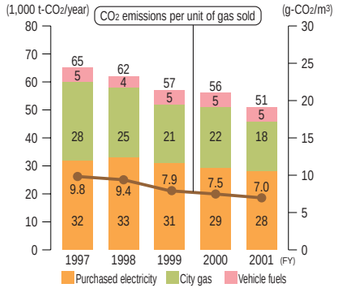
Carbon dioxide emissions from our city gas manufacturing plants were reduced significantly in FY 2001 to 102,000 t-CO_2, amounting to 43% of CO_2 emissions in FY 1990. Osaka Gas also monitors CO_2 emissions from its non-manufacturing sites. In FY 2001, these CO_2 emissions were reduced to 51,000 t-CO_2, amounting to 78.5% of FY 1997 emissions. These figures represent a major achievement of companywide efforts, in which yearly targets were established for each department and environmental goals incorporated in the performance evaluation system. Goals for FY 2001 established in 1998 called for a 10% reduction from 1997 levels, to a target figure of 23.1 g-CO_2/m³, but CO_2 emissions per unit of gas sold through city gas operations in FY 2001 were actually reduced by 19% (to 20.9 g-CO_2-m³) meaning that nearly twice the target reduction was achieved. In FY 2002, we launched efforts to implement the Mid-term Environmental Plan for FY 2005 and to accomplish our Environmental Goals for FY 2010. We will continue to conduct deliberate energy-saving activities for further reductions in energy consumption.

● CO_2 Emission Control Measures ●

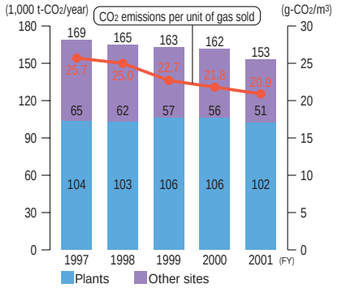
●CO_2 Emissions from City Gas Manufacturing Plants



●CO_2 Emissions from Non-Manufacturing Sites



●CO_2 Emissions from Osaka Gas as a Whole



●CO_2 Emissions

		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2001/1997 ratio
Purchased electricity consumption	Plants (1,000 kWh)	109,554	114,212	115,635	117,694	110,184	100.6%
	Other sites (1,000 kWh)	48,020	48,182	45,544	42,553	41,235	85.9%
	Total (1,000 kWh)	157,574	162,394	161,179	160,247	151,419	96.1%
City gas consumption	Plants (1,000 m³)	12,980	11,052	11,938	11,481	11,632	89.6%
	Other sites (1,000 m³)	11,740	10,538	9,010	9,339	7,974	67.9%
	Total (1,000 m³)	24,720	21,590	20,948	20,820	19,606	79.3%
Vehicle fuel consumption	Gasoline (1,000 liters)	1,937	1,794	1,701	1,645	1,516	78.3%
	Light oil (1,000 liters)	31	25	38	18	18	58.1%
	Natural gas (1,000 m³)	111	158	248	288	334	300.9%
CO_2 emissions (*)	Plants (t-CO_2)	104,482 (71,542)	103,081 (68,744)	106,132 (71,363)	106,443 (71,056)	101,732 (68,603)	97.4% (95.9%)
	Other sites (t-CO_2)	64,959 (50,521)	61,996 (47,508)	56,643 (42,953)	55,308 (42,515)	51,011 (38,612)	78.5% (76.4%)
	Total (t-CO_2)	169,440 (122,063)	165,077 (116,252)	162,774 (114,316)	161,751 (113,571)	152,742 (107,215)	90.1% (87.8%)
CO_2 emissions per unit of gas sold (*)	Plants (g-CO_2/m³)	15.80 (10.83)	15.62 (10.41)	14.81 (9.97)	14.37 (9.59)	13.93 (9.39)	88.2% (86.7%)
	Other sites (g-CO_2/m³)	9.83 (7.65)	9.39 (7.19)	7.92 (6.00)	7.48 (5.74)	6.97 (5.28)	70.9% (69.0%)
	Total (g-CO_2/m³)	25.67 (18.48)	25.01 (17.61)	22.73 (15.97)	21.84 (15.33)	20.90 (14.67)	81.4% (79.4%)

(*) Energy consumption → CO_2 emission conversion method:
1) CO_2 emissions associated with purchased electricity were calculated using the end-user CO_2 emission coefficient (0.6747 kg-CO_2/kWh), which was calculated by the average thermal power coefficient for FY 1996 (source: Japan Electric Power Supplier Association's "1998 Environment and Energy") and the integrated loss factor from supply to demand (source: "1997 Electric Power Utility Almanac"). For details, see page 18. Figures in parentheses, provided as references, were calculated using the end-user CO_2 emission coefficient (0.374 kg-CO_2/kWh) calculated similarly using the average coefficient for all power sources.
2) The other emission coefficients are derived from the "Guidelines for the Establishment of Plans for Promotion of Regional Measures against Global Warming" (August 1993) by the Ministry of the Environment.

Efforts at Manufacturing Plants

In 1990, Osaka Gas completed its conversion from coal and petroleum to LNG, a clean energy source, as the raw material for city gas manufacture. As a result, we succeeded in significantly reducing the emission and discharge of substances that have negative environmental impacts, as well as energy consumption, in the gas manufacturing processes. After that, we have further promoted energy conservation measures, and thus in FY 2001, CO_2 emissions per unit of gas sold at all manufacturing plants were reduced by 11.8% compared to FY 1997.

Examples of Efforts to Reduce Purchased Electricity

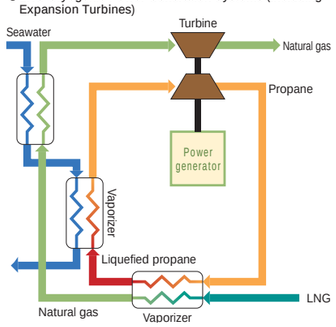
1) Use of Cryogenic Electricity

LNG is liquid gas with an ultralow temperature of -160°C. Osaka Gas generates electricity using the heat absorbed by LNG from the surrounding atmosphere during its vaporization in the city gas manufacturing processes. By increasing the amount of electricity generated by cryogenic power generation, the amount of electricity purchased can be decreased.

2) Use of Expansion Turbines (Gas Pressure Power Generation)

City gas is transmitted at constant pressure from manufacturing plants to transmission pipes. LNG is vaporized in the city gas manufacturing processes, during which it expands to about 600 times its original volume. The energy from this expansion is used to operate a turbine for generating electricity. Osaka Gas is operating two of these expansion turbines. Its total capacity for power generation using expansion turbines and cryogenic power generation equipment is 14,000 kW.

●LNG Cryogenic Power Generation Systems (Including Expansion Turbines)



3) Making Use of Boiled-off Gas (BOG) Re-liquefaction Equipment

During its storage in tanks, a portion of LNG vaporizes. This gas (BOG) has traditionally been sent out at increased pressure using a compressor. By re-liquefying a portion of this BOG and returning it to the LNG tank using the cold energy of LNG, Osaka Gas has shortened BOG compressor operating time.

An Example of Efforts to Reduce Gas Consumption

Reduction of Loads on City Gas Calorific Value Adjustment Boilers Using Seawater

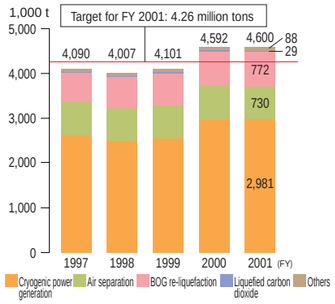
To supply natural gas to our customers in the form of city gas with a standard calorific value of 46.04655 MJ/m³N, a small amount of LPG is mixed in to adjust this calorific value. By switching from the conventional method, in which LPG is vaporized using boiler-generated steam as the heat source, to a new method, in which the heat of seawater is used to vaporize the LPG, Osaka Gas has reduced boiler fuel gas consumption at its plants.

Promotion of the Use of Untapped Energy

Efficient Use of LNG Cryogenic Heat

Osaka Gas efficiently uses the cryogenic heat (-160°C) of LNG, obtained during the manufacture of city gas, for various purposes. The major purposes are power generation using cryogenic heat (including expansion turbines) and BOG re-liquefaction, as described above; these account for approximately 80% of the total cryogenic energy used. In another application, LNG is used as a coolant in the manufacture of liquid nitrogen and liquid oxygen through separation of the air. This contributes to the reduction of electric power consumption. The amount of LNG used for cryogenic heat in FY 2001 amounted about 4,600,000 tons, representing the efficient use of about 54% of the LNG handled in that fiscal year.

●Use of LNG Cryogenic Heat



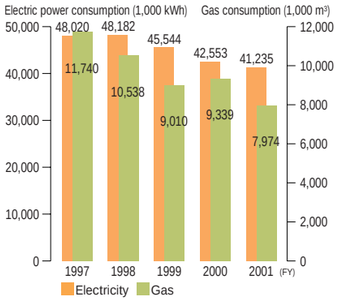
Efforts at Non-Manufacturing Sites

Reduction of CO_2 emissions at non-manufacturing sites takes place largely as a result of the diligent efforts of individual employees who are conscientious about saving energy. For example, the following energy-saving efforts are ongoing at Osaka Gas's various sites.

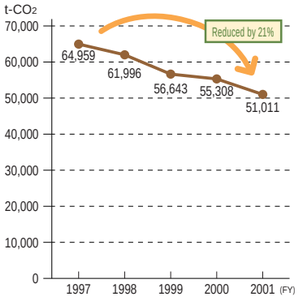
- Reduction of power consumption by removing unnecessary lights, turning off lights during lunch hour and at places where lights are not needed, and selective lighting during the night.
- Reduction of gas consumption by strict control of air-conditioning temperatures (28°C in summer, 18~20°C in winter).
- Reduction of automobile fuel consumption by encouraging drivers to avoid idling and drive at economic speeds, and promoting the use of public transportation.

As a result of steady efforts, CO_2 emissions from Osaka Gas's non-manufacturing sites achieved remarkable reductions of about 21% in FY 2001, compared to FY 1997.

●Energy Consumption



●CO_2 Emissions



Control of Other Greenhouse Gas Emissions and NOx etc.

Efforts at Manufacturing Plants

1) Greenhouse Gases Other Than CO_2

To control methane emissions from analytical instruments, which account for the great majority of these emissions, we are taking the following countermeasures.

- Recovery of methane emitted from instruments for analysis of composition and physical properties of city gas, including gravimeters, calorimeters and laboratory analyzers and re-introduction into low-pressure pipes.
- For calorimeters and other instruments that do not permit gas recovery, conventional models were replaced with new ones, such as ultrasonic models, that do not emit methane.

As a result of these efforts, the amount of methane emitted was reduced to 71 tons in FY 2001.

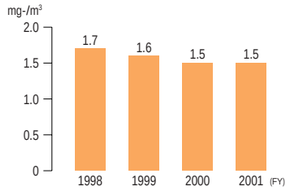
The amount of SF6 stored is 2.6 tons. Because it is kept in tightly closed containers, SF6 is not emitted into the atmosphere and there are almost no emissions of HFC, PFC or N_2O.

2) NOx and COD

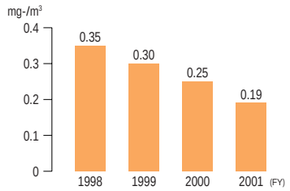
By converting from coal and petroleum to LNG as a raw material for city gas, significant decreases were achieved at our plants for NOx emissions as well as for chemical oxygen demand (COD, an index of water pollution) in wastewater.

We continued to strive for better energy-saving and wastewater management, and as a result, NOx emissions and COD discharge have decreased every year.

●NOx Emissions per Unit of Gas Sold



●COD Discharge per Unit of Gas Sold



Control of NOx and Other Greenhouse Gas Emissions through the Introduction of NGVs

Natural gas vehicles (NGVs), powered by natural gas (city gas), a clean energy source, emit almost no particulate matter, which has been pointed to as carcinogenic, or SOx, a cause of acid rain. Less NOx and CO_2 are emitted by NGVs than by gasoline- and diesel-powered vehicles.

Osaka Gas has steadily replaced its existing company vehicles with NGVs. In FY 2001, 97 NGVs were introduced, the ratio of NGVs reaching 34% (total number 885) as of the end of March 2002.

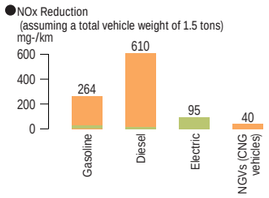
●Example: NGVs Introduced at Osaka Gas


Business vehicle


Bus at the Gas Science Museum

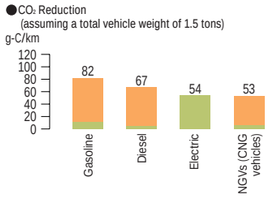

Forklift

●NOx Reduction (assuming a total vehicle weight of 1.5 tons)



Extracted from "Proposals for Mass-Diffusion of Low-Pollution Vehicles" (1994) by the Environmental Information Center.

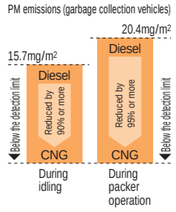
●CO_2 Reduction (assuming a total vehicle weight of 1.5 tons)



Extracted from "Proposals for Mass-Diffusion of Low-Pollution Vehicles" (1994) by the Environmental Information Center.

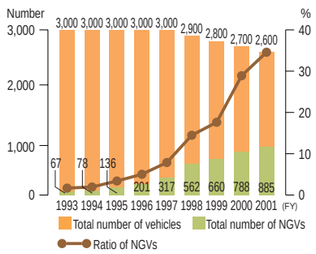
●Zero Particulate Matter

PM emissions (garbage collection vehicles)



Osaka Garbage Collection Vehicle Research Association (1999)

●Introduction of NGVs at Osaka Gas



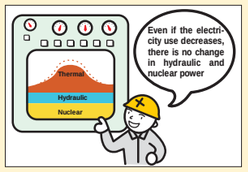
Calculation Method for CO_2 Emissions from Purchased Electricity

CO_2 emission emitted from power plants belonging to power supply companies are taken to be emissions by the consumers, and are calculated using the following equation:

CO_2 emissions (kg-CO_2/year) = amount of electricity purchased (kWh/year) x CO_2 emission coefficient for electric power (kg-CO_2/kWh)

The CO_2 emission coefficient for electric power is defined as the amount (kg-CO_2) of CO_2 emitted from a power plant in generating 1 kWh of power. In Japan, an average coefficient for all power sources is often used, including thermal, hydraulic and nuclear power generation, which is not correct for evaluating the effectiveness of CO_2 control measures.

Why? Power consumption reductions through anti-global warming efforts by consumers result almost exclusively in the reduction of the amount of power generated by thermal power plants, not nuclear or hydraulic. In addition, the Japanese national government's long-term energy demand and supply outlook assumes that the amount of electricity generated by hydraulic and nuclear power plants will not change, regardless of whether energy conservation, development of new energy sources, etc. are promoted or not. For these reasons, it seems appropriate to use the coefficient for electricity sources subject to control of the amount of electricity generated, i.e., thermal power generation, when evaluating the benefits of anti-global warming measures.



For evaluations of countermeasures: Average thermal power coefficient (0.6747 kg-CO_2/kWh for FY 1996)
For status monitoring: Average power coefficient for all sources (0.374 kg-CO_2/kWh for FY 1996)

Hence, it is necessary to use these two CO_2 emission coefficients for electricity generation, depending on the purpose of calculation.

In this report, to ensure the accurate evaluation of the benefits of anti-global warming measures, CO_2 emissions associated with purchased electricity are calculated using the average thermal power coefficient as a general rule, and for reference purposes, annual emissions are also calculated using the average power coefficient for all sources.

2. Reduction of Resource Consumption and Promotion of the Use of Recycled Materials

Points and Future Prospects

As specified in the FY 2010 Goals and the FY 2005 Plan, we aim at zero emissions in our business activities. We have established a review committee dedicated to promoting efforts toward zero emissions and recycling of waste. The recycling rate of excavated soil from gas pipe works reached 67% in FY 2001, enough clearing the quantitative target of 50% or higher in the Mid-term Environmental Goals for FY 2001.

For polyethylene pipe scraps, 100% recycling was achieved in FY 2000. The amount of industrial waste generated has decreased steadily every year. The amount of waste disposal from plants in particular decreased to 47 tons, a decrease to only 4.6% of disposal levels in the early 1990s, approaching the zero emissions level. We have also promoted the thorough sorting of general waste before collection. As a result, the recycling rate for all general waste increased from 48% to 59%. In FY 2002, we are making efforts to further reduce waste generation and to improve the recycling rate. We will also endeavor to strictly control harmful substances and conserve soil and ground water.

•Reduction of Excavated Soil from Gas Pipe Works and Promotion of Its Recycling•

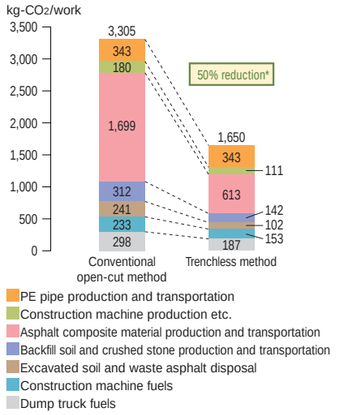
Reduction of Excavated Soil

As a result of a combination of a trenchless method of laying PE pipes (polyethylene pipes) (flow mole bore-more method, compact mole method or pipe splitter method) and shallow pipe laying, the amount of excavated soil generated was reduced by 770,000 tons.

Example: The Trenchless Method

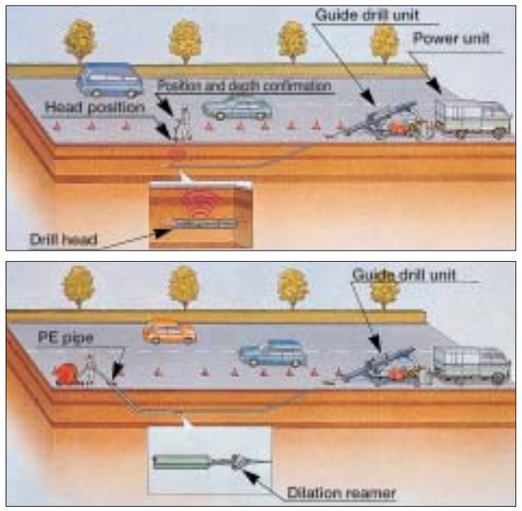
The bore-more method enables the long-distance extension of PE pipes.

●LCA Evaluation of CO_2 Emission Reduction Effects of Trenchless Methods



*Calculated on the assumption of a standard extension of 24 m
Source: Osaka Gas Co., Ltd., "Analysis of CO_2 Reduction Effects of Reduction of Excavated Soil Generation and Its Recycling in Gas Pipe Laying Work" in the Proceedings of the 16th Energy System, Economic and Environmental Conference (2000).

●Bore-more Method



Step 1
A steel rod with a nozzle that injects a jet of muddy water is pressed into the soil while the position of the nozzle is confirmed from the surface.

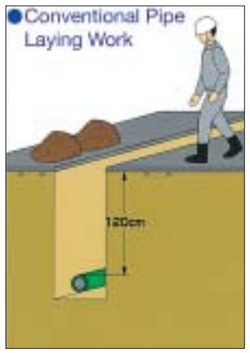
Step 2
When it reaches the drawing point, the rod is connected to a PE pipe. As the rod is drawn along and the hole is dilated to the pipe's diameter using the dilation reamer, the PE pipe is drawn in.

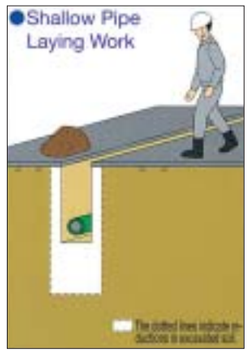
Visit our website for more details
For address see back cover

Promotion of Shallow Pipe Laying Work

Traditionally, Japan's Road Law has required gas pipes to be laid at 1.2 meters below ground level. In 1999, the Ministry of Construction (currently the Ministry of Land, Infrastructure and Transport) announced that the regulations would be modified within the framework of the current legal system to enable gas pipe to be laid at shallower depths.

Laying pipe at such shallow depths enabled us to significantly reduce the amount of sand and soil removed, to reduce the amount of mountain sand used for backfill (preventing corollary environmental destruction), to reduce vehicle fuel consumption, to ameliorate traffic disturbance, and to shorten the work period. As of FY 2001, Osaka Gas received permission for shallow pipe laying from approximately 97% of the administrative authorities in its service areas.





Recycling of Excavated Soil

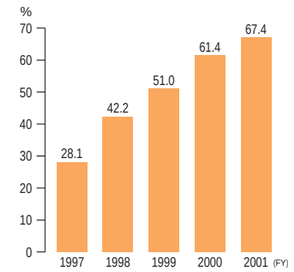
It is common practice to excavate roads when laying gas pipes. As a result, excavated soil and waste asphalt are generated. Since FY 1983, Osaka Gas and its affiliates have constructed a comprehensive road waste recycling system to promote the recycling of excavated soil and waste asphalt. Since FY 1998, in view of traffic considerations and transport time, we have developed a mobile soil recycling (SR) plant to further promote the recycling of excavated soil. In addition, the FK method (simplified sieving method) has been applied in a larger area. As a result of these efforts, the recycling rate improved from 61.4% in FY 2000 to 67.4% in FY 2001.

●FY 2001 Results

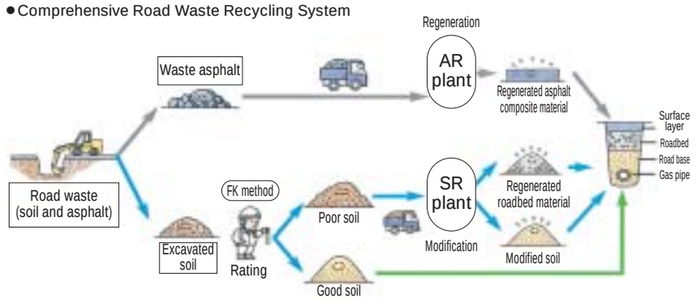
Fiscal year	1997	1998	1999	2000	2001
Estimated amount generated by conventional method (10,000 t)	188	185	187	177(*)	194(*)
Amount reduced (10,000 t)	24	26	30	62(*)	77(*)
Amount generated (10,000 t)	164	159	157	115	117
Amount recycled (10,000 t)	46	67	80	71	79
Recycling rate (%)	28.1	42.2	51.0	61.4	67.4
Amount used efficiently (10,000 t)	—	54	46	30	29
Amount of disposal (10,000 t)	—	38	31	14	9

The figures for the amount recycled include both reuse and recycling. The figures for the amount used efficiently indicate other purposes, such as for farmland and residential landfill. The above figures include asphalt.
(*) The figures for FY 2000 onward include reductions through shallow laying of service pipes and preliminary reinstatement work, as well as urban district gas pipe work.

●Recycling Rate

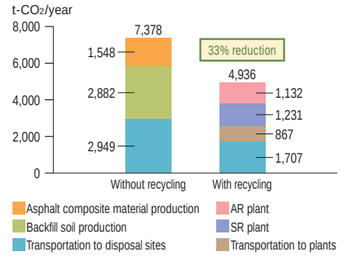


●Comprehensive Road Waste Recycling System



FK method: A simple method for determining the applicability of excavated soil for backfill purposes by examining the hydration condition and fine particle content using a simple tool on site.
SR plant (excavated soil regeneration): A plant for modifying and regenerating excavated soil into backfill soil (road base material) and roadbed material.
AR plant (asphalt regeneration): A plant for regenerating waste asphalt into asphalt composite material for road paving.

●LCA Evaluation of CO_2 Emission Reduction Effects in the Comprehensive Road Waste Recycling System



Source: Osaka Gas Co., Ltd., "Analysis of CO_2 Reduction Effects of Reduction of Excavated Soil Generation and Its Recycling in Gas Pipe Laying Work" (FY 1998) in the Proceedings of the 16th Energy System, Economic and Environmental Conference (2000).

•Recycling of Gas Pipe Materials•

Because we promote the use of polyethylene pipes (PE pipes), which are highly resistant to uneven ground subsidence and earthquakes and do not corrode underground, the amount of PE pipes cut or dug up at construction sites has increased. Osaka Gas is promoting the recycling of this waste material into construction materials. In FY 2000, we introduced a method of recycling pipe joints, achieving a PE pipe recycling rate of 100%.

Since FY 1997, we have promoted the use of recycled pipe material to make indicator posts for buried pipes. In FY 1999, more types of applicable indicator posts were developed. In FY 2000, we started to recycle pipe fragments for room heating resin pipes. As a result, we achieved 100% recycling of PE pipe waste in FY 2001, even though the amount of PE pipe waste generated increased from 105 tons in FY 2000 to 140 tons in FY 2001.

Metal pipes such as steel and cast iron pipes are also 100% recycled by electric furnace manufacturers and recycling companies.

●PE Pipe Recycling Rate

Fiscal year	1998	1999	2000	2001
Amount wasted (t)	54	90	105	140
Amount recycled (t)	27	45	105	140
Recycling rate (%)	50	50	100	100

Pipe indication tapes

Pipe indication posts made from waste PE pipe

●Recycling and Control of Industrial Waste●

In April 2001, the Industrial Waste Disposal Law was amended in order to impose more rigorous regulations on those responsible for waste generation. Accordingly, Osaka Gas strengthened its control of waste shipping and storing manifests.

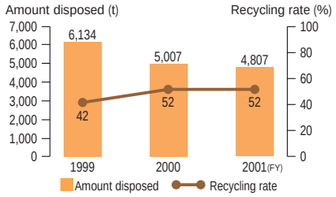
The amount of industrial waste generated in FY 2001 was 10,073 tons, representing a reduction of about 295 tons from the FY 2000 level. The recycling rate for manufacturing plants improved significantly, from 51% to 90%. As a result, the amount of industrial waste generated and discarded from our manufacturing plants decreased dramatically to 47 tons, just 4.6% of the 1,027 tons generated in FY 1993 (the year of the highest waste disposal level in the 1990s). Thus, the zero emissions status was very nearly achieved. For non-manufacturing sites, the recycling rate also improved significantly from 23% to 53%. Osaka Gas has established a highly reliable recovery and recycling system for used gas equipment discarded by our customers, and has been endeavoring to promote the recycling of relevant resources (see page 35). Osaka Gas also collects debris such as rubble, lumber scraps, sawdust, etc., generated during the work of laying gas pipe at our customers. This waste accounts for the great majority of the industrial waste generated by Osaka Gas as a whole. In FY 2001, the recycling rate of industrial waste generated at our customers was 50% (56% for FY 2000). This is because the amount of "rubble" that cannot be recycled at present showed a major increase from 743 tons to 1,774 tons, due to an increase in gas pipe renewal work at our customers. Rubble will soon become almost 100% recyclable in FY 2002, and so the overall recycling rate is expected to improve significantly.

●Industrial Waste Generated and Its Recycling Status in FY 2001 (t/year)　　( ) : FY 2000 results

Waste type	Content details	Generated	Recycled	Disposed	Recycling rate
Sludge	Wastewater mud	108 (76)	75 (32)	33 (44)	70% (42%)
Waste oil	Lubricant oil and cleaning oil	75 (56)	64 (50)	11 (5)	85% (90%)
Waste plastics	PE pipe scraps and insulation	681 (689)	348 (297)	333 (392)	51% (43%)
Metals	Used gas equipment (*)	4,580 (5,002)	3,939 (4,502)	641 (500)	86% (90%)
	Pipe scraps etc.	679 (633)	535 (436)	144 (197)	79% (69%)
Glass, earthenware and china scraps	Glass wool, used fluorescent lamps, etc.	210 (336)	21 (0)	189 (336)	10% (0%)
Debris	Waste asphalt and concrete	1,774 (743)	58 (0)	1,716 (743)	3% (0%)
Lumber scraps	Waste construction lumber etc.	1,466 (1,595)	0 (0)	1,466 (1,595)	0% (0%)
Others	Waste construction materials and others	500 (1,239)	226 (44)	274 (1,195)	45% (4%)
Total	Total	10,073 (10,368)	5,266 (5,361)	4,807 (5,007)	52% (52%)
Breakdown	Manufacturing plants	476 (570)	429 (291)	47 (279)	90% (51%)
	Non-manufacturing sites	1,161 (1,146)	618 (266)	543 (879)	53% (23%)
	Customers	8,436 (8,652)	4,219 (4,803)	4,217 (3,849)	50% (56%)

(*) This represents the amount of used gas equipment recovered from customers when new equipment is sold by Osaka Gas.

●Industrial Waste Disposal and Recycling Rate



●Recycling and Control of General Waste●

In an attempt to control waste generation and to improve the recycling rate, Osaka Gas has promoted general waste volume reduction, sorting before collection and investigation of appropriate recycling methods. As a result, in FY 2001, the recycling rate at all of our sites improved from 58% to 70% for all paper products, and from 48% to 59% for all general waste, as compared to FY 2000.

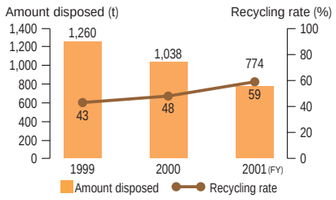
For our Head Office building in particular, which acquired ISO 14001 certification in FY 2001, as a result of thorough implementation of sorting before garbage collection in accordance with the operating manual and the introduction of a composting device, the recycling rate improved dramatically from 63% (FY 2000) to 89%.

The newly introduced composting device processed about 22 tons of garbage into about 4 tons of compost every year and the resulting compost has been used as fertilizer by farmers on contract. Four of these composting devices have already been installed at Osaka Gas.

●General Waste Generated and Its Recycling Status in FY 2001 (t/year)　　( ) : FY 2000 results

Waste type		Generated	Recycled	Disposed	Recycling rate
Paper	Paper (copy paper)	413 (599)	304 (278)	109 (321)	74% (46%)
	Newspapers	129 (138)	129 (134)	0 (4)	100% (97%)
	Magazines	162 (219)	158 (207)	4 (12)	98% (95%)
	Corrugated cardboard	228 (166)	222 (146)	6 (20)	97% (88%)
	Confidential documents	143 (106)	105 (61)	38 (45)	73% (58%)
	Waste paper and others	329 (229)	64 (16)	265 (213)	19% (7%)
Total paper		1,404 (1,457)	982 (842)	422 (615)	70% (58%)
Cans		25 (36)	18 (28)	7 (8)	72% (78%)
Bottles		27 (29)	13 (27)	14 (2)	48% (93%)
Kitchen debris		318 (349)	67 (47)	251 (302)	21% (13%)
Plastics		28 (33)	20 (16)	8 (17)	71% (48%)
Others		75 (102)	3 (8)	72 (94)	4% (8%)
General waste total		1,877 (2,006)	1,103 (968)	774 (1,038)	59% (48%)

●General Waste Disposal and Recycling Rate



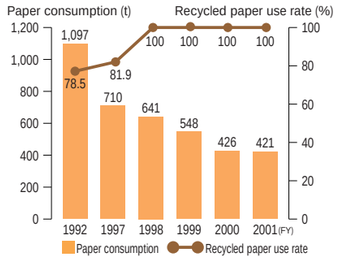
●Reduction of Paper Consumption and Promotion of Paper Recycling (Recycled Paper Use Rate 100%)●

Osaka Gas is working on "reduction of paper consumption" and "promotion of recycled paper use." We have made efforts to reduce the consumption of copy paper, computer output paper, internal and external forms, business cards and letter pads. Our total paper consumption by weight was 421 tons in FY 2001 (62% reduction compared to FY 1992).

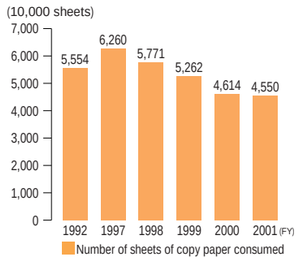
This reduction is attributable to measures such as printing on both sides of internal forms, abolition of internal forms through systemization, reduction of copy paper consumption, and paper size reduction.

Reductions in copy paper consumption were included as a performance evaluation item starting in FY 1999. Since then, various efforts have been made, such as using reverse side of printed paper, thorough implementation of copying on both sides of the paper, introduction of two-sided printers, and promotion of paper-less conferences. As a result, the number of sheets of copy paper used was reduced to 45.5 million in FY 2001, a reduction of about 17 million sheets or 27% as compared to FY 1997. The recycled paper use rate has been 100% since FY 1998.

●Paper Consumption and Recycled Paper Use Rate



●Copy Paper Consumption



●Examples of Our Efforts●

Recycling of Used Fluorescent Lamps, etc. at the Transmission Department

At the Transmission Department, we have investigated the recycling of used fluorescent lamps and batteries generated from individual regional transmission departments. In FY 2001, we designated a company to undertake the treatment of these waste materials on contract as the first step to the "establishment of a companywide recycling system for used fluorescent lamps and batteries," and actually recycled 115 kg (525 tubes) of used fluorescent lamps and 170 kg of used batteries.

Used fluorescent lamps are broken up into various materials to be recycled separately.

The mercury contained in fluorescent lamps is recovered and recycled safely, with no atmospheric emissions occurring during the process from collection to treatment. Regarding used batteries, the nickel, lithium and other rare metals contained in chargeable batteries and button batteries are recovered, and other types of batteries are broken down into metals and manganese dioxide etc. for the efficient use of recycled resources.

Fluorescent Lamp Recycling Facility

Introduction of Composting Device to the Head Office

In May 2001, a composting device was installed on the roof of the Head Office building. Since then, kitchen refuse and leftover food from the employees' restaurant and others have been treated using this device. Traditionally, raw garbage had been handled as general waste from business activities. In this new energy-saving device, the garbage is vacuum dried and compressed using waste heat from co-generation equipment. The amount of garbage generated was reduced to about 4 tons (from about 22 tons generated in FY 2000). The resulting compost is transferred to a fertilizer plant and used in the cultivation of organic agricultural products.

Composting Device

Efforts toward Zero Emissions

Osaka Gas is endeavoring to achieve zero generation of all waste at its manufacturing plants and zero generation of general waste companywide. Such efforts include regulating the generation, reducing the volume, and promoting the recycling of all general and industrial waste.

The figures for the amounts disposed include the residue from material recycling and thermal recycling, as well as the amount not recycled but burnt or used for landfill.

	Goals for amounts disposed		
	1998 (results)	2005	2010
Waste from plants (industrial and general)	230t	25 t(*)	25 t(*)
General waste from other sites	1,000t	500 t	100 t

(*) In FY 2005 and beyond, the amount disposed will approach zero, provided that residues from material recycling and thermal recycling are excluded.

3. Green Procurement and Green Distribution

●Efforts to Green Procurement●

Osaka Gas preferentially promotes the purchase of products, and the award of contracts for construction work and other services, that will have fewer environmental impacts, and considers their "environmental friendliness," as well as their quality, prices and delivery time, in accordance with the "Guide to Green Procurement" established in May 2000.

Specifically, we strive to do the following:

- As a general rule, use copy paper with a recycled paper ratio of 100% and a degree of whiteness of 70%.
- As a general rule, use recycled paper or non-wood paper for printed matter.
- Expand the purchase of office supplies that are recycled or bear the "ECO-MARK."
- Recycle PE pipe scraps into indication tapes etc.
- Change the material used for work uniforms to recycled PET bottle cloth.
- Preferentially use recycled asphalt in road construction work.

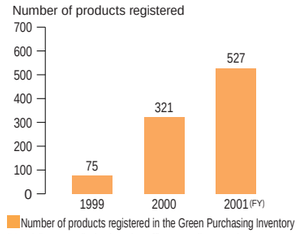
Regarding construction work for gas pipe laying and manufacturing facilities, measures to reduce its environmental impact are required in our "Construction Work Specifications" and the "General Environmental Specifications."

We have also conducted a comprehensive survey every year to evaluate environmental activities by our suppliers, in terms of environmental management systems, acquisition of ISO 14001 certification, environmental philanthropy, and introduction of low-pollution vehicles. By making use of these findings in purchasing activities, Osaka Gas and its suppliers are collaborating on environmental conservation activities.

Results of Green Purchasing

The amount of money spent by Osaka Gas to purchase environmentally friendly products was 96 million yen in FY 2001, representing an increase of about 50% compared to FY 2000. In addition, 527 environmentally friendly products were registered in our green purchasing inventory for office supplies, equipment, etc., showing a remarkable increase from 321 in FY 2000.

●Number of Environmentally Friendly Products Registered in the Green Purchasing Inventory

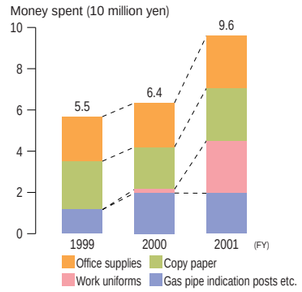


(Note) Data are limited to the office supplies, equipment, etc. purchased by Osaka Gas on a unit price contract basis.

●Example: Environmentally Friendly Product Items Registered in the Osaka Gas Green Purchasing Inventory

Copy paper	Toilet paper
Ballpoint pens	Pencils
Rulers	Rubber erasers
Bookstands	Scissors
Mouse pads	Cutter knives
Paste	Files
Card cases	Office envelopes
Notebooks	Tag paper
Trash boxes	Chairs
Desks	White boards
Work gloves	Tape cutters

●Amounts of Money Spent to Purchase Environmentally Friendly Products



Visit our website for more details
For address see back cover

●Efforts for Green Distribution●

Air pollution associated with vehicle exhaust in urban areas poses serious problems, such as increases in nitrogen dioxide (NO_2) and particulate matter (PM). "Green distribution" has recently attracted attention as a possible countermeasure.

The term "green distribution" refers to activities aimed at reducing air pollutant emissions by preferentially using delivery vehicles with fewer environmental impacts.

Green Distribution Efforts by Local Governments in the Kansai Region

- Six local governments in the Kansai region (Kyoto Prefecture, Kyoto City, Osaka Prefecture, Osaka City, Hyogo Prefecture, Kobe City) announced in June 2001 that they would require their suppliers to preferentially use vehicles with fewer environmental impacts, and are now preparing to implement the measures noted in the announcement.
- The Osaka Prefectural government began implementation of "green distribution" in April 2002, and is promoting the replacement of conventional vehicles with low-pollution vehicles.

Formulation of the Green Distribution Policy at Osaka Gas

Osaka Gas formulated in December 2001, the "Osaka Gas Green Distribution Policy" to request its distributors to preferentially use low-pollution vehicles for logistics, service and sales activities. In January 2002, Osaka Gas started implementing actions based on this policy. This is the first green distribution policy formulated by a private corporation in the Kansai region.

The low-pollution vehicles specified in the "Osaka Gas Green Distribution Policy" are next-generation low-pollution vehicles, including NGVs, electric vehicles, hybrid vehicles, methanol-powered vehicles, vehicles qualified for low fuel consumption and low exhaust gas emissions (models for which vehicle taxes are reduced for low environmental impact), and fuel cell vehicles.

We would like to maintain and expand the concepts in our green distribution policy, as well as to expand its area of application.

Major points of the Policy:

1) All vehicles owned by Osaka Gas should be replaced by FY 2010 with low-pollution vehicles such as NGVs wherever possible and as quickly as possible.

2) Osaka Gas requests its affiliates, service chain shops, construction contractors and suppliers to replace conventional vehicles to the maximum possible extent with low-pollution vehicles for deliveries, service and sales activities directed to Osaka Gas plants and offices.

4. Environmental Management Improvement

Points and Future Prospects

Osaka Gas strives to improve its companywide environmental management system and to acquire ISO 14001 certification. In FY 2001, after the certification of the Transmission Department, the Head Office staff sector acquired certification, which was the first instance of acquisition by a head office among private electricity or gas service companies. In 2002, the Osaka Business Headquarters acquired it. At the other four Business Headquarters that have so far not acquired the certification, the ECO-CHECK program is ongoing to improve the companywide environmental management system.

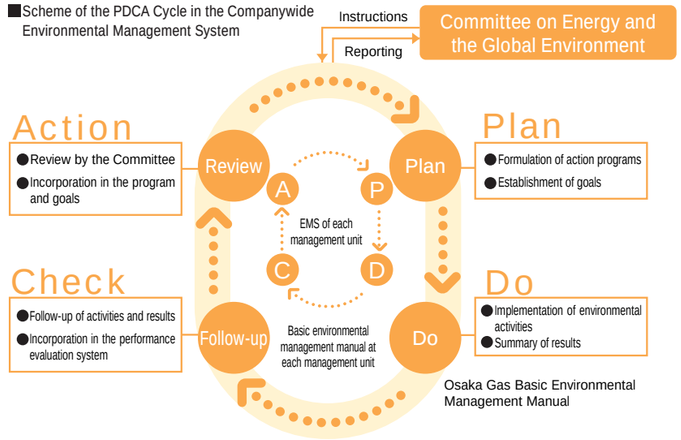
Furthermore, various environmental items were included in the performance evaluation system in FY 1999. Since then, we have achieved steady results.

Osaka Gas aims to acquire companywide ISO 14001 certification, and will improve the environmental evaluation items in the performance evaluation system.

●Establishment and Improvement of Environmental Management System●

Osaka Gas is promoting companywide environmental conservation activities by implementing various programs based on its Environmental Philosophy and Environmental Action Guidelines at the initiative of the Committee on Energy and the Global Environment (see page 4).

■Scheme of the PDCA Cycle in the Companywide Environmental Management System



Efforts toward Companywide Acquisition of ISO 14001 Certification

The ISO 14001 (Environmental Management System) is an international standard aiming at improving environmental conservation performance by legal compliance and continued system improvement (adoption of the PCDA cycle). Following the acquisition of ISO 14001 certification by the Production Department in October 1997, the Senri Energy Center (presently transferred to the Gas and Power Investment Co., Ltd.) and the construction section of the Engineering Department acquired the certification in March 2001. The Transmission Department acquired ISO 14001 certification in June 2001, the Head Office in September 2001, and the Osaka Business Headquarters in March 2002. Currently, the Research and Development Department is moving towards ISO 14001 certification by February 2003, and other departments will begin similar activities in sequence (for examples of these efforts, see pages 25 and 26).

In the Mid-term Environmental Plan for FY 2005, Osaka Gas aims to acquire ISO 14001 certification for all of its departments, including the Production, the Transmission and all Business Headquarters responsible for marketing, in order to promote environmental conservation activities in accordance with ISO 14001 specifications.

●Status of Acquisition of ISO 14001 Certification

Date	Department
Acquired	
Oct 1997	Production Department
Mar 2001	Engineering Department (construction)
Mar 2001	Senri Energy Center (currently operated by Gas and Power Investment Co., Ltd.)
June 2001	Transmission Department
Sept 2001	Head Office Gas Building
Mar 2002	Osaka Business Headquarters
July 2002	Research and Development Department (Kyoto office)
Will be acquired	
Feb 2003	Research and Development Department (Torishima office)

Introduction of an Environmental Evaluation Index to the Performance Evaluation System

Osaka Gas has a departmental performance evaluation system for the annual evaluation of the actual business results of each department. In the past, the items evaluated were indices of profitability, growth potential and contribution to the public benefit, specifically actual sales and incidence of accidents. In FY 1999, another index was introduced to evaluate environmental activity performance. In this evaluation system, degrees of goal achievement, together with various environmental conservation activities, are scored in terms of reductions of CO_2 emissions from energy consumption and copy paper consumption, as these are common to all employees. This system has enabled us to more thoroughly implement environmental improvement activities.

Performance Evaluation

- Values for Customers
- Values for Shareholders
- Values for Society
  - Environment improvement activities at both our business and customers
  - Achievement of environmental goals
  - Compliance with law and guidelines

Violation of Laws Concerning the Environment and Fines Imposed

There were no violations of laws concerning the environment and no fines imposed in FY 2001.

Example: Efforts through ISO 14001 Certification

Production Department (Acquired in October 1997)

1) Features

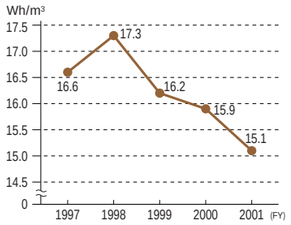
- The three manufacturing plants belonging to the Production Department acquired ISO 14001 certification together.
- Affiliates and cooperating companies based within the plants also participate in these activities.

2) Example: policies and objectives

Policy	Objectives etc.
Reduction of emissions of gases that impact the environment	Reduction of emissions of methane, CFCs, CO_2, NOx
Energy generation using cryogenic heat etc. and efficient use of energy	Efficient use of electricity and fuels and increase in the amount of LNG for cryogenic use
Resource saving by waste reduction etc.	Strengthening of waste management and reduction of waste generation
Contributions to local environmental conservation	Distribution of environmental information and implementation of local environmental conservation activities

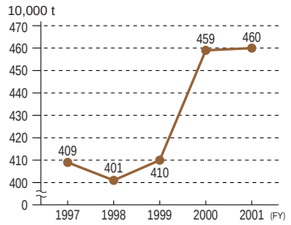
3) Results of environmental conservation activities

●Electricity Purchase per Unit of Gas Sold



●Cryogenic Heat Use

In FY 2000, the amount increased because the expansion turbine at the Himeji Terminal came into full-scale operation.



4) Guidance for cooperating companies

Requests concerning environmental conservation made to fulltime cooperating companies involved in the Production Department's environmental management system (EMS) are carried out through contracts or other means. These companies are requested to exchange relevant information and to participate in local environmental improvement activities via the Environmental Conference. Environmental education programs for cooperating companies equivalent to those of Osaka Gas are also available.

5) Future efforts

We plan to make further efforts with emphasis placed on the following:

- Promote zero emissions at plants.
- Reduce chlorofluorocarbon emissions.

Head Office Gas Building (Acquired in September 2001)

1) Features

- Activities to reduce paper consumption and trash generation and to save energy in common among all departments (office activities).
- Environmental improvement activities relevant to the duties of individual departments (staff activities).

2) Example: policies and objectives

●Office Activities

Policy	Objectives etc.
Energy-saving	Reduction of CO_2 emissions
Resource saving	Reduction of copy paper consumption per employee
Waste reduction and recycling	Thorough sorting before collection of general waste and measuring daily volumes at each department

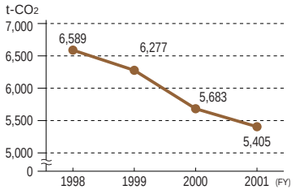
●Staff Activities

Policy	Objectives etc.
Energy-saving and reduction of greenhouse gases	Environmental improvement by establishment and implementation of 16 specific programs, including "installation of composting devices," "recycling difficult-to-dispose-of industrial waste," "notification and improvement of the Guide to Green Procurement," "improvement of environmental activities by suppliers," "environmental education for the management/hierarchy," and "expansion of cleanup activities."
Resource saving, waste reduction and recycling	
Green procurement	
Raising environmental awareness	
Disclosure of environmental information	
Contributions to local and global environmental conservation	

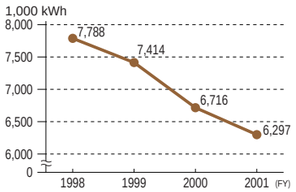
3) Results of environmental conservation activities

Office Activities

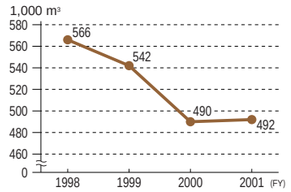
●CO_2 Emissions



●Power Consumption



●City Gas Consumption



Staff Activities

Planned programs were implemented as scheduled, including the introduction of a composting device using co-generation byproduct heat, activities to raise awareness about the Guide to Green Procurement including an awareness status survey, and recycling of difficult-to-dispose-of industrial waste.

4) Future efforts

- Improve equipment and other measures to further conserve energy and reduce CO_2.
- Improve environmental activities (staff activities) relevant to the duties of individual departments.

Sorted collection boxes (paper and trash classified into 16 kinds of waste)

Transmission Department (Acquired in June 2001)

1) Features

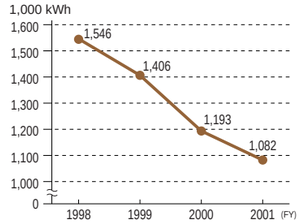
- The first acquisition of ISO 14001 certification by a gas pipeline division among private gas companies.
- The coverage is broad, including not only "fixed sites" but also "mobile sites" in construction work situations.
- Many administrative organizations are involved, with more than 200 relevant environmental laws or regulations.

2) Example: policies and objectives

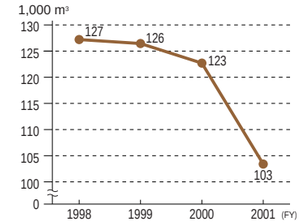
Policy	Objectives etc.
Control of construction work byproduct generation	Improvement of excavated soil and sand recycling rate
Reduction of energy and resource consumption	Reduction of power consumption at stations
	Reduction of power, gas and vehicle fuel consumption at offices
Control of greenhouse gas emissions	Reduction of CO_2 emissions
Control of waste generation	Reduction of copy paper purchase per employee
	Reduction of general waste generation

3) Results of environmental conservation activities

●Power Consumption at Offices



●City Gas Consumption at Offices



4) Future efforts

- Accurate response to the establishment and amendment of environmental laws and regulations.
- Continued improvement of EMS.

Checking tire air pressure to reduce fuel consumption

Quantification of waste by daily measurement

Osaka Business Headquarters (Acquired in March 2002)

The Osaka Business Headquarters acquired ISO 14001 certification in March 2002, representing the first certification among Osaka Gas's 5 business headquarters and also the first case of certification by a principal sales division in the gas industry.

Consideration was given to environmental improvement activities having to do with the particular duties relevant to each individual department, including promotion of energy conservation and recycling at our customers, as well as "office activities," shared by all departments of Osaka Gas. These activities are characterized by including the objective of expanding the sales of natural gas to our customers, mainly by sales divisions, advocated as an environmentally beneficial activity with specific goals such as marketing gas co-generation systems and gas absorption type chiller/heaters.

Implementation of the ECO-CHECK Program

Description of Activities

All the major departments and divisions at Osaka Gas have their environmental activities evaluated on the basis of the ISO 14001 specifications or the ECO-CHECK program, and constant efforts are made to promote environmental improvement activities.

In March 2002, the ECO-CHECK program was implemented at four business headquarters, excluding the Osaka Business Headquarters, which had already acquired ISO 14001 certification, to confirm and strengthen their efforts relating to environmental action.

Specifically, a total of 47 items were checked: 28 for environmental action checkup according to the ISO 14001 specifications, and 19 for evaluation of waste treatment status.

● Examples of Items Evaluated in the ECO-CHECK Program

Category	Item		Description
Environmental action check-up	Environmental policies		Establishment and review
	Plan	Environmental aspects and impact levels	Status and content of planning
		Laws and local regulations	Status and contents of surveys
	Implementation and operation	Goals	Target items and values
		Organization	Status of environmental conferences
		Education	Status of employee education
		Communication	Awareness of employees, cooperating companies, etc.
		Management manual	Establishment and review
		Operation and management	Energy conservation, waste reduction activities etc.
	Inspection and corrective measures		Goal follow-up and corrective measures
Evaluation of status of waste treatment	General waste		Legal compliance by contractors and in contract agreements
	Industrial waste		
	Manifest system		Legal compliance in waste manifest description and storage
	Response to the Home Appliance Recycling Law		Legal compliance

Results and Future Efforts

All four business headquarters established ambitious quantitative targets for power and city gas consumption, conducted detailed surveys on consumption rates, and took remedial action. As for education, employees are well informed of the goals and programs.

Additionally, efforts are made to raise each individual's awareness about environmental conservation and to encourage his or her activities, for example by holding meetings where employees present case studies and excursion tours to waste treatment facilities. To promote environmental activities, the PDCA cycle (in which procedures for energy and resource conservation activities are established and performance is monitored every month) has worked well.

Regarding the appropriate treatment of waste, a responsive system is in operation to ensure compliance with various laws and regulations.

After implementation of the ECO-CHECK program, the Environment Department exchanged information with the four business headquarters and provided feedback on its findings.

●Environmental Education and Awareness-Raising Activities for Employees●

In order to raise the environmental awareness of employees and improve internal environmental activities, we conduct various environmental education and awareness-raising activities. Specifically, environmental education programs are implemented every year for all employees at plants and offices that have already acquired ISO 14001 certification, and so on. In addition, environmental information is distributed to all employees via the Internet and other media to raise their awareness of environmental conservation. Within the framework of the talent-nurturing system of the Personnel Department, we have implemented and improved our internal environmental educational systems and programs to raise the employees' awareness about environmental conservation at various levels.

Example: Environmental Education Program

In the talent-nurturing system of the Personnel Department, step by step environmental educational programs are provided for newly recruited employees and managing officers appointed to new positions.

These programs include lectures on Osaka Gas's efforts and achieved results, and cover global environmental issues, the Osaka Gas Environmental Philosophy, the Environmental Action Guidelines, the environmental management system and ISO 14001, and are designed to raise the awareness about environmental conservation of employees as workers involved in energy business.


Environmental education for newly recruited employees

●Environmental Awareness-Raising Activities●

Environmental Lecture

In Japan, June is known as Environment Month. On June 1, 2001, Osaka Gas held an environmental symposium entitled "The Global System and the Human Sphere in the 21st Century - Considering 2001 Environmental Issues from the Starting Point." After a special address by Professor Matsui of the University of Tokyo, a panel discussion took place.

●Panelists

Takafumi Matsui, University of Tokyo
Koji Yamaguchi, NEC Corporation
Susumu Furutachi, Lifestyle Culture Researcher

Environmental Action Case Study Report Meeting

Within the framework of the internal environmental awareness-raising program, we held the "Third Osaka Gas Environmental Action Case Study Report Meeting" on December 4, 2001. After a keynote speech by Tadao Ando, an architect, Osaka Gas employees made a total of five presentations on their environmental conservation activities.


Special lecture by Tadao Ando

Internal Distribution of Environmental Information

To raise the environmental awareness of each employee and to encourage their individual environmental activities, various forms of environmental information are provided via the Intranet, internal newsletters, internal video news, and other media.

●Intranet
Environment-related topics, particulars of legal amendments, internal environmental events, etc.

●Internal newsletters and video news
News on internal environmental activities etc.

●Internal and relevant conferences
Trends in environmental issues, particulars of legal amendments concerning the environment, etc.

Internal Awards for Environmental Activities

●President's Awards System

This system was inaugurated in 1993 to acknowledge outstanding environmental activities and employees that have made significant contributions to local and global environmental conservation.

Particulars of the FY 2000 awards are given in the table on the right.

FY 2000 President's Awards

Description	Department
Transfer of technology for wet catalytic oxidation process to China	Engineering Dept.
Partial reuse of gas leak alarms	Pipeline & Facilities Engineering Dept.
Improvement of recycling rate of polyethylene pipe scraps	
Development of lean gas engine co-generation exhaust gas purification system	R & D Dept.

5. Proper Management of Chemical Substances

Points and Future Prospects

By converting the raw material for city gas from coal and petroleum to natural gas, Osaka Gas has significantly reduced its consumption of chemicals and now produces almost no emissions or discharge of chemical substances into the environment. We will endeavor to further reduce generation of substances having environmental impacts, strengthen our management of chemicals, and reduce their consumption.

Response to the PRTR Law

The Pollutant Release and Transfer Register Law (PRTR Law) was promulgated in 1999 in order to promote voluntary activities to improve management of chemicals by companies that handle harmful chemicals, and monitor their discharge into the environment in order to prevent environmental damage through the release of these chemicals. Starting in April 2002, such companies are obliged to notify the relevant authorities of the amounts of PRTR-specified chemicals they discharge or transport.

By converting the raw material for city gas from coal and petroleum to liquefied natural gas (LNG), Osaka Gas now handles almost no chemical substances. To further reduce the amounts of chemicals used and discharged, we have made supplementary efforts, including the following:

1) We use chlorofluorocarbon (CFC) recovery equipment in combination with CFC-emitting apparatus in order to reduce atmospheric CFC emissions. We have also reduced the consumption of CFC-based detergents by improving operating procedures.
2) We strive to incorporate into the environmental management system a well-planned program for reductions in chemical substance consumption.

As a result, the only chemical substances with PRTR values that must be reported to relevant authorities currently handled at Osaka Gas in FY 2002 are HCFC-22 and asbestos.

●Substances Subject to Reporting under the PRTR Law (Values reported in FY 2002)

Name	Handled annually (t)	Discharged (t)	Transported (t)
HCFC-22	6.7	6.7	0
Asbestos	0.75	0	0.75

(Note) Total figures are given for substances of which 5 tons (0.5 tons for specified substances) or more are handled annually.

Response to the Chlorofluorocarbon Recovery Law

The Chlorofluorocarbon Recovery Law was enforced in April 2002 with the purpose of controlling atmospheric emissions of chlorofluorocarbons (CFCs) by promoting their recovery and destruction from specified products. When we dispose of commercial air-conditioners, freezers and business vehicles, we entrust the appropriate recovery of CFCs to registered companies.

For commercial air-conditioners (GHP) marketed by Osaka Gas, a system is in operation in which the appropriate recovery of CFCs is entrusted to registered companies at the time of equipment disposal (see page 34).

PCB Management

The PCB Special Measures Law, as formulated in 2001, requires PCB-handling parties to appropriately manage waste PCBs and to report the status of storage to the relevant prefectural governor annually. Osaka Gas owns about 1.5 tons of PCBs and has continued to apply appropriate management of waste PCBs in accordance with the relevant legal regulations. The PCBs now stored by Osaka Gas will be treated at a PCB treatment facility scheduled to be built by the government's administrative authorities.


Storage of waste PCBs

●Quantity of Waste PCBs in Storage by Osaka Gas

Condensers	Fluorescent lamp stabilizers
About 200 units	About 3,700 units

COD, SS, Nitrogen, Phosphorus, etc. Discharge in Wastewater

At Osaka Gas's manufacturing plants, seawater is used to gasify LNG. This process does not produce substances with environmental impacts because it is based on indirect heat exchange. Domestic wastewater and other forms of general wastewater generated in the plants are discharged after appropriate treatment at the site, by passage through purification chambers and other means.

●Wastewater Discharge from Plants (FY 2001)

Amount of wastewater discharged	About 200,000t
pH	7.1~8.6
Chemical oxygen demand (COD)	1.4t
Suspended substances (SS)	3.2t
Total nitrogen (T-N)	1.3t
Total phosphorus (T-P)	1.1t

At the non-manufacturing sites as well, almost no wastewater except ordinary domestic wastewater is discharged. Even when discharged, such wastewater is released in sewers so that there is no possibility of contamination of public water systems.

Measures against Dioxin

In 1999, the Dioxin Special Measures Law was formulated to cover incinerators with a burning capacity of 50 kg/h or more. Osaka Gas has already abandoned such incinerators. We have waste reduction efforts, such as resource conservation and reduction of garbage generation (see pages 21 and 22). We believe that these activities contribute to the reduction of dioxin generated at public refuse incineration plants.

Osaka Gas is also engaged in technical development to reduce the amount of dioxin emitted from municipal refuse incinerators, in cooperation with a municipal incinerator plant manufacturer. One of these developments involves re-burning technology, in which the dioxin and NOx contents in incinerator exhaust gases can be reduced dramatically by introducing natural gas into municipal refuse incinerators. The world's first actual plant based on this technology was constructed at Osaka City's Maishima Refuse Incineration Plant in the spring of 2001.

6. Land Environment Conservation

Efforts to Cope with Environmental Risks

In anticipation of public demands for measures against various environmental risks, Osaka Gas established a Business Site Land Environment Committee and a related project group in January 2001. Since then we have conducted a series voluntary surveys to understand environmental risks concerning soil and groundwater and which measures are appropriate to take. If these surveys reveal contamination, we report the fact to the relevant administrative authorities without delay and take appropriate risk management measures in accordance with their guidance.

Survey Procedures

Our surveys are conducted in accordance with the "Guidelines for Surveys and Countermeasures Concerning Soil and Groundwater Contamination" formulated by the national government. First, chronological data on the operation and the layout of the building and equipment at the manufacturing facilities in question are investigated. Subsequently, the status of surface soil and groundwater contamination are examined. If surface soil or groundwater is found to be contaminated, boring surveys are done to determine the extent of contamination. Since FY 2000, Osaka Gas has conducted voluntary surveys at 22 former manufactured gas plant (MGP) sites where it is possible that the soil has been contaminated. These surveys will be completed in FY 2003.

Efforts to Date

The environmental survey results and measures taken for the four former plant sites found to have soil contamination are summarized below. Although surveys conducted by relevant administrative authorities detected no well water contamination in any area surrounding any of these sites, and we believe there were no impacts on the surrounding environment, we have taken measures to reduce environmental risks.

■ Former Kobe Plant Site

Surveys related to the development plan for the area sold by Osaka Gas to another owner that was formerly the site for its Kobe plant detected totals of cyanogen and lead at levels exceeding their respective acceptance criteria. Subsequently, we took appropriate action with the government's administrative authorities that was completed in November 2001. Specifically, contaminated soil was excavated, washed with water, and divided into different classes by particle size. Contaminants were then separated in the form of sludge, and the purified soil was replaced, having been categorized as recycled soil. This method was adopted because it is economic and effective in terms of resource recycling, in that it enables reuse of the excavated soil. Prior to execution of the work, we established a technology for quickly measuring contaminant concentrations in the purified soil and treated water to ensure the accurate monitoring of the progress of the work and as a highly reliable quality control measure.

Recycling of soil using particle classification washing plant

■ Former Nagahama, Takasago and Nara Plant Sites

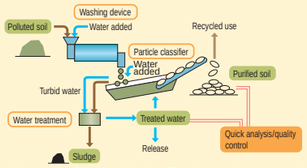
Totals of cyanogen, lead, etc. were detected at levels exceeding their respective acceptance criteria in some areas, and the survey results were reported to relevant administrative authorities. Subsequently, we excavated and removed the contaminated soil and refilled the area with intact soil to reduce environmental risks. The contaminated soil was taken to an offsite special treatment facility. Such countermeasure work was completed within 2001 for the former Nagahama and Takasago Plant site. For both sites, groundwater monitoring is being continued to date.

As for the former Nara Plant site, total cyanogen, lead, total mercury, arsenic, and benzene were detected at levels exceeding their respective acceptance criteria in some areas, and the survey results were reported to relevant administrative authorities. Subsequently, we decided to take the same measures as those for the former Nagahama and Takasago Plant sites. We will soon commence this countermeasure work.

Assumed Cause of Pollution

At these 4 MGP sites, chemical products produced in the purification process for coal gas manufacture can contain substances covered by the environmental standards for soil, including benzene and heavy metals such as cyanogen compounds and lead. It is supposed that these substances penetrated into soil as a result of war damage, natural disasters, equipment breakdown, etc. There is no possibility that these contaminants will occur at present, because we manufacture city gas using liquefied natural gas (LNG), a clean raw material.

Efforts to Apply Land Environment Conservation Technology in the Field



Flow chart of the particle classification washing method

Currently, with the aim of reducing the expense of soil-related environmental measures, we are working to develop new technologies and to bring them into practical application. For example, we are engaged in developing more sophisticated particle classification and washing method, which we have already applied in decontaminating the former Kobe Plant site. Another example is investigation of more efficient treatment of cyan-contaminated wastewater. We are also working to develop a new in situ soil purification technology based on slow-acting natural decontamination processes such as microbial and plant biodegradation and absorption potentials, rather than on the excavation of contaminated soil.

Osaka Gas will also make constant efforts to promote the diffusion of these technologies.

●Plant Site Land Environmental Survey Results

				Kobe	Nagahama	Takasago	Nara
History of city gas manufacturing with coal				1913: Started operation 1966: Abandoned	1912: Started operation 1963: Abandoned	1933: Started operation 1962: Abandoned	1911: Started operation 1967: Abandoned
			Acceptance criteria (mg/l)	Maximum detected value (mg/l)			
Analytical results	Amount found in soil	Total cyanogen (*2)	Not detected (*1)	2.0	1.5	0.9	1.9
		Lead	0.01	0.03	0.04	0.05	0.03
		Total mercury	0.0005	—	—	0.0009	0.0008
		Arsenic	0.01	—	0.048(*3)	—	0.020
		Benzene	0.01	—	—	—	0.490
	Groundwater concentration	Total cyanogen (*2)	Not detected (*1)	—	—	0.3	—
		Lead	0.01	—	—	—	—
		Total mercury	0.0005	—	—	—	—
		Arsenic	0.01	—	0.024(*3)	—	—
		Benzene	0.01	—	—	—	—

(Note) These survey results have been published in our press releases (Japanese only).
(*1) "Not detected" means that the measured value is below the quantification limit (0.1 mg/l).
(*2) The cyanogen detected occurs in the form of ferrocyano complexes. The "Basic Knowledge about Water Quality Testing (February 1996)" by the Kinki Regional Construction Bureau, notes that "the toxicity of metalocyano complexes are relatively low, and ferrocyano complexes in particular are nearly harmless."
(*3) Since the site in question is located in a district where arsenic occurs naturally at detectable levels, it is thought that the arsenic detected was not produced through the city gas manufacturing.

Action Guideline 2

Contribution to Environmental Impact Reduction through Our Products and Services

Osaka Gas is making active efforts to provide its customers with cleaner city gas and thus contribute to environmental conservation, including more widespread use of natural gas, which has the fewest environmental impacts as compared to other fossil fuels, and widespread application of energy-saving systems and devices such as natural gas co-generation systems, and gas absorption type chiller/heaters, i.e., non-CFC air-conditioners.

Osaka Gas is also working to develop energy-saving technologies and environmental conservation technologies that help the reduction of environmental impacts in various situations, including manufacturing plants, houses, and office buildings, and to promote the reuse of resources through recycling activities for used gas equipment.

In FY 2001, the total sales of city gas and equipment associated with environmentally friendly products, such as gas co-generation systems and gas absorption type chiller/heaters amounted to 105.4 billion yen, accounting for 14% of the overall annual sales of Osaka Gas, a leading level in the gas industry.

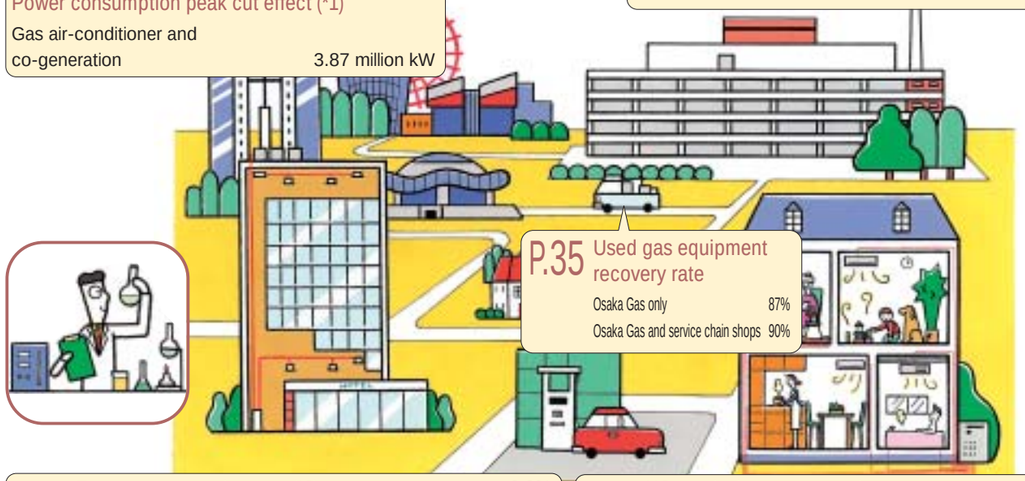
P.34 Gas absorption type chiller/heaters (non-CFC air-conditioners)
Cumulative capacity installed 2.11 million RT

P.33 NGV use 3,770 NGVs
Natural gas filling stations 41 stations

P.32 Introduction of untapped energy 5 sites

P.32 Co-generation
Cumulative number of units installed 1,220
Cumulative capacity installed 1.13 million kW

Power consumption peak cut effect (*1)
Gas air-conditioner and co-generation 3.87 million kW



P.35 Used gas equipment recovery rate
Osaka Gas only 87%
Osaka Gas and service chain shops 90%

P.31
Energy conservation rate (*2) 9.0%
Gas equivalent of saved energy (*2) 725 million m³/year
CO_2 emissions control rate (*2) 18.3%
Amount of CO_2 emissions controlled (*2) 3.857 million t-CO_2/year

P.33
NOx emission concentration control rate (*2) 25.4%
NOx emission concentration control rate for gas equipment sold in this fiscal year (*2) 42.3%

(Results for FY 2001)
(*1) Peak cut effect for air-conditioners is calculated by multiplying cumulative installed capacity (RT) by a factor of 1 kW/RT, with the power consumption peak cut effect per gas air-conditioner unit assumed to be about 1 kW per RT. The effect for co-generations is calculated by cumulative installation capacity (kW). Simultaneous operation is not included in both figures.
(*2) As compared to FY 1990.

1. Contribution to the Reduction of CO_2 Emissions

Points and Future Prospects

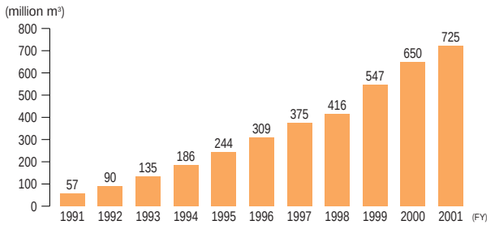
Osaka Gas is working to save energy and to reduce CO_2 emissions at its customers by promoting the wider use of natural gas, the fossil fuel that produces the least CO_2, by facilitating highly efficient energy use through highly efficient gas equipment and systems, typically gas co-generation systems.

In FY 2001, the rate of energy saved as compared to FY 1990 was 9%, well above the quantitative target of 7% for that fiscal year. The FY 2001 quantitative target for a CO_2 emission control rate of 16% was also accomplished, the actual value having been 18.3%.

The amount of CO_2 emissions controlled in FY 2001 was 3.86 million t-CO_2, equivalent to a monetary value of about 13.6 billion yen in social benefits. We will further endeavor to develop and promote the use of highly efficient gas equipment and systems, and to further promote the use of energy-saving systems and equipment.

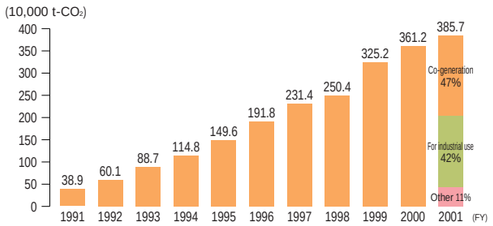
●Promotion of the Wider Use of Natural Gas and Energy-Saving Systems and Equipment●

●Gas Equivalent of Saved Energy (versus FY 1990)



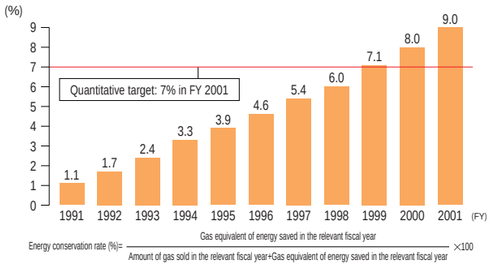
The term "gas equivalent of saved energy" is defined as the amount of gas saved as a result of improvement of the efficiency of gas equipment and systems.

●CO_2 Emissions Control (versus FY 1990)

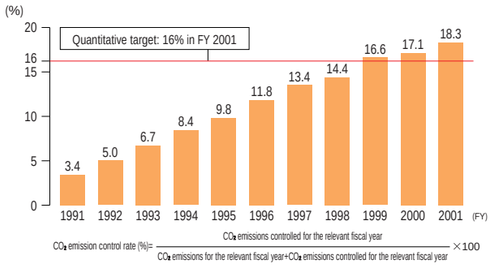


The term "CO_2 emissions control" is defined as the amount of CO_2 emissions reduced as a result of improvement of the efficiency of gas equipment and systems, replacement from other fuels etc.

●The Rate of Energy Conservation (versus FY 1990)



●CO_2 Emission Control Rate (versus FY 1990)

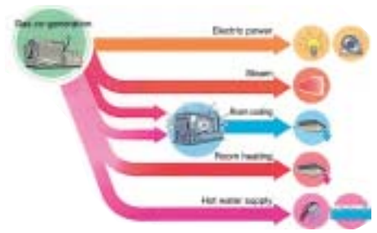


●Promotion of Wider Use of Natural Gas Co-generation Systems●

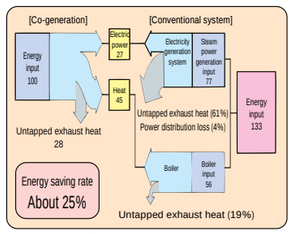
What is a Natural Gas Co-generation System?

In gas co-generation systems, electrical power is generated using gas engines, gas turbines or other motive power generators fueled with city gas or the like, and the concurrently resulting exhaust heat is used efficiently for air-conditioning, hot water supply, industrial steam generation and other purposes.

By utilizing both electrical and thermal energy and appropriately using exhaust heat, up to about 70-80% of energy input can be consumed efficiently, thus saving a significant amount of energy.



Co-generation System

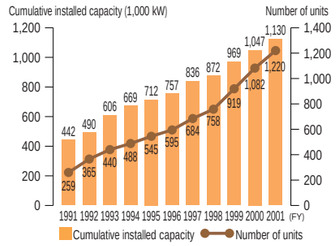


Comparison of Energy Efficiencies of Co-generation and Conventional Systems
Source: Environmental White Paper 1997

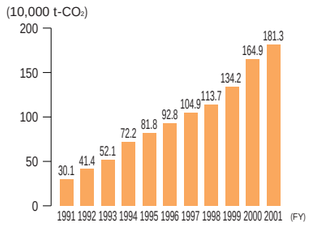
Results of Promotion of Natural Gas Co-generation Systems

In FY 2000, the cumulative capacity of natural gas co-generation systems installed in the Osaka Gas service areas exceeded one million kW, a level equivalent to one large-scale thermal power generation plant. In FY 2001, an additional 83,000 kW of gas co-generation systems were installed, the cumulative installed capacity rising to 1.13 million kW as of the end of FY 2001, accounting for about 50% of the national market. The cumulative number of units installed increased by 138 to a total of 1,220. The corresponding amount of CO_2 emissions controlled by natural gas co-generation is estimated to be 1.81 million t-CO_2.

●Cumulative Capacity and Number of Gas Co-generation Systems Installed



●CO_2 Emission Control through Co-generation (Compared to FY 1990)



●Examples of Introduction of the 9.8 kW Micro Gas Engine Co-generation System

Hotel Sunroute

Hotel Fujiya

Quantitative Targets for Natural Gas Co-generation in National Policy

In the "Long-term Prospects for Energy Demand and Supply" formulated by the national government, quantitative targets for FY 2010 are specified as follows; 4.64 million kW for natural gas co-generation and 2.20 million kW for fuel cells, a kind of co-generation system slated for promotion in future (see page 38). These ambitious target values reflect the national government's great expectations for natural gas co-generation and fuel cells.

Quantitative Target for FY 2010
Natural gas co-generation
About 4.64 million kW

Promotion of Untapped Energy Use

●Facilities Using Untapped Energy

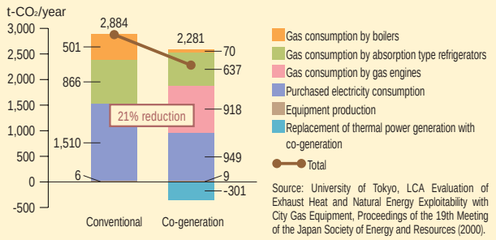
Facility	Heat source	Purpose	Scale	Start
Morinomiya Energy Center	Municipal refuse incinerator exhaust heat	Heating and hot water	41.9GJ/h	May 1976
Rokko Island City	Sludge treatment exhaust heat	Hot water	19.9GJ/h	March 1988
Osaka Nanko Cosmo Square	Seawater temperature differential energy	Air-conditioning etc.	406.9GJ/h	April 1994
Osaka Dome City Energy Center	Gas pressure energy	Power generation	1,155kW	April 1996
Sakai City Clean Center	Municipal refuse incinerator exhaust heat	Electricity generation	12,400kW	April 1997

Topics

Evaluation of the Lifecycle CO_2 of Natural Gas Co-generation

In the case of a natural gas co-generation system installed at a hospital, the lifecycle CO_2 emissions were reduced by about 21% as a result of energy conservation and the replacement value for thermal power generation, as compared to the conventional system without co-generation.

●LCA Evaluation of CO_2 Emissions

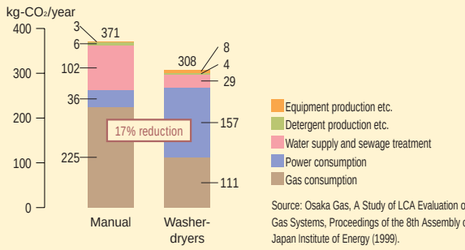


Source: University of Tokyo, LCA Evaluation of Exhaust Heat and Natural Energy Exploitability with City Gas Equipment, Proceedings of the 19th Meeting of the Japan Society of Energy and Resources (2000).

Evaluation of Lifecycle CO_2 of Dish Washer-dryers

When evaluated on a lifecycle basis including CO_2 emissions associated with water use as well as energy use, the total amount of CO_2 emitted is smaller for dish washer-dryers using gas-heated hot water than for manual washing because less water is consumed.

●LCA Evaluation of CO_2 Emissions



Source: Osaka Gas, A Study of LCA Evaluation of City Gas Systems, Proceedings of the 8th Assembly of the Japan Institute of Energy (1999).

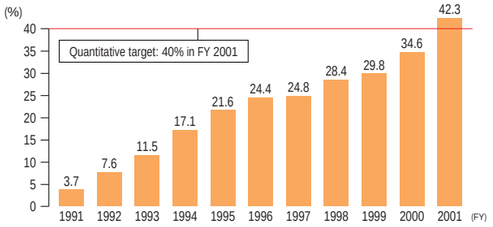
2. Contribution to the Reduction of Emissions of NOx and Other Air Pollutants

Points and Future Prospects

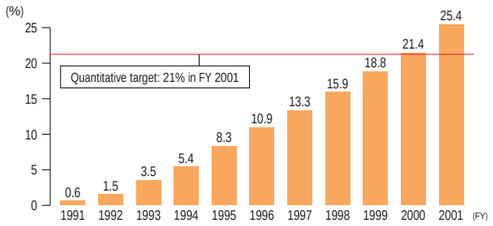
We are endeavoring to promote the technical development of gas equipment and systems that result in reduced NOx emissions during the combustion of city gas, and we also work towards the widespread use of these systems and equipment. As of the end of FY 2001, the NOx emission concentration control rate for gas equipment and systems was 25.4% compared to FY 1990, clearing the FY 2001 target of 21%. In addition, the NOx emission concentration control rate associated with gas equipment sold in FY 2001 was 42.3%, clearing the quantitative target of 40%. Natural gas vehicles are quite effective in reducing automobile NOx pollution in urban regions, and global warming. In FY 2001, 1,018 NGVs were newly introduced in the Kansai region; the total number increased dramatically to 3,770 as of the end of March 2002. We will continue to promote the technical development and widespread use of low-NOx gas equipment and systems.

Promotion of Wider Use of Low-NOx Equipment and Development of Technologies for Reduction of NOx etc.

● NOx Emission Concentration Control Rate Associated with Gas Equipment Sold in Each Fiscal Year (versus FY 1990)



● NOx Emission Concentration Control Rate (versus FY 1990)



$$\text{NOx emission concentration control rate (\%)} = \frac{\text{NOx emission concentration for FY 1990-NOx emission concentration for the relevant fiscal year}}{\text{NOx emission concentration for FY 1990}} \times 100$$

NOx, SOx and Dust Emissions by System Model

The gas systems recommended by Osaka Gas easily meet the standards for NOx emission concentrations set by various local air pollution regulations, as these are not more than 60 ppm for boilers and gas absorption type chiller/heaters, and not more than 100 ppm for small-scale co-generation systems (equipped with denitrification apparatus in case of lean combustion gas engines). Because these systems are fueled with city gas containing almost no sulfur or impurities, they emit almost no SOx or dust. Regarding the fuel cells, no air pollutants are emitted from the cell itself; as for combustion exhaust gases from associated equipment, the NOx emission level is very low - 10 ppm or less - because of lean combustion. Furthermore, there is no problem with SOx emissions because fuel cells have a built-in desulfurization apparatus.

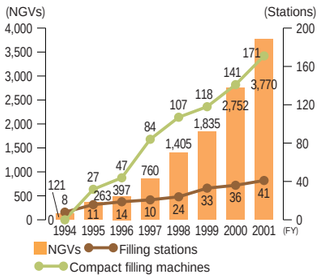
Promotion of Wider Use of Natural Gas Vehicles

As a countermeasure against air pollution in urban regions and global warming, Osaka Gas promotes wider use of natural gas vehicles, as they are environmentally friendly with almost no emissions of SOx or particulate matter and low emissions of NOx and CO_2. As of the end of March 2002, the number of NGVs in use in the Kansai region was 3,770, with 41 natural gas filling stations available.

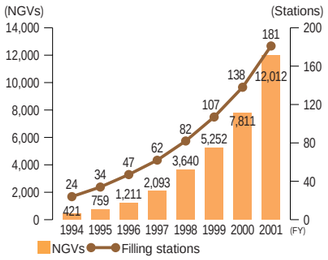
We are endeavoring to increase the number of natural gas filling stations, to lengthen the driving distance of NGVs, and to reduce NGV costs.

Helped along by initiatives to introduce NGVs by the national and local governments and their promotion of green distribution, the time is ripening for the introduction of low-pollution vehicles. Accordingly, Osaka Gas will make efforts to promote wider use of NGVs.

●NGV Use in the Kansai Region



●NGV Use in Japan



(Note) Data on compact filling machines are unavailable

NGVs in Operation in Various Fields


Public Transportation


Logistics


Warehousing


Municipalities

3. Contribution to Chlorofluorocarbon Control

Points and Future Prospects

Chlorofluorocarbons (CFCs), mainly used as air-conditioner refrigerants, are gases not only with ozone depleting effects but also with extremely high greenhouse effect coefficients. Osaka Gas has been working for about three decades to promote the wider use of gas absorption type chiller/heaters, a CFC-free air-conditioning system. As of the end of FY 2001, the cumulative capacity of gas absorption type chiller/heaters installed was 2.11 million RT (freezing capacity), a level equivalent to an estimated reduction of CFCs of about 2,000 tons. As for air conditioners using CFCs sold by Osaka Gas, we started implementing CFC recovery treatment from units being discarded in FY 2000 in order to ensure thorough fluorine management.

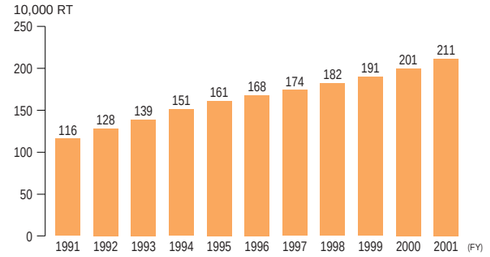
Development and Promotion of Gas Absorption Type Chiller/Heaters

The gas absorption type chiller/heater is an air-conditioning system gentle to the global environment that uses water as the refrigerant instead of CFCs, gases that destroy the ozone layer and contribute to the greenhouse effect. Since its development, this system has been improved to increase its energy efficiency. Currently, the cooling COP (*) of the commercial models is 1.35, a level more than 40% higher than its initial figure (see page 36).

With its excellent performance and economic features, use of the gas absorption type chiller/heaters has steadily expanded, mainly for building air-conditioning. In FY 2001, additional equipment capacity equivalent to 100,000 RT was newly installed, the cumulative installed capacity being 2.11 million RT. The corresponding power consumption peak cut effect is equivalent to about 2 million kW (see *1 on page 30).

(*) COP: An index of energy efficiency (Coefficient of Performance)

●Cumulative Installed Capacity of Gas Absorption Type Chiller/Heaters



Chlorofluorocarbon Recovery from Used Gas Room Air-Conditioners

We have prepared a system for recovery and treatment of CFCs from commercial gas engine heat pump (GHP) air-conditioners and household "Housing Multi" air-conditioners to ensure the complete recovery of CFCs.

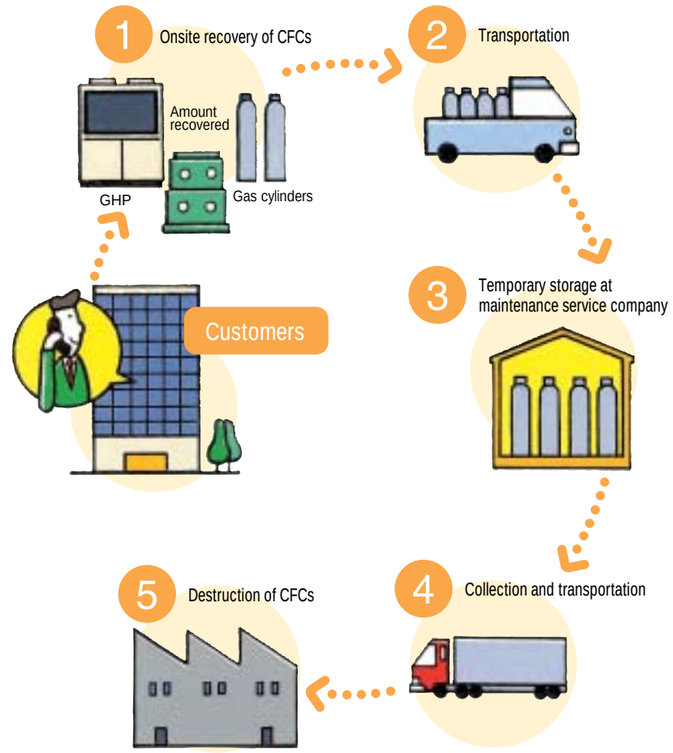
Regarding used household gas air-conditioners, we have joined the home appliance recycling system organized under the initiative of Matsushita Electric Industrial Co., Ltd. to ensure the recovery of CFCs in compliance with the Home Appliance Recycling Law.

Total Weight of Refrigerant CFCs Recovered

(FY 2001)

Item	Result
Total weight of refrigerant CFCs recovered	1,692kg

● Route of Recovery and Treatment of Chlorofluorocarbons from Commercial GHP and Household "Housing Multi"



4. Promotion of Resource Recycling

Recovery and Recycling of Used Gas Equipment and Packaging Materials

In FY 1977, Osaka Gas and its service chain shops established a system for recovering and recycling used gas equipment, etc. Through this system, we endeavor to recover and recycle used gas equipment and other equipment.

We also recycle styrofoam, which we use as a packaging material for gas equipment. Additionally, in FY 2001, we began to recover and recycle corrugated cardboard, also used in packaging gas equipment.

The recovery rate of major gas equipment by Osaka Gas and its service chain shops is as high as 90%.

Recovery Rate for Major Gas Equipment
(Based on the number of units, excluding gas leak alarms)

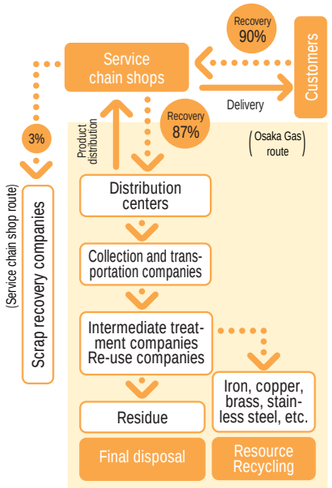
(1) Weight and number of units recovered

Item	Weight (t)	Number
Major used equipment	4,580	352,000
Styrofoam	74	31,071 bags
Corrugated cardboard	69	9,870 bundles

(2) Recovery rate (based on number of units)

Item	Result
①Number of major household equipment discarded (*1)	403,000
②Number recovered via the Osaka Gas route	352,000
③Osaka Gas recovery rate (②/①)	87%
④Osaka Gas and service chain shop recovery rate (*2)	90%

(*1) Number of units assumed to have been discarded in association with the installation of new gas equipment by Osaka Gas.
(*2) The ratio was calculated on the basis of an end-user survey.



Legal Compliance

Of the various laws formulated with the aim of creating a recycling society, the Home Appliance Recycling Law and the Construction Material Recycling Law in particular are closely related to Osaka Gas business operations.

Home Appliance Recycling Law

The Home Appliance Recycling Law obliges manufacturers etc., of household gas air-conditioners to appropriately arrange designated recovery stations for used units throughout the nation. To meet this requirement, we have joined the home appliance recycling system organized under the initiative of Matsushita Electric Industrial Co., Ltd. to ensure recycling of these appliances.

In FY 2001, the recycling rate for gas air-conditioners was 75%, a level much higher than the quantitative target of 55%.

(1) Recycling of Used Specified Household Appliances

Item	Result
①Number recovered at designated stations	3,726
②Number treated for recycling	3,719
③Weight treated for recycling	172t
④Weight recycled	129t
⑤Recycling rate (based on weight,④/③)	75%

(Note) The number and the weight treated for recycling represent the total number and total weight of discarded specified household appliances undergoing essential treatment for recycling etc.

Construction Material Recycling Law

In May 2001, the Construction Material Recycling Law came into force. Gas pipeline work and associated specified construction materials (asphalt, concrete, iron, lumber) are covered by the Law. In response to this situation, Osaka Gas organized a working group to consider measures to be taken, and then prepared an operating manual.

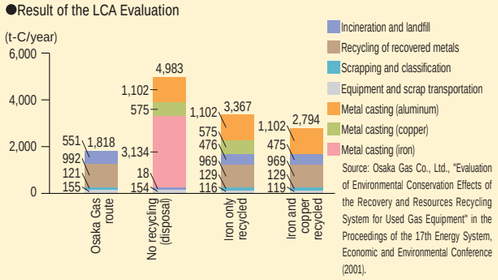
Also a meeting was held to educate the construction work sections of the regional business headquarters and other internal departments and relevant construction companies about matters requiring special attention with respect to the Construction Material Recycling Law.

Topics

LCA Evaluation of CO_2 Emission Reduction Effects of Gas Equipment Recovery and Recycling

The benefit to environmental conservation of the used gas equipment recovery and recycling system was evaluated by Life Cycle Assessment (LCA). Calculations were based on the assumption that in the case of no recycling, metals would be newly manufactured in place of regenerated metals obtained by recycling discarded equipment. The Osaka Gas route recycling system was found to reduce CO_2 emissions by about 3,165 tons per year, accounting for about 64% of the CO_2 emissions that would occur without recycling (calculated for the used gas equipment discarded in FY 2001).

●Result of the LCA Evaluation



Source: Osaka Gas Co., Ltd., "Evaluation of Environmental Conservation Effects of the Recovery and Resources Recycling System for Used Gas Equipment" in the Proceedings of the 17th Energy System, Economic and Environmental Conference (2001).

5. Development of Technologies for City Gas Equipment and Systems

Visit our website for more details
For address see back cover

Present Status and Future Prospects of Energy-Saving Technology Development at Osaka Gas

With the aim of maximizing its performance and efficiently using natural gas, the fossil fuel that produces the least CO_2 emissions, Osaka Gas has actively promoted the development and widespread application of various energy-saving systems and equipment.

First, in the field of gas co-generation systems, the cumulative capacity of the systems installed in the Osaka Gas service areas is equivalent to one large-scale thermal power plant. Currently, we are endeavoring to develop various gas engines with high generation efficiency, including the commercialization of a Miller cycle gas engine with the world's highest generation efficiency for a medium-sized system. In the field of household gas co-generation, we are working to commercialize a gas engine system with a power output of 1 kW with the aim of launching it in FY2003. A polymer electrolyte type fuel cell system is also under active development for commercialization in FY 2005.

We are also developing commercial gas absorption type chiller/heaters with higher efficiency. Their cooling efficiency has improved by more than 40% compared to the initial model, the current model being smaller by about one third of the initial model in terms of unit size and installation space requirements. We are also engaged in developing a triple effect gas absorption type chiller/heater with even higher efficiency, and an even more efficient gas engine heat pump (GHP) for launch in 2005.

As for household appliances, we are endeavoring to increase the efficiency of hot water heaters and gas cooking stoves for daily use. In 2000, we launched "PRIOR ECO," the industry's first latent heat recovery type hot water heater. In recognition of its very high efficiency of 93% for water heating and 88% for room heating, this product received the 2000 Minister of Economy, Trade and Industry Prize in the Energy Conservation Grand Prix.

Osaka Gas will continue to develop systems and equipment, emphasizing not only on the improvement of efficiency but also other environmental aspects as well, including NOx emission reduction, resource conservation and recycling and extension of service life.

Examples of Energy-Saving Equipment Development

Development of High Efficiency Gas Co-generation Systems

Osaka Gas has commercialized a 22 kW gas engine co-generation system showing high generation efficiency (28-29%) for a small-sized system. As for medium-sized systems, we have developed a Miller cycle gas engine co-generation system with a generation efficiency of 40%, the world's highest level for a medium-sized system. Two units of the 280 kW model have already been installed at our head office building. We have also promoted the marketing of gas engines with high generation efficiency (37-39%) procured directly from overseas; more than 50 units have been installed. Large-sized gas engine co-generation systems with high generation efficiency (41-43%) are also under development for commercialization. Other development activities, aimed to meet our customers' various demands, are being made for highly efficient systems, including gas engine systems that use gas generated from waste materials, and heat-electricity variable systems that allow changes in the output balance.

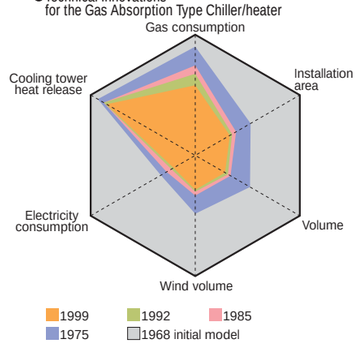
Miller cycle gas engine co-generation system

High generation efficiency (38%) gas engine, 730 kW x 1 unit, installed at the Osaka Medical Center and Research Institute for Maternal and Children Health

Development of High Efficiency Gas Absorption Type Chiller/Heaters

Since the launch of the world's first double-effect gas absorption type chiller/heater in 1969, Osaka Gas has been engaged in developing models with increased efficiency every year. As a result of improvements in freezing cycle efficiency, thermal recovery efficiency, etc., the current model has a cooling efficiency (COP) of 1.35, a level higher by more than 40% compared to the initial model. In addition to this energy-saving performance, we have made efforts to reduce the size and weight of equipment from the viewpoint of saving both resources and space. The current model is about one third of the size of the initial model in terms of volume, installation space requirement and weight. We are now developing an ultrahigh efficiency gas absorption type chiller/heaters with a COP of not less than 1.6, employing a triple-effect cycle.

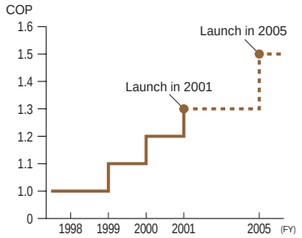
●Technical Innovations for the Gas Absorption Type Chiller/heater



Development of a High-Efficiency Gas Engine Heat Pump (GHP)

Traditionally, we have endeavored to improve GHP efficiency to maintain an advantage over competing equipment. In recent years, our competitors' efforts to improve equipment efficiency have become more active. Against this background, Tokyo Gas, Toho Gas, Osaka Gas, and GHP manufacturers started to develop a high-efficiency GHP with a COP of 1.3 in FY 1998 and launched it in 2001. Our development efforts focused on an increased compression rate and use of the Miller cycle for improvement of engine efficiency, and on reduction of internal pressure loss and excess compression loss for improvement of compressor efficiency. Currently, a super-high efficiency GHP with a COP of 1.5 is under development to be launched in FY 2005.

●Improvement of GHP Efficiency




Yanmar 20 HP

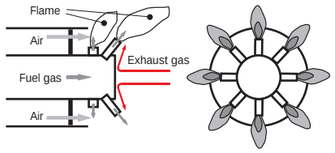

Sanyo Electric 20 HP


Aisin Seiki 10 HP

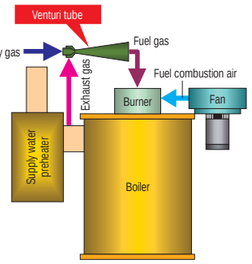
Development of Low NOx Burners for Boilers

To further reduce NOx emissions in exhaust gases from commercial boilers, we are developing low NOx burners for once-through boilers, hot water boilers and water tube boilers. In 2001, we developed an ultralow NOx burner for once-through boilers. This new burner functions at flame temperatures reduced through the action of an exhaust gas recirculation system using divided flames and gas pressure, offering an NOx concentration of less than 30 ppm for a boiler with a vaporization amount of 2 tons/hour (60 ppm for the conventional burner).

●Schematic Diagram of Low NOx Burner



●Exhaust Gas Recirculation Mechanism Using Gas Pressure

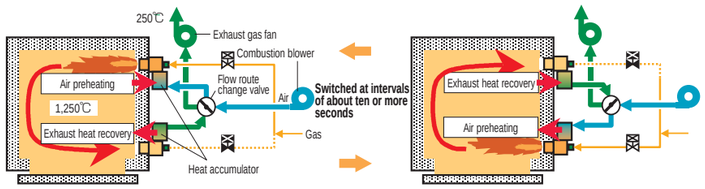


Development of Heat Accumulation Combustion System (Regenerative Burner System)

To promote the use of heat accumulation type combustion systems that offer significant energy saving for industrial furnaces, we have developed various low-cost compact regenerative burners. These systems allow for up to 50% energy savings for high-temperature furnaces operated at 1,000℃ or higher, by using the high-temperature heat energy of the combustion exhaust gas accumulated in the heat accumulator to preheat combustion air. Since 1995, Osaka Gas has installed a total of 38 units, thus contributing significantly to energy saving and reduction of CO_2 emissions.

●Principle of the Regenerative Burner System

Heat retained in exhaust gases from combustion is recovered by a heat accumulator incorporated into the burner



Interview with the President of Kansai Tekko Co., Ltd., One of Our Customers Who Has Introduced Osaka Gas Energy-Saving Equipment


Mitsuharu Yamamoto

We manufacture and market forged products and expanded metals since 1923. We conducted extensive renewal work at our plants in 1992, and at that time we switched from heavy oil to city gas as fuel for the forging plants. Later, to reduce fuel expenses and CO_2 emissions, a regenerative burner system developed by Osaka Gas was introduced sequentially to our furnaces, and currently the six main units of our 12 furnaces are equipped with this system. Replacement with this system has increased our basic fuel efficiency by 35% and reduced CO_2 emissions by 50%. When we constructed a new office building in 2000, we introduced a gas engine co-generation system. The combined result was that we saved 18% of all energy consumed at our plants and offices over the past ten years. We are therefore confident that our factory maintains Japan's highest level of energy saving for a factory of the same type on a similar scale.

Development of Household Co-generation Systems

Aiming at saving energy and reducing CO_2 emissions from homes, Osaka Gas is developing two types of household co-generation systems, one using a gas engine and the other using a polymer electrolyte type fuel cell. Efficient use of the electricity and exhaust heat from co-generation systems would have major environmental conservation benefits by reducing energy consumption (based on primary energy) by about 20% and CO_2 emissions (based on replacement of thermal power generation) by about 30%.

Gas Engine Co-generation Systems

An ongoing field test involves 16 units of a gas-engine co-generation system at our customers' homes, with the following specifications: electricity generation output of 1 kW, electricity generation efficiency of 20%, and an overall efficiency of 85% (both based on LHV). Following a more extensive field-monitoring program involving 100 units, we plan to launch this system in FY 2002.

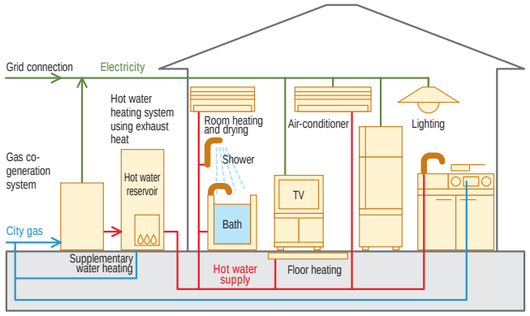
Polymer Electrolyte Type Fuel Cell (PEFC) Co-generation Systems

The polymer electrolyte type fuel cell is expected to show generation efficiency of 35% or more (LHV standard target) even with low output. Currently, two models (1 kW and 500 W) are under development for launching in FY 2005. Using the world's most advanced gas modification technology (production of hydrogen from city gas), we are making active efforts to resolve problems in practical application, including achievement of high durability, high reliability and cost reduction, by developing a low cost fuel processing apparatus suitable for mass production.

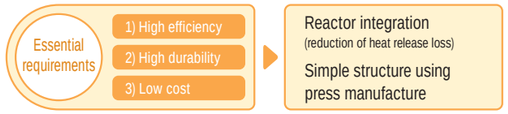

PEFC co-generation system (HPOWER, Sanyo Electric)


Gas engine co-generation system

●Household Co-generation System



●OG (Osaka Gas) Compact City Gas Modification Apparatus




1 kW pilot model

Size:
W 430 mm x D 290 mm x H 395 mm (including heat insulator)

Composition of the modified gas (actual measured values)	
H_2	75.5%
CO_2	20.1%
CH_4	1.5%
CO	0.8ppm
N_2	2.9%

Development of a Household Latent Heat Recovery Type Hot Water Heater

In June 2000, Osaka Gas launched "PRIOR ECO," the industry's first latent heat recovery type hot water heater for household use.

For this we received the FY 2000 Minister of Economy, Trade and Industry Prize in the Energy Conservation Grand Prix for the high thermal efficiencies of about 93% for hot water supply and about 88% for room heating, together with environmental conservation benefits such as reduction of CO_2 emissions. This device is listed as one type of equipment for promotion under the national government's "Climate Policy Program" and will receive a subsidy from the Ministry of Economy, Trade and Industry within the framework of the "Project for the Promotion of Introduction of High-Efficiency Energy Systems to Houses and Buildings" in FY 2002. Currently, we are further promoting the commercialization of hot water heaters and bath water heaters, with the aim of promoting widespread use of latent heat recovery appliances.


"PRIOR ECO"


Titanium heat exchanger of "PRIOR ECO"

Development of High-Efficiency Gas Cooking Stoves

Through various technical innovations such as modifying the shape of the burner and shortening the height of the panrest, we have developed a high-efficiency cooking stove with a thermal efficiency of more than 50% (45% for conventional models). Sales percentages of high-efficiency stoves increased to 92% (54% in previous year) for table-top type and 80% (70% in previous year) for built-in type in FY 2001.

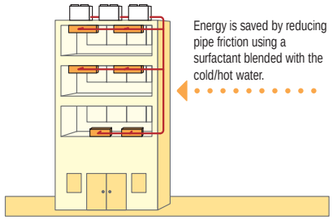

High efficiency gas cooking stove

Building Energy-Saving Technology — Technology for Reduced Friction in Pipes —

Gas absorption type air-conditioning systems provide room cooling and heating by pumping cold or hot water from a refrigerator to the rooms via piping, where a room unit exchanges heat with the room air using the cold or hot water. One long-standing problem has been the great percentage of force needed to drive the pump in the total energy required to operate the system.

Against this background, Osaka Gas, in collaboration with Obayashi Co., has developed a technology for reducing the force needed for the pump. In this technology, we reduced the friction between the water and the pipe by adding a specific surfactant into the cold/hot water. Thus the necessary force can be reduced by up to 50%. It is applicable both in existing buildings and newly constructed buildings.

We will promote energy-saving air-conditioning with less environmental impact by promoting this technology.



Green Model Designation System for Absorption Type Chiller/Heaters

This system was established collaboratively by Osaka Gas, Tokyo Gas and Toho Gas. "Green model" systems are selected from gas absorption type chiller/heaters that are rated as "excellent" in terms of environmental impact reduction benefits of energy and material use, cost performance, and reliability. The following criteria must be fulfilled:

1) Outstanding performance in reduction of environmental impact
2) Economically feasible initial cost, running cost, and life-cycle maintenance cost
3) Guarantee of 5 years or longer

Since this system started operation in 2001, three models have been selected as of June 2002. Three other models are listed as candidates for the remainder of FY 2002.

The cumulative installed capacity of green models in the Osaka Gas service areas is 15,840 kW as of FY 2001.

Green (environmentally friendly) model mark

●Awards Given to Osaka Gas in the Category of Energy Conservation for Gas Equipment in the Past Four Years

	Equipment	Award	Sponsor	Year	Remarks
Household use	Cooking stove equipped with "Super Chao" burner	Technology Prize	Japan Combustion Society	1998	Jointly with Harman Co., Ltd
	Gas table cooking stove equipped with "One-Side Waterless Grill"	Energy Conservation Grand Prix, Agency of Natural Resources and Energy Technology Director-General Prize	Energy Conservation Center	1998	Jointly with Paloma Industries Ltd.
	Gas cooling/heating "Eco-Life Multi"	Technology Prize	Japan Gas Association	1999	Jointly with Rinnai Corporation
	Gas table cooking stove equipped with "Waterless Grill"	Technology Prize	Japan Gas Association	2000	Jointly with Paloma Industries Ltd.
	High-efficiency gas hot water heater "Ex Prior Eco"	Energy Conservation Grand Prix, Minister of Economy, Trade and Industry Prize	Energy Conservation Center	2000	Jointly with Takagi Sangyo Co., Ltd.
		Technology Grand Prix	Japan Gas Association	2001	
	Gas cooking stove equipped with high-efficiency burner	Energy Conservation Grand Prix, Energy Conservation Center Secretary-General Prize	Energy Conservation Center	2000	Jointly with Toho Gas, Tokyo Gas and Paloma Industries Ltd.
		Technology Prize	Japan Gas Association	2001	
Commercial use	Kitchen equipment gas cooking stove and grill equipped with internal flame burner	Technology Grand Prix	Japan Gas Association	1998	Jointly with Toho Gas, Tokyo Gas, Rinnai Corporation, Taniguchi Kogyo Co., Ltd. and Shinpo Co., Ltd.
	High-efficiency gas turbine power generation system combined with refuse incinerators	Technology Prize	Japan Gas Association	1998	
	9.8 kW gas mini co-generation system "E-Combi"	Energy Conservation Grand Prix, Energy Conservation Center Secretary-General Prize	Energy Conservation Center	1999	Jointly with Yanmar Diesel Engine Co., Ltd.
		Japan Machinery Federation Chairman Prize for Excellent Energy-Saving Equipment	Japan Machinery Federation		
		Technology Grand Prix	Japan Gas Association	2000	
	"Condensing Tough Jet"	Energy Conservation Grand Prix, Energy Conservation Center Secretary-General Prize	Energy Conservation Center	2001	Jointly with Toho Gas, Tokyo Gas, Takagi Sangyo Co., Ltd. and Noritz Corporation
Industrial use	Energy-saving low-cost fuel gas compressor for gas turbines	Technology Prize	Japan Gas Association	1999	Jointly with Toho Gas, Tokyo Gas, Miwa Kiko Co., Ltd. and Nihon Comtec Co., Ltd.
	Exhaust gas recombustion technology for gas turbine co-generation	Technology Prize	Japan Gas Association	1999	Jointly with Volcano Co., Ltd. and Chugai Ro Co., Ltd.
	500 kW class high-efficiency gas engine package	Technology Prize	Japan Gas Association	2000	

●Promoting Ecological Design of Household Gas Equipment●

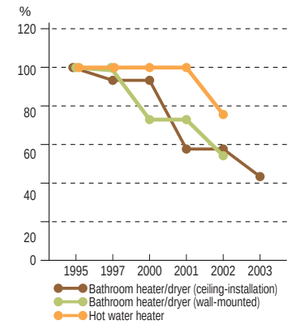
The Ecological Design Concept

Since FY 1995, Osaka Gas, Tokyo Gas and Toho Gas have been collaborating on voluntary activities to promote ecological design for environmentally friendly gas equipment. Specifically, our efforts include preparation of the "Eco Design Manual" (FY 1995), sponsoring an "Eco Design Contest" (FY 1995-1997), and incorporation of ecological design aspects in the commercialization standard check sheet (FY 1999). As a result of these efforts, we have succeeded in reducing size and weight, improving the recycling rate, and reducing the environmental impacts of household gas equipment.

Downsizing of Gas Equipment

One representative example of our efforts to reduce the size of gas equipment concerns the bathroom heater/dryer (KAWAKKU). The current equipment size is about half that of the 1995 models, while retaining the original performance. We are endeavoring to achieve further downsizing of various items of equipment.

●Downsizing of Gas Equipment



Resource Reducing and Environmental Considerations for Hot Water Heaters

In 2000, Osaka Gas introduced shrink film packing to reduce the amount of packaging materials for gas equipment. Compared to conventional packing, this method saves about 60% of packing materials, such as corrugated cardboard. We are promoting the expansion of its applicability to various types of equipment.

Shrink Film Packing

Development of Eco-Flexible Pipes

We have developed a polyolefin resin-based halogen-free material with low environmental impact for covering flexible gas pipes as a substitute for vinyl chloride. Investigations toward its practical application are ongoing.

Eco-Flexible Pipe

Reuse of Speakers for the "Pico-Pico" Gas Leak Alarm

We have made efforts to reuse gas leak alarm "Pico-Pico" since March 2001, the first effort to reuse home appliances in Japan. 90% of the installed units have been collected and disposed of after the expiration of the five-year lease period. In the reuse system, speakers are dismounted from used gas leak alarms and subjected to performance testing. Only those units confirmed to be equivalent in performance to new units are sorted and reused. This instance of reuse reduces about 4 tons of waste per year (*).

(*) On the assumption that about half the units sold in a year are equipped with reused parts.

"Pico-Pico"

Topics

NEXT21

Regarding the growing importance of environmental conservation activities, how should we approach environmental and energy concerns and our lifestyle in urban areas with dense populations and intense economic activities?

Planned by Osaka Gas in pursuit of "affluent urban residence with a good balance between man and nature," the experimental residential complex "NEXT21" (Osaka City) is the embodiment of a feasible idea for future housing. NEXT21 is provided with an ecological garden where residents can feel the breath of nature, apartments designed according to the residents' lifestyles, and future-oriented energy-saving and environmental conservation equipment, including fuel cells and garbage and wastewater treatment systems. Currently, 16 families of Osaka Gas employees are participating in the experimental dwelling program aimed at drawing up a variety of proposals regarding energy, environment, city planning, architecture, and equipment for our residential life in the next generation.

● Aqua-Loop System (garbage and wastewater treatment)

Garbage and wastewater generated in individual houses are treated with specialized equipment in the building. Wastewater is purified using microorganisms and sludge generated through this treatment process and garbage from the houses are decomposed into water, CO_2 and nitrogen by a catalyst technology developed by Osaka Gas. The resulting water is reused for flush toilets and water sprinklers, thus producing significant benefits, including reductions in loads on the sewer system and tap water consumption.

● Greening of the Residential Building

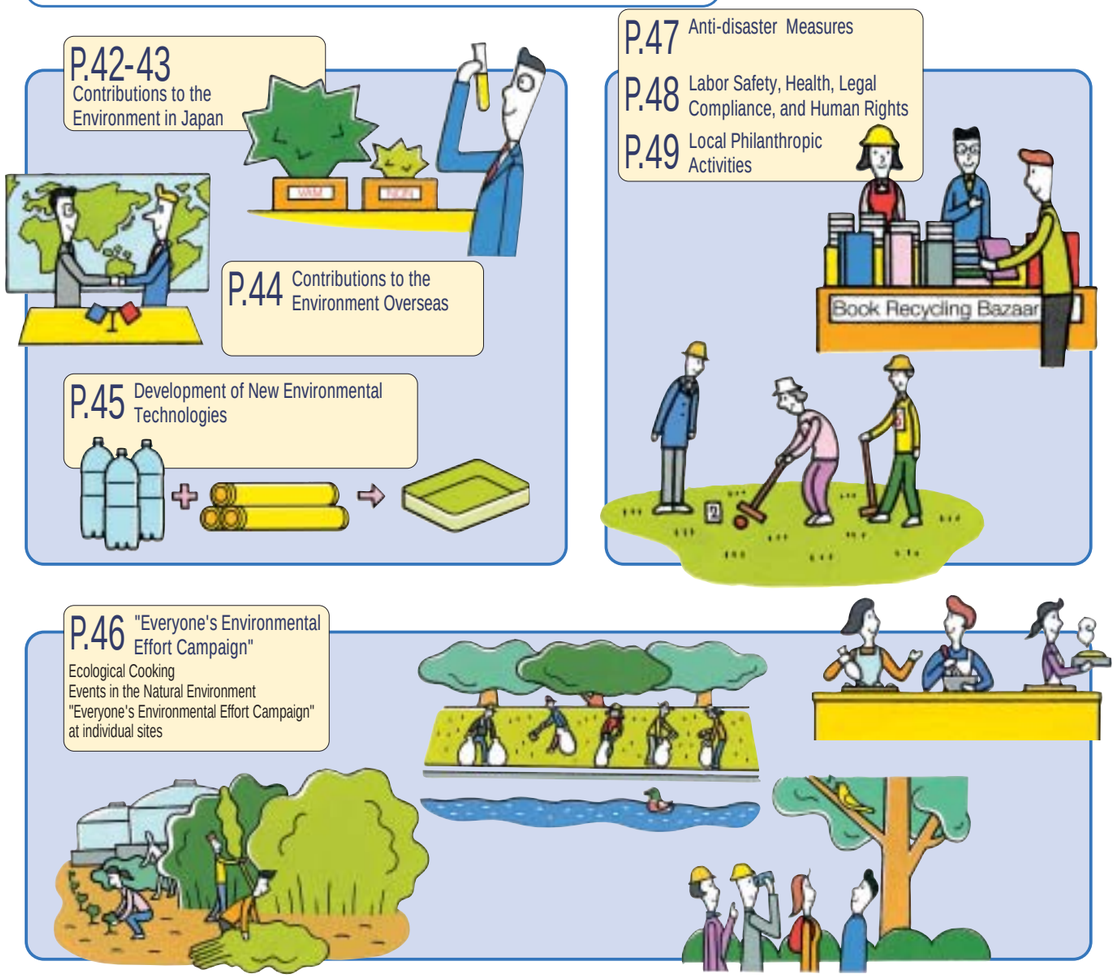
The rooftop and terraces are planted with vegetation, assuring a total green zone of 1,012 m². Since April 2000, this green area has been managed by the residents themselves within the framework of an experimental study on green belt issues in urban apartment houses.

Visit our website for more details
For address see back cover

Action Guideline 3

Contribution to Environmental Improvement Locally, Nationally and Overseas

Osaka Gas is making active efforts to contribute to the improvement of the environment in its service areas and elsewhere, both inside and outside Japan. We are endeavoring to promote the use of our original environmental technologies domestically, and to promote technical transfer to foreign countries. In order to do this in all relevant fields, we are developing a wide variety of new technologies, including resource recycling, waste treatment, biotechnology-related technologies and tree planting. In addition, at all of our sites, each employee understands that environmental issues are his or her own personal concern, and is involved in various local environmental conservation efforts and philanthropic activities in collaboration with local residents.



1. Domestic and Overseas Environmental Contributions

●Contributions to the Environment in Japan●

District Heating and Cooling

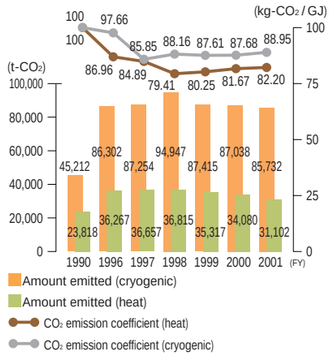
In district heating/cooling systems (DHC), a district energy center produces and distributes cryogenic energy and heat for air-conditioning, hot water supplies, etc., for buildings and other facilities in a comprehensive district. This kind of system has been promoted as essential infrastructure for community planning aimed at environmental impact reduction, energy efficiency improvement, etc.

In 1970, Osaka Gas started the operation of Japan's first full-scale urban DHC in the Senri Chuo area. Since then, we have managed similar systems in a total of ten areas, using city gas, a clean energy source. Small-scale local heat supply systems are also in operation at eight other sites.

In 1976, Osaka Gas introduced to the Morinomiya area a DHC using exhaust heat from a waste processing plant as the main heat source. As early as 1986, Osaka Gas adopted gas co-generation for a DHC, and is involved in DHC operations in six areas that exhibit high energy efficiency using exhaust heat from power generation. The CO_2 emissions per caloric unit produced in FY 2001 were reduced to 89.0% (cryogenic energy) and 82.2% (heat) of 1990 levels.

●CO_2 Emissions from DHC Facilities

(Figures for CO_2 emission coefficient are shown per caloric unit produced)



The DHC operations for nine districts, excluding the Morinomiya District, are now managed by Osaka Gas affiliates.

ESCO (Energy Service Company) Operations

ESCO (Energy Service Company) operations, intended to provide energy-saving services for existing buildings and factory facilities, are one of the energy-saving measures given priority in Japan's national environmental policy. In recent years, the number of companies, municipalities and other local governments considering the introduction of ECSO operations has increased steadily. Making use of its technical know-how compiled in association with the development of gas equipment and systems with high energy-saving performance, Osaka Gas is pursuing ESCO-type operations mainly at Gas & Power Investment Co., Ltd., one of its affiliates.

In April 2002, one of the Osaka Gas affiliates started ESCO services for the Osaka Medical Center and Research Institute for Maternal and Children Health. This project represents the first privately funded ESCO operation at a local government, and was selected as the best proposal in a public invitational competition in 2001. The operating company will provide ESCO services to the customer, including the operation and maintenance of energy-saving equipment, for the next 12 years.

Energy-Saving Technologies for the Osaka Medical Center and Research Institute for Maternal and Children Health

1) A highly efficient gas engine co-generation system (730 kW, power generation efficiency 38%) was introduced. Exhaust heat is used for disinfection, sterilization and hot water supply.
2) A highly efficient non-chlorofluorocarbon gas absorption type chiller/heater (COP 1.4) was introduced.
3) Power consumption was reduced by introducing an inverter control system for cooling/heating pumps and fans.
4) An automatic water-saving apparatus for toilet flush water was introduced.
5) Power consumption for lighting was reduced using staggered light adjustment inverter stabilizers etc.
6) Steam drain water was reused for cooling towers and toilets.

Osaka Medical Center and Research Institute for Maternal and Children Health

Advantages of ESCO Operations

●Energy-saving rate: 25.1%

●Quantitative target for saving fuel and light expenses: 76 million yen

● Circumstances Bearing on ESCO Operations

Promotion of Waste Hydrochloric Acid Recycling Systems

Since 1998, four waste hydrochloric acid recycling systems developed by Osaka Gas are being operated. This technology ensures the recycling of waste hydrochloric acid generated through wire manufacturing and other processes, using waste heat from gas co-generation. It offers a major advantage to our customers in that the amount of hydrochloric acid purchased is reduced while reducing the amount of waste hydrochloric acid generated as industrial waste.

Outdoor type waste hydrochloric acid recycling plant

Development of VAM Fungi Application Technologies

Microorganisms living symbiotically with plant roots known as "VAM fungi" absorb nutrients and water from soil and supply them to the plants, promoting growth. Using VAM fungi, Osaka Gas has since 1998 implemented the "Project for the Practical Application of Afforestation Technology in Tropical Wastelands" in cooperation with Indonesian governmental organizations. Also in 2001, we commenced a research program entitled "A Study of Rooftop Greenery Planting Technology Using Symbiotic Microorganisms" jointly with Kansai Electric Power Co., Inc.

Function
Nutrients and water are absorbed and supplied to the plant from a wider area that would otherwise be out of reach of the plant's roots.

Effects
·Promotion of plant growth
·Improvement of resistance to dryness


Left: Without VAM fungi Right: With VAM fungi

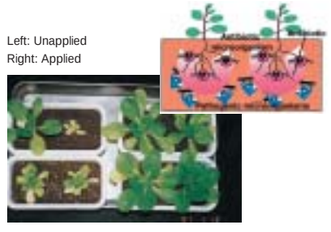
Development of Antibiotic Microbial Materials

In modern agriculture, various environmental issues have emerged, including contamination of river water and groundwater with agricultural chemicals. Against this background, we are developing microbial antibiotics as a technology for controlling plant disease damage with less environmental impact than agricultural chemicals. An antibiotic microorganism is defined as a microorganism that controls the growth of pathogenic microorganisms and their entry into plant tissue. To date, we have successfully developed two antibiotic microorganisms that are effective in the control of two serious plant diseases. These microbial antibiotics have been shown to reduce morbidity from the diseases by an average of 30%. This technology is expected to contribute to agricultural practices having less environmental impact.

Function
The antibiotic microorganism secretes an antibiotic and prevents its entry into plant tissue.

Benefits
Prevention of plant disease damage by low-level treatment of young seedlings

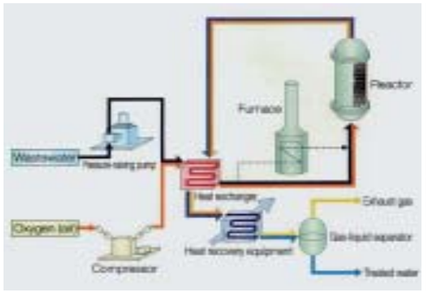
Left: Unapplied
Right: Applied



Promotion of the Wet Catalytic Oxidation Process

Through this technology, pollutants in wastewater, such as organic matter, ammonia and other nitrogen-containing compounds, are rendered harmless using air or oxygen in the presence of a catalyst under high-temperature and high-pressure conditions.

This system has already worked successfully in the NEXT21 (see page 40) etc. It has drawn considerable attention recently, with many businesses inquiring about its applicability to the treatment of various forms of industrial wastewater. Osaka Gas is promoting the widespread application of this system by working to simplify the process and reduce manufacturing and operating costs.



Basic Diagram of the Process


Plant in actual operation

Examples of Introduction of Osaka Gas Environmental Technologies (Excluding Gas Supply Operations)

Technology	General description	Client
Waste hydrochloric acid recycling	Recovery and reduction of waste hydrochloric acid (in combination with gas co-generation system)	Kokoku Steel Wire Co., Ltd.
		Tesac Corporation
		Sunrock Oyodo Co., Ltd.
		Nichia Steel Co., Ltd.
Wet catalytic oxidation technology	Intensive treatment of organic matter and ammonia at high concentrations in wastewater	Nihon Parkerizing Co., Ltd.
		NEXT21 (Osaka Gas)
Sewage sludge fusion technology	Sludge is fused by the coke bed method, recovered and recycled as harmless slag	Osaka Prefectural Government
		Japan Sewage Works Agency

Contributions to the Environment Overseas

Transfer of Wet Catalyst Oxidation Process Technology to China

In China, where serious environmental pollution is occurring as a result of the remarkable industrial development, awareness of the need to conserve the environment is rising more and more. Against this background, technical transfer of Osaka Gas's compact and high-performance "OG type wet catalytic oxidation process (CWO)" to Yunnan High Technology Environment Protection Engineering Company is ongoing. In Phase Ⅰ of the project, tests of various forms of industrial wastewater were completed successfully with a small-scale testing apparatus in 1998.

In Phase Ⅱ, a full-scale plant manufactured in China was constructed with the technical guidance and support of Osaka Gas, and completed on March 1, 2001. Since then, the highest level of water quality has been achieved for various kinds of highly polluted wastewater, and subsequent continual operations were conducted with successful evaluation results. Following these evaluations, China's own project with its own plant started in 2002.


Small-scale testing apparatus (capacity: 200 liters/day)


CWO evaluation plant (capacity: 20 m³/day), completed on March 1, 2001

Other Technical Support Programs Overseas

Osaka Gas Participation in the Northern Taiwan LNG Station Project

In Taiwan, the use of natural gas is promoted as a national policy to achieve a good balance between environmental conservation and economic growth. Currently, only one LNG station is available in southern Taiwan. Establishing another LNG station in northern Taiwan would enable delivery of a stable supply of natural gas to the country's northern districts. Osaka Gas is participating in this project as a provider of funds for the Tung Ting Gas Corporation, which is carrying out the project, and as a project manager.


Planned construction site

Philippines

Osaka Gas and the Institute of Energy Economics of Japan jointly undertook surveys for a Philippine Natural Gas Industrial Developmental Plan, entrusted by the Philippine Ministry of Energy and the Japan International Cooperation Agency (JICA). The Philippine government asked for a long-term master plan for the utilization of domestic natural gas, with an annual production of 5 billion m³. The survey report advises that economic and energy safety be improved and air pollution mitigated, and that contributions be made to the global environment by increasing the use of natural gas and decreasing the percentage of coal and petroleum use, in pursuit of an optimal balance between domestic and imported gas over a 25-year period.

Report on Estimates of Natural Gas Supply and Demand in Thailand and Neighboring Countries

Osaka Gas submitted a report estimating natural gas supply and demand up until 2020 in Thailand and its neighboring countries in preparation for a project aimed at efficient use of the large reserves of natural gas known to exist in the Gulf of Thailand. In that report, anticipated environmental benefits were evaluated through studies of the effect of replacing petroleum and coal with natural gas as thermal power station fuel, widespread use of NGVs, and through a simulation study of the introduction of co-generation systems.

Tree Planting in Australia

In 2000, Osaka Gas established an overseas corporation (Eco Tree Farm Pty., Ltd.) in Australia jointly with Mitsui & Co., Ltd. and started a tree-planting project in FY 2001. This 30-year project is the first time for a Japanese gas company to undertake this kind of effort, in which eucalyptus trees will be planted over a total area of 1,000 ha. We hope to contribute to the prevention of global warming in a way that has raised expectations around the world, by making use of the CO_2 fixation function of forests.


Tree planting in Australia

2. Development of New Environmental Technologies

Visit our website for more details
For address see back cover

Development of New Adsorbent Technology for Natural Gas Storage

Osaka Gas is developing a new method of natural gas storage using an adsorbent, which enables gas tanks to be filled to greater densities than can be achieved by the conventional compression method. This development has been ongoing within the framework of a national project for the promotion of natural gas.

The development project has two aspects: material development of new methane adsorbents that have a storage capacity several times greater than conventional materials, and system development for gas holders and NGVs using these new materials. We have already developed a new adsorbent for vehicles having a storage capacity about six times greater than compressed gas at 35 atm. This adsorbent is under investigation for practical application using an experimental test apparatus for gas holders.


Pilot-scale apparatus

Technology for Fusing Sewage Sludge Incineration Ash

Osaka Gas is engaged in developing techniques to fuse sludge using city gas, in order to reduce the volume and weight of ash resulting from incineration of sludge at sewage processing plants, and also to render it harmless. A test operation is now ongoing that uses a city gas-fired furnace capable of fusing 2 tons of incineration ash per day. The slag generated from this process can be used efficiently as a construction and building material.


Furnace for fusing sewage sludge incineration ash

Recycling Technology for Waste Plastics

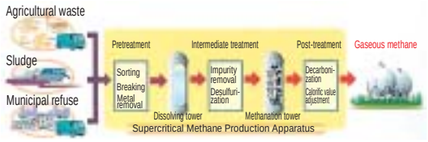
When waste plastics are discarded in the form of mixtures or composite resins, it is difficult to separate the different kinds of plastics. In addition, since treatment through incineration poses the potential problem of dioxin emissions, appropriate treatment technologies are in demand. As a technology for treating waste plastics that are otherwise difficult to treat, Osaka Gas is developing jointly with a boiler manufacturer a system enabling the efficient use of a mixture of city gas and fuel gas obtained by dry distillation of polymer waste as boiler fuel. The experimental results that have been obtained thus far show that the thermal energy recoverable from 1 kg of waste plastics is equivalent to the energy consumed by a hot shower of 15 minutes' duration. The corresponding reduction of CO_2 emissions is 2 kg; this technology is also effective in reducing greenhouse gas emissions.


Boiler using recycled waste plastic

Development of Technology for Methane Production from Waste Using Supercritical Water

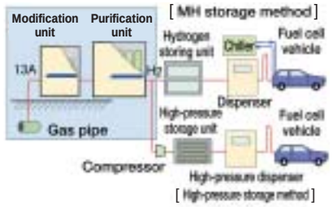
Organic wastes (municipal refuge, sludge, etc.), which are barely soluble in water under normal conditions of temperature and pressure, are rendered soluble using supercritical water (exceeding 374°C and 22.1 MPa), after which they are treated using Osaka Gas's technology for the production of substitute natural gas (SNG), in order to produce methane. A three-year national project has been ongoing since FY 2000.

●Technical Survey on Methane Production from Waste Using Supercritical Water



Development of Automobile Hydrogen Fuel Supply Stations (Natural Gas Modification Type)

Within the framework of a national project aiming at securing a supply of hydrogen, the cleanest source of energy, for fuel cell vehicles, Osaka Gas has constructed Japan's first testing equipment for hydrogen supply stations. Natural gas, the starting material, is modified and purified to produce hydrogen, which is supplied to vehicles. The station has been constructed to a scale of one-tenth of the commercial equipment and can be operated using two methods of hydrogen storage and filling. One method employs a hydrogen-storing alloy and the other uses compressed hydrogen. We will proceed with further investigations to demonstrate the safety and reliability of the station and to collect data that can provide technical guidelines for future hydrogen supply stations.



Topics

Developed "MARICOM," a New Resin Prepared from Waste Polyethylene from Gas Pipe


Mariko Kato
Research and Development Department

More than 100 tons of polyethylene (PE) pipe scraps are generated every year from Osaka Gas business activities. So we began our study with the expectation that a new resin might be created by combining gas pipe PE scraps and waste polyethylene terephthalate (PET) from recovered PET bottles. We believed that, because of their mutually reverse properties, blending PE and PET to make use of their respective advantages would lead to the creation of a high-quality resin. However, these two substances are difficult to blend because of their structural differences. An agent is needed to make them compatible before they can be combined. After about 2 and a half years of objectively testing various agents, we succeeded in discovering one that was suitable. Using this compatibilizing agent, a new resin "MARICOM" was created, which combines the flexibility of PE with the toughness of PET, and is expected to be useful in a variety of applications, ranging from molded products to fibers and films. We would like to make further efforts toward commercializing such products with expanded applications.


Knobs for gas cooking stoves made of "MARICOM"

3. Environmental Contributions to Local Communities

● "Everyone's Environmental Effort Campaign" ●

It is important for each employee to understand environmental issues as his or her own personal concern, as well as to be involved in environmental conservation activities such as energy and resource conservation. It is also important to begin with what can be done easily as a member of the local community, as a member of the family, and as a citizen, in concert with other local residents. In this regard, Osaka Gas is promoting "Everyone's Environmental Effort Campaign," including community cleanups and recycling activities.

Comanywide Activities

Ecological Cooking Class

Everyday environmental awareness is raised through learning how to cook by efficient use of ingredients, resources and energy.


Ecological cooking class

Sponsoring Events in the Natural Environment

Osaka Gas sponsors various programs for observing and experiencing nature and for learning about environmental issues.

- Let's learn about water and nature (in June and August)
- Let's learn about the ecosystem in Kyoto Gyoen Garden (in December)


One of the nature observation programs

"Cleanup Osaka" Campaign

We carry out cleanups at a location selected each year. In FY 2001, 550 participants cleaned up the three major boulevards in Osaka: Midosuji, Yotsubashisuji and Naniwasuji.


Cleaning up a major boulevard

Example: Activities at each Osaka Gas Sites

Osaka Gas's individual sites are also endeavoring to promote specific activities through cleanup campaigns, local environmental events and educational sessions.

Green Belt Improvement Efforts at the Himeji Terminal

With respect to green belt creation, Osaka Gas is making efforts to implement sophisticated factory greening programs beneficial to living organisms. Our program aims to restore forests, paddy lands, fields, ponds, and hills in the West Harima district; these sites also serve as environmental education sites for local children and visitors to the Gas Energy Hall.

1) Improved method for green belt maintenance

Efforts are made to improve the methods of green belt maintenance, such as prohibiting unnecessary application of insecticides and appropriate forest thinning, in order to facilitate the growth of diverse fauna.

2) Arrangement of the biotope area

At the biotope area located in the center of the factory green belt, employees conduct voluntary activities such as introducing fish and other fauna from the river nearby, and transplantation of wetland plants, to make the biotope a habitat for various organisms.


Biotope at Himeji Terminal

Sponsoring the "Children's Environmental Caravan"

Together with the Yao City government and the Japan Environment Association, the Hokutobu Business Headquarters sponsored a "Children's Environmental Caravan" for pupils of three elementary schools in Yao City. Environmental educational sessions were provided to encourage children to learn using all five senses, for example, sensing differences in dirtiness and odor between exhaust gases from NGVs and diesel-powered vehicles.


"Children's Environmental Caravan"

● Example: Activities in "Everyone's Environmental Effort Campaign" at Each Site in FY 2001

Time	Description	Sites
April	Exhibited in "Earth Day in Nara"	Hokutobu Headquarters
	On April 3 (Route 43 Day), cleanup along Route 43	Hyogo Headquarters
May	Voluntary cleanup for the East Asian Games	Osaka Headquarters
June	Exhibited in the "Ibaraki City Environmental Fair"	Hokutobu Headquarters
July	Early morning cleanup campaign around the Kinokawa River	Nanbu Headquarters
	"Osaka Bay Clean Campaign"	Senboku Terminal
August	Exhibited in "Nagisa Eco Life 21"	Keiji Headquarters
September	Exhibited in the Himeji City "Waste Recycling Exhibition"	Himeji Terminal and Hyogo Headquarters
October	Exhibited in the Miyakojima-ku "Flower and Green Festival"	Osaka Headquarters
	Participated in the "My Town Sakai Cleanup Campaign"	Nanbu Headquarters
	Exhibited in the "Nara City Environmental Festival 2001"	Hokutobu Headquarters
	Exhibited in the Kobe City "Green Energy Messe"	Hyogo Headquarters
	Exhibited in the "Urban Dwellers' Activities Festival"	Osaka Headquarters and Personnel Department
November	Participated in the "10,000 People Great Cleanup Activity"	Nanbu Headquarters
	Exhibited in the "Low-Pollution Vehicle Fair"	Commercial and Industrial Market Department
	Sponsored the "Children's Environmental Caravan"	**Hokutobu Headquarters**
December	Exhibited in the "Toyonaka City Environmental Exhibition 2001"	Hokutobu Headquarters
	Exhibited in the "Kyoto Environmental Festival"	Keiji Headquarters
February	On February 2 (Route 2 Day), cleanup along Route 2	Hyogo Headquarters
March	Exhibited in the Osaka City Consumers' Life Rationalization Association "Eco Panel"	Osaka Headquarters
Weekly	Cleanup around the site	Osaka Headquarters
Monthly	Cleanup of public roads along the Senboku Terminal	Senboku Terminal
Biweekly	Cleanup activities around the site	Nanbu Headquarters
Throughout the year	**Maintenance and improvement of the biotope area**	**Himeji Terminal**

4. Social Performance

●Anti-disaster Measures●

At Manufacturing Plants

Osaka Gas's manufacturing plants treat natural gas. Bearing in mind that any disaster at these plants could have an adverse effect on the environment, we have three major disaster prevention programs: "prevention," "early detection" and "containment."

First, "prevention" is ensured by designing and constructing manufacturing facilities that can withstand earthquakes and other disasters, in order to minimize potential damage to equipment that could give rise to gas leaks or other problems. The earthquake resistance of these facilities was verified at the time of the Great Hanshin-Awaji Earthquake.

As for "early detection," gas sensors, low-temperature sensors and flame sensors are installed at critical points, from LNG unloading piers to gas transmission pipes, etc. In the event of a gas leak, the central control room is immediately informed and remote monitoring is available.

Means of "containment" include countermeasures against vessel fires etc., such as water curtain equipment to protect piers, powder fire extinguishers, liquid retaining walls and water curtains for preventing expansion of spills from LNG tanks, cool water sprinklers for protecting the equipment against fire heat, and high-performance foaming equipment for wrapping LNG with special foam in the liquid retaining walls.

The operation of these facilities and equipment is monitored using a fully computerized system. The operators in charge of overall control are educated and trained by well-designed programs. Both day and night patrols are conducted in an attempt to foresee accidents, by monitoring trends in the equipment, and through early detection of abnormalities. In addition, various drills are conducted to ensure appropriate behavior in the event of a disaster. A high level of disaster prevention management is thus ensured.


Central Control Room

At Transmission Department

The Transmission Department is responsible for the basic duties of constructing and maintaining the high-pressure trunklines for the transportation of city gas from the manufacturing plants. Any accidental damage to a trunkline could have a major impact not only on the stable transportation and supply and safety of city gas but also on the environment.

With this in mind, and advocating the slogan "Continue to Maintain Zero-Accidents," we have adopted various prudent policies. For example, we use steel pipes of the best quality for trunkline pipes, with sufficient strength and flexibility to resist earthquakes, etc. The earthquake resistance of these pipes was verified at the time of the Great Hanshin-Awaji Earthquake.

In addition, Transmission Department workers patrol the entire trunkline route several times daily. Furthermore, the soundness of trunkline pipes is confirmed periodically by examination and diagnosis by gas pipe interior examination robots.


Gas pipe interior examination robot

At Supply Department Sector

All of the Service Areas are Managed Centrally for 24 Hours

The Distribution Control Center of the Head Office provides central control to all manufacturing plants and pipeline networks, using a highly advanced monitoring and control system. The status of gas manufacturing and supply is controlled efficiently according to demand on an around-the-clock basis, while operators also endeavor to ensure safety in all sectors. In preparation for emergencies, we have a quick response system in which emergency teams are dispatched from 47 security bases in the service areas, with close communication between the Distribution Control Center and the control centers at each regional business headquarters.

The "5-Year Anti-Earthquake Plan" Completed

We have various countermeasures against earthquakes, such as promoting the introduction of intelligent gas meters. The goals specified in the "5-Year Anti-Earthquake Plan," formulated on the basis of our experience with the Great Hanshin-Awaji Earthquake, were achieved according to plan.

Safety Equipment and Devices

"Gas equipment safety systems," comprised of an intelligent gas meter, gas equipment with safety mechanisms, and a gas leak alarm, are installed at our customers' homes to ensure their safety. In addition, our customers' gas equipment is checked for safety every three years.

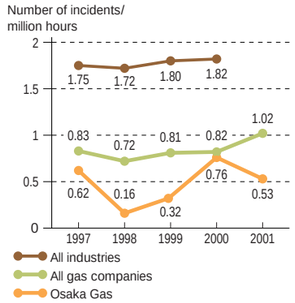
●Labor Safety, Health, Legal Compliance, Human Rights●

Labor Safety

In accordance with our philosophy of respecting human life, Osaka Gas has been actively promoting labor safety and hygiene activities to ensure the safety and health of its employees. Besides the observance of various legal regulations concerning labor safety and hygiene, Osaka Gas has established its own "Labor Safety and Hygiene Control Rules" and various manuals, such as "Driving Business Vehicles." Osaka Gas has also proposed a "disaster index," a quantitative measure of the extent of disaster damage, using its own calculation equation. Using this index, the safety activities of each site are evaluated.

Osaka Gas owns about 2,600 business vehicles and traffic accidents account for the great majority of labor accidents. Bearing this in mind, Osaka Gas places an emphasis on the prevention and reduction of traffic accidents. Employees cannot drive a business vehicle unless qualified with an internal company driver's license, as well as an official driver's license. To secure the internal license, the employee must receive awareness-raising education and actual driver's training at the internal driving training center. Even after obtaining the license, the employee must receive periodic training for license renewal every five years. In the event of a traffic accident, the driver involved must receive special training to prevent recurrence.

●Labor Accident Incidence
(Lost-time Injury Frequency Rate)




Safety driving training using a tricycle motorcycle

Promoting Health

Osaka Gas is making efforts to establish health maintenance and promotion measures together with mental health-related measures. Aiming at an "active and friendly workplace," the "health-building medical checkup" program is conducted as a supplement to the legally specified medical checkup for employees over 35 years of age. To ensure early detection of disease and its prevention, individual guidance is provided based on the checkup's results. Various awareness-raising activities for building better health are carried out, including prevention of obesity by "Walk 10,000 Steps Daily," abstaining from smoking, and moderation in drinking.

Regarding mental health-related measures, workplace mental health care, in particular, is specified as one of the essential items for the educational program for newly appointed managers provided by the Personnel Department. The trainees are educated to conduct awareness-raising activities with "Mental Health Building for Employees in Your Department" as a key item for personnel management.


"Health-Building Medical Checkup Program"

Legal Compliance

In order to be a corporate group characterized by good conduct and openness to society, the Osaka Gas Group formulated the "Osaka Gas Group Corporate Action Standards" in February 2000. These Standards cover 14 areas of concern, including human rights, environmental conservation and product safety. In addition to the compliance with laws, we must pursue our duties fairly, appropriately and in keeping the spirit of the law. The Action Standards describe various aspects of our business operations, and apply to all executive officers and employees of Osaka Gas and its affiliates. We are endeavoring to instill the spirit of the Action Standards in all personnel involved in our business operations by incorporating more specific action standards to our internal rules, operating manuals, etc.

An organization for promoting observance of the Action Standards, called the "Compliance Office" was established in the General Affairs Department in January 2001.

Human Rights

The "Osaka Gas Group Corporate Action Standards" advocates "observance of human rights" as an important action standard. Specifically, the standards include the following provisions: "human rights are our birthright and we must behave bearing in mind that everyone's human rights should always be respected to the maximum extent" and "we must have accurate knowledge about human rights and should not discriminate against our customers, employees and others due to their beliefs, sex, social status, family origin, or the like." It is also required that relevant legal instruments, including the nation's Constitution and the Universal Declaration of Human Rights, should be observed.

To promote awareness-raising and educational programs concerning human rights, the "Human Right Awareness Raising Committee" holds meetings periodically. A "Departmental Promotional Congress" has also been established in each individual department to ensure effective activities for human rights.

●Local Philanthropic Activities●

As a member of the local community, Osaka Gas feels affection for the community and is always conscious of its meaningful connections with its customers. With these in mind, Osaka Gas conducts various activities in the course of daily business and beyond.

Working Together with the Local Community

As a corporate citizen, Osaka Gas makes efforts to work together with the local community, through voluntary services and communication with local residents. With sections in all departments and branches dedicated to this work, the Osaka Gas Group as a whole is involved in a positive way in local events and festivals.

"Better Citizenship Activities"

"Better Citizenship Activities" provide support for Osaka Gas employees who are voluntarily involved in local events or activities beyond their work. It is hoped that they will grow through these activities, enjoying a better life while contributing to the local community. The company also supports each employee by providing information, time, and money.


Decorating the town with flowers grown by employees

Employees' Voluntary Activities - the "Little Lantern" Program -

This voluntary activity celebrated its 20th anniversary in FY 2001. It encompasses a wide range of activities, from charity concerts to collecting donations, holding sign language and finger reading classes, and town cleanup activities. These operations are funded by profits from bazaars and other events and donations collected in donation boxes at all Osaka Gas's sites.


"Little Lantern Children's Theater"

Book Recycling Charity Bazaar

Old books and compact discs stored away at employee's homes are collected and sold for re-use at charity bazaars (twice a year).


Charity Bazaar

Company Support

Providing Information and Motivation

Osaka Gas provides awareness-raising seminars and volunteer hands-on learning programs to motivate its employees to be involved in voluntary activities. It also provides such information to employees through the Intranet.


Website for volunteer activities

Award for Contributions to the Local Community

Osaka Gas awards its individual employees and their groups for contributions to the local community through regional, voluntary, cultural, or athletic activities.

Action Support System

●Volunteer Holidays (long-term)

For employees involved in remarkable voluntary activities, holidays are allowed up to 1 year.

●Community Holidays (short-term)

These holidays are allowed when employees are engaged in regional activities.

●Community Gift System

Osaka Gas supports the activities of organizations that provide support for elderly, young or disabled persons, etc., through its employees involved in such activities.

Osaka Gas Group Welfare Foundation

This foundation was established in 1985. It makes efforts to improve the welfare of the elderly through a grant program and health building projects.

Osaka Gas Foundation for International Cultural Exchange

This foundation was established in 1992 to enhance mutual understanding and friendship with natural gas-producing countries. Currently, it provides various educational support programs for children in Indonesia and Malaysia.

Topics


Ted Harui
Senior Manager,
Better Citizenship
Development Office,
Personnel Department

For Employees to Become a Full-fledged Member of Society

At the Better Citizenship Development Office, various events are planned to motivate employees to become voluntarily involved in philanthropic activities. A questionnaire survey to employees conducted 10 years ago revealed that only 20% of respondents had worked as volunteers, but this ratio increased to 52% two years ago. Our activities have achieved steady results.

The objective of this program is for each employee to grow into a full-fledged member of society. Initially, a richly cultured person having hobbies and special skills unrelated to his or her job was desired. Currently, a more advanced level of citizenship is in demand, in which the person is interested in environmental conservation or support for socially challenged people. We will make active efforts to continue to nurture self-supporting citizens.

Information Disclosure and Communication

Environmental Website

An "Environmental Actions" column is available on the Osaka Gas web site. It publishes a broad spectrum of information on the environmental activities of Osaka Gas. Also accessible are many pieces of relevant information, including facts about city gas and energy-saving ideas and supplementary data for the Environmental Report.

Environmental Report

Osaka Gas has published an Environmental Report every year since 1994. Every issue provides a systematic description of the company's environmental activities. Since 2001, a digest version based on the Report has also been issued to provide an abbreviated description. In 2002, this supplementary report was renewed as the "Osaka Gas Eco Note," designed to provide more readily understandable information (Japanese only).

●List of Awards Received

- Environmental Report Award for Excellent Reporting (sponsored by Toyo Keizai Inc.) 1998, 2001
- Prize for Excellence in the 3rd Environmental Report Grand Prix (cosponsored by the Environment Agency) 1999

●Circulation of the Environmental Report

Year	Japanese	English	Digest
1999	8,000	2,000	–
2000	8,500	1,500	–
2001	7,000	1,500	7,000
2002	7,000	1,500	7,000

Gas Science Museum and Gas Energy Hall

The Gas Science Museum and the Gas Energy Hall were built at the Senboku and Himeji Terminals, respectively. Focusing on natural gas, an environmentally friendly clean source of energy, enjoyable participation-oriented exhibits are presented to motivate not only adult visitors but also children to think about energy and environmental issues, natural gas-related technologies, etc.

●Number of Visitors (persons)

	FY 2000	FY 2001
Gas Science Museum	66,522	65,792
Gas Energy Hall	27,585	25,672



(Left) Gas Science Museum
Opened in October 1982 as Japan's first museum for gas-related science.

(Right) Gas Energy Hall
Various exhibits are presented to enable visitors to enjoy learning about the earth, science and energy.

Elementary School Extramural Classes

Osaka Gas provides the two PR pavilions described above and the adjoining manufacturing plants as places for extramural classes for a large number of children, mainly elementary school pupils. Through participation-oriented exhibits, movies, and bus excursions through the plant, issues related to the gas industry, energy and the environment are taught.



Scenes at an extramural class

Energy and Environmental Education

With the aim of deepening the understanding of energy and environmental issues and natural gas for children, Osaka Gas has published brochures for educating school students about energy and the environment. It is hoped that these brochures will motivate the readers to think about global environmental conservation and the efficient use of energy.


Brochures for energy and environmental education (Japanese only)

●The "Gas Science Museum Extension Service"

Employees visited classes at a total of 22 schools as the "Gas Science Museum Extension Service." Similar services are available from the Gas Energy Hall.

●Internet School

"Preliminary Learning" and "Post Hoc Leaning" programs were held on the Internet to enhance understanding of energy and the environment both prior to and after visiting the Gas Science Museum. A total of 39 elementary schools participated in this program.

Osaka Gas Discover-Life Pavilion "DILIPA"

The Osaka Gas Discover-Life Pavilion "DILIPA" is a showroom full of useful information on housing, including an introduction to the latest models of gas equipment and systems and proposals for housing plans fitted to individual lifestyles. It offers a large number of experience and participation-oriented exhibits to encourage actual, physical recognition of various functions.


"DILIPA"
Opened: November 1991
Number of visitors in FY 2001: 425,322

A Meeting with the Kansai Consumer Group Network Committee

Osaka Gas endeavors to invite opinions from a wide range of its customers in the hopes that we can apply them to our business activities. In this context, we hold an annual meeting with the Kansai Consumer Group Network Committee. The agendas range widely from our management plans to security and the environment. At the FY 2001 meeting, opinions were exchanged with regard to the issues such as measures for reduction of greenhouse gases, the future prospects for the wider use of NGVs, and matters concerning the acquisition of ISO 14001 certification.


The FY 2001 meeting

Independent Review

Osaka Gas's Approach to Independent Review

In recent years, environmental reports have become more important as a way of disclosing information to stakeholders and as a reference for evaluation of the environmental management of companies. Accordingly, there is a demand for improvement in the reliability of environmental reports. To meet this demand, some companies have already accepted independent reviews. There are two major approaches to independent reviews of environmental reports: 1) an attempt is made to evaluate the contents of the entire environmental actions of a company, or 2) emphasis is placed on insuring the accuracy of the data given in the environmental report.

Regarding approach 2), unified criteria for desirable and levels of investigation are not now available and the problems relating to the cost of the investigation have also been pointed out. With emphasis placed on inviting knowledgeable people from outside the company to give their opinions and advice on how we can improve our environmental actions and information disclosure, as well as increase information transparency and reliability, Osaka Gas held a series of "Meetings for an Exchange of Opinion about Osaka Gas's Environmental Actions."

●Meetings for an Exchange of Opinions about Osaka Gas's Environmental Actions●

Summary of the Meetings

●1st Meeting (March 20, 2002)

We described Osaka Gas's environmental actions, results, and the 2001 Environmental Report to everyone at the meeting.

●2nd Meeting (April 5, 2002)

To deepen the members' understanding of our environmental activities, an excursion was held to inspect onsite efforts at the Senboku Terminal and the Osaka Business Headquarters.

Particulars of the Inspection

Senboku Terminal

- Environmental activities at the plant
- City gas manufacturing processes
- Co-generation, central control room, Gas Science Museum, etc.

Osaka Business Headquarters

- Gas pipe laying work site (trenchless method)
- Efforts to reduce waste generation
- Anti-disaster system, district heating/cooling system, etc.

●3rd Meeting (May 23, 2002)

Based on the findings in the first and second meetings and the excursion, written opinions were submitted from each participant. We explained Osaka Gas's responses and countermeasures and exchanged opinions.

Participants

Takashi Gunjima, Doshisha University
Minoru Mizuno, Osaka University
Kayoko Sakai, Yasuda Fire & Marine Insurance Co., Ltd.
Hideo Iida, Osaka Liaison Committee of Consumer Organizations
Yoshiaki Uda, Osaka Environmental Counselors Association
Haruko Negita, Network "Earth Village"
Lin Yong hui, Doshisha University

Responses and Countermeasures Regarding Opinions Expressed

The opinions we received raised a total of 75 points. These opinions and our responses were classified into three groups: 1) points to which we responded, 2) points that expressed appreciation for our efforts, and 3) points for which long-term efforts are required.

● 1) Example: Points to Which We Responded

★Activities

Opinion	Page
Green distribution should be included in the Environmental Goals for FY 2010.	5-6
Promote the widespread use of the trenchless method.	19-20
Further promote green procurement.	23
Efforts outside the company are also important for reducing environmental impacts.	30-46 etc.
Endeavor to create products that contribute to the reduction of environmental impacts.	36-40

★Disclosure

Opinion	Page
Examples of activities that are the most advanced in the gas industry.	9,10,16,19,32
Regarding CO_2 reduction rates, show relative data compared to FY 1990.	16
Describe efforts concerning chlorofluorocarbons other than recovery and recycling.	18,28
Efforts concerning environment-related new products and services other than internal efforts.	20,28,36-40,42-45
Be positive about including negative information in the Report.	28,29
Be positive about disclosing information about measures against soil pollution.	29
Regarding disclosure of information on new products etc., describe not only positive aspects but also problems and challenges.	33,38
Include specific examples of "efforts undertaken together with customers."	37,42
Information disclosure on anti-disaster measures was recommended.	47-48
How about PR focusing on social contributions to local communities?	49
An overall description of the Osaka Gas Group and an introduction of particular environmental measures.	53
Enhance information disclosure via web sites.	All
Provide more detailed description of terms.	All
Show data sources whenever possible.	All
Unify the base year for data presentation.	All

●2) Points That Expressed Appreciation for Our Efforts

Opinion
Environmental actions and social contributions have been emphasized as one of the most important points of business management, and specific efforts have been made successfully.
Activities aiming at zero emissions have been promoted with steady results.
Within the framework of the EMS promotion system as required by ISO, the manufacturing sector, cooperating companies, and affiliates have made integral efforts to improve the environment.
Activities for saving resources and energy have been conducted successfully.
Efforts to improve co-generation efficiency and to promote the use of co-generation systems have been successful and gas equipment recycling efforts are also commendable.
Various systems are available for companywide support of employees' social contributions.
Support has been provided for overseas programs concerning energy efficiency improvement technologies and environmental conservation technologies.

●3) Example: Points for Which Long-term Efforts or Collaboration with the Administrative Authorities and Local Community Are Required

Opinion	Response
Create a vision of an environmentally conscious society and devise specific steps and scenarios for its realization over a time span of 30 to 50 years, together with the public.	We think that it is important to create a vision in partnership with the various stakeholders in order to create an environmentally conscious and recycling society.
Promote efforts toward sophisticated technologies for the efficient use of waste plastics in place of thermal recycling.	We are engaged in R&D activities concerning the production of high quality recycled resins from waste plastics and various methods of material recycling of waste plastics, in an attempt to achieve expanded use and increased product lineups (page 45).
I look forward to the time when the system with co-generation, district heating/cooling and garbage recycling at Osaka Dome City will be advanced to a wider eco-community system including water circulation, greening and natural energy.	We hope to expand the idea of the Osaka Dome City system so that it will be reflected in our Eco-community Plan involving the administrative authorities that includes measures against the heat island phenomenon such as rooftop planting.
Consider environmental accounting that includes consolidated subsidiaries.	We think it will be necessary to consider further the matter of including consolidated subsidiaries in our calculations.
Make efforts to include Osaka Gas excursion tours etc. in education programs in schools.	Currently, we are endeavoring to improve environmental learning programs at our pavilions and at schools. We will make more active efforts.
It is hoped that the experimental residential complex NEXT21, in which an ecological community is incorporated experimentally, will be expanded nationwide.	NEXT21, designed to incorporate next-generation energy-saving and environmental conservation systems, is open to the public and its concept and experimental details are posted on our web site in order to promote its understanding. We will continue to publicize this system.
I hope you will present your vision concerning the problem of resource depletion in future.	While potentially available resources such as natural gas and methane hydrate are reportedly abundant, the energy consumption in developing countries is expected to increase; we think it is necessary to make efforts to develop new energy sources, including hydrogen and solar power.
I hope you will offer products more friendly to users from the viewpoint of ergonomics.	We will endeavor to create more readily usable products, including the development of equipment friendly to the elderly and the disabled.
I hope you will develop a system in which gas consumption by each piece of equipment can be checked at home.	We are carrying out studies in an attempt to develop a convenient way to measure the current status of city gas consumption by each piece of household gas equipment.

Overview by Professor Gunjima, the Chairman

Osaka Gas is striving to supply less expensive energy that is gentle to humans and gentle on the environment, and to develop and practically apply "higher efficiency" energy systems and equipment. I am deeply impressed with the company's efforts to integrate environmental management into its business management. I recommend that various environmental improvement activities conducted at workplaces be described in a realistic manner in the Environmental Report so as to facilitate the reader's understanding of Osaka Gas's environmental actions.

Summary

These "Meetings for an Exchange of Opinions about Osaka Gas's Environmental Actions" were held to improve the quality of our environmental actions. Compared to last year's "Meetings to Invite Opinions," more extensive programs were implemented, including an onsite excursion, submission of written opinions from participants, and three opinion exchange meetings. All participants joined in to give us a wide range of opinions and suggestions.

In response to these suggestions, we enhanced various data and included an increased number of examples of activities. As for the points raised that require long-term efforts, we will promote suggested activities to improve the level of our environmental actions.

We would like to continue to invite advice and opinions from knowledgeable people outside the company, endeavor to improve the level of our environmental actions and ensure transparency.

Yuji Matsumura
Vice-President
Chairman of the Committee on Energy and the Global Environment

Efforts by Osaka Gas Affiliates

●Environmental Activities by Osaka Gas Affiliates●

As of the end of March 2002, the number of Osaka Gas affiliates was 120 (including 43 consolidated subsidiaries), consisting of 74 (including 23 consolidated subsidiaries) in energy-related business sectors such as district heating/cooling, sales and maintenance of gas equipment, power generation and supply, and ESCO operations, and 46 (including 20 consolidated subsidiaries) in urban business sectors such as real estate development, restaurants, information processing services, sales of coke and chemical products, leasing of vehicles and management of institutions for the care of the elderly.

These affiliates actively pursue environmental conservation activities and environmental business as an important factor in enhancing their corporate value. Also, these companies are promoting environmental actions along with Osaka Gas in various contexts, including green procurement and green distribution (page 23), recycling of used gas equipment (page 35), district heating/cooling, ESCO operations (page 42), and use of cryogenic heat (page 17).

●Environmental Impact Data of Osaka Gas Affiliates

Of the 120 affiliates, 24 companies in the following categories were included in this analysis:

1) All companies with manufacturing plants (18 companies including 10 consolidated)
2) Companies with 100 or more employees without a manufacturing plant (6 companies including 4 consolidated)

	Power	Gas	Kerosene and light oil	Gasoline	CO_2 emissions	Water	Copy paper	Industrial waste	Companies	Total sales
	1,000 kWh	1,000 m³	1,000 ℓ	1,000 ℓ	1,000 t	1,000 m³	1,000 sheets	1,000 t	Number	0.1 billion yen
FY 1999	195,594	15,979	1,927	582	175	618	11,126	12.6	19	1,180
FY 2000	207,755	16,043	2,018	543	183	633	11,665	16.0	21	1,259
FY 2001	260,331	84,632	1,980	630	380	1,483	12,357	17.5	24	1,356

Because three companies were either newly included in the Osaka Gas Group or started business operations in FY 2001, the overall amounts of CO_2 emissions, water consumption and industrial waste generation have increased. Excluding these three companies, CO_2 emissions per unit of sales decreased by 6% over the same three-year period, copy paper consumption decreased slightly, and water consumption remained nearly constant.

Regarding industrial waste, the overall increase in its generation is attributable to expanded business operations by one gas pipe work company and one equipment company, which account for the majority of the waste generation total. Excluding these two companies, the amount of industrial waste generated per unit of sales decreased by 11% over the three-year period.

●ISO 14001-Certified Osaka Gas Affiliates

Cold Air Products Co., Ltd., Gas and Power Investment Co., Ltd., Kinrei Co., Ltd., Ad'All Co., Ltd., Kansai Research Institute Inc., Liquid Gas Co., Ltd.*, CRYO-AIR Co., Ltd.* (*: manufacturing plants only)

Example: Efforts for Environmental Conservation

Kinrei Co., Ltd.
(http://www.kinrei.com/index.html)

Kinrei constructed an environmental management system for its frozen noodle manufacturing plants in Tsukuba and Senboku, and acquired ISO 14001 certification in October 2001.

All employees of these two plants have made efforts in accordance with the company's environmental philosophy to efficiently use resources and energy, to appropriately sort waste and reduce its generation, and to promote resource recycling. They have also put together a recycling system that deals with food waste generated through the manufacturing process, recycling it as hog feed.

Gas and Power Investment Co., Ltd.

The company's Senri Energy Center, which acquired ISO 14001 certification in March 2001, endeavored to reduce energy consumption, CO_2 and NOx emissions and waste generation, and achieved an energy-saving rate of more than 3%, as compared to 1999. Additionally, the center replaced chemicals, including PRTR-specified chemical substances, with substitutes having less environmental impact, and held meetings with local residents to discuss environmental issues. As a result of these activities, the Senri Energy Center has been recognized as an "environmentally friendly energy center" by its customers. At its other energy centers, energy-saving activities are conducted using the EMS concept.

Urbanex Service Co., Ltd.

This company is promoting energy and resource conservation and urban environmental protection at our customers through its business operations that include maintenance of buildings and facilities and management of district heating/cooling plants. It is endeavoring to save energy through such activities as continuous monitoring of energy consumption, letting in outside air in spring and autumn, regulating air-conditioner temperature settings, and turning lights off during breaks. In addition, the company has made various proposals to the owners of the buildings it manages based on its business know-how, which will lead to energy-saving for those entire buildings.

●Environmental Businesses by Osaka Gas Affiliates●

Name of company	Description	Contact address
Apriti Sesamo Co., Ltd.	Offers environmentally friendly cooking methods.	4-1-2, Hiranomachi, Chuo-ku, Osaka 541-0046, Japan tel:+81-6-6205-4609 fax:+81-6-6204-5096 http://www.og-group.or.jp/apriti/
OG Road Co., Ltd.	Recycling of asphalt composites, crushed stone, and excavated soil.	1-4-132, Hokko, Konohana-ku, Osaka 554-0033, Japan tel:+81-6-6468-4175 fax:+81-6-6468-6550 http://www.og-group.or.jp/ogroad
Cogeneration Technology Service Co., Ltd.	Provision of an environmentally friendly dispersion type power generation system.	2-37, 3-chome Minami, Chiyozaki, Nishi-ku, Osaka 550-0023, Japan tel:+81-6-6584-8853 fax:+81-6-6584-8854 http://www.cogene.co.jp/
Gas and Power Co., Ltd.	ESCO business for energy-saving and environmental conservation planning for buildings and manufacturing equipment.	4-1-2, Hiranomachi, Chuo-ku, Osaka 541-0046, Japan tel:+81-6-6205-4557 fax:+81-6-6205-4703 http://www.og-group.or.jp/gandp/gaiyou.htm
Kyoto Research Park Co., Ltd.	Supports environmental business efforts in industrial and academic sectors in Kyoto Prefecture.	134, Chudoji Mimamimachi, Shimogyo-ku, Kyoto 660-8813, Japan tel:+81-75-322-7800 fax:+81-75-322-5348 http://www.krp.co.jp/
Osaka Gas Engineering Co., Ltd.	Provision of environmental improvement technologies, including sludge treatment, soil purification and water treatment.	Morinomiya Sky Garden House, 1-4-2, Nakamichi, Higashinari-ku, Osaka 537-0025, Japan tel:+81-6-6973-5151 fax:+81-6-6973-5100 http://www.oge.co.jp/
Kansai Research Institute, Inc.	Contracts environmental research and consultation for acquisition of ISO certification.	134, Chudoji Mimamimachi, Shimogyo-ku, Kyoto 660-8813, Japan tel:+81-75-322-6830 fax:+81-75-322-6820 http://www.kansai-ri.co.jp/
OG Auto Service Co., Ltd.	Leasing of low-pollution vehicles, mainly NGVs.	Mimamimorimachi Chuo Building, 2-6-2, Higashi Tenma, Kita-ku, Osaka 530-0044, Japan tel:+81-6-6352-3181 fax:+81-6-6356-6070 http://www.ogas.co.jp/index.htm
OGIC Co., Ltd.	Reuse and recycling business for used PCs and peripherals that can no longer be leased.	3-3-9, Azuchimachi, Chuo-ku, Osaka 541-0052, Japan tel:+81-6-6264-3003 fax:+81-6-6264-3000 http://www.gas-ogic.co.jp/
Techno Green Co., Ltd.	Provision of environmental technologies for tree planting and garbage treatment for urban beautification.	Osaka Gas Senboku Terminal No. 2 Facility, 3-1, Takasago, Takaishi-city, Osaka 592-0001, Japan tel:+81-72-268-0276 fax:+81-72-268-1566 http://www.og-group.or.jp/tec/
Osaka Gas Chemicals Co., Ltd.	Development, manufacturing and marketing of products that contribute to environmental conservation, such as carbon adsorbents.	3-6-14, Bingomachi, Chuo-ku, Osaka 541-0051, Japan tel:+81-6-6262-3427 fax:+81-6-6262-5599 http://www.ogc.co.jp/j/index.htm

These websites are linked from our websites
For address see back cover

Editor's Postscript

In environmental action, I think it is important to emphasize three things: 1) every employee should make constant efforts to save energy and resources not only at the workplace but also at home and in society, 2) development of technologies and systems should be promoted to support measures over the long term, and 3) appropriate actions should be taken to cope with environmental issues and to meet social needs.

This Environmental Report provides improved information on environmental performance data, and social performance etc. Also described in detail are the results of the independent review of Osaka Gas's environmental activities and its Environmental Report by our stakeholders. Regarding environmental accounting, an attempt was made for the first time to convert into monetary values the social benefits (external effects) of reducing emission of substances that have environmental impacts. Accordingly, the total number of pages increased by about 30% compared to the previous issue, with detailed data accessible on our web site.

Finally, I would like to ask you to feel free to give us your opinions for further promoting our environmental actions and creating a more easily understandable report. Thank you.

Toshiharu Okajima,
General Manager of the
Environment Department

●History of the Environmental Activities of Osaka Gas●

1989 The Environmental Management Dept., part of the production sector, was reorganized into the Environment Dept., a companywide staff organization.

1990 "The Committee on Energy and the Global Environment" was established.
Received the Environment Agency Secretary-General's Award in the 17th Environmental Awards for the "coke bed process for fusing and recycling sewage sludge."

1992 The "Osaka Gas Environmental Philosophy" and the "Osaka Gas Environmental Action Guidelines" were formulated and published.

1993 Action plans for individual departments were formulated.
1st annual President's Award for Environmental Activities.
Futuristic experimental residential complex "NEXT21" was completed.

1994 Received the MITI Minister Prize in the 3rd "Global Environmental Award Grand Prix."
The "1993 Osaka Gas Environmental Report" was published.

1995 The Great Hanshin-Awaji Earthquake occurred.
The Nishi-Yodogawa pollution case reached final settlement through conciliation after 17 years of dispute.

1996 Received the MITI Minister Prize for the "recovery and recycling system for used gas equipment."
Received the Japan Builders Association Award Special Prize for "NEXT21."

1997 The Production Department acquired ISO 14001 certification.

1998 Received the Environmental Report Award for Excellent Reporting for the "1998 Environmental Report."

1999 Results of environmental efforts at individual departments were incorporated into the performance evaluation system.
Received the Third Environmental Report Grand Prix Prize for Excellence.
Received the Energy-Conservation Grand Prix etc. for the 9.8 kW co-generation systems.

2000 The Guide to Green Procurement was established.
The Environmental Goals for FY 2010 were established.
Received the Japan Gas Association Technology Grand Prix for the "Ex Prior Eco" high-efficiency hot water heater.
Received the Gold Prize from the Pacific Basin Economic Council for environmental actions.

2001 The Green Distribution Policy was formulated.
The Mid-term Environmental Plan for FY 2005 was established.
Received the Environmental Report Award for Excellent Reporting for the "2001 Environmental Report."