# — Open Innovation — Our R&D Policy

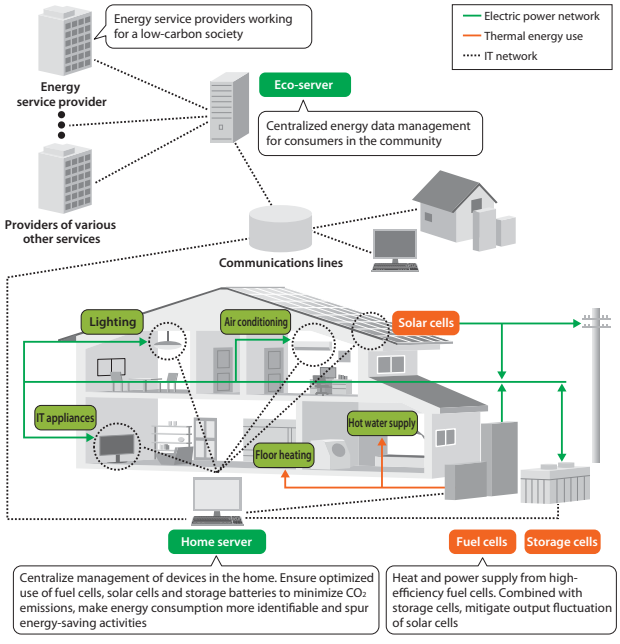
The Osaka Gas Group views research and development as the most effective means to differentiate itself from others and to strengthen its competitive edge. For this reason, the Group strategically invests in fields such as energy and the environment and develops and commercializes new technologies. In recent years, the Company has pursued a policy of "Open Innovation" in an effort to speed up and increase the efficiency of R&D by leveraging external technologies. "Open Innovation" refers to making information about the key technological challenges that we are contending with available to external entities such as major corporations, small-to-medium sized companies, venture businesses, government-affiliated organizations, universities and international research institutes. By linking both external and internal resources, we seek to develop technologies that will contribute to the realization of a low-carbon society and support the expansion of our business fields.

## Technology Development for the Realization of a Low-Carbon Society

### Efforts to Increase Energy Efficiency in Households

#### ◆ Smart Energy Houses

The Company is currently conducting verification tests on "smart energy houses" that conserve energy and reduce $CO_2$ emissions in households. This is made possible by combining three batteries — residential fuel cells, solar cells and rechargeable batteries — for optimal operation. In the fiscal year ended March 31, 2010, we participated in the planning of "The Smart House Verification Project" commissioned by the Ministry of Economy, Trade and Industry (METI) in an effort to determine the feasibility of optimal operation control systems that use three batteries. In the fiscal year ending March 31, 2011, in order to accelerate development and raise social awareness about smart energy houses, we constructed new residences for technical assessment (at our laboratory at Torishima, Konohana-ku, Osaka City), and experimental dwelling residences (Oji, Kitakatsuragi District, Nara Prefecture), where we plan to demonstrate the underlying technology and verify their advantages. So that "smart energy houses" can be launched in the shortest possible time, we are planning to conduct verification tests until the end of the fiscal year ending March 31, 2014 and to complete technical development to the level of practical use in 2015.




#### ◆ Residential Solid Oxide Fuel Cells (SOFCs)

Following the release of the "ENE-FARM" residential fuel cell cogeneration system, the Company has joined forces with Kyocera Corporation, Toyota Motor Corporation and Aisin Seiki Co., Ltd. to co-develop solid oxide fuel cells (SOFCs) for households. SOFCs generate power very efficiently (LHV standard: 45%), and therefore, households with a relatively low thermal demand can enjoy the environmental and economic benefits. As the power-generating unit is compact, it can be installed in residences where space is limited, such as detached homes and apartments. In the fiscal year ended March 31, 2008, the Company joined in the planning of an experimental study that was conducted by The New Energy Foundation. By the fiscal year ended March 31, 2010, a total of 80 units had been installed and operated in actual residences for the purpose of collecting various data. This project will leverage the technology and know-how of the co-developers, with the market launch of SOFCs scheduled sometime before 2015.


Residential solid oxide fuel cells (SOFCs)

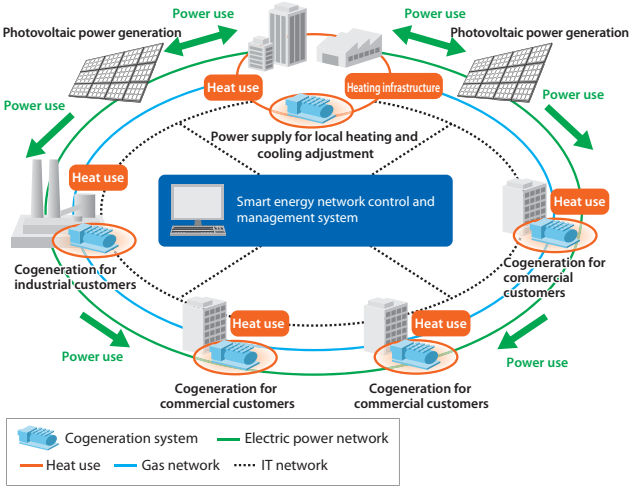
### Efforts to Increase Energy Efficiency in the Community

#### ◆ Smart Energy Networks

A smart energy network is a system that leverages information technology to optimally control energy demand by combining multiple power sources including renewable energy and

cogeneration to share electricity and heat among consumers in a mutually accommodating manner. The system aims to achieve the efficient use of heat (which accounts for more than 50% of final energy consumption), harmony between the grid and dispersed systems and the active utilization of renewable energy in order to facilitate significant energy savings and $CO_2$ emission reductions within communities that are linked by information and communications technology.

The Company commenced construction of the network in May 2010 and will gather and analyze data and conduct system improvements. In this experimental project, photovoltaic units installed in four locations and five customer cogeneration systems have been linked together around an existing district heating and cooling facility (the Iwasaki Energy Center). Remote monitoring and control will be conducted based on the interchange of electrical power while heat is utilized at each site. Through this project, we expect to achieve $CO_2$ emission reductions of approximately 30%.




## Solar Cooling: Solar-Powered Air-Conditioning Systems that Utilize Solar Energy

"Solar Cooling," solar-powered air-conditioning systems for commercial and industrial use, are systems that efficiently utilize solar energy to provide cooling in summer and heating in winter. In June 2009, the Company commenced verification tests within business facilities with the goal of system commercialization. The system is composed of a solar collector, which heats water by efficiently gathering solar energy and transforming it into a more usable form, and a gas absorption chiller heater with auxiliary waste heat recovery (GENELINK), developed as an exhaust heat utilization unit for the cogeneration system. The heated water produced by transforming solar energy is used as a thermal source for GENELINK in the summer, providing cooling through the production of chilled water. In winter, the warm water is used directly for heating. As the preferred thermal source is solar energy, the system is able to achieve highly energy-efficient space heating and cooling.

Solar heat collector system

Hot water (90°C)

Absorption GENELINK system

Natural gas

Use as cooler

Chilled water (7°C)

**Solar cooling enables approx. 30% energy-saving**

# Technology for Stable Gas Supply, Safety and Peace of Mind

The Company is working on technological innovations to provide customers with a safe and reliable supply of gas. In the fiscal year ended March 2010, the Company developed "sealed magnetic particle testing" as a new non-destructive testing method that will be used to examine discontinuities on the surface of spherical gas holders. Sealing suspension containing magnetic particles in a transparent inspection sheet eliminates the effects of flaws and other defects in the coating, thus removing the need to strip paint or perform other pre-treatments that were previously required in magnetic particle inspections. This method therefore facilitates the overall reduction of inspection time and shortens work time. The Company will continue to develop technology that improves safety and enables a stable gas supply.

Field test

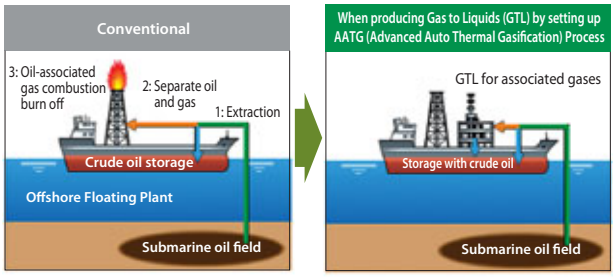
# Technology Development that Contributes to Environmental Conservation

## ◆ New Syngas Manufacturing Process (AATG Process)

Syngas ($H_2$ + CO) is manufactured using oil-associated gas as a raw material which has been conventionally combusted and discarded in large volumes. The gas is then turned into liquid fuel. This process facilitates the reduction of $CO_2$ emissions and the effective utilization of raw materials. The Company has worked in cooperation with JGC Corporation to conduct a pilot demonstration of this compact syngas manufacturing technology, Advanced Auto Thermal Gasification (AATG) Process, which is suited to offshore plants. The process capitalizes on the AATG characteristic of easy $CO_2$ recovery. As part of our campaign for commercialization of this process, we are currently proposing its adoption by Japanese chemical manufacturers who are planning to construct new facilities or refurbish existing ones as a means of manufacturing syngases used in chemical processes.

* The Japan Oil, Gas and Metals National Corporation (JOGMEC) commissioned the Company to conduct this research.

**Technologies that effectively use oil-associated gas**




- $CO_2$ emissions per year **600,000 tons-$CO_2$** (per offshore floating plant)

- $CO_2$ emissions per year **300,000 tons-$CO_2$ (−300,000 tons-$CO_2$)**
- GTL production (extra crude production) **+3,000 barrels/day**

Note: Oil fields size 10,000–100,000 barrels/day

AATG Pilot Equipment (Experimental)

## ◆ Coal Mine Methane (CMM) Enrichment Technology

In our quest to contribute to the fight against global warming, we have developed "coal mine methane (CMM) enrichment equipment," which enables coal extraction-associated low-concentration methane gas that is released into the atmosphere to be enriched and effectively utilized as cogeneration and boiler fuel, as well as other uses. We have succeeded in conducting a verification test using pilot equipment at the Fuxin Coal Mine (Liaoning Province, China)*. Since the fiscal year ended March 31, 2010, we have been working to further improve performance and reduce costs, aiming for early launch onto market. The equipment leverages the Company's materials technology, which enables selective adsorption of methane from a mixed gas composed of air and methane.

* New Energy and Industrial Technology Development Organization (NEDO) Collaborative Research Project for fiscal years ended March 31, 2008 and 2009.

Low-concentration CMM (coal mine methane) enrichment equipment (verified)

## ◆ Energy-Creating Wastewater Treatment Process (Hydrothermal Gasification Process)

The Company is currently developing technology that will facilitate wastewater treatment through the breakdown of industrial effluents — which had been impossible with conventional biological treatment methods — using a hydrothermal gasification process, while facilitating the creation of methane for use as fuel. Pilot plants have been established in semiconductor foundries and demonstration operation is scheduled to commence in November 2010. Going forward, we will commercialize this technology as a wastewater treatment process for similar types of chemical plants.

## ◆ High-Efficiency Methane Fermentation Technology (Methasolution) that Utilizes Sludge and Raw Garbage

The Company has developed new technology for turning waste into highly efficient biogas, which can then be used as a renewable energy source. The Company has employed its own unique resin reforming technology and ultra-high temperature solubilizing technology (registered trademark: Methasolution) to break down and ferment "whole" garbage and plastic bags used to hold garbage in a short period of time.

# Efforts to Improve Services and Enhance Productivity through the Observation of Human Behavior

In the past, services relied heavily on human experience and intuition. Now, however, we are engaged in research on and promotion of "service science" to enhance productivity through the adoption of scientific methods. These methods have already produced many successful results in the form of a consignment business, including the sharing of sales and marketing know-how, the development of store layouts that facilitate easy product selection by customers and productivity enhancement through the creation of workplace environments that are easy to work in — all based on the observation of human behavior. The Osaka Gas Human Behavior Observation Research Center was established in July 2009 to promote the dissemination of service science, which employs behavior observation methods. We are working to expand the human observation business throughout the Group.

# Intellectual Property Activities of the Osaka Gas Group

## Intellectual Property Strategy

We believe that technology development is an important foundation for growth. For this reason, we have set down the following three basic policies on intellectual property activities and are taking active steps to implement them.

### Reinforce intellectual property rights acquisition in important technology areas

We are working to reinforce acquisition of intellectual property rights capable of helping to strengthen business operations in areas of strategic management importance for the Group now or in the future, including residential energy systems.

### Promote open innovation through utilization of intellectual property

In actively disclosing technologies in which we are proficient outside the Company and effectively implementing technologies which have a competitive advantage, we promote open innovation through maximum utilization of our intellectual property as key technologies.

### Strengthen intellectual property throughout the Group

We are currently working to strengthen intellectual property throughout the Group by creating a common infrastructure for intellectual property expertise within the Group that covers areas such as risk management and personnel development.

## Strategic Patent Applications

The Group has been developing strong rights coverage by identifying the extent of rights that must be obtained, centering on key technological areas, and then submitting patent applications. To that end, we have employed various methods including patent portfolio management. In particular, we are strategically filing patent applications in technologies related to cogeneration systems for households such as fuel cells.

In the fiscal year ended March 31, 2010, the Group submitted 449 patent applications.

**Patent applications by the Group** (Applications)

| 06/3 | 07/3 | 08/3 | 09/3 | 10/3 |
|---|---|---|---|---|
| 471 | 407 | 390 | 353 | **449** |

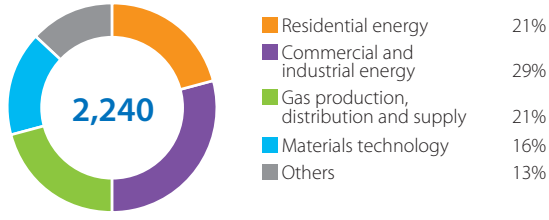
## Patents Held by the Group and their Use

At the present time, in the area of energy for households, the Company holds patents in technologies including cogeneration systems and mist saunas. In the area of commercial and industrial energy, we hold patents in such technologies as cogeneration systems and gas air conditioners. In the production, distribution and supply area, we hold patents in technologies including LNG tank technologies and non-excavation pipeline installation methods. Furthermore, in the materials technologies area, we hold patents in fine chemicals and other related technologies.

Patents are utilized in the Company's businesses, and also actively licensed to other companies. As of March 31, 2010, 2,240 patents were held Group-wide.

**The Group's patent portfolio by business type**

(As of March 31, 2010)




## Intellectual Property Risk Management and Related Personnel Training

In order to reduce intellectual property risk for the Group as a whole, we continue conducting risk reviews and plan to standardize review systems and widely share information, the foundation of intellectual property activities. We also conduct intellectual property training and awareness-raising activities so as to raise the knowledge level of Osaka Gas Group employees. These varied activities include training sessions run by instructors from inside and outside the Company for different objectives and employee ranks, and publication of an email magazine that includes intellectual property news and administrative reminders.