

**Development of “SOLAMO”, the gas hot water system
with combined use of solar heat for condominiums**

Main author

M. Ohishi

Tokyo Gas Co., Ltd

Co-author

T. Tsuneki

Tokyo Gas Co., Ltd

**Kazuyoshi Toriumi
Gastar Co., Ltd.**

F. Yabe

Noritz Corporation

N. Takahashi

Yazaki Energy System Corporation

Hiroya Hamano

Sankyo Tateyama, Inc. SankyoAlumi-Company

M. Nasu

Rinnai Corporation

JAPAN

1. Abstract

Recently, the energy saving level required for household equipment has been rising year after year to help create a low-carbon society, and the diffusion of renewable energy is accelerating with the support of the Government of Japan, the Tokyo Metropolitan Government, and so on. The gas industry has focused on integrating gas and renewable energy, and Tokyo Gas has developed SOLAMO: a gas-fired hot water system utilizing solar heat. With this system, part of the domestic heat demand for hot water and heating can be covered by solar heat. We commercialized the first SOLAMO system starting in 2010, and there are now four systems for detached houses and three systems for condominiums being marketed today.

The SOLAMO system consists of a solar collection unit, a hot water tank unit that stores solar heat, heat transfer pipes connecting these units, and also a remote control panel to operate the equipment. Every system has a highly efficient latent heat recovery type gas water heating system called Eco-JOES, and comes with a mode that allows hot water to be heated by solar power alone. When sufficient heat is not available due to the weather, the gas water heater can provide hot water instantly at any time. Moreover, the remote control panel features a solar heat monitor and a display that indicates the solar heat collection status in real time, helping users to perceive that they are using solar energy.

In Tokyo, the percentage of newly built housing in the form of condominiums was over 70% in 2012, and this will continue to increase. The installation of environmental preservation equipment on condominiums will provide the key to increasing the amount of renewable energy use in the future. In our company, we market two systems that have heat collection units built into the handrails of balconies and one system that has heat collection units for resident private use installed on the rooftop deck of a condominium. In this paper we report the specifications and features, the amount of solar heat collection, and so on, for each SOLAMO system for condominiums.

TABLE OF CONTENTS

- 1. Abstract**
- 2. Introduction**
- 3. Major Specifications and Characteristics of Each System**
 - 3.1 SOLAMO system for installation on balconies of newly built condominiums**
 - 3.2 SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium**
- 4. Summary**
- 5. References**
- 6. List of Tables**
- 7. List of Figures**

2. Introduction

In order to create a low-carbon society, the required level of residential energy efficiency increases every year, and government, including the municipal and national levels, is accelerating the promotion of renewable energy. In particular, the Tokyo Metropolitan Government has set a goal of reducing greenhouse gas emissions in Tokyo to 25% below 2000 levels by 2020 with the promotion of renewable energy and so on.¹

The gas industry has focused on integrating gas and renewable energy, and Tokyo Gas has developed the SOLAMO gas-fired hot water system utilizing solar power. With this system, customers can cover part of their domestic thermal demand for hot water and heating using solar heat. Since its release in 2010, we have created a lineup of four systems for detached houses and three systems for condominiums.

According to a statistical survey by the Ministry of Land, Infrastructure, Transport and Tourism, the condominium form accounted for about 70% of new housing built for sale in Tokyo in the 2013 fiscal year.² In the future, this ratio will continue to increase. In terms of the amount of renewable energy, it is important to install SOLAMO in condominiums.

The Tokyo Metropolitan Government is implementing a 2-billion-yen project to assist in the promotion of hot water systems using solar heat for condominiums during the five years from the 2011 to 2015 fiscal years. Homebuilders who install systems using solar heat can receive a subsidy of half the equipment and construction cost up to 500,000 yen per home.

The Resources and Energy Agency has also subsidized business operators utilizing heat from renewable energy, and the number of subsidies for installing systems using solar heat has been increasing recently.

We have a lineup of two systems for installation on the balconies of newly built condominiums and one system that has a heat collection unit for resident private use installed on the rooftop deck of a condominium. In these systems, one of the systems for installation on the balconies of newly built condominiums has already been presented, at the International Gas Union Research Conference 2011.³

The present report outlines the major specifications and characteristics of the other two systems.

3. Major Specifications and Characteristics of Each System

3.1. SOLAMO system for installation on balconies of newly built condominiums

The SOLAMO system for installation on the balconies of newly built condominiums was released in October 2011. Table 1 shows the specifications of the system, and Figure 1 shows the appearance of the system.

Table 1 Major specifications of SOLAMO system for installation on balconies of condominiums

Hot water storage unit	Type: TFT-C11DRS-AWC Tank volume: 90 L Heat collection method: Forced circulation of heat transfer liquid Application of solar heat: Hot water supply Size: H 1690 mm × W 720 mm × D 300mm (When combined with water heater)
Water heater	Eco-JOES system (42 kW class highly efficient latent heat recovery type gas water heating system)
Heat collection unit	Type: TYS-S3011DVK3 series Type of collector: Flat type Tilt angle of collector: 90°(vertical) Surface of collector: Approx. 3 m ² (1 m ² × 3 sheets) PV panels : 4.3W × 2 sheets (serial connection) * Collectors are built into the handrails of balconies. * Unit has PV panels to drive heat collection pump.
Remote control panel	Type: TFKR11ABDE2GIJSV * Remote control touch panel equipped with solar heat monitor. * Switching mode that allows hot water to be heated by solar power only.



Figure 1 Appearance of SOLAMO system for installation on balconies of condominiums

The development concept was to reduce CO₂ emissions by using solar heat and installing hot water storage units in condominiums as well as heat collection circuits for floor heating. Until the release of this system, solar heat energy had been used for only the hot water supply, but with this system, solar heat energy can be used for floor heating.

The specifications of the heat collection unit are the same as the system reported previously. The tank unit volume of 90 L and 300-mm depth were developed in order to install the system easily. A remote control panel was developed, which has easy-to-use arrow keys and a solar heat monitor to check the energy balance.

In this system, if the solar isolation exceeds a given amount during the use of floor heating, the switching valve of the heat collection circuit is switched from the tank to floor heating in order to preferentially use the solar heat for the floor heating. If the amount of solar isolation is not sufficient to use the floor heating, the combustion heat of gas is also used for the floor heating.

The amount of solar heat used for floor heating depends on a number of conditions. For example, if the floor heating is used in a living room of approximately 20 m² from 7:00 a.m. to 11:00 p.m. on a sunny day in winter, solar heat can be used for the floor heating from 9:00 a.m. to 2:00 p.m. In this case, the floor heating can be used with the use of only solar heat without gas consumption for about two-and-a-half hours from 11:30 a.m. to 2:00 p.m. In fact, solar heat covers half of the amount of floor heating, and can be stored as 40°C hot water.

The system can reduce CO₂ emissions by about 29% per year compared to conventional hot water heaters by adding the effect of Eco-JOES.

3.2. SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

Figure 2 shows an image of the SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium.

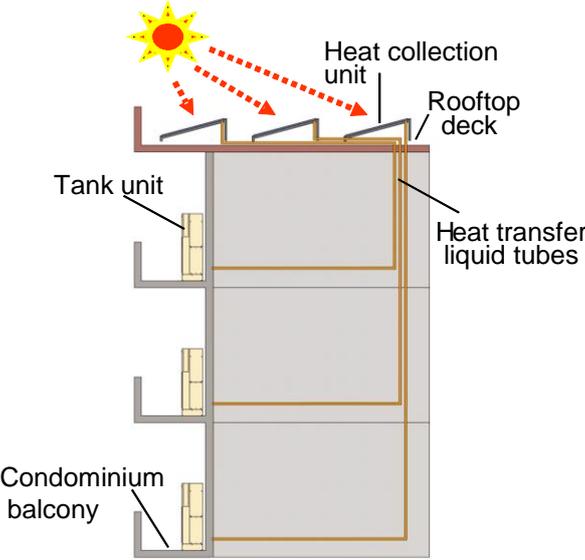


Figure 2 Image of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

The heat collection units are installed on the rooftop deck of the condominium and connected to the tank units installed on the balconies of each resident. In fact, the collection units are dedicated for the private use of the residents.

The solar heat collection pump is powered by solar isolation and the heat transfer liquid is heated at the heat collection unit. The heat transfer liquid flows to the tank unit in tubes and the water in the tank unit is heated by heat exchange with the liquid.

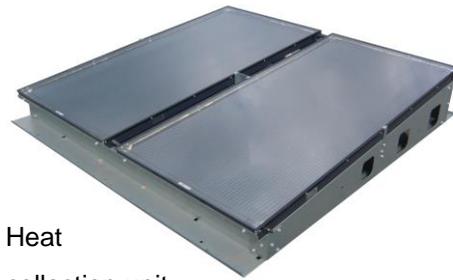
Table 2 shows the major specifications of the SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium, and Figure 2 shows the appearance this system.

Table 2 Major specifications of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

Hot water storage unit	Type: TI-C12D Tank volume: 100 L Heat collection method: Forced circulation of heat transfer liquid Application of solar heat: Hot water supply Size: H 1900 mm x W 480 mm x D 650mm (When combined with water heater)
Water heater	IT4211 series (42 kW class latent heat recovery type) Highly efficient gas water heating system *Capable of separate settings from hot water storage unit.
Heat collection unit	Manufacturer: Yazaki Energy System Corporation Type: GSC-H220 Type of collector: Flat type Tilt angle of collector: 5° Surface of collector: Approx. 4 m ² (2m ² x 2 sheets)
Remote control panel	Type: TIKR09A-BE2GISV * Remote control touch panel equipped with solar heat monitor. * Switching mode that allows hot water to be heated by solar power only.



Tank unit and heat source equipment



Heat collection unit



Remote control panel for kitchen

Figure 3 Appearance of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

The system was designed with a family of three in mind, as a system for installation on a balcony. The 100 L volume tank was developed taking into account the working space and so on. On the assumption that the tank unit is installed in a common passageway, the tank can be separated from the water heater. The water heater is an Eco-JOES high-efficiency 42 kW class latent recovery type gas water heating system. If the solar isolation is not sufficient because of bad

weather, the gas water heating system temporarily supplies hot water. In fact, the hot water can be used at any time without a negative effect on convenience.

In the standard collection unit installed on the rooftop deck of the condominium, the collector is integrated with the mount. The tilt angle of the collector is 5° and the surface of the collector is approximately 4 m² (2 m × 2 sheets).

A remote control unit was developed based on the touch panel type EneLook remote controller, which displays gas, water, and electricity consumption on the remote control panel. On the display, users can check the solar heat usage status (solar heat monitor), heat collector indicator, hot water storage level indicator, reduction in gas consumption, and reduction in CO₂ emissions made possible by the SOLAMO system.

In addition, by turning off the switch, users can change the mode to use hot water heated only by solar power when using lukewarm water for washing hands, dishes, and so on.

Compared with a system for installation on a balcony, this system has several merits. For example, the system is less affected by the shadows of other buildings and less dependent on the azimuth direction, does not affect the appearance of the building, and is not dependent on the handrail design of the balcony. In addition to these merits, the amount of solar heat collected by the system is greater than that with a system for installation on a balcony because of the difference of the tilt angle and the surface area of the collector. In fact, this system can reduce CO₂ emissions by about 37% per year compared to conventional hot water heaters, with the addition of the effect of Eco-JOES.

On the other hand, the system has some drawbacks. For example, there is significant heat loss from the heat transfer liquid tubes, and it is difficult to connect the tubes to the rigid tubes and penetrating segment of the compartment and so on.

4. Summary

SOLAMO was developed in order to integrate renewable energy and gas-fired hot water supply systems using solar power.

SOLAMO systems for installation on the balconies of newly built condominiums and a system with heat collection units for resident private use installed on the rooftop deck of a condominium have been released, and these systems will be further developed depending on future customer needs.

5. References

- 1) Bureau of Environment, Tokyo Metropolitan Government, March 29, 2012. 2012 Enforcement Status

of the 10-year Project for a Carbon-Minus Tokyo.

- 2) Construction Research and Statistics Office, Policy Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 30, 2014. Statistical Survey Report on Building Starts.
- 3) Sazanami, Y., et al., (2011). Development of “SOLAMO” Gas Hot Water System with Combined Use of Solar Heat. Proceedings of the International Gas Union Research Conference 2011, Volume 4, pp. 2537-2552.

6. List of tables

Table 1: Major specifications of SOLAMO system for installation on balconies of newly built condominiums

Table 2: Major specifications of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

7. List of figures

Figure 1: Appearance of SOLAMO system for installation on balconies of condominiums

Figure 2: Image of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium

Figure 3: Appearance of SOLAMO system that has heat collection units for resident private use installed on the rooftop deck of a condominium