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PERFORMANCE OF SOLAR AIR-CONDITIONING SYSTEM USING SOLAR ABSORPTION CHILLER IN INDONESIA

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1. Introduction

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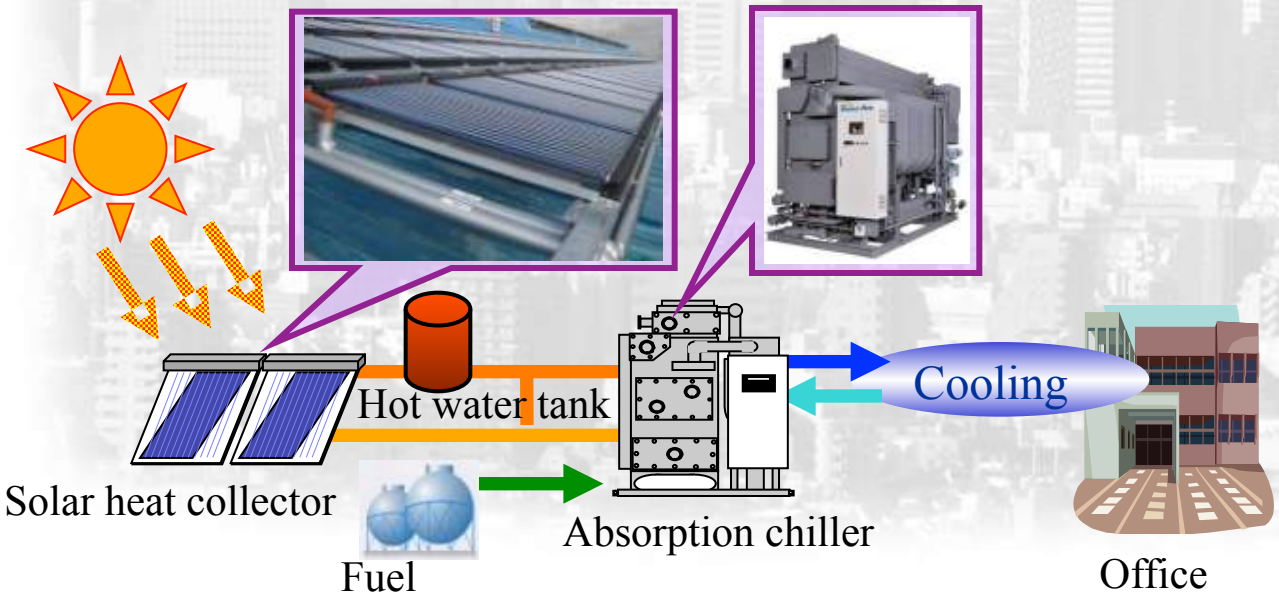
This project includes detailed design of cooling absorption system utilizing solar energy, and also local workshops for possible business expansion in Indonesia.

"Entrusted business on the technical cooperation for solar aided air-conditioning system in Indonesia started in 2013." sponsored by Ministry of Environment Japan.

Solar Cooling System in University of Indonesia (UI) has been used since Jan. 2014



New Building in University of Indonesia

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2. Solar Absorption Chiller

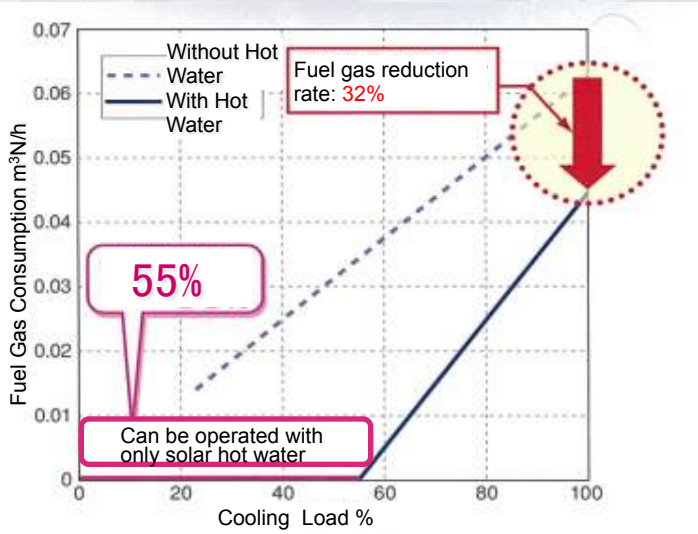
#2

We have developed the absorption chiller utilizing a solar power. Since our developed absorption chiller utilizes solar energy which is renewable, it contributes to energy saving and minimizing CO2 emission.

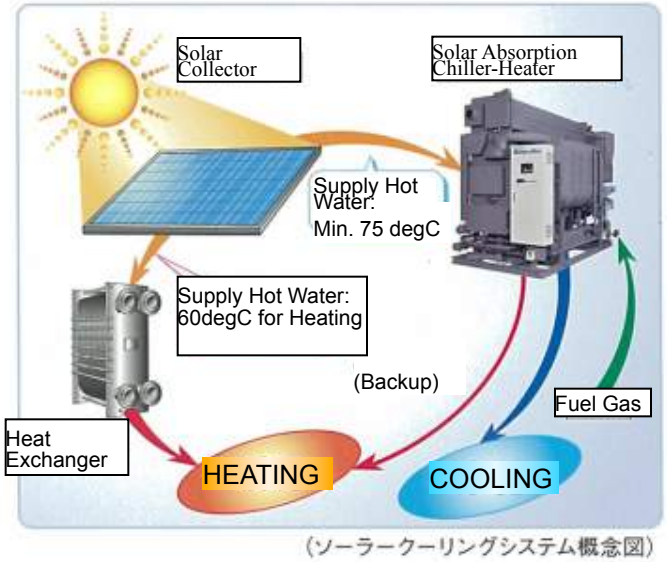
Drastic reduction of fuel consumption

Fuel gas reduction rate: 32%
(at the rated point):

Can be operated by 55% load with only solar hot water



Lowest temperature of solar hot water supplied to the chiller: 75 degC



(ソーラークーリングシステム概念図)

2. Solar Absorption Chiller

Basic Specification of Solar Absorption Chiller

			Solar absorption chiller-heater	
			Inlet tenmp. of hot water :90℃	Inlet tenmp. of hot water :75℃
Coefficient of performance (COP)	With hot water	–	1.91	1.43
	Without hot water	–	1.30	1.30
Heating efficiency	(Without hot water)	–	0.86	0.86
Chilled water	Inlet-Outlet temp.	℃	15.0→7.0	15.0→7.0
	Flow rate	$m^3/(h \cdot RT)$	0.378	0.378
Cooling water	Inlet-Outlet temp.	℃	32.0→37.6	32.0→37.2
	Flow rate	$m^3/(h \cdot RT)$	1.00	1.00
Hot water	Inlet-Outlet temp.	℃	90.0→79.5	75.0→71.9
	Flow rate	$m^3/(h \cdot RT)$	0.115	0.115
Heat recovery rate		kW/RT	1.40	0.41
Energy saving rate		%	32	9
Max. cooling capasity onli hot water heating		%	55	28

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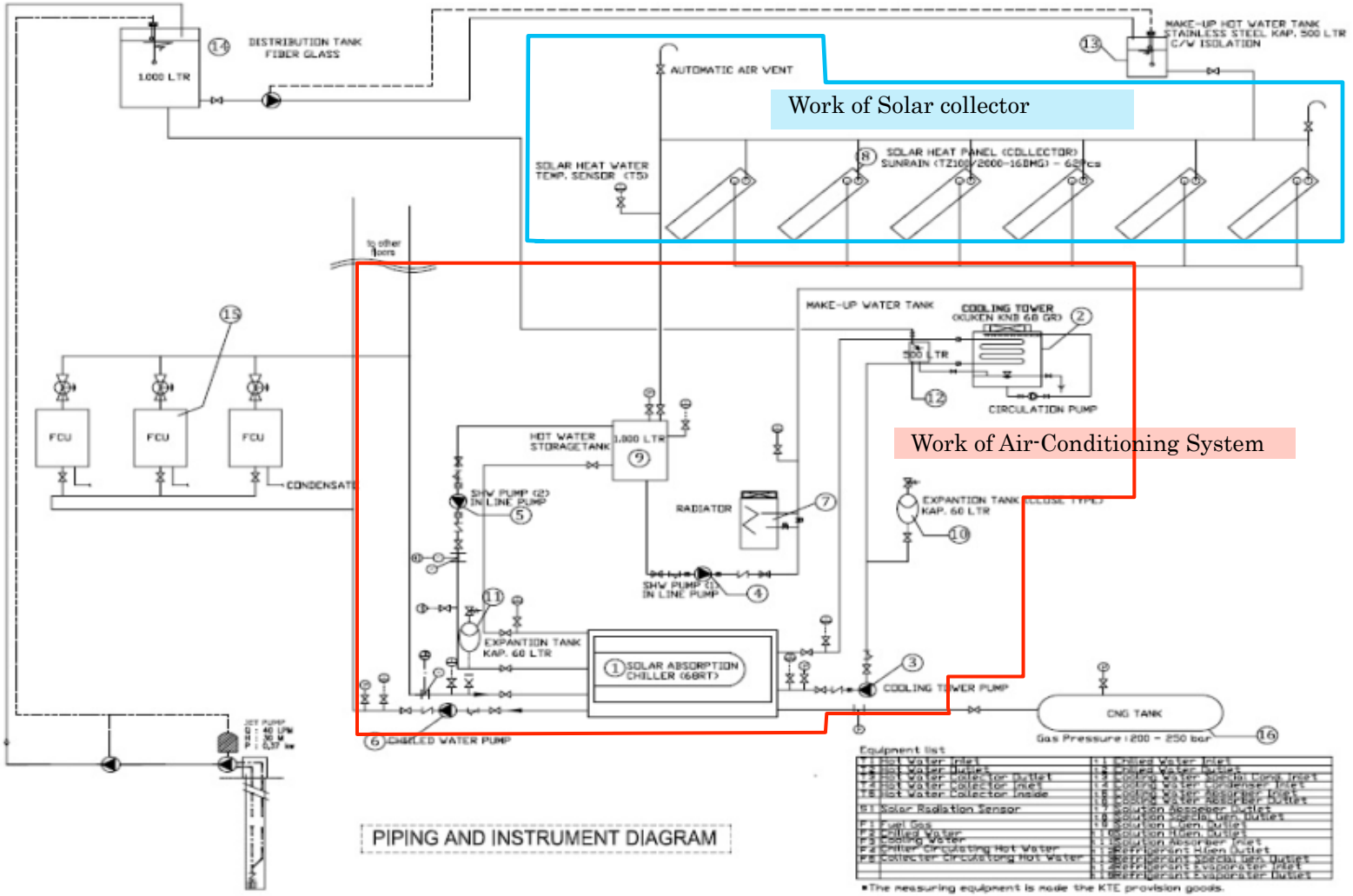
3. Solar Air-conditioning System

#4



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3. Solar Air-conditioning System

Work of Air-Conditioning System






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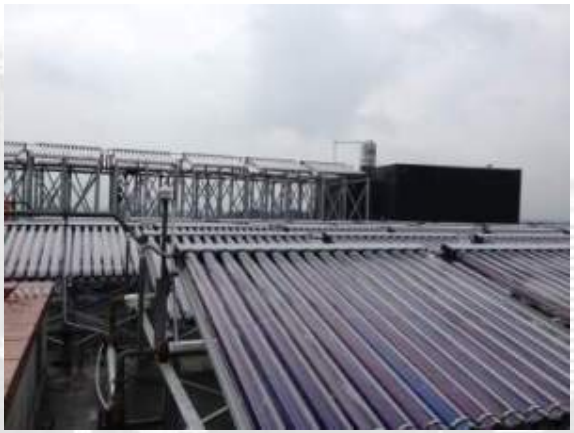
3. Solar Air-conditioning System

Work of Solar Collector



4. Estimation

Verification of the effects relating to a test done in the University of Indonesia regarding solar cooling absorption chiller system utilizing solar energy.(1)

Comparison equipment specification

	Solar absorption chiller	Conventional electric chiller
Chiller	Solar absorption chiller x 1 Capacity 281kW Fuel gas consumption:(Hh=9080kcal/m^3_N) With solar using :14.0m^3_N/h Not solar using:20.5m^3_N/h Electricity consumption:2.25kW	Electric chiller x 1 Capacity 281kW Electricity consumption: 70.25kW(COP=4)
Facility	Solar hot water pump No.1:1.5kW Solar hot water pump No.2:0.75kW Radiator:1.5kW	

Comparison between solar absorption chiller and conventional chiller【RP basis】

		Electric chiller	Solar absorption chiller
Amount of Energy	Electricity	183,600 kWh	16,369 kWh
	Fuel gas	- m^3_N	45,974 m^3_N
Energy cost	Electricity	181,257,972 RP	16,535,437 RP
	Fuel gas	- RP	96,085,660 RP
	Total	**181,257,972** RP	**112,621,097** RP
	Difference	-	-68,636,875 RP
	rate	100 %	62 %
CO_2emission	Electricity	183,049 kg-CO_2	16,320 kg-CO_2
	Fuel gas	- kg-CO_2	88,730 kg-CO_2
	Total	**183,049** kg-CO_2	**105,050** kg-CO_2
	Difference	-	-77,999 kg-CO_2
	rate	100 %	57 %

4. Estimation

Verification of the effects relating to a test done in the University of Indonesia regarding solar cooling absorption chiller system utilizing solar energy.(2)

Assessment in the entire Indonesia

1. In one year

- **CO2 reduction ⇒ 94,000 tCO2/year**
- **Sox and Nox reduction ⇒ Sox 1.5 t/year ,Nox 0.85 t/year**

2. Ten fiscal years

- **CO2 reduction ⇒ 940,000 tCO2/year**
- **Sox and Nox reduction ⇒ Sox 15 t/year ,Nox 8.5 t/year**

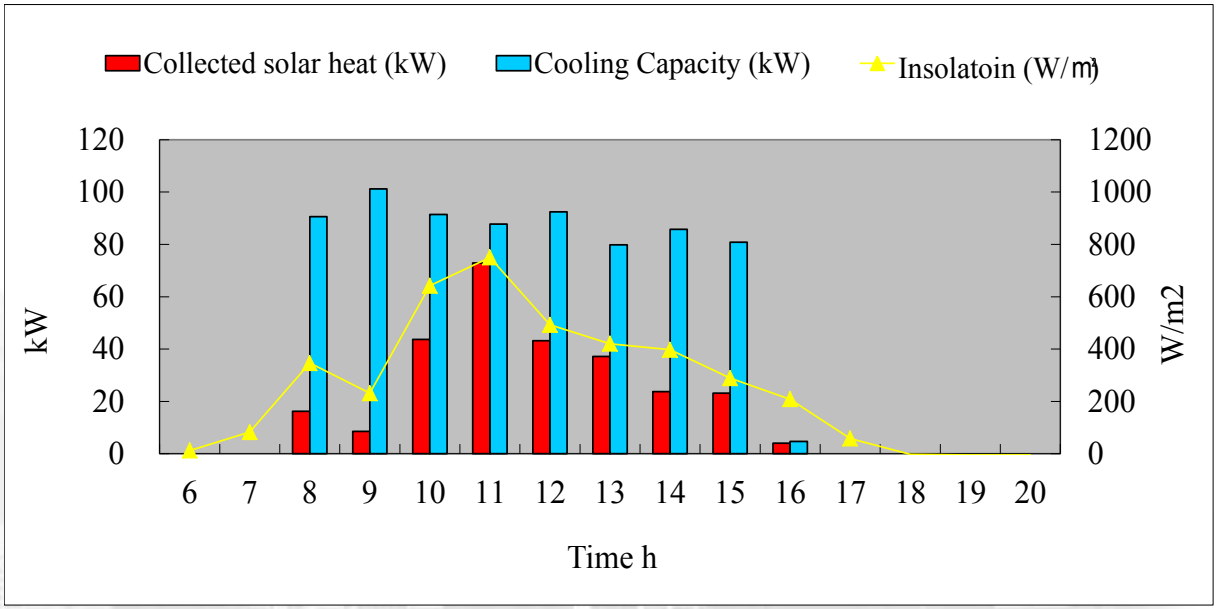
※When assuming that the like quantity is introduced after year second. The effect triples in year third., ten in year tenth.

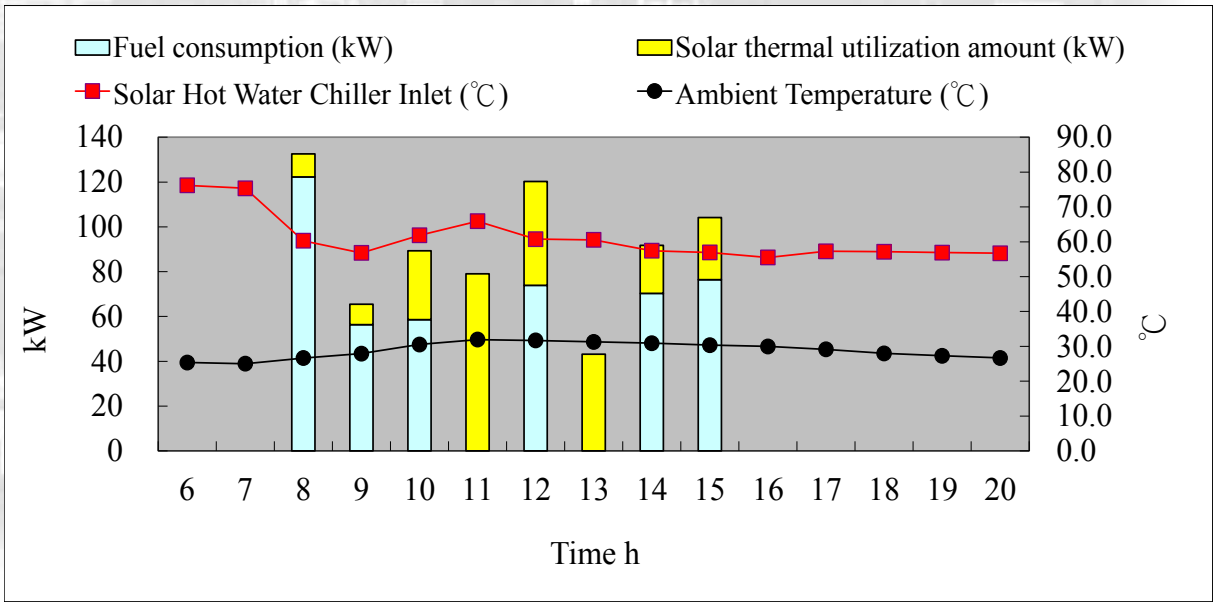
3. Trial condition

- **The following sectors are prospective introduction sites: industrial sectors with full gas utilities, commercial sectors, government and public offices, hospitals, and hotels.**
- **By considering the introduction ratio of gas absorption chillers for central air conditioning in the above sectors in Japan, we aim to introduce 100 units of 96,000 USRT (340,000kW) yearly starting 2015 as a reference target for the introduction amount.**

5. Test Result

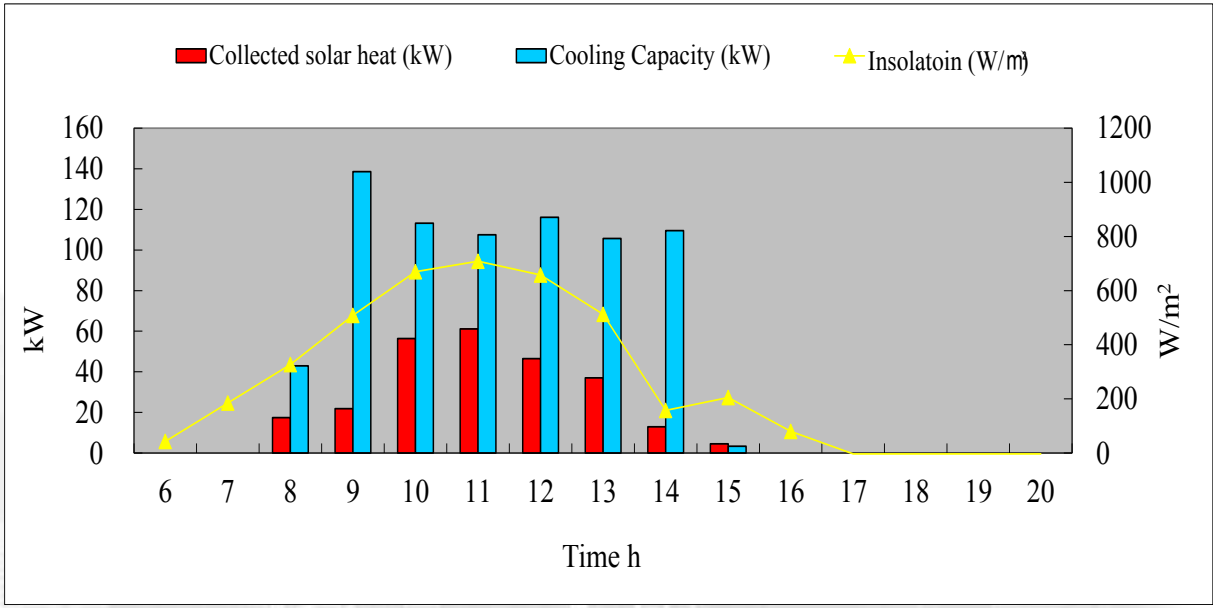
- 14th Feb. 2014
- hot water obtained from the solar energy collector is used at 60～75℃
- Enabled gas amount to be reduced by 26.5%

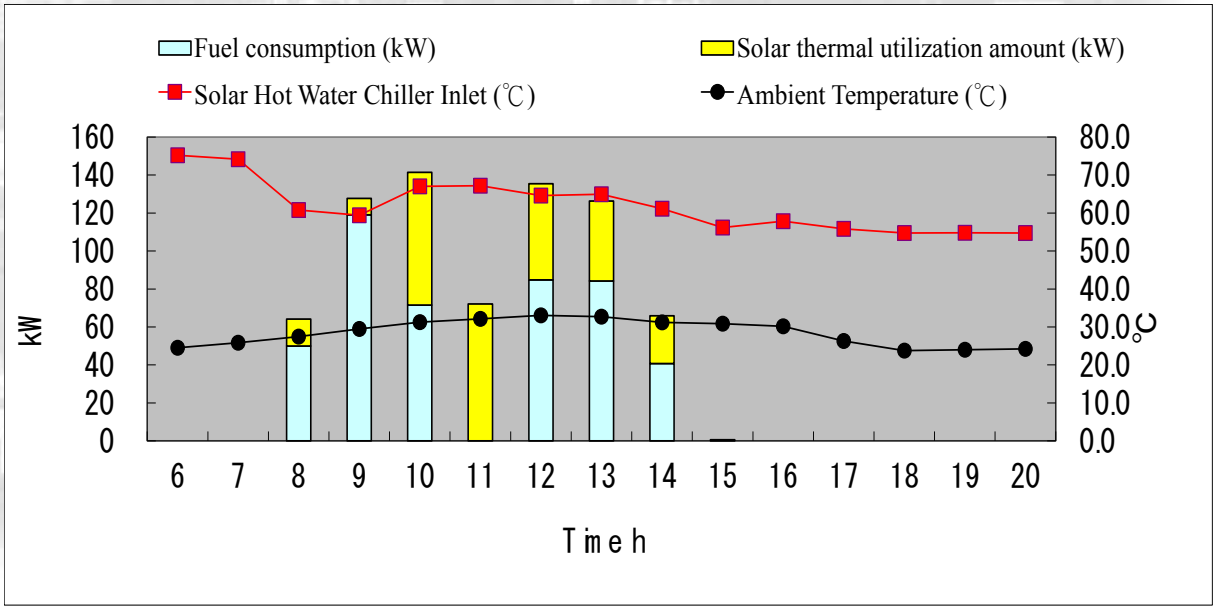




5. Test Result

- 20th March 2014
- hot water obtained from the solar energy collector is used at 60～67℃
- Enabled gas amount to be reduced by 27.9%





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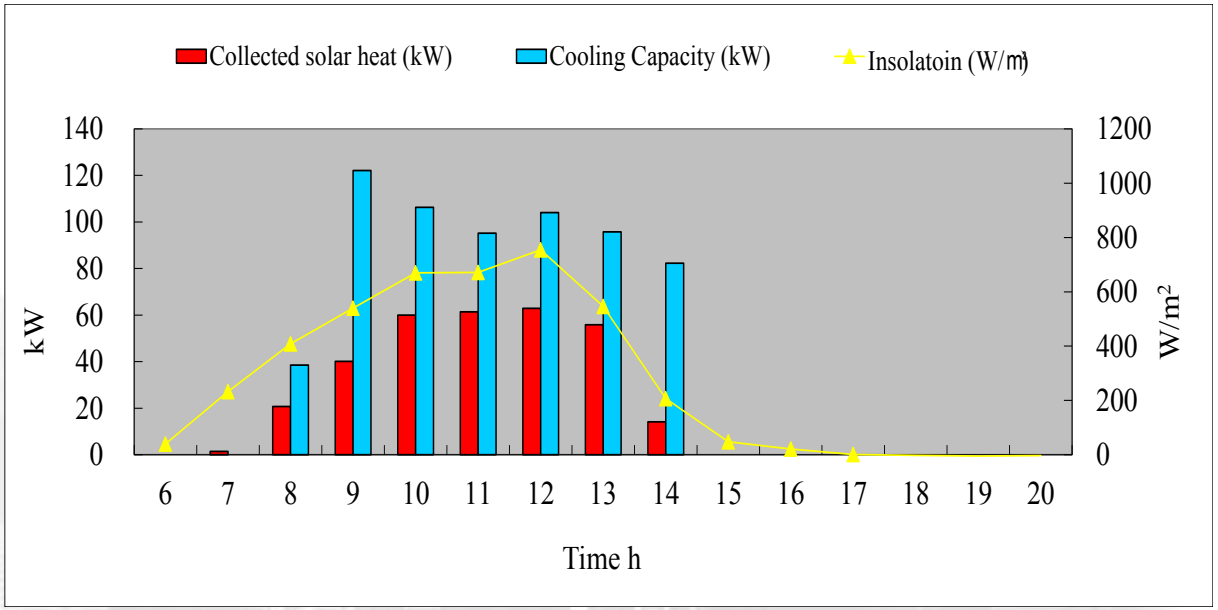
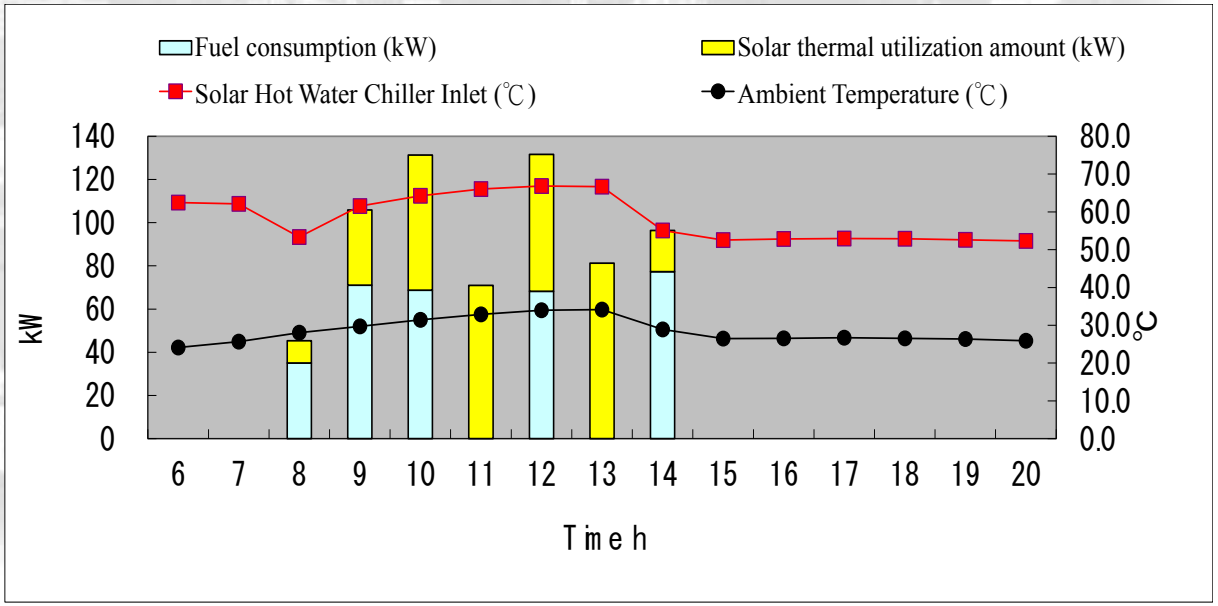
5. Test Result

- 17th April 2014
- hot water obtained from the solar energy collector is used at 55～69℃
- Enabled gas amount to be reduced by 39.7%





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Thank you very much!