Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

ANALYSIS OF SOLAR HOT WATER HEATER AND STEAM GENERATOR USING CYLINDRICAL CONCENTRATOR WITH ACTIVE TRACKING AND DATA UPDATE

[1]Ankush R Dawand, [2]Anup E Ghurde, [3]Dr. Sachin karale
[1] PG Scholar Dept. of Mechanical Engineering G H Raisoni University Amravati
dawandankush@gmail.com

Abstract:- Steam generation with low costs and high energy efficiency is critical for reducing water pollution during an energy crisis. However, there are numerous barriers to practical energy utilisation for solar steam gen eration.Our systematic invitation provided a clearer understanding of how to improve the steam generation rate in this review. Including improving light absorption, Reducing heat loss optimizing water supply. This article aims to make a comprehensive review solar water heater and steam generator using cylindrical concentrator with activeDevice for data tracking and updating. The solar radiance can be incident directly on the cylindrical Reflector that is connected to the water reservoir by using an active tracking device.
The electronic control unit will provide precise and realtime readings. Furthermore, by using a data updater dev ice, previous recordings will be kept accurately. Concentrating collectors absorb solar energy and convert it into heat to generate hot water or steam at the required temperature, which can then be used for thermal applications .The developing countries like India where solar energy is abundantly available; there is need to develop technology for harnessing solar energy for power production.

Index Terms- Active tracker ,Battery panel, Cylindrical reflector ,Copper wire at collector ,Display, Gravity flow fluid ,Manual Data ,Micro- controller, Motor driver, Photo sensor.

I. INTRODUCTION

Increasing Population, urbanization and industrialization demands energy at a higher rate. India is facing a serious problem of meeting adequate energy supply to customers at reasonable cost . In recent years the world is concerned about end lasting energy supply problem. If the world goes on using the traditional fuels only. It is most likely that the world will have all development activities and the human civilization will come to a stagnant position after some days. Under such circumstances, solar thermal technology can make a major Contribution to the use of solar energy in place of fossil fuels.
Solar radiation is a promising renewable energy source because the hourly incident solar flux on the earth's sur face exceeds annual global energy consumption.
Efficient solar energy harvesting for steam generation is critical for a wide range of applications, from large-scale power generation, absorption chillers, and desalination systems, to compact applications like water purifi cation, sterilisation, and hygiene systems in remote areas where the sun is the only abundant energy source.
Current solar energy generation methods rely on a surface or cavity to absorb solar radiation and transfer heat to the bulk liquid directly or via an intermediate carrier fluid, which requires high temperatures.

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

The device will be more efficient. Solar heat at medium temperatures can be used in chemical, paper, textile, and food processing industries for drying, sterilising, cleaning, evaporating, steaming, and conditioning (heatin g and cooling) of industrial buildings. Hot water or low-pressure steam at medium temperatures (80
25) can be used for pre-heating water (or other fluids), household processes (washing, dyeing, etc.),
or solar system direct coupling.

II. PROBLEM STATEMENT

Solar radiation can be widely used for the generation of electricity and water heating purpose, as well as a supporting energy source for central heating installations. Commonly, water heating integrated systems for buildings have two parts: a solar energy collector and a water storage tank. The solar collector is the key Solar heating systems include this component. They collect the sun's energy, convert it into heat, and then transfer that heat to a fluid. Solar water heating mechanisms can be active or passive, but active mechanisms are more commonly used. The active mechanism uses pumps to move the liquid between the collector and the storage tank, whereas the passive mechanism relies on gravity and the natural tendency of heated water to circulate. The collector determines the performance of this solar system. The collector absorbs the maximum amount of heat from the sun and this energy is used for heating the water. However, in our most recent research project, we were able to obtain both water heating and steam generation. but optimize this technique it may very useful for future application. Thermal energy from a large amount of Total energy requirement at household and industrial purposes. By conventional means of getting thermal energy causes of air pollution breakout, also cost of such energy is higher. So the problem with conventional ways of thermal energy convention are pollution and limited availability of non-renewable energy sources and thus the cost of fuel.

III. OBJECTIVES

There are following objectives –

• To study the available literature and report on required topic,
• To study effectiveness of hot water generation using cylindrical reflector or collector.
• To Study Effectiveness of steam generator, • To Study active tracking system for experimental model.
• To Study the efficiency by conducting testing on experimental model • To analyze above objectives using real time data update.

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

IV. BLOCK DIAGRAM & WORKING PRINCIPLE

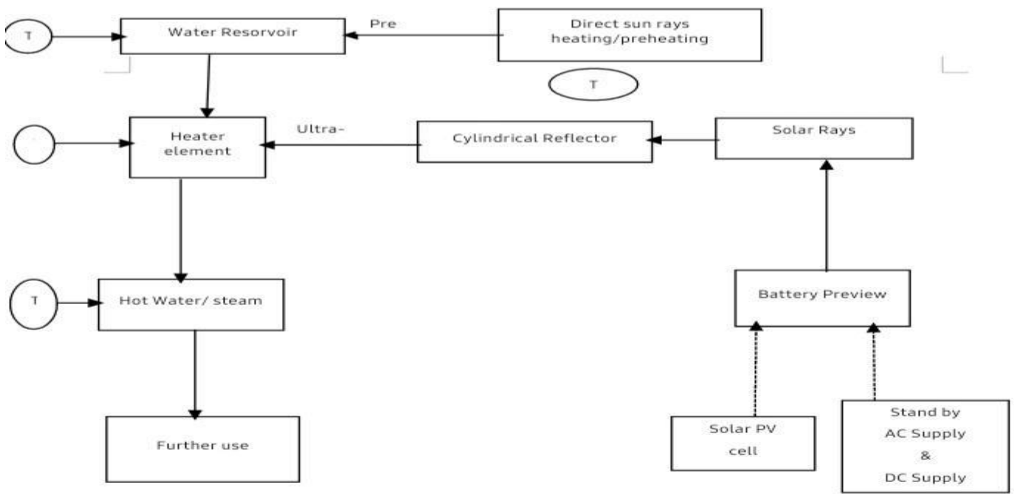


Fig 1- Block diagram of Proposed System

a) Following components are used for this Project:-

- Solar Panel
- PU Tube (Polyurethane Tube)
- Dry Cell lead acid battery
- Copper tube
- Jumper connecting wires and Ribbons
- Reduction Gearbox
- Output Shaft Gearbox
- Motor side Pulley Wheel
- Bronze Bush Bearing
- Sheet Foam

b) Working Principle:-In this project solar energy from the sun rays can be used in the form of thermal energy for the provided requirement points and uses. In this paper system there will be a semi cylindrical reflector use to direct incident solar rays to a concentrator.

• This concentrator in a simple copper pipe or tube. The project incorporates a water liquid reserve wire which will alone act as preheater. Liquid from this reservoir it's provided to the copper concentrator via regulator value for volume or flow regulation as per requirement.

• The incident solar rich are reflected by the semi cylindrical reflector to the copper concentrator which heat up the copper concentrator to very high extent.

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

• The liquid is regulated and allowed to flow through the concentrator copper pipe where heat is exchanged to the preheated liquid where the liquid air water gets hot and does the hot liquid or water can be optimized through the project by regulating the flow the same water can be converted to steam as well.

1. During day time the Sun rays and direction is continuously changing and these rays are incident on the reflector which it's always perpendicular to the base time where the efficiency of the system varies is throughout the day. 2. In this project we are using AC to tracking device which will attract the sunrise throughout the day and make it fall on the reflector which trap the Sun rates to the system more efficiently. For the purpose of copper photo sensor is made this photo sensor data is analyzed by an electronic control unit and directions of this reflector is manage accordingly.
3. Temperature reading at various point in the system will display.
4. This is how the system will work. This solar water heater and steam generation using active tracking device can be used in various purpose.

c) **Experimental Setup:-**Figure1 shows the fabricated solar water heater. The collector is tilted at an angle of 90 with respect to the horizontal plane. The ambient temperature, the inlet and outlet temperature from the collector were measured every hour from 8:00 am to 6:00 pm on two different days. It should be noted that incessant rainfalls prolonged test duration. The flow rate was determined by using a stopwatch and a calibrated container to obtain the volume of flow per minute. The hygrometer shows the humidity of water measure that also. This was done repeatedly

d) **Testing Procedure :-**

1. The solar water heater was positioned southwards to ensure reception of solar radiation throughout the testing period.
2. The storage tank was then filled with water using the buffer tank and connected flexible pipes.
3. The ambient temperature was recorded, and the initial readings of the inlet and outlet temperatures were taken from the attached thermometers and value of humidity were taken from hygrometer.
4. The inlet valve to the collector was opened to start the cycle.

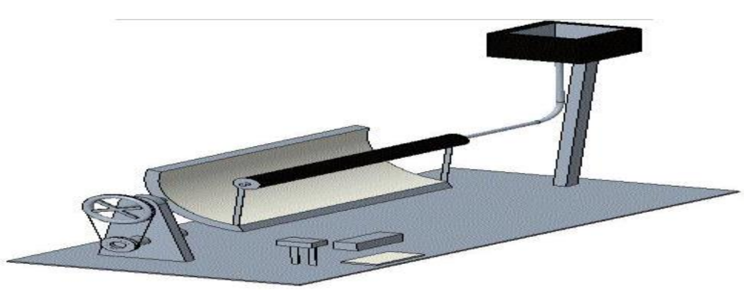


Fig 2 – CAD model of Proposed System

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

V. RESULT ANALYSIS & OBSERVATIONS

a) Observation With Active Tracking Device-

Observations of Solar Water Heater and Steam Generator Using Cylindrical Concentrator with Active Tracking device and Data Update are tabulated below.

Table1: Observation with tracking device

Time	**T1 Ambient Temp**	**T2 Inlet Temp Pre-heated Water**	**T3 Metallic Base Reflector Temp**	**T4 Temp of Receiver plate**	**Toutlet Outlet temp**		**Humidity**
					T5 Hot Water Temp	**T6 Steam**	
08:00	32°	33.5°	36.1°	85°	65°	Nil	54%
09:00	34°	35.6°	39.1°	98°	69.5°	100	48%
10:00	35°	36.5°	41.3°	98.5°	73°	100.1	43%
11:00	37°	38.5°	44.8°	99°	78°	100.2	39%
12:00	38°	39.8°	46.5°	99.5°	83°	100.3	34%
01:00	39°	41.2°	47.9°	100°	86°	100.4	30%
02:00	40°	41.3°	49.0°	102°	93°	100.6	29%
03:00	39°	41.0°	47.4°	100°	87°	100.4	28%
04:00	38°	39.9°	46.2°	98°	80°	100.3	27%
05:00	37°	38.7°	44.2°	95°	78°	100	29%
6:00	68°	37.5	42.6°	90°	74°	Nil	31%

b) Observation Without Active Tracking Device

Observations of Solar Water Heater and Steam Generator Using Cylindrical Concentrator without Active Tracking device and Data Update are tabulated below.

Table2: Observation without tracking Device

Time	**T1 Ambient Temp**	**T2 Inlet Temp Pre-heated Water**	**T3 Without Metallic Base Reflector Temp**	**T4 Temp of Receiver plate**	**T outlet Outlet temp**		**Humidity**
					T5 Hot Water Temp	**T6 Steam**	
08:00	32°	33.5°	36.1°	84°	65°	Nil	54%
09:00	34°	35.6°	38.1°	95°	68.5°	100	48%
10:00	35°	36.5°	40.3°	96. 5°	72°	100.1	43%
11:00	37°	38.6°	43.8°	98°	78°	100.2	39%
12:00	38°	39.8°	45°	98.5°	82°	100.3	34%
01:00	39°	41.2°	49°	100°	85°	100.4	30%
02:00	40°	41.3°	48°	102°	92°	100.5	29%
03:00	38°	39°	46.4°	99°	85°	100.2	28%
04:00	36°	37°	44.2°	96°	77°	100	27%
05:00	34°	35°	41.2°	94°	75°	Nil	29%
6:00	30°	33°	38°	85°	70°	Nil	31%

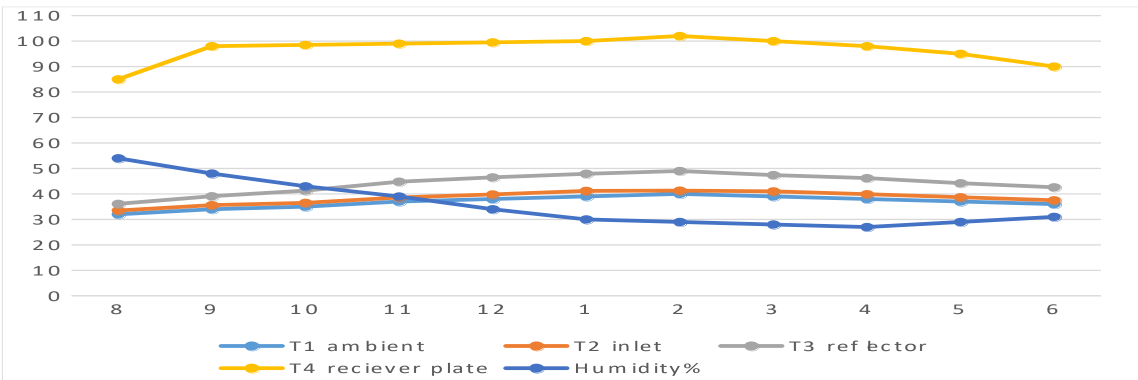
Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

c) Collector efficiency

The collector efficiency of the solar plate depends on the heat intensity. The more intense heat on absorber plate the more the efficiency. The solar radiation varies according to the position of the sun. Here 1100 W/m2 intensity of solar energy is used average one year for only. The solar cell was used to measure the intensity of solar radiation. When the sky was cloudy the intensity of solar radiation was less. It was found from the experimental data that the efficiency was high at noon, it increases from 9.00 am to 12.30 pm and decreases after 1.00 pm. For mass flow rate 5 kg/hr the highest efficiency is 31.11% which was more than 14.11% for the previous collector (Reading was taken in same month).

d) Time vs Input Temp graph for active tracking device:

Performance study represents the study of collector efficiency. This includes the maximum temperature supply of water, useful heat gain collection efficiency etc. To obtain these parameters the collector inlet and outlet temperature, mass flow rates, diameter of the pipe, area of the collector are to be known

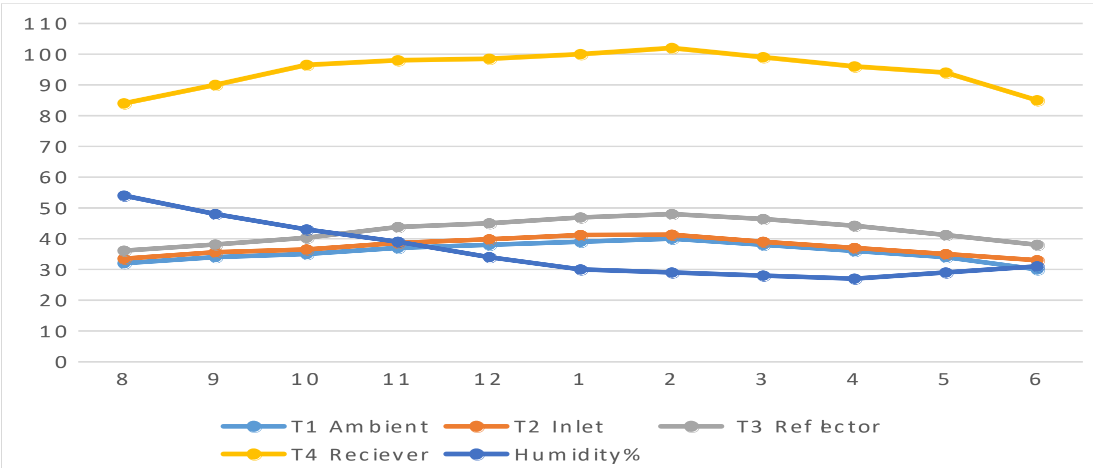


Graph1: Time vs Input Temp for active tracking device

It can be seen that the outlet temperature increases slowly in the first few hours, but then increases rapidly from noon to a peak at 2:00 pm. It is important to note that irradiance peaks an hour before peak outlet temperature. From Figure 1, it can be seen that the highest efficiency occurs when the outlet temperature reaches its peak value. It can be seen that the outlet temperature is closely related to the efficiency. The data required for SWH performance analysis can be viewed below. Experiments were conducted in two groups on three different days. The first group was in the late rainy season and the second in the dry season. Calculate the instantaneous system efficiency using an average flow rate of 0.0025 kg/s and other readings taken during the test.

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

e) Time vs Input Temp graph without active tracking device:



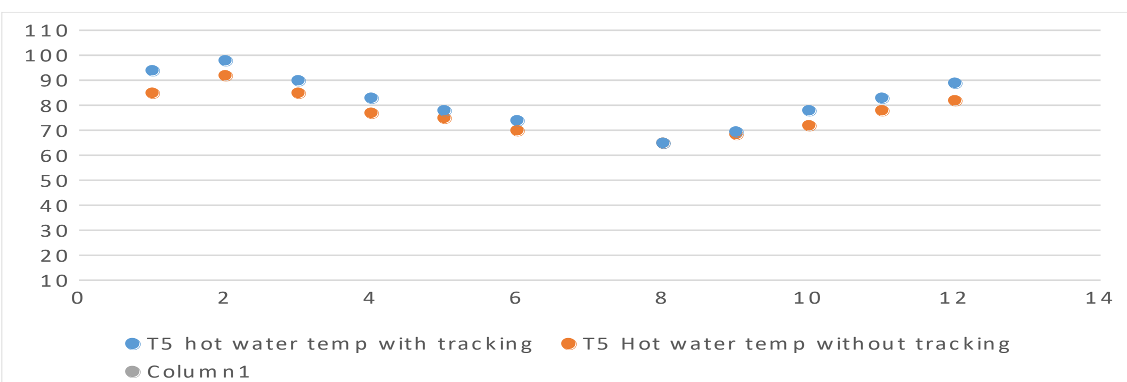
Graph2: Time Vs Input temp without Active tracking device

From Graph 2, it is seen that the outlet temperature slowly rises for the first few hours, but then increases rapidly from midday till its peak at two pm. It is important to note that the irradiance levels peak an hour before the outlet temperature peaks. The highest efficiency is observed at the time when the output temperature peaks. It can be deduced that the outlet temperature and the efficiency have a close relationship.

f) From Tracking Device and Without Active Tracking Device

All the figures of temperature differences vs. daytime graph Graph.2 shows a parabolic curve because up to a particular time of the day the temperature difference is increased and after that it starts to decrease. Again, all the figures of the efficiency v, temperature difference. Graph.1 shows a line of upward direction in rightward because efficiency always increase with the increase of temperature difference.

g) Time vs Outlet temp with and without Tracking Device



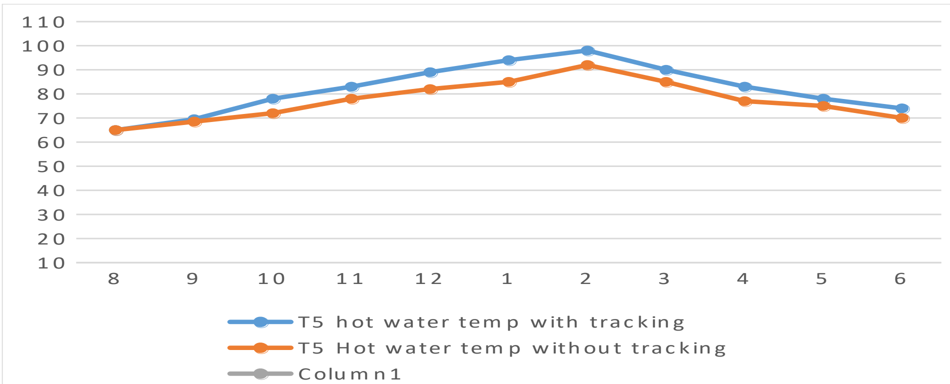
Graph3: Time vs Outlet temp with and without Tracking Device

Graph.3 shows the outlet temperature having a similar gradient to the ambient temperature till the point where the irradiance peaks. At that point, the inlet temperature rises slightly while the ambient temperature drops a bit. The irradiance levels peak an hour before the outlet temperature just as in the first day's testing. Graph3

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 3,Issue 1, Dec.2022
Paper Id: – IJ2022V3I1 -3A-C,
ISSN 2582-6026

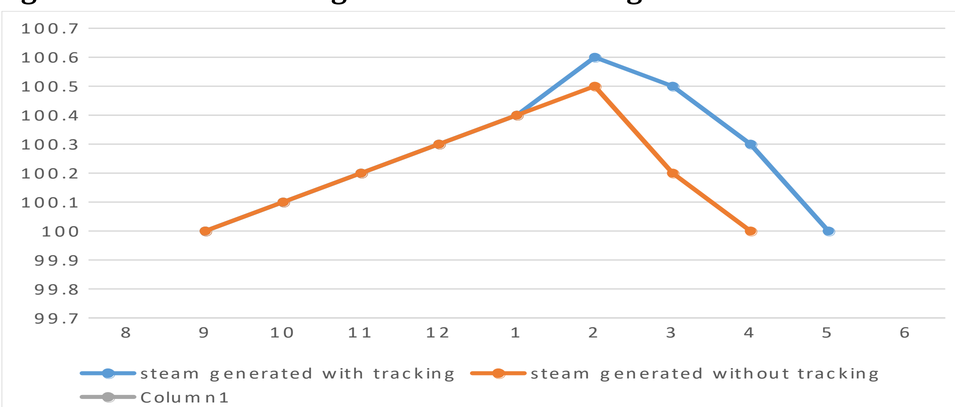
shows that the efficiency of the system has a similar trend line to that of the outlet temperature. The maximum efficiency recorded.

From Both the temperature we can conclude that the output and efficiency of result with tracking device are more efficient and accurate.



Graph 4: Time vs Outlet temp with and without tracking device

g) Time Vs Steam generated with tracking and without tracking



Graph5: Time Vs Steam generated with tracking and without tracking

Graph 5 shows the steam generated with tracking and without tracking device. The output obtained during 2:00pm to 3:00pm maximum and it attains the peak point for more time while in without tracking device we get peak point for the short time.

VI. CONCLUSIONS

At present, in most of the cases fossil fuel are used to produce superheated steam, but solar energy that renewable energy, can be a great source of heat in this purpose. The use of renewable energy provides our environment Clean and comfortable, no electricity bills. However, this concentrator is capable of producing superheated steam from water at ambient temperature. Cylindrical collectors can be used to generate sufficient quantities of superheated steam for industrial purposes. The collector can also be more easily equipped with active tracking devices the maximum input from the sun. Besides these, to keep the construction cost low, the cylindrical solar collector is constructed using locally available materials.

REFERENCES

[1] Khanal, R.; Lei, C. Solar chimney—A passive strategy for natural ventilation. Energy Build. 2011, 43,1811–1819.

[2] P. Sivakumar, W. Christraj, M. Sridharan, and N. Jayamalathi, "Performance improvement study of solar water heating system," ARPN Journal of Engineering and Applied Sciences, vol. 7, no. 1, pp. 45–49, 2012.View at: Publisher Site | Google Scholar

[3] A. M. S. Luis and A. R. R. Richardo, "Modeling and identification of solar energy water heating system incorporating nonlinearities," Solar Energy, vol. 81, no. 5, pp. 570–580, 2007.View at: Publisher Site | Google Scholar

[4] S. Seddegh, X. Wang, A. D. Henderson, and Z. Xing, "Solar domestic hot water systems using latent heat energy storage medium: a review," Renewable and Sustainable Energy Reviews, vol. 49, pp. 517–533, 2015.View at: Publisher Site | Google Scholar

[5] J. Rekstad, M. Meir, E. Murtnes, and A. Dursun, "A comparison of the energy consumption in two passive houses, one with a solar heating system and one with an air–water heat pump," Energy and Buildings, vol. 96, pp. 149–161, 2015.View at: Publisher Site | Google Scholar

[6] L. Yuwu, C. Linlin, Y. Dandan et al., "The effect of measurement uncertainty and environment on domestic solar water heating systems' energy efficiency grades," Energy Procedia, vol. 70, pp. 371–378, 2015.View at: Publisher Site | Google Scholar

[7] O. Langniss and D. Ince, "Solar water heating: a viable industry in developing countries," Refocus, vol. 5, no. 3, pp. 18–21, 2004.View at: Publisher Site | Google Scholar

[8] J. K. Kaldellis, K. El-Samani, and P. Koronakis, "Feasibility analysis of domestic solar water heating systems in Greece," Renewable Energy, vol. 30, no. 5, pp. 659–682, 2005.View at: Publisher Site | Google Scholar

[9] A. Houri, "Solar water heating in Lebanon: current status and future prospects," Renewable Energy, vol. 31, no. 5, pp. 663–675, 2006.View at: Publisher Site | Google Scholar