EIE-06-256 REEPRO

Promotion of the Efficient Use of Renewable Energies in Developing Countries

Show Case documentation

Show Case No.: 11

ITC Campus, Phnom Penh

Authors

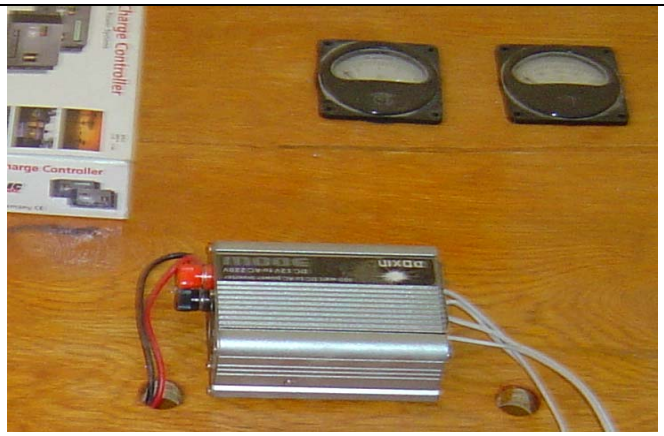
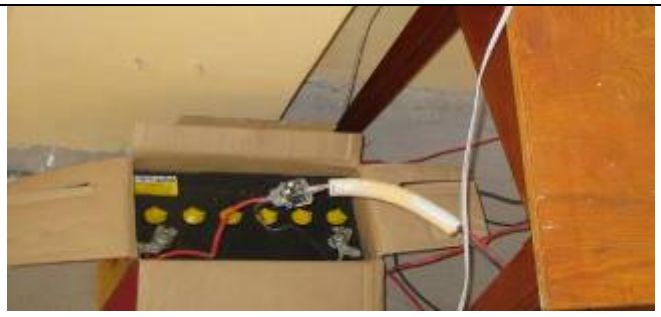
Phok Chrin, ITC

December 2009

1 Showcase Document

REEPRO Training equipment data sheet 1

Type of Equipment: (tick off the type)	PV	Solar Thermal	Biomass to Energy		
	✓				
Name:	**Solar home system**				
Location of the equipment:	Fix for training show which is installed at ITC, Department GEE				
Year of purchasing:	2008				
Operator: (Name and address)	ITC staff at laboratory ITC at Electrical and Energy Engineering.				
Planner: (Name and address)	ITC, Pochentong Blvd, Toul kok district, Phnom Penh				
Detailed description of the installation: (technology, function, benefit for training, etc. max 150 words)	A 12V solar home system was installed at ITC. This systems consists of 2 PV modules with maximum output capacity of 150Wp (2x75Wp). A 70Ah-battery is used to store energy that is used for Lamp and fan when there is no sunlight or during the night time. A charge controller: with capacity of 12A is used for overcharge protection or overload protection of the batteries. The inverter converts the DC current to AC current which can produce the maximum output of 300W. The installation of SHS at ITC was done by the trainees of Level 1 course 4. The solar panels are installed on the roof of ITC which attached to a fixed stand. A DC cable from solar panel to charge controller is about 7m longer. The battery is placed nearby charge controller. The inverter connects to DC load port of charge controller. DC voltmeter, AC voltmeter and AC Ampere meter are used to measure current and voltage.				
Generated Energy service: (tick off the energy type)	electricity	heat	gas	light	
	✓			✓	
Power output of installation: (kWel, m³ biogas, kW th, etc.)	150Wp				
Financing* (tick off the financing type)	private investment	loan	donation	grant	
				✓	
Investment costs in US$*	1220USD				
Maintanance costs in US$*	ITC has to remove battery every 3 years which costs 100USD				
Savings*	At ITC is mainly used for experimental only not for daily appliance used.				
Energy sale income in US$*	N/A				
Comments	This system uses for experimental set up for the student at ITC every years in the field of Renewable Energy.				

Pictures and grafics	Solar Home System
Solar panel with capacity of 150Wp (each panel 75Wp)	
12/24V Charge controller of 12A with a DC voltmeter	
300W Inverter, with a AC voltmeter and a AC Ampere meter	
Batteries of 70Ah	

Lamps	

REEPRO Training equipment data sheet 8

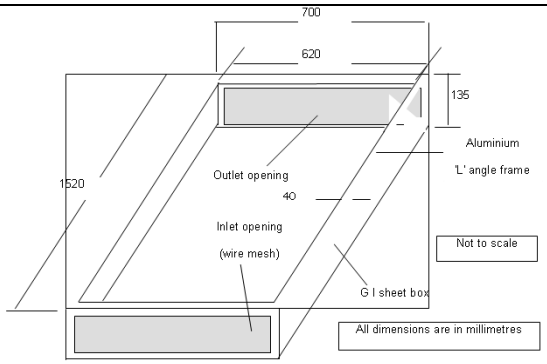
Type of Equipment: (tick off the type)	PV	Solar Thermal (Hot Water)	Biomass to Energy		
		✓			
Name:	**Solar Hot water**				
Location of the equipment:	Fix for training show which is installed at ITC, Department GEE				
Year of purchasing:	2009				
Operator: (Name and address)	ITC staff working at laboratory ITC at Electrical and Energy Engineering.				
Planner: (Name and address)	ITC, Pochentong Blvd, Toul kok district, Phnom Penh				
Detailed description of the installation: (technology, function, benefit for training, etc. max 150 words)	A solar hot water system was installed at ITC. This system consists of absorber, tube, and water tank with storage capacity of 150l. The store tank that is used for storing hot water. The absorber is used to absorb the heat from the sun to exchange the heat inside the storage tank It is a glazed flat plate absorber that consists of a plastic absorber in a flat rectangular housing. The collector is provided with a transparent cover on the upper surface. Two pipe connections for the supply and return of the heat transfer medium are fitted, usually to the side of the collector. On one side of the absorber pipe is connected to cool water at the lower of strange tank and other side is connected to upper. The hot water circulates in the absorber and exchange the heat in the storage tank. This is the first time that ITC has built solar hot water by using black plastic absorber. The heat exchanger is also good enough to do the experiments. Next step, we would like to make the absorber from metal because metal can exchange the heat faster than plastic.				
Generated Energy service: (tick off the energy type)	electricity	heat	gas	light	
		✓			
Power output of installation: (kWel, m³ biogas, kW th, etc.)	150L				
Financing* (tick off the financing type)	private investment	loan	donation	grant	
			✓		

Investment costs in US$*	500US$
Maintanance costs in US$*	NA
Savings*	NA
Energy sale income in US$*	NA
Comments	This equipment is use for student experiment only
Pictures and grafics	
Solar absorber, from front size	
At the back of Solar absorber	

On the top of Solar absorber	
The storage tank with capacity of 150L	

REEPRO Training equipment data sheet No. 8

Type of Equipment: (tick off the type)	PV	Solar Thermal (Hot Water)	Biomass to Energy		
		✓			
Name:	**Direct-solar box dryer**				
Location of the equipment:	Fix for training show which is installed at ITC, Department GEE				
Year of purchasing:	2009				
Operator: (Name and address)	ITC staff working at laboratory ITC at Electrical and Energy Engineering.				
Planner: (Name and address)	ITC, Pochentong Blvd, Toul kok district, Phnom Penh				
Detailed description of the installation: (technology, function, benefit for training, etc. max 150 words)	A direct-solar box-type solar dryer suitable for household drying of agricultural products has been developed at ITC. The dryer can dry 4-5 kg of fish, bananas, and also for all kinds of vegetables in a single batch, at a temperature of about 35-58 °C. The performance of the box dryer was evaluated as per an evaluation procedure for solar dryers, which was also developed at ITC. A comparison of the test results with a solar cabinet dryer indicate superior performance of the dryer, considering not only the thermal performance but also factors such as loading/unloading convenience, operation and maintenance, quality of dried products, floor area requirement for dryer installation and cost of dryer.				
Generated Energy service: (tick off the energy type)	electricity	heat	gas	light	
		✓			
Power output of installation: (kWel, m³ biogas, kW th, etc.)	Can dry 4-5kg of fish, banana, all kinds of vegetables in a single batch				
Financing* (tick off the financing type)	private investment	loan	donation	grant	
			✓		
Investment costs in US$*	300US$				
Maintanance costs in US$*	NA				
Savings*	NA				
Energy sale income in US$*	NA				
Comments	This equipment is use for student experiment only				
Pictures and grafics					

System sizing	
Solar dryer box	
The fish in solar dryer box	

2 Show case development and operation

2.1 Show case definition workshop

The showcase implementation is under the frame work of REEPRO because ITC offers the Technicians and Engineer every year. The renewable energy is subject to climate change where the students start their careers after completing the degree at university. The Lab facilities of renewable energy are solar PV, Solar dryer and solar Hot water.

2.2 Showcase planning

Figure 1 shows the block diagram of SHS at ITC, the SHS components are: Solar panel with capacity of 150Wp (each panel 75Wp), 12/24V Charge controller of 12A with a DC voltmeter, 300W Inverter, with an AC voltmeter and an AC Ampere meter and Batteries of 70Ah

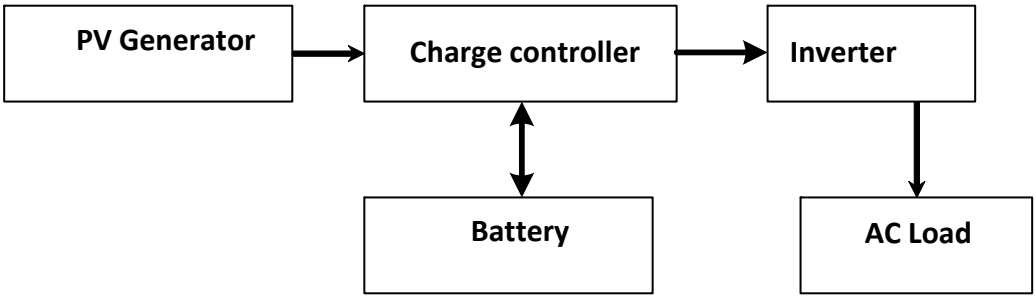


Figure 1 Circuit block diagram solar PV

The design of this dryer was based on thermal performance and product quality optimization. The box dryer consisted of a rectangular box made of GI sheet, with a open top. The box was insulated at the outside with glass wool, and clad with GI sheet. A 3mm window glass covered the top of the box, and was hinged to the box at the left edge. This facilitated opening and closing of the cover glass, for access into the box. Figures 2 illustrates the dimensional and construction details of the dryer.

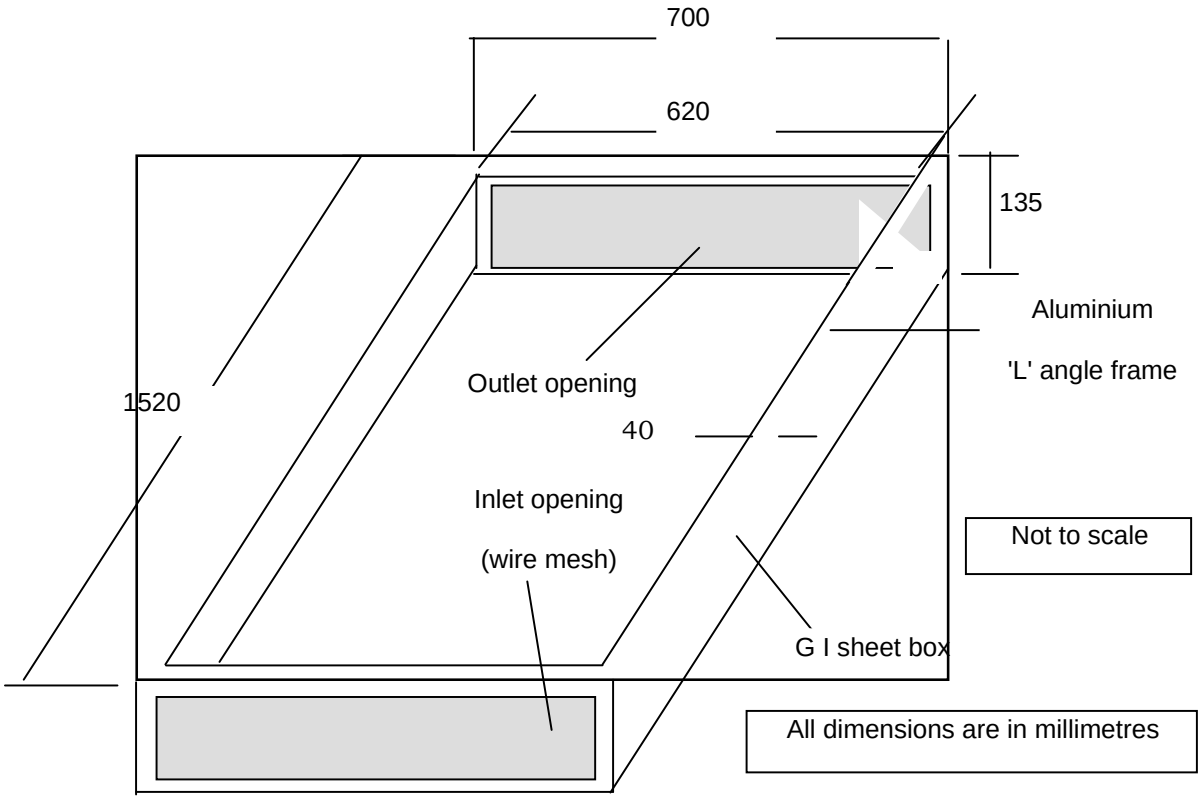


Figure 2 Block diagram of Solar dryer

The Hot water was designed to obtain high-thermal performance (Figure 3). The absorber box consisted of a rectangular box made of GI sheet (100cm*180cm). On the top of the box is placed with glazed flat absorber. Inside the rectangular box, it is painted with the black color. The two pipes are used to connect the circulation of water.

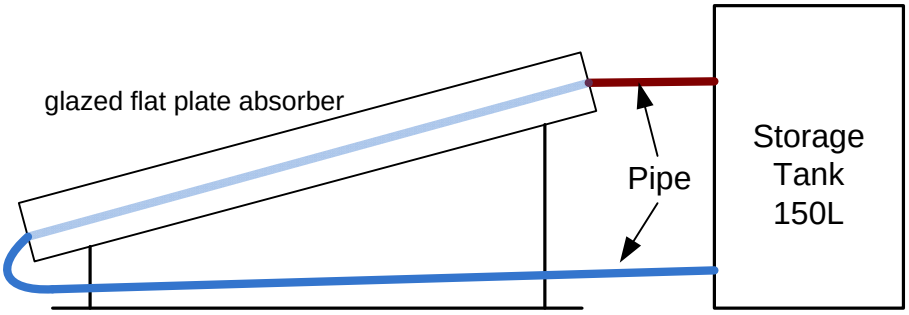


Figure 3 Diagram of Solar dryer

2.3 Show case implementation

The installation of SHS, Hot water and solar dryer at ITC were done by the trainees of Level 1 course 4 and ITC student.

SHS system

Figure 4 shows the PV panel that install at ITC with capacity of 150Wp. PV panels were attached to a fixed stand. The angle is set 15^{o} to the south direction. The PV panel is connected in parallel because we use 12V system. A DC cable is used to connect panel PV to charge controller with length of 7m.

Figure 4 PV panel on the fixed stand on ITC roof

The table in figure 5 is placed the charge controller, inverter, Dc voltage meter for PV module at the input terminal of charge controller. AC voltage meter and AC ampere meter are connected at the output terminal of inverter.

Figure 5 Charge controller and Inverter

Solar Hot water

Hot water construction is started with the fabrication of the absorber box. Aluminium L angles are used to construct the box frame. As in the absorber box, 4 sides of the outer box are kept closed. At the back of absorber is then filled with black metal. On the top is placed by the glass. The dryer box is placed on a mild steel stand, which provides a tilt of 20° (Figure 6). The dryer is placed south, to maximise the solar radiation

Figure 6 Solar Hot Water

Solar dryer Box

The dryer construction is started with the fabrication of the inner box. Aluminium L angles are used to construct the box frame, which is then covered with a GI sheet at the back and two sides.

The outer box is made of GI sheet, but without a frame. As in the inner box, two sides of the outer box are also kept open. The outer box is then filled with a fibreglass wool mat of 50 mm thickness, and the inner box is placed over it. The sides are then packed, screwed and sealed with silicone sealant to make the joints watertight.

The dryer box is placed on a mild steel stand, which provides a tilt of 20° to the dryer (Figure 7). The dryer is placed south, to maximise the solar radiation

Figure 7 Solar dryer

2.4 Show case operation

The 3-operated systems are given below:

Solar PV system:

SHS is used for practical work on solar energy:

- I-V characteristics of PV Module
- How to obtain I-V curve
- Measurement of open circuit voltage (O.C.)
- Short circuit current (S.C) of PV module

Solar Hot water:

- Measurement of temperature inside the storage tank
- Measurement of temperature outside the storage tank (storage tank without absorber)
- Measurement of temperature in storage tank every hour from 9:00h to 16:00h
- Curve of Temperature Vs Time (inside and outside)
- Comparing the temperature of the water

Solar dryer:

- Measurement of temperature in inside solar dryer box
- Measurement of temperature outside the box by using thermostat
- Measurement of temperature every hour from 9:00h to 16:00h
- Drying curves considered the moisture content of the products.
- Drier comparing to the sun drying.

2.5 Show case supervision

This project is supervised by Dr. Jurky and Mr. Phol Norith on November 2009. The design and installation are good since all the renewable lab is places closed to each other.

The equipment is regularly use for student experiment. This assured the constant maintenance of the equipment.