


# Solar Assisted Bakery



## Anjum Munir<sup>1</sup>, Iqra Ayub<sup>1</sup>, Abdul Ghafoor<sup>1</sup> and Waseem Amjad<sup>3</sup>

<sup>1</sup>Department of Energy Systems Engineering,  
University of Agriculture, Faisalabad

<sup>2</sup>Department of Farm Machinery & Power,  
University of Agriculture, Faisalabad



Pakistan has been facing energy crisis for the past few years due to huge gap in supply and demand which is about 6000 MW in peak summer season. Therefore, it is necessary to develop innovative technologies for the thermal applications of renewable energy sources. Pakistan is blessed with all types of these resources like solar energy, wind energy, biogas, biomass, etc. out of which solar energy is preferable option because Pakistan lies in the solar belt receiving average solar insolation of 5–7 kWh/m<sup>2</sup>/d in most parts of the country. Baking is an energy intensive food process causing complex physical,

chemical and biochemical changes in the product as processes of heat and mass transfer take place simultaneously. Several problems are associated with conventional methods of baking to process the food, for example:

- a) A large quantity of heat energy is consumed for the preparation and heating of food.
- b) Pakistan Bakery Industry has grown with an average rate of 6.5%-7.5% during 2005-2014. So energy demand for baking is increasing.
- c) The use of firewood and fossil fuel for the generation of heat is not only the cause of deforestation but also responsible for environmental pollution.
- d) Under these conditions, the baking and cooking employing conventional energy sources is not cost competitive.

The use of solar bakery can reduce the depletion rate of firewood and fossil fuels, evading harmful carbon emissions that trigger global warming. Keeping in view the above facts, a Solar Assisted Bakery unit has been developed which was compatible with 10 m<sup>2</sup> Scheffler reflector to provide off-site baking facility. The performance evaluation of this unit has been carried out in terms of its efficiency and energy production under local climatic conditions of Pakistan.

## Development and Operational Principle

The solar assisted bakery unit is installed at Agricultural Engineering Workshop, University of Agriculture Faisalabad (Latitude, 31° 26' 48.28"). Major components of this unit are primary reflector, secondary reflector, glass window, zig-zag receiver, pebble bed storage, inner and outer chamber of baking unit, baking trays, solar fan, DC motor, solar panel, electric heater and insulation as shown in Figure 1. Inner chamber of bakery (60 x 60 x 60 cm<sup>3</sup>) is made of 0.8 mm thick steel sheet. Scheffler reflector is used as a heat source and its concentrated solar radiations are intercepted by secondary reflector that are further concentrated on the zig-zag receiver (H: 330 mm, W: 360 mm, L: 360 mm) of the bakery unit. The receiver is protected by a tempered glass window, cut into strips to avoid the breaking of glass due to heat expansion. When the air is passed through this receiver, it takes up the heat and becomes warm. A PV fan creates a draft for the air to flow and distribute it into the baking chamber (oven) through perforated screens for uniform air distribution. After taking moisture from the product, air leaves the chamber at the bottom where pebbles are placed to store some thermal energy for 1 to 2 hours of independent baking. A temperature gauge is also provided to indicate the inside temperature of the bakery unit. The temperature for different baking products can be set by increasing/decreasing the area of the receiver expose to the primary reflector. A conventional source of heat such as electric heater of 3000 W is also provided for baking purpose if there is adverse climatic condition and no enough solar intensity is available to get the desired temperature. An electric control panel is also provided to control the electric heater.

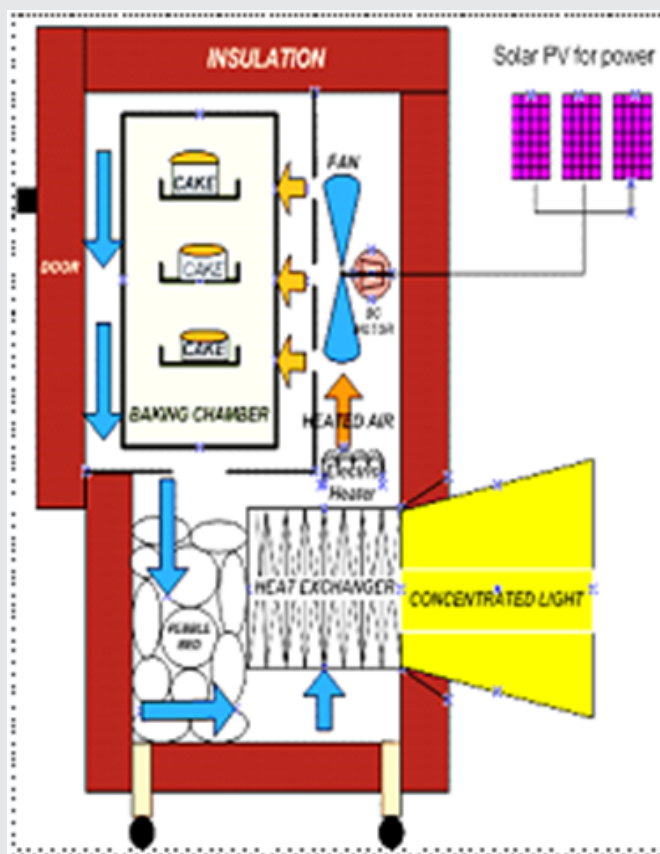


Figure 1: Solar Assisted Bakery unit

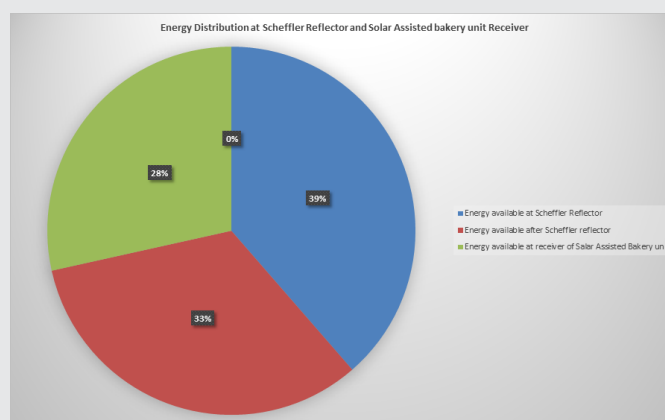
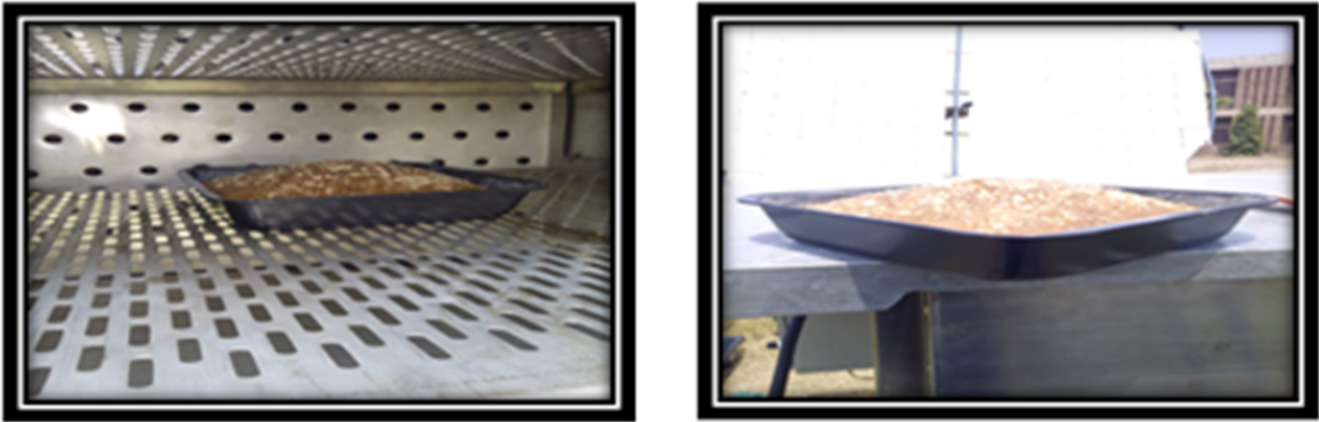


Figure2: Energy distribution at Scheffer Reflector and Solar Assisted Bakery Unit



**Figure 3:** Solar Baked cake in Solar Bakery

## Technology impact

- a) The required baking temperature (200-230°C) can easily be achieved with this unit which is enough for efficient baking of various products.
- b) The use of Solar Assisted Bakery Unit is a sustainable energy solution for on-farm baking to minimize the depletion of firewood and fossil fuels used for heating and baking purposes.
- c) One solar bakery unit can save 150 tons of wood per annum if used for commercial purpose on large-scale.
- d) The solar bakery unit is accessible for more than 6 hours per day so approximately baking of 60 kg of bread can be done each day.
- e) The unit is more cost effective as compared with other conventional baking system because of its low operational cost.

