# Portable Stored Solar Thermal Energy for Household Use

University of Illinois at Urbana-Champaign and Sun Buckets, Inc.

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## Concept

We seek to address the global cooking problem and have interviewed over 150 potential users at locations around the world to better understand their needs, issues with current cooking techniques, and opportunities for improvement.

In our current system, we use a reflective dish to concentrate solar radiation into a sealed vessel that collects, stores, and recovers thermal energy at high temperatures (on the order of 300-400C). One prototype includes a thermal storage material sealed into a metal vessel surrounded with insulation. It is nominally 30 cm (12") diameter, 15 cm (6") tall, and weighs about 8-10 kg (20 lb). We have used it to stir fry, deep fry, pan fry, bake, and boil a variety of foods like legumes, breads, and meats in ways that mimic traditional cooking customs and the use of fire. Note that the concept is widely scalable, so the capacity, size, and weight of the concentrating dish and the collection-storage-recovery vessel can be adjusted appropriately for various applications.

## Performance

We have "charged" vessels (i.e., collected solar thermal energy without electricity or batteries) in the field under a wide range of ambient temperature conditions (0-35C), wind conditions, and solar exposures (sun rise to sun set, summer to winter solstice) using low cost, off the shelf parabolic reflectors to concentrate the solar radiation. One version of the prototype - containing about 5 kg of thermal storage material - charged to over 350C in an average of about 2 hours, with the exact time varying depending on the ambient conditions. We have used simple water boil tests to quantify the amount of recoverable heat, and we typically recovered 2 MJ of energy (boiling 6-9 liters of water). On average, the first liter of water boiled in about 3 minutes. We have stored the thermal energy for later use, and have stored for as long as 12 hours and then boiled a liter of water.

## Plans

We are modifying the prototype system to improve performance, reduce charging time, enhance boiling performance, increase storage capabilities, and reduce the size of the vessel. We will continue to test in field conditions and with authentic end users. We are exploring options for international field-testing, especially in locations with abundant solar energy and high fuel costs.

We have both a commercial start-up enterprise – Sun Buckets, Inc. – and a university research team – Stored Solar Thermal Energy at the Institute for Sustainability, Energy, and Environment at the University of Illinois at Urbana-Champaign, USA.

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