Concentrated Solar Cooking & Heating System

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Abstract

The Phase I student team designed, built, and tested a novel means of solar-powered cooking and heating using concentrated sunlight. The system demonstrates safe and use-friendly outdoor and indoor heating capabilities.

Objective

To develop a prototype based on the proposed new solar cooking technology which is safer, user-friendly, and more versatile than box or parabolic solar cookers. It is also the objective that the solar heat being provided for indoor heating/cooking so that the technology can benefit people, planet, and prosperity all over the world.

Background

Solar heating is a sustainable technology which requires no fuel and has minimal post-fabrication carbon footprint. It can help to alleviate electricity demand for heating purposes, which is a poor use of high-quality energy.

Typical solar cookers:

- **Users subject to sun burning/light**
- **Limited use for outdoor only**
- **Has not attracted a customer base in developed countries**

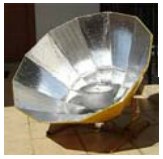


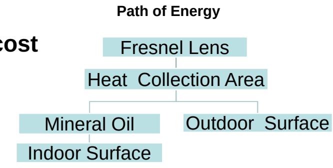
Figure 1 Parabolic Reflecting Cooker

Tasks required students to review and overcome disadvantages in previous technologies. They applied knowledge of many mechanical and optical engineering methods, including solar radiation, heat transfer, fluid mechanics, and system design and fabrication.

Design

Main Features:

- **Large Fresnel lens and low cost**
- **Fixed focal point**
- **Manual dual axis-tracking**
- **Heat transfer fluid loop**
- **Well insulated surfaces**
- **Sunlight shield and user protection**



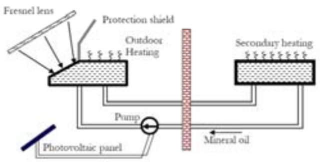
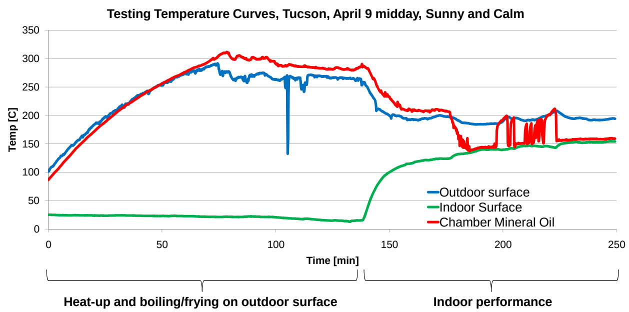


Figure 2 Design-stage conceptual schematic and prototype testing

Prototype Performance

Outdoor surface (pump off)	Indoor Surface (pump on)
Max temp[1] = 290 C = 550 F	Max temp = 150 C = 300 F
Boils water and vegetable	Can cook directly on surface
Can pan fry	Hot enough to boil water
Energy efficiency[2] = 70-85 %	Efficiency[2] = 20-35%



Discussion & Recommendations

Promising start of a new level of solar cooking technology.

Outdoor model could serve as a barbeque-type setup or street vendor stand.

Ray of light could be completely isolated for safety.

Can provide heat during peak evening hours with a small-scale thermal storage tank.

Non-cooking applications could include air and water heating for home use.

Heating and fluid modeling could improve performance.

PV system for powering pump (10-20 W) can enhance sustainability.

Patent pending and commercialization is promising

Phase II Proposal

Objective: Develop a commercially viable system

Main Tasks:

1 – Develop a low-cost automatic tracking
2 – Enhanced cooking surfaces and heat transfer
3 – Integrate a heat storage component
4 – Market study (developing/developed nations)
5 – Minimize cost & weight

Collaborate with industry:

Several private and public institutions have already expressed interest for commercialization.

1 – Outdoor surface could get hotter without oil inside. Highest frying temperature for meats is 265 C. Typical electrical stove temperatures are around 260-315 C

2 – Efficiency is measured from sunlight incoming to lens to output at surfaces. For reference, highest possible efficiency from solar thermal tower electricity plant to an electric kitchen stove is 35-40%