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Center of Science, Technology, and  
Society

# Technology Research: Solar-powered Cooler

**ILUMÉXICO**  
PRENDE LA LUZ DE MÉXICO

November 2014

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# Technology Research: Solar-powered Cooler

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## Introduction

When asked, customers showed interest in a variety of solar-powered products. These products were appliances and entertainment devices such as a blenders, washing machines, stoves, freezers, fans, televisions, stereos, and telephones. Many customers also asked for bigger solar systems in order to save more energy and attach more accessories, such as phone chargers. The most popular product requested was a solar-powered refrigerator (30% of population in Campeche). Led by a team of student engineers from Santa Clara University's School of Engineering, Iluméxico has embarked on a journey to develop its next solar-powered product: a small-scale solar-powered cooler to be used by rural customers throughout the Mexico region.

## Customer Interest and Needs

Iluméxico's customer base, rural customers who are not included in the federal government's electricity grid expansion plans in the coming years, have little or no access to electricity. The light they have comes from gas-powered lanterns, candles, or generators that run on expensive fuels. While some have solar systems, which are sold in the more populated towns for an affordable price, they often break or are purchased in an incomplete package, so many customers are forced to attach them to car batteries or other sources.

The limited access to electricity also means that customers do not have the luxuries of the developed world, one of them being refrigeration and cooling. Not only are customers kept from simple pleasures like a cold beverage on a hot day, they lack the proper temperatures needed to store foods and beverages for their livelihoods and health. With refrigeration and colder temperatures, mothers can store leftover food for the family to eat the next day; fisherman and farmers can to store dairy, meat, and fish products without the worry of spoilage; doctors and local caretakers can prescribe medicines and antibiotics that require storage at lower temperatures; storekeepers can sell products for a slightly higher price because they are cold and less likely to perish. The many benefits of refrigeration would improve the quality of individual lives, but would also improve the standard of living as a whole.

## Considerations for last mile customers

Refrigeration for rural markets is different than in the developed world. Below is a list of considerations that must be taken into account when designing appliances for base-of-the-pyramid customers:

- Limited space availability inside and outside the home. Many families have small houses with a large number of children and animals and need to be mindful of the available space.
- Mobility and ease of transport. This is especially important for migrant families, or people who plan to use the appliance for their livelihoods, such as fisherman and farmers who hope to sell their goods at the market.
- Use of energy. Although the appliance would be solar-driven, the design must take into account days in which there is limited sun, where the panel would not receive high amounts of solar energy, or extreme heat, where the system would use high amounts of energy to keep the temperature at a low level. If the system were to fail, it could cost dinner for the family or a day's worth of goods to sell at the market.

From the information gathered about the customer need in rural off-grid Mexico, SCU engineering students decided to design an affordable, lightweight, durable, and portable solar cooler that can be used in any off-grid location. The portable solar cooler will use thermoelectric modules as the cooling mechanism, as they are a small and lightweight form of cooling.

## Customer Profiles

There are roughly four different customer profiles identified throughout typical rural, off-grid areas that could use a cooling system for food and beverages:

- *Storeowners* and *mobile merchants*: cannot sell certain products because they do not have a proper refrigeration system with access to electricity
- *Housewives* are restricted in what they purchase with regards to quantity and types of food
- *Fresh food merchants* cannot carry their products long distances due to spoiling. Designing and implementing a solar cooler would keep food fresh for a longer period of time, which in turn decreases the number of trips taken to the market and lengthens the edibility for perishable foods, while allowing for portability and transportability.



## Why a Cooler and Not a Refrigerator?

- A cooler is more portable and durable than a refrigerator because there are fewer moving parts, which decreases the overall weight and the need for outside maintenance
- A conventional refrigerator requires a compressor, expansion valve, coiled heat exchange pipes, and refrigerant, which all contribute to a more complex system.
- Refrigerators do not work well in an unstable environment; they must stay in the same position until they are stabilized before they can work effectively. The portability and durability of the cooler means they can be carried in the back of a pickup truck for distribution, and will be able to work right away after they are charged from the solar panels.

By having a solar cooler, rural off-grid communities will have an accessible, sustainable technology to cool and preserve perishable food items. These communities will also not be as limited as to the kinds of foods they can eat. Overall, a solar cooler holds out the promise of an improved quality of life for those in off-grid communities.