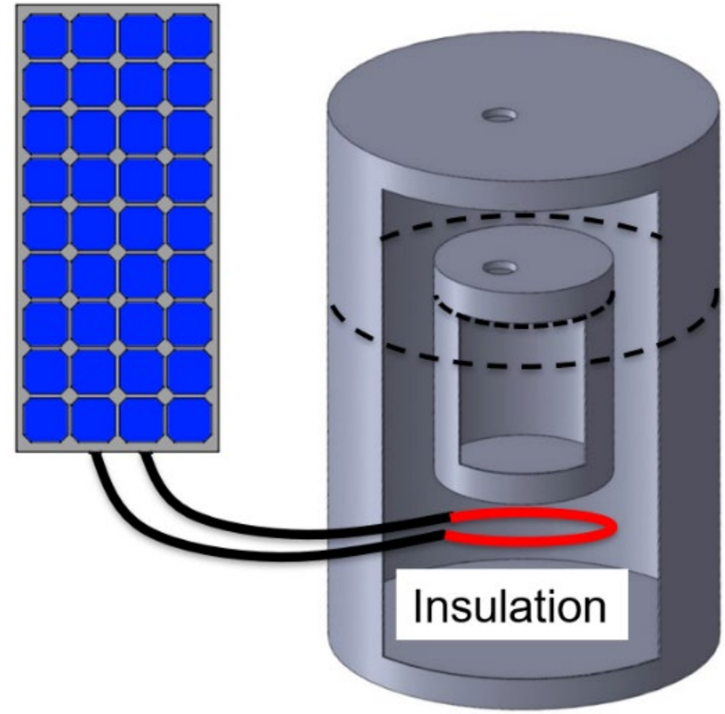
<u>Insulated Solar Electric Cooking (ISEC)</u>

The basic design is an electric heater connected to a (~ 100 W) solar panel. The vood chamber must be insulated to accumulate the heat provided over a long period of time.



Daily energy can also be stored in a battery or by some thermal means such as melting a Phase Change Material (PCM) or heating a piece of metal. However, storing the energy in the food itself is the cheapest, easiest design.

100 W will bring 1 kg (or liter) of water to a boil in an hour, so over the course of a day, we can cook ~ 5 liters of stew, beans, rice, etc.

As long as there is sufficient water in the pot, the temperature will not rise above 100 °C. But there should be thermal protect to prevent a fire for the case, it is left empty

Boil and Simmer: We've cooked a lot of food by this simple method.

Africa Stem Education Initiative (ASEI) produced a nice prototype, which provides valuable lessons.

They’ve produced a heater that so far has not corroded the electrode ends, by spotwelding a nail to the NiCr wire, reducing the temperature of the junction to the electrical power leads. The heater plate itself is casted locally from reclaimed aluminum, and has a space for the 180 °C thermal cut off switch.



Aluminum is reclaimed locally and casted in molds made of moist sand

ASEI uses a similar casting process to make the insulating ISEC body from "vermicucrete": concrete using insulating vermiculite rather than sand. It is a better insulator and somewhat lighter than sand concrete but is not as strong. The prototype is functional and physically appealing (see next slide). However, it is heavy (~ 15 kg) and poorly insulated (the outside is pretty hot during use) for three reasons:

- The vermicucrete is more thermally conductive than fiberglass insulation
- The entire top is made of rather thick aluminum, a very conductive metal
- There is a continuous path of aluminum from the food to the outside.

ISEC by ASEI

20 ASEI Prototype-1 were shipped to Malawi beginning of September, 2022. The shipping cost was more than the construction cost, and many of the cookers were visibly damaged upon arrival – although all seemed functional.

One bag weighs 100 kg. They were a struggle to transport.

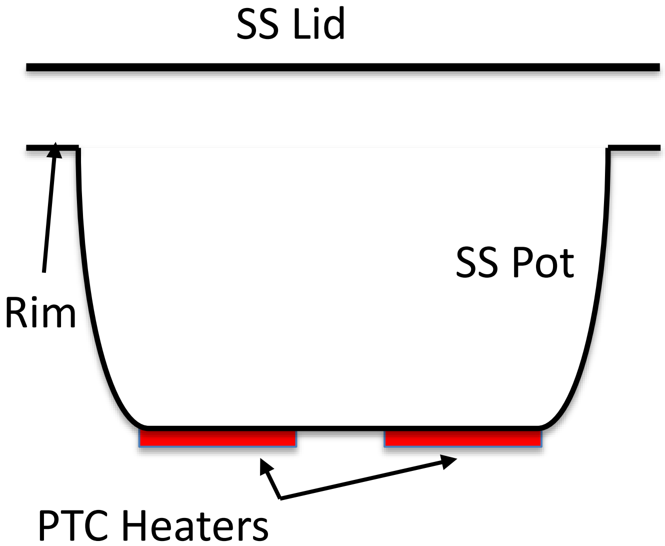
As an alternative to the thermally conducting aluminum casing, we found that metal mesh – reinforced concrete could be casted in thin (~ 0.5 cm) layers. Reducing thermal conduction along the upper surface by more than a factor of 10.

We were able to cast an upper cooking surface and even an entire cooking pot if desired.

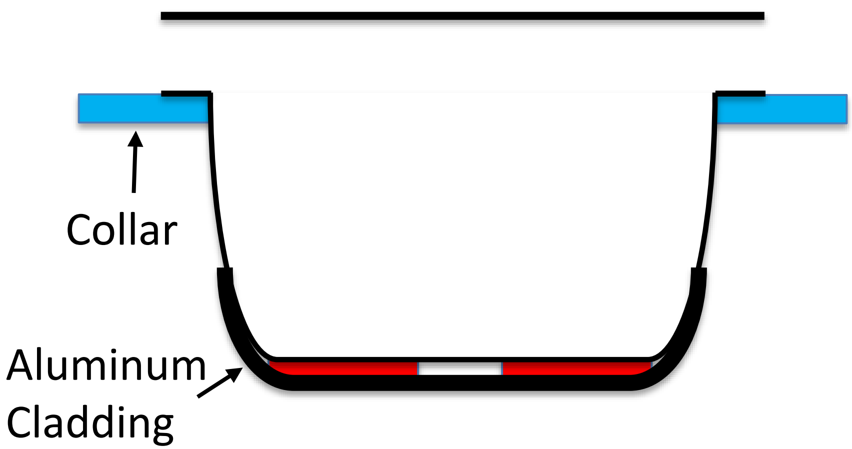
Thin-walled stainless steel is also a good non conducting building materia.

ASEI ISEC is great… Some thoughts on improvemets

1) Aluminium connection is bad insulation, which could be replaced with stainless steel and steel mesh – reinforced concrete
2) Positive Thermal Coefficient (PTC) thermistors could replace resistive heaters, eliminating the need for thermal safety measures.
3) The inner portion of the ISECs could be shipped in a nested geometry reducing cost, allowing for complete construction on site.



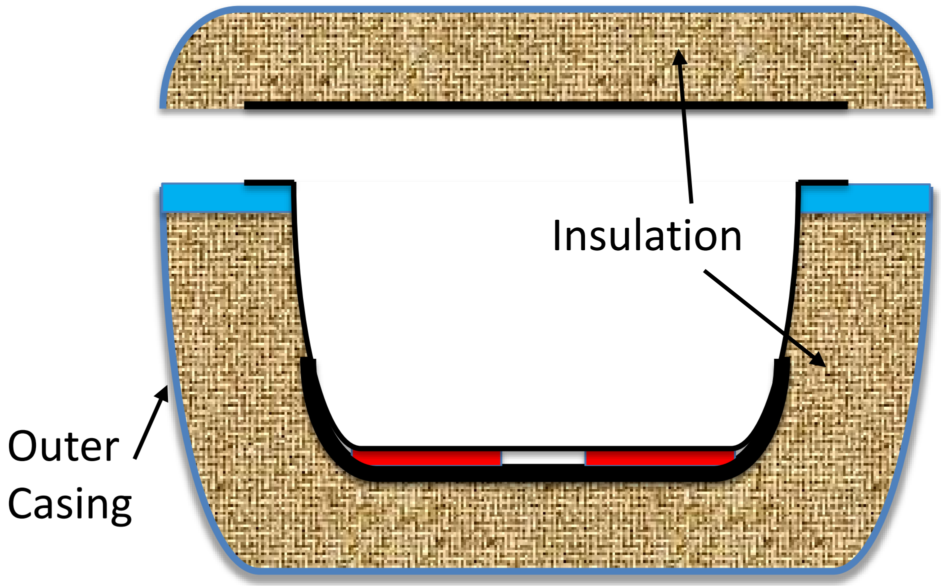
Stainless Steel Pots with wide rims and flat lids are widely available. 220°C PTC heaters can be glued to the bottom with RTV cement. Aluminum pots are locally made and can also be used. The better thermal conductivity reduces the problem of a hot spot by the heaters but loses more heat through the rim.



Aluminum cladding can be glued to the bottom of the pot to conduct the heat away from the PTC heaters to the food. This will reduce both the heat loss through the insulation as well as reduce thermal damage to the insulation.

A collar can be made of concrete reinforced with steel mesh (~5 mm thick). Such a collar has good physical strength but small thermal conductivity.

In this form, the ISEC (with cord and USB charging port) could be stacked in nested form and shipped inexpensively.



The outer casing and insulation can be added at the dissemination site. The outer casing could be a plastic tub or bucket, or even a permanent structure made of wood, mud, brick, etc.

The insulation could be polyester (melting temperature: 260°C). If higher temperature thermal storage is desired, then (at least) the part of insulation close to the pot should be of higher temperature material.