The European Solar Panel Cooker - ESPaC

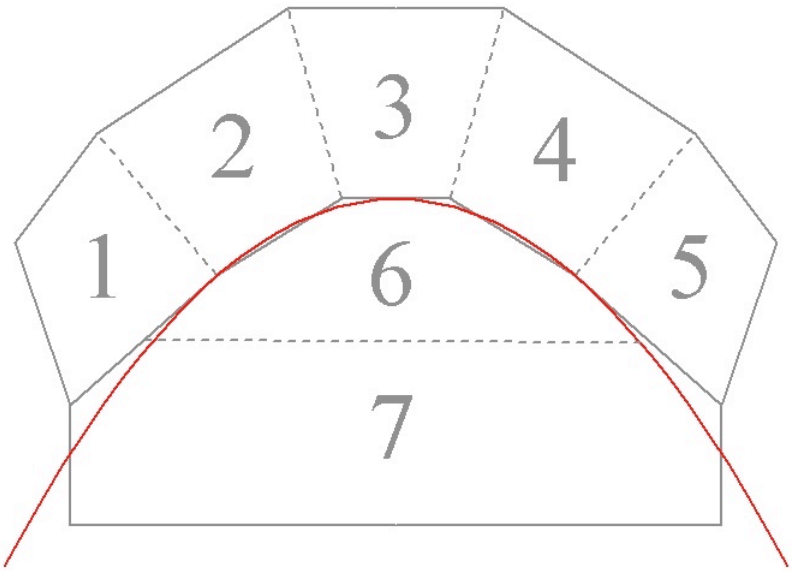
By Bernhard S. Müller - poverty-oriented energy solutions. Issued July 2016.

Introduction

The ESPaC is a modification of the panel cooker, originally invented by the French scholar Roger Bernard and further developed by Barbara Kerr, Jay Campbell and Edwin Pejack. They gave it the name CooKit, which was successfully distributed by many ten thousands worldwide.

Roger Bernard lives at 45 degrees northern latitude. The American co-developers Kerr, Campbell and Pejack optimized it to rather near equator applications by giving the rear center panel (No. 3) a trapezoidal shape. In conjunction with the other panels it performed well all year up to 35 degrees latitude, during summer up to 45 degrees. **The ESPaC is a modification of the CooKit to perform up to 65° latitude. Since the power of the sun rays is weaker at low-sun locations due to absorption, Mie scattering and Rayleigh scattering, the reflector material must be of high quality and high reflectivity.**

Basically, the CooKit and the ESPaC are simplified parabolic cookers. Both of them direct seven primary reflections directly to the pot, plus several secondary reflections.

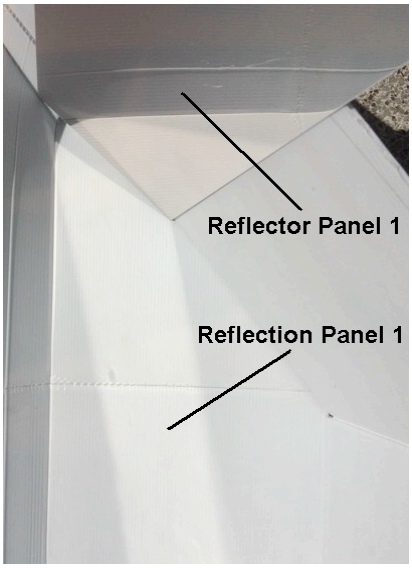


Picture 1: doubtless, panel cookers like the CooKit and the ESPaC are simplified parabolic cookers.

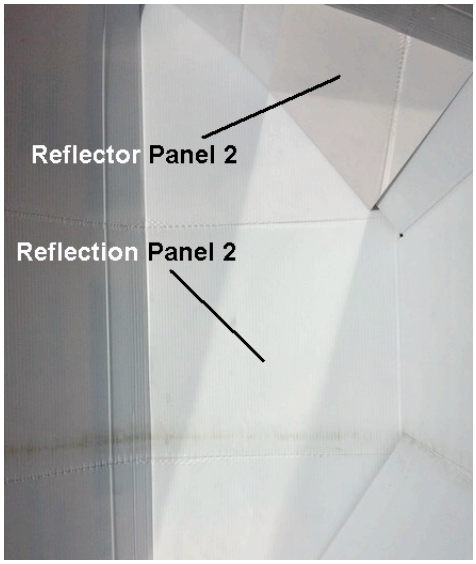
Testing the reflections

The ESPaC has been constructed with a CAD/CAM program to find the correct angles easily. Laser pointers are very helpful to explain the reflections. In such a case it is helpful to simulate the pot with a semi-transparent white cylinder.

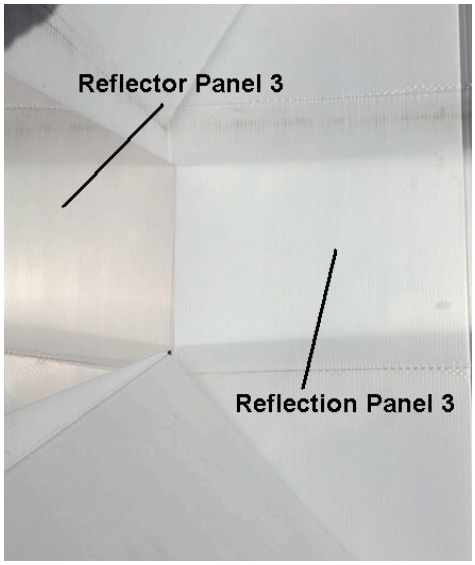
For the ESPaC the inventor applied a different test method to display the reflections in a more comprehensive manner: All panels except the specifically tested one, were left white. This procedure was repeated for every single panel.



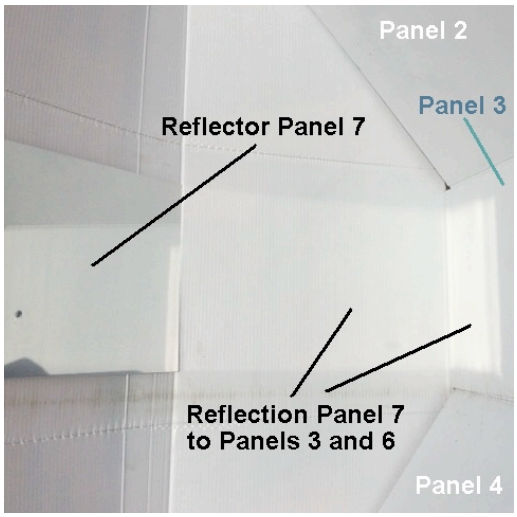
Picture 2: Reflection from Panel #1 (or 5) across the focal section



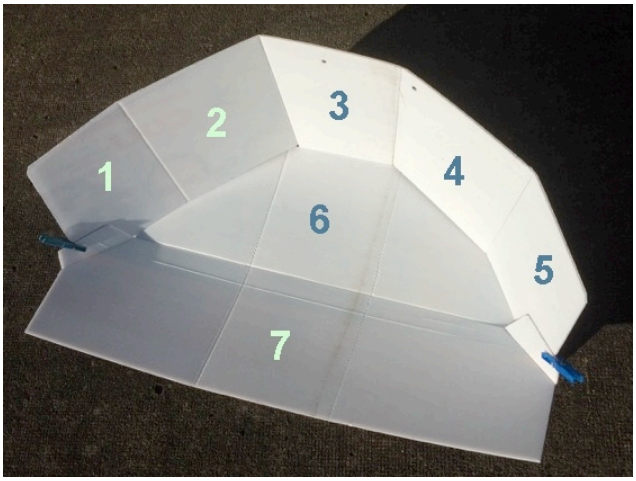
Picture 3: Reflection from Panel #2 (or 4) across the focal section



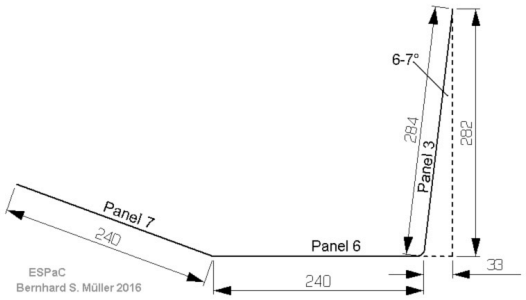
Picture 4: Reflection from Panel #3 across the focal section



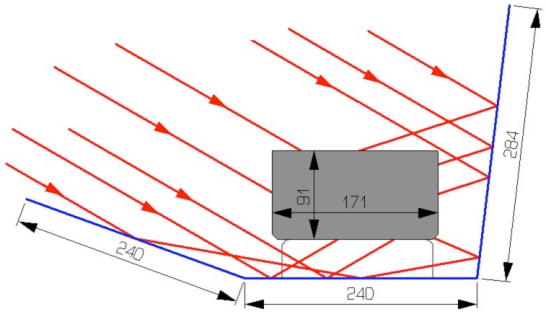
Picture 5: Reflection from Panel #7 across the focal section to panel #3



Picture 6 (right):
Arrangement of the panels by numbers



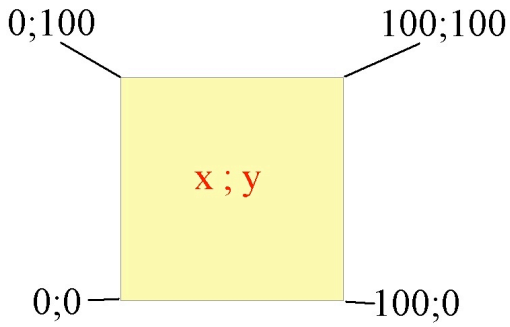
Picture 7: lateral cut through panels 3, 6 and 7



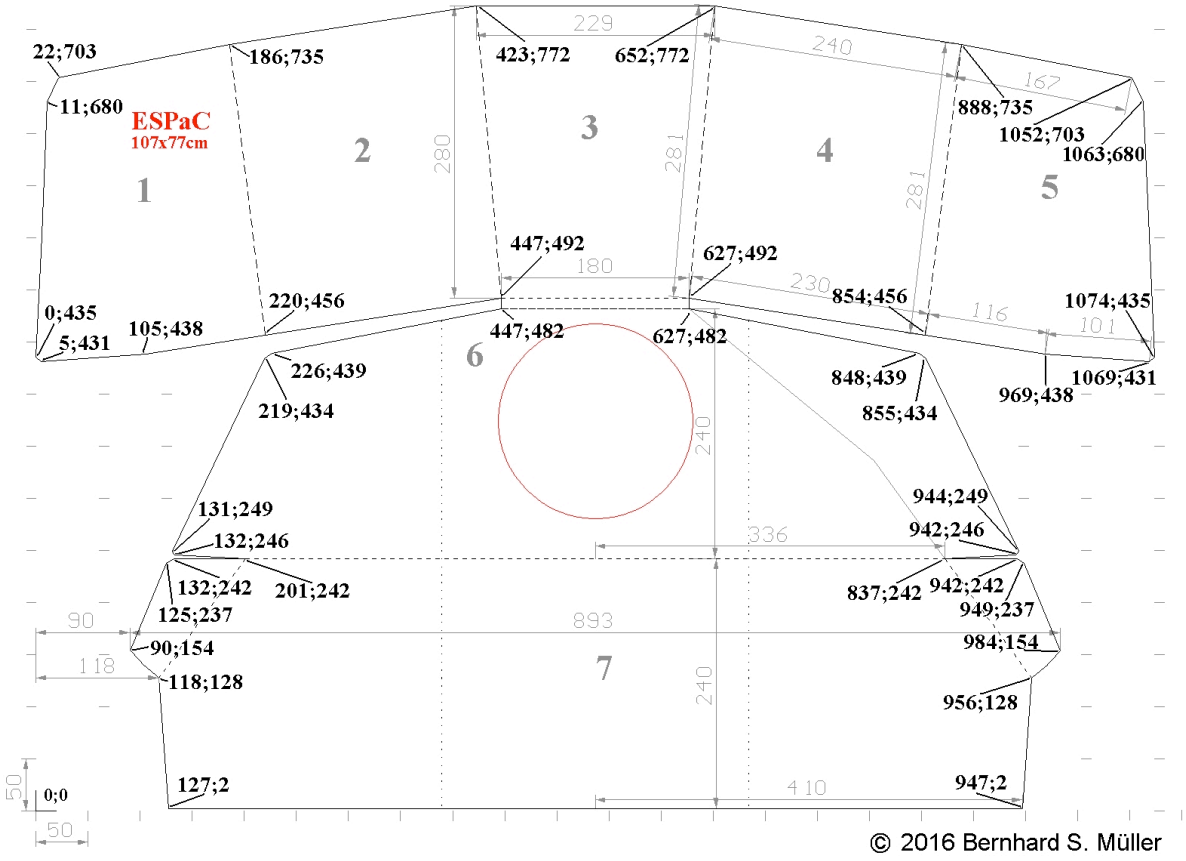
Picture 8: lateral cut showing direct and reflected sun rays. Panel 7 shall be adjusted 2/3 of the sun angle above horizon.

The Plan

The cutout of the carrying material, cardboard or polypropylene board can be done with scissors or a box cutter. The numbers on the drawing determine the measurements in x;y coordinates in millimeters. The first number shows mm from left edge, followed by a semicolon and the second number, which shows mm from bottom edge.



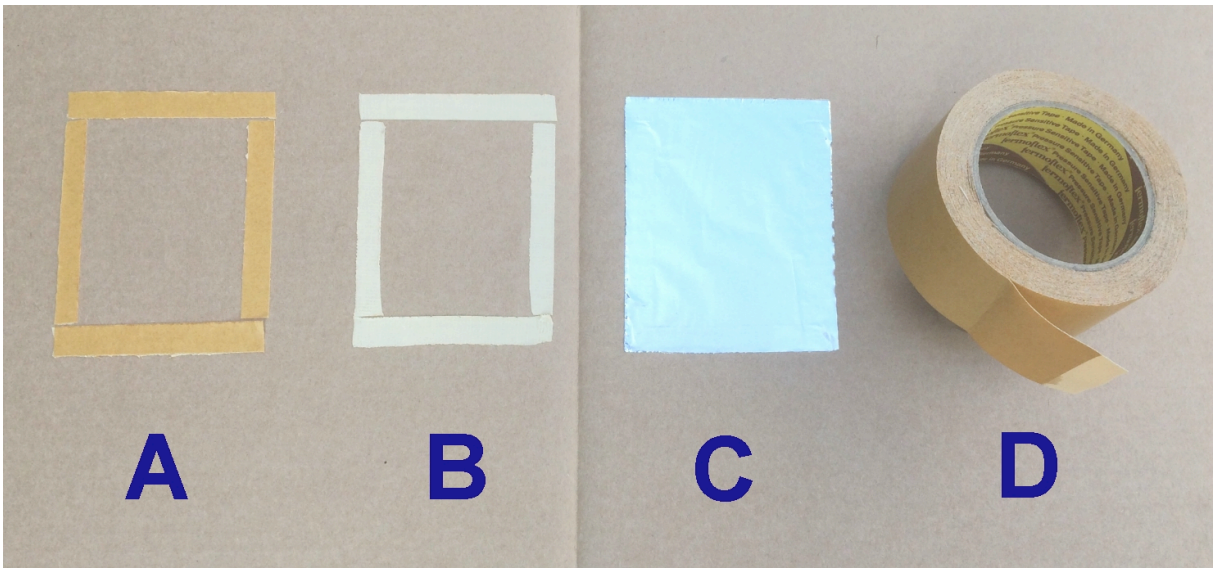
Picture 9: Coordinates allow you to work very precise. Also, it is quite easy to program a CNC machine or similar devices.



Picture 10: The measurements - displayed as coordinates - enable to program DXF- or DWG-files. Of course, the coordinates allow to execute precise cuts as well. A file with higher resolution is available. DXF-files can be obtained from the author at € 15. Upon receipt, the amount will be donated to a charity organization in Africa. Write to: bs_mueller@gmx.net or take advantage of the contact form at www.mueller-solartechnik.com

Application of reflector foils

The methods how to glue-on various materials are widely known and do not require further explanations. Most common are reflector foils with an adhesive layer. Using regular glue to apply aluminum foil is probably the cheapest method. Prof. Celestino Ruivo of the university of the Algarve, Faro, Portugal, introduced another method at his seminars: the application of non-adhesive reflectors with double-sided tape.



Picture 11 explains the steps

Step A: apply the double-sided adhesive tape on the carrying material, in this case cardboard.
Step B: remove the separator foil
Step C: apply reflective foil
D: Sample of double-sided adhesive tape, in this case Fermoflex. Any other one will do it.

Please try to utilize low-adhesion tape. The cheapest ones are just good enough.

Trapping the heat

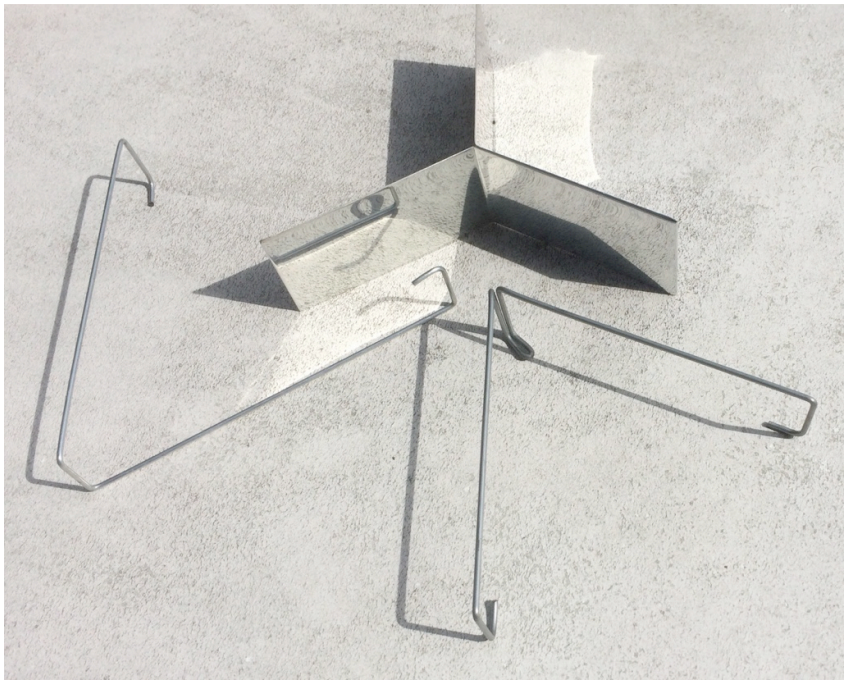
Solar panel cookers require heat traps - some call them green houses - to avoid the heat to escape the system. If baking foils of Polyester or Polyethylene are considered, more and more foils need to be bought as time goes by. Some manufacturers, like Dr. Hartmut Ehmler's LightOven (Germany), supply heat traps made of Polycarbonate with their cookers. Celestino Ruivo from Portugal recommends 2 recycled windows of front-loader clothes washing machines.

Selecting the right pot

To capture the entire frequency range of the solar radiation, dull black pots with lids shall be considered. The author invented, especially for panel cookers, the Jar-in-jar heat trap: a blackened jar inside a clear jar. Obtain details on the Jar-in-jar and many more information on solar cooking and food drying at www.mueller-solartechnik.com

Trivets

As shown in picture 8, trivets allow additional reflections to the pot. The height of the trivets depend on the sun angle and the pot diameter. A compromise of about 5 cm height is recommended to maintain stability. The trivet is usually inside the heat trap.



Picture 12: Trivets for solar panel cookers. 2 of them are made of used coat hangers, the one in the rear is made of polished aluminum waste.

Picture 13: A black pot with trivet inside 2 recycled windows of clothes washing machines in a panel cooker.