Third International Conference **CONSOLFOOD**2020

Advances in Solar Thermal Food Processing

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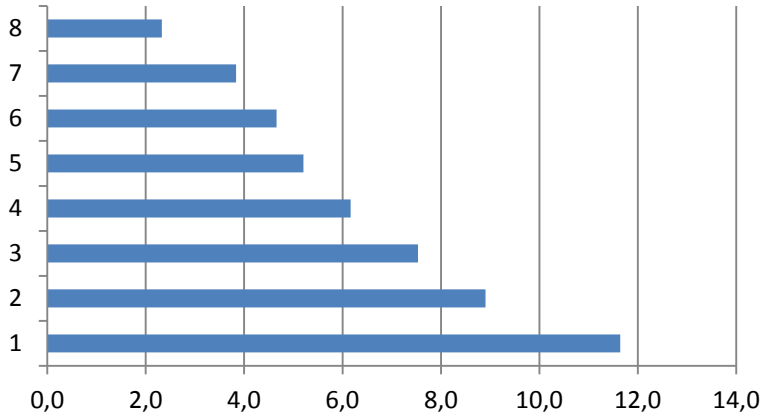
INSTITUTE OF ENGINEERING; UNIVERSITY OF ALGARVE; CAMPUS DA PENHA; FARO-PORTUGAL

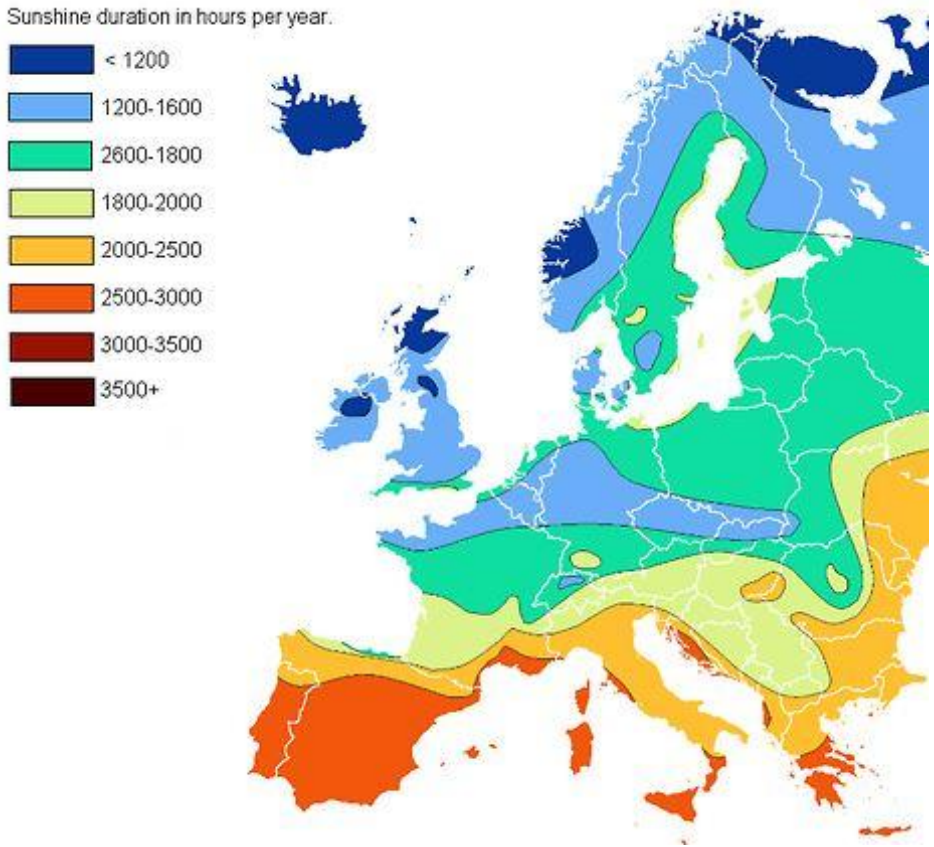
Cooking with stored Solar Energy

Seggy & Jane Segaran

SF Innovations
York, UK

Its tough to Solar Cook in the UK





Even in Spain and Portugal

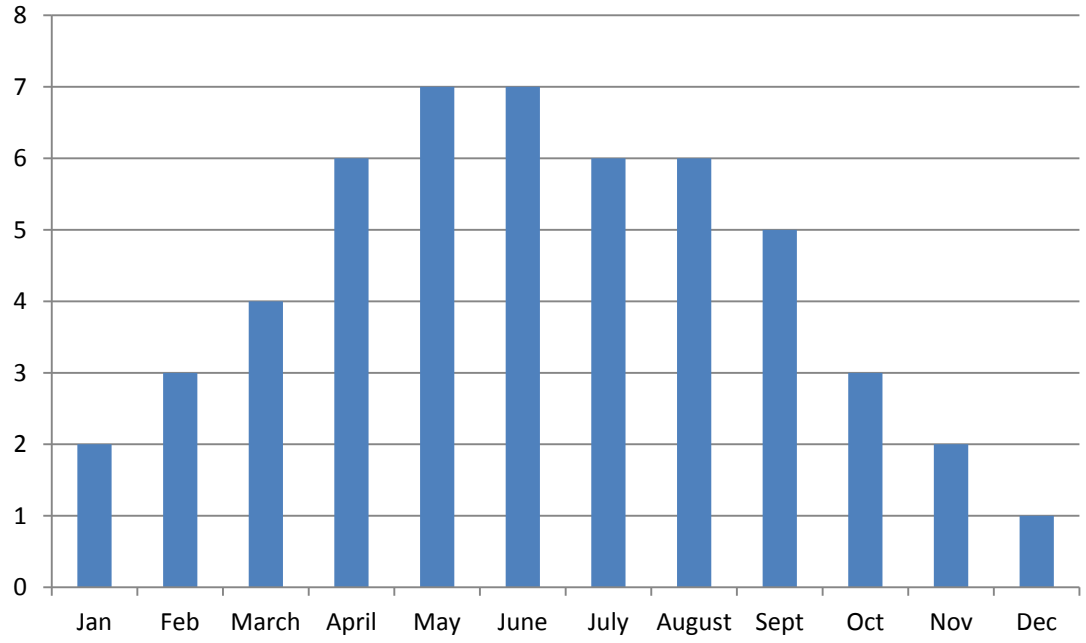
- One cannot cook with solar power
- On cloudy days
- In the evenings
- Indoors

Storing solar energy to use later is a solution

Our solution :

- Storing solar power in a battery during hours of sunshine for cooking at any time of the day.
- **Storing solar energy**
  - Photo Voltaic (PV) Panel
  - Charge Controller
  - Battery
- **Cooking with a battery**
  - Heating pad
  - Insulated Box

Average hours of sunshine per day in the UK



Storing solar energy

- 100 W Photo Voltaic (PV) Panel
- Average energy harvested per day:
- Summer is 50 Watts over 6 hours = 300 Watt hours
- Winter is 50 Watts over 2 hours = 100 Watts hours

Charge Controller

- Interfaces between the PV panel, the battery and the load.
- Prevents the battery over-charging and over-discharging.
- Lengthens battery life of Lead Acid battery.
- Will only discharge battery to 50% of rated capacity.

75 Ah Lead Acid Leisure Battery

- Total stored power 75Ah x 12V
  - 900 Watt hours

- Available power (50%)
  - 450 Watt hours

Cooking with a Battery

- 120 Watt heating element
- These are designed for 3D printer heating beds, but are ideal for our cooker.
- 12V operation
- Waterproof
- Will stand temperatures upto 200 deg C
- Easy to wire up
- Low cost and widely available

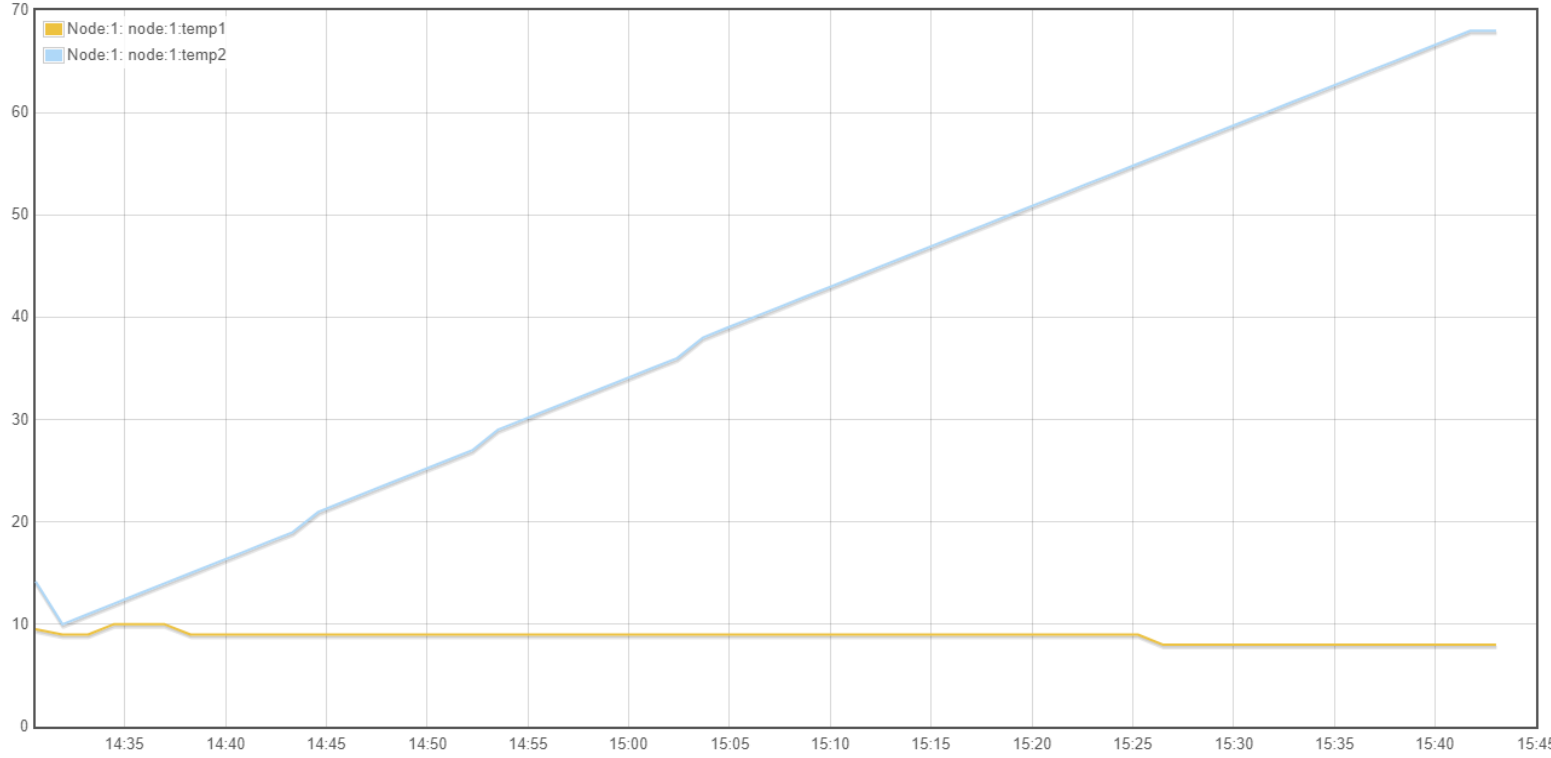
Insulated Box

- Made with cardboard box
- Kingspan Insulation
- Lined with cardboard on the inside
- Covered with aluminium foil.

Cooking power

- Carried out the water heating test (Dave Oxford shortcut method)
- Heat 1 litre of water in cooker
- Monitor water and ambient temperature
- When temperature differential is greater than 50 deg C
- Monitor temperature rise over 10 minutes
- Cooking power = temperature rise in 10 minutes multiplied by 7

Cooking with a Battery



Cooking power

- Powered from 12V Battery – power measured as between 90 and 110 Watts
- Power at 66 deg C: Temperature rise of 8 deg over 10 minutes – so 56 Watts
- Power at 50 deg C: Temperature rise of 8 deg over 10 minutes – so 56 Watts
- Outside temperature = 15 deg C
- So power (as measured by Dave Oxford short method) is 56 Watts
- This compares well with cooking power of panel and solar box cookers

Cost of basic system

100 W Photo Voltaic (PV) Panel	£100
75 Ah Lead Acid Leisure Battery	£75
120 Watt heating element	£10
10 Amp Charge Controller	£10
Insulated Box	£10
Miscellaneous items	£10
Total Cost	£215

What can you cook in an insulated heated box?

Anything you cook in a solar cooker

Rice

Lentil curry

Stews

Bread

Cakes and scones

Biscuits

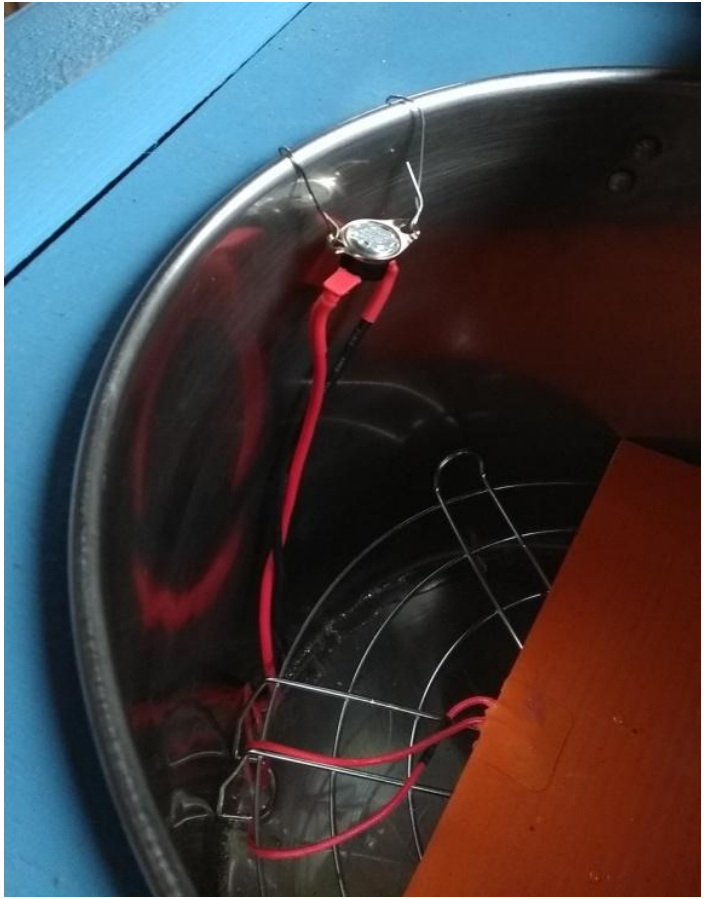
Hints and Tips

Adding a thermostat

Will prevent heating pad overheating and save energy

Add in series with heating pad

Has to withstand 15 Amps and 150 deg C



Hints and Tips

Using a Watt Meter

Allows you to monitor battery status and power consumption

If you have 2:

Add one between PV and charge controller

Another between charge controller and heating pad

Hints and Tips

Keeping the heating pad in contact with the cooking pot

Will maximise heat transfer and cooking power

Using a Dutch Oven

Nice even cooking

Makes baking easier

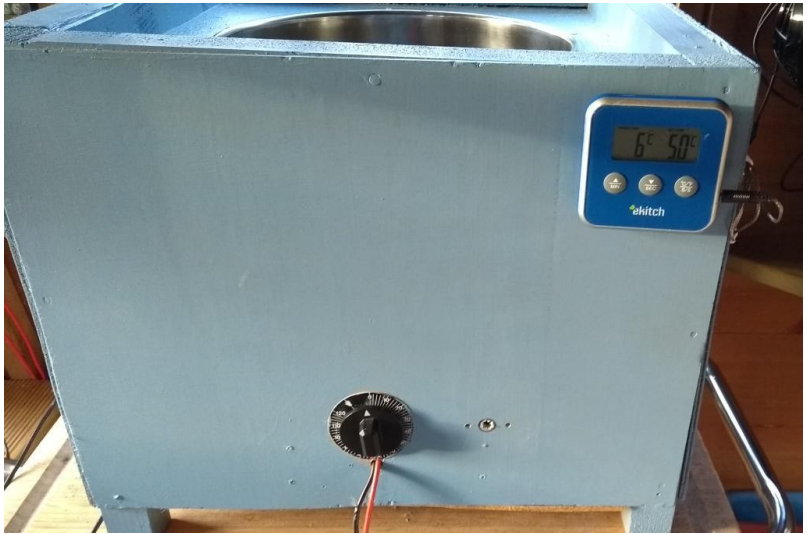
Hints and Tips

Adding a timer control

Will prevent the battery draining by accident

Adding a therometer

Monitor cooking temperature



Benefits of cooking with stored solar energy

- Technology is here and now
- Parts are widely available and prices are coming down fast
- Easily understood and maintained
- Can cook indoors
- Modest cost
- Can be made in most parts of the world locally
- Doubles up as a ‘fireless cooker’

Commercial 12V cookers

Roadpro

Moulded plastic construction on the outside

Moulded metal on the inside

Power consumption 70 to 100 Watts

Cooking power 56W

Looks like made in China

Circa £50

Commercial 12V cookers

Travel Buddy Marine Oven

Stainless steel construction

Power consumption 100 Watts

Timer control

Temperature control

Cooking power < 20 Watts

Mainly for warming up

Made in Australia

Circa £200

Off-grid cooker at the Green Gathering 2019, Wales