Sustainable Cooking

By Nev Sweeney

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1.0 Sustainable Cooking – An introduction

What is 'sustainable cooking'?

An AI bot that I know suggested a definition – "Sustainable cooking is a way of cooking that reduces the environmental impact of food production. It involves using sustainable ingredients, reducing waste, and supporting local food systems."

The website "Sustainable Cooking Australia" looks at it this way – "In order to establish what sustainable cooking really is we first need to have a good understanding of the true definition of sustainability. To sum it up in just a few words this cannot be put better than it was in 1987 when the United Nations Rutland commission defined sustainability as " Meeting the needs of the present without compromising the 'ability' of future generations to meet their own needs". With this in mind it now poses the question " how can the way one cooks affect the 'ability' of future generations being able to meet their own needs?".
https://www.sustainablecookingaustralia.com.au/what-is-sustainable-cooking

The Website "Made to Sustain" says - Sustainable cooking goes beyond a trend; it's a conscious choice rooted in environmental responsibility. It is defined by its commitment to reducing greenhouse gas emissions, supporting local farmers, and opting for responsibly sourced ingredients.
https://madetosustain.com/sustainable-cooking-how-to-reduce-waste-and-make-great-food/

Appropedia, the sustainable wiki says that 'Green Cooking' "Involves using energy-efficient methods and eco-friendly practices to prepare food, reducing environmental impact. This approach encompasses various techniques, from choosing sustainable ingredients to utilizing energy-saving appliances."
https://www.appropedia.org/Green_cooking#:~:text=Green%20cooking%20involves%20using%20energy,to%20utilizing%20energy%2Dsaving%20appliances.

It goes further to identify six Key Practices that make up green cooking –

1. Energy-Efficient Appliances: Use appliances that consume less energy, such as induction cooktops and pressure cookers. Induction cooktops are particularly efficient as they heat food directly through electromagnetic energy, reducing cooking time and energy use.
2. Eco-Friendly Cookware: Opt for cookware made from sustainable materials like cast iron or stainless steel. These materials are durable, conduct heat well, and reduce the need for high-energy cooking.
3. Sustainable Ingredients: Choose locally sourced, organic ingredients to minimize transportation emissions and support sustainable farming practices.
4. Minimize Waste: Implement practices to reduce food waste, such as composting kitchen scraps and planning meals to use ingredients efficiently.
5. Solar Cooking: Use solar cookers to harness the sun's energy for cooking, which is a clean and renewable energy source. Solar cooking can significantly reduce reliance on conventional energy sources.
6. Low-Energy Cooking Techniques: Methods like steaming, microwaving, and slow cooking use less energy compared to conventional baking or frying. These techniques can also preserve nutrients better, contributing to healthier meals.

The purpose of this eBook is to provide information on key practices 1, 4 and 5.

After this introduction, Section 2 talks about using existing cooking gear efficiently, and covers using pressure cooker, wok and the 'lid-on' cooking technique. This is followed by Section 3 which covers cooking with stored heat, where the theory and practice of stored heat cooking and how to build three designs of stored heat cookers are discussed.

Section 4 talks about cooking with the sun directly (as opposed to using solar panels to generate electricity and then using the electricity to power cooking appliances, that

comes a bit later.) Instructions on how to make four direct solar cookers of varying complexity.

Section 5 talks about how top set up, operate and cook with a rocket stove, and then moves on to cover how to construct three different rocket stove designs of varying sizes and complexity. Section 6 discusses other methods of cooking using biomass as fuel including how to set up and cook on an open fire two ways, and how to build an outdoor cob (clay and straw) oven that can be used for baking, making pizzas and roasting.

Section 7.0 (as mentioned earlier) talks about the techniques and appliances we use to cook using electricity harvested from our solar panels and stored in our batteries. Section 8 provides suggestion for books for further reading on the subjects covered in this eBook. There are also several appendices providing plans and other documentation for some of the projects described above.

2.0 Using conventional cooking gear efficiently

2.1 On the stove-top

Use the minimum amount of energy while cooking by bringing the pot to the boil on high then turning it down to low so it simmers rather than boiling vigorously.

Electric hotplates can be turned off a few minutes before the food is finished cooking so that the cooking is finished off by the heat remaining in the coil.

The area underneath gas burners or electric hotplates should be kept clean and shiny so more of the heat will be reflected back up onto the base of the pot.

When using electric hotplates make sure the bottom of the pot or pan is flat and has not warped, so that the energy from the hotplate is transmitted directly to the pan and not lost to the surrounding air, likewise ensure that the pot fits the size of the hotplate or burner so that no energy is wasted around the edge.

Thick walled, high quality cookware makes most efficient use of heat by distributing it better around the food being cooked; this allows a lower heat setting to be used. A tight-fitting lid also allows more efficient heat use by retaining steam within the pot.

One- pot meals using a large pot and dividers or a steaming basket can be used to cook a number of different vegetables on one burner or hotplate.

2.2 Under the Grill

The grill cooks quickly and cheaply and can be further speeded up by lining the grill pan with aluminium foil. Best use of the grill can be made by combining foods which can be cooked this way such as tomatoes and mushrooms to be served with grilled meat.

2.3 In the Oven

Make the best use of the oven's high energy consumption by cooking several courses or meals at the one time; an apple pie as dessert after the roast dinner or a number of casseroles, one for eating and the rest for freezing. If it is not possible or desirable to cook a number of dishes at once in the oven then increase the size of the one you do cook and use the leftovers as a base for another meal, for the next day's lunch or to freeze.

As with electric hotplates, ovens retain heat after they have been turned off, so turn your oven off 10 minutes before the end of cooking time and allow the stored heat to finish off the cooking free of charge.

Except for bread, cakes and pastries the oven should not be preheated, especially where the cooking time is an hour or more.

Check that the seal on your oven door is working by inserting a piece of paper between the oven and the door, if the paper remains in place when the door is shut the seal is fine. If not, it is letting the hot air out and wasting energy so the seal should be replaced. The oven door should be opened as little as possible during cooking.

Baking dishes of glass or ceramic ware make best use of the heat and allow the oven temperature to be set 10°C lower. Similarly dark or blackened bread tins are more effective for bread baking.

To make the best use of cheaper cuts of meat they should be tenderised by marinating the night before in a little lemon juice or wine, which can reduce cooking time by up to 30 minutes.

Make sure that any meat which has been frozen is fully thawed before being put into the oven; if this is not done, particularly on large cuts of meat, the cooking time can be doubled or more.

2.4 Cooking with the lid on

In many situations then cooking on top of the stove we don't think about it, but leave the lid of the pot off, whether it is so we can see what is going on, to prevent it from boiling over or because that is just the way we cook, we leave the lid off. There are, however, some situations where leaving the lid on can allow a reduction in the energy used to cook our food by as much as 75%!

During cooking, steam rises from the food and takes with it a proportion of the heat energy we are putting in with gas or electricity or whatever to cook the food. By keeping that steam and energy in the pot with the food we can reduce the amount of heat energy we need put in to cook a given amount of food. We can take advantage of this salvaged heat by reducing the amount of heat input applied to cook the food, or reducing the time taken to cook the food, or both.

In many cases you won't need to buy anything new, just use your existing cooking apparatus in a new and more efficient way. There are other environmental benefits which will follow too –

- Some of these techniques can be used to replace cooking under the grill or in the oven and both of these methods use more energy than cooking in a frying pan.
- By keeping the lid on you reduce spatter and mess to an absolute minimum so cleaning the stove top becomes quicker, easier and does not require a battery of chemical cleaning agents.

Now that I have your interest, on with the show! –

2.5 Lid-On Frying

For this technique it is best to have a heavy bottomed frying pan, to disperse the heat evenly, with a close fitting lid. My preference is stainless steel but enamelled cast iron works really well too (I must admit I distrust non-stick and aluminium cookware) the good ones can be expensive but will last a lifetime.

This technique is suitable for meat, fish and vegetables. For example, chicken pieces (free range of course!) can be cooked this way by putting a small amount of oil in your frypan. Place your chicken pieces skin side down, place the lid on the frypan and putting it on high heat until the chicken starts to sizzle, then turn the heat down to medium high for 10 minutes, then turn the pieces over for another 5 to 10 minutes and viola!

Steak can be done in a similar fashion (ours is local grass and fed, occasionally we feel evil enough to buy some). Assuming your steak is 2.5cm thick and you want it medium, place the steak(s) in the pan on high heat with the lid on for 2 minutes, then remove the lid and turn, cook for another 2 minutes. Now leave the steaks to rest with the heat source turned off but the lid of the pan still on for two minutes. This is only a guide and you should experiment with the technique until your steaks come out how you want them.

For vegetables, cut up 450 grams of mixed (preferably home grown, but at least organic) veggies so the pieces are about the same size, place them in the pan and add a splash of oil (we use Aussie olive oil for cooking) and cover. Place the pan over high heat and once the veggies start to sizzle, cook for one minute, toss the pan (while holding onto the lid of course) to redistribute the veggies every minute or so for about 5 minutes then remove from the heat. Bung in a bit of soy sauce or vegetarian oyster sauce (made from mushrooms), toss well and away you go. This technique is sort of a cross between stir frying and steaming your veggies and is very energy and nutrient efficient.

Freshly Cooked Broccoli and Cauliflower Mix

Lid-On Boiling

When I first learned this technique I found it to be a bit counterintuitive, I always brought the water to a boil with the lid on, but once it had boiled it was a case of the lid comes off, the food goes in and you get it up to a rolling boil again until the food is cooked. I must admit that when the water boiled over because I left the lid on my response was to take off the lid rather than turn down the heat. Oops!

Anyway if you cook like me you can save yourself a fair bit of energy by turning the stuff you normally cook on a rolling boil down to a medium low heat and leaving the lid on. If you just cook at a low boil try leaving the lid on and turning the heat down to low and if you need to simmer turn the heat down as low as it can go and leave the lid on. This one simple technique can save you money and energy, with no loss of cooking time or efficiency. It works for veggies, pasta, grains and dried beans and poached chicken or red meat.

This technique can also be used to cook pasta or using the energy stored in the water, retained through leaving the lid on. Bring the water to the boil in the pot as you would usually and then toss in your pasta, replace the lid and re-boil the water. When the water starts to come back on the boil just turn the heat off and cook the pasta for the amount of time your normally would. The pasta will come out al dente and you will save lots of energy (= money).

So there you have it, a simple technique that can save you energy, time and money; it is good for the environment too and requires little or no extra equipment, just a behavioural change. Why wouldn't you give Lid-On cooking a go?

2.5 Cooking with a pressure cooker

Some other methods of fuel efficient cooking discussed in this section require only a small outlay on equipment, unfortunately this is not so with the pressure cooker which may cost over $200 if bought new. While I am a fan of buying second hand where possible, in the same way you would think twice about buying a second hand toothbrush, a second hand pressure cooker may not be a bargain either.

Pressure cookers operate at high pressure (the name is a dead giveaway, eh?) and while a catastrophic failure is unlikely it would certainly ruin your day if it happened. The pressure cooker in question may be being passed on due to previous problems and if you don't absolutely know its history, give it a miss. Also, older types may not have all the safety features that the modern cookers have (ours has three separate systems to prevent overpressure) so for the sake of peace of mind, I suggest sticking with a new buy only. And read the instruction FIRST, not after all else has failed!

For the investment however, the pressure cooker does cook 66% faster than cooking at atmospheric pressure, with a subsequent saving in time, nutrients and energy, also no laborious preparation of food or equipment is required. If you are going to spend the money anyway, go for a stainless steel model, it will last you a lifetime. I don't trust aluminium cookware generally but specifically for pressure cookers, stainless steel is

much tougher and more forgiving of mistakes and rough use.

A pressure cooker works by allowing steam pressure to build up inside it to the tune of 70 to 105 kPa (10 to 15 PSI) above atmospheric pressure. At atmospheric pressure water boils at 100°C (212°F), no matter how long you boil it , but at 105kPa water boils at 120°C (248°F), so food can cook much more quickly. This allows the use of cheaper cuts of meat and ingredients that require longer cooking such as boiling chooks or dried beans. Dried beans can be cooked in 35 to 45 minutes in a pressure cooker and require no pre-soaking.

The main problem which can arise with pressure cookers is if the food swells up or foams up while cooking so that it blocks the pressure relief valve. To prevent this, the cooker should never be filled to more than two-thirds capacity and foods that have a tendency to foam, such as split peas, should be avoided.

It was in my mind to buy a large pressure cooker so that we could also use it for food preserving work (ie pressure canning) and while I am not sure of the where's and why for's, I have read that pressure cookers SHOULD NOT be used for pressure canning. So I thought I would pass that little gem of information on, so you don't make the same mistake I did.

While they are a great way to save money, energy and nutrients if you are unfamiliar with the pressure cooker get hold of a good modern cookbook to help you through the initial stages of learning to use it.

2.6 Cooking with a wok

The Chinese cooking pan known as a wok has been in use in Chinese kitchens for somewhere around a thousand years and because of its cheapness, efficiency and versatility it deserves a place in more Australian kitchens. The traditional round-bottomed wok is adaptable to most heat sources such as the gas stove, rocket stove kerosene or LPG primus, methylated spirits camping cooker, wood burning fire or, when a hole is cut into the plate, the family barbecue. The one power source it cannot be used on is the electric stove, but these days flat-bottomed woks are available for just this purpose.

Woks are very cheap in the Asian shops to be found in most large cities (ten to fifteen dollars each), so cheap you can afford to have more than one. They are available in a number of materials, the more common being aluminium, stainless steel, pressed mild steel and cast iron. I prefer the traditional pressed mild steel wok but the other types would be just as good.

The dish for which the wok shines over all other pans is the stir-fry, where all ingredients are cut up very finely and then cooked very quickly over high heat; this is economical on both energy and nutrients. Cooking in this manner is also different and a lot of fun! The Asian practice of using rice or noodles and vegetables in quantity and then using meat in small amounts as flavouring is also a trick worth learning. There are lots of good Asian cook books, but once you have mastered the basics it is a cuisine

which allows a lot of improvisation.

When you buy your pressed steel or cast iron wok you will need to clean it then "season" it, to give it a protective non-stick surface. First wash the wok with thoroughly with hot water, detergent and soap pad to remove any antirust or oily coatings, rinse, then dry.

Now rub the inner surface with a thick layer of good quality peanut oil and heat the wok until the oil appears to steam or smoke. After 3-5 minutes remove the wok from the heat and allow it to cool; then wipe away excess oil. The wok is now ready for use. After the wok has been used to cook in, it should only be rinsed with hot water to clean it. If detergent and cleaners are used on the inside surface it will need to be re-seasoned before its next use. When the wok has been cleaned and before you store it away wipe a thin layer of peanut oil onto the inner surface to act as a rust preventative.

The only absolutely essential accessory for your wok is the round-nosed shovel like implement (called a 'charn', see above photo) used to move food around the inside of the wok. If you are flush with cash other handy bits to have are a wire ladle for removing deep-fried morsels from hot oil, a solid ladle, a bamboo steaming basket or two, an aluminium or chrome steel ring to stick the wok on when it's off the heat and, of course, chopsticks. These add-ons increase the versatility of your wok so that it can be used to steam, braise, deep-fry and shallow-fry as well as stir fry.

3.0 Cooking with Stored Heat

3.1 Theory and Practice

The idea of cooking with stored heat has been around since medieval times, when they used to place their pre-heated cooking pots in a nest of hay, stray or dry leaves etc in a box or hole in the ground to finish cooking, thereby maximising fuel use. This practice continued in various guises and places up until the early part of the 20th century when, with advent of cheap electricity, we seemed to have forgotten about it. Hay box

cookers, as they are sometimes called, did enjoy a revival in the late 70s to early 80s when the fuel crisis set in and you can find instructions on how to make them in the self-sufficient living books of the time. They are a great tool to help you live more sustainably so maybe there should be a revival of the haybox again now!

Why bother?

- You can save fuel used to cook your dinner from between 20% and 80% depending on the recipe and how long it would normally cook for, the longer the cooking required, the more you save.
- In line with saving fuel, unless you live on a bush block and only burn wood, whatever fuel you use you will have to pay for so you can also save money.
- Reduced fuel usage (gas or electricity) means reduction in greenhouse gas production as well so you are saving the environment too.
- Longer cooking at lower temperature means that you maximise nutrients and flavour in the food you are cooking.
- I don't know about you, but I get nervous about leaving appliances on while I am not home, so you can put you dinner on before you leave for work, as you would with a slow cooker, but with no external energy input you won't come home to a pile of smoking wreckage!
- They are cheap, easy and lots of fun to build
- The food can sit in the stored heat cooker forever and not get burned or overcooked.
- While they are ideal for winter soups and stews they will also reduce heat input into the kitchen in summer
- Surprise your friends & amaze family, they turn up expecting a feed and find nothing on the stove, after a few minutes worried conversation you can yell "Ta Daaaaaaaa!" and pull a fully cooked meal out of the stored heat cooker. (Yes, I do have a perverse sense of humour)

The Components

To build a stored heat cooker you need to have three basics; an outer container, insulation material of some description and the inner cooking pot.

The Outer Container

The outer container can be a Styrofoam Esky or recycled broccoli box, an old trunk, wooden box or barrel, in fact any container that is large enough to hold the pot and insulation and is airtight. Wooden boxes or barrels with cracks between the slats or staves will need to be lined with cardboard or aluminium foil to ensure they are airtight. If the material of the box is also a good insulator such as Styrofoam, so much the better. The outer container can also be made from fabric as the Wonderbox is, but more on that later.

One thing I have found is that if the outer container resembles a nice piece of furniture such as an ottoman, blanket box, wooden chest etc it is more likely to be given space inside the house and so more likely to be used. The original one I made out of an old esky (see article in this section) worked extremely well but suffered from the fact that it looked like crap, even after Linda gave it a coat of silver paint to spruce it up it just looked like a silver painted old crap esky. So starting out with a nice looking container is a good thing, if you can build it even better, but since I made my original one I have bugged the living daylights out of Linda by saying of every bit of furniture we see that is box-like “you could make a hay box cooker out of that!”

The Insulation

There are a whole stack of things you can use as insulation and some obvious (and less obvious) ones are listed below -

- Hay or straw
- Crumpled newspaper
- Polystyrene foam
- Vacuum
- Blankets / clothing
- Wood wool/shavings
- Sleeping bag
- Wool /Feathers
- Leaves
- Perlite
- Sugar cane mulch (AKA bagasse)

There are no doubt other materials not on this list that you have access to and that could be considered as insulation for a stored heat cooker, but there are a few characteristics that are worth thinking about before you make your decision. Obviously enough the insulation must be able to withstand cooking temperatures, at least 100°C should be allowed for and it should not pump out toxic fumes or fibres. On the face of it, fibreglass (glasswool) would make a good choice, cheap, light and a great insulator, but it is nasty stuff to deal with so would not be a good idea.

Any insulating material should be able to be formed nice and snugly around the pot to reduce heat lost through convection and should be dry and able to be kept dry as insulation loses much of its insulating properties when wet due to conduction of the heat away through the water. Depending on the effectiveness of the insulation, it should be a minimum of 50 to 100mm thick (the exception here is when using a vacuum as the insulator, but that is difficult to home produce!). A very effective insulator like polystyrene foam need only be 50mm thick but the more traditional hay or straw should be 100mm thick as a minimum.

The Cooking Container

The pot could be made of a material that retains its heat well, such as Corning Ware, heavy stainless steel, well-seasoned or enamelled cast iron, or stoneware but if your cooker is efficient enough, the material of construction of the pot won't make that much difference. More important that the material of construction is the shape, it should have the smallest surface area per unit volume that you can manage. Of course the shape with the smallest surface area per unit volume is a sphere and spherical cooking pots are not that easy to come across, but the hint is short and squat like a billy not wide and flat like a frying pan.

The lid should also seal fairly well, have a lip so any condensing steam goes back into the pot and it should not have a steam hole as seems to be popular in pot lids these days. If the pot you wish to use is not perfect in the lid department but it is probably best to make up a bit of flour and water dough and use it to seal the rim and any steam holes the lid should have. I've tried this and it works really well.

Other Types of Stored Heat Cooker

There are commercial brand-name stored heat cookers on the market but the cheapest and most readily available commercial stored heat cooker is the wide mouth thermos flask, which uses a vacuum as the insulating medium. The vacuum flask makes a good cheap feed for one person and is portable so you could start it before going to work then take it to work for a hot, cooked lunch.

Interested in the idea but not sure if you want to go to all that effort? You can make an expedient stored heat cooker by preparing your dish as you would if you were going to transfer it to a stored heat cooker and then wrap it up in a blanket or two and stuff it into an eski, polystyrene broccoli box or if nothing else is available and corrugated

cardboard box. This will give you some idea how they work and it is a great idea if you get a blackout in the middle of cooking dinner!

Getting the best out of your stored heat cooker

You can cook many standard recipes in your stored heat cooker, particularly if they are "wet" recipes like soups, stews, casseroles and the like so trawling through your recipe books for these and recipes designed for slow cookers and one pot dishes should net a whole stack of possibilities. There are some things to look at though in adapting the recipes for use with the stored heat cooker –

1. Multiply cooking times by 3 at least so that the food is cooked through. There will not be a continuous heat input during the cooking process and although there is plenty of heat put into the dish at the start as it slowly cools the time taken to cook the food fully extends. Having said that, even cheap cuts of meat cooked in the stored heat cooker will come out moist and tender every time because of that long slow cooking.

2. Reduce water in the recipe by 25%. The pot will be well sealed and without the continuous heat input driving off water you will find that you don't need to put as much in to achieve the same consistency as you are used to.

3. Size the recipe so the pot is full, that way the maximum heat is stored in the food in the pot and it will retain its heat for the longest time, making for the most efficient cooking.

Using Your Stored Heat Cooker

OK, let's say they you have built your cooker and found or developed a recipe to try out in it and you are ready to go, what next? First off, bring your pot to the boil using whatever heat source you have available. Gas or electricity is most likely but it adds to the fun if you have built a rocket stove or solar cooker of some description and that way you know that no fossil fuels at all have been burnt to cook your food.

When your pot has been brought to the boil you will need to keep it there for long enough to ensure that the heat gets right to the centre of portions of food that you are cooking, so that for something small like rice, five minutes on the boil might be enough but for larger food like, say, whole potatoes 15 minutes boiling would be required. Once the boiling time is completed seal up any steam holes or cracks with a flour and water dough and place the pot in the cooker. Leave the pot in the cooker for the calculated cooking time and remember NO PEEKING! It lets the heat and steam out, slowing down the cooking process.

Once the cooking time has elapsed remove your pot from the cooker and check the temperature, if the temperature has dropped down to cooler than you like, reheat before you serve it and then enjoy! If you have left the pot in a lot longer than you planned to it will not overcook but if it has cooled down to below 60°C, bring it to the boil and re-boil for 5 minutes or so just to make sure there are no problems with bacteria.

Other Uses

You stored heat cooker does have a few other uses that you can put it to, like making yogurt. Yogurt is simply made in your stored heat cooker by heating milk in the cooking pot to about 85°C for a few minutes then let it cool to 45°C, throw in a couple of tablespoons of natural yogurt or live culture and then place into your stored heat cooker and leave overnight. Add some fruit and (hush, hush) maybe a bit of sugar and you have homemade yogurt.

You and also use it to place bread dough in to rise in cold weather (if it is big enough), use it to keep food cold in hot weather. If your cooker is portable you can use it to keep food hot while travelling to give you a good hot meal on the road and if you have pots

that fit your solar cooker, you can cook stuff during the day and then use the stored heat cooker to keep it hot until time for your evening meal.

Potential Difficulties

Like all technologies, this one is not a totally unmixed blessing, as with any slow cooker you can't decide you want to eat in half an hour, your meals must be planned to give you sufficient time to prepare them and then have them stay in the cooker long enough to finish the cooking time. The stored heat cooker's forte is not small meals, it is at its most efficient when you have the pots full, so if you are cooking for a crowd that's great but if not you may have plenty over to freeze for later! You also need to keep an eye on the insulating material, particularly if it is organic, as it can become damp with cooking steam and lose part of its insulating properties. The damp can also encourage bugs with the consequent smell and risk of contamination so air the cooker regularly and if in doubt replace the insulation.

3.2 Making a Stored Heat cooker – Furniture Based

My previous effort worked well, was cheap and easy to build, but had some shortcomings, I never did get around to building a nice wooden box for it to go into so it looks just like what it is, a crappy old esky, even after Linda gave it a coat of silver spray paint to tart it up for sustainable house day. Due to its crappy appearance it rarely made it into the house so it didn't get used as much as it should have and these things are great for saving energy. I just had to come up with something better!

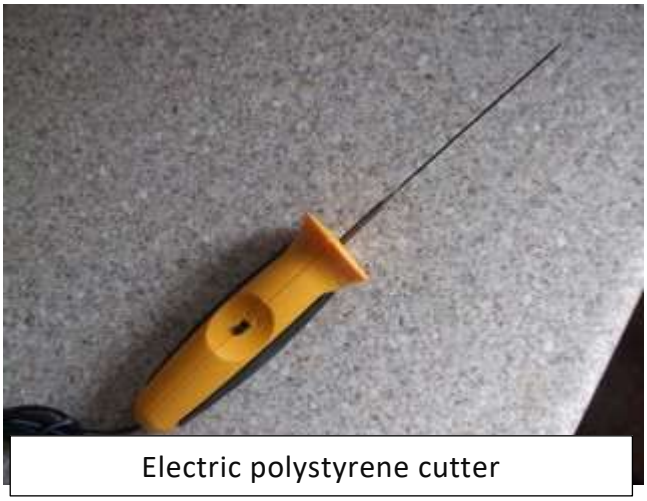
To make things better I needed to do a couple of things differently –

1. Build the thing into a nice looking piece of furniture that didn't look out of place inside the house and could be located near enough to the cooking area to make it readily useable.
2. Instead of using a billy or two as the cooking vessel, build it around cooking pots that we regularly use anyway making it easier to work out the recipes etc.

After some serious looking I found a comparatively cheap blanket box with a padded top that you could sit on, it was covered with a dark vinyl material and fitted our "decor" reasonably well, so I got it.

Converting it to a stored heat cooker was easy, I used the sheets of waste polystyrene foam that I had gotten hold of while working for the concrete precaster and cut them to size using a more sophisticated hot wire polystyrene cutter. We got hold of the cutter from a craft/model supply place in Gosford and rather than having a thin wire strung between contacts it had a stronger electrically heated wire attached to a handle that you can just push into the polystyrene and start cutting.

I cut a couple of sheets and put them into the box as insulation for the bottom of the pots and then cut three more sheets to act as insulation around the pots. The box is long and narrow so it took two pots easily; I selected a stainless steel 3 litre pot and a Pyrex casserole of about 4 litres capacity, then placed them on a



Electric polystyrene cutter

polystyrene sheet, traced around the bottom and then using the cutter, cut out a disk, leaving a hole the same size as the pot. I test fitted the pot into the hole and had to make a couple of minor cuts but the stainless steel pot fitted well. The Pyrex pot tapered from the bottom outwards to the top so it was a bit trickier but in the end I was able to get a reasonable fit.

To ensure that the holes were in the right place, I put the cut sheet on top of an uncut one and using a pencil, drew around the inside of the hole, transferring the outline to the uncut blank. I then pressed the hot wire cutter into service and cut around the pencil line, placed the two sheets on atop the other and test fitted the pots again. I followed this process a third time, making sure the pots fitted the entire profile of the hole, and then fitted the cut sheets into the box.

One pot fitted and one pillowcase in place

While most of the pots were now covered by the polystyrene foam sheets, the tops were still exposed so I got hold of a couple of pillowcases and filled them with polystyrene bean-bag beans and then Linda sewed them up. During that operation it is REALLY easy to spray beans all over the place and the staticky little things get into the strangest places. We found the best way to do it was to sew up the open end except for about 10cm or so, then put a wide mouthed jam funnel into the opening and sticky tape it in

Using the jam funnel to fill a (red) pillowcase with beans

place and pour the beans in through there. That method resulted in the least amount of beans lost.

In the event we got carried away and put too many beads in, there needs to be enough so that the tops are covered by at least 50mm of beans but not so much that the pillow case is too hard to conform to the top of the pots. We had to take out about a third of the beans that we had originally put in to get the fit right.

The new cooker is getting quite a bit of use and both containers have been used to make a number of meals, and it has been working so well that we talked about it with our eldest daughter and she thought it sounded great. We picked up an ottoman that was hollow inside and had a removable top and she and I made it into a stored heat cooker together. She has made several batches of “ottoman soup” and has found that it works really well.

The ottoman, ready to make ottoman soup!

3.3 Making Stored Heat Cooker – Fabric Based

I have always wanted to try out a stored heat cooker based on an insulation filled fabric bag. They are light and easily portable, cheap to make and from what I can gather work tolerably well. A friend of ours has one she keeps in a cane basket and it looks pretty good and she likes it. So we got together with some friends one Saturday afternoon and made one, it was lots of fun and we had a great time. I would recommend it as a great activity for friends and family and you get a stored heat cooker at the end of it.

The basic idea is that you cut out two circles of fabric, place one on top of the other and sew a small circle in the centre which becomes the bottom when filled with polystyrene foam bean bag beans. Then sew a dozen or more radiating lines from the central circle, out to the circumference of the circle. Fill each segment formed by the stitches with polystyrene beads and sew the open end shut. Sew on a draw string around the circumference of the circle and then draw it up tight around the pot you wish to cook in. Then make up a circular “cushion” filled with beans to sit on the top, inside the draw string, to prevent heat being lost through there.

Simple hey?

If you want a look at the pattern, check out Appendix 1 of this eBook.

This is how we made ours, in a bit more detail –

1. Get hold of the fabric you want to use. (You will need at least two and a half metres of cloth.)

2. It should be capable of putting up with contact with pots at 100^{o}C so a natural 100% cotton fibre material is probably best, for the inside at least. Fold the material in half and draw a 95cm circle on the fabric by putting a pencil in the centre, tying string onto it and then place some tailors chalk or soap at the 100cm mark on the string. Using the pen as a pivot, draw the circle with the tailors chalk or soap.

3. Cut out the circle, this will give you two disks of cloth. Turn the cloth so that the "wrong Sides" are together so that the pattern side of the cloth will be visible from inside and outside the bag.

4. Choose the pot you will be using inside your wonder bag and place it directly in the centre of your circle. Trace around the bottom of your pot with the tailors chalk or soap so that you have a circle drawn in the centre of the cloth disks the same size as your pot. This will most likely give you a circle 150mm – 200mm diameter.

Setting Out

5. Sew the two disks together using the centre circle but leave about 50mm unstitched, then use this gap to fill the centre circle with polystyrene beans until it is 20-25mm thick. Then sew the 50mm gap closed to form a central disk.

6. Lay out the cloth disks on a flat surface and draw 12 lines with the chalk or soap from the central circle out to the circumference of the cloth disk so that they are roughly equal distance from each other.

A bag ó Beans

7. Sew each line through both cloth disks from the circumference of the disk, into the central disk, forming 12 segments. Leaving a 2cm seam allowance fill each segment with bean bag beans. We found the easiest way to do this was to get hold of a 1 or 2 litre plastic or glass jug, pour the beans from the plastic bag into the jug then fill a segment using the jug(s). The 2 cm seam allowance will leave enough room to sew the segment shut. It works best if you fill one segment and then sew it shut before starting on the next one. Or the beans get EVERYWHERE!

8. Once all segments have been filled and sewn shut sew bias binding around the circumference of the bag. When we did ours the bias binding turned out to be about 35cm short, but rather than add on the extra, we simply hemmed it and it allowed us to pull in the top a bit tighter.

9. When the bias binding is in place, tie some cord or ribbon (we used thin ribbon) onto a safety pin and push it through the inside of the bias binding to form a draw string. It is just a case then of slowly working the draw string so that the edges of the segmented disk is drawn up into a cup shape around the pot to be used for cooking.

10. To make the top pillow cut out two disks of the same cloth as the cooker, a bit larger than the opening at the top of the cooker, ours came out at 260mm in diameter. Put the disks right side together and sew around the edge leaving 9-10 cm unsewn. Turn the sewn disk inside out so the fabric is right side out and fill with bean bag beans. Then sew the opening closed to stop the beans escaping.

Your wonderbag is now complete and ready to start cooking in!

4.0 Cooking with the Sun

4.1 Introduction

When I think about cooking with the sun, I think of two possible ways to go –

a) The higher tech indirect method, and
b) The lower tech direct method.

The higher tech method requires quite a few bits and pieces including solar electric panels, batteries, a solar charge controller such as an MPPT (Maximum Power Point

Tracker) and an inverter to convert the 12vac or 24vac from the batteries into 240vac. As well as this you need a whole lot of copper wire to transfer the power around your system, but it allows you to use your standard home appliances (depending on the size of your system) like an electric benchtop oven or induction cooker. This represents a fair bit of cash and requires work by licensed electricians to make it all come together but pays dividends in terms of convenience and allows you to 'cook with the sun' even after the sun has gone down!

In contrast, cooking with the sun using the sun directly is much simpler. There are many different designs out there of direct solar cookers and I have made and used quite a few. You don't need any assistance from tradies, you can do all the work yourself and the materials are comparatively inexpensive. Having said that, I do make use of professional glass cutters where glass and/or mirror cutting is required, but if you are, as they say 'skilled in the art' that might not be an issue for you. The rest of the construction requires only moderate DIY skills and I figure if I can do it, almost anyone can. There is also a certain satisfaction in cooking food using only the sun in a device you have build yourself. Every time I cook a meal in the solar oven I am amazed that it has been cooked wholly using the heat coming directly from the sun.

The downside is, of course, that you need a sunny day to do the cooking, plus you can only cook while the sun is shining and high enough in the sky to provide sufficient heat. Our main meal of the day is our evening meal and the low tech route can cause difficulties for that approach. However, by teaming up with another low tech cooking method – cooking with stored heat, it is still possible to have that hot evening meal even if the time of year means cooking with the sun will finish a bit early.

We have and use both approaches here, although I will admit that the convenience of the high tech method makes things easier, it does not have the satisfaction associated with the low tech method. Also, we had direct solar cooking appliances many years before we had the money to put the higher tech cooking methods in place.

Hence the writing of this eBook. I want to enable people who don't have the means to put their own solar electricity system in place to still be able to save money and energy, reduce waste and pollution, as well as increasing personal satisfaction by cooking directly with the sun.

4.2 The 'No Tech' Solar Oven

I love the idea of using the sun's energy directly, no pollution, no waste and no (energy) cost, it's fun to experiment with to dry or cook food or generate electricity and helps you become more independent from the power grid. Over twenty years ago I became interested in solar cookers, they are the obvious answer for when you have no fuel to cook your meals with, you want to increase your level of self-sufficiency and/or sustainability, do something good for the planet or you just want save money. It was one of those ideas that was just so good!

After a quick trip around the net I found **www.solarcooking.org** with plenty of low or no tech plans for building solar ovens and after some consideration I decided I wanted to build solar box cooker, this is basically one cardboard box inside another, with a clear panel to let the sun in (construction details to follow). It was mind bogglingly, cheap and easy to build, real alternative technology .....and it worked like a heap of crap!

I made it as per instructions, tried to cook a number of dishes using several different

food containers and the best that I could do was attain 60°C and that was in full sun! All it would do was warm the food and after a full day in the sun I still had to do most of the cooking in the gas oven.

The principle or theory that I was working on was that the inside box was insulated by then outside box and the inside box was then lined with aluminium foil to reflect the sunlight back onto the cooking pot once it had made it through the clear panel. So much for that theory! So I put it away in the shed and forgot about it for a while.

After doing some more searching on the net I found a small footnote on another website where a bloke who had been experimenting on his own account said that the secret was to have thin walled, matt black painted cooking pots and a matt black steel panel in the bottom to absorb the heat. This heat was then passed on to the cooking pot, in direct contact with it by conduction. This was exciting stuff and sounded like a serviceable new theory, but would it work?

Well, I put in a matt black steel panel and believe it or not, it did! All of a sudden I could

get up to 90°C and was able to cook an aluminium billy full of spuds perfectly in less than two hours. This technology made sense and worked fine if you set it up right.

Here is how I made the no-tech solar oven –

Construction details

1. Get hold of a large cardboard box, a smaller cardboard box (one which allows at least an inch of dead space all around once it is inserted in the larger box) a Glad® or equivalent brand oven bag, some aluminium foil, PVA glue and the steel plate with some matt black paint. Car engine enamel works well and puts up with the high temperatures.

2. Centre the bottom of the smaller box over the top of the larger one and, using a Stanley knife or equivalent, cut a hole in the top of the larger box so that the smaller one can slide into the larger one.

3. Now line the larger box with aluminium foil, shiny side out. This can most easily be done by getting hold of some PVA glue and a paint brush and painting the glue onto the cardboard and then smoothing on the foil. If the glue is a bit thick to use a brush, thin it down by mixing in a bit of water.

4. Cut the corners of the top of the smaller box into flaps and fold them out so that they support the smaller box centrally in the larger box. If you are going to insert insulation this should be done before the flaps are glued into place, locking the smaller box into the larger one. The insulation could be crumpled newspaper, straw, wool, polystyrene beads or what-have-you, anything that provides insulating dead-air spaces.

5. The smaller box may now be lined with aluminium foil, also shiny side out.

6. Once the inner and outer box are assembled and glued, the lid can be made by placing a flat piece of cardboard over the top of the double box and cutting it to leave a 25mm edge all around. The line where the box sits can then be scored and the ends cut to form flaps, the flaps are then folded down and around at the corners and glued, forming a tray shaped lid. This lid then has a three sided cut to put in the top of it to form a large flap the size of the inner box and then tape an oven bag over the hole to form a clear window to let the sun in.

7. The bottom of the flap should also be lined with aluminium foil to act as a mirror to reflect sunlight into the oven. A Z-shaped piece of wire is then inserted in the edge of the flap and the top of the box to keep the flap open at the right angle to act as a reflector.

8. To finish off the oven cut a piece of sheet metal to fit the bottom of the inner box, and hit it with some non-toxic matt black aerosol spray. Install the plate and you're ready to cook!

No Tech Cardboard Box Solar Oven

All it took was a couple of hours work and very little outlay (mostly for the oven bag) and I had raised my level of self reliance a notch! Well worth a go..... and as I said at the start - if I can do it, anyone can.

Inside the outer box showing alfoil lining and wool used as insulation

Inside the inner box showing alfoil lining and matt black metal plate

4.3 Our Main Solar Oven

Original Build

So having now found out how to make a solar oven work, it was time to get serious. A cardboard no-tech oven (see above) is one thing, but I wanted something that would last and would be more efficient. Having said that, I still have the original oven and it must be almost 15 years old now, it hasn't had a lot of use but is very valuable for demonstrating the principles of solar cooking.

I had picked up a book called "The Solar Cookery Book" by Beth and Dan Halacy yonks ago, and in it was a description of how to make a more efficient, and more permanent, solar oven. The oven was an angled box made out of 3/4" plywood with a glass front and reflectors to make use of the sunlight over a greater surface area than just the top of the box itself. Here was a solar oven of substance! I have seen similar designs that require the glass front to be fixed and a door to be cut in the back of the oven through which the food is put in the oven and retrieved. This seems to me to create immediate problems with sealing the oven, so I much prefer the simpler design described below, where the glass front is openable and the main body of the oven is a sealed unit.

The only time I seem to find to complete these major projects is over the Christmas break, and so it was with this one, it took about two full days of work to put together as well as some running around to get the glass front. The main body of the oven is constructed of ¾ " thick marine plywood, and I was lucky enough to have a couple of three foot by four foot sheets of the stuff in my garage. A friend of mine in the business was able to get me some 25mm thick compressed fibreglass batts and I had some thin, galvanised steel sheet left over from a previous project.

CONSTRUCTION DETAILS

The box

The carcase of the cooker was made out of 3 sheets of 20mm marine plywood, the base was cut to 500mm x 440mm, the two sloping sides were made by cutting diagonally across a 440mm x 440mm sheet to give a long end of 330mm and short end of 90mm. The third sheet was to form the front and back of the cooker, it was originally 435mm x

540mm and a cut at an angle of 60° was made in the 435mm side 90mm from one end. All cuts were made with a handheld, 200mm circular saw, the guide being tilted to achieve the 60° cut.

The solar oven hot box without glass

These were assembled into an open topped, angle sided box by fitting the front, back and sides to the outside of the base and then gluing and screwing them into position. Once this was completed, I cut the 25mm fibreglass insulation using a metal ruler and Stanley knife, first the one to go over the base and then the sides, back and front. To hold the base pad in place I secured it with four flat head nails about 50mm in from each corner, the other pieces rested in place temporarily.

Using tin snips I cut thin galvanised sheet to be placed over the fibreglass insulation, the one fitted to the base just rested on the four flat head nails, but the front, back and both sides were nailed in place using two flat head nails each that passed through the metal and fibreglass and into the wood, holding the entire assembly secure.

To finish off I applied two coats of matt black, high temperature enamel from a spray can over the metal lining, the edges of the fibreglass and the edge of the wood. To fully dry the enamel and remove any trace of solvents I then sat the whole box in the hot sun for a couple of days.

The next part was to get hold of the glass front, so I approached a local glasscutter and explained what I wanted. The Halacy book specified double strength window glass, which meant nothing to my glazier. Considering the temperatures that I hoped to develop (160°C+) he suggested special high temperature glass at a cost of over $200 for the 520mm x 520mm sheet that I wanted. After picking myself up off the floor I suggested that this was a tad outside my price range and was there no alternative? We agreed to try double thickness window glass (ie 6mm instead of the standard 3mm) but he was somewhat sceptical that it would work. At a price of $20 for the piece, I could afford a few mistakes!

Solar Oven Hot Box with Glass in Place

The case had by now dried sufficiently to continue work on it and I fitted some brown felt strips to the top edge of the box to seal the edge where the glass sat on it. The felt works well but faded to a light brown/crappy colour with the first use, so much for that idea. OK now comes the test for your cabinet making skills, the glass is absolutely flat and will show up any irregularities in the edge of your box……..mercilessly. Yes, I did have a bit of fill in at the lower left hand corner, where the 60° started out a bit wonky, so I shaved down a bit of thin wooden moulding that I had hanging around and glued and tacked it in place with panel pins.

This left a 10mm strip around the outside between the glass and the edge of the top of the box, by tacking on some split moulding, this formed a frame for the glass to sit in, and sit it did…… reasonably well anyway. Of course the question could be asked “how the hell do you get the glass on and off?” and I’m glad you asked, because thereby hangs a tale! The ultimate idea was to drill a hole through the glass and fit a wooden knob secured by a screw, but at this time I lacked a glass drill so I quickly bent up a bit of galvanised steel into a U shape, drilled a hole for the knob, which I installed and then fitted the whole thing over the glass, it looked chatty but was serviceable.

Detail of corner showing steel, insulation, felt and timber

When I finally did get around to drilling the hole and fitting the knob, it was only a matter of weeks before there was a split through the centre of the glass plate, which seemed to originate at the hole. Hmmm……that glazier may have been right……..bugger! I did think that it may have been due to the metal screw and the glass expanding and contracting under heat at different rates, but to be sure (after going back, cap in hand to get a new $20 piece of glass) I re-fitted the chatty but serviceable steel and have had no further problems (that was over 8 years ago).

So, now that I had completed the box itself, I was impatient to try it out and in full sun I found that I was able to get to 90°C to 100°C…….but I wanted more!

The Reflectors

To increase the efficiency of the oven by increasing the area harvesting the sunlight, I made some reflectors. The more of the suns' heat reflected into the oven, the higher the possible temperatures and I considered making the reflectors out of mirrors, but mirrors are heavy, expensive and fragile. Other possibilities are polished aluminium or mirror stainless, but these also tend to be expensive. To keep costs and weight down, I decided to use aluminium foil glued to 3mm medium density fibreboard (MDF) which has white melamine applied to one side.

The reflector was made up of two different shaped sections, with four pieces of each section. The rectangular sections were 540mm x 610mm, these were screwed onto the box with the 540mm side against the side of the box. When these were screwed on, it left four triangular spaces in between the rectangular reflectors, these were filled by triangular sections 610mm x 610mm x 390mm. The rectangular sections were fixed to the solar oven using two galvanised sheet metal brackets about 40mm x 100mm, bent to the required angle. The triangular sections were initially taped to the rectangular sections with packaging tape for testing, but this started to fall off and has now been replaced with two 50mm galvanised hinges bolted between each section.

Prior to fitting, the reflector sections had to be covered with aluminium foil (you guessed it…..shiny side out!) glued to the plain side of the MDF sheets. The best and most wrinkle free way of doing this is to paint the MDF with glue (in this case PVA) and then set it down on the already laid out aluminium foil. This worked well with the triangular sections, but because of the size of the rectangular sections they could only be partially covered this way. The rest had to be applied by placing the foil onto the pre-glued surface, which resulted in more wrinkles.

There is an aluminium foil tape available at hardware stores, and I have intentions of getting hold of some and using it to tape up the joints, to reflect more light and give a neater appearance. The reflector is then attached to the solar oven box by self-tapping screws. If built to size the angles should work out pretty well correct but to help in setting up, the angle between the back of the side panels and side of the cooker box should be 150°, the angle between the back of the top panel and the back of the cooker should be 180°(ie a straight line is formed) and the angle between the lower panel and the front side of the cooker (not the glass face) should be 120°. I used an ex-school protractor and the angles worked out OK.

The oven, once assembled, takes up a lot of space, and unless your have large amounts of free space (which we don't) it is handy to be able to separate and flatten out the reflector into sections for storage. As my elder daughter's boyfriend asked when he went out into the backyard and saw the completed solar oven – "Wow! What are you doing with the satellite dish?"

The oven works pretty well and in summer will develop 160°C to 180°C. It has produced some wonderful roasts and casseroles, and I think that it could do a lot more. The next trick will be to try baking bread in it. The oven is designed to be tipped up in winter, with what is normally the base of the oven becoming the back wall. This allows the lower angle of the suns rays to be made use of more effectively, but even so the best I have been able to do in mid winter is 120°C. This is still hot enough to cook most things, even though it takes somewhat longer.

Although quite a bit of work, the building and using of both ovens has been both educative and fun, and when the sun shines we can use it directly and cut down our use of fossil fuels, which is a win for us and the environment.

Update

The oven has now been in service for many and is still working well. The main problem that has emerged is that is it big, bulky and a pain in the bum to manoeuvre. When pulled apart it takes two people about 10 minutes to re-assemble, which reduces the likelihood of reassembly (especially seeing as I am the only one who does it!). So it tends to sit on the back deck partially in the weather and this is starting to have a detrimental effect on the ply, I consequently have applied 3 coats of oil based gloss paint (fire engine red!) and it now looks a lot happier. To make using it easier I have now installed it on a small trolley and store it under in one of the sheds so that to use it means it only needs to be wheeled out and turned towards the sun.

Over the last 3 years I have been using it to bake solar (sourdough) bread, and it turns out beautiful bread all year round, contrary to my initial expectations. The bread tin that I use was my wife's grandmother's and is ideal for solar making, it is made out of thin tin plate, it has a flat bottom and is sprayed black on the outside. I don't time the bread but just keep an eye on it until it looks browned enough. The only concession to using the sun is that you need to turn the tin around so that the other long surface faces the sun about half way through otherwise one side is perfectly cooked and the other is still a bit doughy – a trap for young players!

The aluminium foil – not as reflective as it once was

After 3 years in service the aluminium foil was starting to look a bit worse for wear, so I have covered it with a thin sliver coated plastic wrap, the type sold by the roll to wrap presents in. I haven't used the whole roll yet and it only cost me about a dollar – good value. It appears to be more reflective than the alfoil. I used the same old faithful PVA glue to attach it straight over the alfoil and it appears to have stuck so far. The problem was that I was unable to place the reflectors on the silver film so it looks like the surface of the moon in reverse (bubbles not craters!), but that notwithstanding it works well.

2015 Refurb

Our solar oven has been in regular use for over 15 years and has been starting to look a bit ……. worn. The reflectors are not flat anymore and are not so reflective anymore either. The reflective surface becomes dusty and oxidised over time and just doesn't work as well, some of the hinges holding the reflectors in place have come off also. The main box of the oven is still in good nick, although the felt edge seal is a bit worse for wear too. All up it is time for a refurb.

The oven as it was

The original set of reflectors were made from 6mm MDF (Medium Density Fibreboard) with a melamine coating on one side. They worked pretty well and were light enough but over time they have warped so that not all of the light falling on them is reflected into the oven box, reducing the oven's efficiency. This time I am having a go with 6mm 3 ply plywood which is a bit heavier but is also more rigid and resistant to warping because of the laminations. The plywood is also a bit more expensive. I was able to pick up 3 600mm x 1200mm sheets which is more than enough to make the four square main reflectors and four triangular corner reflectors.

To start I removed the originals from the oven box and recovered as much of the hardware (screws and hinges) as possible. I then marked out the new reflectors based on the dimensions of the originals with a one metre stainless steel rule and pencil, then made the required cuts with my hand circular saw. There was a bit of damage to the sharp points of the triangular corner sections but generally the approach worked fairly well.

The carcase of the oven with reflector attachments in place

After some consideration I decided it was easier to apply the reflecting material to the reflectors before installing them on the oven. The reflecting material which I used was the same as last time ie metallised plastic film gift wrap, with the unprinted reflective side facing out. It must be going out of fashion because I found it much more difficult to locate this time, so if you are going to make one of these ovens, start looking in newsagents and “el cheapo” shops now. If you can’t find the metallised plastic film then use aluminium foil with the shiny side out.

My original idea was to use some double-sided tape to secure the film to the reflectors – bad idea! First off if I pulled it off the reel too fast it left most of the adhesive of the other surface and my double-sided tape became single sided. Even when I was able to secure it to the reflector with an adhesive side out, id did not stick very well to the plywood so as I tried to apply the film the tape came away from the plywood and of course stuck to itself and to the reflecting film making one big mess!

The plywood reflectors cut out and ready to coat

I ended up by going back to the way I made the first one, painting each of the boards with a mix of PVE glue and water (50:50). The PVA is not an instant stick to you can remove and re-fix the film if there is a problem and by rubbing the surface over with a cloth you can move air bubbles to the edge of the plastic film and then out, making the surface flatter. To make the job easier I also cut the film oversized, then once the glue was set and the film stuck to the plywood well and truly I trimmed off the edges with a VERY sharp knife.

With the reflectors now in good shape I had a look at the bent steel brackets which connected the main square reflector panels to the plywood carcase of the oven. There a two of these on each side, each one connected by a single screw fixed into the side of the oven. They had become a bit deformed and bent out after being well used for 15 years or more so I unscrewed them and panel beat them back into shape with my trusty ball pein hammer and using the flat spot on the back of one of my engineers' vises as an anvil. The ones on each side of the oven had a tendency to slip back and forward if I tugged on the reflectors because they were only secured by a single screw, so I installed a second screw on each one to prevent this happening again.

Installing the second screw to stop the attachment from rotating

To fix the triangular corner reflectors to the main square side ones I used hinges at the top and bottom of each reflector. The easiest way to put the oven back together is to screw the square reflectors back into place on the oven carcase, affix the hinges to the triangular sections and then screw the triangular sections onto the square sections, thereby tying everything together (I hope!).

The freshly coated reflectors

The one downside of reassembling the oven with the film in place on the reflectors is that I do it by placing each hinge on the outside (uncoated) surface of the reflectors and then drilling through from the outside to the inside (coated surface) of the reflectors and then putting a bolt through each of the holes. Why is this a problem I hear you ask? Well, drilling the hole in from the uncoated side means that, more often than not, the drill dislodges and mangles the film rather than cutting through it cleanly. The only way I have found to do it without screwing it up is to hold a piece of wood firmly over the film and then drill through the reflector and film into the wood block. If you can hold the wood in place the hole is very neat and no other damage is done. (if you can't it still screws up!)

I worked my way around, first securing the square reflector which stands vertically at the back of the oven, and then the one on the right-hand side. I then then secured the corner reflector between the two squared ones. I then fitted the next square reflector in the series and the next corner one until they were all fitted.

The Finished Article

With the reflectors replaced the oven looks more like its old self, and is working better than ever. It has been well worth the effort and was long overdue!

Note: The plans and dimensions for the reflecting solar box oven are available as Appendix 2 of this eBook.

4.4 Parabolic Reflecting Solar Cooker

We have had the solar oven for many years and it will do most things that a normal oven would do, but I also wanted a solar cooker that would allow me to fry onions or boil up soup or other things that are traditionally done on the stovetop. I found the design for a parabolic reflector style solar cooker in the book “Cooking with the Sun” by Beth and Dan Halacy and used that as a basis for the cooker I put together.

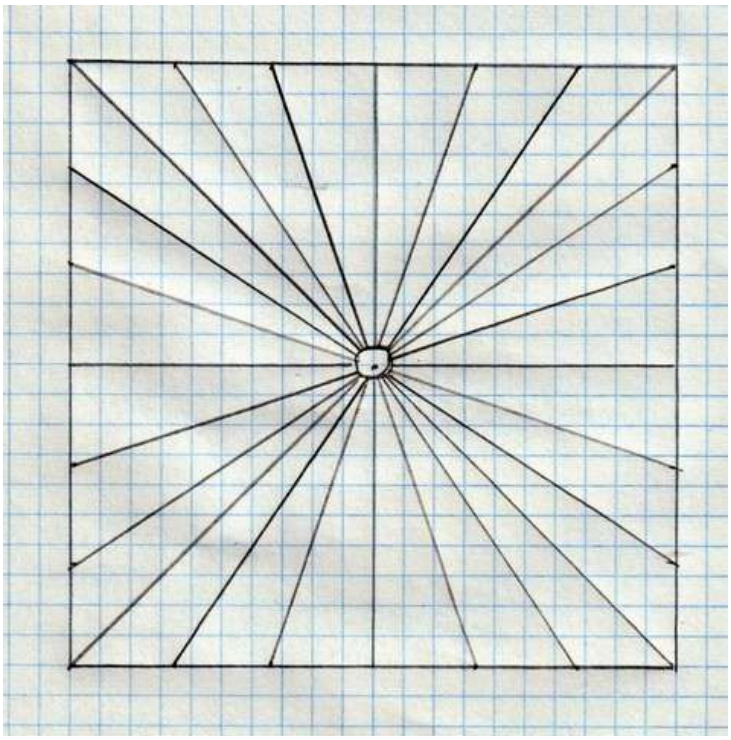
The way it works is that the reflective surface of the dish is pointed towards the sun and all the light (and heat) falling on the dish is reflected onto a single focal point. This is the point at which the cooking pot (or whatever) is placed, harvesting the heat coming off the reflector.

The base

In the original design, the primary material of construction was corrugated cardboard, but I was after something a little more robust and so I decided to use 6mm MDF for the base and 3mm MDF for the ribs. The original design also called for sides to be installed as well but I never bothered with those. In hindsight, they would probably be a good idea!

I bought a sheet of MDF and then cut it down to 820mm x 820mm with my circular saw. With the base now cut to size I needed to mark out where the ribs were to go and to fit the pipe flange (which would allow the pipe to be fitted which supports the cooking equipment).

To mark out the base I took a pencil and my one metre stainless steel rule and drew a line between each of the diagonals on the base, and then drew in lines joining the midpoint of each side, so that I had the positions for 8 ribs now in place. With these lines in place it was now just a case of measuring between each set of lines (which was, of course 410mm) dividing it into thirds and making a mark at each point. I then drew a pencil line from each marked point into the centre.

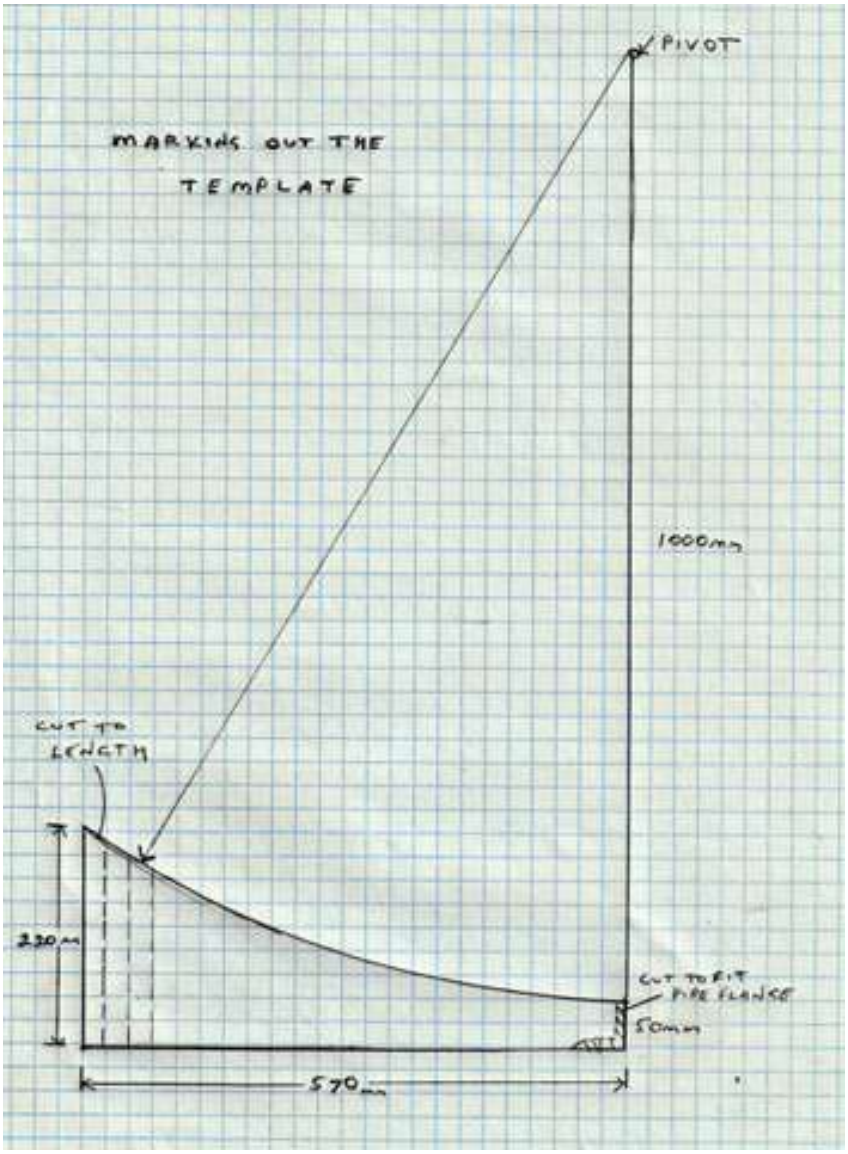


Thus, the base now had lines marked for 24 ribs.

The next trick was to install the centre pipe flange. The flange itself was 100mm in diameter and was set up to take 25mm diameter galvanised pipe. (Well, that is what you would get nowadays, the stuff I had was sitting around for years and was all imperial, the new stuff works just as well). I sat the centre of the flange over the centre of the base, where all the radiating lines converged, and then marked where two opposing bolt-holes were onto the base, drilled them out then bolted the flange in place. We were on our way!

Making the ribs

To mark out the ribs, the first thing to do is construct a template for the longest rib, which can then be used to mark out all the other ribs. The longest rib will be 220mm high at the highest end, 50mm high at the low end and 570mm long. Draw it out onto the material you wish to use as the template, (I used the 3mm MDF but you could use corrugated cardboard) get hold of a thin strip of wood a bit over a metre long and secure it such that one end pivots one metre away from the low end. Holding a pencil or pen at the end of the wood closest to the rib, use it to draw a curved line between the high and low ends of the rib. That is my best description of the process, but for a bit of clarity see the pic below.



With the rib set out, cut it along the lines with a knife, saw or if you have one, a band saw, making sure to stick exactly to the line. If all else fails cut the rib out a bit larger than the line, then use sandpaper to remove the material outside the line. Obviously, the more accurate the template is, the better all the ribs will be. There will also need to be a cut out from the bottom of the low end so that it can be fitted over the pipe flange in the centre of the baseboard.

To make the rest of the ribs it is just a case of using the template to mark them out and then cutting them out using a knife, hand saw, band saw or whatever you have on hand. Since only the diagonal ribs will be as long as the longest one, all the other ribs will need to be cut back so that they will fit on the baseboard.

Assembling the ribs

This means attaching the pre-cut rubs to the baseboard, which already has the pipe flange in place. To do that I used a construction adhesive, liquid nails. It was just a case of running a bead of adhesive along the bottom of the rib, putting it in place that then holding it for a short time to give the adhesive some time to set up, then moving on to the next rib. They can be done in stages or all at once, it is then best to leave the set up for at least 24 hours or even better for 7 days to give the glue time to reach full strength.

Applying the Reflective Surface

There are a number of ways to do this, but the one I used and which seems to work best is to get hold of some mirror finish card from our local newsagent.

To make the sections of the mirror I measured up the longest triangle and made a pattern from cardboard, overhanging the ribs on each side. I used this to cut out four

triangles from the mirror card, then turned it over and cut out four triangles of the opposite side. I then followed the same process (measure, pattern, cut from one side then cut from the other) to make the rest of the mirror triangles. There is no need to get too finicky with cutting and gluing the pointy ends, they will be covered once the mirror is finished.

To apply the mirror card reflective surface to the ribs, it is just a case of applying adhesive (construction adhesive will work) to the ribs and then placing the mirror card, face up onto the ribs on each side, smoothing it out and holding it for a few minutes so it will stick. It works best if only every second set of ribs is used first, and then left to cure. The next day the infill mirror card between each existing mirror card can be applied. To finish off I cut a 100mm disc of the mirror card, then cut a 25mm hole in the centre. I then glued the ring of mirror card over the centre of the mirror (mirror side up of course!) so that the centre of the reflective area was tidied up and covered with reflective surface.

Cooking surface mount

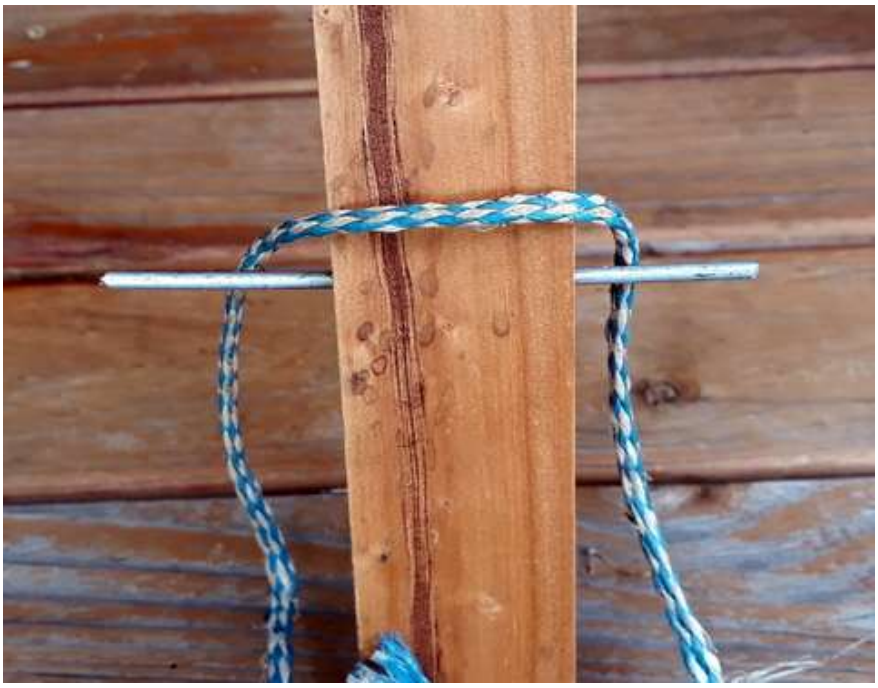
The idea is that the focal point on which the sun's rays are to be concentrated is on the bottom of the cooking pot or hotplate to be used. To achieve this, I screwed the 25mm steel tubing into the galvanised pipe flange in the centre of the completed parabolic dish, then using the shadow of the pipe on the mirror surface to point the dish directly at the sun. The curve of the dish is based around a 1 metre radius curve so the focal point of the reflected light should be around 500mm along the steel tubing (so your steel tubing should be 550mm to 600mm long to allow for some variation).

I made a mark around the pipe where the focal point was (quickly! It heated up remarkably fast!) then turned the cooker out of the sun. When the pipe had cooled I traced around the pipe at the focal point parallel to the ground, removed and then cut the end of the pipe off with my angle grinder. That way the end of the pipe would be flat when I wanted to put anything on it.

Obviously, sitting a pot on the end of the pipe would be anything but secure so I welded a piece of 330mm x 3mm threaded rod and 290mm x 6mm steel bar (it was what I had available) into a cross formation on the end of the tube to support the cooking pots etc.

Cooker support

Unless you live on the equator, having the cooker lying flat on the ground won't achieve much so there has to be a way to set the correct angle of the cooker so that the focal point is on the bottom of the cooking pot.



To make the support I got hold of some 42mm x 19mm DAR pine about 1100mm long. I then drilled a series of 4mm holes through the 19mm sides of the pine, starting at 600mm from the ground and then every 30mm for seven holes. I then inserted a length of mm aluminium welding rod 120mm long to secure the twine to. To hold the reflector and support together I cut 450mm of twine and tied both ends together to form a circle. To hold the twine onto the reflector I screwed a small rope cleat to the back of the reflector at the top.

To use the support it is just a case of hooking the twine over the cleat and then around the aluminium welding rod through the pine support. The angle can be varied by moving the aluminium rod through a higher or lower hole, depending on the angle of the sun.

How does it work?

It actually works very well! I used to do some work with paraffin wax and used the parabolic cooker to melt the wax on many occasions. I did also use it for cooking, usually as a way of boiling water and making soups or stews, but I also used it for frying in a frypan and that worked well too. As far as I could see there were three drawbacks to this type of solar cooker and the first one may be (OK, was) due to my crap design –

1. The location of the pot on the supports was not hugely secure. The pot or pan could slide about a bit when being inspected or stirred. In fact one day a billy can full of wax fell of due to the effect of wind and paraffin coated a part of the reflective surface. This can also cause problems when trying to move the apparatus so that it continues to face the sun during the cooking period. It would be better to remove the pot, move the

reflector, then replace the pot on the support. Not a big issue, but an issue nevertheless. A better pot support design could fix the problem I am sure!

2. Speaking of wind, due to the particular design of the cooker, the pot or pan in use sticks out and away from the cooker so that on a day with good sun, but a cool or cold wind, some of the heat is taken away resulting in the pot being cooled by the wind and the cooking time extended.

3. As with other solar cookers, you need to be careful when looking at the pot to ensure you don't cop a face full of reflected solar. Dark glasses should always be worn and care taken when performing such operations.

Bearing the above points the parabolic solar cooker has given us many years of faithful service and I would highly recommend it, either as a standalone or in conjunction with a solar oven

Postscript

I have heard it said that all good things must come to an end and so it has proven with our parabolic reflecting solar cooker. Recently, we were subjected to three years of La Nina, or in other words – long spells of very wet weather. This meant there was not much use for our solar cookers and so they mostly stayed in the shed. What I did not know is that the shed had also developed a leak over the area where the cooker was stored. When I finally removed it from the shed, it was so water damaged (the MDF had expanded and broken apart) as to be irrecoverable. It is, therefore, with heavy heart that I announce that our parabolic reflecting solar cooker is no longer with us.

4.5 The 'Primrose' Reflecting Panel Solar Cooker

I first came across this type of solar cook about 20 years ago and determined to make one. I saw similar constructions on two websites, one was French and the other German, one referred to it as the 'Nelpa' (an anagram of 'panel' evidently) and the other called it a 'Primrose' (no idea where they got the name!). The thing I found

interesting was that, while each site had plans, they left out certain critical dimensions. Fortunately (for me) they left out *different* dimensions so that I was able to put the two plans together and build one for myself!

The cooker may be broken down into two pieces:
– The carcase – which supports both the cooking gear, consisting of a matt black painted pot, and the reflector, and
- The reflector unit itself

The way it works is that the reflector is a series of rectangular glass mirrors mounted in such a way that, when faced towards the sun, the reflection of the suns' heat from the mirrors all hit the bottom of the cooking pot. The carcase has a glass bottom on the box that supports the cooking pot allowing the sun's rays to heat the bottom, and some of the sides, of the pot. The reflector is mounted in the carcase so that its angle can be changed to ensure that the heat hits the pot. It is also constructed so that the reflector can be pulled up against the carcase to make storage and transport easier.

How I built the Carcase

The carcase is composed of four legs with a plywood box at the top that has a glass bottom and supports the cooking pot. There is some insulation inside and outside the box to reduce heat loss.

I made the two sides (each consisting of two legs) from 42mm x 18mm DAR pine. I cut two 910mm lengths of the pine to form the vertical legs and joined them together with two 395mm horizontal braces, one 115mm up from the bottom and the second one across the top, all of them being screwed into place with a single countersunk wood screw, in from each end. I then added in another piece of pine, angled so that the top of the pine was 100mm from the top on one side and 200mm from the top in the other. This would form the support for the glass bottom of the box. I then made the second side, same as the first!

On the legs closest to the reflector I attached on each a piece of thin galvanised steel sheet that was 110mm x 42 mm on the outside of the leg about 200mm up from the bottom end of the leg with two screws. I then drilled a 6mm hole through the leg and steel sheeting 50mm up from the bottom of the plate. This is to act as the pivot point for the reflector.

I then joined each side together using a single piece of 19mm thick DAR pine which was 660mm long by 220mm wide and held in place by 4 countersunk wood screws. The sides of the box are rounded out by a piece of DAR pine 620mm x 112mm x 20mm which is angled back slightly from the bottom to the top to allow the reflector to rest against it when it is folded up. It is covered by 20mm thick fibreglass insulation 600mm x 120mm and secured by two wood screws and washers.

Insulation removed

Insulation in place

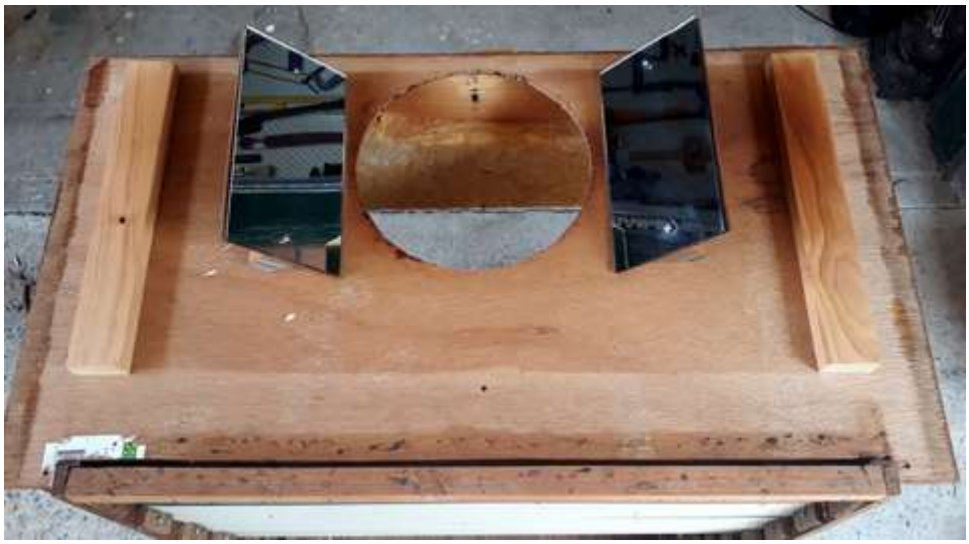
The side with cover removed showing insulation in place

The bottom of the box is formed by a piece of 3mm glass, 620mm x 350mm in size, secured against the bottom of the box by 5mm plywood tacked in place all the way around it. The top of the box is formed by a piece of 10mm plywood 720mm long x 400mm wide. The top has a 205mm hole to support the cooking pot and a cutout on the front of 620mm x 20mm also to allow the reflector to be folded up against the face of the carcase. To make a better seal but still allow the top to be removable, I put some felt between the top and rest of the carcase to prevent the heat escaping.

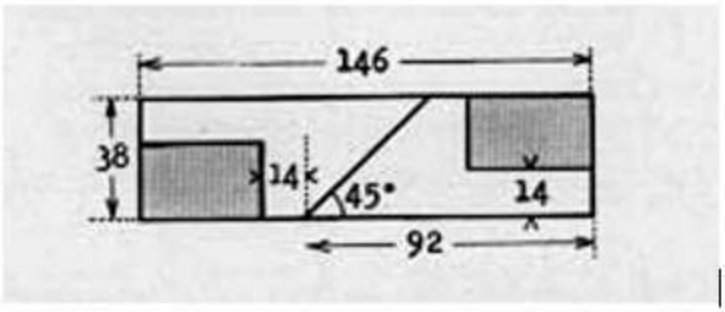
Looking down into the carcase, top removed, through the glass bottom

The top from above

Due to the cooking pot being so much smaller than the width of the cooker, there is also a fitting each side holding a piece of mirror angled at 45° to reflect more of the suns heat onto the sides of the pot. The diagrams below show the dimensions of the fittings (two per side mirror) and where they are fixed in place.



How the fittings are fixed to the underside of the top



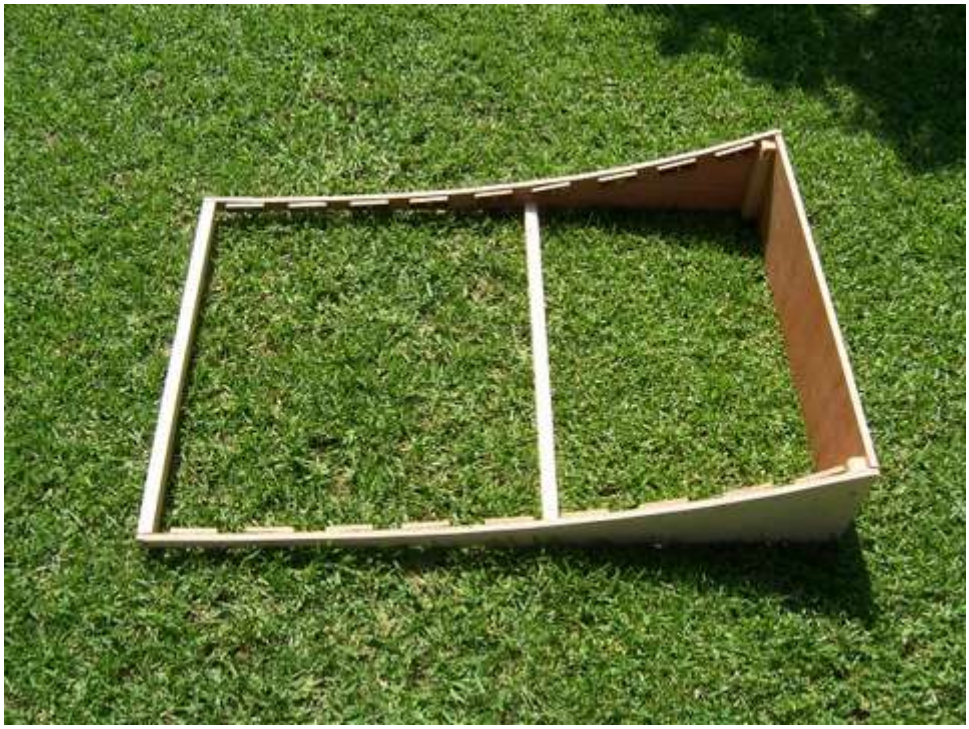
Dimensions of the fittings

The pot is a 205mm stainless steel pot and lid, with the outside of the pot painted with matt black engine enamel. I removed the handle of the pot so it would fit into the hole and made sure the pot I used had a flange on the top edge so most of the pot would sit down into the cooker but not fall through.

I probably could have made the cooker a bit narrower, but I wanted to make sure that things were stable, and it was unlikely to tip over.

How I built the reflector

The reflector is a box 900mm long by 620mm wide, and the sides are graduated from 20mm thick at its thinnest point up to 172mm at its deepest point. It is made from 10mm 5 ply. Mounted on the reflector are 9 x 100mm wide by 595mm long pieces of mirror glass. Due to the mirrors I had available there are a number of different thicknesses of glass. (hint: thicker is more robust, so better).

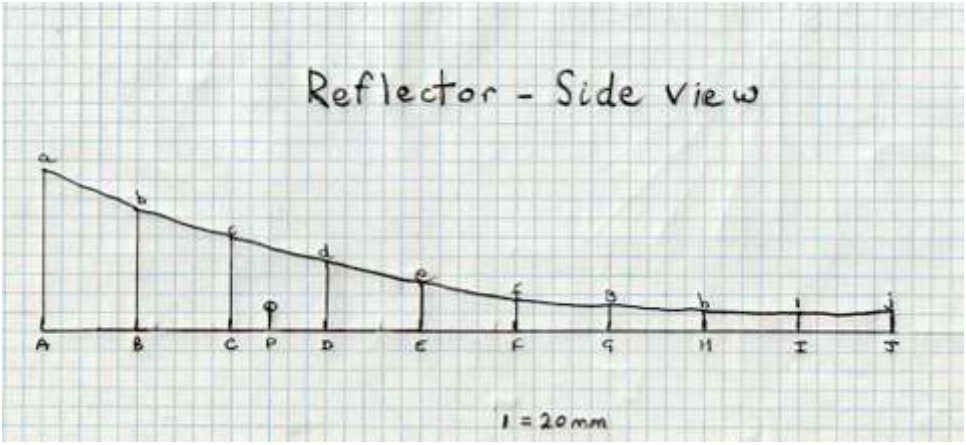


Regarding the mirror glass reflectors, it had been my intention to cut them to size myself, using a hand glass cutter. I had enough mirror glass to cut the 9 pieces I needed for the reflector plus some spares. Having irretrievable stuffed the first couple I had tried to cut, I decided this was a job for a professional and approached a local glazier to cut them for me, which they did. I can't remember how much it cost, but it wasn't too much and being 20 years or so ago would be no indication of what that might cost today. Moral of story: there is no shame in getting help with the more technical parts of a project!

The sides of the reflector are graduated so that the reflection from each individual mirror will hit the same spot, ie the bottom of the pot through the glass bottom of the carcase.

To build the reflector I got hold of some 10mm plywood as mentioned above. Three pieces were required – 2 x 879mm long by 172mm wide to make the sides and 1 x 600mm long by 172mm wide. For the fourth part of the reflector box (at the thin end) I used some 20mm x 20mm pine.

To make the curve on the sides of the reflector box and thus ensure the mirrors were at the correct angle, I marked what would be the bottom of the reflector at intervals as per the 'Horizontal Distances' in the table below. I then measured out the 'vertical distances' as per the table below. By joining up the tops of the lines, this gave me the correct curve to place the mirrors on and I then cut out the curve from both sides of the reflector box.



Horizontal Distances		Vertical Distances	
A-B	91.5mm	A-a	172mm
B-C	94.5mm	B-b	131.5mm
C-D	96.5mm	C-c	99mm
D-E	98mm	D-d	73mm
E-F	99mm	E-e	53mm
F-G	99.5mm	F-f	38.5mm
G-H	100mm	G-g	28.5mm
H-I	100mm	H-h	22.5mm
I-J	100mm	I-i	20mm
A-P*	240mm	J-j	21mm
		P*	27mm

Using some 20mm x 20mm pine in the corners as braces I put the reflector box together using wood screws and added a 20mm x 20mm pine brace 365mm from the high end of the reflector box.

To put the mirrors in I screwed supports made from 20mm x 5mm rounded edge moulding with one side sawn off to make it flat, to the inside of the sides of the reflector box so that the mirror could be put in place inside the reflector box and at the correct angle. Once the mirrors were in place I secured them by screwing more 20mm x 5mm rounded edge moulding along over the top of the ends of the mirrors.

I drilled a 6mm hole in each side of the reflector at point 'P*' (P standing for 'pivot!) and then slid in a 6mm x 50mm bolt with a wingnut on the outside to tighten the pivot and secure the reflector to ensure it remained at the correct angle.

Advantages and disadvantages

Advantages of this design

- The lid is accessible (as opposed to a solar oven where the whole pot is enclosed) allowing the food to be tasted, added to, stirred etc.
- The bottom of the pot is heated, allowing parts of the recipe to be fried before putting the lid on eg, when making spaghetti Bolognese the onions and garlic can be fried off, then the mince added and browned before adding sauces etc. This is impractical when using a solar oven style cooker.
- Steam escaping when the food is heated does not condense on the reflector.

Disadvantages of this design

- It is far and away the most complex design I have ever put together.
- Some heat will be lost to the system in the steam escaping from the lid and through the uninsulated lid itself.

While it is a complex build, it was a lot of fun and has now been in existence for 20 years and still is working perfectly. There has only ever been one issue, when we had an open day and it was out for inspection, the child of one couple decided it was built to be climbed in and when our backs were turned, he did just that, breaking one of the mirrors. It was only a minor hiccup as I had spare mirrors prepared for just such an occasion.

Note the missing mirror

5.0 Cooking with a Rocket Stove

5.1 Introduction to Cooking with a Rocket Stove

To start it, crumple up a bit of newspaper and push it down into the combustion chamber without completely obstructing the air intake, get some thin dry twigs and push them into the fuel chamber until the protrude into the combustion chamber. Then drop some lit matches down onto the paper until it catches, it may take a few or you might want to add a few drops of accelerant like kero or metho, but not petrol (Which is too damn dangerous!). Even with the metho make sure not to look down into the combustion chamber when you drop in the match or you may lose an eyebrow or two, think Adam Savage on Mythbusters.

While I have read reports of these things starting up “like a rocket” that has not been my experience, it tends to start slow and may take a few minutes to really get going, especially if the fuel is not bone dry or if the weather is cold. Use the same process you normally would for starting a fire – start out with thin easily combustible twigs and then once the fire (combustion chamber) has warmed up you can use twigs up to 10 -12mm in thickness and it will go like a rocket!

Due to the output of the rocket stove hitting the bottom of the cooking vessel and then being directed around the sides, it seems to me ideal for use with the rounded shape of a wok and the high heat, high speed also suit the wok style of cooking. The wok ring used to support the wok on top of the rocket stove keeps it pretty close to the right distance from the outlet for the hot gases and the ventilation holes in the side are close to the same surface area as the combustion chamber outlet. In other words, all the heat from the twigs hits the bottom of the wok. As an experiment I half-filled our most used size of wok half full of water and was able to heat it from dead cold to over 90°C in a 20 minutes or so.

While it takes a bit of food preparation, usually done inside, the cooking done on a rocket stove outside is essentially no different in concept from cooking on a barbeque, just a lot quicker and more efficient. I have cooked fried rice, Chinese style omelettes and a number of stir fries using our rocket stove, and I continue to be amazed at how easy, efficient (and fun!) the cooking is, and it floats my boat that I can cook out dinner with a few twigs grown in the front yard. Following is how I do it –

Preparation is important in this style of cooking so I harvested the veggies I was going to use and cut them up into strips, rounds or small lumps and set them out on two cutting boards ready to be taken outside, I also broke a half a dozen of our home produced eggs into a mug and whisked them with a fork. Alas the noodles I was using were not homemade but bought fresh from our local supermarket. I took all of the ingredients as well as the sauces out onto the back deck in preparation for cooking. I have not gotten around to making legs for the rocket stove so placing it on the back deck while I stand on the ground brings it up to the right height and the deck itself provides plenty of work space to set things out where I can get at them.

Once everything is in place I started the stove and waited until we were getting a good draught of flame out the top, the wok went on top and some oil went in to heat, once the oil was smoking (just a minute or two) the egg went in I moved it around until it was cooked and cut into lumps, I then removed it from the wok into a container. The wok reheated within seconds, and I added the veggies one type at a time, onions and hard veggies first, followed by the softer ones with about a minute of cooking between each one and then put the cooked egg back in to reheat.

With the eggs and veggies cooked I tossed in the noodles and heated them through and added the sauces, in this case some oyster sauce and char siu (Chinese barbeque) sauce. While the additions and cooking was going on I was keeping an eye on the heat and adding new twigs as the originals burned down. A stoker would be handy but I have been quite able to keep the fire going and still cook with all the dishes that I have made with the rocket stove so far.

The dish was finished so I took it inside to eat, removing the largest of the still burning

twigs and letting the fire burn down. Once the fire was out, I tipped the small amount of ash left onto one of the veggie patches. So I was able to cook a meal for three, with leftovers, in about 15 minutes or less using just trimmings from the mulberry tree taken last year.

I did put the rocket stove in the garage as rain was predicted and water in the wood ash insulation removes or reduces any insulating properties and causes it to all clag together, so if you are using wood ash to insulate your rocket stove, keep it dry!
You can even barbecue over a rocket stove (Vegetarians avert your eyes)

5.2 Making a Rocket Stove – Type One

This little low-tech wonder of high efficiency cooking was developed by an American gentleman, Dr Larry Winiarski for use in the third world to reduce firewood usage. I have also seen them referred to as right-angle stoves.

I had been aware of them for some time but made a critical error in understanding how they worked and only recently realised their true value and made one for us to use. They are ideal heat sources when the sun doesn't shine and use sustainable, renewable biomass (wood).

In principle you take a right-angle tube about 100mm in diameter or 125mm square and insulate the firebox heavily so that head from the fuel goes into cooking your tucker rather than heating up the stove. You can use thin wall steel for your right-angle tube-like tin cans or galvanised stove pipe, I used a bit thicker wall tube because it was what I had lying around, but also it will last longer. You can use a mixture of clay and sawdust to make insulating bricks to construct the right-angle combustion chamber but you have to work out a way to fire them. By and large the steel combustion chamber works

for me!

Construction details

The outer casing of the stove is easy to build out of a recycled 20 litre tin which, again, is what I had hanging around, I also had the 90mm steel tube and some ashes hanging around to use as insulation. I could build this thing for virtually nothing!

I cut a roughly 90mm hole about 35-40mm in the side of the tin about 35-40mm up from the bottom and another 90mm hole in the centre of the top. I did this by first using a set of steel dividers to scribe where the holes would be, then using an electric drill and a 2mm or so drill (all the marking get worn off my drills, comes from not tightening up the chuck enough) holes inside the circumference of the scribed circle. By jiggling and angling the drill back and forth you can sever the small webs between the holes. Then using a round file and ball pein hammer you can clean up the hole so it actually looks round! Due to the curve of the tin the hole in the side will need to be a bit wider than the scribed circle but a bit of extra filing and a bit of tapping with your ball pein will sort it out. Try your tube for fit often to make sure you don't go too far.

That part was relatively straight forward except that I chose a Sydney heat wave day when it was 45ºC in the garage and I was sweating like a pig! I then had to cut the pipe on an angle so that when I turned the pieces around they met at a neat right angle. I figured I would do this the same as I would for a bit of square timber by marking off the section to cut with two parallel lines around the tube 90mm apart and a then marked an angle around the tube between the two lines so that I had a line at 45º around the tube. I then cut this line using an angle grinder (my favourite tool!) fitted with a metal cutting disk. This should have meant that when I turned the two cut ends of the tube around, they would meet at a neat 45º. Did I ever tell you that I don't understand the 3 dimensional geometry of tubes? The cut surfaces had a really weird profile and lots of open space, but with my trusty angle grinder, this time fitted with a grinding disk (did I mention it is my favourite tool?) I tapered the angle off to something closer to 40º and the fit was reasonable.

My next trick was to weld the tube in the right-angle position. Ummm I'm not as good a welder as I thought I was either, but with the arc welder on 70 amps and with a couple of 1.6mm rods I managed it with a minimum of blow-throughs and curse words. It don't look pretty but it will hold together and be a sealed joint. If I had had an oxy-acetylene set I would probably have done a better job, but I didn't so there you go.

All of this just goes to illustrate why people buy an already formed right-angle section of stove pipe, so they don't have to go stuffing around like I did to sort out that part of the design. All in all to cut and weld the tube probably only took me about 4 hours…….easy! If I was doing it again I would probably make a tin-can or paper mock up first so that I could work in some easier material and get the real thing right first time. I'm a bugger for not doing that though!

I hunted through my stock of scrap metal and came up with a length of 6mm steel strap. It was somewhat thicker than I was looking for but would do the job and the width and length looked good. It had a couple of angles welded to it but judicious application of my favourite tool and they were gone. I then tack welded this piece into the bottom of the combustion chamber so that the fuel would sit on this plate but as the fuel burned, air would be drawn in underneath to ensure that there was efficient combustion. The plate should sit in the horizontal fuel chamber but not protrude into

the vertical combustion chamber.

I then installed the right-angled tube into the supporting steel 20 litre container and poured in the ashes that I was going to use as insulation. I had been saving ashes from our two wood burning heaters for use in the garden but in keeping with the ethic of using stuff that I had on hand, in they went. You could use perlite or vermiculite, anything that would stand up to the heat and contain trapped air to act as an insulator. Sand and earth etc. are good thermal mass, ie they absorb and retain heat but are not good insulators so should not be used in this case.

The next thing is to set up some chocks for the cooking pot, wok or whatever to support it the right distance above the hot gases coming out of the stove chimney. To make sure that as much of the hot gases as possible are used, the pot should be arranged so that the area between the end of the chimney and the bottom of the cooking pot is the same as the cross sectional area of the chimney itself.

I use ours quite a lot with our wok for stir fries, omelettes and the like and find that the commercial wok ring that I use to support the wok over the output of the combustion chamber works really well. I have a cast iron square fry pan sort of thing I use with it for

barbeques and that works well with the wok ring too.

Fuel

One of the reasons that I have taken such a shine to the rocket stove is that around where I live the parks and roadsides and park like areas have lots of tall gum trees. There trees seem to drop a constant stream of twigs and small branches which accumulate until they are hit by the council mower. These sticks are an ideal size for use in the stove, plentiful, sustainable and free but any small sticks such as cut up pallet wood or other waste timber could be used.

5.3 Making a Rocket Stove – Type Two – By Kevin Mechelmans

Make a list of materials you think you'll need to make the rocket stove and then collect them. I initially intended to use two Alpen blend drinking chocolate tins and a 1kg coffee tin (free from work) but ended up substituting one of the chocolate tins for a longer asparagus can as the chocolate tin did not have the height.

I drew up circles on the 1kg tin and the chocolate tin which will serve as my combustion chamber. I removed the bottom of the asparagus tin with a can opener.

I then drilled 3.5 mm holes just inside the line marked on both tins and then cut out the circle with side cutters. After removing the cut-out I made small cuts every 2-3 holes to make the metal more pliable and pushed down the sharp ends into the tin.

Draw up a circle using the asparagus can as a mould on the lid of the coffee tin. Then drill and cut out the mould as previously done.

I then pushed the chimney (asparagus can) into the combustion chamber (chocolate tin) and fixed them together with two small screws.

I took the cut-outs and fixed them together as shown to serve as a base for the combustion chamber and chimney until the perlite went in.

I glued the combustion chamber in place with a glue-gun (I know it wouldn't last once the stove got going but I needed the extra support until the perlite and lid where in

place). At least it was designed to be heated up and release a minimum of toxic fumes (Nev's still alive).

I still needed to divide the fuel and the airflow so I made some cut-outs from a drink can, I know what you're thinking the combustion chamber will reach up to 1000 deg C and more and aluminium will melt at around 660 deg C, but it was all I had on hand. Did some consulting with Nev on the firing day and going to make some modifications to the combustion chamber so I can fit a steel plate in there and still fit the lid on.

I made some pot stands out of a spaghetti tin but they proved to be too flimsy to hold a 2litre pot of water so a trip to Bunnings was needed where I picked up the perlite and 2 pieces of metal with holes every 5mm which I cut in two to produce 4 brackets.

I marked up where I wanted to put the brackets ensuring I have enough clearance to allow for airflow I then drilled the holes in the stove and used pop rivets to hold them in place and then bend them down to the required height. Tip: add in the perlite before you put on the brackets, luckily the brackets are pliable so I could still get the lid off.

With the perlite added it was time to find some fuel and fire up the stove! Tip: use a pot/kettle that either your missus or the mother-in-law does not mind getting black. As Nev provided the kettle, fuel, some tools and some good advice he was the one to fire up the stove.

We used a whistling kettle with approx 1.5 - 2litres of water. It took around 15mins to boil the water. There was a fair amount of smoke, but that could have been due to the glue and fuel holder (aluminium drink can) melting.

All in all it was a fun and productive project that used the minimum of bought materials that in my opinion worked out pretty well.

Also in the end I made Linda a cup of coffee with the boiled water (it had the old campfire taste to it) and cleaned the kettle after letting it cool a bit to hoping to ensure I stayed in her good books.

I am already drawing up plans for my 2nd and 3rd and 4th stoves. I have two more 1kg coffee tins and one 500gr coffee tin, might do the 500gr one first, would like to use 2 chocolate tins as initially intended.

5.4 Making a Rocket Stove – Type Three – by Don Lanham

Why a rocket stove you ask, I happen to have a lot of twigs fall from trees around me and this is all that is needed to fire up the stove for a quick meal. I don't need all those big logs you normally associate with an open fire, and it burns so clean, without the risk of setting the surrounds alight.

On the other side, I work with metal and find certain bits and pieces laying around destined for the scrap bin. A good permie finds a way to reuse these sorts of things so from an old piece of 125mm pipe which used to water mushrooms and some bathroom floor off cuts when combined, make what you see here.

How to Make It

First I started with the old pipe and mitred the end at 45° and re-welded it to form a right angle. Using some off cuts off a flooring job, I've bolted the sides together with angle strips. Size was carefully calculated using the formula "use what you got". The little piece of RHS (rectangular hollow section) you see on the bottom is just to make the pipe stand up during its initial trial, at the moment it's inverted.

The lovely scalloped top ‘just happened’ so my billy would fit inside and still allow airflow around and up the sides. From another 2 equal length off-cuts of the pipe, I laid them in a piece of channel (to make straight lines) and marked out 4 equal sections in each, which were then slit with a skinny wheel on my little grinder, thus giving me 8 equal sections which when tacked together were the right diameter to insert my billy and looked quite cool too.

What insulation to use

Again, using the formula from above “use what you got”, it was time to collect some dry grass and moist clay to make a mix. This was mixed together and placed inside the stove and rammed tight enough not to fall out when it came time to turn the stove back up the right way.

Now the heavy bit, turning it over. It’s so easy to push over but to stand it up the right way again I had to use a bar up the chimney for leverage and carefully pack some more mix on the ground to steady it in the vertical position. Note, this is not what you might call mobile but rather a fixture, an outdoor cooking centre.

There, done and tested, you should hear the stove when it fires up, sounds like a rocket as the air flow gets going up the chimney, hence its name.

You can see three little bolts on which the frying pan sits (giving free flow for the heat to surround and flow over the frypan) and the billy sits inside, or rather hangs by its handle over the hole collecting nearly all the heat exiting the chimney, a rather efficient cooking method.

As you can see by the times taken from photos, it cooked a damper, steak and eggs, all served up in under 30 minutes.

On another occasion, pot of vegies boiling in 3 minutes, all on small sticks otherwise useless except for kindling.

Conclusion on viability of the Rocket Stove being fit for Purpose – Resounding success

6.0 Cooking with Biomass

6.1 Cooking on an Open Fireplace

6.1.1 Making and Using a Pot support

When we bought the place over 35 years ago, one of the first things that went into the house was a “Burning Log” brand open fireplace, we were sleeping on a mattress on the floor but that didn’t matter, we had our own open fire! We love it and we have given it plenty of use since we’ve had it, but it is pretty inefficient, and a lot of the heat goes up the chimney. I also suspect that it wouldn’t meet modern emission guidelines either, so we are planning on getting a more efficient wood burner that we can cook on and bake in.

Having said that, years ago we did make up a couple of fittings to allow us to cook on the fire and both worked fairly well, the first one is a steel frame I made to support a cooking pot over the fire and the second is a reflector oven.

Pot Support

The support is designed to go over the fire grate so that it is possible to have some wood burning underneath it to provide cooking fire, but this is obviously designed to fit my grate and I have no idea how standardised or otherwise fire grates are. Needless to say you may need to alter the dimensions of your pot support to reflect the size of your grate.

It is fairly simply made from 12mm square steel bar, the two bent sections that sit over the fire and on the fire grate are 420mm long with the two stringers joining then and providing the support for the pot being 150mm long. To make this you do need to have welding gear, or know someone who has it and can use it.

Mark off about one third in from each end of the longer sections with engineer's chalk (soapstone). Apply heat to the marked area with an oxyacetylene set, when it is glowing red (make sure you have a thick pair of welders leather gauntlets so you don't get burned) take hold of the end and bend it to about 130 to 135°included angle, then do the other end and then complete the process by bending the other long section.

Once the steel has cooled try it on your grate and make sure that there is enough overlap on each end to keep the pot stable and that the angles are right so that the flat top section will level when the pot support is in place. If things are not good you may need to re-heat and re-bend the bars until the fit and remain stable. Once you have got it where you want it, set it up with the bent legs in the air and the two longer sections separated in the middle by the two stringers, forming a box. Use your arc welder to run a bead along the join between the long sections and the stringers so that they are held reasonably firmly. Re-check again to make sure the post support will fit over the grate and if all is well, run another bead on what is now the top side to secure the steel bar together.

With a bit of luck it is now right to go, but before firing up the fire place and giving it a go, do a trial run with the pot you intend to use full of water and make sure that everything fits where it is supposed to and it is stable. A pot of boiling stew in your lap is not that great when you would rather be eating it!

It works quite well in practice but is certainly not a “set and forget” type of cooking. The area under the pot support limits the size of the logs you can place under it and a few smaller ones keep the fire hot enough to cook well, but burn down quicker so you do need to keep an eye on the fire and the food every so often. Although, if everyone is gathered around the fire and having a good time, this won’t be a problem. You also need to have good, thick cookware, cast iron is ideal, to distribute the heat and prevent the food being cooked scorching.

6.1.2 Making and Using a Reflecting Oven

I put this together with assistance from my brother a few years ago, you don’t have to have a sheet metal worker in the family but it sure helped me. The plans for this little gem can be found as an appendix at the end of this eBook.

Using a thin felt tipped marker, I transferred the lines from the plans onto some galvanised 0.5mm thick sheet steel that I had floating around, and then using some offset tin snips (Wiss brand if you must know) I cut the shapes out for the oven body and the oven reflector. While it doesn't take a lot of words to say that, to cut the shapes out of sheet metal with any pair of tinsnips is a crap-load of work.

The straight kind of tinsnips are OK but for any large work an offset pair is much easier to work with, although these days I would be much more likely to connect up my nibbler to the battery drill and use that. The nibbler is much easier and quicker to work although if you are good with the tinsnips you may find them to be more accurate, it is easy (or at least easy for me) to get off line with the nibbler.

Anyway that was then (well before I had bought my nibbler) so tinsnips were my only real option. If you are using tinsnips too, it makes sense to have a pair of sturdy gloves handy because the cut edges are SHARP and sheet metal running with blood is not easier to work with, especially if the blood is yours.

Once both shapes are cut out, we can get into the real work! At this point it is probably worth mentioning that there will be a requirement to fold the metal to make the body of the oven and then fold the edges of the reflector over so they can be wired. This can be done in a number of ways and if you don't have a press brake hidden away in your garage somewhere you may wish to consider making a **simple sheet metal bender** first.

They are comparatively easy to build and handy if you intend to do almost any sheet metal work because you will no doubt need to bend or fold it at some stage.

The body of the Oven

OK, so you have either built the folder and/or have some wide jaw vice grips (often called flat jaw welders vice grips, both will come in handy!) to help bend the metal, cut the profile of the body out of sheet metal and scribe all fold lines. Mark the hole near the apex of the side, centre punch it to prevent the drill wandering and then drill out a hole the appropriate size of the wire you intend to support the food, the thicker the better. You could use fencing wire, I used 5mm rod salvaged from an old pram, with the ends bent straight.

With the hole drilled insert one end piece of the oven body into the bender down to the scribe line and bend up at than 90°, then repeat with the other end. Using the welders vice grips bend the sides of the bottom tray up to 90° to form the bottom tray and the corners back so they will fold around the outside of the bottom tray and form a leak proof edge. Bend all edges of the sheet which are to be wired out using a pair of welders vice grips to start the wiring process. Wiring the edges increases strength and stiffness of the finished product as well as removing any sharp edges on the metal

which could result in cuts.

Complete the assembly of the oven body by placing a piece of hardwood on the inside of the bottom tray and hammer the corners around the end of the tray to lock them in place.

To wire the edges, cut a 740mm length of wire (I used 2mm galvanised wire) and make a 90° bend 180mm in from each end leaving a 380mm length in the centre, this is important so check the measurements! Support the oven body on a hardwood block and place a 180mm section of the wire into the fold along the edge of the oven upright. Using a cross-pein hammer, fold the bent edge of the oven upright over the wire such that the wire is held snugly. Take the wire around to the other side so that the 380mm section acts a bridge between the apexes of the two uprights and do the same on the other side. The result should be a wire running down each side of the oven and across the top, holding the two apexes steady and reinforcing the top of the oven. All of the other edges can be wired using a similar process.

Making the reflector

Assuming your reflector is cut out in accordance with the plan, scribe all fold lines and using the welders vice grips, bend all the edges over to about 90° in accordance with the plan. Using the cross pein hammer, bend the two 380mm sides and the 386mm edge with the 13mm corner cut off over so that they are sitting flat against the reflector. Place the remaining edge of the reflector over the top wire of the oven such that the side of the reflector without the folds faces in. Using the cross pein again, hammer the last remaining fold down over the top wire of the oven, securing the reflector and the oven together.

Using the Oven

The food to be cooked is hung from the main (5mm thick) support wire and then the whole oven is place facing the oven, about 30cm away from where the flames are, we had to get a couple of bricks to get the oven up high enough to cook properly. We found that this oven roasts chooks pretty well if you wire them, feet first, to the support wire.

Note: The plans for the oven body and reflector are available as Appendix 3 of this eBook.

6.2 Making a Cob Oven

Introduction

I have made two cob ovens in my time, the first one didn't really work very well, not because of the process but rather my design. The space I had to fit it into at the time was rectangular rather than square so my choice was either to make it exceptionally small or to make it more like an ellipse rather than round. I decided to build it in the longer ellipse shape, and that turned out to be the wrong decision!

The oven never did draw very well, even after I added a chimney. It did get hot and we mucked around with it but it needed an insulating layer it never got and after sitting around and looking more and more dilapidated the cob part was broken up last year. I am currently working on a few different ideas because I still want a homemade wood oven in the backyard. I did make another one for a local farm with a group of volunteers and it was round, and worked well, but again due to the vagaries of chance, the farm has a new manager and that oven too has been broken up.

While my track record with ovens still in existence has not been good, I have had an opportunity to learn the process of actually making them pretty well. This is what I have learned.

Making a Cob Oven

Contrary to popular belief, building with cob has nothing to do with corn, it is making up a mix of clay and straw and forming it into hand sized lumps called "cobs", so the name pretty much becomes self explanatory. So I suppose the next question you may ask is, "why bother?" Wood fired pizza or bread ovens have become a popular back yard accessory, they produce great tasting food and make a great centrepiece for back yard living, but they also use a readily available (even in suburbia) and sustainable fuel that costs virtually nothing. So they must be a great thing to have. You can pick up a DIY oven kit for $1500 (ouch!) or even get one built on your site for a little over $3000 (ouuuuuuch!!), so they do have drawbacks.

It is possible, however, to build your own from scratch for very little cash and you can lure family members into helping with the promise of the previously mentioned wood

fire cooked bread, pizza and roasts etc. and rest of this article will show how you can do it.

This is the process that I used -

1. Select your site
2. Gather your raw materials – sand, clay, straw, bricks and material to make the base out of.
3. Set up the base
4. Install fire bricks
5. Set up the inner sand form
6. Make the oven itself
7. Decorate the oven

1. **Site Selection** – You may have some choice in your site or if your place is like ours, there is not a lot of room so you fit it in where you can. In the best of all possible worlds your site should be –

- Flat,
- Close to where you are going to prepare the food for cooking,
- Sheltered,
- Located so that smoke will not bug your neighbours, your family or (trust me here) smell up your wet washing,
- Located so that the oven opening faces away from the prevailing wind, and
- Be free of fire hazards

Let's face it, no site is going to be perfect, but tick as many of the above boxes as you can manage.

2. **Grabbing the Raws** - There are a number of things you will need to get together to make your oven and it is much better if you can have them all ready to go before you start. First off you will need something to make a base for the oven out of such as stone, concrete blocks, wood, bricks..... I think you get the picture! You want the oven to be high enough up to be easy to work with so waist height for the cook would be ideal (say 900mm to 1000mm). Clay is a no-brainer, you may be able to dig it from your

own property but failing that see if you can find someone willing to let you dig out a few garbage bins (quite a few probably) of clay from around their dam or any other open section of the property.

I had a connection with a clay tile and a brick making company so I was able to put the bite on them for some clay. The brick clay was very good but the tile clay was more like pottery clay, very pure with not enough sand. It shrank a lot during drying so I had to add a lot of sand but it still shrank quite a bit. The second oven was made from clay dug from a dam on the property hence my earlier comments.

You could try talking to any local brick or clay tile manufacturers to see if you can get access to their quarries for a bit or as a last resort talk to your local landscape supplies place, that is likely to be the most expensive option. You could possibly dig some out of any cuttings at the side of the road, but some of these government types may take a dim view of this practice.

Brickies sand and straw can be bought from hardware and gardening places or rural suppliers. You will also need bricks to form the floor of the oven, the best kind are fire bricks and to get these you will need a specialist wood fired oven or barbeque supplier, try your local yellow pages to find one. Normal building bricks can be used but they will not stand the heat as well and will eventually burn through, if you do not intent to use the oven that much they may be a reasonable, low cost option.

3. Setting up the base – How you do this really depends on what materials you have earmarked for the job. I used concrete blocks left over from the destruction of an old incinerator/ barbeque with two appropriately sized concrete pavers on top and for the farm we used bush rock cemented together with a formed concrete top to act as the base for the oven. Just make sure that it is strong enough to hold the (considerable) weight of clay that will form the oven itself.

4. Installing the fire bricks – There are a number of ways to set this up, insulating bricks on the bottom and fire bricks in a second layer on top, just a layer of fire bricks or just a layer of normal house building bricks. In both cases we have just used one layer of fire bricks as the oven base, but if you were using normal bricks install them on edge so that there is a flat surface to cook on and more mass of brick to withstand the fire.

Put a layer of clay over your base about 50mm thick to set your bricks into, making sure you have enough bricks to cover the entire baking area of the oven. We started by putting a couple of bricks at the outer edge of the base in the area we expected to put the oven opening. Once you have a brick located in the clay where you want it, install others by sliding them down the face of any brick(s) already installed, this ensures that you get a close fit and avoid getting clay in between the fire brick faces. In that way you can be sure of a smooth and gap free cooking surface and not have to worry about ash getting lodged in any gaps between the bricks.

5. Setting up the inner sand form – The outer shape and size of the sand form will set the inner dimensions and contour of the interior of the oven. It is best to use a fine brickies sand that will hold its shape when moist. Draw a circle on your bricks that sets out where the inner wall of the oven will be, then pile on your sand making sure it is moist and will hold its shape. Form a nice round high dome such that the dome is 65% to 75% of the dome diameter, or, if the dome is 1 metre in diameter it should be 650mm to 750mm high. In practice, if you think you have it right by eye, measure it. Odd on it will still be too low, so the hint here is to actually measure it. Once the dome is roughly formed, smooth it off to a nice smooth surface with a steel concrete trowel

which we found gives a great finish. Once the firm is to your liking cover it with one to two layers of wet newspaper, this will help you tell where the form finishes and the cob starts when you dig out the sand form.

6. Making the oven – Now the fun starts! This process is fun anytime but will be more comfortable in warmer weather; wet clay can be bloody cold!

a. Mixing the Clay - The process starts by laying out a decent sized tarpaulin, at least 3 metres square. The first layer will be the thermal mass layer and so contains no straw, so put a couple of garbage bins-full of clay onto the tarp and one or two of sand depending on how much sand is in your clay, if there is already lots you don't need to add much sand, if there is very little, add more.

Roll the mix in the tarp and get it as homogenous as you can, then get your volunteers and do the barefoot stomp and twist on the clay mix to incorporate the sand. As the

mix spreads pull up the edges of the tarp and roll it back to the centre. At this point looooots of volunteers would be handy, the original oven was made by just my son-in-law and myself but the second one had lots of volunteers and this made the job much easier and more fun. Add water if the clay is too stiff for the sand to be incorporated properly but not so much that you get a sloppy swamp.

b. Forming the Cobs - When you have a batch of clay/sand mix ready to go, shovel it into a wheelbarrow or two, to make it easier to get at and start forming the clay into cobs by moulding it with your hands into a form that is slightly bricklike about 100mm wide, 100mm in height and around 300mm long. Place this around the edge of your form at the base, then place the second one behind it and so on one after the other.

Make sure you smooth them in to form a continuous layer and continue the process until you have the first layer finished. Subsequent layers can be applied in the same way, but keeping the tup surface of each cob at right angles to the sand form so that by the time you get to the top the last cob is like the keystone in an arch, helping the dome of the oven support itself when the sand form is removed.

c. Cut the Door – Cut a semi-circular hole in the side of the oven that you intend to use as the access. This will form the doorway and should be 63% of the height of the inner sand dome to allow for correct draw for ventilation. You can use a long knife to cut through the cob and mark out the shape of the door, then scrape out the soft cob material until you get to the inner sand form covered by newspaper.

d. Scrape out the Sand – The sand has done its job of supporting the cob to form the dome of the oven and now it has to be removed to leave the inside ready for firing. If you are building a large oven or the cob is really wet and sloppy, you might want to let the oven dry out for a couple of days before attempting this! You can use anything available to scrape the sand out, but your hands will work the best. Work slowly and scrape the sand into a garbage bin or similar for later recovery.

Work with your hands slowly to remove the sand, you will be able to feel when you hit the layer of newspaper over the top of the sand and the big hint when you do, is to stop digging. Keep going and clean out as much of the sand as you can, leaving the inside of the oven to dry out ready for firing. Once the inside is dry it will make it much easier to sweep out any sand residue.

Making the Door

One of the doors I made myself, it was just some timber bolted together until it was about 50mm thick then cut to shape. It charred up pretty quickly and I don't know how long it would have lasted in heavy use. The other one was made for us by a fitter and was black painted steel with a hand/bracket on the outside to keep it upright and it worked very well.

7.0 Cooking with Solar Electricity

It's funny, but when we were living mostly on the grid with only the lights and fridge running through a 12v solar/battery set up, we passed on a lot of our electric appliances to friends to reduce our electricity usage. We did this especially with the appliances which used electricity to generate heat for cooking and replaced them with a number alternatives such as the solar oven, rocket stove, wood heater (with cooktop and oven), stored heat cooker and the gas stove. Now, while we still use those alternatives, we are producing more solar electricity than we use in summer, and I was looking for ways to take advantage of some of this excess.

But I also wanted more!

I wanted appliances that would reduce our need to burn gas for cooking, thus reducing costs and greenhouse gas emissions (the electricity being solely produced by the sun. I also wanted appliances which were versatile and could be used to produce a number of different types of dishes. They should not be too expensive (OK no 3 is a bit pricey but it makes sense when you think about it) and they should not be too power hungry so that the batteries would not be swearing at me when I turned them on. Again, no 3 is a bit different but it is controllable. This is what I have come up with:

1. Rice Cooker

Addesso brand (Model No CFXB22G) 5 cup rice cooker rated at 400 watts

Rice cookers are remarkably convenient, once you set them up and turn them on they will run until the rice is cooked and then switch automatically from "cook" to "warm" keeping your cooked rice or whatever warm until you want to serve it. They are also wonderfully versatile! We started out just cooking rice, but then moved on to our own recipe for **rice and beans** which also contains diced veg, which we serve with a curry sauce.

Obviously the rice cooker was designed to provide well cooked rice every time and riced based dishes such as vegetable biryani, chicken rice, risotto, rice salad, Asian style paella and various fried rices, will all come out well cooked each time. However, you can cook lots of recipes that are not primarily rice as well. These include –

- pasta dishes and noodle dishes
- Beef, chicken, pork or seafood recipes (any number of curry recipes exist for these proteins)
- Legume dishes like lentil soup or chick pea curry
- Egg dishes including curries, omelettes and even scrambled eggs
- Plain or spiced vegetable dishes like steamed veg or vegetable curry.

The rice cooker does not use lots of power, well within the demands of our system, and it generally takes only 10 to 15 minutes for riced based dishes but can take longer for other styles of rice cooker cooking!

2. Slow cooker (AKA crockpot)

Russell Hobbs brand (Model 4443BSS) 3.5 litres, rated at 160 watts

While I am a fan of stored heat cookers (see above), there is an undeniable charm around the set and forget cooking style of a slow cooker. We have enjoyed making a number of dishes generally around wet cooking ie soups, stews, and casserole type of stuff.

A favourite is a wonderful **freezable vegetarian dish** based around legumes such as red kidney beans, black beans and chick peas, veg such as corn and Mexican type spices. I make it and then after eating it one day, freezing the rest for ready meals. We found the recipe on Tasty.com but there are lots of cookbooks out there. We are moving towards a vegetarian diet but the humble slow cooker is renowned for its superpower of making cheap cuts of meat tender.

It is only recently that I have become aware that slow cookers can do other things than the standard soups, stews and casseroles. They can, in fact, be used to bake bread,

make yoghurt, cook porridge, as well as making cakes, sauces and desserts. They are a remarkably versatile device, which will enable you to get the most out of your solar electricity a while preparing delicious meals.

3. Induction Hot Plate (Portable)

Philips brand (Model HD 4992) Rated at 2100 watts

This hot plate is considerably more expensive and certainly uses lots more power than the previous two appliances – but!

It has been a recent acquisition for us because up until recently I saw the power consumption and thought "my poor batteries" and didn't bother. However I saw one operating at a friend's house and realised that you can turn them down!

Induction cookers have a number of things in their favour, and one is very efficient conversion of electrical energy to heat. The hotplate does not heat up itself, but induces a current in the conductive bottom of the cooking pot so that up to 90% of its heat is transferred to the pot versus 35% to 40% for gas. It can boil our kettle for tea or coffee in 3 minutes flat! I wanted it also so I could take advantage of the long summer days when preserving tomatoes and tomato sauce to boil water for processing the jars without going through a stack of gas.

It is not all beer and skittles however. The cooktop does need a cooking pot with a magnetic bottom (you can test using a magnet) or it will not work. Also, while it excels in boiling water, cooking wet stuff and steaming our veg, it has taken some getting used to for frying, and it does have a tendency to burn if not monitored well. Some things (like my world famous veggie patties) I still need the constant low heat of the gas on low to get right.

They can be very cheap (around $50), but my researches turned up that the cheaper ones don't last as well (surprise surprise), don't have the flexibility and don't have cooling fans (which improve service life) so we paid $175 for ours. While it is rated at 2100 watts we have found that for most things 1800 watts seems to be its maximum setting and for some things, like frying, it can be turned down to 300 to 400 watts and still work very well. That way I can monitor the state of the batteries and if there is a problem I can turn the hotplate down. Overall, we are very pleased with it though.

It has been interesting getting back into cooking using electricity again, and if you'd said to me a couple of years ago that this is what I would be doing, I wouldn't have believed you!

8.0 Resources

8.1 Cost Effective Cooking

The Thrifty Cookbook (476 ways to eat well with leftovers) – Kate Colquhoun – Bloomsbury Publishing (UK) 2009 ISBN 978 1 4088 0081 2 – Contains some good basic data about how not to waste food as well as simple stuff like stock, making your own bread and jams plus Pizza! A smattering of international recipes from the Middle East, India and South East Asia. Probably not much new if you are an accomplished cook but a great resource if you are new to the game.

The Credit Crunch Cookbook – Katy Denny (Exec. Editor) – Octopus Books (UK) 2009 ISBN 978 0 600 61977 2 – Covers waste not, want not, basic budget meals for light, main and sweet, gourmet touches on the cheap and low cost eat-in recipes for Italian, Mexican, Indian, Thai and Chinese. Some of the recipes in these cheapo books can be a bit rough (unless you like lots of offal) but they are really good in this one. Good tips on cost cutting too.

The $21 Challenge – Fiona Lippey & Jackie Gower – Simple Savings International P/L (AUS) 2009 ISBN 978 0 9806533 0 4 – They have developed a process whereby you use the stuff you have in your cupboards and can only spend $21 per week of new stuff, the idea being that it helps you focus on the important stuff while saving heaps of money. Lots of good cheap recipes as well as a section on using up excess/leftovers effectively. They have a website about the process - http://www.simplesavings.com.au/

Table Tucker – Penina Petersen – Hachette Australia (AUS) 2009 ISBN 978 0 7336 2444 5 – This is another "system" but is very environmentally friendly in its approach. The principles are cooking with seasonal ingredients, grow your own veggies, bulk buying, shift old habits and eat less meat, reduce waste, water and energy consumption and embrace earth happy ideas. LOTS of good info on menu planning and lots of good recipes. They also had a website but it no longer seems to be active.

Champagne Life on a Beer Budget – Maree Wrack – Champagne Life Beer Budget (AUS) 2011 ISBN 978 0 9807070 0 7 – Nary a recipe to be seen on this one. It is more about savvy shopping, ideas to help you save in your approach to food buying and cooking, decluttering and getting control of your outgo. The website referenced in the book no longer works.

The Pauper's Cookbook – Jocasta Innes – Penguin Books (UK) 1971 ISBN 9780711235618 (was re-issued recently). The book has over 250 recipes covering the standard stuff, leftovers, quick dishes based on pantry stuff, money saving extras and living off the land, special occasion dishes and dieting on the cheap. There are also sections on menu planning and kitchen equipment. Recipes are a bit out of date (liver kebabs???????).

The New Pauper's Cookbook – Jocasta Innes & Kate Harris – Random House (UK) 1992 ISBN 0 09 175434 8 – Similar to the above with additions of sections on Pasta Faster and Veggies for vegetarians. There is still plenty of offal but there are more international recipes and no sign of liver kebabs.

Good Food on a Budget – Georgina Horley – Penguin Books (UK) 1969 ISBN 978 0233961644 – This little paperback has over 500 pages of recipes and information. Lots of information about equipment and setting up a kitchen, basic operations about baking and other kitchen processes, buying vegetables and cutting up meat, all the basic stuff is there. The majority of the rest of the book is recipes set out by month, which would need to be turned around by 6 months for southern hemisphere to hit the season's right. Some recipes are a bit out of date but at least there is nothing about liver kebabs.

Penny Pincher's Cookbook – Sophie Leavitt – Lancer Books (US) 1973 ISBN 7254 0172 9 – There are a series of "hints" at the back and front of the book, the rest being divided up into recipes for cereal and bread, eggs, soups, meat, fish, vegetables, salads and desserts. There is also a small section on herbs and spices. There are no "international"

recipes, just American home cooking with the odd weirdo thrown in like peanut soup…. It is a small parerback.

The Money Saver's Cookbook – Geri Tully – Tower Publications (US) 1970 ISBN N/A – This is another small paperback, not much background just a series of recipes based around meat, poultry, fish, casseroles, leftovers, sausage canned meat and fish, vegetables, rice variations and desserts. There are a couple of pages at the back on suggested kitchen equipment.

The Complete Hassle Free, Money-Saving Kitchen Handbook – Diana Walton & Hilda Kassell – Signet (US) 1974 ISBN 978-0451058607 – This is also a book of techniques rather than recipes. There are sections on spending less at the supermarket, food preparation, using herbs and spices, getting over difficulties like running out of an ingredient and what to substitute, how to use the freezer and other stuff on food storage. There is also a section appliances, partying on the cheap, cleaning up and growing plants from pits and seeds. No a lot of info in each section but interesting nevertheless.

The Thrifty Gourmet – Ann Marshall – Angus & Robertson (AUS) 1974 ISBN 0 207 12453 1 – This is a small book (77 pages) and a little bit dated but it has some good ideas as well. It is divided into ideas on how to economise, then recipes and ideas for breakfast, soup, hogget and lamb, beef and veal, liver and kidneys (!!!!) working with a tough chook, fish, sausages and sundries. There is also a small section on entertaining on a budget and desserts.

Beating the Cost of Cooking – Mary Berry –Independent Television Books (UK) 1975 ISBN 0 900 72737 3 – From (a much younger looking) Mary Berry of "The Great British Bake-off" fame. She starts put talking about setting up your kitchen and what equipment is required, then talks about making the most of food covering how to shop then making meat, fish et. Go further. She then gets into the recipes around starters, meat and fish, pasta cheese and eggs, rice and vegetables. She also has sections on one-

pot meat cooking, cooking with left overs, puddings, cakes and biscuits. Mostly good recipes with a few weirdo's thrown in like cream of lettuce soup.

The Next-to-Nothing Cookbook – Helen Harrison – Bay Books (AUS) 1982 ISBN 0 85835 564 7 – This one is mostly recipes, lots of sections with a few recipes in each section. Sections include soup, meat, stews and casseroles, spicy dishes, fish, cheese and eggs, beans and cereals, vegetables and salads, dressings, sauces and herbs, sweets, cakes and biscuits. There is also a section on party treats and lollies and one on household management which talks about left-overs, being thrifty and rescuing cooking disasters.

Better Meals for Less – George Cornforth – Review and Herald Publishing Association (US) 1975 ISBN 978 0 3855 2909 9 – The book starts with a chapter on food and nutrition in general then goes on to provide recipes for meat "analogues", bread, soup, legumes, nuts and eggs, vegetables, salads, fruit and simple desserts. It has some "interesting" recipes such as nut meat a la king but the recipes are healthy as well as vegetarian.

8.2 General Sustainable Cooking and Eating Books

The Green Kitchen – Richard Ehrlich – Kyle Cathie Ltd (UK) 2009 ISBN 978 1 85626 804 2 – This one is a really good book for cooking more sustainably with techniques and recipes for cutting energy use, saving money and reducing waste. The techniques (with accompanying recipes) covered include lidded cooking, microwave cooking, pressure cookers, no-cook cooking and cooking for multiple meals. There are also sections on equipping a green kitchen, greener cleaning and reducing waste. Lots of great information, this is a great little book.

The Green Food Bible – Judith Wills – Transworld publishers (UK) 2008 ISBN 978 1 90581 118 2 – This book reflects the UK experience (obviously) and some of the information about importation of food and statistics around green food production may not translate here, and will be a bit out of date. Section one discusses what the term 'green' actually means, and what people think it means. Section two talks about organic food and what that means, its advantages and disadvantages and how to make choices around food. Section three unpacks

the broader subject of ethical eating and issues associated with it like local, fair trade, food miles, cheap food, seasonal eating plus other factors and how they interact. Section four talks about ethical shopping such as supermarkets vs small shops, farm shops and markets food labelling and packaging (again all UK-centric), Section five, the green kitchen, covers food storage, prep and cooking, food waste, cleaning up as well as other issues like growing your own and picking your own. Section six covers seasonal menus and recipes, section seven covers eating out and section eight discusses and A to of 'green' food. Lots of good info, if some is a bit dated and some colour photos.

Simple Green Suppers – Susie Middleton – Roost Books (US) 2017 ISBN 978 1 61180 36 5 – This is mostly a recipe book for one-dish vegetarian meals. An introduction talks about the overall strategy of the book, that is to say adopting the idea of eating vegetables plus one other ingredient as a single dish meal. It then covers how to refresh and restock your larder, embrace 'make aheads', focussing on one-dish recipes and then how to design your own veggie supper. The rest of the book is devoted to recipes are grouped in chapters that pair up veggies with another specific ingredient. In order the chapters cover veggies plus noodles; plus grains; plus beans; plus leaves; plus toast; plus tortillas; plus eggs; and plus broth. We have found it to be a very helpful book. Lots of colour photos.

The Organic Kitchen – Lance Reynaud & Duncan Campbell – New Holland Publishers (AUS) 1996 ISBN 978 1 86436 412 2 – Chapter one talks about what organics is and the various certifications that are around, followed by definitions of various terms relating to food and growing an whether they are acceptable for organic use. Chapter two is 'keeping and organic kitchen' covering pest control (cockroaches, mice etc), kitchen hygiene, kitchen ecology, cooking equipment (they suggest not having a microwave because it emits radiation eg Xrays, so they do not understand the difference between ionising and non-ionising radiation) and preparation equipment and how to store food. Chapter three is how to eat organically all–year-round and includes charts on seasonality of food in Australia and what foods are available when as well as where processed foods come from (Aus or overseas) Also covered is basic how to preserve fruit and veg. Chapter four covers 'organic cooking' including cooking hygiene, common herbs and spices and how to use them, sprouting, soups, sauces and dressings, main courses including meat, veg, fruits and nuts, raw foods, desserts, breakfasts and baby food and baking. Chapter five, 'the organic cookbook' is a series of

recipes. The book gives a good introduction into a lot of topics, but not a lot of depth in each one. It has the odd black and white photo.

The Conscious Kitchen – Alexandra Zissu – Clarkson Potter Publishers (US) 2010 ISBN 978 0 307 46140 7 – This is not a recipe book, but more a how to buy and cook food, clean up and deal with waste. The introduction talks about essential terms like 'organic', 'agribusiness' and 'fair trade' and what they mean. Chapter one covers what sort of food to buy and talks about organics, GM foods, local foods, carbon footprint and local vs organic food. Chapter two covers fruits and veg and where to shop, chapter three covers farm animals, the ethical options and what they mean and where you can get the products, chapter four covers similar for dairy and eggs, chapter five for seafood, chapter six for drinks and chapter seven for packaged foods. Chapter eight focusses on pots pans, food storage and table top, or in other words what you are cooking in and on, avoiding plastics and setting you table safely and sustainably. Chapter nine covers appliance and low energy cooking which focusses on the best appliances to get and getting the best out of your appliances (including microwaves!). Chapter ten covers safe and sustainable clean up and chapter eleven covers dealing with waste in the kitchen. It is a small book with lots of information. No photos.

The Kitchen Handbook (an Environmental Guide) – Teri Degler& Pollution Probe – McClelland & Stewart Inc. (CAN) 1992 ISBN 978 0 7710 7144 2 – This is an oldie but a goodie, mostly a 'what and why' book, but with some recipes at the end. Chapter one covers setting up your green kitchen including making the most of space, setting up for recycling, composting, tips on appliances and what you need, water, lighting and cookware. Chapter two covers stocking your shelves with environmentally friendly goods, when fruit & veg are in season (in Canada), labelling, is it greenspeak or really green, livestock and fish issues, a few recipes. Chapter three is about using the green kitchen including what cooks quicker, getting the most out of your appliances, plastics and food safety, protein form plants, growing edible plants inside and using leftovers. Chapter four covers storing and preserving foods to avoid waste, Chapter five covers eco cleaning and pest control, and chapter six provides a series of recipes (19 all up) for the green kitchen. Chapter seven (the kitchen audit) provides information for you to review your existing kitchen and work out how you can implement the improvements in each chapter of the book, which is a wonderful idea! The book has lots of line drawings.

The Conscious Cook – Giselle Wilkinson – Brolga Publishing P/L (AUS) 2008 ISBN 978 1 921221 38 5 – The first half of the book is composed of fifty one recipes broken down into sections: Party (9); Soups (6); Mains (22) and Desserts (14). The second half is divided into a number of parts and chapters. Part one is titled 'how what you eat affects you', and focusses on health and nutrition, food issues like food additives and GM foods, organics and wholefoods. Part two is titled 'how what you eat affects you' and is focussed on sustainability, fair trade, local eating and waste. Part three is titled 'what you can do about it' and focusses on personal actions around sustainability and diet, cooking, local food, shopping and what food to buy, Australian made, globalised food supply and green cleaning. Last of all is a 'conclusion' that summarises what needs to be done and why the book was written. The book has lots of colour photos.

Ethical Eating – Angela Crocombe – Penguin Books (AUS) 2008 ISBN 978 0 1 300856 9 – Chapter one discusses the issues associated with ethical eating including climate change, water use, overfishing, animal welfare, erosion and salinity, chemical use, toxins in food, packaging and economic 'externalities'. Chapter two discusses organic and biodynamic farming, what they are, how they work, are certified etc. Chapter three discusses fruit and vegetables including seasonal produce, chemicals, hydroponics and native foods. Chapter four covers issues associated with chicken and egg production including organic and free range. Chapter five covers meat and the issues associated with its production including feedlots and native animals for meat. Chapter six covers issues associated with dairy production and chapter seven seafood including overfishing and aquaculture. Chapter eight discusses drinks including soft drinks, alcoholic drinks and hot drinks. Chapter nine discusses vegetarianism, Chapter ten ethical eating movements live slow food and fair trade, chapter eleven discusses GM foods. Chapter 12 discusses processed foods, marketing and irradiation, chapter 13 food shopping and chapter 14 is a conclusion with a page and a half of suggestions for ethical eating. Every chapter has a summary of one page at the end called 'In a Nutshell'. There are no photos or line drawings in this book.

You can have your Permaculture and Eat It too – Robin Clayfield (self-published in AUS) 2013 ISBN 978 0 99230 181 1 – is this a cookbook for gardeners or a gardening book for cooks? This book is sort of divided into two parts, the first third of the book talks about permaculture principles and ethics, zone one and two, being hands on in the garden, pest control and making an income from your garden and takes up the first 80 pages. The remainder of the book covers stuff that you rarely see about cooking for a small or large group of people using mostly vegetarian and some out of the ordinary ingredients. The first section covers useful cooking tools, cooking in bulk, special needs and diets, as well as food prep. The second part provides a whole stack of recipes under such subjects as recipes for 4 or 40, healthy eating and food combining, permaculture foods including bush tucker and weeds. Also included is a section on the edible flower garden, cosmetics from the garden and 'tit bits' like bottling, cheesemaking, butter, tofu, miso and tempeh, TVP seaweed and food storage. The last section covers after dinner fun and games. This hugely useful book is worthwhile having on everyone's library shelves. There are some line drawings.

Diet for a Small Planet – France Moore Lappé – Ballantyne Books (US) 1975 ISBN 0 345 27429 6 – This is my copy, it has probably been updated many times since then. This small paperback is over 400 pages long and is very information dense, dealing with the accessing of protein without resorting to meat. While it does have some recipes, it is not primarily a recipe book, but is more about the 'why' and the 'how' of meat free protein. The book is written in four parts. Part one is about current protein sources and the issues with their exploitation, Part two is bringing protein theory down to earth, covering issues like how much is enough, is meat necessary and protein complementing. Part three is Eating from the earth: where to get protein without meat, which discusses protein sources, how they the food groups rate protein wise, getting the most protein for the least calories and your protein dollar. Part four covers Eating form the earth: how to get protein without meat, talking about protein combing, kitchen short cuts, what to have on hand and shopping. The book has a small number of line drawings.

Recipes for a Small Planet – Ellen Buchman Ewald - Ballantyne Books (US) 1973 ISBN 0 345 27230 X – This is the recipe book associated with 'Diet for a Small Planet'. There are two non-recipe sections at the front: Protein complementarity and Living with the earth in mind. The book then moves on for the next 300 or so pages on applicable recipes broken down

into sections entitled ‘What’s for breakfast’, ‘What’s for lunch’, a subsection on one pot meals and another on raw foods, ‘What’s for Dinner. This is followed by two sections on bread, one on cookies and bars (sweets), ‘just desserts’, and ‘dairy delights’ and a series of appendices on basic cooking, useful utensils etc. It is a gread companion volume to help put the ideas espoused in ‘Diet for a Small Planet’ into action in your life. The book also has a small number of line drawings.

8.3 Cooking with Biomass

Build Your Own Barrel Oven – Max and Eva Edleson – Hand Print Press (US) 2012 – 978 0 9679846 9 8 – This is another one hit wonder but a ripper! Everything you wanted to know about turning a 200 litre steel drum into an outside, biomass powered oven. Construction instructions are detailed and there are lots of colour photos and line drawings.

Rocket Mass Heaters – Ianto Evans & Leslie Jackson – Cob Cottage Company (US) 2014 ISBN 978 0 9663738 4 4 – Just what we all wanted (well I did!), a book about rocket stoves! While, as the name suggests, this book is about designing and building space heaters using rocket stove technology, there are also instructions on making small scale cooking stoves as well. Maintenance and fuel choices are discussed and there is a surprisingly honest page or two on the drawbacks of using this technology and some interesting case studies. Lots of line drawings and colour photos.

Build Your Own Earth Oven – Kiko Denzer – Hand Print Press (US) 2004 ISBN 978 0 9679846 0 2 – This is THE manual on how to make your own cob pizza oven. It covers a bit of history, tools and materials required to construct it, making the base, step by step instructions on making the oven and the tools required to operate it. Some black and white photos but lots of line drawings to illustrate what you need to do.

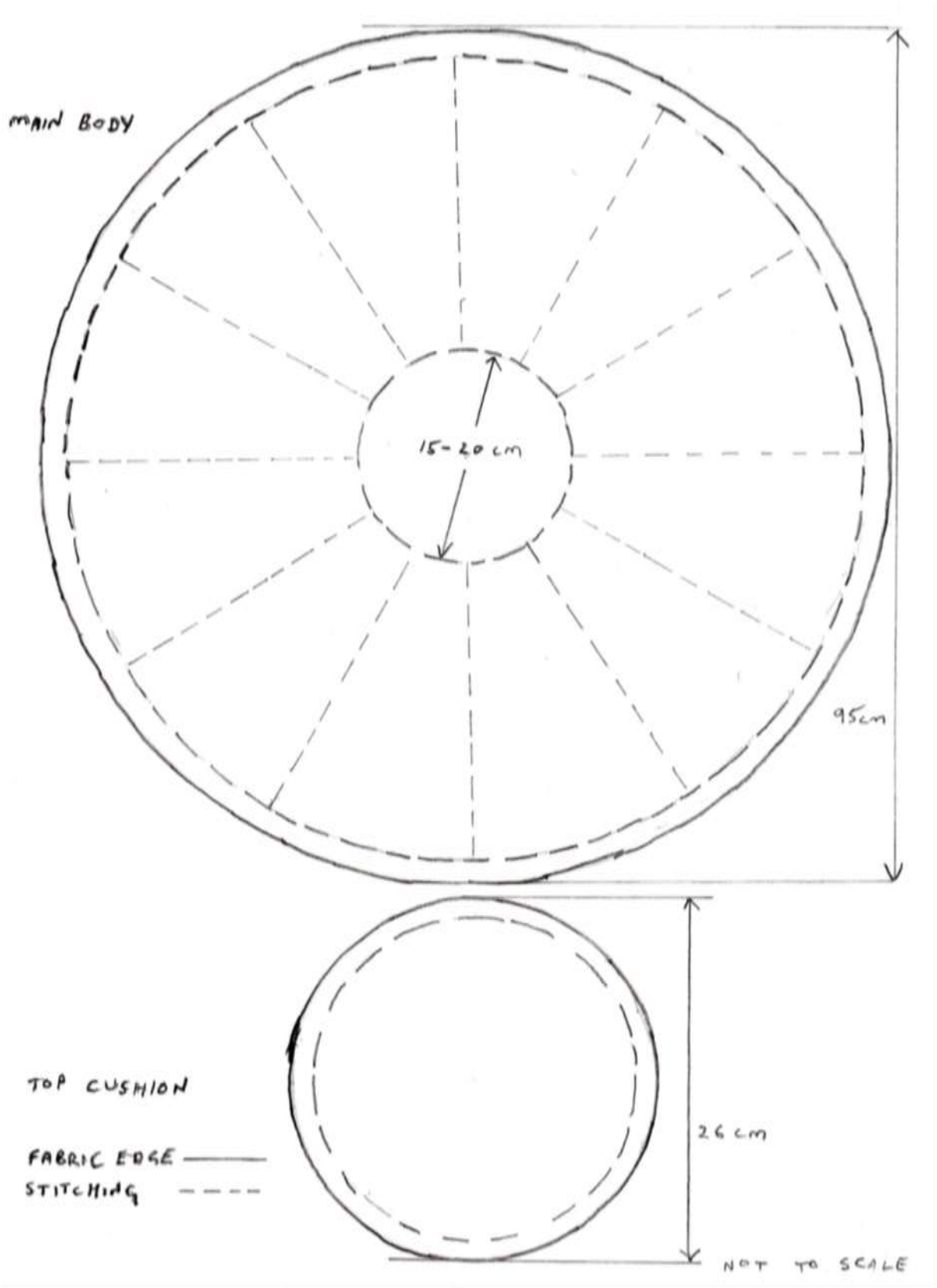
Lorena Stoves (designing, building and testing wood conserving cookstoves) – Ianto Evans & Michael Boutette – The appropriate technology project of volunteers in Asia (US) 1981 ISBN 0 917704 14 2 – This a manual on how to desing and build your own stove using local materials and low tech processes. Construction is mainly of clay and how to win and process the clay so it is ready for use is covered in detail. There are some black and white photos and lots of line drawings of stove designs and how they work.

8.4 Cooking with Solar

Cooking with the Sun – Beth & Dan Halacy – Morning Sun Press (US) 1992 ISBN 0 9629069 2 1 – This is another oldie but goodie, it is the book responsible for my interest in solar cooking and the plans in the book are what I based my solar oven on. The book covers some history then gives detailed instructions on building a solar oven and hotplate. The rest of the book is given over to recipes appropriate for use in solar cookers. Some black and white photos and some line drawings to illustrate construction methods.

Appendices

Appendix 1 – Fabric stored heat cooker pattern



Appendix 2 – Reflecting Solar Oven Plans

Yes, I know, all the measurements are in imperial. I made the oven many years ago and these are the measurements I followed, so get used to it!

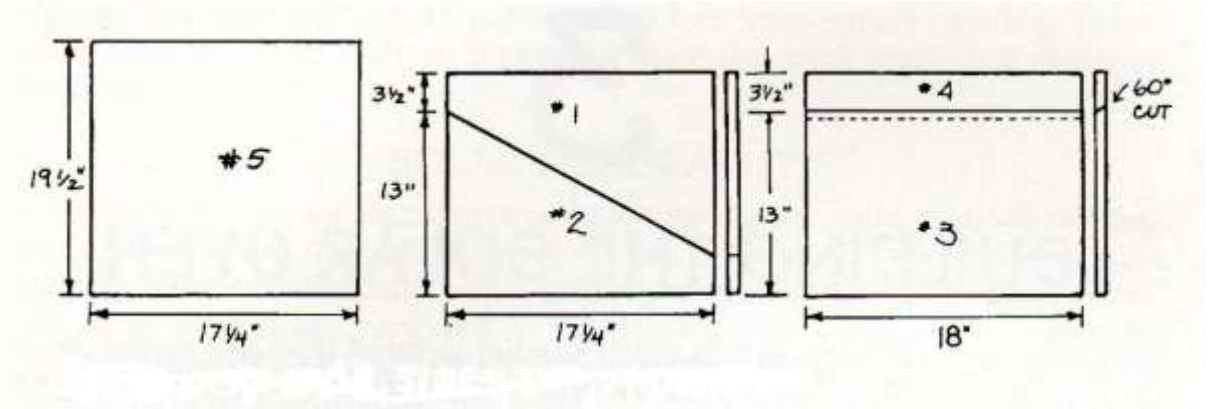
Materials List

Plywood
1 off 16 ½”x 17 ¼” by ¾” thick (to make the sides)
1 off 16 ½”x 18” by ¾”thick (to make the top and bottom)
1 off 19 ½”x 17 ¼”by ¾”thick (to make the back)
4 off 18”x 18” by ¼”thick (to make the main panel reflectors)
4 off 15”x 18”x18”by ¼” thick (to make triangular corner panel reflectors)

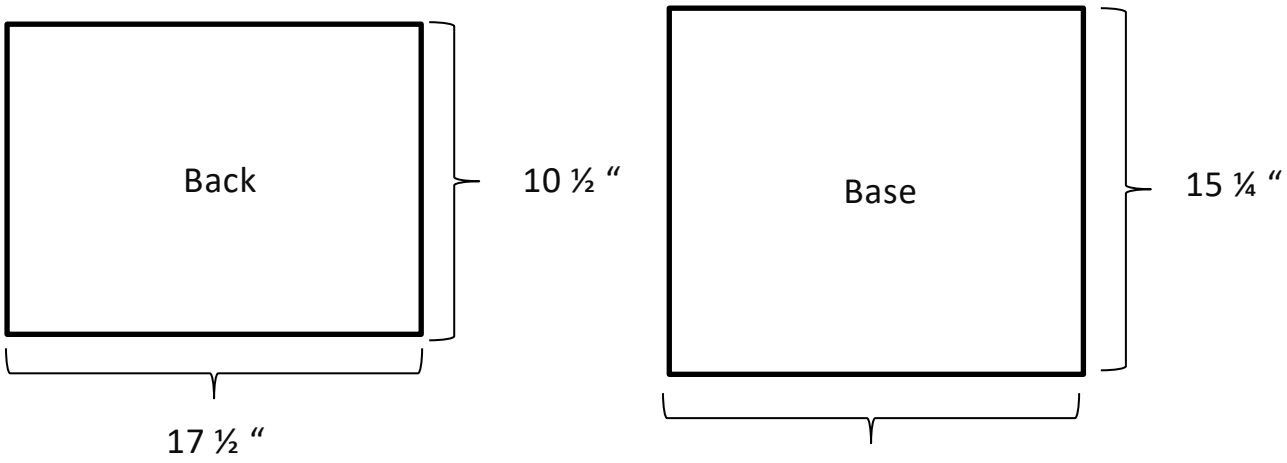
Galvanised Sheet Steel
1 off 10 ½”x 17 ½” by 1/32” (0.5mm) thick (back)
1 off 15 ¼”x 17 ½”by 1/32” (0.5mm) thick (base)
2 off 10 ½”x 15 3/8” x 3”x 16” x 1 ¼” by 1/32” (0.5mm) (sides) – see diagram

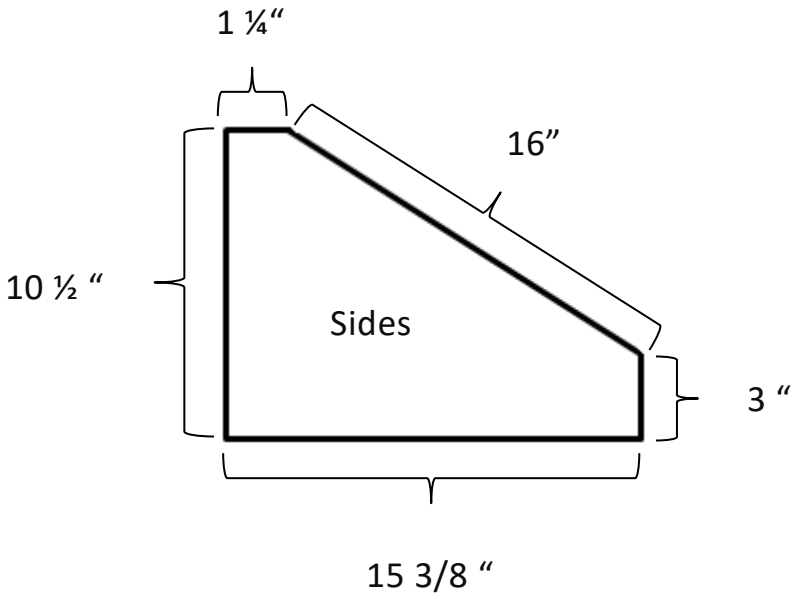
Other stuff
8 square feet of compressed glasswool insulation 1” thick
1 off ¼” (6mm) thick window glass 18 7/8” x 18 7/8”
4 off wood strips 1/8”x 3/8”x 20”
8 off aluminium or sheet steel 1” x 4” for attaching reflectors to oven body
1 off wooden drawer knob and attachment screw
Assorted screws and nails
A can of matt black engine enamel

Plywood Shapes

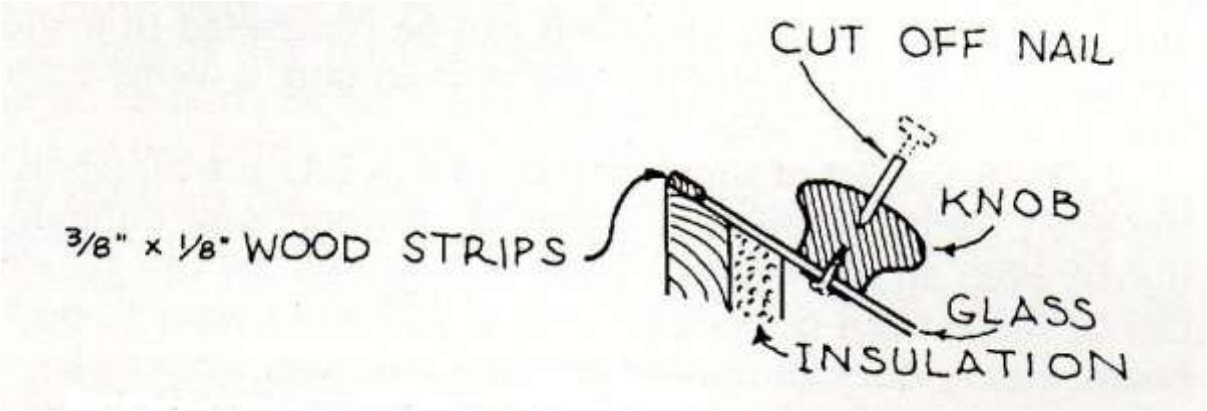


Sheet Steel Shapes

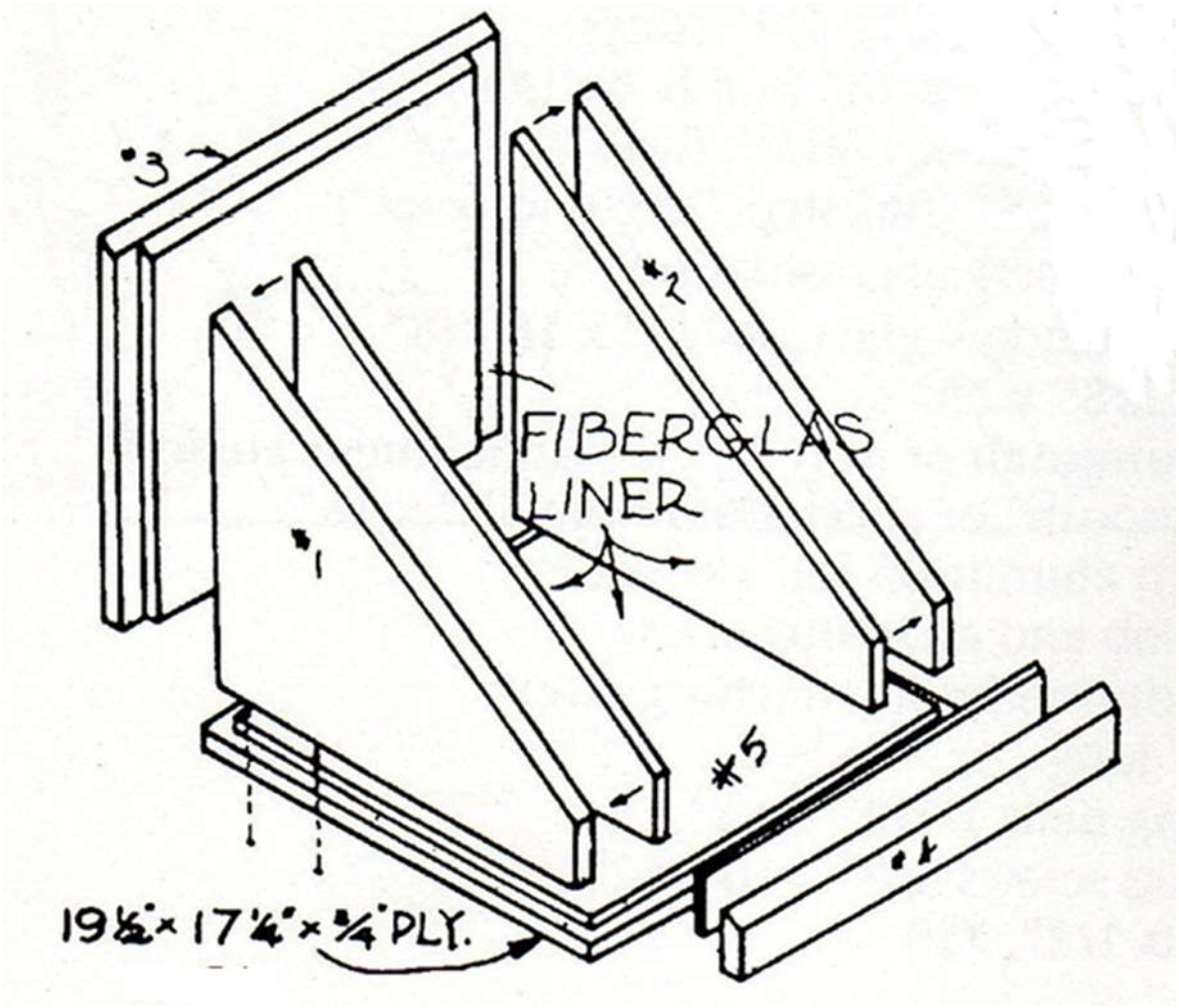


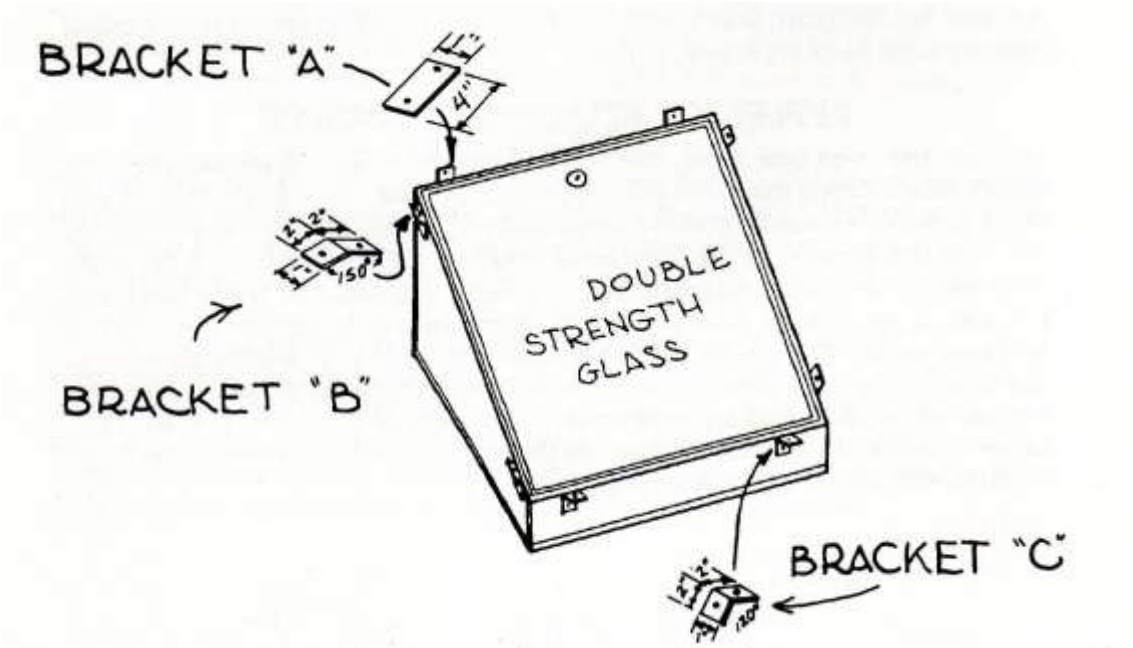


Wood Strip and Knob Attachment

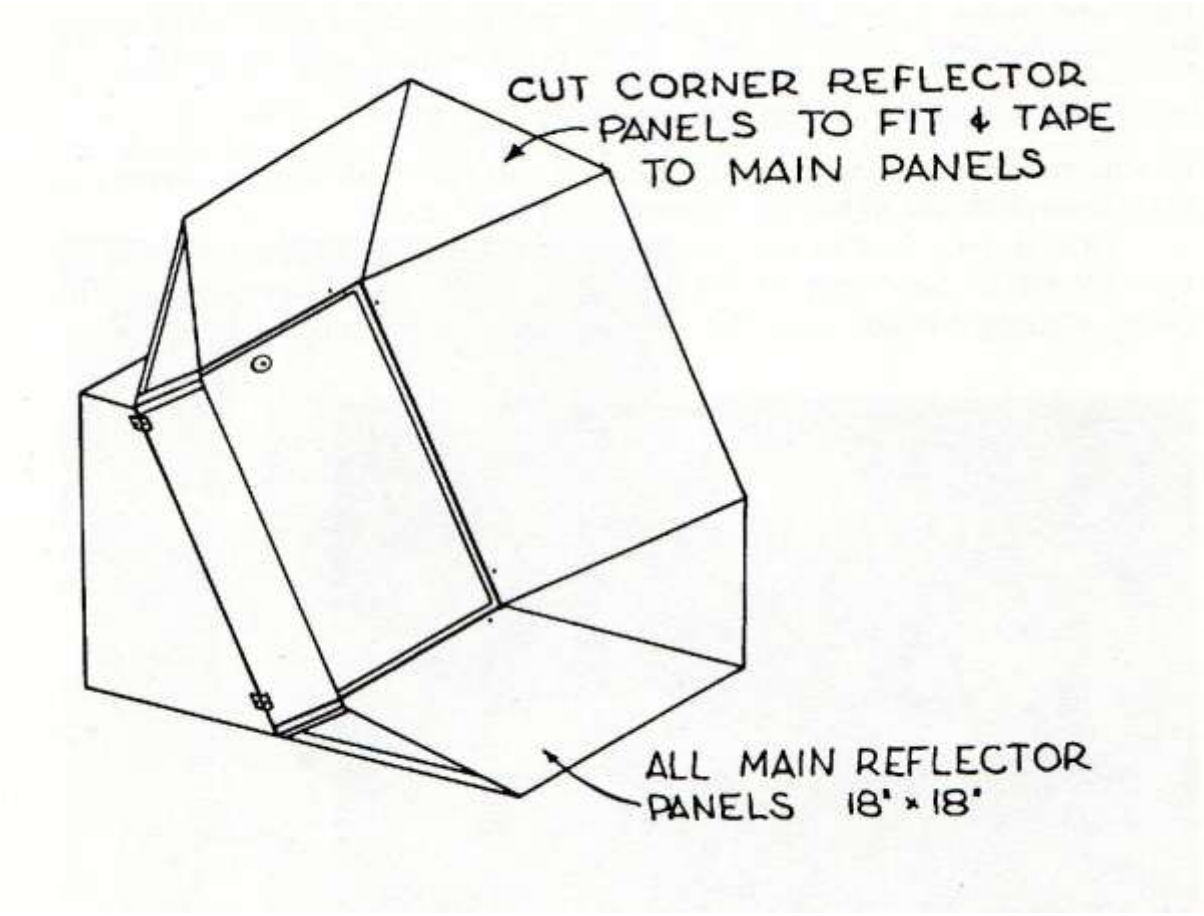


Oven Body Assembly
Fitting Brackets to the Stove Body

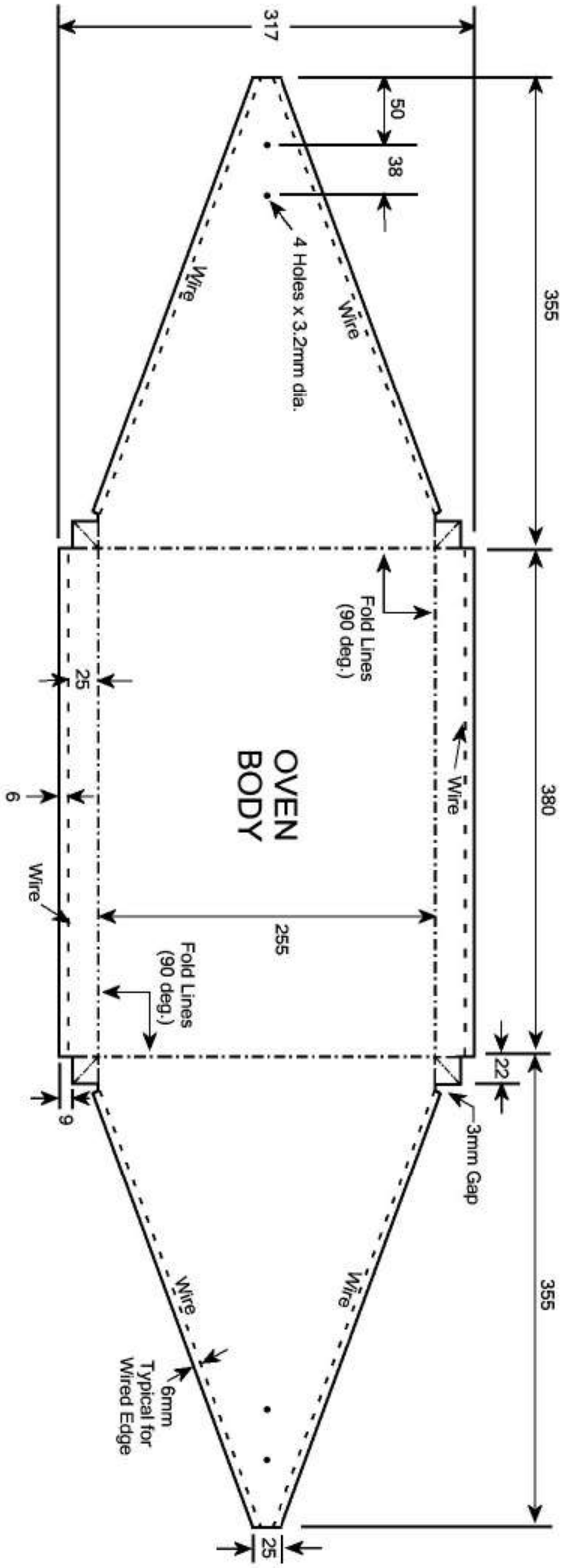


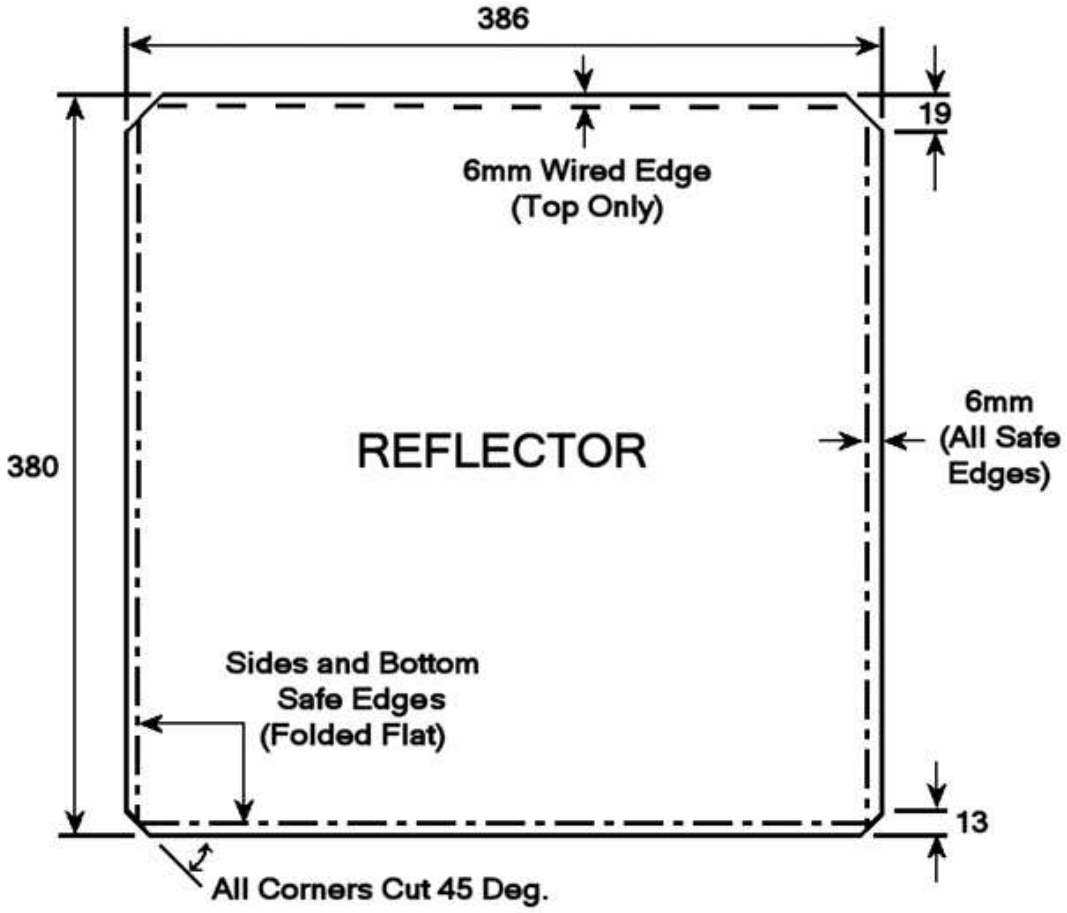


Reflectors Fitted to the Oven



Appendix 3 – Fireplace Reflecting Oven Body and Oven Reflector Plans




386
19
6mm Wired Edge
(Top Only)
380
REFLECTOR
6mm
(All Safe
Edges)
Sides and Bottom
Safe Edges
(Folded Flat)
13
All Corners Cut 45 Deg.