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■ Off Grid Living & Stories

Building a Cabin on a Budget

Building an Off Grid Dream

Firewood: *How much do you need for winter?*

■ Photo Journal

A collection of rustic barns and cabins

■ Energy

Solar Panel Mounting Options

■ Food & Gardening

Winter Crop Storage: *10 crops that keep for months*

■ Prepping & Survival

Ancient Weapon Making: *The atlatl and dart*

■ Off Grid Tech

Top 10 Off Grid Building Machines

Building a Cabin on a Budget

By Eric Wichman, offgridworld.com

Building a cabin on a budget is easier than some might think, but it does have its challenges. When I say 'easy', I don't mean it's easy to build. I mean it's easy to save money and build on a budget when you do everything (or as much as possible) yourself.

The biggest expenses in building are materials and hardware. You must be creative in how and where you acquire materials, the tools, and the equipment needed to build your cabin.



This article will touch on the basics and also assumes one already has proper permitting in place and the building skills to build a basic structure. This article also focuses on sustainability, impact on the environment, and cost.

Depending on whether you're building your cabin on a permanent foundation or placing it on concrete blocks or stone pillars will also have a large impact on how much you will spend to build your own cabin. There's a huge price differ-



ence in building a cabin on a concrete foundation compared to placing it on concrete blocks or stone pillars. Septic, water, and power are the three big concerns after shelter.

So...Where do you start? With the land.

Your choice of property is, perhaps, the single most important aspect to building your cabin. It very well could determine the success or failure of your off grid homestead.

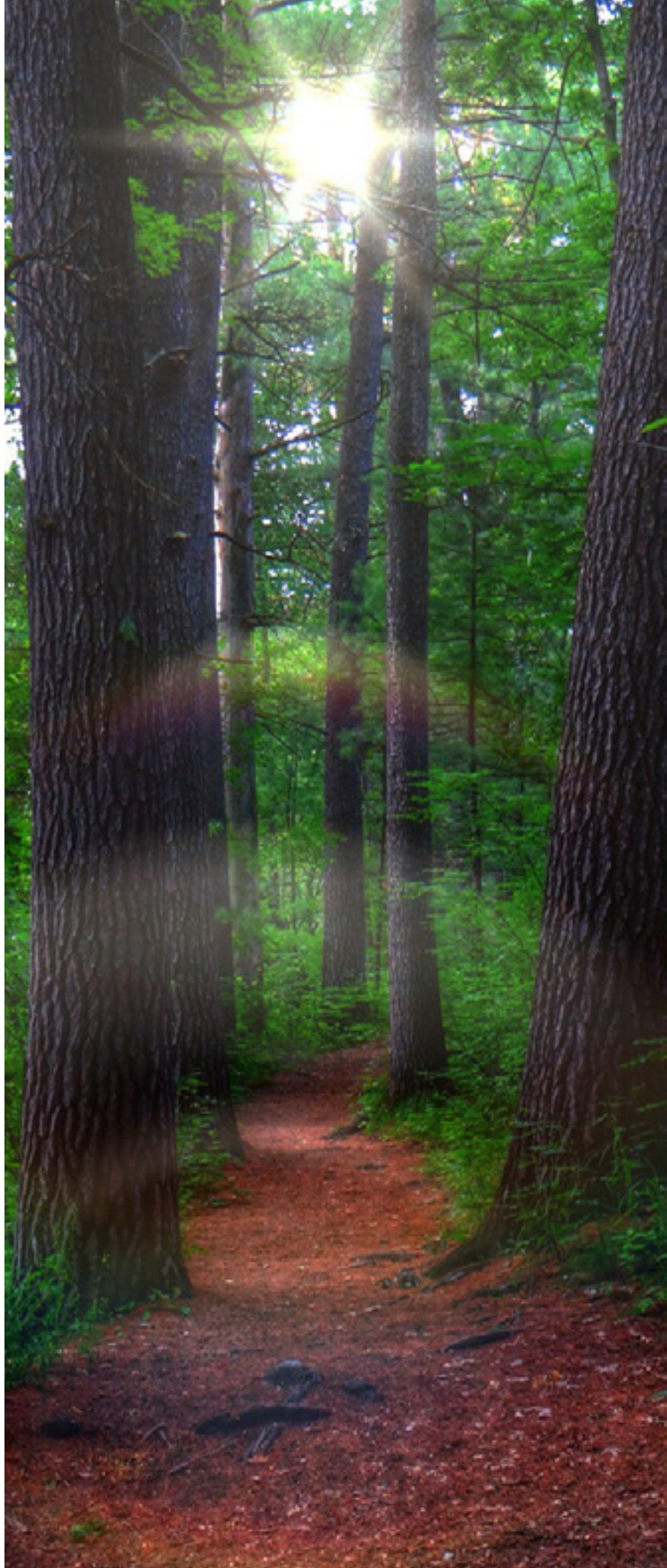
Picking The Land

Before we get into the details of building a cabin on a budget, let's discuss the land. If you've done your homework you've picked land that has the natural resources you need. This will save you much more money than you realize, especially if you know how to build. Even if you don't know much about construction, it's a good idea to source your materials wisely and not try to buy everything from the store.

In the old days pioneer settlers would pick their land based on the natural resources available. They had this whole living sustainably almost down to a science. They had to back then, because it was literally a life or death choice. If they chose a location which didn't have the resources needed then they would not survive. There was no Walmart, Home Depot, Lowes or Ace Hardware store to run down to for supplies. They had to fend for themselves, and therefore had to pick land that provided them with what they needed.

In modern times we've forgotten how to do that, or rather, since we have all the resources at our fingertips, we don't need to do that anymore. Picking a piece of land becomes more about the covenants and convenience of location to schools, shopping and entertainment. We've become complacent as a society and we take the natural resources for granted, thinking and expecting them to always be there.

Living off the grid is about being self sufficient, and if you're going to live off grid you need resources.





Water, timber, and rock:
If you find a parcel of land with these three resources, you're well on
your way to building a sustainable off grid life.





Water, Timber, and Rock

With these three things - water, timber, and rock - you can do almost anything. First and foremost, you need water for drinking, cooking, and sanitation. The timber and rock will provide you with the materials to keep warm and build your cabin, barn, and livestock areas.

Picking a parcel of land with plenty of trees and rock is vital. Water is kind of a no-brainer. You must have water, whether it's a lake, stream, river, creek, pond, natural spring, or well. You'll want to pick a piece of land which already has water or with water easily accessible. Also, for security and safety reasons, it's a good idea to make sure you're not too close to a large source of water. In the case of a societal collapse, a large water source will become a magnet for people and could cause risks. Try to pick a property which has water but is not too conspicuous.

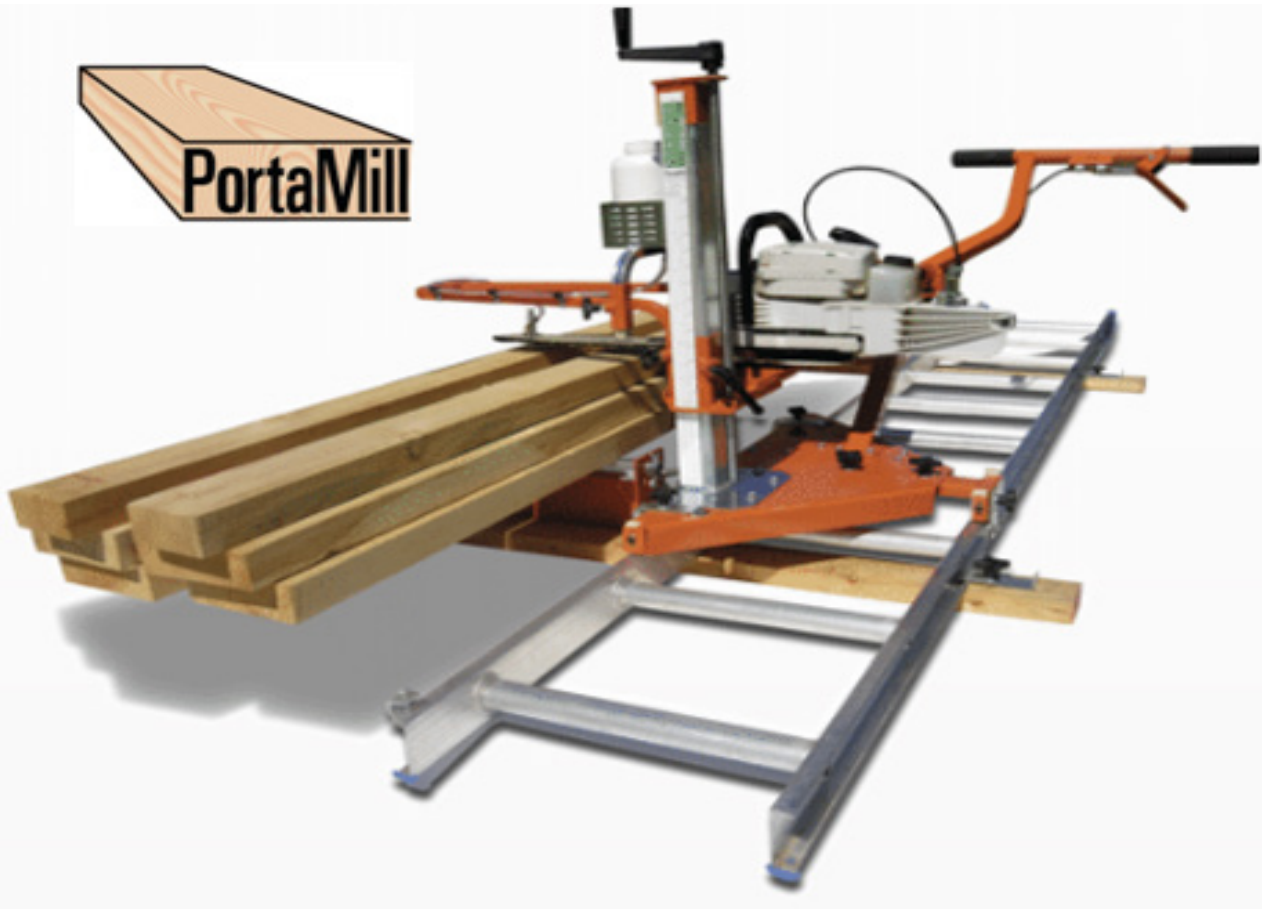
You can save a ton of money building your cabin if you can do the majority of the work yourself and avoid having to buy all of your materials.

Choosing a property with natural resources available will allow you to reap the rewards of having a piece of land that provides everything you need well into the future.

The Right Tools For The Job

I personally have a philosophy that is when you have the right tools and equipment, not only can you do the job right, it saves you time and money in the long run. That's why when I build my cabin I'll be investing in the tools and equipment needed to create my own materials from the natural resources available on my land rather than buying my materials at retail stores.

Not only does this cut costs exponentially, it will save money for years and years to come because the tools and equipment purchased for building a cabin can be used for as long as you own the land. The use and money savings over the years will not only pay for the cabin, but will



A portable sawmill can save thousands in lumber costs and can also become a source of income.
Images via [Norwood Sawmills](#)



LumberMan
MN26



allow you to build more, and potentially even give you an income stream.

Tools & Equipment

The first piece of equipment you need (and perhaps the most important) if you're going to build your own cabin and don't want to buy your lumber, is a portable sawmill. Yes, that's right. A sawmill. This almost completely removes the need for you to buy lumber, drastically reducing the overall cost of materials.

Cost vs Reward

According to the [National Association of Home Builders](#), the average cost of lumber for framing, trusses, joists, etc. in 2013 for an average sized home is about \$47,000! (this for a 2600 square foot suburban home)

I don't know about you, but I don't have \$47k to drop on lumber, and to build my cabin (approximately 1500 square feet) I know I'll need about \$30k in lumber if I buy it from the store. So I've decided to build with natural untreated lumber that I mill myself with a portable sawmill. There are a few reasons why I chose this route:



NO HARMFUL CHEMICALS - Most lumber is treated in some way, and I don't want it in my home with my child, and neither do I want to contribute to damaging the environment. Milling my own lumber just makes sense.

INCOME OPPORTUNITY - Most people do not own a sawmill, and if your neighbors need lumber, then you have the opportunity to provide that to them at a hugely discounted price, saving them money, and providing a good extra income for your family as well.

The next piece of equipment you might need is a tractor or backhoe. You will always have a need to haul things around your property, and you'll need to dig and level and clear land for other structures like barns, stables, corrals etc. A good tractor or backhoe is a great piece of equipment to own, and with the savings you have on the lumber, you have more than enough to purchase a good used one.





There are countless ways to utilize recycled and repurposed materials in your building projects, from old shipping pallets that companies throw away to resources available at used materials stores.

I personally am purchasing a backhoe because it's multi purpose, and I can do much more with it than I can with a tractor.

SUSTAINABLE SELF SUFFICIENCY TIP: Multi-Use Tools & Equipment

I look at off grid living as not just a lifestyle but a self sufficient necessity and when I pick the tools and equipment for my off grid homestead, I make sure that they can be used for multiple purposes. This not only simplifies things, it saves me money because I don't have the added expense of spending money on "specialty" tools that only do certain jobs. To me that's a waste. It's not sustainable, and if a tool just sits in the toolbox or in the barn, I have no use for it. It's money that's being tied up that can be used elsewhere. Being self sufficient means choosing the right tools, but it also means making sure you can do more than one thing with them.

Hand & Power Tools

Basic hand tools like hammers, screwdrivers, axes, knives, tape measures, and a good pair of pliers and wrench set are all obvious must-haves for your homestead.

Repurposed & Recycled Materials

Since we live in a society that consumes (unfortunately) we can use that to our advantage and recycle and repurpose materials for use in our homes. Construction companies throw away and donate a lot of materials, manufacturing facilities have gazillions of pallets and crates that are normally just thrown away into landfills, and department stores have lots of surplus hardware that can be used.

Sustainability & Conservation

"Wait a minute," you're probably saying. "What about all the trees you cut down to build your cabin? That's not sustainable!" You're right. If all you did was cut down trees and not replant then yes, it would be bad because it's just not cool to chop a bunch of trees down and not give back to the earth, in my opinion. So, that's why I've decided to plant 3 trees for each tree I cut down. If the earth is providing me with what I need to build my home, and is giving me the resources I need to provide shelter and a home for my family, then the right thing to do is give back and plant more trees than I use. That is sustainable.

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Eric is the founder of offgridworld.com



Building an Off Grid Dream

By Mike & Wendy Tanner, floodslanding.com

Mike and Wendy Tanner decided back in 2011 to make a life changing decision and follow their dream of going off grid by purchasing a campground in the backwoods of Ontario, Canada. This is their off grid story and how they built their dream.



We are happy to talk about our experiences that we've encountered on our adventure here in Northern Ontario. Mike and I decided in 2011 that we would like to do something different. We have always enjoyed the north, along with hunting and fishing, so we decided to look for a lodge to buy and run. We spent the winter of 2011 and spring of 2012 looking at various lodges all over northern Ontario. On Easter weekend we came north to Cochrane, about a 6 1/2 hour drive from our home in Washago, and looked at "Flood's Landing", a campground on the Frederick House River consisting of 130 acres and 6 small cabins. We had to walk in from the road - a 1 km



walk - because the soft spring conditions of the driveway were not favourable to drive on.

We were very intrigued to see this camp. The driveway into it was treelined and after 1000 feet of going straight it rounded a bend and overlooked the rapids in the river below to our left. It continued to wind down a hill and around 2 more bends

before we came to the 6 little cabins and the campground beyond. We were sold on it just from that walk in. It was exactly what we were looking for: private and semi-remote, road accessible, lots of land, and the river. We were very excited to see what it held around the bend. We saw great potential, made an offer, and



Left: Assembling our Norwood sawmill - something we vow we will never be without again!

Below: We go out and cut the trees we need to use for our building projects, haul them back with our bulldozer, and process them with the sawmill.









Drilling a well, and a cabin in progress



Constructing the Northview cabin



before the end of the weekend the seller had accepted. The journey began!

We moved in the middle of May 2012 and listed our house in Washago for sale. We went from a beautiful hand-hewn log home, which we purchased in 2008 and renovated with a brand new 32' x 40' garage that my husband built, to a 16' x 24' one room cabin with a

wood stove, a propane stove/oven, and a generator for power. It had no indoor bathroom, no septic, no well, no hydro, and no phone. It was a change of lifestyle as well as a change of address.

The first year we cleaned up the property, cut the grass, and met our seasonal campers who were already tenants prior to us becoming the owners. We learned



where the fishing holes were, explored our property, photographing all the wildflowers and critters we came across, and thought about where we would like to build our home and how we would build it.

With all the timber available on our property we decided to purchase a sawmill and build everything, as much as possible, ourselves. Our house in Washago sold in September of that year and we started making our plans to begin building the new rental cabins and hopefully a home in 2013.

We purchased our Norwood sawmill in the summer of 2013, and we vow we will never be without a sawmill ever again! It has been a huge learning experience just in the process of milling the logs - from going out and selecting and cutting them with a chainsaw, to hauling them out with our little bulldozer that we found for sale here in Cochrane and milling them. Our property is under the Town of Cochrane limits, therefore we need building permits for everything we construct.

Our plan is to be open in the winter to rent the cabins to snowmobilers, so to get the greatest warmth in our cold winters we decided that instead of going with full log walls, we would do a post and beam interior





that extends out on the porch, and put up exterior log siding. Our walls are studded with 2' x 6' boards, insulated, and vapour barriered. The ceiling rafters are 2' x 8" and insulated and vapour barriered as well. The

floor has 1" poplar boards with tar paper laid down underneath blue styrofoam insulation, then topped with plywood that we will be covering with poplar off our mill to finish. When the cabins were completed we





Our Poplar Ridge cabin

finished all the wood and beams with Sikkens Cetol Natural stain. We love the warm and ambient look this gives the cabins, especially at night when the generator lights them up.

We had the cabins wired for a generator to plug in and in the next year we are exploring our options for going with solar and wind power. The cost of water is too high and we like the idea of being off the grid. Our plan is to have 6 - 8 new cabins, a central washroom/shower building and a store/office/dining room when we are complete.

We have been putting our focus on the business, so we haven't started our home yet. This is the beginning of the 3rd winter that we've been in our little cozy cabin, and although last fall we had a well drilled and a

septic bed installed, the summer bathroom is now decommissioned because the lines will freeze, and we are back to the loyal outhouse for the winter. All good things come to those that are patient, and the experience wouldn't be the same if we had everything we left behind in the south. We find we notice little things with all the changing seasons, from animal tracks in the snow to northern lights in the midnight sky and the sound of the water rushing over the rapids as the snow melts in the spring. And so much more. To anyone thinking of doing something like this all we can say is it is a journey, there will be ups and downs, but it is all part of the adventure and the learning never ends.

At this time we have 3 cabins completed - "NorthView", "Poplar Ridge", and "The Moose Shed". Our fourth is started, and in the spring of 2015 we will begin our



The view from our cabin in winter

main building to have it completed before fall, with water and a washroom that can be used year round. Perhaps if the building season allows and things go well, we will begin our home, too.

Costs To Build:

Our cabins are 16' x 20' with a 6' porch, a one room open concept with 2 double beds, a propane stove-top, a propane furnace, table & chairs, and all dishes and cooking utensils provided. They do not contain washrooms, as we are building the central washroom/shower facility for all to use.

The cost of the materials to build one cabin, including windows, door, steel roof, insulation, propane furnace, stovetop, the cost for a licensed electrician to fit them for a generator, and the propane contractor to run the propane lines, is approximately \$13,500.00 complete. The headboards for the beds we made with the saw-mill, and if we had purchased all the lumber it would have cost closer to \$22,000.00. We gained additional

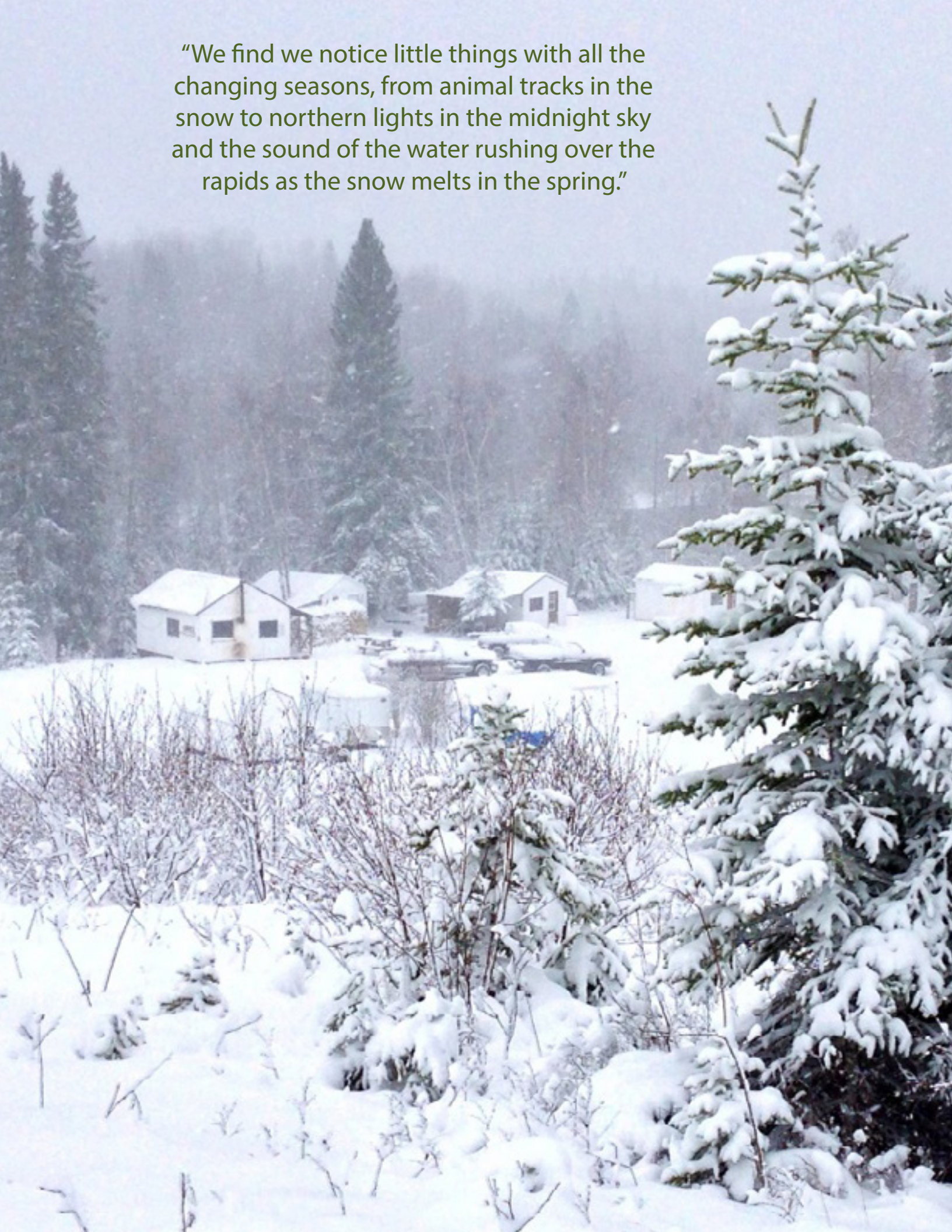
savings because we constructed the cabins ourselves, except for the electrical and propane components. Because the cabins are for commercial use, the electric and propane needs to be done by licensed contractors.

The process of cutting logs takes a bit of time due to the drying. This past year on Easter weekend we cut down and hauled out all the trees we need for the third cabin, but then we waited about 4 months to mill them and piled the lumber so it could dry with air around it. We preserve the wood when we build with it and as long as there is no direct heat they have done well (direct heat as in from a furnace in winter. We haven't rented them in the winter as of yet, but plan to.)

Fuel is expensive here in the north, so it is our biggest ongoing expense. It is currently \$1.25/litre, but has gone as high as \$1.40/litre. We use it in the sawmill, dozer, backhoe, generators and chainsaws.



“We find we notice little things with all the changing seasons, from animal tracks in the snow to northern lights in the midnight sky and the sound of the water rushing over the rapids as the snow melts in the spring.”





FIREWOOD

How Much Do You Need for Winter?

by Mike Turber

For some people, predicting how much firewood is needed for the year is not difficult and can be figured out based on how much firewood was used the previous year and whether that amount was sufficient. Factor in a winter weather forecast (as if these are ever accurate!) and maybe some extra in case of an emergency and you are done, right? Well, for many the answer is not so simple. Perhaps you have added a room, had children, want to heat a barn for horses or livestock, or any number of other factors that can change how much wood you'll use. Or it could be your first year burning firewood and you have no idea how to calculate the necessary amount.

If you use wood to heat your home, your water, and to cook your food, getting the correct amount is essential. You may find it impractical to go out in the dead of winter to chop more or even search for people selling cords of firewood. It is best to get it right before winter hits.

If this is your first winter in a new home, you could ask the previous owner a few questions to help you calculate how much wood you might need:

- What temperature did they keep

the home? (day and night)

- How much cooking did they do?
- Did they heat the water continuously or just when needed?
- Did they buy the firewood or chop their own?
- If they purchased the firewood, did they have a negotiated deal you can continue?

Perhaps the most important factor in calculating how much wood you need is knowledge of the winter





Modern wood stoves, like the one above, are much more efficient than older models. This is something to keep in mind when calculating how much and what type of wood to procure for the winter

weather. If you are new to the area, you will want to know the winter forecast. To do this you can use the time proven and trusty Farmer's Almanac or you can visit the NOAA (National Oceanic and Atmospheric Administration) website. The average winter season is about 5 months and, of course, this depends on your location. Pay close attention to December, January and February temperatures. We have provided links at the end of this article. With this info, you can adjust your calculation accordingly.

Firewood Basics

Now let us look at the firewood itself. Virtually all firewood is similar, regardless of type. The density and moisture content is what influences how the wood burns, and its value as firewood. Denser hardwoods



like maple and oak have more energy content per cord and therefore release more heat per cord. They also produce longer lasting fires and coal beds, making them a more efficient choice. These are more expensive, but they make up for that in the amount of BTUs (British Thermal Units) they release. Softer woods like birch, pine, spruce and poplar are less dense, burn faster and do not produce long-lasting fires or coal beds when burned. Soft woods are better for temporary fires, so you may want both types for various reasons.

Normally, hardwoods are the preferred firewood, especially in central and eastern North America, but softer woods make excellent fuel for spring and fall use. Your only choice may be softwoods like spruce and pine and light deciduous trees like birch and aspen. Be extremely careful burning pine, as it can be very dangerous because it may produce excess creosote in the flue, putting you at higher risk

for a chimney fire. Lodgepole pine is better than ponderosa because it creates less creosote. Clean your flue at least once a month and more often when burning softer woods. Newer and more advanced technology wood stoves, furnaces, and fireplaces function very well with a wide variety of firewood types because of better combustion control over older conventional style appliances.

Where to get firewood

Do not wait until winter is knocking on your door to get firewood, especially if you are buying it. The law of supply and demand is always in effect and this is very true of firewood buying.

*If you have the resources,
cutting your own firewood is
a very cost effective way to build
up your supply*

Here is a gem of a tip: FREE FIREWOOD!

You should think about firewood year round and one great source for FREE firewood is Craigslist.





Just search for “free wood” and you will be amazed at how much is there. A little work and a truck may be necessary, but you cannot beat the price!

The official measurement for firewood is called a “cord”. A cord is a organized pile of wood 4 feet high by 4 feet wide and 8 feet in length. This is 128 total cubic feet so keep this in mind when buying by the cord for storage concerns.

You will generally see a price range of about \$150 to \$300 per cord. The price fluctuates based on the type of wood, the demand, and delivery. Delivery is the easiest to negotiate. Check online on places like Craigslist, your local newspaper classifieds, and local lumber or hardware stores. You may even find firewood sellers along the side of the road certain times of the year.

Here are some tips to keep in mind when buying firewood:

- Do not purchase firewood over the phone. Visit the supplier so you can visually inspect the wood

to make certain it is dry and that it is of the type you need.

- Bring a tape measure and make certain you are getting the amount you are paying for.
- Watch the supplier load the wood.
- Make sure the pieces are split and small enough for you to use.
- Do not buy wood by the “pile” or “truckload”. Use known sizes like “cords” and fractions thereof.
- Buy wood in the spring so you can monitor the seasoning (drying, curing) process.
- Look for wood that is clean with no sand, mud, moss, or other issues.
- Avoid mixed batches of wood, especially if pine.
- Ask around for recommendations of suppliers from long time residents.
- Ask for a deal if you plan on buying future cords from the supplier. For example, if the supplier is asking \$250 for 1 cord and \$450 for 2 cords, ask if you can buy 1 cord for \$250 and the next for \$200 or maybe \$225 at a later date. You will be surprised how many “yes’s” you can get!

The most often overlooked issue when buying wood is the length and diameter you need. If you plan on spending time and effort splitting and cutting your own wood this will not be an issue. However, if you plan ahead, you can get exactly what you need from a supplier, already cut and split to the sizes you can use. Remember for stoves and furnaces, pieces should be about 3 inches shorter than the fire box size. Shorter pieces are better for handling and maintaining the fire. The length of the pieces should not vary by more than 2 inches. If so, you will have issues loading and stacking in both your storage area and in the appliance. The best average size is anywhere from 14 to 18 inches in length.

Large diameter pieces will smolder longer, but smaller pieces are easier to ignite. Finding the balance depends mostly on the appliance and the amount of maintenance you plan on for the fire. Ideally, 3 to 6 inches, measured across the widest section, is best. The trade

off for buying firewood cut to these sizes is cost. Wood cut to fit various appliances is going to cost you more.

When buying firewood, you should look to sources that use sustainable methods for harvesting. Make an effort to buy from those who use good forest management practices. You should also vary the types of wood you buy and use softer woods in the spring and fall.

Stacking & seasoning firewood

If the wood still contains a lot of moisture, you will want to stack it outside for seasoning and drying if you are in a dry climate. To do this, stack the wood in equal stacks with room in between to allow airflow to carry the moisture away and allow for sufficient sun for heating.

If possible, do not stack the firewood directly on the

Split firewood cures much faster than whole pieces, so try to cut and split your pieces early to allow plenty of time for the wood to dry out before burning.



ground as this can cause mold and rot. Pallets are perfect for keeping wood up off the ground. You can cover the stacks to keep rain off but do not cover the sides and do not use a tarp, which will trap moisture. Most wood contains about 50% moisture and you will want that number down in the 10% to 15% range before burning.

The softer the wood, the faster it will season and dry. Pines, spruces, aspen and such are soft woods and may only require as little as 3 to 6 months to season. Harder woods like oak and maple may take up to a year to properly season. Buying seasoned wood is more expensive so plan ahead!

To determine when your wood is dry enough, you can buy a moisture meter. However, this is not essential. For a quick moisture test, just split a piece of wood and feel for moisture. You can also test burn a piece. A wet piece will make hissing sounds in a fire. A dry piece should light relatively quickly. Dried wood will also show signs of cracking or splits on the ends. Wood will normally yellow or turn grey as it dries. Another

way to test for moisture content is to bang 2 pieces together. Dry wood sounds somewhat hollow and wet wood will sound solid. Dry wood also weighs less than wet wood, with as much as a 50% weight difference in some cases.

Stacking wood for curing and storing wood long term are two different things. During the seasoning process, you will want to stack the wood as mentioned earlier. Perhaps the biggest mistake people make is when storing firewood. Firewood should be stored in a dry, covered area sheltered from rain, sleet, snow and wind. Do not store large amounts of wood inside your home. Store just the amount you plan to use over the course of a few days indoors. Storing excess wood indoors is a fire hazard, and mold spores in the wood can become airborne, causing a potential health hazard.

Maximizing Efficiency

A few simple steps can be taken to make the most of your firewood supply. If you have a wood burning stove, a handy way to increase the efficiency of heat-



ing your home is through the use of a heat exchanger. Sending heat up a flue without redirecting some of the heat is perhaps the biggest waste of energy you could make. Another huge waste of heat is drafty floors, walls, windows, doors, ceilings and attics. Insulating these areas will drastically reduce the amount of wood you will need to burn, saving you money, time, and most importantly, keeping you comfortable.

So, how much will you use?

Depending on your situation and the weather, you will most likely use somewhere between 1½ to 4 cords per year. Larger families in a large home with many appliances may use up to 6 cords a year. Using kerosene or electric heaters to heat specific areas of the home, such as an office or bathroom, could prove an effective way to extend firewood reserves. A modest 1,200 square foot home with 2 people in a moderately cold climate should expect to use about 2 cords.

A good rule of thumb is ¾ to 1 cord per person in a 1,200 square foot home if your average winter (Dec., Jan., and Feb.) temperature is 45 degrees. Add 1/3 to ½ cord per person for each 10 degree drop in average temperature and the same for each additional 500 square feet of living space.



Editor's note: cutting your own firewood is a cheap option for obtaining your yearly supply, if you have the resources and don't mind a little extra work. If you own your own land and have plenty of trees, you can probably get a large part of your stash just by cleaning up the dead and damaged trees on the property. If you live near a forest, look into getting a cutting permit from the Forest Service and go select your own trees to cut down. Forests are full of standing dead trees, which make excellent firewood, or you can cut up fallen trees. Cut them in the spring or early summer so they have several months to cure before you need to burn them.

In my family, we have three houses among us that use wood burning stoves for heat, so every spring and summer we turn the firewood gathering into a family venture. We cut up any trees off my par-





ents' land that were damaged or killed the previous year, then we get permits from the Forest Service for the remainder of what we need. My dad has a nice, gas-powered wood splitter on his property (something I HIGHLY recommend if you will regularly be splitting your own wood), which drastically cuts down on the amount of time it takes us to process several loads of wood. Split wood cures faster than whole pieces, so we try to split everything as soon after cutting it as possible. Although, I always keep quite a few larger, unsplit pieces in my pile because they take longer to burn, so I like burning them overnight.

The Forest Service cutting permits are cheap - currently \$5 per cord here in the Black Hills - and we

can usually cut and split enough firewood for each of our houses in one or two weekends. After we have it cut and split, I haul what I need to my house with a few truck and trailer loads, until I have enough stacked up in my back yard to last the coming winter. We try to have this whole process finished by the beginning of the summer so the wood has plenty of time to cure. It feels great to get all the work out of the way when the weather is nice and to know that the job is finished. I never have to worry about scrambling to cut or buy wood in the dead of winter.

If you have family or friends that burn wood, consider grouping up to get your supply together. It's well worth the effort!

Resources:

Average winter temperatures by area: <http://www.currentresults.com/Weather/US/average-state-temperatures-in-winter.php>

www.woodheat.org

www.noaa.gov





Photo Journal

A collection of rustic
barns and cabins





























Solar Panel Mounting Options

Roof, Pole, or Ground Mounted Solar?

by LaMar Alexander, simplesolarhomesteading.com



There are several options for mounting panels other than on a roof. Here are a few:

Ground mount rack

A ground mount rack is typically made of wood or steel. The panels are attached to the rack and kept low enough for easy snow removal and maintenance. The drawbacks of this system are that the panels are more prone to damage from kids, rocks thrown from a lawnmower, or theft. Ground mount racks can be fixed mounts or made adjustable for tilt to capture winter and summer sun. This type of mounting system works well for smaller off grid power systems.

I have used many different mounting systems for my solar panels over the years, though my main system has always been mounted on racks on my porch. In winter that has been a real hassle because snow can get high here and getting up on a ladder or climbing out a window to push off the snow at my age is not safe or smart.

If your panels have a good winter angle, then snow will fall off of them, but keeping them clean and doing routine checks and maintenance if they are mounted on a roof may not be ideal unless your system is very large.

Pole or post mount

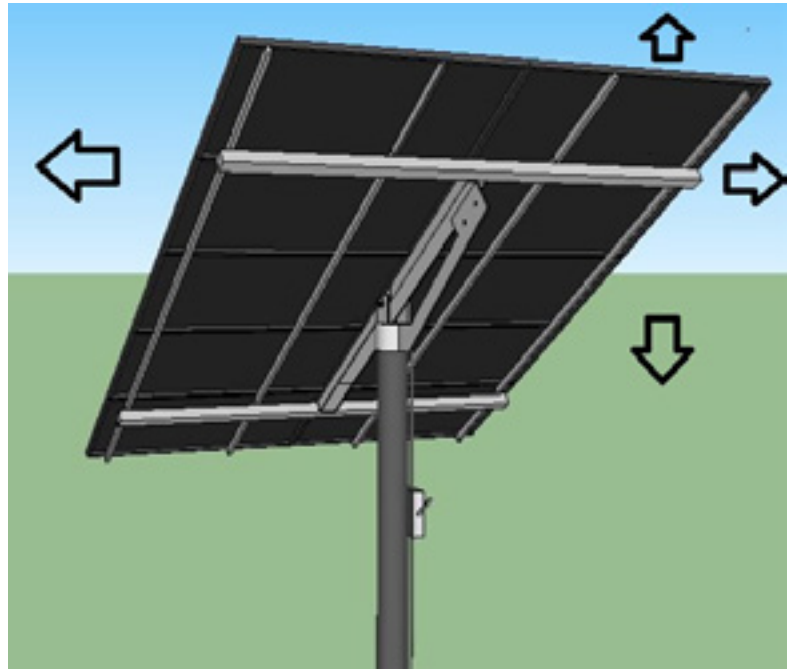
Pole or post mounting is a good option for your solar panels if you want to adjust tilt and angle to maximize sun exposure. The pole is usually made of steel but wood posts can be used. Mounting swivels and racks are available commercially or you can fashion your own. Some pole mounts are manually adjusted or you can get optical solar trackers that will track the sun as it crosses the sky. The benefits of these systems are they are low enough for easy maintenance and will maximize sun exposure. The drawbacks are that they are

generally more costly and mechanical and tracking adjustments do not always work correctly.

Adjustable RV or Roof Mount

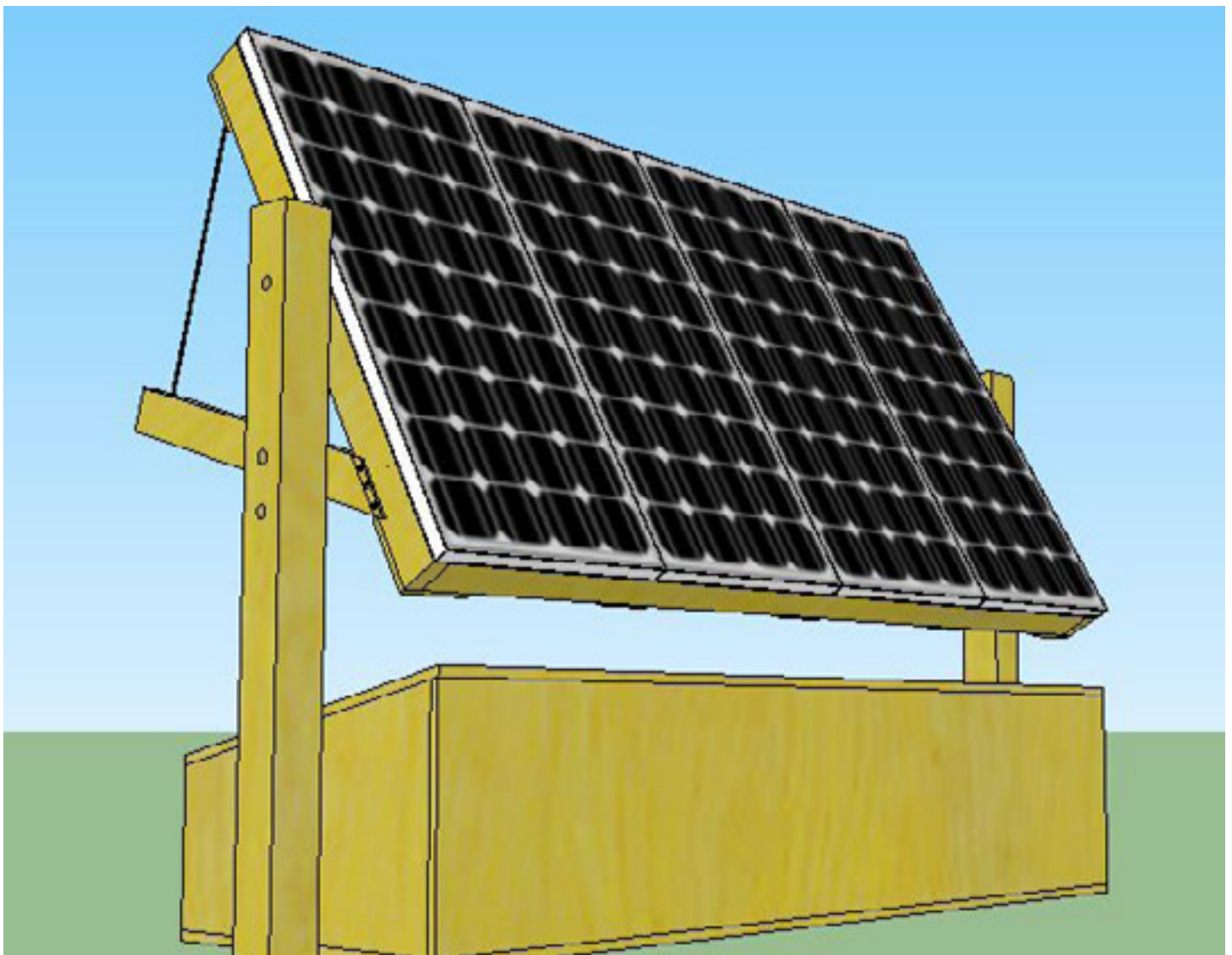
If you need to be able to adjust the tilt of your panels, there are several brands of commercial adjustable mount systems available that allow you to tilt the angle from horizontal to vertical and several angles in between.

If using these for a house roof mount, please be aware of your local building codes and regulations. Any permanent attachment of a solar mount or device to a house may require a permit and inspections and may effect your homeowner insurance.

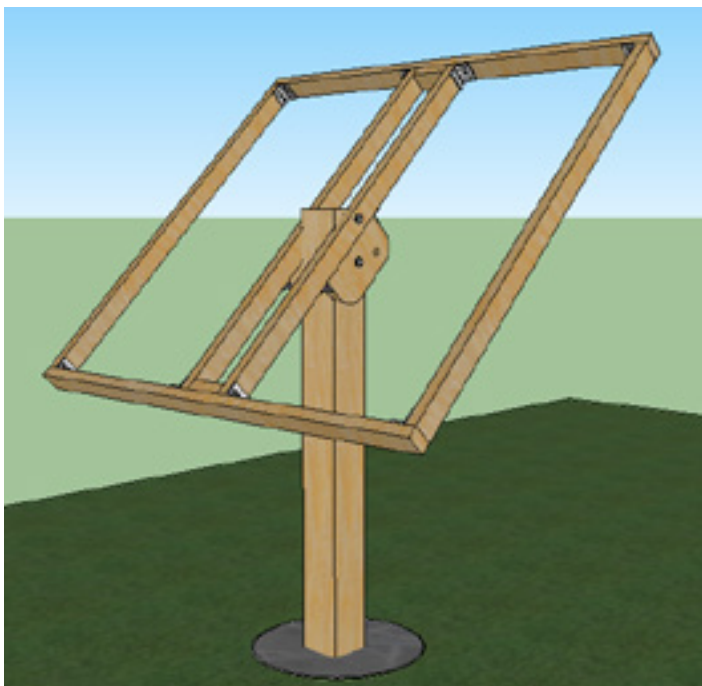


Above: a pole mounted solar panel has the advantage of adjustability for maximizing sun exposure. Below: the author's ground mounted solar setup, holding four 100-watt Renogy panels





Above: Larger systems can be mounted on wooden posts with a storage box built underneath for batteries. Below: Another adjustable pole mount option.



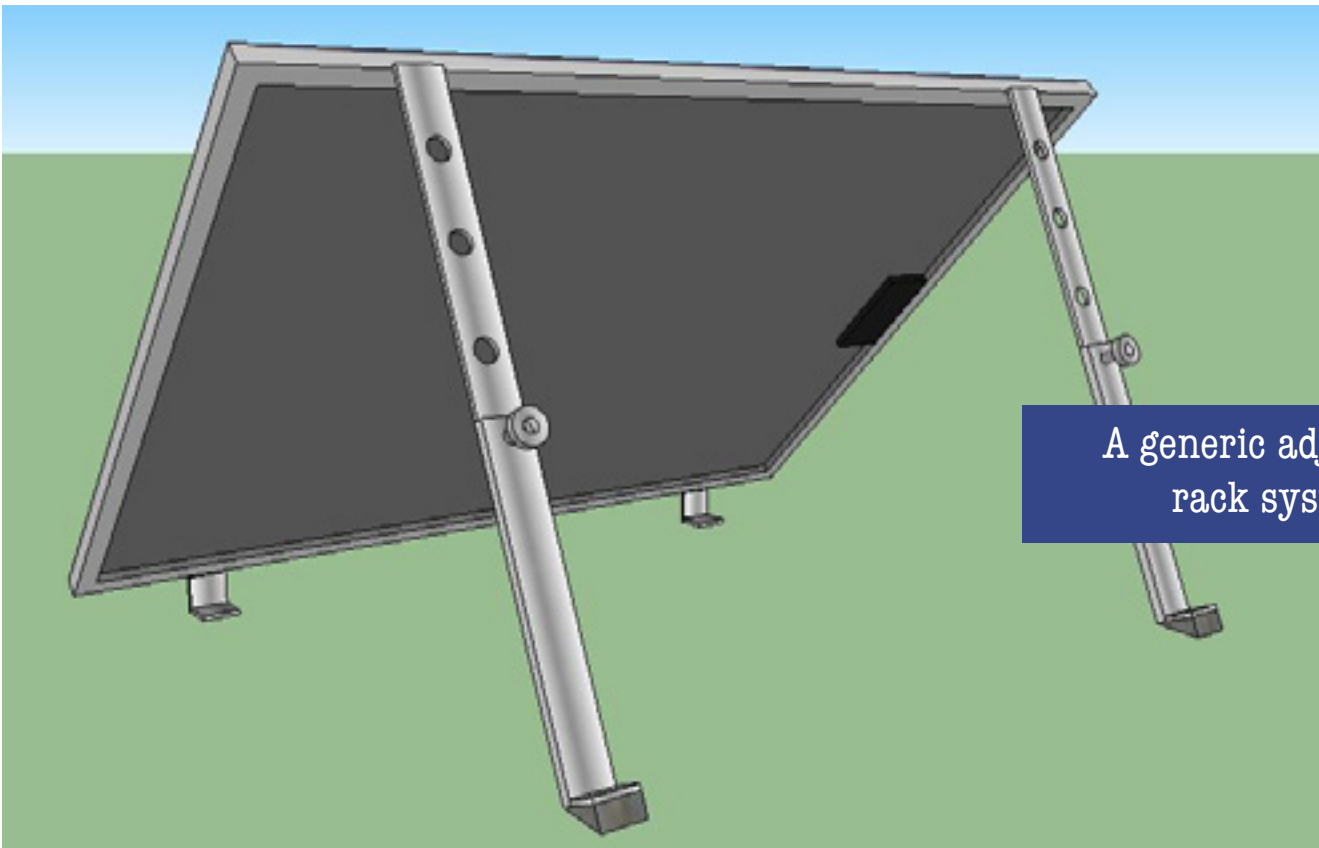
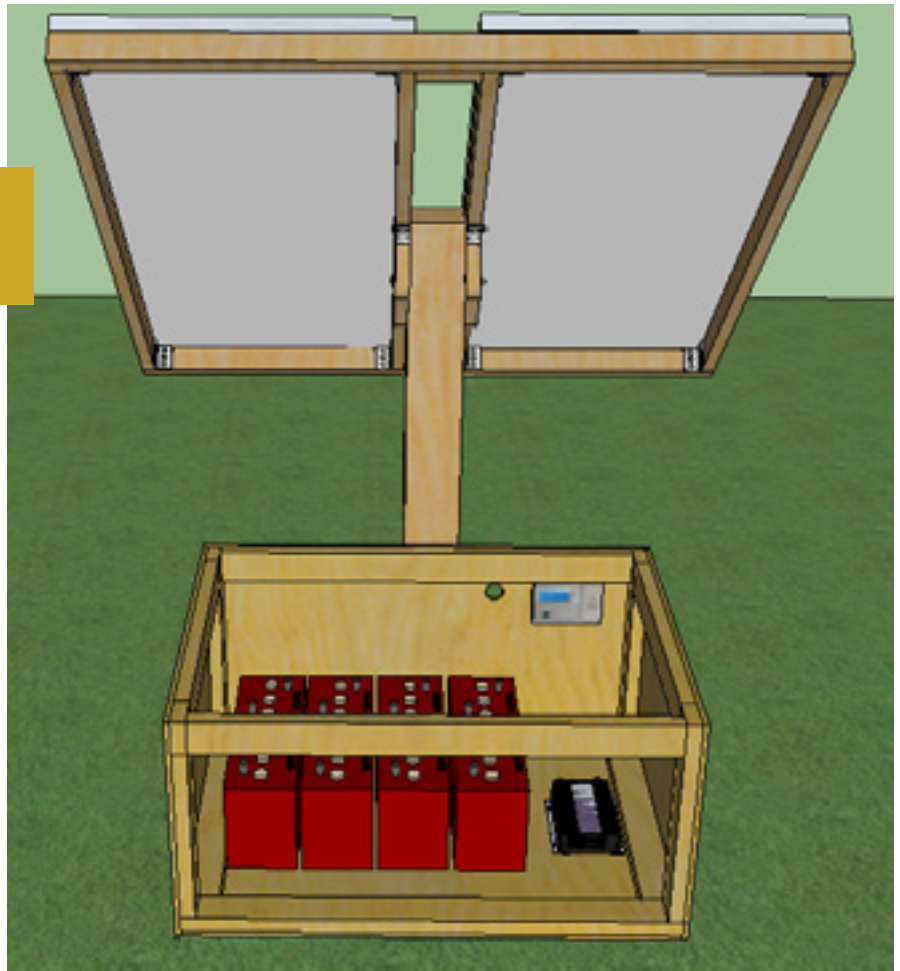
A pole mounted panel system with an attached power box

Flat Roof Mount

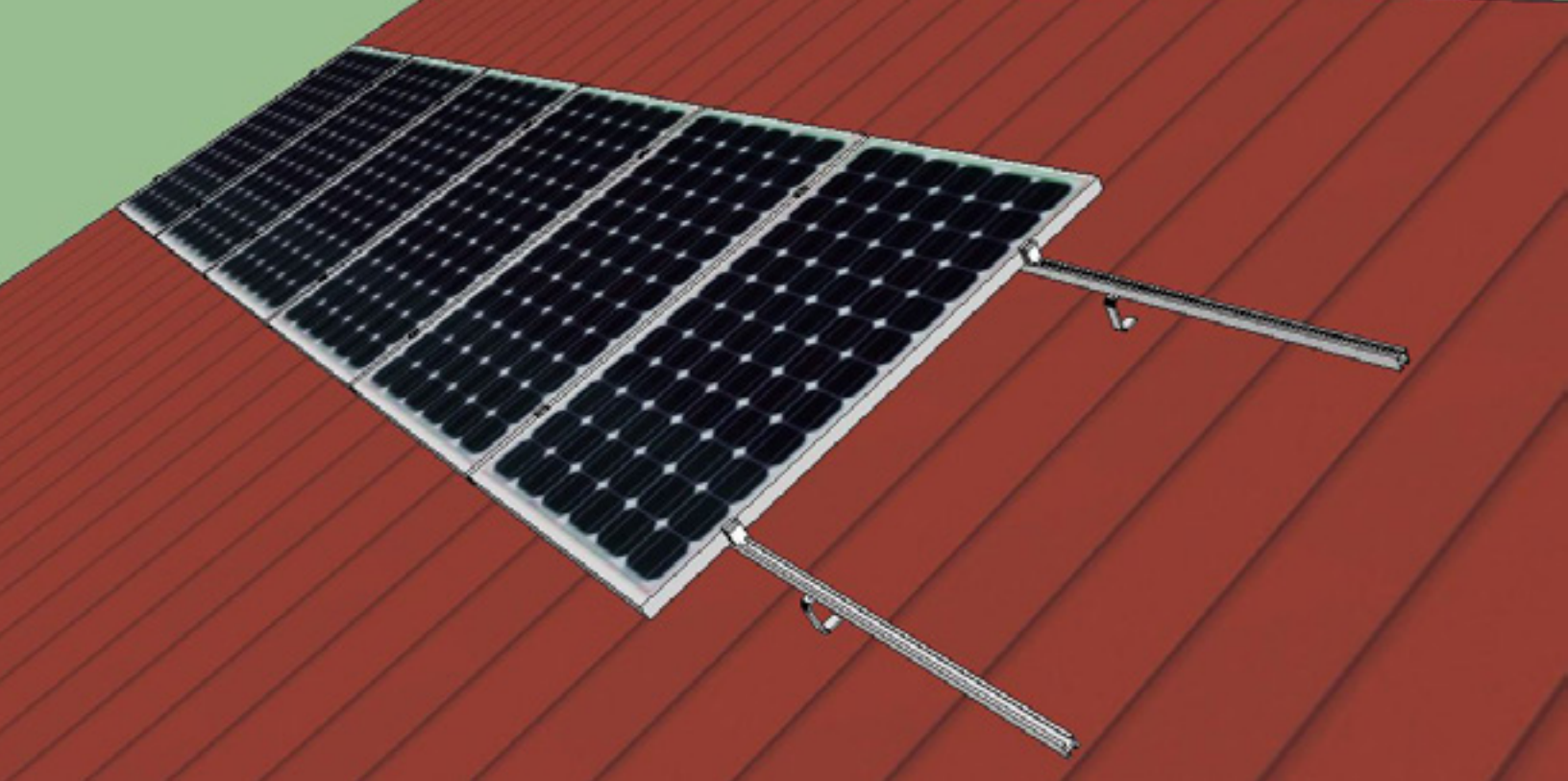
If your roof has adequate pitch/angle and you will not be adjusting the panels, then a simple mount system can be constructed out of Z brackets and roof rails.

Be aware that there may be wiring, plumbing and duct work under any roof structure so you must be very careful in drilling through a roof to mount your panels. Professional help is recommended.

Again, check your local building codes and regulations before installing this type of mount on your roof.



A generic adjustable rack system



A simple, flat roof mount using Z-brackets and rails.

Mobile Trailer Mount

If you need to take your solar power system with you to a vacation cabin or want to be able to use it as a portable power station, a trailer mount system might be the best option. This keeps the panels low for maintenance and allows you to move the panels to get the best sun. The trailer can also be used to house your batteries and other equipment, and even haul a generator to a remote cabin. The main drawback of this system is that you need a trailer and trailers may not be secure from theft in all locations.

Proper sighting and orientation for your panels

Solar panels have to receive good sunlight in order to produce power, so proper panel sighting and orientation is important.

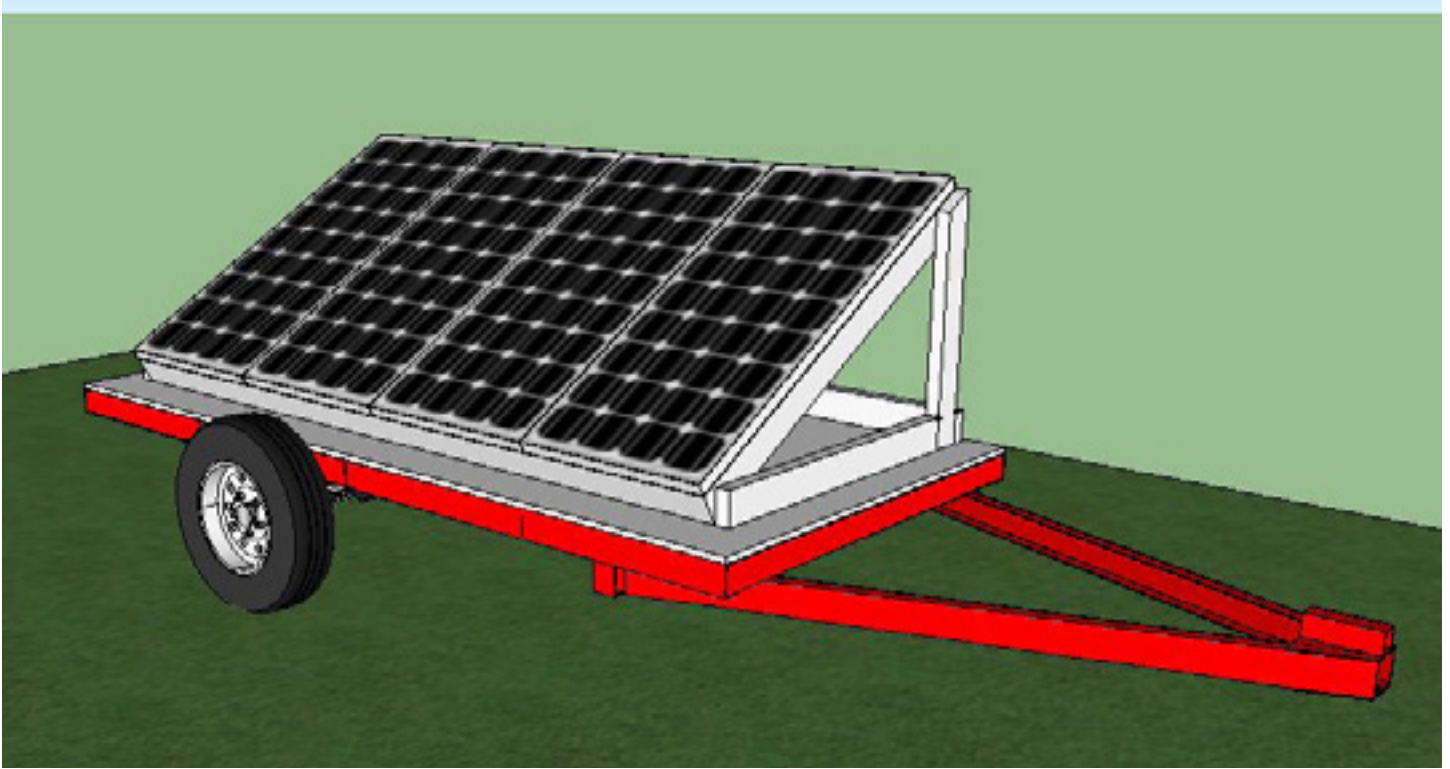
Panels should face the sun for the majority of the day. Any shade or shadows will effect their efficiency. Shadows can result from nearby trees, structures, or other features on your property that can block the sun. Those shadows will change positions as the sun moves across the sky.

Before sighting your panels, you need to spend a sunny day watching the intended location to determine if it is free of shadows. An easy way to do this is to use a piece of cardboard about the size of your panels and set it where you want to locate the panels. Watch throughout the day for shadows forming on the cardboard. Any shadows will effect efficiency, so the panels should be located in an area completely free of shadow interference.

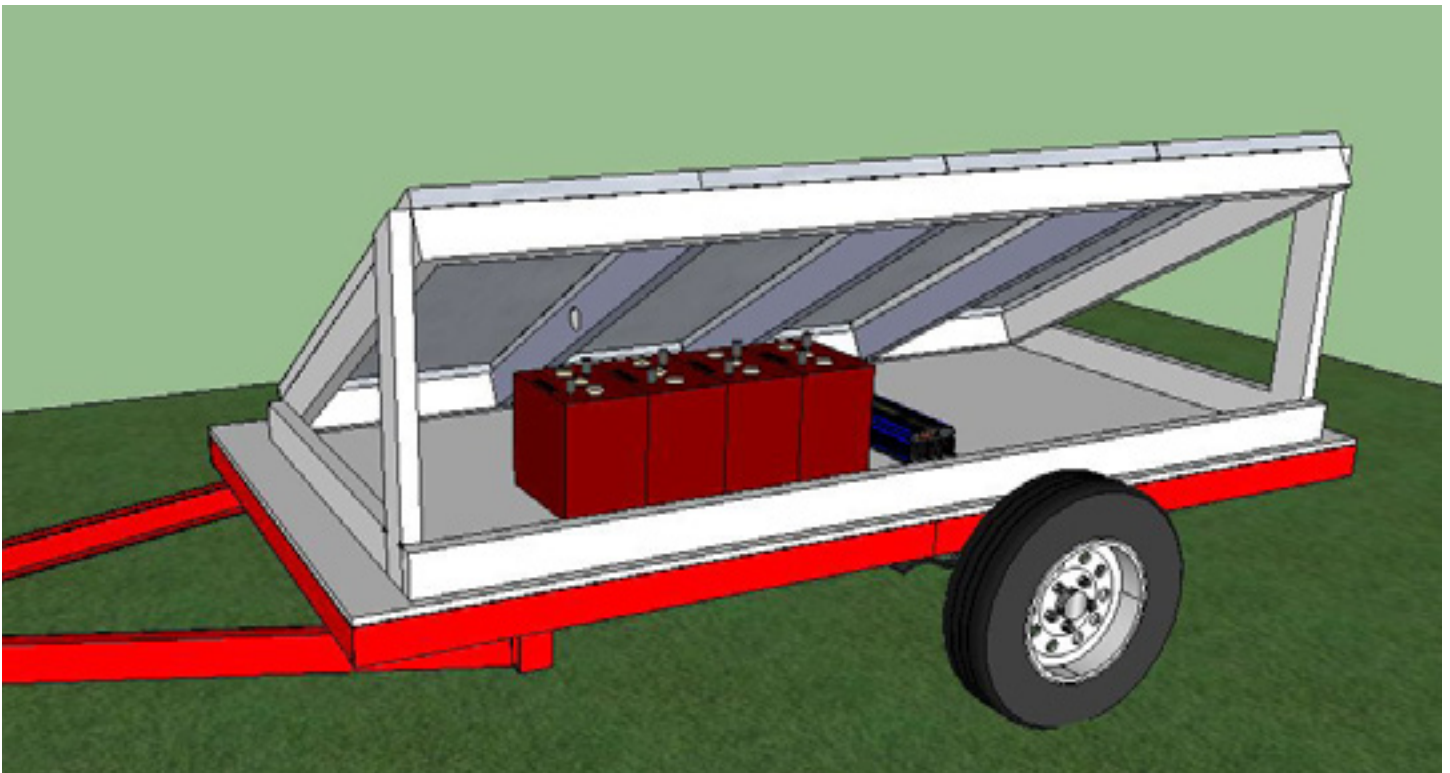
Trees can sometimes be pruned or cut down to allow more sunshine, but be aware that young trees will continue to grow and a tree that is not shading the panels now might cast a lot more shade as it grows.

Orientation of your panels is the angle, or tilt, of the panels and is used to capture more sunshine when the sun is higher in the summer and lower in the winter in most areas. If you are using an automatic tracker mount system, the panels will move to face the sun automatically and you will orient the panels according to the instructions for the tracker equipment.

For fixed mounts, you will orient the panels as close to true south as you can get. Solar panels should always face true south if you are in the northern hemisphere, or true north if you are in the southern hemisphere.



Solar panels mounted on a trailer makes your system portable. The batteries and a generator can be stored underneath the panels.



True north is not the same as magnetic north. If you are using a compass to orient your panels, you need to correct for the difference, which varies from place to place. Search the web for “magnetic declination” to find the correction for your location or see the link

section at the end of the article.

For adjustable mount systems, you will want to orient the panels to different angles depending on the time of year. In summertime, the sun is usually very high



A dual axis solar tracker makes pole mounted panels extremely efficient, as they are always aligned directly toward the sun

in the sky, and as winter approaches it travels across the sky at a lower angle, so adjusting the panel tilt will capture more sunshine based on the travel angle of the sun.

Most off gridders adjust the tilt of the panels two or four times a year. The correct angle of tilt depends on your specific geographic location and is beyond the scope of this article to explain. Please use the links at the end of the article for more information on finding the correct angles for your area.

These are just a few options to consider for your small off grid systems. I chose a ground mount rack for my system and have been very pleased. I no longer need to climb on ladders or out onto a roof for cleaning and maintenance; I can keep them clean and do maintenance with the panels sitting low to the ground. Another option with them being more easily accessible is that I pay more attention to them to make sure they are working and safe.

Which ever mounting system you chose, it must be solid. Follow the manufacturers recommendations for proper mount connections, grounding, and wiring. Panels not secured properly can become very expensive kites in a storm, can create a path for lightning to

follow, or can cause harm to your house and family, so take the time to ensure they are installed properly and safely.

Visit this link to see a complete description of my ground mount 400 watt off grid solar panel system and the components I used to put it together:

<https://www.youtube.com/watch?v=2QYXsZaOY1w>

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The location of your panels requires careful consideration for optimal efficiency. This flat roof mounted system sits in partial shade, which should be avoided if possible.

Need help finding true South for aligning solar panels? Check out these sites:

http://rimstar.org/renewnrg/finding_true_south_pole.htm
<http://www.solarpaneltilt.com/>



Potatoes, onions, and garlic are just a few of the crops you can keep in storage for most of the winter

Winter Crop Storage

and 10 crops that keep for months

by Shannon Oyler, sageandsunflowers.com

Fall is in full swing, meaning many gardeners are busy preserving the last of their garden crops. Freezing, canning, drying, and storing foods takes time, but is well worth it when it comes time to enjoy that bounty through the dark days of winter. If you're a gardener, you probably find yourself in the same boat I always do at the end of the growing season, with loads of veggies and fruits that still need to be preserved or quickly used up before they go bad. I enjoy the processes of preserving: drying herbs, canning delicious salsa mixtures, and stockpiling my freezer with home-grown foods. But, I have to admit, by this time of year, I am just over it and want an easier alternative to spending hours in the kitchen preparing foods. Ever feel that way?

Don't get me wrong, I am definitely thankful for what my garden produces, especially during an unseasonably warm fall like we've been having here, since my garden just keeps on producing well past the time it would be frozen in a normal year. But I try to plan my gardens now around foods that don't all require much work to store. There are plenty of garden fruits and veggies that store very well over a long period, if con-

ditions are right. Some can even be stored all winter long! Many root vegetables can be left in the ground until you need them, and some types of greens do well in the garden well into fall. The goal with storing foods is to keep the plants in a dormant state for as long as possible, and this is fairly easy to achieve with a little understanding of the needs of individual plants.

Storage Basics

Whether you grow food yourself and end up with more than you can eat or purchase produce in bulk while it's in season, there are many varieties that can be successfully stored, without being preserved, for weeks, or even months.



Temperature and humidity are the two most important factors to consider when selecting a location for crop storage



Potatoes keep longer than just about any other crop - up to 9 months in a cold, moist location. They can be stacked in boxes or baskets and removed as needed

For best results when it comes to storing, try to harvest (or purchase) produce when it's at its peak maturity, as underripe or overripe foods will spoil more quickly. It pretty much comes down to common sense as to which foods you should choose for long-term storage: avoid anything damaged, diseased, or bruised, as these will not keep near as long as undamaged food. Anything that's not a candidate for long-term storage

should be used up right away or preserved using another method, such as freezing. Never wash your crops before storing them; a few clumps of dirt is just fine until you're ready to eat the food.

The two most important factors when it comes to success with long-term food storage are temperature and humidity. Every type of food has different requirements, so the key to making your harvest last as long as possible is to understand what conditions each of your crops needs for optimal storage.

Home Storage Ideas

If you're fortunate enough to have a root cellar, you are way ahead of the game on providing a good environment for food storage. If not, it just takes a little creativity to find a place around your home that works. While temperature and humidity requirements may



differ among varieties of food, all produce stores best in dark, well-aerated locations.

Most homes have areas that can be adapted for food storage. You can use a thermometer to test a few areas around your home to see if conditions are right. As long as you have a cool area where food can be kept away from light, you can likely store it successfully. Here are a few ideas:

1. **Basements** are often the ideal location for storing food, as they are almost always darker, cooler, and more humid than the rest of the home. Small rooms or basement hallways without windows can be perfect for stashing crates or shelves of food.
2. **Closets** are plenty dark enough, so they can be a great option if you have a closet in your home that meets the temperature and humidity requirements of the food you want to store. Consider using an old dresser or set of shelves within the closet for a convenient way to stack your food.
3. **An enclosed porch**, if foods are not exposed to light, works very well for food storage. I always use the porch out my back door for keeping boxes of vegetables and apples for an extended period of time. My porch has a lot of windows, so I have a corner where I keep a cabinet with doors that serves as a dark location.
4. **Sheds** are usually dark and unheated, with conditions similar to enclosed porches. This is another storage area that I use often; my garden shed is full of wooden shelves that I can easily store many flats of vegetables on.
5. **An unheated garage** can provide a great environment for crops. You can set up food storage shelves in a dark corner, or just line boxes and crates of food along the walls.

Apples can store for months in low temperatures and high humidity





burying a plastic bin or tote in the ground and layering potatoes or carrots in it with straw or shredded newspaper. My beets and carrots are still in the ground at the time of this writing, and we've had several below-freezing nights. I just go out and dig them up as I need them, and they're staying cool, crisp, and delicious.

10 of the best crops to keep in storage

There are several types of crops that work better than others for keeping over winter. If you keep these in mind as you are planning your garden each year, you can ensure you end up with a nice mix of foods that need to be used up or preserved and those that can be stored.

Here are 10 of the best foods to grow for long-term storage:

6. ***Don't forget about your yard!*** Some gardeners leave root vegetables in the ground throughout the fall and into the winter, covering them with straw or mulch to keep the ground from freezing. You can also make your own small-scale root cellar by

Carrots, beets, and parsnips can be kept in the ground well into winter as long as they are protected with a thick layer of straw, leaves, or blankets. It can't get much easier than that!



1. Potatoes

Potatoes should be harvested in the late summer or early fall after their foliage has died back. They store best if they get an initial curing period right after they are dug up, which will toughen up their skins and extend their storage life. To do this, lay them out on newspapers or burlap sacks in a cool (50 to 60 degrees) and dark, well-ventilated place for about two weeks. After this time, they can be stacked in ventilated baskets, crates, boxes, or bins and kept in a dark location. If the temperature is ideal - about 35 - 40 degrees - and the humidity is high - around 95% - potatoes can keep for 4 to 9 months.

2. Beets

Beets are a root crop that can keep for long periods in the right circumstances. They should be kept just above freezing (32 - 35 degrees) and at around 95% humidity. In these conditions, they can store for up to 5 months. Beets, like many root vegetables, can last a long time when packed in clean, dry sand inside “breathable” containers like wooden boxes or crates. If you don’t have pest problems in your area, you can even leave beets underground for winter storage. Just cover them with a thick blanket of straw or leaves - at least a foot deep in cold climates - and dig them up as you need them. We’ve had such a nice fall here, with warm days and cold nights (despite a very early September freeze), that I’ve kept all my beets in the ground and have been pulling up just a few at a time when I’m ready to cook them.

3. Carrots

Carrots store best at temperatures just above freezing and at about 95% humidity. They actually do very well in the refrigerator if prepared properly. To store carrots in the refrigerator, cut the stems down to about half an inch in length and place them, dry, in the bottom drawer of your refrigerator. They can keep for up to 3 months this way, as long as they are kept moisture-free. They can keep for up to 5 months if packed in dry sand and stored in a cold and dark location. Like beets, carrots can be kept in the ground right through





Onions and garlic can be cured and stored for up to 7 months in a cool, dry location

the winter if they are properly covered in a thick layer of mulch and pulled up as needed.

4. Winter squash

The term “winter squash” applies to several varieties of squash that are harvested in the fall and can keep for the majority of winter, including acorn squash, butter-

nut squash, sugar pumpkins, kabocha, and spaghetti squash, to name a few. These require relatively higher temperatures and lower humidity than root vegetables for optimal quality when stored. Winter squash should stay at a temperature of about 50 - 55 degrees and at 50 - 60% humidity. In these conditions, they can keep for 2 to 6 months in storage.



5. Onions

Onions are ready to harvest after their foliage droops and begins to turn yellow. They can be pulled up and laid on top of the soil to cure for a week or two if the weather is dry and there is no danger of frost. Otherwise, let them cure indoors in a dry location. They are done curing when the skins tighten around the bulbs and the necks and foliage dry out. They can then be stored in baskets or mesh bags and kept in a cold location (32 to 35 degrees), at about 60 - 70% humidity. They should keep for up to 6 to 7 months.

6. Garlic

Once you get garlic growing in your garden, you can save the biggest bulbs from each harvest and plant them the following spring, and you'll probably never have to buy this valuable crop again. Garlic should be harvested and cured much like onions. Cure the bulbs in a dark, dry place for a couple weeks, then store them in a place where they get about 60 - 70% humidity at a temperature of 32 to 35 degrees. They can be stored in boxes or can be braided together by the stems and hung to store. Garlic can last up to 6 to 7 months with proper storage.

7. Cabbage

Cabbage is another great crop for storing right in the garden as temperatures cool, as long it is protected from frost. Ideally, cabbage should be stored at 32 - 35 degrees and 95% humidity. To extend the storage life, wrap cabbage heads in several layers of newspaper and stack them in a root cellar or even in a hole dug into the ground outside (as long as you keep the hole covered with straw or a thick blanket of leaves or mulch).

8. Parsnips

Similar to carrots and beets, parsnips are a root vegetable that can be stored in the garden as long as possible, with proper protection. They also store well in a refrigerator crisper drawer, as long as they are kept dry. Parsnips like temperatures of 32 - 35 degrees and 95% humidity. In ideal conditions, they will keep for 2 to 6 months.

9. Apples

Apples are a crop that can keep for extended periods in low temperature/high humidity storage. I have always kept a bowl of apples on my counter top, but we eat them pretty fast around here, before they have time to lost their crispness. Keeping a few out at room temperature is fine, but for long-term storage, apples keep best in the crisper drawer of a refrigerator in an unsealed bag or in a cool location stacked in baskets

or boxes lined with plastic or foil to retain moisture. They do best in temperatures between 32 and 35 degrees and at about 95% humidity. Remember to only try storing good quality apples because the old saying that one bad apple spoils the bunch is true; apples give off ethylene gas, and bruised or spoiled apples give it off more quickly and can hasten the spoiling of surrounding apples.

10. Pears

Pears are much like apples, requiring high humidity and low temperature (32 - 35 degrees and at about 95% humidity) for the chance to keep for an extended period of time. For this reason, the crisper drawer of a refrigerator can provide the ideal environment for them. They can keep for up to 7 months.

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A quick guide to fruit & vegetable storage

These crops last for at least a month in the proper conditions:

Crops for Cold (32-40°), Humid (90 - 95%) Storage

Apples

Beets

Cabbage

Carrots

Celeriac

Celery

Grapes

Leeks

Parsley

Parsnips

Pears

Potatoes

Radishes

Rutabagas

Crops for Cold (32-35°), Low Humidity (60-70%) Storage

Garlic

Onions

Crops for Cool (50-60°), Low Humidity (60-70%) Storage

Hot peppers

Pumpkins

Winter squash

Sweet Potato

Visit this link for a handy PDF explaining more about food storage:

<http://www.gardening.cornell.edu/factsheets/vegetables/storage.pdf>

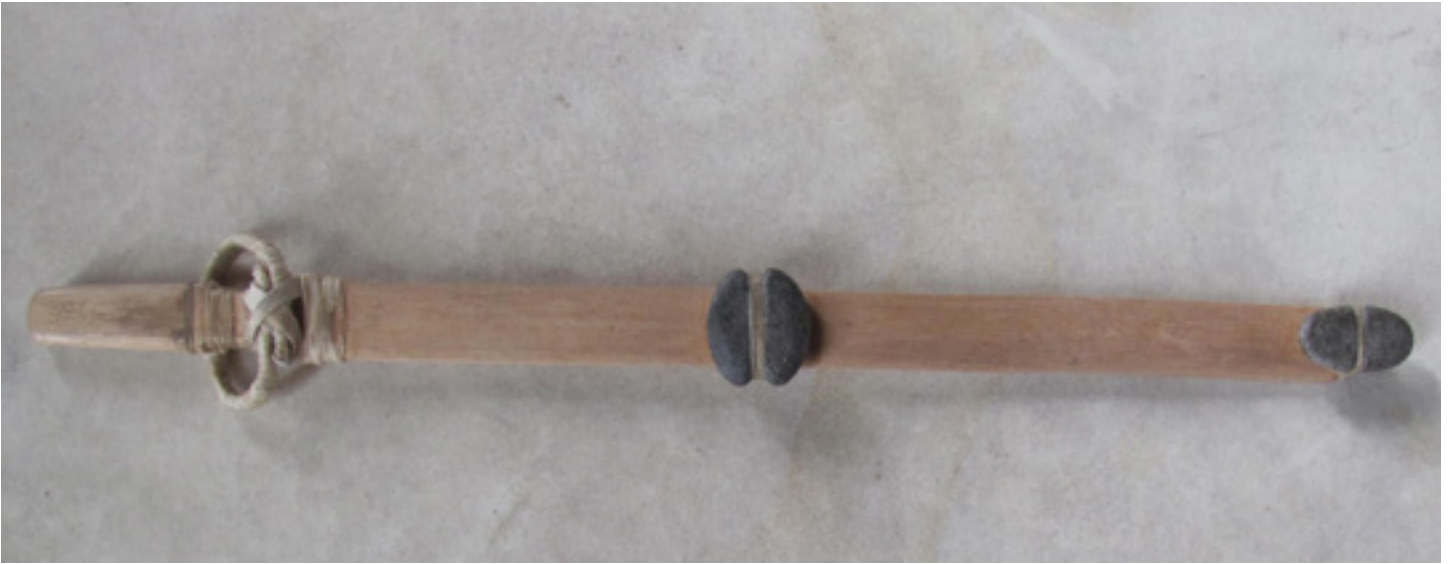




The Atlatl and Dart

Ancient Weapon Making
by Michael Tomlinson





The atlatl is an ancient spear-thrower used before the invention of the bow and arrow.

For thousands of years before the invention of the bow and arrow (which only goes back about 2,000 years in North America) the atlatl and dart were the most powerful weapons used by stone age man. They allow three to four times the range and power of a hand thrown spear. They are easy to construct with minimal tools and could drop a 3,000 pound Bison antiquus in its tracks. It is a weapon the military teaches to construct and use in a survival situation. Atlatls are fun, powerful, easy to construct, and deadly in the right hands.

The atlatl is a simple, flat stick with a bit of flex to it that has either a socket or peg at the end that is used to lengthen the arm and push the back end of a dart (sort of a large arrow) towards a target. There are dozens of designs and styles, but I will focus on the style used by the basket maker culture for its simplicity and effectiveness. I will also cover a modern version that can be constructed with gar-

den supplies for fun and practice.

Several ancient specimens of atlatl, averaging about 22 to 25 inches long, have been found in caves. They consist of a flat stick about 1/4 inch thick, and about 1 to 1 1/4 inch wide. The handle end has a buckskin

and sinew set of loops added and the tip has a small peg carved into the wood for the base of the dart to rest on. A few specimens also have small stones added above the handle and mid way up the stick. There are a few ideas as to what these were used for. One theory is that these act as a silencer to prevent the stick from making a woosh noise and scaring game. I don't buy this, however, as you are close enough to game when you swing the atlatl that movement would also startle the animal. The second idea is that the stones add heft to the throw, but physics doesn't agree with this as it would be like tying stones to the tips of your bow and expecting better results. The idea that rings true to me is that it provided enough re-





The peg and hollowed out channel at the tip of an atlatl. The dart is launched from the peg and the channel helps guide it as you load.

sistance to the flexible stick to slightly “cock” the atlatl back like a diving board, while the dart bends in resistance to the thrust and acts like your knees on a diving board springing away from the board at release. This provides more thrust than a stiff atlatl with a large banner stone attached. Most examples had small feathers and fetishes attached under the stones for decoration or luck charms.

The dart is a strong piece of wood either split and shaved into a round, or a natural sapling about the height of the user. The tip has a socket for a short fore-

shaft and the base has a shallow socket for the spur on the atlatl to sit in. They were fletched with two feathers laid along the socket end and held in place with sinew.

The socket is about two inches deep and 3/8” diameter. It is wrapped with sinew from the end to about three inches down to reinforce the thin wood around the fore-shaft. A small quiver of replacement fore-shafts with stone points was carried along with two or three darts. When a dart was launched and struck an animal, the fore-shaft was buried to the dart and as the animal ran the dart would fall off and the hunter would

Several types of atlatl tips, with pegs and sockets



retrieve it, add another tipped fore-shaft, and throw again until the animal was down. The fore-shafts were also held like a knife in butchering.

Making your own atlatl

To construct a basket maker style atlatl, you will need a strong, springy wood. Any of the woods used to construct a bow will work, such as Osage orange, hickory, white oak, etc. Atlatls are also a good way to re-use broken bow limbs. You will want a splinter about 22 inches long and 1/2 inch thick for starters. Work it from the sides until it is about 1 1/4 inch wide. Then scrape it following the rings like you would a bow limb until it is about 1/4 inch thick and has a bit of a flex in it - not much, but a slight bend ability as you flex it over your knee. On the tip draw an X on the wood and carve down, leaving the wood behind that will become the peg. A shallow channel dug out will help guide the dart to the peg as you load. The peg should be rounded so that the dart swivels on it as the angle at launch changes. If you want, you can reverse this and make a socket on the atlatl and a rounded base on the dart. Experiment and see which you prefer.

The only tools you really need to carve your atlatl and darts are a stone chip, or modern scraping blade, and a drill of stone or steel. The originals were drilled by holding a stone drill bit in a board or between the toes and spinning the shaft like a fire drill onto the drill bit until the desired depth was achieved. If using a power drill, be careful not to blow out the side as you go deeper. I use a small bit first for the larger one to follow. It only has to be deep enough to hold the fore-shaft snug and should always be reinforced to prevent splitting on impact. For practice, a hardwood shaft or one of antler can be substituted for the stone blade fore-shaft. I use a steel one for practice and it has lasted several years.

Loops are added to the handle for grip. To make a loop, take a piece of soft leather or buckskin and cut it to about 10 inches by 3 inches. Roll it into a tube and make a 1 inch incision length wise all the way through in the middle. Slide the handle through this and push it up about four inches. Now, curl the ends around and put them through the slot in the leather to form two loops. Some people use one for the thumb and fore finger, some use the fore finger and middle finger. You can use the grip that is most comfortable for you. Use





Rawhide loops are added to the atlatl handle for grip

wet sinew to hold down the buckskin. Hide glue also helps hold the leather in place. If you want to experiment with weights, find a small, flat, rounded stone and attach it at various intervals along the shaft to see if it improves your throw. Not all ancient atlatls had them, and I really see no difference in performance on mine, but I do add them to look as close to the originals as possible.

Darts & arrowheads

If you have the ability to flint knapp, make a few points of the desired style to add to your fore-shafts. Most arrow heads larger than an inch or two were actually dart points from different eras. Folsom points were used on darts, for example, where Clovis were used on hand thrust spears. You want your fore-shafts to be strong; I usually use scrap chokecherry from my



reject arrow shafts or split hardwood scraped into a dowel. Groove the end for the point to sit in, add the point and wrap with wet sinew, paint with hide glue, and allow to dry. You can also use artificial sinew and wood glue, epoxy, or whatever you have on hand. The fore-shaft should be 8 to 10 inches long and tapered slightly at the base to easily fit into the socket on the dart. It should be snug enough not to fall out on launch, stay straight on impact, and release when in place. Again, experiment with what works best for you. Try to stay consistent with size and weight of blades as this will affect the resistance and flex of the dart on launch.

For the dart, I use straight, natural shoots as they have concentric growth rings the entire length, that are heat straightened like large arrow shafts. Dry and scrape the bark off. You can remove bends by heating



Left: Arrow heads from different eras. If you are able to flint knapp, you can make your own arrows.

Below: The groove carved into the tip of a dart, ready for the tip to be inserted and wrapped with sinew



the shaft over coals, a gas stove, BBQ, etc., then bend the opposite direction as the natural bend and allow to cool. Natural shafts will always need tweaking just like natural arrow shafts. You can also use long dowels, or make them yourself by cutting long boards into 3/4 inch x 3/4 inch and scraping them to round. Try not to violate the grain or it will snap on launch at the weakest point.

Use the ground end of the shaft (the thick end) for the socket, and the sky end for the fletching. To add the fletching, take two feathers that are from the same wing of a bird, or from the tail, that are fairly long. Turkey tail feathers work well. Shave down the feather shaft a little so they are flexible and will lie flat on the shaft. Use wet sinew to hold the ends down by wrapping and allowing to dry. They may also be fletched like a modern arrow. They need only add drag on the base to keep them straight in flight.

A modern twist to making the dart is to buy the green, plastic-covered steel poles in the garden section at the store, or the bamboo shoots used to tie plants to. Duct tape fletching can be applied at one end and washers or some sort of tip on the point end as weight. These are

cheap and easy practice darts.

Throw some darts!

Now for the fun part. Get a bale of hay or some sort of target for practice. Packed snow makes a fun target range as you hunt snow beasts. Take the atlatl in your throwing hand and guide the dart shaft onto the peg. I always keep my pinkie, ring finger, and middle finger on the handle of the atlatl, then use my forefinger and thumb to keep the dart on the peg. Use your opposite hand to hold the mid section of the dart until you are standing with your legs a couple of feet apart. If you are right handed, keep your weight on your right foot and place your left foot in front pointed at your target. Use an overhand throw with your left hand pointing towards your target in a flat hand salute. Do not get wild on the swing and go out to the sides. The best way I can describe it is to push the dart base through the tip of the dart at the target. If you go side to side your aim will suffer and you may even drop the dart next to you



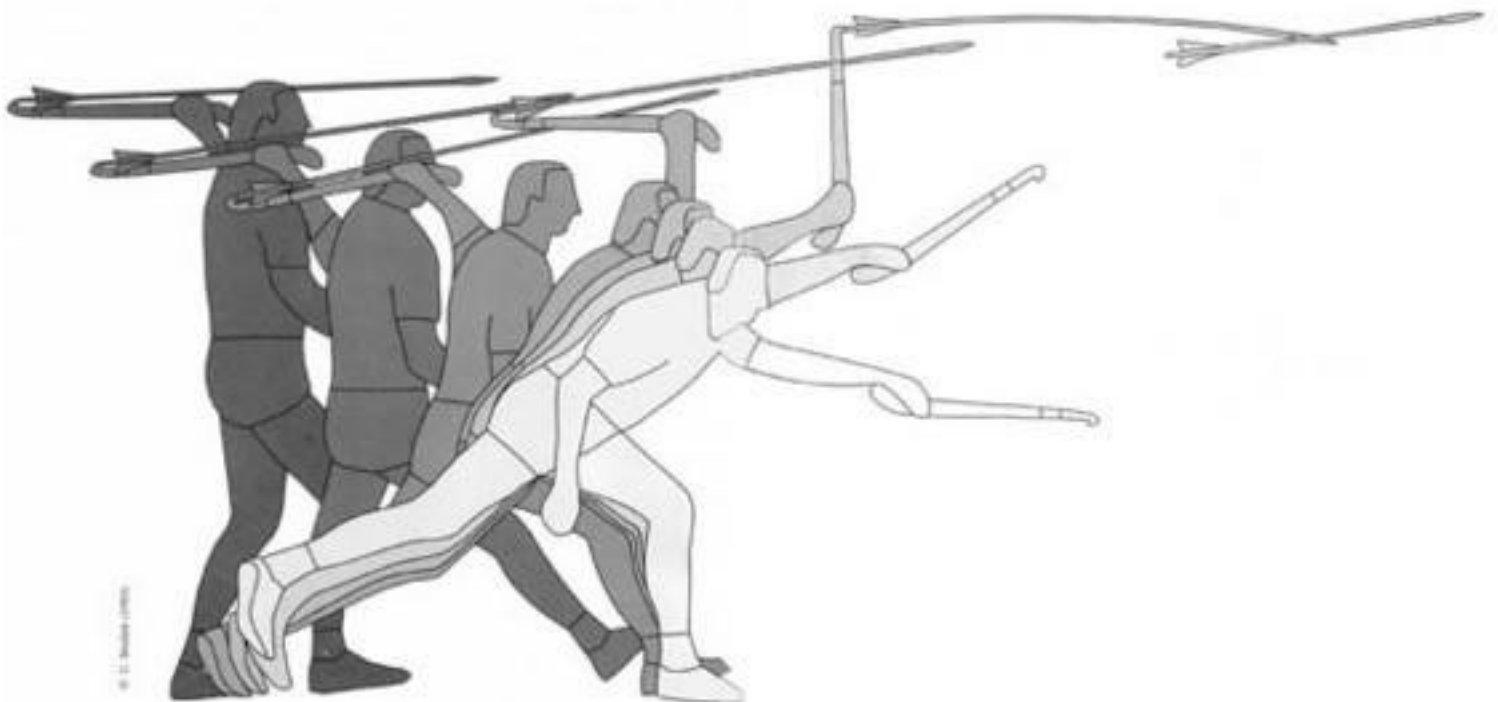
as the peg slides out of the socket. It is not a natural movement and 99% of the people I see fail on the first attempt. Relax, take a deep breath and practice until you are comfortable with it. It takes some time.

Once you are comfortable with throwing, you can experiment with atlatl length. My accuracy went through the roof when I took a couple inches off the end of mine. I have several and have chosen my favorite. On the bright side, they are cheap and easy to make so experimenting won't cost much more than time. I

can throw about the length of a football field with a skipping sort of throw. These weapons have amazing hitting power. The way the dart and atlatl combine to lengthen the distance of your throw is amazing. Try your best without it and see how your range is doubled, if not quadrupled, with the atlatl. Be safe, and enjoy your new toys!

If you want to hunt game with your atlatl, it is legal in some states. Check your local laws and regulations to see if you can use it in your area.

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.....Top 10.....

HIGH-TECH OFF GRID BUILDING MACHINES

by Justin Zimmer

*Off grid living doesn't mean
primitive living!*

We love technology, and if it helps build shelter cheaply, efficiently, and with on-site or easily transported materials, it really takes the cake. Here we have our top 10 favorite building machines that leverage modern innovations to improve traditional building designs.

NUMBER 10: The Loom

That's right, [the loom](#): one of the oldest technologies in your off-grid tool-kit, it's simple, human-powered, and can take any material that you can turn into a strand or cord. You might want a blanket or rug for your new earthbag home, or even gloves, pants, sweaters, and all those other things that granny used to make, but what about a hammock? Or an awning? A sun screen, or just a windbreaker for the porch you

built facing that frequent mountain breeze? You can use plastic grocery bags to make durable handbags, which would be great for an outdoor sun screen and windbreaker. Or, just create beautiful wall hangings that spruce up your adobe hut and bring a little color to those earthy walls.

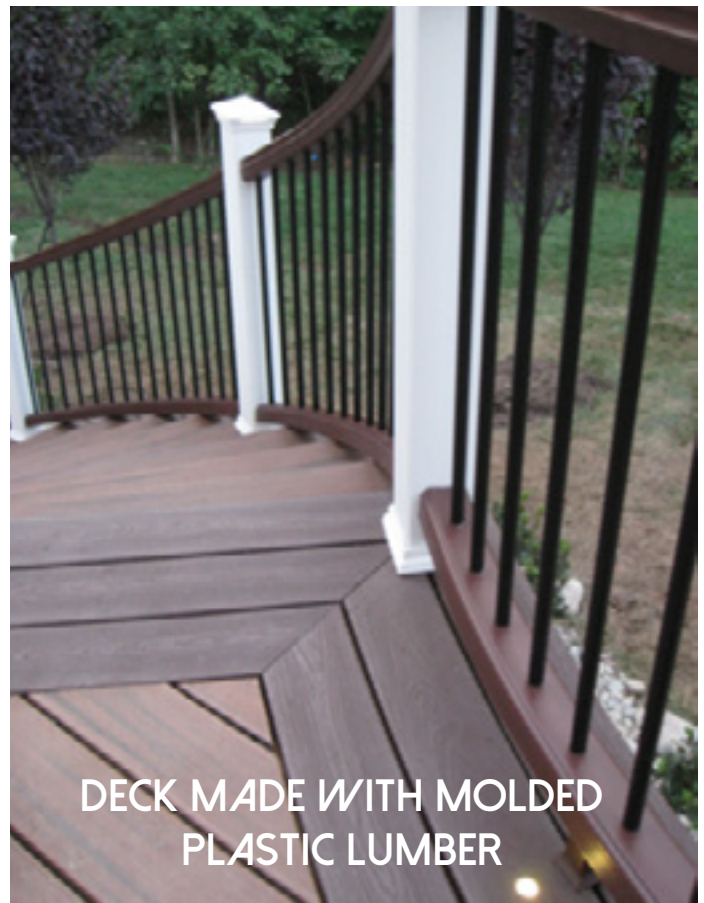




CONCRETE 3D PRINTER

NUMBER 9: Flow Molding Plastic Lumber

This one isn't a particular device, but a [process](#) that utilizes [multiple devices](#) and recycled materials. One of the biggest problems today in our oceans and in our landfills is plastic waste. Plastic is everywhere. Right now, in my pantry, there are about a thousand grocery bags that my town's recycling program won't let me put into the big blue bin, and so will likely end up in the landfill when I can no longer manage the landslide of plastic that greets me every time I open my pantry door. This is all material that can be chopped up, melted down, and extruded into boards that can be used in the construction of buildings. Unless you're planning on living purely off the land and never setting a foot in Walmart again, you are likely going to end up with plastic trash that you need to dispose of, and if you're way off the grid, that means burying it on your property. With a flow molding process in place in your workshop, you can make plastic filament for your 3-D printer, new boards for a chicken coop, or a spare bathroom for Uncle Carl. Going into town and



DECK MADE WITH MOLDED PLASTIC LUMBER



WOOD-PLASTIC COMPOSITE

scavenging the plastic bags and materials from your local dump and turning it into building material will reduce the plastic that breaks down into tiny pieces and kills ocean wildlife, or bags that trap wild birds on

the coast.

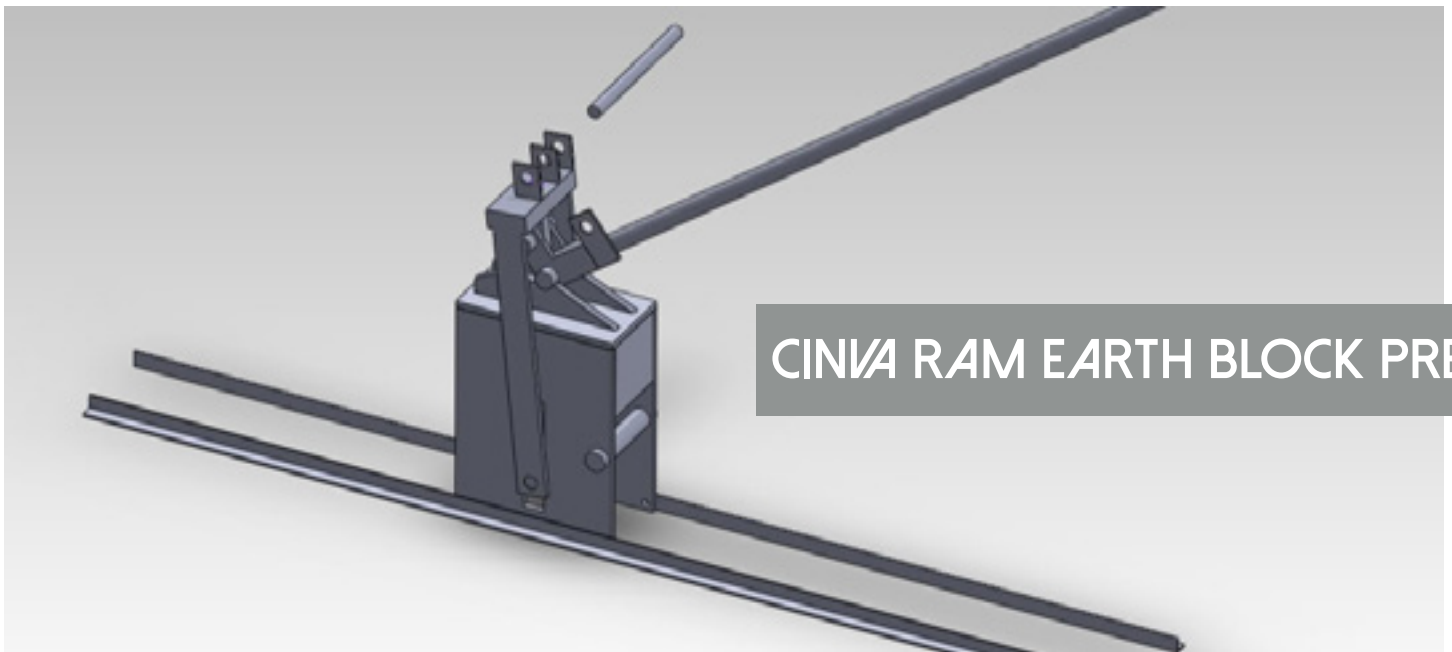
Plastic lumber also doesn't rot, is water proof, and keeps trees in the forest while taking plastic out of the dump. Having a small plastic recycling center in your off grid workshop or community is beneficial, not only for your off grid project, but to the landfills and wild-life of your surrounding communities.

NUMBER 8: The Cinva Ram

We've talked about this baby [before](#), and its existence as a fully open design that you can build yourself with a little bit of welding skill and a whole lot of elbow grease has granted this design inclusion in our top five list. The Cinva Ram is an earth block press that was originally developed in 1952 by [Raul Ramirez of the Inter-American housing center in Columbia](#). With a 2-person team, this machine can produce 2 compressed earth bricks per minute with only human power.

NUMBER 7: Open Source Ecology Liberator

The [Open Source Ecology](#) project has a ton of great machines, so we're giving them another place with the big brother of the Cinva Ram: The Liberator. Sure, it sounds like it should come dressed in spandex and a cape, but this machine is meant to free people from the insane cost of constructing one of the basic needs for survival: shelter. ["Using the CEB Press, two people can build a 6 foot high \(1.83m\) round wall, 20 feet \(6.1m\)](#)



CINVA RAM EARTH BLOCK PRESS

[in diameter, 1 foot \(30cm\) thick, in one 8 hour day...](#)” And that’s some serious building power using little more than the dirt under your feet.

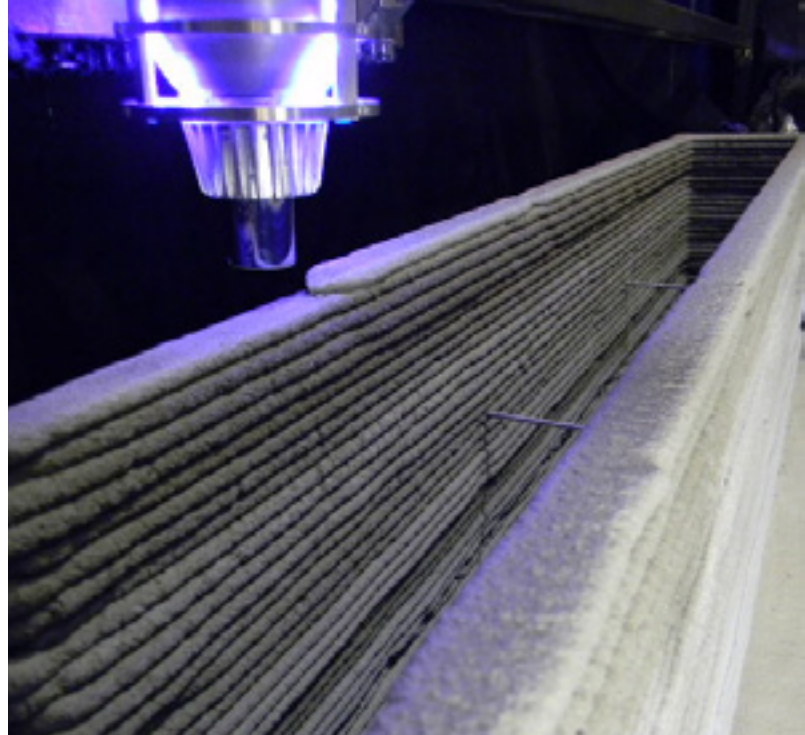
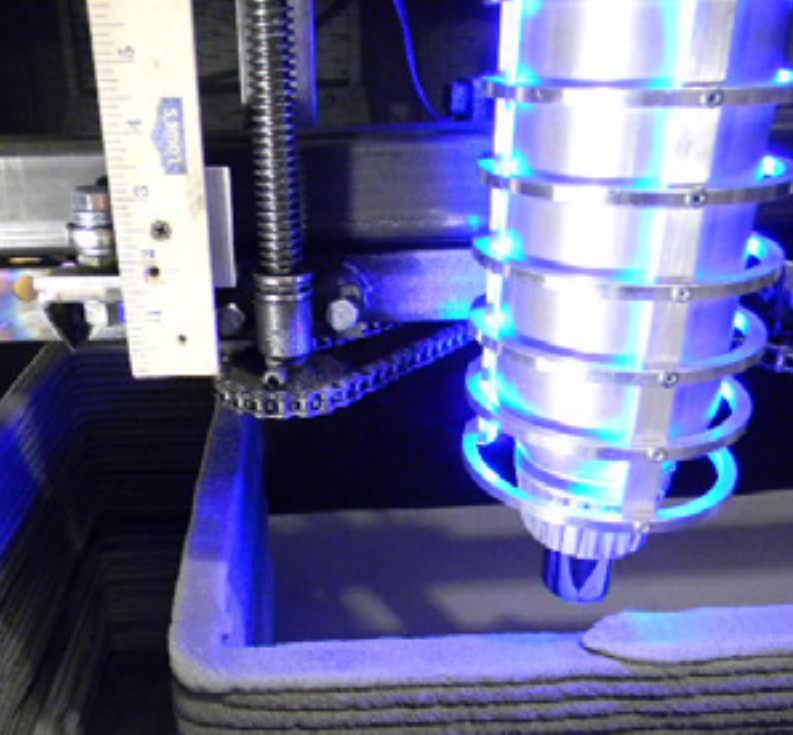
The Liberator is almost fully automated. All you need to do is collect the dirt and pour it into the hopper. This device is also portable. It can be packed into a medium sized crate and loaded onto a medium sized pickup truck. Like all Open Source Ecology projects, the plans are available [online](#) and, according to [Marcin Jakubowski](#), the founder of Open Source Ecology, [this device can be build for about \\$1500 whereas commercial equivalents go for more than \\$20,000.](#)



CINVA RAM EARTH BLOCKS

THE LIBERATOR: COMPRESSED EARTH BLOCK MACHINE





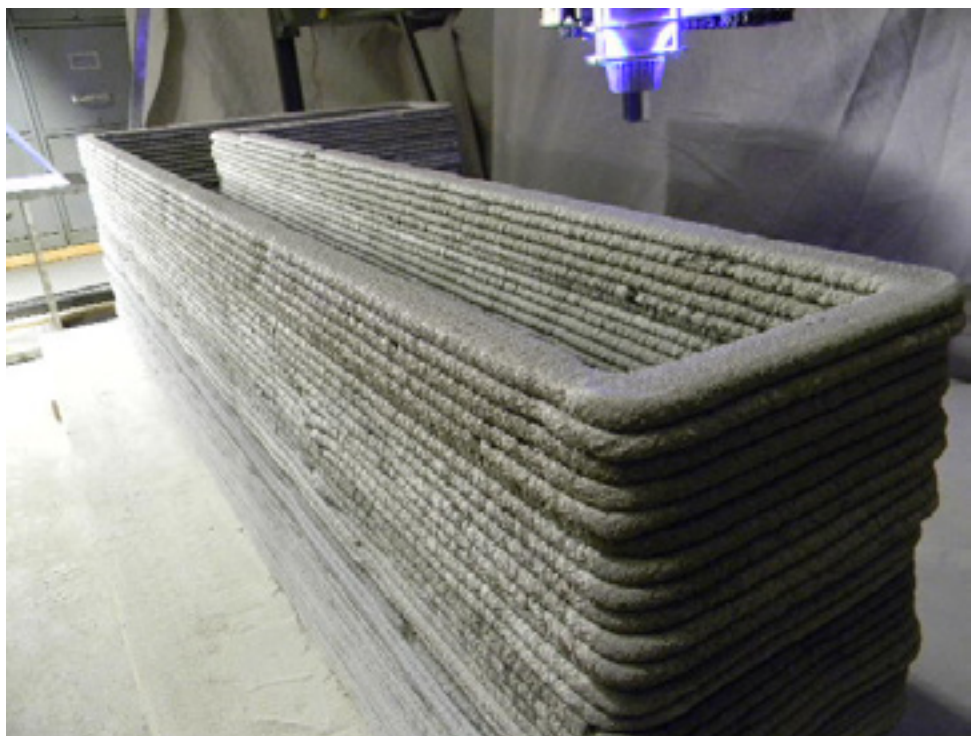
CONCRETE 3D PRINTERS

NUMBER 6: Audrey Rodenko's Concrete 3-D Printer

If you're into outdoor 3-D printing, then [Audrey Rodenko](#) is someone you should keep an eye on. A couple of years ago, Rodenko got interested in the idea of a 3-D printer that could build homes outdoors, and so he decided to build himself one. [From scratch!](#) And now, 2 years later, he printed a castle out of concrete in his backyard, showing the diverse design space of 3-D printing technology whereas many 3-D building designs to date have stuck with the 4-walls-and-a-roof design that every architect draws when they're 5. This castle, complete with towers and battlements, might look like nothing more than a playhouse, but it truly is a model for the future of construction. With the portability of Rodenko's design, this machine would be an excellent off grid tool. Rodenko is planning now to build a full sized house with his machine, and something tells me it's going to be more interesting than 4-walls-and-a-roof.

NUMBER 5: WASP Mud Printer

Get it? Because wasps make their homes out of mud by spitting it out in layers like a 3-D printer? Okay, maybe that wasn't what they were thinking, but the Italian 3-D printer manufacturer [WASP](#) (World's Advanced Saving Project) is certainly making strides in the outdoor 3-D printing industry with their latest project that uses



3D CONCRETE PRINTED HOME IN CHINA



mud to build domed huts. The device is portable, and designed to be used in villages where off-grid is synonymous with no-kidding. WASP recently [showed off the design](#) at the Rome Maker Faire, and, while it still has a few bugs to work out, it is certainly not far from a product that can take mud and turn it into a home.

NUMBER 4: WinSun House Printer

In China, there is a company building houses at a rate of about 10 per day using a giant 3D printer with cement and construction waste. We've mentioned them [before](#), and figured this device deserved its spot alongside the other outdoor 3D printers in our list. These houses aren't much to look at, but they're just the prototypes. According to WinSun inventor Ma Yihe, [his printers can print any design his customers bring to him](#).



NUMBER 3: Contour Crafting Robotic Construction System

Here's another [Off Grid World Favorite](#): the [Contour Crafting](#) process is the top of the line in concrete 3-D printing. With projects that range from residential construction to fricken Moon bases, this brainchild of University of Southern California professor [Dr. Beh-](#)



EARTH BAG MACHINE

[rokh Khoshnevis](#) has applications that span the gamut of building, with serious interest by [NASA](#) and adobe building applications in conjunction with [CalEarth](#). While concrete may not be the most ideal off-grid building material, considering you need to somehow get it to your homestead and you literally need tons of the stuff, research into adobe materials make this process and ideal solution for off grid structures, especially those in desert areas. Adobe buildings have [survived](#)

[hundreds of years](#) in the desert and have a [high thermal mass](#), which makes adobe buildings comfortable in hot and cold weather.

On the Moon, about as off grid as you can get in the goldilocks zone, moon-dust adobe reduces the materials and weight that need to be blasted off from Earth for a Lunar homestead. 3-D printers using the Contour Crafting process make any number of structures possible for a growing presence on the Lunar surface.





STRAWJET SYSTEM

NUMBER 2: Ensor Equipment SBM 1200 Sandbagger

You might think that a machine that fills earthbags for you defeats the purpose of DIY earthbag construction, but after bag number 1000, you might look at your blistered palms and think, “screw this noise, there’s gotta be a machine that does this faster!” Well, Ensor Equipment has the machine for you. The [SBM 1200](#) is a sandbag filling beast that can fill [6,000 to 7,200](#) bags per day with minimal human interaction. It will run on diesel, gas, or propane, and for greener sites with solar panels, it will run off a 60A 220V 3-phase circuit (okay, so a lot of solar panels!).

6,000 bags will build you a [mighty big house](#), so you’d only need this thing for a short period, and it would be ideal for an earthbag neighborhood.

NUMBER 1: StrawJet

The [StrawJet System](#) makes haste out of hay waste and turns it into tightly baled beams called “[cables](#)” for construction. Now, anyone who’s into sustainable building knows that hay bales are awesome for insulation, and even some [home builders](#) have taken to using baled hay as insulation in traditional residential building. StrawJet claims that they can use a variety of materials such as hemp, palm fronds, and even to-

bacco stalks to make these cables. However, more than just a machine that makes long hay “cables”, StrawJet is an entire construction system, with several supporting devices that go together into a [unique style](#) of hay bale building that is more sophisticated than simply stacking bale blocks like legos.

Utilizing plant waste as a building material also reduces the building’s carbon footprint. Grain stalks left to rot release CO2 into the atmosphere. While that CO2 is re-absorbed during the next growing season, trapping it in a sterile binding and then encasing it in a building takes that CO2 out of the atmosphere for an extended period of time, perhaps a century or more. If we replaced much of our timber based building materials with seasonal grains we would not only protect our forested habitats, but also create an industry that actively removes greenhouse gases and help curb the effects of climate change. While dirt and mud solutions reduce timber use and use materials from the site itself, reducing the need for transported materials, no building material actively stores carbon like biomass and whether it’s grain stalks, hemp, palm fronds or fast growing lumber, buildings using these materials do more for the environment than any material listed so far. That’s why we’re giving the StrawJet the number one slot in our list of Top 10 Off Grid building machines.



