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Please Remember

Safety First! Everything you do that is related to your DIY project is at your own risk.

Please use safety precautions at all times. If you do not understand something or do not feel comfortable doing something - consult a professional.

Thank you for trusting our product. Because you trust us, I'd like to return the favor by presenting you a fresh new project. I hope this project will mean a lot in terms of mobility, reliability and independence, regarding your energy independence.

Introduction

We all use power for our daily lives, but it is something that we all take advantage of far too much. We have essentially forgotten about what makes power usage plans work out so well. It is no wonder why so many people these days are worried about what can happen in cases where the power in an area is at risk of harm.

It is imperative for you to understand what can be done in the event of a major power outage. This entails more than just a blackout or something else happening that causes the power to go out for a few hours. Rather, this involves what may happen if a massive disaster or attack develops and causes the power to be lost for an extended period.

The threat that comes with a power outage can be very significant. You could risk losing power for weeks or months at a time. This is an especially significant concern when you consider how dependent people are on electricity for all of their daily functions and needs.

With this in mind, you have to look at what you can do to produce the energy that you need so you can stay safe. There are many options to consider, but you have to particularly think about what you are entering into.

This guide will help you to recognize what you can do when producing a material that can generate energy while on the go. You can use this quite well when you're looking to get out of an area during an emergency or when you need to get the power that you require for any intention.

You will read about how well the technical features of generating power will work. Details on friction, clutches, and solar panels will be covered in this guide. The information may sound complicated to outsiders, but it is surprisingly easy to follow and utilize when you understand how the efforts that go into producing power work.

The project in question is called the PowerPack System, or POWERPACK Case. The design is made to produce consistent power through solar energy. The design will provide you with the results you deserve. The best part of working with this is that the setup can work with many outlets and different types of batteries. You can expand upon the design of the setup if you wish as well. Anything that can be done with the PowerPack System will help you get more out of your power-generating demands and can make all the difference in the world when planned accordingly.

You will find information on how to produce the case and how to use the right materials. Information on how to produce the Faraday cage needed for the setup and how to add an EMP cover can also be found in this guide. All the design details that you will come across should help you with getting more out of the work you put in.

It is critical to know what you can do when handling the materials you need for generating power. You will be surprised at how well you can produce power when you use the right materials and you recognize the various principles that go into generating that power.

Caution

Although the voltage produced by your solar-powered array should be minimal and will not be a threat to you, it is vital for you to follow the instructions included in this guide. All electrical components and batteries have unique risks regardless of their strengths or how energy may be produced.

Always use the appropriate protective gear when working on the project listed in this guide. This includes the appropriate eyewear and glove protection for keeping you safe in your work.

You may also be subjected to local laws regarding how you are able to generate energy where you are located. You might have to contact local power utilities to see if you can get your solar-powered array ready for use in any intention.

Understanding the Concern

It would be an understatement to say that our lives depend on electricity. When the electricity in our homes is out, we start to worry. We start to think about how unproductive we may be. There's also the concern of how electricity is needed for powering up our air conditioners, our freezers, and many other massive appliances. We take many of the things in our lives for granted; this can be difficult to manage, but it is a part of life that everyone could experience in their lives.

Stores and retailers around the country require electricity to keep their operations going. Businesses need energy to get in touch with other people throughout the work day. The fact that so many hospitals rely on electricity to keep items like dialysis machines and respirators active only makes power all the more important.

However, there is no true way how anyone can keep one's power on all the time. Any major weather event, whether it is a hurricane, ice storm, or tornado, will cause power lines to break down and energy to stop flowing to homes. This requires many utility repair crews to get on out to fix the problem. Sometimes it gets to the point where it might take days for the power to go back on in some places due to the utility workers not having enough time to take care of all the people who need help.

What's more concerning is that there are more blackouts in the United States today than ever before. The Department of Energy states that the number of blackouts in the United States has risen to new highs. The country has more blackouts lasting longer than an hour than any other developed country in the world.

There are also concerns that such blackouts could last for a while. In 2005, Hurricane Katrina struck the Gulf Coast, thus causing many around New Orleans and other surrounding areas to be without electricity for up to six weeks after the storm struck. The people of the Gulf Coast were not able to get in touch with other people through a phone service, nor could they use air conditioners or refrigerators to keep themselves cool. Online access was

also unavailable because the routers and computers needed were taken down. Businesses and stores were also closed because their security systems, cash register systems, and other vital utilities were not working.

The horrors of Hurricane Katrina remain fresh in the minds of people around the country. The stories of people being left in an area where they had to find foods to eat inside garbage dumpsters were alarming and shocking. So, what would happen if something like this happened throughout much of the country?

Is Our Infrastructure Really Ready?

A massive disaster that causes a large portion of the United States to lose its power could happen someday. A disaster like an event caused by an EMP could be a risk to the country's electrical system.

An even larger concern comes from how the country's electrical grid is not as strong as it used to be. The electrical grid is aging and needs repairs. The power plants, sub-stations and lines that were built around the country were originally designed to have a lifespan of 50 years. But some of these plants are older than 50 years of age. Many of the electrical lines around the country are more than a hundred years old and are still being used today. It is no wonder why the American Society of Civil Engineers gave the United States a D+ grade in its Infrastructure Report Card.

That D+ could be brought up to a C if the $3.6 trillion needed for building up the country's infrastructure was to be spent. It's uncertain as to what could be done to make that grade even higher. But one point is for certain in that the trillions of dollars needed to resolve the infrastructure's issues aren't going to come out of nowhere.

Attacks May Come

Even worse, the United States has various enemies who have vast ideological issues and disputes. Any terror-related group could try to attack the country's electrical grid. This could impact the entire country or at least a sizeable portion of it.

The types of attacks that our country is at risk of bearing with include many concerns that come in various forms:

Cyber-warfare. Electric power was taken out in parts of Ukraine and Africa as hackers broke into the computers that control power plants and sub-stations in those areas. China and Russia have also invested in extensive programs that could attack various computer systems around the world, including systems that impact power grids. The United States' electric grid experiences a cyber-attack every day on average, although that is primarily to test defenses.

Terrorist attack. There are nine substations around the United States, but information on where they are located is unknown. But if one of those substations was destroyed in a terrorist attack, the electric grid could be disabled for a whole year. One substation near San Jose was attacked by sniper fire in 2013, but that has been interpreted as a live-fire test to see how people may respond to a terror attack.

EMP. An electro-magnetic pulse could be produced by a solar flare or even from a nuclear bomb that explodes about 300 miles above the atmosphere. The power of an EMP could destroy the electric grid. An EMP Commission report states that many things could happen if an EMP occurred; this includes about 90 percent of the population dying of starvation before the grid can be fully repaired.

The risk of an EMP or any other attack could be significant. Even worse, the number of possible attacks that might come along will only increase over time. NSA and US Cyber Command leader General Keith Alexander states that there will almost likely be more cyber-attacks against the grid, with

many of them being orchestrated by terrorists, opposing governments, and other enemies of the state. Alexander also says that while many attacks can be easily repairable, the timeframe for how long it would take to repair those issues remains questionable at best.

Any problems that might come about due to a terror attack could be serious or significant. Any larger attack might also make it harder for repairs or other responses to be made as needed.

But Can You Still Live?

It is true that you could live without electric power. Our ancestors were able to live without power for generations. But at the same time, those people were more used to hard physical work and dealing with issues in lives. Meanwhile, many of the skills that those ancestors were able to work with have been forgotten by society or are considered obsolete.

In addition, we continue to rely on electricity for everything we want to do in our lives. We use electricity to cook foods, build homes, and other actions. Many of us today's have the stamina or strength needed to do things like what our ancestors were able to do.

The Energy Risk

It is possible for you to survive without electricity, but it is not too easy. You might have far too many items in your home that rely on electricity. Some of the appliances and tools you use can help you with handling everything from cooking food to taking care of medical functions. Without power, you might struggle to survive because all those items are no longer working.

In addition, we often keep our most secure bits of data on our computers, phones, tablets, and other electronic devices. It might be tough for you to gather important survival data if you don't have it printed out somewhere. Seeing how it is easier for people to use electronics for communication purposes, it can be tough to even think about printing the simple things out somewhere or at least having reference to something from outside your electronic items.

While electronic devices aren't going to necessarily help people with finding clean water, they may provide people with information on how to clean that water. You can get these devices to work for you, but even those might run out of power after a while. The threat only makes it harder for anyone to live through a massive or long-term power outage.

But the greatest risk that comes with a power outage comes not from being unable to use things, but also from the threat of a “new normal.” People like normalcy because it is something that reminds people about how well their lives had been before disaster came about. Many people in the Gulf Coast have been unable to get back to that “old normal” after Hurricane Katrina. The people of Sukuiso, Japan have also struggled to get to that old time when in 2011 a tsunami destroyed the Fukushima Daiichi Nuclear Power Plant.

Normalcy will become a thing of the past when you don’t have electrical power. This makes it so important for people to find ways to produce electrical power. This is to try and restore a sense of normalcy in life. While anyone can create a new life in the “new normal,” it is still difficult to create the old life that one had.

It is estimated that the total sum of human knowledge will double every two years on average. Technology has made it easier for human knowledge levels to grow. A loss of electricity could result in a loss of all that knowledge and understanding. This makes it all the more important for people to retain the skills and things that they know, even if they aren’t able to immediately use all that knowledge when a disaster strikes.

Understanding Prepping

A good portion of why the project you will read about in this guide is useful is thanks in part to the hard work of the prepper community. This group of people from around the world is focused on knowing what to do in the event of any major emergencies or disasters.

The prepper community has been growing over the years as more people begin to discover the risks that are prevalent in our society. People will plan their prepping efforts based on one of two things in mind:

People may bug out, or get out of their properties because their homes are unsafe.

People may bug in, or stay in those spots because the outside world is too dangerous.

The goal is to survive in a disaster. It is difficult to figure out what can be done though in a disaster. No two disasters are ever alike. There's no real way to predict what might happen in the future either.

Some preppers have even gone as far as to get firearms for their protection. Many people aim to look for handguns, shotguns, and many other firearms that they can use for hunting down food or for protecting themselves against other predators. But while it is one thing to protect you against one person, it might be harder to secure yourself against an angry mob of many desperate people.

Don't forget that you might be noticed by other people while you're trying to survive. You might come across some people who want to attack you when they see what you are doing to survive. They would want to take what you've got for their own.

In most cases, you would have to bug out rather than bug in. This comes as people might notice your property and try to attack it many times over. But at that point, you would have to hurry out of your home before people might notice you. This makes it vital for you to find a way to produce electricity while on the go.

Preppers often forget about what they can do when generating power while on the go. Much of this comes from how hard it would be to produce solar panels on a small cabin in the woods or to install a wind turbine in some spot.

The power you use when bugging out has to be portable. More importantly, it has to be something you can carry on your body, not something that you would have to tow with a vehicle. Compact items you carry on yourself might not produce as much energy as something larger, but you have to make sure the power is handled right.

It is true that the prepper community sounds like it is crazy when all is considered. But the fact is that the prepper community recognizes the worries that have come about in society over time. The increased risk of various emergencies and disasters around the world has been a point that many preppers are pointing at when it comes to them being ready for whatever may come about. The increasing power of hurricanes, as evidenced in 2018 with Hurricanes Florence and Michael, only makes it all

the more important for people to think about what they can do when getting the most out of their power in such emergencies.

But to make the most out of your power when prepping, you have to consider the alternative energy sources that are available. The next chapter is all about looking at the various energy sources you can utilize for your needs.

Alternative Options For Energy

You might be surprised at how well energy can be produced these days. You will have an easier time surviving if you have the proper energy sources on hand with you.

The good news is that there is an assortment of options you can consider for producing energy. However, there are some problems that come with each option.

Gas Generator

A gas generator uses fuel to produce energy via a battery attached to its setup. This is the most traditional option for you to look at.

Pros

You can find generators in many sizes, including ones that can power an entire house

Options that work with gasoline, diesel, natural gas, and propane are all available

Many generators can link up to a property and will turn on automatically when the power runs out

Many generators are cheap to buy

Cons

The gas that you use would cause emissions to come out; you cannot use a generator in a closed environment

The generator might be noisy

You would use several gallons of gas per day to keep the generator running

You might not be able to get the gas or fuel needed for keeping the generator going; sometimes the fuel might be expensive due to its scarcity

Solar Power

Solar power involves you using a series of panels that can receive solar energy from the sun. The panels will convert that solar energy to actual energy. The power is linked up to a battery that will charge up various items.

Pros

You can find panels in various sizes

A clean energy solution

You will always have access to the sun’s rays

Little maintenance required

You don’t have to pay anything for solar power

Cons

Won’t work when it is cloudy or it is too dark to get power

Can be tough to install

You need a massive array to get the power you need

The solar panels themselves are expensive to get

Wind Power

Wind power entails you utilizing a turbine that links to a windmill that collects wind. The turbine will take in kinetic energy from the wind. The energy is then converted into regular energy that goes to a battery.

Pros

A clean power option

Can operate at any time of day

A simple mechanism can work for producing energy

Cons

You need at least 10 miles per hour of wind to get the wind power generator working

A larger turbine is needed for producing extra power; this might be tough to gather

You might be limited over how large your turbine may be depending on where you are; some places might not allow you to keep one

You have to regularly maintain and replace the bearings on a wind generator

Some turbines may produce lots of noise

Hydroelectric Power

You can use hydroelectric power for helping you to get the energy that you require. You can use water by having it move through a proper turbine or other setup that will produce energy based off of the water's motion and pressure. Hydroelectric dams can be found all around the country; these include many power plants that help to power homes with ease.

Pros

Any kind of water source can be used for hydroelectric power

Does not produce emissions

A water wheel or other item could help with supporting energy production

Cons

It may be tough to find a spot where water flows well enough to produce energy

The process may not work well if the water is dirty

You might need to get a permit to use a hydroelectric generator in water off of your property

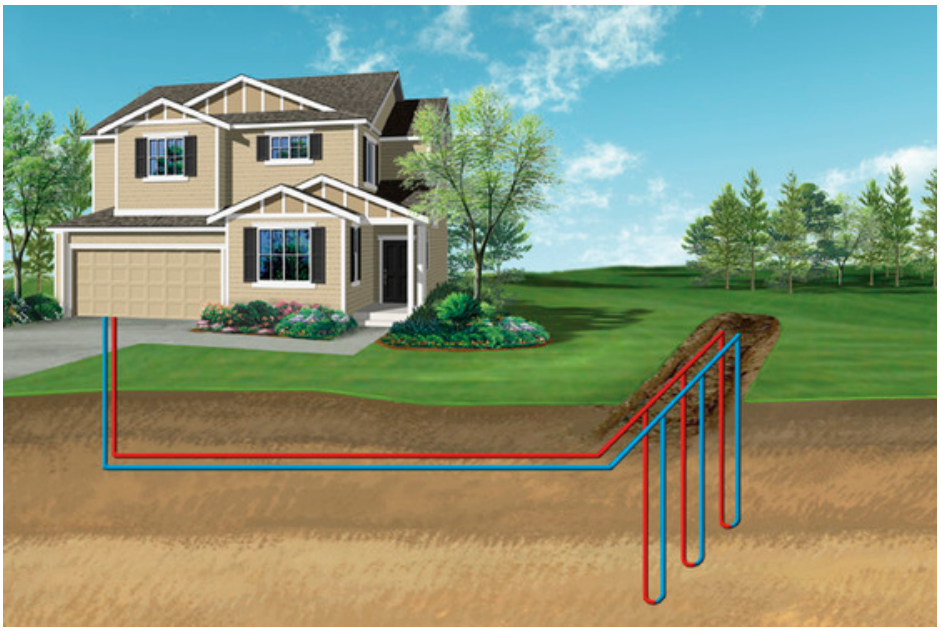
Geothermal Power

Geothermal power lets you use the planet's natural heat. The heat inside the planet can be found by digging deep into the surface to find the power. Naturally, most people use geothermal power for heating their homes, but that power can also be used for creating energy for your daily use.

Pros

The energy produced can last for as long as needed

You can produce this energy without generating emissions



Cons

It may be difficult to dig deep enough to find the heat inside the planet

Hard to handle in high-elevation spots; it is easier to use geothermal power in the western end of the country where the elevation is lower

You would require extra help for getting a generator set up; this includes looking at the thermal conditions in the area you want a generator in

Biomass Power

You also have the choice to use biomass power for getting energy. Biomass power works as biological materials are converted as carbon is separated from materials. While old fossil fuels are items that are harvested over time might break down to produce fuel, those who not necessarily biomasses; rather, biomass energy entails things that can be quickly restored.

Plants, crops, trees, and landfills are often used to produce biomass. As carbon is separated from the original materials, it becomes easier for power to be generated. The resource is renewable so long as the compounds needed for energy are available for use.

Pros

Can work with many crops and plants

Does not produce greenhouse gases

Combustion is easy to produce for getting the energy ready

Can reduce the sizes of landfills

Cons

The methane produced may be dangerous in some cases

Not as strong as fossil fuels

May be a challenge to produce a generator that runs on biomass

Hydrogen Power

Another choice you have for an alternative energy source is hydrogen. Hydrogen is a valuable material, but it is often paired with many other elements. For instance, water naturally contains hydrogen, but about a third of that water contains other elements. The key part of hydrogen power is to separate the hydrogen from the rest of whatever that compound comes with.

Hydrogen power is produced through a mechanism that separates the hydrogen from the water. When the hydrogen is separate, it becomes easier for energy to be produced.

Pros

A clean source of energy

The only waste left behind is clean water

No emissions produced

Can be generated many times over

Cons

Can be dangerous if you have far too much

The process for producing energy is complicated

Expensive to produce and store

All of these options for alternative energy are intriguing, but you should be cautious as you aim to get any of these sources to work for you. Alternative energy works best when you have a clear plan on hand based on your surroundings and whatever might be easier to use at a time.

For instance, hydroelectric energy is best if you are near a source of water. You could also use solar power if you have enough room for it and you have

exposure to the sun's rays. You might be impressed with how well different energy sources can work, but you also have to ensure that the source you prepare can work to your liking and that it will not be at risk of getting you into any trouble.

Our project is going to focus on solar power to allow for energy to be produced. This is the best option that we have regarding the setup, even if this is not as perfect as people might expect to find.

THE RISE OF THE POWERPACK PROJECT

As the name of the system implies the PowerPack Project was based on one very important requirement which is - that it had to be portable; but I had already defined portable as man-portable, not vehicle portable. I also wanted something that would work no matter where I was. In other words, I didn't want my plans to be limited by whatever power generator I came up with.

What most people refer to as a portable generator is a gasoline generator on wheels. While the generator itself might be portable, I'm not so sure that the fuel for it is. I guess if all you're doing is going to a construction site where you need electricity, a gasoline generator on wheels can be considered portable. But there's no practical way of taking enough fuel along on a bug out to keep that generator running. So, for my needs, those aren't portable at all.

That left only a few options, solar power or wind power combined with what Keith discovered. While I like wind power, those units aren't really all that portable either. I suppose one could be brought along in pieces and assembled on site, but that kind of defeats the purpose of portability being mobile.

The time it would take to assemble and erect a wind turbine makes it impractical as a portable unit. So now, all we have is solar PLUS Keith's secret.

Well Keith discovered that one big problem with some of the energy sources out there such as wave power, stream-flow power and some types of wind power is that they're limited to short up-and-down or back-and-fourth motions.

The power is there, but instead of rotating in one direction so you can drive a generator handily, the motion is more like that of a handle on a bumper jack.

His discovery wants to offer a solution. Accepting full or partial rotation in either direction at one end, it delivers full rotation, single direction at the output shaft.

If you put in wagging power from a stubby-tailed dog at one end it would come out as rotting power at the other.

The secret is a pair of form sprang overrunning clutches that lock up when turned in one direction and free-wheel when turned in the opposite direction. They rotate two ring gears that have two pinions in between.

The use of such a device means a very simple and direct connection between an alternate-energy device and the workload.

And combined with the versatility of a portable solar generator we managed to create an ultra efficient power generator that you can take with you whenever, wherever.

That's how the POWERPACK project started.

So the next step was to start looking around for a portable solar generator and I did found a few. But to be honest, I didn't like the price tag. Granted, solar power is expensive and has always been expensive. That's why we don't have more of our power production coming from solar. But there's

just something about paying enough for a portable power generator to more than make a couple of payments on my house that just bothered me. It should be possible to do it cheaper.

Being the do-it-yourselfer type, I decided to look into building my own PowerPack generator...and you know something? It is cheaper. Not only do you save about half the price of buying commercial solar panels, but by eliminating the expensive custom case that those other units come in, you save another bundle of money. Ultimately, you end up with what you need, at a fraction of the cost.

So, that's what I'm going to show you; how to build your own. Actually, I'm going to show you several different ways of building your own. We're going to start with the simplest system I could build and then add to that, upgrading it. That way, you can decide what you want to build. There's no way that I can tell you what you need or what your budget can handle, only you can do that. So, I'm not even going to try. I'll lay out all the options and leave it up to you to decide.

I'm also going to give you the option to use this system as a base for your home emergency power system. What we're going to do can be used as the base for that system, simply by expanding on the power generation and power storage parts of the system. That way, you can have emergency power at home, as well as when you bug out.

The good thing is, none of this is really all that hard to do. If you're fairly good at making things, then you can make this system. I'll show you what you need and how to do it. I'll even show you how to get by without a few expensive tools, so that you don't have to spend a lot of money on tools that you might not use again. Just because I tend to collect tools doesn't mean everyone does and I don't want to push you to have to buy tools that you don't need.

I'm also going to give you complete parts lists and show you what I paid for those parts. You may be able to find them cheaper than I did, but being the cheap sort, I tried to get them as cheap as I could. As such, eBay is one of

my favorite sources of supply. For things I couldn't find on eBay, I'll tell you where I got the best price.

All in all, this is a great project that you can easily do on your own. Now, that doesn't mean the same as quickly. I'll warn you now that working with solar cells is a slow, tedious process. The same can be said about working with sprockets, gears and pinions...it requires a bit of attention and determination...But that’s why you’re here right?

I suggest taking your time with the solar cells or you'll end up breaking them. Solar cells are made of paper-thin glass and as you can easily imagine, they break quite easily. So, care is needed in building this power generator, or you're going to waste a lot of money on things that you just throw in the trash.

Basic Electronics

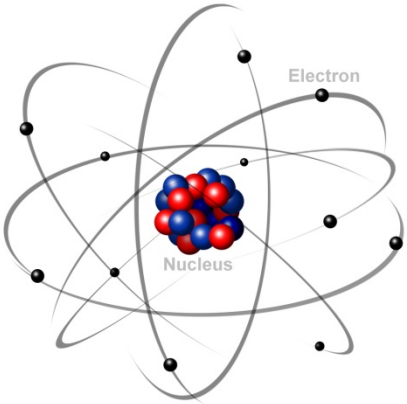
You need to recognize the basics associated with the electronics that you will be utilized when planning your generator. Understanding how these materials work can help you with getting more out of your task at hand.

Let's look back at what you might have learned back in high school chemistry. Atoms contain three specific particles:

Protons – Positively charged

Neutrons – Do not have any charge

Electrons – Negatively charged; these orbit the nucleus in a series of layers



The electrons are the most important parts to notice. Electrons are capable of moving between atoms, thus forming molecules. The electrons are also vital for helping to get electricity to start working. Specifically, electricity is produced when electrons move between atoms. The most electricity is produced when those electrons really start moving along.

How Do Electrons Move?

To make the most out of your energy stores, you have to look at how the energy you produce moves. Electrons can move in one of two directions:

Direct Current (DC) – The electrons will move in one direction. A battery-powered device will run off of DC power.

Alternating Current (AC) – The electrons go back and forth. Anything that you plug into an outlet will run on AC power.

The generator you are going to create produces DC power. But it can also be converted into AC power so you can use it in various appliances.

Voltage

The voltage consideration is important to note. Voltage is a measurement of the potential that the energy has. Specifically, voltage is a measure of how much power is produced off of a source. An item that is grounded has zero voltage and therefore is not producing energy. The generator you are using will produce voltage that separates the generator from the ground.

You will produce more force when you have a higher energy voltage. This is especially the case for electronic devices that use motors. More volts provide a greater amount of energy needed to get something large to work. For instance, a drill might use a 12-volt battery, while a second uses an 18-volt battery. The one with the larger battery produces more torque. On the surface, this would mean that the 18-volt drill is more powerful and therefore more effective.

But in reality, you have to watch for how efficient a device is when compared with its voltage. Items that need more voltage often work that way because they are larger in size and cannot run on their own unless you produce enough power or energy to get those items ready for use.

Also, items are designed to work at a very specific voltage rating. An item will not work when it is not getting enough voltage. Meanwhile, anything that is taking in too much voltage could be destroyed from that excess power.

It is also possible to produce AC and DC power. But items can only handle one of those two currents.

For instance, let's look at how a light bulb works. You might take a standard bulb that works for a flashlight running on two AA batteries and install that bulb into a flashlight that operates with four AA batteries. The bulb would burn out because it is taking in far too much energy. But if you install that two-battery bulb into a flashlight that uses only one AA battery, the bulb will not work at all. The bulb would not get the energy it requires to stay active.

Consumption

Another measurement of energy to see involves the consumption that goes into a device. The consumption refers to how much energy is used up. There is no real way how any single device can perpetually produce electricity.

Consumption is measured in watts. Every watt that is consumes will result in a power source having one less available watt to work with. For instance, a battery might use one watt of power at a time. But if all those watts are used up, the battery will no longer be useful. You would have to either recharge it or throw it away if you are unable to recharge the setup.

The watts could be interpreted as a measure of how long you can use a power source for. But the watts would also have to be measured carefully as the number of watts that you use could vary based on whatever you might be using.

You have to watch for how much power your generator is to produce versus what is going to consume that power. This moves into the next point you should notice for your PowerPack System.

Battery Power

Another measurement to see involves battery power. Most of electrical sources we use operate off of DC power. An AA battery will produce 1.5 volts of DC power, for instance. But a device that runs on an AA battery will use 1.225 volts of power from that battery. A device that uses many AA

batteries will use that same 1.225-volt standard for each battery no matter how many of those batteries are incorporated in the process.

The reason why that voltage will drop is because the usage of power within the battery causes the unit to wear out. As you keep on using a battery, its voltage will drop. The voltage eventually falls to where the device that runs off of batteries will not work any longer.

But aren't devices that operate with more volts going to hurt items that use smaller voltage totals? It is perfectly fine if the voltage is slightly higher. A 1.5V battery is not going to hurt a 1.225V item because the increase in voltage is so small. If anything, the battery works with this in mind to ensure that the device will keep on working for a while. When the battery's voltage falls to 1.225V or below, the device will stop working.

Now, it helps to look at the wattage of the batteries. An alkaline AA battery contains 2.6 watt hours of power. This means that 1 watt of power is used every 2.6 hours. 2 watts can also be used in 1.3 hours. After that period ends, the battery voltage will go below 1.225 volts. The battery can no longer power a device that needs the energy.

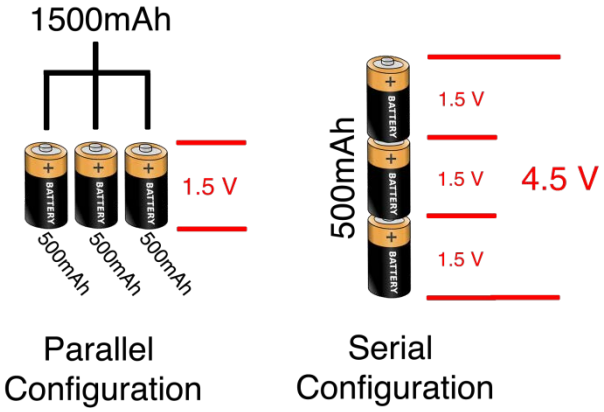
Different types of batteries will produce varying voltage levels and can also hold varying amounts of power. An automotive battery will produce 12 volts of power and store a massive amount of energy.

Also, the materials that a battery is made out of will influence what you would get out of something. Whereas an alkaline AA battery can hold 2.6 watt hours of power, a carbon-zinc battery of the same size holds 0.65 watt hours.

You can also find rechargeable AA batteries, but those also come with varying power levels. A nickel-cadmium battery runs with 1.2 watt hours of energy. A nickel-metal hydride battery uses 2.52 watt hours. A lithium-ion battery is even stronger at 3.1 watt hours.

Connecting Batteries

As powerful as individual batteries can be, they work even better when they are strung together. You can get multiple batteries to link up to produce a more powerful setup. The solutions you can consider when connecting batteries together entail the following choices:



Series

The first option for connecting batteries is to produce a series. In this, the positive pole on one battery is linked to the negative pole on the next battery. You might notice this when you add many batteries into a flashlight with all those batteries being aligned in a row. As the batteries are aligned, the power produced will increase. The added power makes it easier for a larger item that requires more volts to work.

For instance, you might have three AA batteries in your setup linked together in a series. The total voltage in that setup is 4.5 volts. But the voltage for each battery will remain 1.5 volts. It is up to all of those batteries in the same layout to make the process work.

The higher voltage potential is still a big part of what makes this work. Anything that uses more than just one battery can accomplish more things than what something else can. But the key to see that the battery power is easy to manage.

While it is true that a device that uses many batteries in a series woks with more power, it is up to the item itself to see how that power is used. A cordless power tool that uses a higher voltage with more batteries may produce added mechanical power, but it is up to the quality of the tool to see if that extra power is worthwhile.

You have to look at how well the mechanism on the device you are working with is laid out. This is to confirm that the device you want to utilize can work accordingly and be effective for the task at hand.

Parallel

You also have the option to organize your batteries in a parallel configuration. In this, the corresponding poles are all connected by wires that link to each other. One wire is used for linking a positive pole of one battery to the next, and a separate wire is used for the negative poles on those same batteries. The process works for batteries of the same size and capacity.

The main difference here is that while the voltage increases for a series of batteries, the wattage increases for a parallel array. The output power for four AA batteries in a parallel arrangement will remain at 1.5 volts. But if each of those batteries can produce 2.5 watt-hours of power, then the series will generate 10.4 watt-hours. The added power may provide you with the added ability to consume more energy at a time before the batteries run out of their charge.

The Concept of Amps

Amps are critical to review when looking at how power is to be consumed. Amps, or amperes, are a measure of how much power is available. The measure could also be a review of the amount of power that is moving through an electrical wire.

Whereas watts are a measure of power being consumed, amps is a measure of how much power is being produced right now. In some cases, more

power could be moving through a wire than what is being consumed. However, that point is rare.

In many cases, you will come across electrical devices that let you know the number watts of power an item can consume. Meanwhile, you might also read about how many amps of power are required in some items. The good news is that it is easy to calculate these two points.

You can use the following equation for converting watts to amps:

Find the wattage of an item.

Divide the wattage by the voltage.

You will get the amps in the unit.

To go the other way and convert the amps to watts, you must do this:

Find the number of amps.

Multiple that total by the voltage.

You will see how many watts are in the item.

Let's say that you have a toaster oven that uses 3 amps at 120 volts AC. This means that it would use 360 watts of power. By taking 3 and multiplying by 120, you would get the product of how many watts are produced.

You will have to look at this when figuring out the size of the power supply that you create. This is also to figure out the things that you can power with it.

Watch For the Wire Size

You might not think much about the wire you are using in your electric setup, but you have to ensure the wire is strong enough to handle the amps you are producing. You would require a larger wire if you're going to work with more amps of power at a time. An excess amount of amps on a small

wire will cause heat to generate within the unit. The added heat would cause the wire to melt in some of the worst cases. The plastic insulation would melt, but after that the deepest parts of the wire will fray and wear out.

You have to look at the gauge of your wire. This is a measure of the size of the wire. The gauge number is determined by the American Wire Gauge system.

A wire with a smaller gauge number will have a larger diameter. You must choose an appropriate wire gauge based on the number of amps that are going to go through your electric system.

Here are a few numbers to consider when getting wires ready for your use:

Wire Gauge	Amps the Wire Can Handle
2	95
3	85
4	70
6	55
8	40
10	30
12	20

The amperage of a wire may vary in many cases. It is easier for you to get better amperage total with a copper wire.

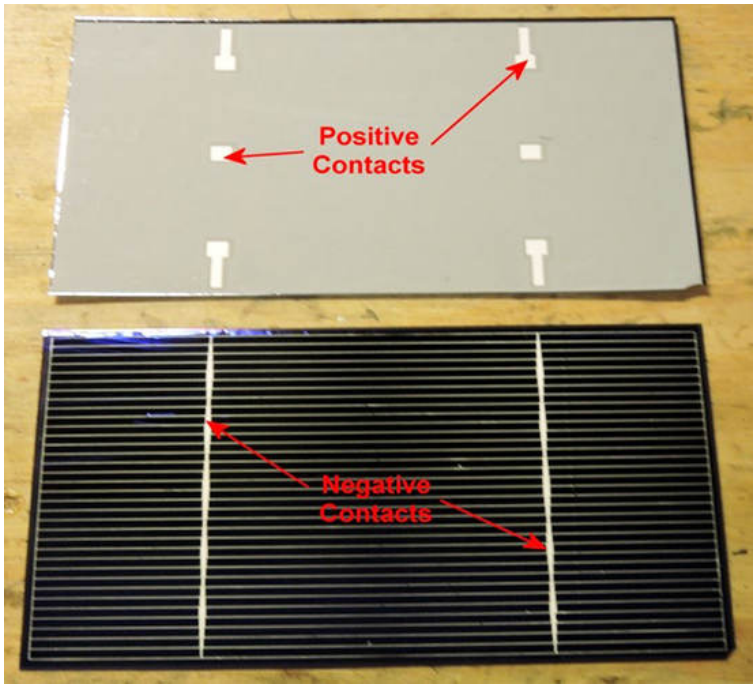
Aluminum could also be used, but that material may be risky. When an aluminum wire has a larger amount of amperage moving through it, the wire will be at an elevated risk of expansion. This would cause a connection to wear out. The expansion could also cause an electrical fire in the worst cases. In short, it might be better for you to stick with a standard copper wire that most people utilize.

How Basic Electronics Relates to Solar Panels

All the things you have read here about basic electronics are important to note, but you have to also look at how these details relate to the solar panels you wish to utilize for your power source. You must notice how the electronic features of a solar panel work so you can get this to be organized accordingly.

Basic Arrangement of Poles

Solar cells work like batteries in that both of these items generate electrical currents through both positive and negative poles. But while a battery produces electricity through a chemical reaction, solar cells produce that same power through a photo-chemical reaction. Light mixes with the chemicals inside a cell to produce energy.



In addition, solar cells can be arranged in a series of in a parallel layout. Remember, the series setup adds voltage while a parallel arrangement adds current.

The side of the solar cell that faces the sun is the face side. This is a blue surface that has some silver or white lines going through the body. The side is the negative pole on the cell.

The back side is gray and is the positive side. You must ensure these two sizes are inspected well and that the two parts are working accordingly.

How Many Volts?

A solar cell will produce 0.5 volts DC. This is regardless of how large the cell is. This is similar to how many types of batteries of different sizes use a 1.5 volt DC voltage.

Also, a larger cell will produce more watts or a greater current. This is in spite of the voltage being the same. You will have to review this in that the added wattage from a large cell will provide you with extra power that you can take with you.

A Note About Wattage

The wattage that you will get out of a cell will vary based on its size. But you must note that a solar cell is not going to produce watt-hours of current. Rather, it only produces watts of current.

A solar cell cannot store electrical power. Rather, that cell that only produces the power. Therefore, the cell will produce a certain wattage when the cell gets enough light. However, the cell will not produce any power when the light is gone. Therefore, the cell needs a consistent amount of light for it to produce the renewable energy that you can utilize in many forms.

What Is the Size?

A solar cell can come in many sizes. You can find very small cells or some massive ones that can take up residence in a field. But the most common sizes you will find are 3x6-inch and 6x6-inch sizes.

For this guide, you will be working with 3x6-inch cells. Such cells do not require you to produce panels that might be too massive to the point where you cannot transport them. While it is true that a 6x6 cell can produce about 4.2 watts versus the 1.8 watts generated by a 3x6 cell, you would still need to ensure that your power source is fully portable.

You do have the option to adjust your cells and use them in many forms based on how much power is to be produced within those cells. You can create various sells that come with different power levels based on what you feel is appropriate for your power production needs. But you must also look at how well those cells are prepared based on what is available for your use and that you have a plan for managing that energy as you see fit.

Linking the Cells Together

As you produce your solar array, you will utilize cells that link up to each other to create a large panel. But while the 0.5 volts of power that comes from each cell might help you with producing some energy, that might not be good enough. Rather, you have to get many cells together in one array to be easy to set up and plan out.

This leads to a good question – how much power do you require. You might need enough power to charge up a mobile phone, or even enough to get a car battery up and running if needed.

For instance, you might have a cell phone charger that operates on 5 volts DC power. You could use ten cells to create 5 volts DC so you can charge up that phone. Meanwhile, you might need 24 of those cells to power up a 12-volt marine battery for a boat.

But when getting your battery, you have to link up a specific number of cells. In particular, you need to work with 36 solar cells to create 18 volts DC. This is a standard for solar arrays that works for 12-volt lead-acid batteries. The 18-volt solar arrangement has long been utilized to charge those batteries, including ones that may work in some boats and other small vehicles. The power that comes from the solar array will be converted

into the power needed to run the vehicle or other item that the battery is connected to.

But if you need 12 volts, why can't you just use 24 cells instead of 36? You have the option to do that, but the power produced by a solar array will be heavily dependent on how well the sunlight in an area works. The cells have to be in direct contact with the sunlight coming in from overhead. If the sun is blocked by clouds or the sunlight is at an angle, the solar cell array will not work as well. Only a partial number of cells would be active. Therefore, you need those twelve extra solar cells as a buffer to protect you from any possible problems that may come about due to you not having enough of a charge for a 12-volt battery.

After you produce a panel with enough cells, you can get a second panel ready. You will then need to link those two 36-cell panels together in parallel to increase the wattage or current being produced. Therefore, you would have two 18-volt panels, but the total wattage that is generated will be twice that of what you would get out of a single panel. This gives you more power to handle many items while also having the voltage needed for powering up many things wherever you are.

You have the freedom to work with any kind of solar array setup that you want to work with. But for this guide, you will still use the 3x6-inch layout. The layout should be easy to work with and plan out accordingly.

BUILDING YOUR POWERPACK BOX

Without further ado let's start building our own version of the PowerPack system step-by-step.

DON'T FORGET SAFETY FIRST.

In preparing for the building process, you need to gather the tools, supplies, and equipment you'll need to keep in your work area. Having your supplies and equipment assembled ahead of time will help ensure a smooth process without any delays caused by looking for the things you need. Fortunately, the tools you need for the building process are not expensive and are easily accessible at auto parts supply stores, at some large box discount stores, or online.

Here's the basic list of supplies and tools you'll need and where to find them:

NOTE: These are just suggestions. Some of the tools are optional. Feel free to do your own research before starting.

List Of Tools:

Pliers

Cable Cutter (Pliers)

Flat and Cross Screwdriver

Cable Crimper Pliers

Decorticator Pliers

Box Cutter Knife

Sliding Measuring Calipers

Fixed Wrenches

Plastic Cable Ties

Hand Drill

Drill Bits

Components (Electronic Parts Needed)

Multimeter (Amp\Voltage Measuring Device)

Solar Panel Cable Coupling

Power Inverter 12V – 110V (220V) at 800W

Solar Charger Controller

Electrical Cables For Wiring (Red And Black) ϕ1.5-2mm– 3.5 Ft (10 M)

Metallic Coupling For Solar Panel Fixing – You Can Choose From A Large Variety Screws, Washers And Nuts ϕ6, 2.4 Inches, 1.6 Inches And 1 Inch Long

Connectors

On/Off Switch

Socket For 110V Or 220V

Car Lighter Socket 12V

USB Socket

2 x Threaded Metal Rods

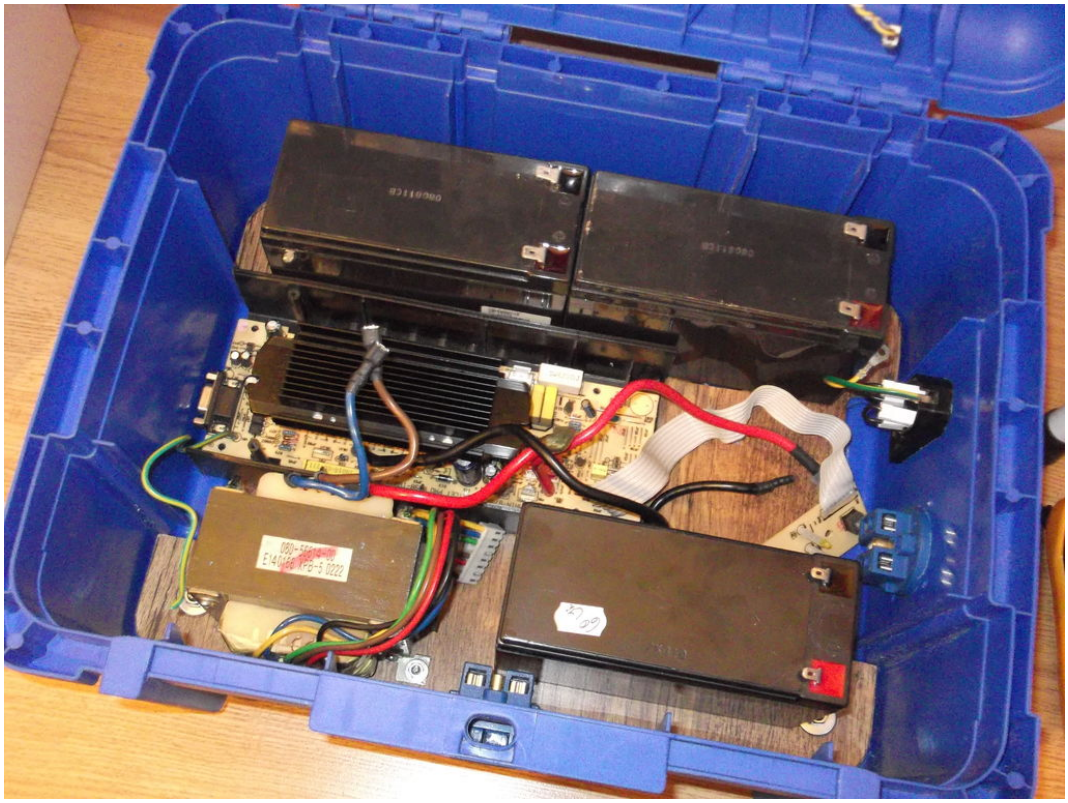
2 x 40 / 50W Solar Panels

2 Smaller sized car batteries or a Big One

1 Suitcase Inside Which We'll Assemble The Power Bank For Better Maneuverability And Ergonomics

For testing the Device we'll use: 2 Halogen x 10W bulbs, 2 x 10W bulbs, 8 x 100W bulbs connected in parallel. Also, we'll use a cell phone and other household devices.

Producing a POWERPACK Suitcase



The next thing to do is to create a suitcase that offers support for all the materials you wish to utilize. The suitcase will work with two solar panels. These panels can link to the wire materials that you prepared earlier. You can use this to make the setup more durable and capable of being transported anywhere. After all, the ability to transport the power source is a big part of what you came here to learn about in the first place.

Start with a tripod to help you sustain the solar panels you wish to utilize.

A tripod made for spot lights is best.

Get a permanent market and measuring tape. These are to be used for finding and marking the middle of the aluminum frame that you will hold your solar panels in.

Watch for where the hole is drilled while getting the middle of the frame ready. The threaded rod must not touch the surface of the solar panel if you wish to make this work well enough for you.

Be cautious as well, as the aluminum frame can be very easy for you to drill into. The drilling must be done well without possibly puncturing the solar panel. You can also smooth out the edges on the hold if desired to create a better surface.

Repeat the process of the first two steps for the second solar panel you want to use.

Mount a washer and nut on one end of a threaded rod that will go through the first panel. Tighten that rod in place with another nut on the other end to allow that panel to be kept in place.

Add the middle part of the pipe and then secure another nut there to get the tripod connection to stay secure. Avoid adding too much tension or else the surface will be at risk of cracking apart.

Repeat that fifth step for the second panel.

Review the connections on each panel. These connections should be clear and not tangled or obstructed. The top parts of the threaded rods can be removed if desired.

The good news about this process is that the solar panels that you will use should be semi-wired. Many solar panels are available with their connections already intact. But you can also find some DIY kits that include all the wires and connectors you need for getting the setup ready.

Reviewing the wiring connection on the panel. The panel should have the wires arranged in a parallel layout. This should work regardless of how many other panels you have.

When getting connections ready, you must start with the positive line with a positive connector and red line. Use one end at a mom connector where you will connect the red cable on the interior pin.

Secure the end of the wire and tighten that wire to see that it links to the proper metallic pin.

Add the tightening sleeve and the coupling. Tighten the surface; this should be light in weight.

Repeat on the other negative side; this should include the negative connector with the black wire.

The number of red and black wires should be equal to each other. Aim to have one for each panel you will use.

Producing Your Own Solar Cells

You can create your very own solar cells if you do not have a pre-made array that you can secure those cells within your PowerPack System suitcase. But to make this work, you have to see how well the panels are produced. You need to understand how to solder electronics to make this work.

Order a series of solar cells. You can use as many as needed.

Review how many watts the cells can produce when finding a solution. Be sure the cells you order are arranged accordingly.

Find glass that can be used for covering the cells if the cells you have ordered were not covered.

Solder a series of tabs onto each cell. Add flux onto all the solder points. Keep these soldered from positive to negative in a series.

Be cautious as you work with soldering materials. The tabs can be very fragile.

Organize your cells in a straight edge and tape them together. Allow for an 1/8-inch gap in between each one.

Add solder onto the points and then solder the tabs onto those surfaces. Test these materials to see how well the materials work.

The design can include strips that feature six or nine cells if desired. Be cautious with these as they can break easily if not handled accordingly.

Lay the cell strips face down on the glass. Solder the cells in a series.

For a 60 watt panel, you would need 36 cells. This is a general rule of thumb for when you're trying to produce a large enough surface.

Solder the diode that comes with the kit to the positive end and then add an old electrical cord.

Pour epoxy encapsulate over the surface after everything has settled in. Use a paint brush to spread the material.

This step works best after you have waited a few days to allow the electrical arrangement to settle. After this, you would have to wait a few more days to allow the epoxy to settle itself.

How Big Can Your Panel Be?

The size of the panel will vary based on what you have built. The panel you produced in this example, which entails 36 cells, is 26-5/8 by 32-3/16 inches. You should split this panel into two halves to make it easier for you to carry it around.

The smaller panels will not do much outside of powering up a cell phone. Therefore, you would have to connect the panels in serial and then in parallel to produce more electric power at a time.

The panel should be sizeable to where you can collect energy, and yet the design has to be made to where the unit will not be too hard to control or utilize. Knowing what you will get out of the organization is vital to your success.

Design Options

You can use a few design choices for making it easier for you to get your panel ready. These designs include the following prominent choices:

Two Rows

You can use various design choices for when you're aiming to produce the best possible panel. First, you could create a traditional panel that is split in half. You can take one 18-cell panel and produce it in two strings with nine cells in each one. The panel is long and narrow and will measure about 13-5/8 inches wide. The standard height of nearly three feet may still be tough to handle with a backpack, especially if you are traveling in a tight spot. Still, the panel is narrower than what your backpack is probably like.

The large height dimension makes it so you can lay that panel against a tree. You would point the solar array to the south to get the light needed for the power you demand.

Three Rows

Another design choice is to use entails three rows of six cells each. This is to produce a 20x22-inch design that is closer to square in size and might take in more power. You can use this to produce a better design for handling your materials without struggles.

This is a little wider than the other choice, but it is easier to carry around in an area filled with tree branches and some brush materials.

The glazing, plywood, and solar cells for this or the other design should be utilized accordingly. Some added aluminum would be needed though. This would entail the aluminum for framing the separate panels being handled. Added hinges and latches can be produced to get those panels to link up accordingly.

You also have the option to use one row, although that might not be effective enough. At that point, the row would not have enough room for collecting the power that you want to utilize.

Planning the POWERPACK Suitcase Properly

The solar panels you are using in the POWERPACK suitcase will help you with getting the electrical power that you need. The electric setup you used to get the panels active and to produce the right sources for power will also be to your advantage. But you have to watch for how well your PowerPack System suitcase is to be planned out.

The problem with your solar panels is that they will not always work right. The output will decline when it is cloudy. The output will also go away at night. Don’t forget that you are producing 18 volts of DC power when you use the proper example here.

Solar Charge Controller

The greatest concern is that the power in your solar panel is never going to move right to the device you want to power up. The electrical energy in the panel will be used to charge up a battery. The battery will store the electricity needed to get a device powered up. The power will be more consistent at this point.

Your solar panel will be linked to a solar charge controller that is then linked to a battery. The controller charges that battery, but the unit will work off of a 12 to 24 volt DC input instead of something with a 120 volt AC input.

The battery will be charged when the solar panel is secured and gets enough sunlight. The charge controller will also ensure that the battery will not discharge through the solar panel, thus ensuring that the power in the battery will stay active.

Battery

The battery that you will use in question must be made with a surface that is easy to handle. The most prominent type of battery you can use here is a lead-acid battery. Lead-acid materials are designed as cheaper forms of rechargeable batteries.

You would have to use a smaller lead-acid battery for a portable solution. That battery must be sturdy enough to keep the power running, but the battery itself is already heavy as it is.

Also, you have to watch for how the battery can handle a deep cycling process. This effort refers to when the battery discharges more than half of its way. The lead from the plates will fall off and move to the bottom of the battery case. Enough lead can cause the cell to short out while the battery is unable to produce 12 volts of power.

Fortunately, you can use marine batteries for your needs. These are lead-acid batteries used in boats and other small vehicles. These are capable of lasting through various deep cycle routines. There is extra space at the bottom while the plates are also thicker. The plates may be worn from deep cycling, but the plates will have enough lead to allow for a suitable charge. Naturally, these batteries will go bad after a while, but the lifespan of such a battery is longer.

The battery may also include a measurement called cold cranking amps. This is a measure of power in amps that the battery needs for starting up a car's engine. The measure is the highest total of amps that a battery can produce for 30 seconds at 0 degrees Fahrenheit. The battery needs to produce enough amps to help get the car to start up in that difficult condition

Meanwhile, the reserve capacity is a point of note. This is a measure of how long a batter can handle a 25 amp discharge before the battery gets to half-charge. This is the point where the battery is no longer useful. These specifications are made for car batteries.

Small lead-acid batteries are not rated with those two measures. These small units are measured with the number of amp-hours of power that are included. This is similar to the reserve capacity, but the measure refers to the number of amps of power that the battery can produce for an hour.

There is the option for you to look for another type of rechargeable battery outside of a lead-acid model, but your search may end up fruitless. The problem is that newer technologies tend to come on the market at high prices. Lead-acid and nickel-cadmium batteries are cheap because they are commonplace.

But over time, the development of lithium-ion batteries has helped to create lighter batteries that handle better charges and last for a while. Lithium-polymer batteries are also designed with smaller bodies. The changes in battery technology should be noticed, although at this juncture it may be

best to use a lead-acid battery as that is the easiest model for you to utilize right now.

Solar Charge Controller

A solar charge controller is a battery charger needed for taking the 18 volts from the panels and moving it into a suitable source for charging a 12-volt battery. The controller reviews the charge and ensures the battery is not charged for too long. Some controllers may provide you with a display that shows how well the charging process is being handled.

You should see what the capacity for a controller is. The capacity should be strong enough to where you have enough power to work with while being easy to manage in any situation. An amperage rating greater than the total power produced should be chosen for the best results.

A 30-amp controller may work in many cases. A smaller one could also be used if needed.

The controller may utilize a PWM or Pulse Width Modulation or Maximum Power Point Tracking or MPPT process. The MPPT process uses a PV array output voltage to be higher than what the battery bank can handle while not losing power. A PWM controller only regulates the output voltage and not the current. Therefore, the MPPT process will give you more power and stay efficient for your energy generation needs.

A controller may also include a 5V USB outlet. This is not always needed, but this might be useful when you consider how so many electronic devices are charged off of USB ports. The reduced voltage of the outlet is also a plus.

Inverter

The inverter will help you with converting the power you generate into something that you can utilize. You might use a voltage inverter to take 12 volts DC from the solar cells and then convert it to the 120 volts AC that you want. The inverter should work in a set way based on what you want out of

its power, although the size of that inverter will vary based on its maximum output and how long it can sustain an output without wearing out. A 750 watt voltage inverter works best for the situation at hand.

The continuous wattage of the inverter may influence how it works. The wattage is a measure of how much power the device can produce over time without being damaged. This level should be produced consistently so long as you have the battery power for it.

The peak wattage of the inverter is another measure to see. The wattage is the power the unit can output for about 30 minutes without being damaged. This is usually twice the continuous wattage. The wattage should not be drawn for too long or else the unit will overheat and wear out.

Securing the Suitcase

Now that you understand the parts of the suitcase, you can get it all set up.

Add the battery into the case. Use the connectors for the bases. Add the red connectors on the positive base and the blue connectors to the negative. The black connectors go to the solar panels.

You should measure all the connections you will use for your lid. The connections should be planned accordingly to ensure the links are not going to be too extensive.

Get the cable for the link between the inverter and battery and also for the charge controller and battery measured. The cables should be long enough to where a connection can be established, but not tense to where they could break.

Use Styrofoam to stiffen the inverter so the unit will not try to move around.

Prepare a final position for a charge controller. The connection side should be up so it is easy for you to access the content.

Connect the inverter to the battery. Link the red connections with each other and the same for the black ones.

Link the inverter to the socket. Take a cable from a plug and secure an on/off switch for controlling the socket power. Over 12-volt sockets should have enough power added.

You can also get another switch for the sockets if desired, although that might not be needed when the low voltage of the suitcase is considered.

You should see the yellow, brown, and blue wires coming from a plug. The yellow wire is the grounding wire. The brown is the faze, and the blue is the null.

Secure the positive base of the inverter on the positive base of the switch. The other base on the switch should go to the battery. Red cables should be used on both parts.

You must look at the charge controller and then get its connection ready. Always connect the controller to the battery first. Add the panels to the controller after the battery is secured.

Use the icons on the controller to review how well the connections can work. Review the couplings with positive and negative signs to get the controller connected to the battery. Don’t forget that the cables being used should be linked to the right spots depending on the colors being utilized.

Link the proper cables from the controller, switch, inverter, and 12V sockets.

Some sparks may be produced by the battery charge; this should be a natural effect of the process.

These steps should help you with getting the controller to power up and be ready to handle energy. The design will help you quite well with getting the energy you desire for all your operations as you see fit.

Getting the Perfect Suitcase Ready

Now that you understand the effort needed for the POWERPACK suitcase, you have to look at what you can get out of the design. Here's an example of what you can do when finding the right suitcase for the POWERPACK project.

First a UV-stable surface for the case, preferably with a black color that conducts heat well.

Keep the size of the suitcase down. A suitcase that is about 40x30x6.5 cm in size is always helpful. Something about 600 to 700 grams in mass can also be light enough to carry without struggles.

The size in this example should have room for two 10-watt solar panels.

See that the suitcase has ribs on its edges to keep the switches and other items secure. A handle and some locks are also welcome.

Gather the proper materials for the suitcase.

For this suitcase, you will need:

12V DC to 220V AC inverter

The proper batteries. While a lead-acid battery is the easiest to use, you can use a marine battery if possible. A lithium-ion battery may also work, although this might be cost-prohibitive for your task.

Two 10 watt solar panels

A 7A lead-acid battery charge controller

A digital voltmeter

Aluminum composite panels needed for holding your panels together

Diodes to reduce battery voltage to start the inverter. These diodes may be disabled later if you want to save power. This feature may be found in lithium-ion batteries.

The necessary screws, power outlets, and switches you wish to incorporate

After you get these materials, you can continue with the task of producing your POWERPACK suitcase.

Remove the aluminum frames from the solar panels. Do not break the glass surfaces.

Remove any large connector terminals so these can be divided up to be smaller.

Fix the terminals to the aluminum composite frames. You can use a Sika WT40 PU adhesive material to make this work. Test the materials to see how well they can fit in a box.

Add two parallel sets of three diodes in a series. These should help with reducing the top voltage of the pack.

Depending on the batteries you use, you might experience some heat generation. You can add cooling fins to the surface if you want.

Add a bent aluminum sheet out to hold a voltmeter.

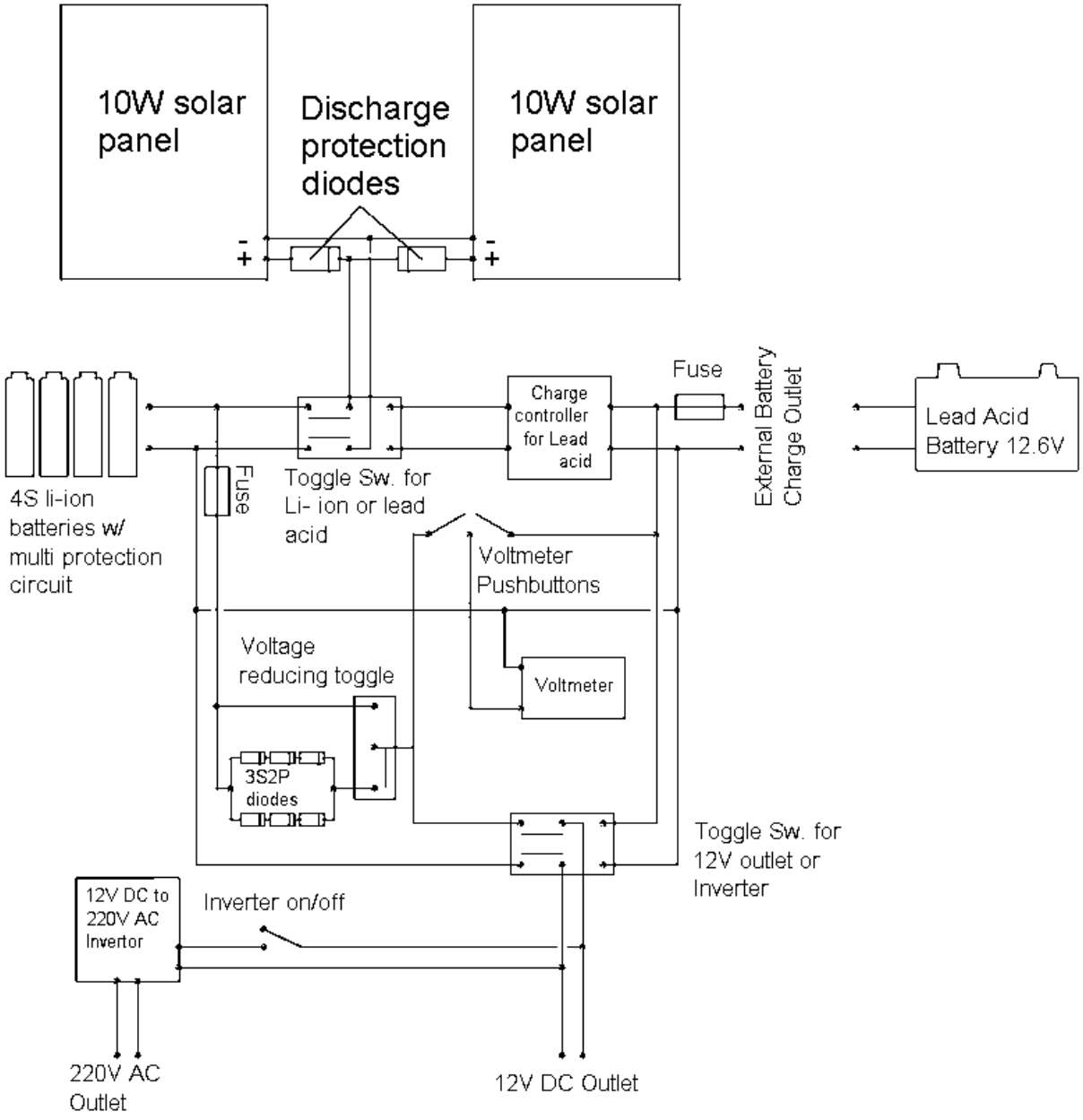
Secure paper labels so you can identify what is on a surface.

Paper labels can be produced by a laser printer. You can cut hose labels to the sizes you want to use. Transparent tape may also be incorporated if those labels do not come with certain adhesives.

Apply double-sided tape and 0.4mm grey PET film for a digital screen.

Remove the outside shell of the inverter to cut down on its size. This is a fully optional choice for your use and may work for when you need to add extra batteries into your suitcase.

Directly power your battery charging port. Review how the batteries are measured.



The overall design should help you with creating a suitcase that is compact and weighs a little under 4 kg. The design can use an extended charging time of about three to four hours and may come with many outputs, including a 220V AC, 12.6V DC, and 5V DC. You can use a USB output if desired too.

The 220V output power should be 100 watts. The car battery charging port should be on the outside and work with a fully automatic array. The batteries must be fused together as well.

The overall setup can cost around $200 in most cases, although the pricing will vary based on the size of the setup and how much power you utilize at a time.

You can also add LED surface lights to the outside if you wish. These lights should not use much power, but you would have to be careful with how these are to be applied.

Testing the Suitcase

You can test your suitcase after you are done with setting it up. You should have a battery at this point that can store energy from your solar panels. The inverter for transforming a 12V source into 110V (220V) should be included as well. A charge controller that moves the flow of energy from the solar panels to the battery should be used as well.

As for the body of the suitcase, this works best when you have a handle for added mobility. You can also check on ports for how the cable will be rolled to panels and how you can apply the surface onto the tripod that you want to utilize. The design should produce a full power grid that is easy to apply and secure. The panels can also be hooked up at an angle so the unit can gather the most possible solar power.

To test the unit, you should look at a USB charger port. A phone can be linked to that charger. You can also test two halogen 10W light bulbs on the setup if desired.

To start, connect the box to the panels and then plus in the bulbs. After that, plug in the phone. You should see that the items will start working and be charged up if the battery has been charged from all that solar energy the unit should have collected.

The design can work with a charge that takes about three to six hours to attain. The amount of time your battery can last for will also vary based on the materials you are using. For instance, you can get four 100W light bulbs powered for about 12 hours at a time.

You also have the option to test a larger appliance, but that appliance should be less than 800 watts in power for you to use this.

How to Add Power To Your Suitcase

You can get more power added to your suitcase if you feel you have a stronger need for extra power. The added power you can get in the suitcase can vary, but that total should be something suitable for your energy and charging needs. You might use the unit to power larger items, but you must have extra capacity for getting this to work to your liking.

The battery is going to produce the power. The solar panels only collect the charge for the battery. The wiring uses the proper mechanics and gears needed to allow the power to be produced accordingly.

Replace the Battery

One way how you can increase the power supply in your suitcase is to replace the battery. You can add a newer battery that is more powerful into your setup. You should buy and install a deep cycle marine battery for the best results. This type of battery can be found at an auto parts store or other similar retailer.

Be advised that a deep cycle battery is rated in reserve capacity, the total that a battery can handle 25 amps of power before the voltage goes under 10.5 volts. The reserve capacity can be from 60 to 240 minutes at a time.

Top posts are often found on a deep cycle battery as well. Some side posts may be included, and adapters can be used on the top posts if needed, although those would require extra work for use.

Of course, the battery in your POWERPACK array might have to be replaced no matter how new or old your setup is. You would have to replace that battery to ensure the setup can generate enough power as you see fit. All batteries can lose their charges after a while even if they have been used for years. Until the day when a battery that can run forever is invented, you will have to consider this point for your work.

Finding a Li-Ion Battery

A lithium-ion or Li-ion battery is a good choice to see when looking to upgrade your battery setup. The design of such a battery is more effective and will add extra power to your setup as you desire.

A Li-ion battery uses male and female connectors. The female works with a voltage charger. The male provides power to a material.

You can get a Li-ion battery charged up quite well while also avoiding data memory loss among other common problems. The design can help you with producing a plan that is easy to handle.

The battery should have enough amps of reserve current, but you should look at how many amp hours are available. To figure this out for an Li-ion battery, multiply the Li-ion amps of reserve current by 0.4167 to get an accurate amp hours measure.

The wires for a Li-ion battery pack are also smaller than what you would find for a larger battery. The voltage inverter should be checked to ensure it does not draw far too much current out of a battery or else the wire will burn. In other words, you might want to use multiple Li-ion batteries to add power and to keep the wires from being overloaded.

The Li-ion battery packs should also have two connectors on their bodies. These connectors are equal to one standard connector, as they link to the same spot in the battery pack. You should cut the longer lead off and use that link to secure the battery packs to each other. The lead that you cut off has to be sealed so a short will be prevented. Heat-shrink tubing can be added onto the end of a wire, heated, and crimped with pliers to create a secure cap.

You don’t have to use electrical tape to secure the ends of the wires. Instead, electrical tape should be used to connect packs with each other.

For the best result, use three Li-ion batteries to add power while keeping the space from overheating. The three red positive leads from your three

batteries should be soldered with each other. Do the same for the black negative leads.ke the red wires slightly longer so they will not short out.

Any exposed wires that go outside the suitcase onto a solar panel should be secured with heat-shrink tubing. This is to keep those wires from being harmed by anything outside a spot.

Again, the battery pack should be linked accordingly to the solar panels in a manner similar to what you used with a lead-acid battery. The Li-ion battery setup needs to connect to a converter and then to the solar panels. The tripod layout for keeping the suitcase easy to set up at an angle should still be utilized to enhance how well the design works and how energy can be collected.

Adding Solar Panels

Another point to use involves adding extra solar panels to your POWERPACK setup. You can add more panels so long as you have enough to match up with the amperage limit on your charge controller. A 30-amp controller works best to give you support on many panels, for instance.

The added panels must be linked in parallel. This allows the wattage to rise while the voltage is the same.

Your battery will charge up faster when you have more panels. But you must see that the cables that link to your power setup are confirmed accordingly.

Upgrading your POWERPACK suitcase can make a difference when planned right. You have many choices to work with when getting an POWERPACK suitcase ready, so be sure you look at how well the setup is planned out the right way.

Making Your Suitcase More Versatile

As useful as an POWERPACK suitcase can be, it is important for you to look at some of the other things you can do with your unit. This chapter will focus on adding different items to make the suitcase a little more functional while especially being convenient for your use.

Voltage Meter

A voltage meter will let you know how much power you have in your battery setup, thus helping you to figure out how well the battery is working. You can use this to identify what you can add to your layout.

The meter may be applied to the terminals on your battery. The meter should give an approximate readout on how much of a charge is included on that battery. Although this added feature is not a necessity, it does help to at least know about how much power is left on one's battery when getting the unit up and running. Having a clear idea is vital to the success of the meter's operations.

12-Volt Power Connector/USB Connector

You can get a 12-volt power connector added to your suitcase to make the setup capable of handling portable devices. Many pieces of camping gear will run on 12V power. You can use the connector to go with any other units on your setup to start powering up more of these mobile items. The best part is that you don't have to worry about any annoying engines or emissions from an engine when getting this ready for your use.

A 12V power connector can be designed with a large round hole. This is similar to the old cigarette lighter features you might have found in older cars, although those lighters have been converted to be basic 12V ports for producing energy for portable items.

On a related note, a USB connector may be incorporated in the setup. The connector drops the 12 volts in the battery to 5 volts, thus helping you

charge up mobile device through a USB link. The design should work for just about every major portable device of value to you.

You should start by installing the components for the suitcase before the wiring is utilized. You cannot install these new ports after you secure the power switch in its place with screw posts.

Start by using quarter-inch slip-on crimp connectors that work with your sockets. Also, 14 gauge wires work best to make it easier for energy to be handled well without the wires being at much of a risk of heating up. But sometimes you might find a 10-12 gauge yellow wire to go with a 14-16 gauge blue wire. Not all setups will offer this.

An added wire may come out from a connection. You can get a wire to come from the last slip-on connector on your black wire and also from the red wire power switch. These two should link to the load connection on the solar charge controller. The voltage inverter power should move past this and get power right from the battery, although the lighter load for connections can work through load lugs on the charge connectors.

With this, the power switch can work with 12 and 5-volt links. The switch can also disconnect the power meter to prevent excess battery drawdown. The voltage inverter can also use a dedicated power switch to shut down the unit when it is not being used.

You can produce the connection and control panel for your setup on the backing board with some screws or foam mounting tape. You might need to use some machine screws and nuts while drilling from the back part of the backing board to install this feature and to keep it secure in a spot.

EMP Shielding

The shielding you add will keep the suitcase from being hurt by a possible EMP attack. You need a secure shield to ensure that the voltage inverter and charge controller and everything else inside your unit will not be at risk of being destroyed.

Plexiglas is ideal for your use as it is a plastic material that can be heated to soften the surface but not to melt it. The plastic material uses a thermoset design where plastic resins are mixed with a catalyst and produced in a mold. The design will be flexible when you heat the material and bend it around the suitcase.

The plastic has to be laid out over the heat and then bent when it is hot. The surface should cool off when in the desired shape. The arrangement will help you with keeping the unit comfortable while ensuring a device will work to your liking. The unit should be large enough to where you can fold it over the suitcase while offering openings for ports and a solar power connection.

Be advised that you might spend hundreds of dollars to get the Plexiglas material ready. You would also need a sizeable sheet that you can bend over the entire body of the suitcase when the plastic surface is heated.

You should use some hinges along the ends of the plastic to keep the material secure. A few half-inch dowel pins may also be applied around the ends to create a firm body that keeps the suitcase covered.

Some scrap Plexiglas materials can also be applied around the outside to produce a firm body around the base. The scrap materials can work to keep the setup under control, although the effort should be handled well.

You can add a few holes into the Plexiglas to allow the material to fit through any connectors that secure the solar panels together. Glue materials should also be included for firmly producing a secure seal all the way around the case. A heat gun may also work along the bend line to produce a firm design that is easy to handle.

You have the option to paint your Plexiglas if desired. The paint can work well, as Plexiglas is regularly made with a clear body to produce an easier setup for installation. Be sure to see what you can get from this design so it becomes easier for you to get a material applied right.

Using Aluminum For Your EMP Shield

While Plexiglas is appealing for your EMP shield, it might be easier for you to utilize aluminum for your EMP shield. Aluminum is a popular metal for how it is light in weight. More importantly, aluminum might be more effective than Plexiglas.

The key here is that the EMP will produce more intense radio waves that have a greater potential. The power could end up hurting any materials that it gets in the way of. But while an EMP is attracted to a metal like aluminum, it is not going to pass through the metal. The EMP is absorbed and conducted by the metal, thus keeping the EMP from moving beyond the metal material and causing damages.

Think of an aluminum case as being like an airplane. Today's commercial airplanes are made with mostly aluminum materials. Even when lightning strikes a plane, the lighting is conducted by the metal, thus moving around the surface and continuing on outward without impacting the plane.

You can use aluminum sheeting that is flexible and capable of moving over your surface if possible. You can also use an aluminum flashing material that is 0.009 inches thick if needed; this is a material similar to what you might find on some peaked spaces on a rooftop.

Your aluminum sheet can be cut just like how you prepared the Plexiglas earlier. But the aluminum will not be as likely to break off at an angle. Watch for how the aluminum is bent from the score and then bend it back and forth a couple of times so the surface can break. The process is conducive for creating a unique pattern that might fit a little better over your suitcase.

What About the Solar Panels?

The solar panels may be hurt by the EMP, but the materials will not be disabled altogether. The solar panels may lose about 5 to 10 percent of their power efficiency. But panels will still produce electricity to keep the power source running accordingly and without struggles. You will still produce electricity out of your panels even after an EMP moves forward. The covering over your setup will ensure that the panels will keep on getting energy out to the battery you wish to use.

Waterproof Cover

The next thing to add to your case is a waterproof cover. The electronics have to be kept from water so they will continue to work in any condition.

You could technically use a plastic bag or poncho to go over the unit while outdoor when it is raining. But it is easy for one of those bags to be burn up and worn out from tree branches and other items. Therefore, a cover that features a sturdy water-resistant fabric would be a much better choice for you to consider when getting the item you want to transport protected accordingly.

The two more commonly utilized types of water-resistant fabrics you can find are rip stop nylon and Arctica. Rip stop nylon is a popular choice for how it has been utilized by the military for years for many items, most

notably for parachutes. The material is also used for tents among other items. The material should not be confused with other nylon-based materials that are somewhat water-repellant but are not as efficient.

Arctica is also noteworthy for how it is a fabric used for rain jackets. The firm body of Arctica ensures that the material can be easy to handle.

Rip stop nylon is much easier for you to find than Arctica. In fact, that nylon material is often cheaper for you to find than anything else. The nylon material is sturdier than anything you might find out on the market, but you should watch for how well you can tear it up so your materials will be easier to work with and handle.

The material that you use can then be prepared in any shape or form you see fit. You have many choices to work with when getting your material aligned and ready for use, but you have to ensure the surface is organized well enough so it will not be hard for you to get the materials you are using laid out and planned to your liking. Be sure you watch for how anything you wish to use is trimmed and prepared so you will produce a firm design that is easy to utilize and does not produce any troubling effects.

Producing a Faraday Protection Cage

You might have all the parts ready for your PowerPack System, but you also need to watch for how well the setup is protected. At this point, you will need a cage for covering the entire setup. This is where the use of the Faraday cage will come into play. The case is vital for seeing that what you want to utilize is secure and ready to be handled in any form you see fit.

A Faraday cage is a container that features conducting items like metal plates or wire mesh. The plates may shield the setup from outside electric fields. This can prevent electromagnetic interference from an EMP or other surface.

The electric field becomes stronger when you are closer to an electric source. The field will work within a particular volume of space to produce the power needed for creating a magnetic connection. The Faraday cage uses a certain volume of space and may come with conductive materials on its body. This is to create a better design for handling electric fields.

Coulomb's Law

There is an important point to note regarding the Faraday cage called Coulomb's Law. This is a law stating that the charges in a conductor while at equilibrium should be as far from one another as possible. The net electric charge in the conductor should also be on the surface of that material.

Any net electric field found inside the conductor can cause a charge to move as the charge is prevalent. But the equilibrium states that the net force in the conductor should be zero. Therefore, the electric field inside the conductor should be zero. This is to ensure that the charges are distinct and separate so the power unit can work.

On a related note, the electric field inside a conductor at equilibrium has to be zero, but the charge in the conductor must also be on the surface or boundary. The conducting volume should move with a charge impacting a

surface field to create a better surface that covers more energy at a time. This is also to prevent outside electrical interference from getting in the way.

A way to notice this comes from an experiment that Michael Faraday, the scientist and namesake of the Faraday box, produced. He dropped down a metal ball that he rubbed onto existing metal sources to produce static electricity and added that ball to a metal bucket on top of a wood chair. The ball moved into the bucket and did not touch the inside walls. At this point, the charges will be moved along through electrostatic induction.

Building the Faraday Cage

The idea of the Faraday cage is a necessity to review. But to make this work accordingly, you have to plan the cage out right to make sure the setup is handled accordingly. You can produce a Faraday cage in a matter of moments for your POWERPACK unit:

Gather a metal box.

Link the inside part of the box with newspaper. Use as much as you can handle.

Wrap the objects for inside of the box in more newspaper. Add those items into the box when you are done.

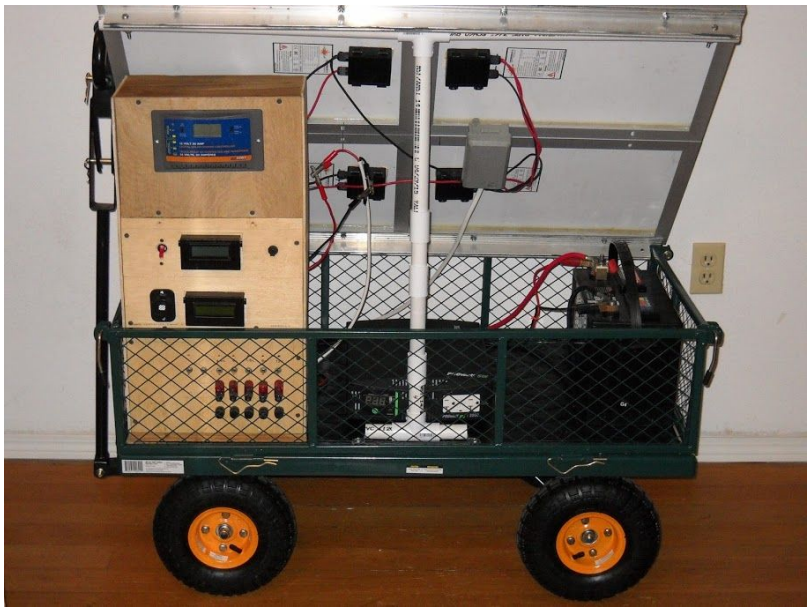
Add more newspaper on top of the items if you have enough space for doing so.

Close the lid and tape the surface shut.

At this point, the box should have a secure space for all your power-generating items.

Setting Up a Power-Wagon

The suitcase that you will utilize will be effective and helpful for a portable need, but you can also produce a solar wagon if you prefer. This is a slightly larger material that you will have to tow with you, although it is light enough to where the material could be towed around on a wagon.



The power wagon in this chapter is a material that is made off of a re-purposed garden cart. The cart features a unique solar panel frame and the necessary solar electronics that you have to utilize. This might cost at least $1,000 depending on how well the design is handled.

Set up the base for the power wagon.

The wagon needs to be planned with a frame on a steel garden cart. The cart will hold your solar panel and your electronics. You can bolt or weld the materials together depending on what you feel is more appropriate for the task at hand.

Gather the proper materials as needed.

You can find various off-the-grid solar items from a website like altestore.com. You can also use that site to get an off-grid calculator to get an idea of how large your setup should be versus whatever you plan on installing.

You can also find materials from a steel and electrical supply shop if you wish. The items you use should be measured based on what you feel is appropriate for your use.

Find the proper measurements for the wagon. Review how the flat bar and metal frame materials are going to fit the wagon and that they are compatible with the solar panel you wish to utilize. The solar panel must also be positioned at an angle based on your location's latitude.

Add an outdoor metal paint like Rust-o-leum onto your wagon.

Bolt your frame to the wagon with some machine screws and lock washers.

The solar panel should be bolted to the top part of the wagon.

This process is being done with the assumption that you are going to use an angle for getting the panel ready. The angle is needed for positioning the panel to where it is more likely to take in the sun's rays without issue.

Check on the electric and mechanical features of the wagon.

Look at the battery; a 12-volt model is clearly ideal for your use. The battery should link to a 60-watt solar panel, although a smaller 20-watt unit may work if you have to. The setup should be paired with a 300 watt inverter and 15 amp charge controller. You can add LEDs and a USB port if desired, but the power being handled should be used accordingly.

Add a bike lock to your wagon so it can remain secure. Part of this includes keeping the material secured well.

This is not so much to keep people from stealing your item so much as it is for ensuring the unit will stay in a secure place while outdoors, particularly a spot where the unit will consistent get the solar energy that it is trying to attain.

Always turn the breakers on the setup off while you are not using it. This is to keep you from draining the battery.

Always use a water-proof material over the electronics.

It is best for you to keep the wagon secure and indoors when it is raining. Either way, you should have a plan for what to do in the event that it starts to rain where you are when you are trying to use the material.

The wagon can be utilized well for powering many small items during any outdoor event, but it will be even better for when you're looking to get energy during a power outage. Again, the lack of any emissions produced by the material will be a huge plan for you to look at.

Points To Consider For Getting a More Powerful PowerPack Ready

While you have the option to get a good suitcase prepared for many small needs, you should consider how well something larger might work. The great news is that a large-scale version of the power box from the PowerPack System can be much greater and efficient for you to utilize than something very small and potentially hard for you to work with.

The design of the suitcase can come with a few extra 12-volt batteries. You can use many of these batteries at once for something like an AC output inverter.

But as you work with producing a larger box, you have to carefully review what you are going to get out of your support system in general. The following points can be used for producing something effective and useful while incorporating more power in the setup in general.

Look at the amp-hours included on the batteries while ensuring you are using the same voltage total for each of those batteries.

Having some extra batteries on handle may help you with producing a stronger box. But be advised that using many of these batteries of the same voltage level would still require in the same voltage, but a different number of amp-hours. Using three 12V/7.2AH batteries will result in the production of a 12V/21.6AH bank.

You will need to reinforce your box to ensure it is stronger in size.

The box will be heavier due to all the added batteries. You need to use metal reinforcements for the design. Also, you might have to use a cart or wagon to pull something with depending on how large the design setup is.

Watch for how the lines on your setup are organized.

Any live lines for your design have to be kept separate from the grounding wires. All grounding wires should be connected to an input plug ground wire to keep the layout secure.

Be advised that when camping, no grounding would be available.

Watch for how you're going to plan a DC panel.

The DC panel should feature a UPS board that includes a fan to help you with keeping the heat in the area down. This is especially for when you're going to plan an Uninterruptable Power Supply or UPS board that may come with the electronics you are using for the setup.

Add the grooves to the bottom part of the box to allow wires to safely move through. The wires may go along with the said grooves.

A good idea is to use a double-sided adhesive tape material. You can use this on the bottom part of each battery while including some plastic ribbons for added security along the surface. The key is to keep the materials from moving around inside the box as you try to use it.

The assembly should include several items like two plastic spacers to identify the polarity of each item used in the case. This is to identify the voltages and power features being handled.

Add a plastic cap on each of the poles to keep them from being shorted.

Add a solar regulator on the external connectors. A solar panel may help you with recharging the power bank when used.

You also have the option to add even more batteries to the setup if you prefer. But again, the batteries work best when they are of the same voltage and possibly an identical size.

See if you can add a panel voltmeter. This would require a separate power supply of nine volts. A 9V battery may be appropriate for this situation.

Look for LEDs that can display lights showing what is happening with your connection.

An LED may come with three light colors. A green light shows when a material is working. A yellow light may also show when it is loading. The red can work when the battery voltage gets too low or when there is an AC overload in your setup.

The effort you put in for making your PowerPack System unit more powerful should be analyzed well based on what you plan on producing within your setup and that you have a decent idea for what you wish to utilize.

USING YOUR POWERPACK SYSTEM - APPLICATIONS

Here are some clever ways you can use your PowerPack System:

The PowerPack Unit and The PowerPack Box:

You can easily combine the PowerPack unit with you PowerPack suitcase/box/wagon such as when you are on the move the PowerPack unit will create energy by capturing the movement.

You can also place the PowerPack unit into a backpack when you go on your trips so you can have energy on demand.

The PowerPack Suitcase And The Wind

You can unfold your PowerPack suitcase and put it on a shaft, much like a wind turbine. Then you can place a fin at one end so it will rotate depending on the wind direction. The PowerPack unit will capture the rotation in either way and transform it into electricity.

The PowerPack Unit and The PowerPack Wagon

Obviously you can upgrade you PowerPack Wagon and add the PowerPack unit on it. While you are on the move the PowerPack unit will capture the chaotic movement and transform it into electricity.

The PowerPack Unit and Water Power

The PowerPack unit will work perfectly as an wave/stream power generator. You'll need to enclose the PowerPack unit into a waterproof housing and then just throw it into the stream of water near you and let it do the job. It works just as well for tidal energy.

Transforming the PowerPack unit to capture up and down movement

With just some simple modifications you could transform your PowerPack unit into a railroad/road movement capturing device. Well if you live near a busy road you can use the modified PowerPack unit to capture the energy of passing cars.

The PowerPack wind unit

You could use the PowerPack unit to create a special vertical windmill that will capture winds energy more efficiently than any ordinary windmill. Instead of capturing the wind energy horizontally the vertical blades will capture the wind's changing direction. Another option is to create some special blades that create a "8" like movement twisting a shaft from left to right around its axis. Then attaching the PowerPack unit to that shaft will allow the unit to capture the pendulum like movement and convert it to electricity.

Conclusion

The POWERPACK System is one of the most outstanding solutions you could ever utilize for your energy needs. While you can call it an POWERPACK case, suitcase, box, array, or project, the same outcome will come about when you use this power system. The design will utilize energy that is easy to manage and will not produce any difficulties over how you are able to get the power that you demand for any intention.

It will be easier for your home to be self-sufficient when you use a renewable energy source. But even more importantly, you can use this while on the go. The material can be used as a portable source of energy that is safe and easy to handle.

The most important thing though is to ensure that you use a proper plan for getting your POWERPACK unit ready. You can use this to create clean and free electrical power, but this only works when what you're going to use is handled right. You have to ensure your design is organized accordingly and that you are capable of managing the costs associated with the project without struggles. You have to look at the costs based on what you will be purchasing while also looking at the mechanisms available.

The panels used and the conversion process needed for generating energy off of solar power should be planned properly based on what you are gathering and how your setup at large will work. You can use this to save money on your power-generating needs even if you're only going to use that new power source for a limited time.

It is important for you to see how well this setup can be planned out. Today's power sources have become increasingly difficult to work with. There is no way how you can be ensured a secure power source every day. Also, power costs are only going to keep on rising in value, thus making it possibly harder for you to get things done right and without struggle. But the good news is that the PowerPack System will assist you with producing consistent energy and making it all work right the first time around.

The best part of working with the POWERPACK task is that it entails peace of mind every time you handle it. The effort is worthwhile as you will invest just a brief bit of time and money to ensure you will have power that can last for as long as needed provided you have a proper solar energy source.

With so many people being heavily reliant on electricity these days, it is no wonder why so many are looking for ways to get the power that they need during various emergencies. Having a power source on hand is a must for ensuring you are protected and that you will not be at risk of harm for any reason. Good luck with getting your unique PowerPack System ready so you can get all the power that you need for any purpose.

WHERE TO FIND THE MATERIALS

Here is the list where you can find the most important components for this project:

For Solar Panel Battery Charging Controller Regulator

a. Ebay.com

b. Ani.SolarShop

c. Mlsolar.com

d. Ebay.com

For Battery (AGM 80A – the one we used). Here are similar items with similar characteristics:

a. Solarpanelstore.com

b. Wholesalesolar.com

c. Amazon.com

d. Acosolar.com

For Solar Panels:

a. Mlsolar.com

b. Ebay.com

c. Solarpanelstore.com

d. Solarxxl.com (for Europe clients)

e. Enjoy-solar.de (a good kit)

f. Acosolar.com

For Inverter 110/220-12v:

a. Amazon.com (a double sized version from one used in the videos).

b. Eco-worthy.com

c. Ebay.com (for upgrades)

d. Solarxxl.com (identical with the one we used)

For 110/220v Panel Mounting Socket:

a. Alliedelec.com

b. Aliexpress.com

For 12V Auto Socket

a. Amazon.com

For USB Socket:

a. Amazon.com

For ON/OFF switch:

a. Amazon.com

For Terminal Connectors (on the cables):

a. Eco-worthy.com

For Panel connectivity:

a. Solarpanelstore.com

b. Ani.solar Shop

For tripod sustaining panels:

a. Dynamitetoolco.com

b. 12voltsplus.com

For our Australian customers we can recommend you this site:

https://www.solaronline.com.au/

For all the other components, we recommend you General / Local Shops.

In order to cut your acquisition bill we recommend you to follow these steps:

- Decide the scale of your system according to your needs;

- See if you can find items like batteries, invertors' cables on General Shops or even second hand shops. If you buy anything from a second hand shop, make sure that you receive what you asked for and also a test for the device would spare you for further problems.

- Follow our guides as much as you need in order to complete your device.

Thank you for your time and trust. If you have questions, we'll be more than happy to answer them on the support address, and will reply as fast as possible.

APPENDIX – Metric To AWG Wires

AWG Number	Ø [Inch]	Ø [mm]	Ø [mm²]
6/0 = 000000	0.580	14.73	170.30
5/0 = 00000	0.517	13.12	135.10
4/0 = 0000	0.460	11.7	107
3/0 = 000	0.410	10.4	85.0
2/0 = 00	0.365	9.26	67.4
1/0 = 0	0.325	8.25	53.5
1	0.289	7.35	42.4
2	0.258	6.54	33.6
3	0.229	5.83	26.7
4	0.204	5.19	21.1
5	0.182	4.62	16.8
6	0.162	4.11	13.3
7	0.144	3.66	10.5
8	0.128	3.26	8.36
9	0.114	2.91	6.63
10	0.102	2.59	5.26
11	0.0907	2.30	4.17
12	0.0808	2.05	3.31
13	0.0720	1.83	2.62
14	0.0641	1.63	2.08
15	0.0571	1.45	1.65
16	0.0508	1.29	1.31
17	0.0453	1.15	1.04
18	0.0403	1.02	0.823
19	0.0359	0.912	0.653
20	0.0320	0.812	0.518
21	0.0285	0.723	0.410
22	0.0253	0.644	0.326

23	0.0226	0.573	0.258
24	0.0201	0.511	0.205
25	0.0179	0.455	0.162
26	0.0159	0.405	0.129
27	0.0142	0.361	0.102
28	0.0126	0.321	0.0810
29	0.0113	0.286	0.0642
30	0.0100	0.255	0.0509
31	0.00893	0.227	0.0404
32	0.00795	0.202	0.0320
33	0.00708	0.180	0.0254
34	0.00631	0.160	0.0201
35	0.00562	0.143	0.0160
36	0.00500	0.127	0.0127
37	0.00445	0.113	0.0100
38	0.00397	0.101	0.00797
39	0.00353	0.0897	0.00632
40	0.00314	0.0799	0.00501