Tl;dr…
So let's get straight into it:

- If you want to run appliances, devices, and lighting in your campsite – you'll need a deep cycle battery. It's not recommended to use your vehicle's starter battery.
- To keep your drinks cold, you'll need to connect your fridge to a battery – which will also need to be connected to a charging system i.e. a solar panel or running vehicle. You can't skip the battery part, it needs to be in the system.
- There is some basic arithmetic you can use to work out how much battery power you need to power your devices, and how much solar or vehicle power you need to keep that battery topped up.

With a bit of knowledge, you'll be powering your campsite in no time! Image: Hard Korr

Common Questions About a 12V and Solar Setup:

- 'What size battery do I need to run your fridge – and how long will it run for?'
- 'How do I connect my solar panel to my fridge?'
- 'How many solar panels do you need for a caravan?'
- 'Can I run my fridge from my car's starter battery?'

All valid questions that we receive almost every day from customers starting out with 12V and solar power. The information below answers all these questions, so by the end you'll be armed with enough knowledge to label yourself a 12V ninja!
But first…

Solar panels are a key part of your setup. Image: Hard Korr

The Difference Between Volts, Watts and Amps

These are the three electrical ratings you'll find stamped on the compliance stickers of electrical appliances.
You'll need to understand the basics of these three ratings, so here's a quick analogy:

> *A battery (volts) forces an electrical flow (amps) through a cable, which produces power (watts) to run a device.*

For the purpose of this article, all you really need to know is:
Volts (V) – 12V is the amount of force your car battery and alternator delivers
Amps (A) – Think of this as the volume of electricity the battery is pushing through a cable.
Watts (W) – A measure of power that is easily converted to Amps with the following formula:
Watts ÷ Volts = Amps
Amp-hours (Ah) – Calculated by multiplying Amps by hours to represent consumption over time. Deep cycle batteries have a rating that specifies how many Amp-hours (Ah) they

contain.

What's Needed for a 12V Solar-Charged Setup?

There are three components to a basic 12-volt solar-charged setup:
1. The devices you want to run
2. A battery to power the devices you want to run (generally a deep cycle battery)
3. Something to charge the battery that is powering the devices you want to run
You can't skip Step 2; you need a battery in your system! You'll also need a solar controller between the solar panel and battery, to regulate the charge going into the battery. These are generally integrated into or form part of the wiring that came with your solar panel.

The factory-installed cigarette outlet isn't heavy-duty enough for high currents. Image: Companion

Can I Run These From a Factory Cigarette Outlet in my Car?

Good question!
Factory-installed cigarette outlets are often made with lightweight housings and cables that won't handle high currents, or even medium currents, for long periods without becoming hot. These outlets are often rated to handle a maximum of 120W or 10 amps (using our formula from earlier: 120W ÷ 12V = 10 Amps) at any given time, and are also generally only powered when your vehicle is on. This has them useless at the campsite.
They are also wired to your vehicle's starter battery, which leads us to our next common question…

How Long Will my Fridge Run From my Vehicle's Starter Battery?

Not nearly as long as a deep cycle auxiliary battery or power pack will!
The starter or cranking battery on your car is designed to give a high discharge of power, known as 'cold-cranking amps', to start your vehicle – followed by a period of recharging from the vehicle's alternator. A deep cycle battery, however, is much happier with a prolonged and slow discharge.
Whilst you could power your fridge for short periods from a cranking battery, we recommend only doing so whilst your vehicle is running – otherwise, you'll potentially be calling for road service.

A battery box is an option that you have. Image: Hard Korr

Is the Best Solution to Install an Auxiliary Battery or Use a Portable Power Pack?

In this article, I will refer primarily to a portable power pack, but the basics are the same for both of the following setups.
A portable power pack is generally not dependent on a vehicle, so you can locate your solar panel and power requirements wherever you need it i.e. in a tent or camp kitchen. This is versatile and ideal if you don't have space for a second battery under the bonnet.
Another option is to install a second or 'auxiliary' deep cycle battery into your vehicle, where you use your vehicle's alternator to charge the battery. This hard-wired setup is ideal for those on the move every day. It can also be beneficial for those wanting to stay in one location for a period of time as it facilitates batteries with larger power storage – but you'll probably need to include solar charging in your setup.
Setting up an auxiliary battery in your vehicle requires a little knowledge if you are doing so by yourself. Alternatively, an auto electrician can install one professionally for you.

If you don't have space for a second battery, a portable power pack might work for you. Image: Goal Zero

How do I Work Out my 12v Power Requirements?

Grab yourself a notepad and pen, and write down all the Amp ratings for each of the appliances you want to run in your campsite – converting watts to Amps with our formula from earlier.
Let's assume (I'm making up figures here) you want to run a 12V fridge rated at 2.7A max, and two camping lights each rated at 0.6A.
With all of these appliances running non-stop, they will be consuming 3.9 Amps. (2.7A+0.6A+0.6A = 3.9 Amps).
Consider though, that your lights will only be consuming power for a few hours in the evening and your fridge will only consume power whilst its compressor is running, which will be cutting in and out to maintain temperature.
So – hourly power consumption will, for the most part, be far less than the maximum. It will also vary over 24 hours, depending on the time of day, ambient temperature, and how often you open your fridge.
Let's look at three different times of the day. Just as a disclaimer, I've made up the figures below for the sake of simple calculations:

Daytime – Fridge Only

Daytime running fridge only: 7am-5pm = 10 hours
Estimate that fridge cycles: 15 mins on/15 mins off = 30 mins/hour = 2.7/2 = 1.35 Amps
Total consumption over 10 hours = 13.5 Amp-hours

In the day, with just your fridge running.

Evening – Fridge and Lights

Evening running fridge and lights: 5pm-9pm = 4 hours,
Estimate that fridge cycles: 10 mins on/20 mins off = 20 mins/hour = 2.7/3 = 0.9 Amps
Camping lights: 0.6A each = 0.6A x 2 = 1.2 Amps
Total consumption of 2.1 Amps over 4 hours = 8.4 Amp-hours

In the evening, with both fridge and lights in use.

Nighttime – Fridge Only

Nighttime running fridge only: 9pm-7am = 10 hours
Estimate that fridge cycles: 5 minutes on/25 minutes off = 10 minutes per hour + 2.7/6 = 0.45 Amps
Total consumption over 10 hours = 4.5 Amp-hours

At night, with just your fridge running.

If we now add the daytime, evening, and nighttime consumptions together, we get our total approximate consumption for the full day.
Total: 13.5 Amp-hours + 8.4 Amp-hours + 4.5 Amp-hours = 26.4 Amp-hours

What Size 12V Battery Do I Need?

The standard Sealed Lead Acid (SLA) or Absorbed Glass Mat (AGM) batteries, which are the most common and affordable portable deep cycle batteries, are rated to 44 Amp Hours (44 Ah). An in-vehicle or hard-wired setup is often around 100 Ah.
But, these batteries can only be discharged to 50% of their rated capacity, which gives you 22 Ah of usable power if we use a 44 Ah battery as an example.
Given that, in our example above, our appliances are consuming 26.4 Ah over 24 hours – giving us less than a day of power from a 44 Ah battery, and a little under 2 days out from a 100 Ah battery. So, we need some way to charge the battery after these timeframes.
A lithium battery, however, will give you more usable power and a longer lifespan at approximately half the weight, albeit at a higher price tag. There are different lithium battery chemistries with LiFePo4 being the most common for 12V deep cycle applications. These batteries offer 75-80% of their rated capacity for use meaning a 100 Ah lithium battery would give us 3 days of power in our example above.
Note that these figures are never exact. There are inefficiencies that need to be allowed for, so use these calculations as approximations.

Solar panels will keep your battery charged. Image: Hard Korr

How Can I Keep my Battery Charged Up?

If your battery is hard-wired to your vehicle's charging system, driving your vehicle every day will keep your battery topped up. Plus, if you've also got solar panels hooked into your vehicle setup, you're as good as 'set and forget'.

If you're using a portable power pack, you'll need to plug it into your vehicle's charging system whilst driving – or, if you are staying at camp for the day, you can use a solar panel. Solar panels are generally rated in Watts; the higher the wattage, the quicker they charge your battery. They are not perfectly efficient at converting the sun's rays into power, so we need to factor in a rough figure of a 20% inefficiency rate.
Each battery type has a different charge profile and you need to match your solar controller or DC charger to the battery type. You can't, for example, use your cars alternator to directly charge a lithium battery, you will need to use a lithium compatible DC-DC charger in your system, which will add cost but will also improve the charge of your battery. Thankfully, many solar and DC chargers are now being produced to charge all battery types but it is worth double checking.

Use the formula to figure out how to keep your battery charged.

Let's Do the Maths

Referring to the diagram above, let's assume you have a 120W solar panel. If we go back to our formula again and divide watts by volts, this gives us 10 Amps (120W ÷ 12V = 10A). If we factor in our inefficiency rate of 20%, we are down to 8 Amps that your solar panel is delivering to the battery (10Amps – 20% = 8Amps).
But remember, our fridge is still consuming 1.35Amps from the battery at the same time. The rate at which the battery is actually being charged in this scenario is the difference between input amps and output amps, which in this case is about 6.65Amps (8A – 1.35A = 6.65 Amps).
A solar panel is only going to deliver charge during the sunlit hours, and not in the shade – so let's assume that we chase the sun all day by moving the solar panel around, and acquire 8 hours of sunlight.
So, at 6.65 Amps for 8 hours, a 120W solar panel can potentially deliver 53.2Ah of chargeback into our battery (6.65Amps x 8hours = 53.2Ah). This is far more than the 22 Ah we need to charge a depleted battery.
If we work backwards, we can work out roughly how many actual hours of sunlight we need to charge a 50% depleted battery whilst our fridge is still running, by dividing the charge needed by the consumption.
22 Ah ÷ 6.65A = 3.3 hours approximately, to reach full charge whilst your fridge is running.

Make Allowances for Overcast Days

The angle of the sun and the atmosphere impact the amount of sunlight reaching a solar panel, and reduce the output. In reality, if your solar panel is in full sun for 8 hours, you are likely only acquiring 4-6 hours of it's potential capacity per day. Furthermore, the output of the solar panel may be reduced to almost nothing on cloudy days, so it's worth ensuring you have a few Amp-hours in reserve.
Long story short, in the above situation, if the weather is clear and sunny and you are chasing the sun with your solar panel each day, you'd theoretically be set to stay in the one spot for as long as you want. If you are relying on your vehicle, charge times will be much

less, given a vehicle's alternator generally delivers a much higher current. You can usually find details on your alternators Amp output in your vehicle manual.

Once your 12V system is set up, it will serve you well. Image: Hard Korr

One Last Thing to Note…

Solar and your vehicle's alternator don't always deliver a full charge in the same way a good 240V battery charger can. So, it's worth hooking them up to one of these and giving them a full charge once every 6-12 months.

That may seem like a whole lot of information, but in reality it's just the basics. There's a lot more to learn when it comes to setting up a 12V system in your vehicle.

For now though, at least you can ensure your drinks stay cold!

Ben and Lauren discuss powering up at the campsite early on in Season 1 of the Snowys Camping Show:

How long has it taken you to come up with your ideal 12V power setup?