# What are 'Peak Sun Hours'?

**What does '3 peak sun hours' mean? And how do you understand it in a way that helps you choose the right kit? Here's a full explanation!**

Going off-grid with solar means becoming well-versed in understanding the sun. On our DIY solar power kit pages, we reference peak sun hours - estimating power generation in relation to them and what that can run. We wanted to demystify how to understand peak sun hours, NZ averages, and the calculations you'll need to properly plan [which kit is right for your needs](#).

We get pretty technical in the article, so get in touch with us if you'd like us to do the maths instead.

### What are peak sun hours?

A peak sun hour (PSH) is not simply an hour with direct sunlight – it is a way of measuring the *intensity* of the sunlight across the course of the daylight hours. A PSH is equivalent to one hour in which the sunlight (aka solar irradiance) reaches an average of 1000 Watts of energy per square metre – 1000W/m2 of solar irradiance for an hour. Using this allows us to give more accurate estimations of the kit's performance.

1000W per square metre is a lot of sunlight, and that intensity of sun is likely to only occur at the height of the day.

It is also the standard which solar panels are measured against in the lab - meaning that over the course of a PSH, a panel appropriately pointed toward the sun should be producing close to its specified rating. E.g., a panel rated at 385W should produce close to 385Wh of power (before system losses) when the solar irradiance is 1000W/m2, and will produce *less* than 385Wh during times in which the solar irradiance is less than 1000W/m2.

Need help understanding the technical terms? [Read our jargon breakdown here.](#)

### How is a peak sun hour used to measure sunlight in a particular location?

Peak sun hours can also be used as a cumulative measure of the sunlight across the whole day.

The sun doesn't shine at the same intensity as a PSH all day, and it fluctuates in intensity depending on both the time of day and the weather. For example, the sun might shine at the intensity of 500W/m2 in the morning and afternoon, and during midday on a very clear day it may even shine as intensely at 1100W/m2.

So, if 1 PSH = one hour in which the solar irradiance is 1000W/m2 then:

- One hour during the morning receiving an average of 500W/m2 of sunlight is equivalent to 0.5 PSH.
- One hour at midday that receives an average of 1100W/m2 of sunlight is equivalent to 1.1 PSH.

**So, what does that look like over a whole day?**

**Say we compared a log of the solar irradiance during an average day in January to an average day in July at the GridFree office in East Auckland, with the panels facing north and tilted to their ideal angle - it might look like this:**

| Hour | Hourly W/m2 Jan | Cum. kWh/m2 Jan | Hourly W/m2 July | Cum. kWh/m2 July |
|---|---|---|---|---|
| 5am | 10 | 0.01 | 0 | 0 |
| 6am | 51 | 0.06 | 0 | 0 |
| 7am | 184 | 0.24 | 6 | 0.01 |
| 8am | 341 | 0.59 | 76 | 0.08 |
| 9am | 485 | 1.07 | 277 | 0.36 |
| 10am | 609 | 1.68 | 387 | 0.75 |
| 11am | 701 | 2.38 | 443 | 1.19 |
| 12pm | 732 | 3.11 | 460 | 1.65 |
| 1pm | 701 | 3.81 | 421 | 2.07 |
| 2pm | 635 | 4.45 | 355 | 2.43 |
| 3pm | 510 | 4.96 | 255 | 2.68 |
| 4pm | 357 | 5.31 | 125 | 2.80 |
| 5pm | 195 | 5.51 | 4 | 2.81 |
| 6pm | 55 | 5.56 | 0 | 2.81 |
| 7pm | 10 | 5.57 | 0 | 2.81 |
| **Total** | **-** | **5.57 PSH** | **-** | **2.81 PSH** |

As you can see, the day in January received 5.57Wh/m2, and the day in July received 2.81Wh/m2. This means the Jan day had 5.57 PSH, and the July day had 2.81 PSH.

Knowing these numbers means you can calculate the expected energy production for your location. Keep in mind this is historical data used to make averages and predictions, and isn't necessarily an accurate reflection of what exactly will happen.

**How do you calculate energy production from peak sun hours?**

This is a really simple calculation – you simply add up the Watts of your solar panel array and multiply that by the number of PSH. So, if we have just two 400W solar panels set up on that Jan day, it's 800W x 5.57h = 4456Wh. This can then be used to estimate what you can run. You can learn more about that here.

**Why do we base our estimates for what you can run on "3 peak sun hours"?**

We base the estimates provided for our kits on the expectation that the solar panels will capture at least 3 PSH a day, for at least 80% of the year. We've chosen this number because, based on 5 years of data from NIWA, New Zealand is expected to receive 3 or more PSH for approximately 301 days in a year - which is just over 80%.

This is a prediction for the whole country, and many places in New Zealand can expect an average of 3 PSH a day over the winter months, although some areas such as Invercargill might average much less – closer to 2 hours per day over the same time. As it is a prediction of averages, you should also expect that some days will have more sun and some days much less sun.

**Things to consider:**

Those PSH estimates and panel ratings are based on the solar panel being at the ideal tilt and direction to capture sunlight, and this is not always possible.

In New Zealand, it's best for solar panels to point due North to maximise power generation. Anything greater than 20 degrees away from North will have a significant impact on power generation, so if you're not able to point your panels north, you won't be able to maximise your power generation.

A common situation for our customers is that their building is not facing north, so they will either add more panels to compensate (if they are mounting the panels on their roof), or they will switch to a ground mount so they can install it facing north.

Panel tilt can be a little trickier. Because the sun is not at the same height in the sky year-round, the ideal tilt for solar panels is different across the year, a compromise will have to be made when setting up panels. This is why you will hear some people mention solar trackers, in which panels move and track the sun to get the absolute maximum amount of solar possible - it is also much more complex and expensive.

Many people choose to simply set the panel tilt to the ideal for winter – that way you can maximise the solar collection when there is less available, and in summer it's not as essential to have it optimised. Some people will change the tilt of their panels twice a year to optimise for summer and winter.

Read more about tilt and angle.

**What might your solar panel tilt look like?**

We used NIWA's SolarView tool to collect these predictions of the average PSH per month for the GridFree office, facing due north using both 27 and 52 degrees of tilt (summer and winter Auckland ideals). As you can see, the higher angle helps collect more sun over winter but gets less in summer.

| Month | Summer Angle (27) Cumulative kWh/m2 | Winter Angle (52) Cumulative kWh/m2 |
|---|---|---|
| Jan | 5.57 | 4.88 |
| Feb | 5.16 | 4.69 |
| Mar | 4.73 | 4.48 |
| Apr | 3.72 | 3.68 |
| May | **2.90** | **2.96** |
| Jun | 2.46 | 2.54 |
| Jul | 2.75 | 2.81 |
| Aug | 3.41 | 3.35 |
| Sep | 4.11 | 3.88 |
| Oct | 4.68 | 4.25 |
| Nov | 5.10 | 4.47 |
| Dec | 5.24 | 4.54 |
| **Total** | **49.83** | **46.53** |

**How do peak sun hours change across the country?**

Peak sun hours tend to increase the closer you are to the equator, so Kaitaia will always get more sun than Invercargill. However, it's not a smooth gradient change from North to South – Wanaka for example gets quite high levels of sun. The lower elevations of the country also tend to catch more sun, while the mountains don't.

You can get an idea of how solar irradiance changes around the country by looking at the map at the end of this document.

**How can you find expected peak sun hours for your location, and your ideal tilt?**

You can use NIWA's SolarView tool to predict an average of your PSH for your location. Simply search for the address where the solar panels will be installed, add in the tilt of the solar panels, add in the direction or bearing of the panels (if it's not due north), and click Create SolarView. You can then jot down the numbers from each "(Month) 23.00" row in the Cumulative kWh/m2 column to give you your location's version of the tables we've shared above.

You can also adjust the panel tilt number to see what angle is optimal, or use this guide.

**How do you use these numbers to choose a kit?**

Peak sun hours are a convenient measure of how much power your solar panels can generate, so now that you know roughly how much sun you can expect in your area, you can work out how many solar panels you need to suit your location.

If you know how much power you need to generate, you can use this figure to see how large your solar array will need to be to make that work with your sun hours. If you're not sure how much solar you need, you can use this article to work it out.

If you need to generate 4000Wh a day to support your power use, you can then divide that by the PSH. If you're willing to use a generator to get through days with low sun, you can take the amount you expect to get for at least 80% (or ~300 days) of the year – for us that would be 2.96, the lowest number if we take out the ~60 lower sun days in June and July.

So 4000Wh/2.96h = 1351W. That means we need a solar panel array that is at least 1351W. You then divide that by the size of your panels to know how many you need – if we use 385W panels then the calculation is 1351/385= 3.5, so we would need a minimum of 4 solar panels.

Alternatively, if you know that our suggested "What can this kit run?" items look pretty accurate to your intended power usage, you can work from our estimates.

For example, the Bach Kit is estimated to generate a little over 4,500Wh with 3 peak sun hours – 4x 385W panels = 1540W x 3 = 4620Wh. We base our power usage estimates on consuming 80% of that generation (to allow for losses and wiggle room), so that would be about 3600Wh of power use.

**What do I do if my area has less peak sun hours than the average?**

If, for example, your area only gets 2.3 PSH for 80% of the year, you would input 2.3 in the above calculation. 1540W x 2.3 = 3542Wh. This is about 75% of the generation, and we would estimate you could then only support 2830Wh (3542x0.8) of power use for ~300 days of the year without needing to run the generator – that's the equivalent of removing a fridge from your power use.

In this case, you could either jump up a kit size, add panels, or use the generator more – just as you would do if your panels weren't able to face north or have the ideal tilt.

If you went up to [the Freedom Kit](), which has 8 panels, the calculation is 8 x 385 = 3080 x 2.3 = 7084 x 0.8 = 5667Wh of power use supported.

If you added 2 panels (panels must be added in sets of 2 for the Bach Kit) the calculation is 6 x 385 = 2310 x 2.3 = 5313 x 0.8 = 4250Wh of power use supported.

There are pros and cons to both approaches.

Adding 2 or more panels will make it easier to charge your batteries when there's less sun, but you won't have extra storage to make use of it when the sun isn't an issue.

Going up a kit size means you will generate a lot more power and (if your power usage doesn't increase) you will be discharging the battery bank less, but you will still have the same amount of generation relative to your battery bank, so it will charge slower than having more panels. It also typically allows for more leeway and easier expansion should your needs increase in the future.

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Hopefully you're feeling more confident in your understanding of peak sun hours, NZ averages, and how you can use that to size your solar power system. If you're not sure what the right option is for you, or you need any help with the calculations, we're happy to offer advice!

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## Learn More:

To learn more about off-gridding, especially solar, make sure you check out our knowledge base at: https://gridfree.store/blogs/how-to-articles/

Check out solar power options, from individual components to complete kits, on our website: https://gridfree.store/collections/complete-off-the-grid-solar-kits

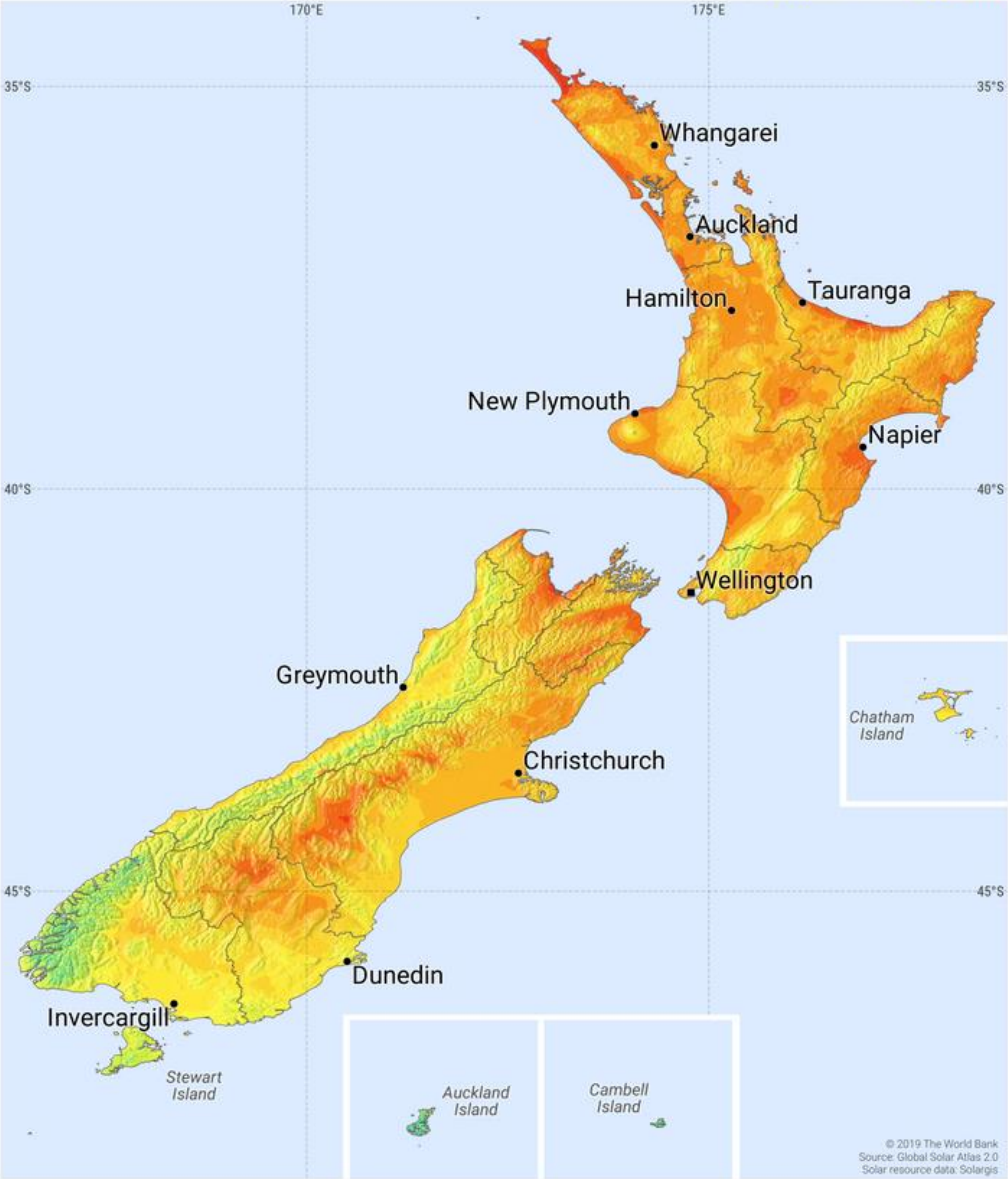
SOLAR RESOURCE MAP

# GLOBAL HORIZONTAL IRRADIATION

## NEW ZEALAND

WORLD BANK GROUP

ESMAP SOLARGIS




Long term average of GHI, period 2007-2018

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|---|---|---|---|---|---|---|---|---|
| Daily totals: | 2.0 | 2.4 | 2.8 | 3.2 | 3.6 | 4.0 | 4.4 | kWh/m² |
| Yearly totals: | 730 | 876 | 1022 | 1168 | 1314 | 1461 | 1607 | |

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