SunSynk System Mode Setup
Strategy for
Minimal Grid and Maximum Solar Use

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This document is an insight as to how I set up my solar system to maximise the free solar energy I generate, and to minimise my need to use expensive grid energy. Each household/business has different profiles and needs, and the intention is to provide insight and understanding so that you can setup your own system accordingly

Core Setup

This is a setup based on the perfect environment with no threat of loadshedding or grid failure. Use of solar during the day, use of stored solar in the battery through the night, with a chance of having to use the grid in the late early morning hours if the battery is not large enough to make it through the night. It will form the core setup to which loadshedding/grid failure strategies can be added

The Sunsynk will blend electricity from different sources and the sources are chosen in priority of solar, battery (if settings make it available), and finally grid. If a source is unable to meet the demand, the shortfall will be supplemented with the next source that is available. In the early morning as solar begins to ramp up, as solar increases, so does the battery supply decrease to only provide the difference to the house load

A LiFePo4 battery can be fully discharged with no damage
Not going lower than 10% (90% DOD) is the normal requirement to meet the 10 year warranty or 4000 cycles (10 years)
Not going lower than 20% (80% DOD) is the suggested requirement to meet the extended life of the battery of 6000 cycles (16 years)

System Mode setup should be viewed NOT as how high you want the battery to charge, but how low you are willing to take the battery SOC ensuring you have enough left for emergency situations

The battery will automatically be charged up to 100% by any excess solar that is not being used by the house demand. There are no settings needed to make this happen

In my opinion there is no need to have HIGH SOC values during the day when solar can supply the house load and will also charge up the battery anyway

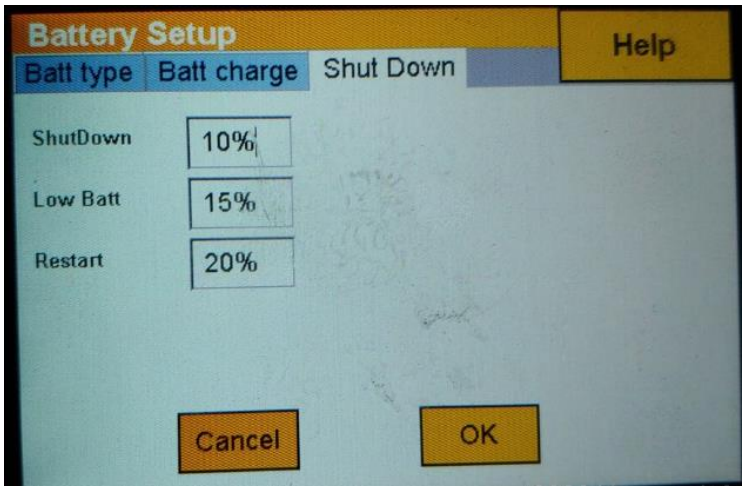
View it as the fuel tank in a car :

Battery Shutdown : 10% = End of Reserve Tank (Emergencies)
System Mode SOV/V% : 20% = Empty (How far you can take it without any issues)

You fill up and drive until you reach the end of the tank

You do not keep filling up when you reach ¾ tank, or fill up, drive around the block and fill up again

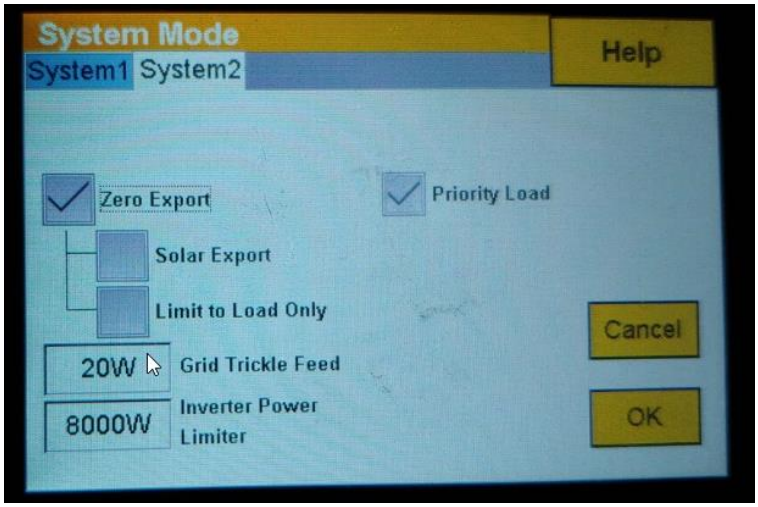
If you are driving where there may be a shortage of fuel stations (“Loadshedding”) you estimate how much fuel you need to get to the next fuel stop and drive ensuring the tank does not go below that level



I want to ensure my battery warranty and so the lowest I want to take my battery is down to 10% before the system will **Shutdown**. This will only be in dire emergencies as daily use will be controlled by the system mode SOC/V% settings. This essentially is my reserve tank

Low Battery will start to sound an alarm on the inverter when the battery reaches 15%

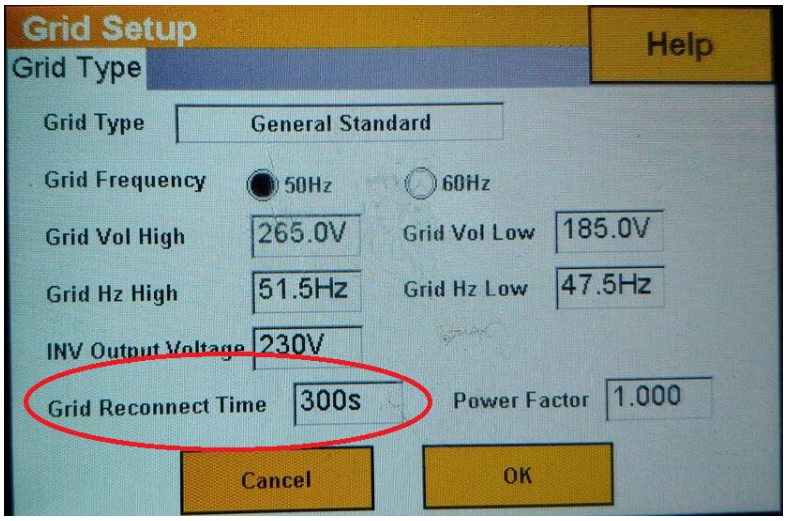
If the battery is shut down, it will need to be recharged back to 20% before it can **Restart** and become available to be used again



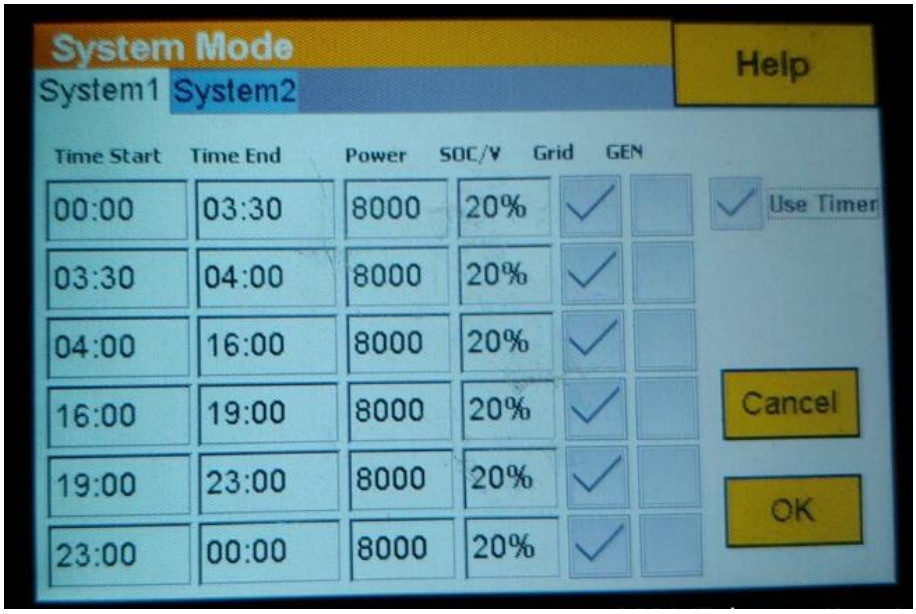
Priority Load is ticked so that solar will be sent to the house load before it charges the battery with excess solar. The house load is critical and must always be met, the battery can stay at a SOC level with no ill effect. If the battery has priority and there is not enough excess solar to supply the house load (sunrise or rainy day), the system has no option but to supply the house load from the grid

I do not export any of my solar

I use 20W of grid continually to ensure my prepaid meter does not trip. In reality the inverter uses a lot more than the set 20w



I set the **Grid Reconnect Time** to 300 seconds so that the system will not start using the grid until 5 minutes have passed, after the grid reconnecting, to ensure the grid is stable after the surge demand caused by all households' appliances suddenly starting up



Use Timer is ticked so that the time slots and set SOC/V will be used. If this is <u>not</u> ticked the battery will always be kept at 100% and will only be used when there is no solar or grid available (UPS backup solution)

Start and **End** times are not important and only need to run chronologically over a 24 hour period

SOC/V% are all set to 20%. This will ensure the battery should be limited to the preferred daily 80% DOD and ensure the suggested 6000 cycles. This provides the maximum use of the battery capacity, and free solar generated electricity, before having to start using the grid

All **Grid** is ticked so that should the battery SOC fall below the 20% it will immediately be charged back up to the SOC/V% by the grid (if it is available). If you do not tick Grid and the battery SOC is below the SOC/V% the grid will supply the house load, but will not charge the battery. The battery will remain at its current SOC

When using the battery, the battery SOC will drop until it reaches the 20% SOC/V% level, where the grid will start to be used to supply the house load, and the battery kept at the set 20%

The grid will only be used to supply the house load once the battery has reached the SOC/V% level and will only be used to maintain or charge the battery back up to the SOC/V% level. Only solar will be used to charge the battery to levels higher than the SOC/V% and will do this automatically (with no settings) once there is excess solar after supplying the house load

Should the grid fail while the battery is at a higher SOC than the set SOC/V%, then the battery will continue to be used to supply the house load as it would under normal conditions

Should the grid fail while the battery is at or reaches the SOC/V% level, the battery will be used to further supply the house load and the SOC will drop below the set SOC/V% until it reaches the Shutdown %. Should the grid return during this time, the grid will again be used to supply the house load, as well as charge the battery back to, but no higher, the set SOC/V%

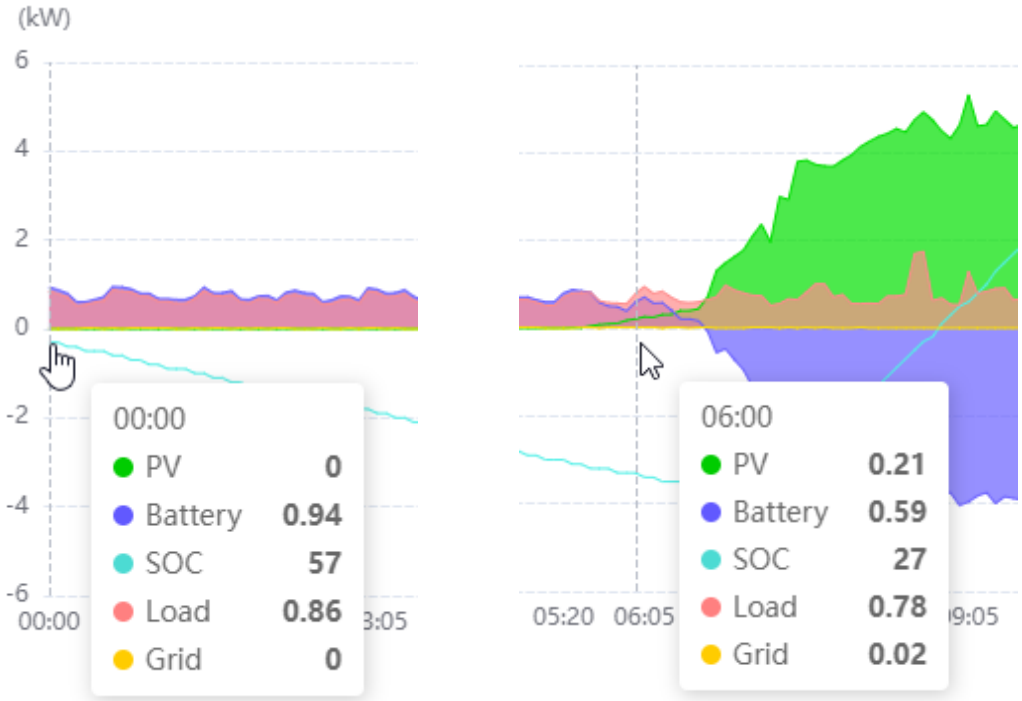
Loadshedding

To limit the risk of loadshedding increase the SOC/V% to a level where you still have the 20% base, but add enough battery % to get through the loadshedding period should you need to use the grid when it is unavailable

Hourly % drop (hr%drop)

Determine what % your battery will drop in an hour when only running the essentials needed during loadshedding

Typically this will be in the early morning so demand and SOC drop during this time is a good value to use. The drop must be constant with no grid or solar supply in-between. Do over several days to obtain an accurate trend for your needs



The SOC starts off at 57% at midnight and drops down to 27% at 6:00

30% drop over 6 hours = 5% drop per hour

Hourly Charge % (hrChg%)

Determine what % you can charge your battery in 1 hour when charging from the grid

This must be done when there is no solar and when the battery SOC is lower than what you expect to be able to charge in an hour. The time period must run for 1 hour and so you must choose a time in the future to start the process

Charging should be done with only the essential load running

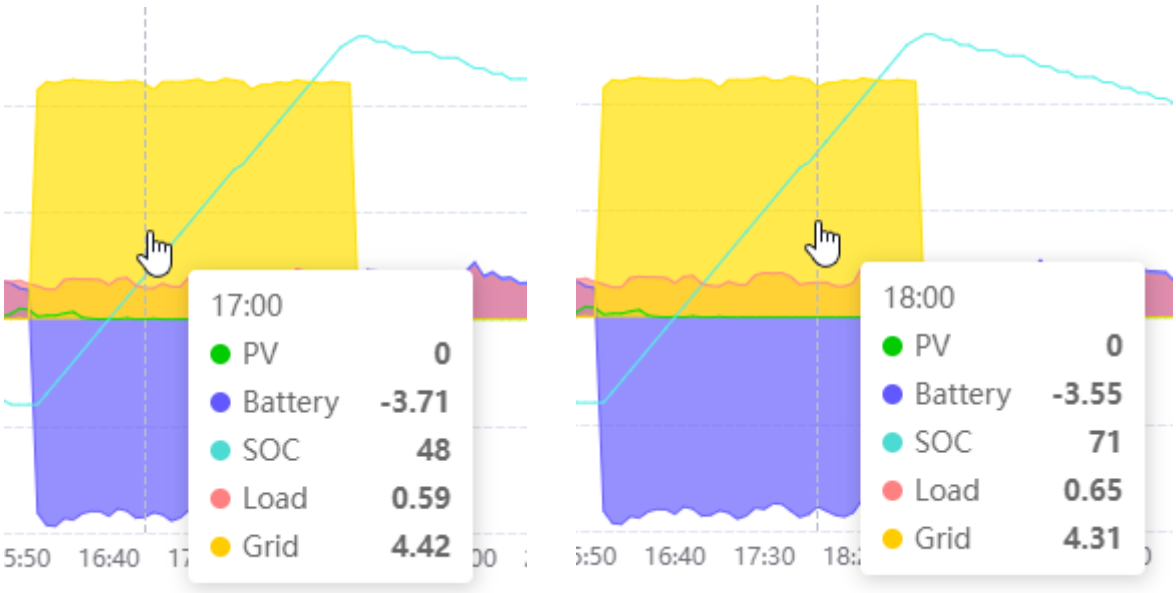
Typically this can be done in the early morning hours when the need to charge to meet loadshedding is needed and the house load is at its lowest

Change a single time period in the system mode setup

- Change the times so that the time period will only run for 1 hour. As an example from 2am to 3am
- Change the SOC/V% for that time period to 100%
- Ensure the Grid is ticked

This will force the system to start charging the battery from the grid for 1 hour. Although set to 100% it should not be expected to reach that level within the hour

Remember to reset the time period after the test



SOC increases from 48% to 71% = 23% increase in charge over 1 hour

No-Fuss-Most-Grid Setup

This setup is the easiest and most secure with little intervention, but will use more grid unnecessarily

Depending on the loadshedding stage and the expected hours to be off during load shedding, change the SOC/V% for every time period according to the following

20% (base) + (LS hrs x hr%drop) + spare %

2 hour loadshedding : 20% + 10%(2 x 5%) + 2% = 32%

4 hour loadshedding : 20% + 20%(4 x 5%) + 2% = 42%

Time Start	Time End	Power	SOC/V	Grid
00:00	03:30	8000	32%	✓
03:30	04:00	8000	32%	✓
04:00	16:00	8000	32%	✓
16:00	19:00	8000	32%	✓
19:00	23:00	8000	32%	✓
23:00	00:00	8000	32%	✓

This will ensure you still get the maximum use out of the battery (2hr = 68% DOD, 4hr = 58% DOD), but will ensure that you will always have enough battery SOC to get through any loadshedding session

Ensure the **Grid** is ticked so that once the loadshedding has ended and your SOC is below your SOC/V% threshold, you want the grid to immediately start charging the battery and taking the SOC back up to the safe SOC/V% level. With **Grid** not ticked the SOC will remain at its current level

Alternates to provide additional grid savings would be

1. If there is stage 4 during the day (2hrs) but stage 6 at night (4hrs) you can set up the times and the SOC/V% for the different stages

Time Start	Time End	Power	SOC/V	Grid
00:00	01:00	8000	42%	✓
01:00	04:00	8000	42%	✓
05:00	16:00	8000	32%	✓
16:00	19:00	8000	42%	✓
19:00	23:00	8000	42%	✓
23:00	00:00	8000	42%	✓

2. Only set the higher SOC/V% for periods you know there is a risk of loadshedding (early morning), keep the other periods (daytime) at the 20% level

Time Start	Time End	Power	SOC/V	Grid
00:00	05:00	8000	42%	✓
05:00	09:00	8000	32%	✓
09:00	16:00	8000	20%	✓
16:00	19:00	8000	20%	✓
19:00	23:00	8000	20%	✓
23:00	00:00	8000	20%	✓

Fiddly-Less-Grid Setup

This setup will ensure the least amount of grid use, but requires constant modification of the system mode parameters to meet the changing schedules and weather patterns

Keep all time periods set to the ideal 20% SOC/V%

When you expect a chance of hitting a loadshedding stage at the same time as your battery has low SOC, create a time period just before the start of the loadshedding period

The duration of the time period should be enough to charge the battery from its SOC when it enters the time period, to the SOC/V% you want the battery to be when loadshedding starts. The calculated hrChrg% will determine how long this will be. From my bottom level of 20%, and based on my 23% I would need half an hour to charge up to 32% for 2hrs loadshedding, and 1 hour to charge up to 42% for 4hrs loadshedding

The SOC/V% for this time period is changed to the expected loadshedding duration

20% (base) + (LS hrs x hr%drop) + spare %

2 hour loadshedding : 20% + 10%(2 x 5%) + 2% = 32%

4 hour loadshedding : 20% + 20%(4 x 5%) + 2% = 42%

Time Start	Time End	Power	SOC/V	Grid
00:00	03:30	8000	20%	✓
03:30	04:00	8000	32%	✓
04:00	16:00	8000	20%	✓
16:00	19:00	8000	20%	✓
19:00	23:00	8000	20%	✓
23:00	00:00	8000	20%	✓

Loadshedding expected @ 4-6 am

Using this configuration, the battery is used to its full capacity, saving on grid use majority of the time, but ensures there is enough capacity to get through an expected loadshedding period

When the system reaches the start of the specified time period

- If the SOC stays above the SOC/V% during the period the battery will continue to be used
- If the SOC reaches the SOC/V% after the start of the period, the battery will be used until it reaches the SOC/V% and then the grid will be used to supply the house load and maintain the battery SOC
- If the SOC is lower than the SOC/V% the grid will supply the house load and will charge the battery to the required SOC/V%. Once reached the grid will still provide the house load, but only maintain the battery at the SOC/V% level

Ensure you have **Grid** ticked so that the battery can be charged to the required level from the grid

Typically this method is not required when there is sunshine and solar generation, or if the battery SOC is high during early evening. It is required for loadshedding periods when the battery levels are expected to be low - in the early morning and/or around sunrise when the solar is not enough to supply the house load. Also be aware of weather conditions in the morning as cloud cover can delay solar generation to later in the day

Rainy days and Arbitrary Top-Ups

On most days and under ideal conditions the core setup works very well – House load and battery charge covered with solar during the day, night covered by the 100% charged battery with only a slight possible need to use the grid in the early morning hours. On these days there is no need to modify the system mode setup

There are days when there is just not enough solar generation to cover the house load and to charge up the battery sufficiently

Arbitrary topping up the battery from the grid is as easy as setting a system mode time period and changing the SOC/V% to the level you want the battery to be charged. The duration of the time period can be calculated by how much you want to increase and knowing what % can be increased per hour. Or you can simply set a long period and monitor from time to time and then reset the SOC/V% once the desired SOC has been achieved

Time Start	Time End	Power	SOC/V	Grid
00:00	03:30	8000	20%	✓
03:30	04:00	8000	20%	✓
10:00	12:00	8000	50%	✓
12:00	19:00	8000	20%	✓
19:00	23:00	8000	20%	✓
23:00	00:00	8000	20%	✓

Beware of charging the battery to 100% from the grid when there is little solar generation in the morning, often I have found the clouds can disappear and the battery can be fully charged using solar in the afternoon

I will normally wait for the end of the day to make a decision as to how high I want to top up the battery from the grid knowing that there will not be any chance of solar to complete the task

I will only increase the SOC in the morning to just enough to secure enough generation from the battery should it be needed to supplement the low solar generation for the day (on most days solar is enough to feed the house load most of the time, and may only need a small amount from the battery to supplement) and this may only be a 5-10% increase. Loadshedding during the day should also be taken into account

Always reset the SOC/V% after the top-up has been achieved

Using the generation graphs I have determined my average SOC % drop for

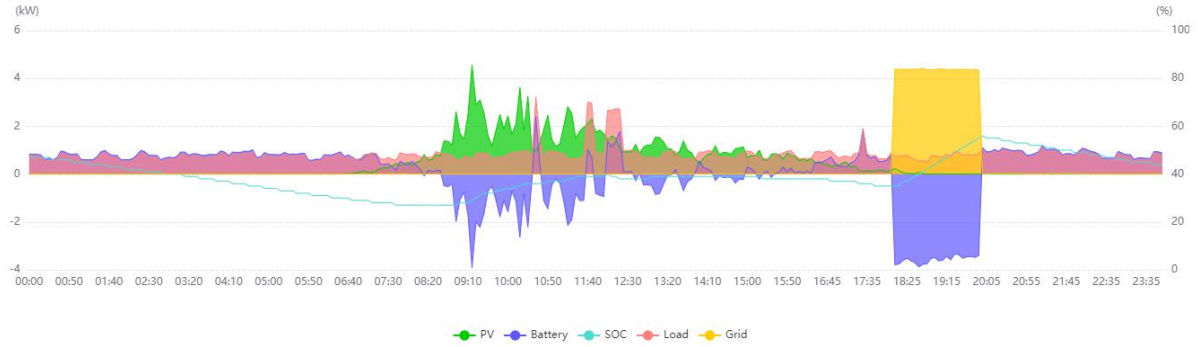
- Sunset to Sunrise (summer and winter)
- 6pm – 8pm
- 6pm – Midnight
- 8pm – Midnight
- Midnight – 6am
- 8pm – 6am

Using these trends I have a quick and easy idea of where my battery SOC will be at a certain time, and if and when the battery is likely going to run out and I will need to use the grid

I know that I will normally use 30% of the battery between 8pm and 6am. Based on the SOC at 8pm I can make accurate decision as to if the battery will make it to 6am, and/or when it would be expected to run out during the night

To ensure the battery will make it through to 6am I need the battery to be on at least 52% SOC at 8pm (52%-30% = 22% = 20% base + 2% safety). If there is loadshedding at 6am, or I know there is possible bad weather that will delay solar generation, I will add the estimated hr%drop value to arrive at the desired outcome

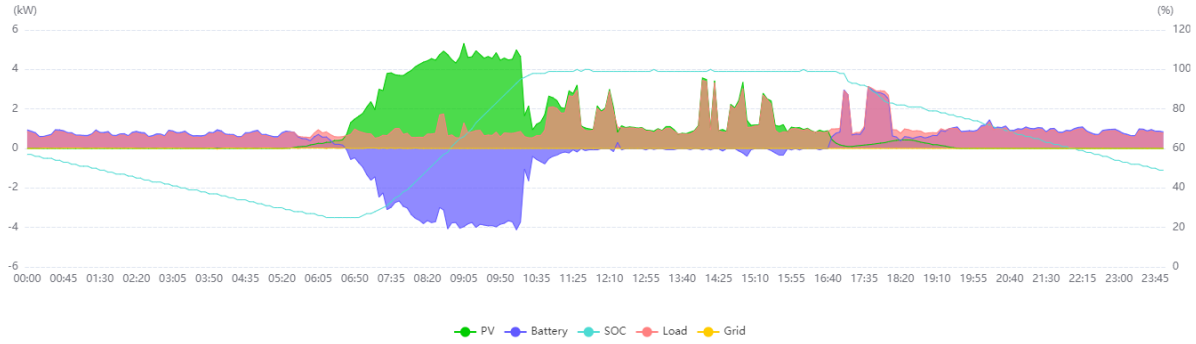
On a bad battery charging day, around sunset I will determine what charging from the grid I will need to do in order to be at desired SOC at 8pm. At this time I will change a time period to provide enough time (based on the amount that can be charged in 1 hour and the amount of SOC % that needs to charged), and set the SOC/V% to the level I need the battery to be charged to using the grid



Time Start	Time End	Power	SOC/V	Grid
00:00	03:30	8000	20%	✓
03:30	04:00	8000	20%	✓
04:00	16:00	8000	20%	✓
16:00	18:00	8000	20%	✓
18:00	20:00	8000	60%	✓
20:00	00:00	8000	20%	✓

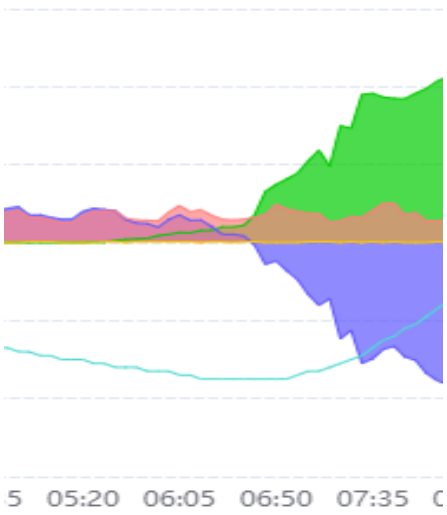
Always reset the SOC/V% after the top-up has been achieved

Application



The system starts the day with the house load being supplied by the battery which has a SOC of 57% which gently drops to 25% at its lowest point

In the early morning the house load is at its lowest and the best time to have to use the grid if required



At 5:40 the solar starts to ramp up and starts to feed the house load with what it can generate, at the same time reducing the battery demand to the difference needed (reducing the dropping battery SOC significantly until it levels out at 25%)

At 6:40 the solar is generating enough to meet the load demand, as well as generate excess energy which is used to start charging the battery

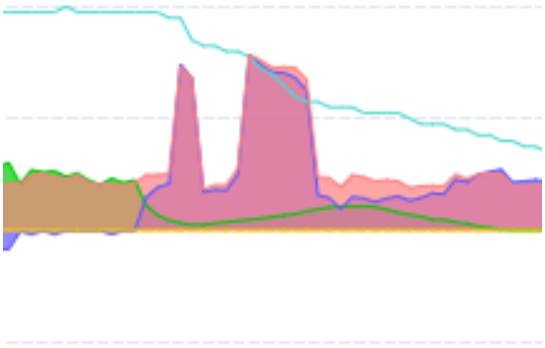
As the day progresses the solar ramps up and easily meets the load demand and puts significant excess energy into charging the battery, raising the battery SOC accordingly. Notice the drops in solar generation as the clouds pass over, and the spikes in house load, and that the battery charge is dropped for that period

At 10:15 the battery SOC has reached 96% and the battery management slows down the charging for the last 5%, and so the solar ramps down to match the lower demand

At 11:35 the battery SOC is at 100% and the solar is ramped down to only meet the house load demand

During the day there are spikes in the house load which are supplied by the solar

At 16:40 as the solar generation starts to diminish and can no longer meet the full house load, the battery is used to supplement the shortage that the solar is unable to provide



Solar is unable to supply the load spikes and these are supplied from the battery diminishing the SOC quite dramatically

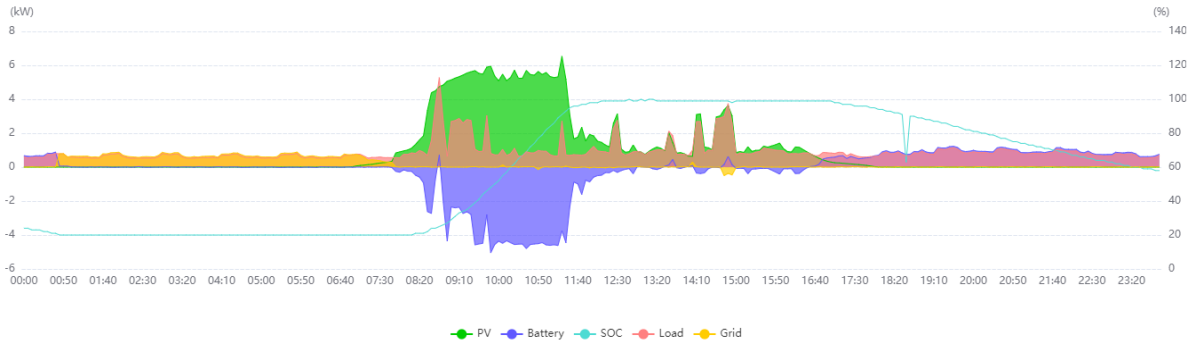
There is a slight increase in solar generation during the early evening until solar stops generating at 19:35 and the house load is totally supplied by the battery

The battery SOC falls during the evening as it supplies the house load

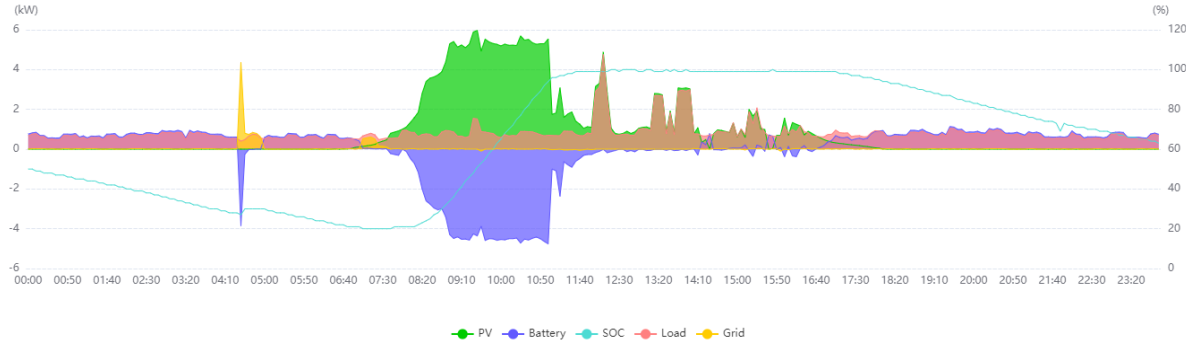
There is no requirement to use GRID power at all and everything has been met with solar or free solar energy stored in the battery

An example of battery hitting the SOC/V% level very early in the morning, and running off the grid until the solar was able to supply the house load and charge the battery (with no risk of load shedding)

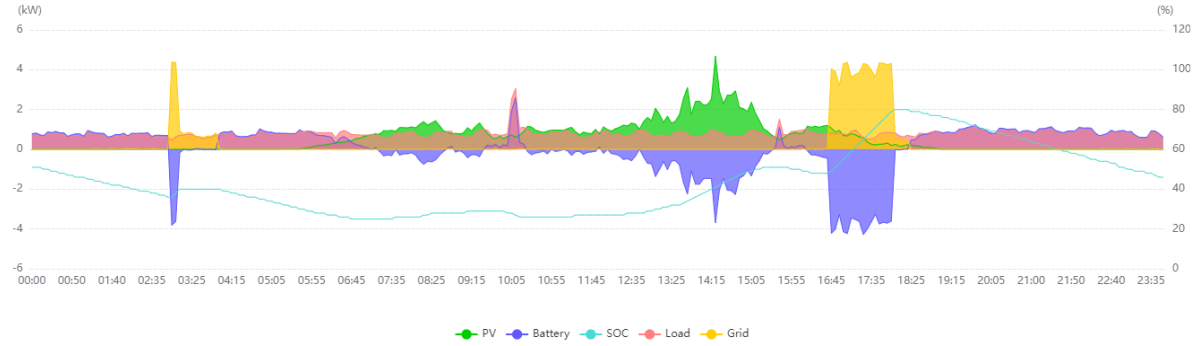
This is the ideal scenario where the early morning demand is at its lowest and so grid use would be at its lowest



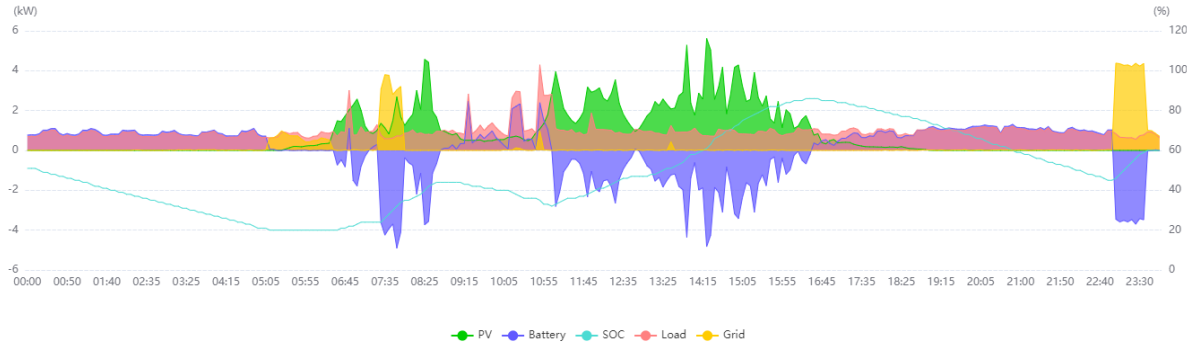
Sometimes the SOC will be close to the loadshedding SOC/V% when it hits the set period, in this case the battery is charged by the grid with a short burst to get it to the required level, and then it is maintained by the grid at that level until loadshedding starts



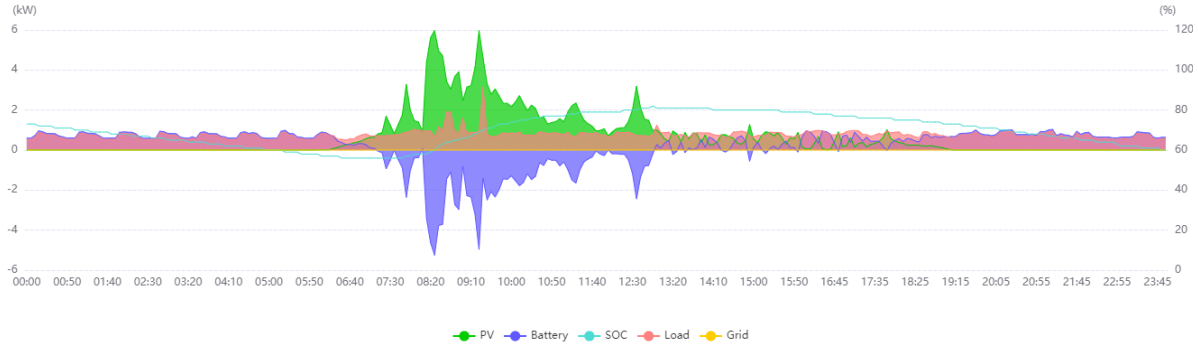
Enough solar to supply the house load with some grid top-ups to cater for loadshedding. Note the morning versus afternoon solar generation. Don't charge up too early, you never know will come later



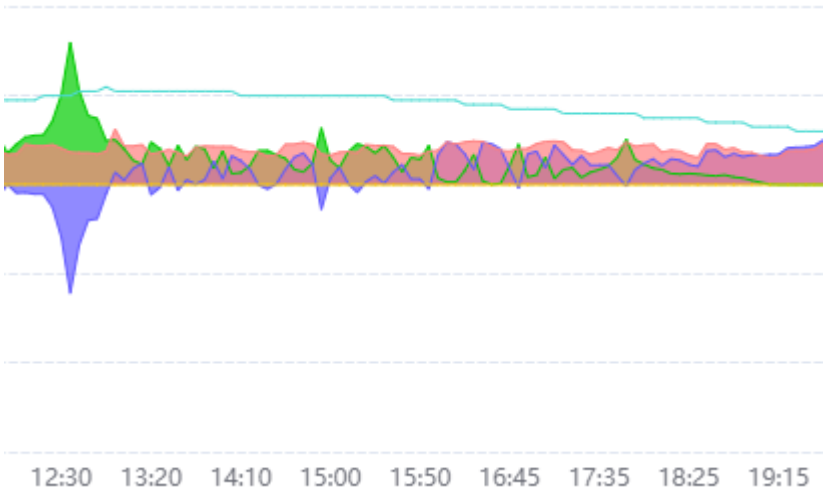
Note the use of battery to supplement solar between 9 and 11 am. If the battery SOC/V% was set to a high level for this period then the only option would be to use grid at that time



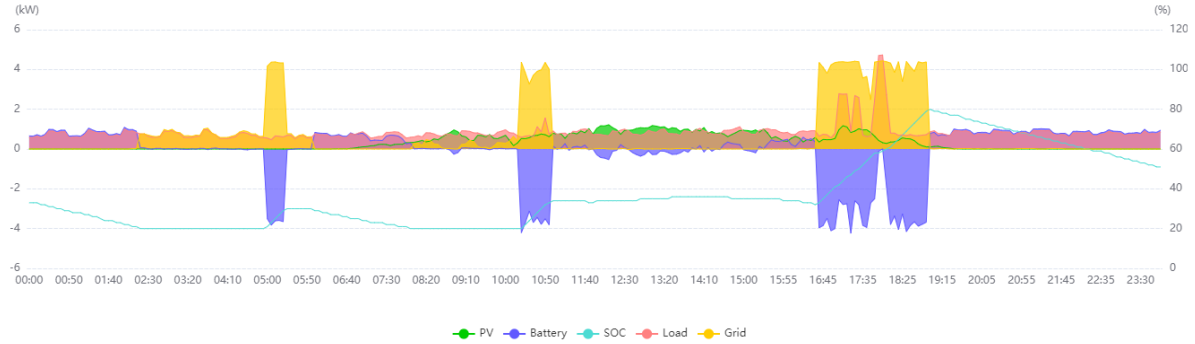
Another example showing the importance of setting the SOC/V% to a low safe level and not a high level. Having reached 80% using solar during the morning, solar bottomed out during the afternoon and at times could not meet the house load demand. When this happened, battery was used to supplement the demand, only dropping 4% over 6 hours. If the battery SOC/V% was set at 80% or higher during this time the system would have had to use the grid for this purpose as the battery would not be available



Notice as well short blips of battery charge when the solar did manage to generate a little bit of excess energy



A very bad solar day with multiple grid top-ups needed to get through the day and loadshedding



The perfect solar day, batteries charged by 10:30. Just a pity not enough electricity demand to extract the full potential of the solar system