Introduction

This technical note gives an overview of the Selectronic solar storage calculator, STELLA.

STELLA has been designed to assist sales personnel with the configuration and comparison of up to three SP PRO based battery storage systems, providing expected performance data and a list of the major components for each configuration.

It is important to note that whilst STELLA is a very impressive system performance simulator, its purpose is to assist in the pre-sales process and is not to be used as a system design tool.

Major features

Major features of STELLA include:
- Web based software that can be run from most of the standard browsers, including iPad, iPhone, Android tablets, Android phones and Windows computers and devices,
- On screen pop-up help to guide the user as needed,
- Simple touch screen user interface,
- STELLA interactively suggests solar capacity, battery size and SP PRO model as configuration data is entered,

Overview

STELLA is designed to assist sales personnel in the pre-sales process of an SP PRO based "Solar Hybrid" system; that is a system connected to the electricity grid and generally incorporating battery storage.

STELLA assists in determining the configuration and basic performance of a solar hybrid power system designed to load shift, that is to store and consume at a later time any excess solar.

STELLA asks you step-by-step for all the information needed to suggest a configuration. If you are not sure of the information, take your best guess or use the calculated default value. STELLA will then suggest a list of major components required.

STELLA will suggest a solar hybrid power system based on self-consumption, operating as follows:
- When the sun is shining, the SP PRO directs the solar power being generated in the following order:
  - Into the loads,
  - Into battery bank storage (unless there is no battery),
  - Into the grid, up to the export limit.

- When there is not enough direct solar power to run the loads, then the solar power stored in the battery will be used.

- Power is only used from the grid when there is not enough direct solar power and stored solar power to run the loads.

Usage Screen

The opening screen gives a brief description of the operation of a Solar Hybrid system that has been configured to self-consume the generated solar.

A summary of the Terms and Conditions of STELLA have been outlined at the end of this page. If you agree with these conditions then click on the box to accept. If you do not agree with these Terms and Conditions then please do not use STELLA and leave this page.

When the terms and conditions have been agreed to and the box is checked, the **START** button will become available. Click on this to start STELLA.

Input parameters

Data is collected by STELLA using slider controls, selection boxes and check buttons.
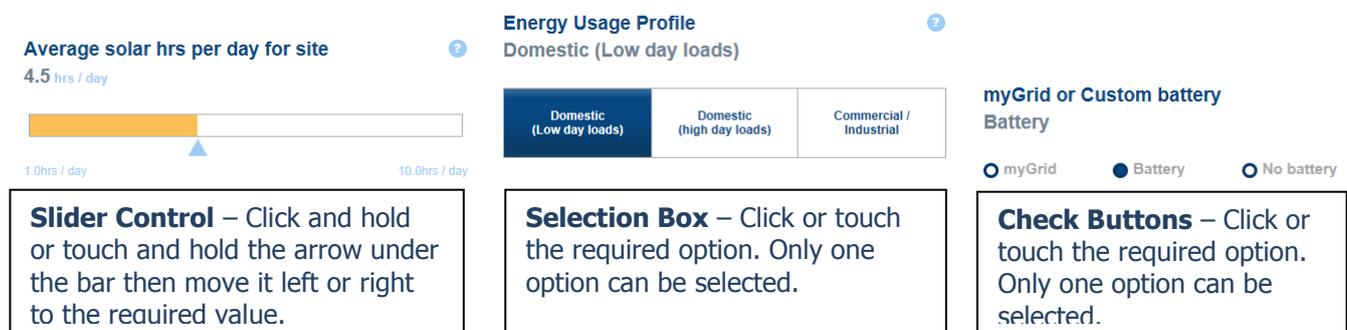
Average solar hrs per day for site ❓
4.5 hrs / day

1.0hrs / day   10.0hrs / day

Energy Usage Profile ❓
Domestic (Low day loads)

| Domestic (Low day loads) | Domestic (high day loads) | Commercial / Industrial |

myGrid or Custom battery
Battery

⭘ myGrid   ● Battery   ⭘ No battery

Slider Control – Click and hold or touch and hold the arrow under the bar then move it left or right to the required value.

Selection Box – Click or touch the required option. Only one option can be selected.

Check Buttons – Click or touch the required option. Only one option can be selected.

Each parameter is entered in the order that it appears on the screen. As each parameter is entered, STELLA interactively adjusts the subsequent parameters to a suggested default or disables any invalid combinations of parameters.

Due to the interactive nature of STELLA, it is necessary to enter each parameter in the order they appear on the screen. If a previously entered parameter is changed then STELLA will reset subsequent parameters back to their default values. This may overwrite any previously entered values and these will need to be re-entered.

Figure 1 below shows an example of the *Input Parameters* screen and the order in which they need to be entered.

Usage

Input Parameters

Average daily energy consumption
15.0 kWh

Maximum AC load support power
5.0 kW per phase

Energy Usage Profile
Domestic (Low day loads)

| Domestic (Low day loads) | Domestic (high day loads) | Commercial / Industrial |

Energy used during sun hours
15 % = 2.3 kWh

Type of PV solar
Selectronic Certified Manage

| Selectronic Certified Managed AC coupled | Generic AC coupled, any grid inverter | DC coupled |

Maximum export allowed by Utility
30.0 kW

Average solar hrs per
4.5 hrs / day

Maximum Output of Solar
4.1 kW per phase = 18.6 kWh / day

SP PRO Model Family
SPMC481

○ SPMC2   ○ SPMC241   ● SPMC481   ○ SPMC482   ○ SPMC1201   ○ SPLC1200   ○ SPLC1202

Suggested Model

myGrid or Custom battery
Battery

○ myGrid   ● Battery   ○ No battery

Battery Type
Lead acid sealed blocks

| Lead acid sealed blocks | Lead acid sealed 2V cells | Lithium |

Daily minimum State of Charge
60 % min SoC

Battery capacity at
800 AH = 38.4 kWh

Battery design life
8 years

Battery cycle life
1850 cycles down to 80% SoC

Off peak tariff on weekends
No, 7 battery cycles per week

| No, 7 battery cycles per week | Yes, 5 battery cycles per week |

Backup generator when grid fails
No

| No | Yes |

CALCULATE RESULTS

Figure 1: Example of *Input Parameters* screen and the entry order of parameters.

SELECTRONIC

STELLA solar storage calculator

CUSTOMER LOAD PROFILE

Average daily energy consumption ❓
15.0 kWh

1kWh   100kWh

Maximum AC load support power ❓
5.0 kW per phase

0.1kW per phase   20.0kW per phase

Energy Usage Profile ❓
Domestic (Low day loads)

| Domestic (Low day loads) | Domestic (high day loads) | Commercial / Industrial |

Energy used during sun hours ❓
15 % = 2.3 kWh

0%   100%

The first four parameters are related to the customer's energy usage and load profiles. STELLA uses this information to calculate a suggested SP PRO model, values for installed PV solar and battery size as follows:

Parameter name	Description	Effect on subsequent parameters
Average daily energy consumption	Specify the expected amount of energy consumed by the customer on an average day.	Increasing this value increases the suggested *SP PRO Model Family*, the *Maximum Output of Solar* and *Battery capacity at C10*.
Maximum AC load support power	The maximum power required from the SP PRO by the customer's loads during backup.	Increasing this value increases the smallest allowed *SP PRO Model Family*.
Energy Usage Profile	How much of the *Average daily energy consumption* is used during the time when the solar is being generated.	Increasing this value decreases the *Battery capacity at C10* (less solar needs to be stored).
Energy Used during Sun hours	This is a fine adjustment of the previous parameter.	Increasing this value decreases the *Battery capacity at C10* (less solar needs to be stored).

SIZE AND TYPE OF SOLAR

Type of PV solar ❓
Selectronic Certified Managed AC coupled

| Selectronic Certified Managed AC coupled | Generic AC coupled, any grid inverter | DC coupled |

Maximum export allowed by Utility ❓
30.0 kW

0.0kW   30.0kW

Average solar hrs per day for site ❓
4.5 hrs / day

1.0hrs / day   10.0hrs / day

Maximum Output of Solar ❓
4.1 kW per phase = 18.5 kWh / day

1kW per phase   30kW per phase

Enter these values in the order they appear on the screen and STELLA will change or disable the subsequent values as required. Once the first three values are entered, STELLA will suggest a value for **Maximum Output of Solar** that will provide enough energy to supply virtually all of the **Average daily energy consumption**. Another value may be entered bearing in mind that with less solar more energy will be used from the grid and with more solar, more energy will be exported to the grid or wasted.

Parameter name	Description	Effect on subsequent parameters
Type of PV Solar	The method by which the PV solar is controlled and connected into the system.	When *Generic AC Coupled* is selected then *Maximum Export allowed by Utility* is set to maximum.
Maximum export allowed by Utility	The export limit imposed by the Utility for that site.	If this value is less than *Maximum output of Solar* then a GO series SP PRO will be specified under *Components Required* in the *Results* page.
Average solar hrs per day for site	The value for the site, taken from solar tables.	Increasing this value decreases the *Maximum output of Solar.*
Maximum output of Solar	**AC coupled solar** - The maximum AC output of all the PV solar combined. **DC coupled** – The maximum DC output from the solar controller.	Increasing this value decreases the *Maximum output of Solar.*

SELECTING THE SP PRO MODEL

SP PRO Model Family
SPMC481

O SPMC240   O SPMC241   ● SPMC481   O SPMC482   O SPMC1201   O SPLC1200   O SPLC1202

Suggested Model

STELLA will suggest an SP PRO model size based on the previously inputted parameters. Any invalid selections will be disabled.

The suggested SP PRO may not always be the smallest allowed SP PRO model. This is so that the SP PRO has enough charge capacity to be able to push all the excess solar into the battery. A smaller SP PRO model may be selected but more solar will be either exported to the grid or wasted.

myGrid or Custom battery
myGrid

● myGrid   ○ Battery   ○ No battery

myGrid Model
MG032048-S6

○ MG008024-S6   ○ MG016024-S6   ○ MG016048-S6   ● MG032048-S6

Suggested battery capacity at C10: 610 AH = 29.3 kWh.
Selected myGrid battery capacity at C10: 520 AH = 25.0 kWh (Battery is 48 Volts, Lead Acid Sealed blocks)

Daily minimum State of Charge

60 % min SoC

30% min SoC   80% min SoC

Off peak tariff on weekends

No, 7 battery cycles per week

| No, 7 battery cycles per week | Yes, 5 battery cycles per week |

STELLA will only allow myGrid to be selected for SPMC240, SPMC241, SPMC481 and SPMC482 models of SP PRO. For other models a Custom Battery configuration must be used.

STELLA will select the closest myGrid kit to suit your previous configurations. It will also advise you of the suggested battery capacity and the myGrid battery capacity to allow comparison. If the suggested capacity is greater than 20% or less than 30% of the selected myGrid kit then STELLA will display a warning.

Any valid myGrid kit may be selected.

Parameter name	Description	Effect on subsequent parameters
Daily minimum State of Charge	The State of Charge the batteries will be discharged down to each day.	Increasing this value increases battery life and the Suggested Battery Capacity.
Off peak tariff on weekends	Customer chooses whether or not to discharge the batteries on weekends.	If YES then the battery life is increased because the battery bank is only cycled 5 times per week rather than 7 times per week.

SELECTING BATTERY

myGrid or Custom battery
Battery

○ myGrid   ● Battery   ○ No battery

Battery Type
Lead acid sealed blocks

| Lead acid sealed blocks | Lead acid sealed 2V cells | Lithium |

Daily minimum State of Charge
60 % min SoC

30% min SoC   80% min SoC

Battery capacity at C10
610 AH = 29.3 kWh

100AH   2500AH

Battery design life
8 years

5 years   25 years

Battery cycle life
1850 cycles down to 60% SoC

500 cycles   10000 cycles

Off peak tariff on weekends
No, 7 battery cycles per week

| No, 7 battery cycles per week | Yes, 5 battery cycles per week |

When Battery is selected, STELLA will suggest values for each of the parameters in this section based on the previously entered parameters and the **Battery Type** selected. At this point STELLA will allow all or some of the parameters to be changed based on the known battery data.

Parameter name	Description	Effect on subsequent parameters
Daily minimum State of Charge	The State of Charge the batteries will be discharged down to each day.	Increasing this value increases battery life and the Suggested Battery Capacity.
Battery Capacity at C10	The capacity of the intended battery bank in AH at the 10h discharge rate.	Increasing this value reduces the *SoC at the end of a solar day* (in Results)
Battery Design life	The maximum time the battery is expected to last when used in a standby application.	Caps the *Expected battery life* (in Results).
Battery cycle life	The number of charge/discharge cycles when the battery is discharged to *Daily minimum State of Charge* each cycle.	Increasing this value increased *Expected battery life* (in Results) until *Battery Design life* is reached.
Off peak tariff on weekends	Customer chooses whether or not to discharge the batteries on weekends.	If YES then the battery life is increased because the battery bank is only cycled 5 times per week rather than 7 times per week.

SELECTING NO BATTERY

myGrid or Custom battery
No battery

○ myGrid   ○ Battery   ● No battery

This option is normally selected for a system where the customer is self-consuming most of the generated PV solar energy. In this case the SP PRO GO series inverter is acting as an export limiter to ensure the export power remains below the limit imposed by the Utility for that site.

When *No Battery* is selected, STELLA will set the *Type of PV Solar* to *Selectronic Certified Managed AC coupling* and disable input. Additionally, the *Maximum AC load support power* setting will be set to zero and disabled. STELLA will only choose an SP PRO GO series inverter in this configuration.

The suggested value for the *Maximum output of Solar* is the same regardless of the *myGrid or Custom battery* setting. So when *No Battery* is selected, you may be able to reducing the *Maximum output of Solar* with only a minor impact on system performance.

BACKUP GENERATOR

Backup generator when grid fails
No

No	Yes

Select this option if the system is subject to frequent or long term grid outages that require an auto start backup generator.

STELLA will include a Grid Fail Generator Backup kit in the Results section.

Results

Once all the parameters have been entered click the [CALCULATE RESULTS] button.

A summary of the entered parameters, list of inverter components and expected system performance will be displayed.

SUMMARY OF PARAMETERS

	Option 1 (edit)	Option 2 (edit)	ADD COMPARISON
Average daily energy consumption	15.0 kWh	18.1 kWh	
Maximum AC load support power	5.0 kW per phase	2.3 kW per phase	
Energy Usage Profile	Domestic (high day loads)	Commercial / Industrial	
Energy used during sun hours	35 % = 5.3 kWh	75 % = 13.6 kWh	
Type of PV solar	Selectronic Certified Managed AC	Selectronic Certified Managed AC	
Maximum export allowed by Utility	30.0 kW	30.0 kW	
Average solar hrs per day for site	4.5 hrs / day	4.5 hrs / day	
Maximum Output of Solar	3.9 kW per phase = 17.6 kWh / day	4.4 kW per phase = 19.8 kWh / day	
SP PRO Model Family	SPMC481	SPMC240	
myGrid or Custom battery	Battery	Battery	
myGrid Model	-	-	
Battery Type	Lead acid sealed blocks	Lithium	
Daily minimum State of Charge	60 % min SoC	30 % min SoC	
Battery capacity at C10	610 AH = 29.3 kWh	300 AH = 7.2 kWh	
Battery design life	8 years	20 years	
Battery cycle life	1850 cycles down to 60% SoC	5000 cycles down to 30% SoC	
Off peak tariff on weekends	No, 7 battery cycles per week	No, 7 battery cycles per week	
Backup generator when grid fails	No	No	

A summary list of entered parameters is displayed for each of the entered options. If any of the parameters need altering in Option 1 then click on "Option 1 (edit)" at the top of the list. Similarly for Option 2 and Option 3 where they exist.

To add another configuration to the list click on [ADD COMPARISON] at the top of the next blank list.

COMPONENTS

A list of the SP PRO, grid inverter components and accessories required is displayed by STELLA. This will assist the sales personnel in providing quotes to their customers.

If more information is required, each component contains a link to the product web page.

SP PRO Model

If the *Maximum Output of Solar* is greater than the *Maximum export allowed by Utility* then the nearest GO model is suggested. The GO model will have an export limit that is no greater than the *Maximum export allowed by Utility.*

Otherwise an AU model is suggested here.

When *No Battery* is selected for *myGrid or Custom battery*, then a GO series is always suggested.

SOLAR GRID INVERTER

A combination of suitable grid inverters is suggested here based on the *Maximum Output of Solar*. Any other combination of grid inverters is valid so long as the connected PV solar does not exceed the rating of the grid inverter.

For *Selectronic Certified Managed AC coupled* the grid inverters must be Selectronic Certified models.

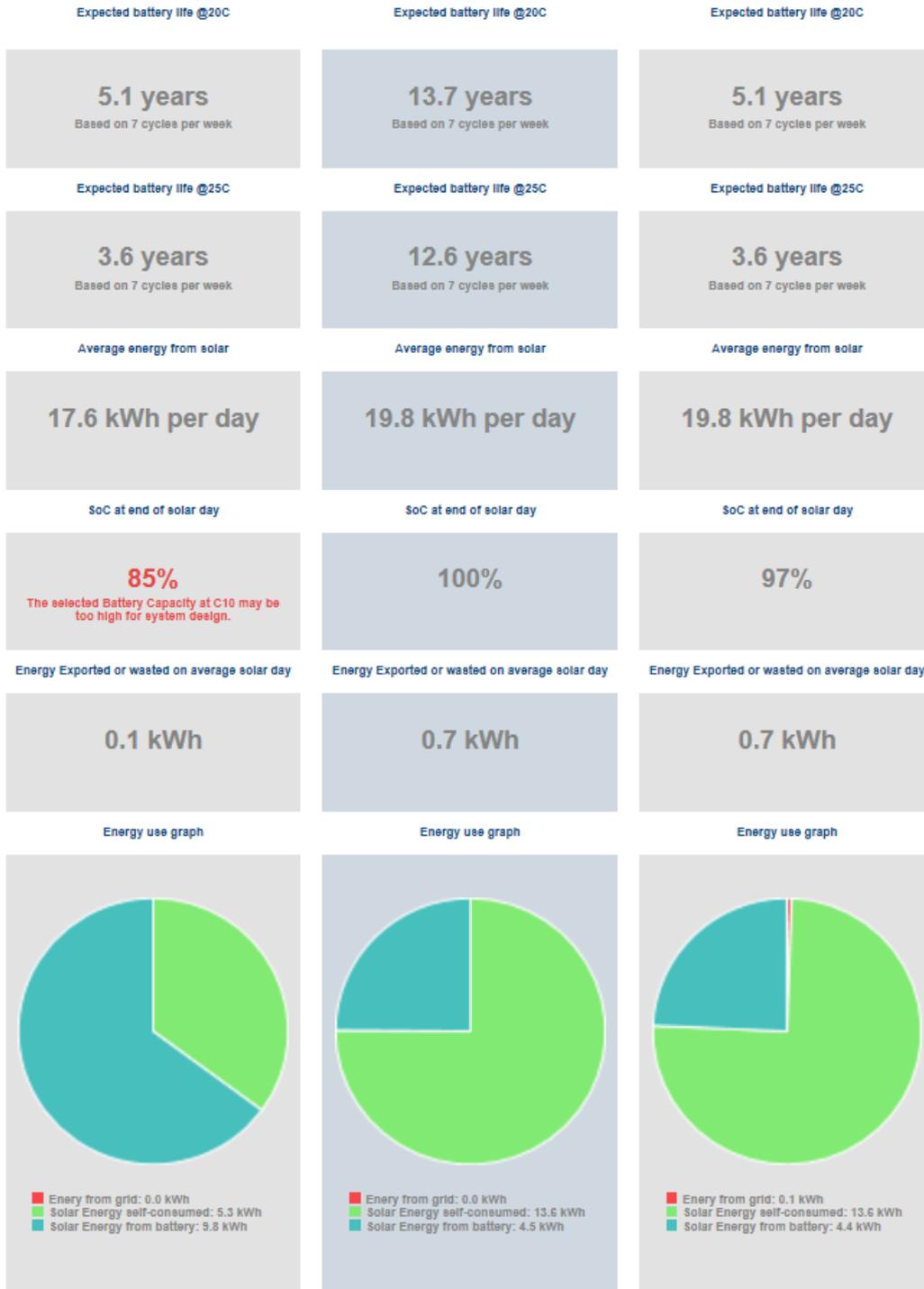For *Generic AC coupled, any grid inverter*, any compliant grid inverter is suitable.

For *DC coupled,* any suitable DC Solar controller may be used.

BATTERY BANK

Either the custom battery bank specifications or the selected myGrid model number is displayed in this section.

SP PRO AU Model: SPMC481

Drawing on our inverter experience since 1951, the SP PRO contains features not found in other inverters. With highly accurate thermal power management and high speed digital signal processing, the SP PRO sets new standards for reliability, power density and flexibility.

More Info ›

SP PRO GO Suggested Model: SPMC240-0.0

The new Selectronic SP PRO Grid Optimised series of inverters carry on the SP PRO's tradition of strong, reliable inverters but are optimised specifically for grid connected applications. More and more, power utilities are demanding limits on how much power you can export to the grid and the SP PRO GO makes this a snap.

More Info ›

SP PRO GO Suggested Model: SPMC240-0.0

The new Selectronic SP PRO Grid Optimised series of inverters carry on the SP PRO's tradition of strong, reliable inverters but are optimised specifically for grid connected applications. More and more, power utilities are demanding limits on how much power you can export to the grid and the SP PRO GO makes this a snap.

More Info ›

Selectronic Certified grid inverters
You will need 1 ABB PVI 4.2 TL-OUTD-SCERT
or any combination with a total of 3.8 kW = 17.8 kWh / day total AC output.

ABB Solar inverters utilize over 40 years of experience and advances made in inverter and power converter technology that have contributed to ABB becoming the world leader in frequency converters and also one of the largest suppliers of wind turbine converters.

More Info ›

Selectronic Certified grid inverters
You will need 1 ABB PVI 5000 TL-OUTD-SCERT
or any combination with a total of 4.4 kW = 18.8 kWh / day total AC output.

ABB Solar inverters utilize over 40 years of experience and advances made in inverter and power converter technology that have contributed to ABB becoming the world leader in frequency converters and also one of the largest suppliers of wind turbine converters.

More Info ›

Selectronic Certified grid inverters
You will need 1 ABB PVI 5000 TL-OUTD-SCERT
or any combination with a total of 4.4 kW = 18.8 kWh / day total AC output.

ABB Solar inverters utilize over 40 years of experience and advances made in inverter and power converter technology that have contributed to ABB becoming the world leader in frequency converters and also one of the largest suppliers of wind turbine converters.

More Info ›

Custom battery bank Required

Battery type: Lead acid sealed blocks

Battery capacity at C10: 610 AH = 29.3 kWh

Battery nominal voltage: 48V

Custom battery bank Required

Battery type: Lithium

Battery capacity at C10: 300 AH = 7.2 kWh

Battery nominal voltage: 24V

myGrid Model: MG016024-S6

With the new myGrid Energy Centre, managing your energy is now possible. The myGrid kit is a convenient and simple way to store energy and use it at the time of your choice.

Suggested battery size 520AH = 12.5 kWh

More Info ›

SYSTEM PERFORMANCE

Expected battery life @20C	Expected battery life @20C	Expected battery life @20C
5.1 years Based on 7 cycles per week	**13.7 years** Based on 7 cycles per week	**5.1 years** Based on 7 cycles per week

Expected battery life @25C	Expected battery life @25C	Expected battery life @25C
3.6 years Based on 7 cycles per week	**12.6 years** Based on 7 cycles per week	**3.6 years** Based on 7 cycles per week

Average energy from solar	Average energy from solar	Average energy from solar
17.6 kWh per day	19.8 kWh per day	19.8 kWh per day

SoC at end of solar day	SoC at end of solar day	SoC at end of solar day
85% The selected Battery Capacity at C10 may be too high for system design.	100%	97%

Energy Exported or wasted on average solar day	Energy Exported or wasted on average solar day	Energy Exported or wasted on average solar day
0.1 kWh	0.7 kWh	0.7 kWh

Energy use graph	Energy use graph	Energy use graph

Energy from grid: 0.0 kWh
Solar Energy self-consumed: 5.3 kWh
Solar Energy from battery: 9.8 kWh

Energy from grid: 0.0 kWh
Solar Energy self-consumed: 13.6 kWh
Solar Energy from battery: 4.5 kWh

Energy from grid: 0.1 kWh
Solar Energy self-consumed: 13.6 kWh
Solar Energy from battery: 4.4 kWh

For each configuration, STELLA displays the results that would be expected on a typical or average solar day. A typical solar day is a day where the solar generated is equal to the *Average energy from solar.*

When *Yes* has been selected for *Off peak tariff on weekends,* the results displayed are for week days only as it is assumed that the batteries will not be cycled on weekends.

Generally more energy will be used from the grid on those days of the year where the solar production is less than the average (Less than *Average energy from solar*).

Result	Description	Notes
Expected battery life @20C	The expected life of the battery. This is *Based on 7 cycles per week* if there is no off peak power on weekends (*No* selected for *Off peak tariff on weekends*), and *Based on 5 cycles per week* if there is off peak power rates on weekends (*Yes* selected for *Off peak tariff on weekends*). STELLA assumes the batteries won't be cycled during the weekend if there are weekend off peak rates.	This is only a rough guide and does not consider secondary effect on battery life.
Expected battery life @25C	As above but at 25C.	This is only a rough guide and does not consider secondary effect on battery life.
Average energy from solar	Expected AC energy from the PV solar on an average solar day.	
SoC at end of solar day	The Expected State of charge (SoC) of the battery at the end of an average solar day, assuming the SoC started at the *Daily minimum State of Charge*.	If this value is below 90% then STELLA will give a warning. The system parameters may be adjusted according to the warning.
Energy exported or wasted on an average solar day	With no export limit, this is the energy that will be exported to the grid. If there is an export limit then some of this energy will be wasted.	If this value is high then it may indicate an excess of PV solar capacity. Try reducing *Maximum output of Solar*.
Energy use graph on average solar day	A pie chart showing where the energy is coming from on an average solar day. On days where there is less than average solar, then it is expected that more energy will be used from the grid.	To reduce the *Energy From Grid* try increasing the PV solar and/or battery capacity.