Increased Self-Consumption with
SUNNY ISLAND and SUNNY HOME MANAGER

SMA FLEXIBLE STORAGE SYSTEM

Planning Guidelines

Table of Contents

1 Natural Self-Consumption, Increased Self-Consumption and Energy Self-Sufficiency

PV self-consumption is the consumption of PV energy which takes place directly at source or in the immediate vicinity of the generating source. Self-consumption is economically viable when the cost of generating the PV power is lower than the cost of purchasing power from the electricity grid. Moreover, self-consumption of PV energy relieves the load on the electricity grid and helps to avoid transmission losses.

The first key factor influencing self-consumption is the self-consumption rate, i.e. the proportion of PV energy used on the spot.
The self-consumption rate is primarily influenced by the ratio of PV energy generated to the energy demand.

- If the power generation capacity is on the low side and the energy demand sufficiently large, a significant proportion of the PV energy can be used on the spot. This even applies when the high points of energy demand and PV generation do not necessarily coincide time-wise. However, to meet demand peaks arising from the electrical loads, additional energy will be required from the electricity grid.
- On the other hand, if available PV energy exceeds demand due to a disproportionately high power generation capacity, it will only be possible to use a very small part of this energy directly. The excess energy must be fed into the electricity grid.

The second important factor in the self-consumption rate is the specific load profile. Since the temporal distribution of the PV power is predefined within narrow limits, the load profile is practically the sole factor determining how well generation and consumption are synchronised over the day. Consequently, the load profile has a huge effect on the internal consumption rate - but this is only true if the ratio between power generation capacity and energy demand is well balanced.

In light of the continuing trend towards lower feed-in compensation, the focus of plant design is increasingly being diverted away from maximising PV generation and towards supplying the loads as fully as possible with PV energy. Therefore, the significance of the self-consumption rate and of technical solutions for its enhancement is rising constantly.

Natural Self-Consumption

Natural self-consumption is given when the PV energy generated is immediately consumed in the household.
Hence, it corresponds to the intersecting set of generation profile and natural load profile. A typical four-person household in Germany achieves a self-consumption rate of approximately 30% with a 5 kWp PV plant. However, this is only a rough approximation due to the dependence of the self-consumption rate on the individual generation profile and the load profile. The orientation of the PV array and temporary shading are decisive factors determining the individual generation profile, while individual life habits are crucial for the load profile.

Increasing Self-Consumption

At a constant value for PV generation and energy demand, it is only possible to optimise self-consumption by performing a meaningful adjustment of the load profile. To this end, there are three strategies to choose from:

- You can modify the load profile by running time-independent electrical loads purposely at times when there are high excess PV capacities. Thus, the Sunny Home Manager can increase the self-consumption rate by approximately one third, i.e. from 30% to 40%, by automatic and intelligent load control.
- You can store excess PV energy in a battery from which loads are supplied which cannot be run at flexible times. The Sunny Island system takes care of this buffering process. In an average household with a standard design of the Sunny Island system components, the self-consumption rate can be almost doubled, i.e., from 30% to approximately 55%.
- You can combine intelligent load management with temporary storage of PV energy. Thus, if the Sunny Island system is combined with the Sunny Home Manager, it is able to increase the self-consumption rate by more than double, i.e., to approximately 65%.

These figures are based on an annual PV generation of 5,000 kWh, and an annual power consumption of the same magnitude.

Self-Consumption Rate and Degree of Self-Sufficiency

All the proposed measures for increasing self-consumption have the goal of utilising the greatest possible proportion of generated energy on the spot. This proportion is expressed as the self-consumption rate:

$$\text{Self-consumption rate} = \frac{\text{PV energy utilised directly}}{\text{Generated PV energy}}$$

On the other hand, the self-sufficiency of a system signifies the ability to supply the loads largely without having to purchase electricity from the grid, e.g., by operating a PV plant. The greater the proportion of generated PV energy which is used to meet the energy demand of the loads on the spot, the higher the self-sufficiency of such a system will be. This proportion is expressed as the degree of self-sufficiency:

$$\text{Degree of self-sufficiency} = \frac{\text{PV energy utilised directly}}{\text{Energy demand of the loads}}$$

2 Systems for Increasing Self-Consumption

2.1 Load Control System

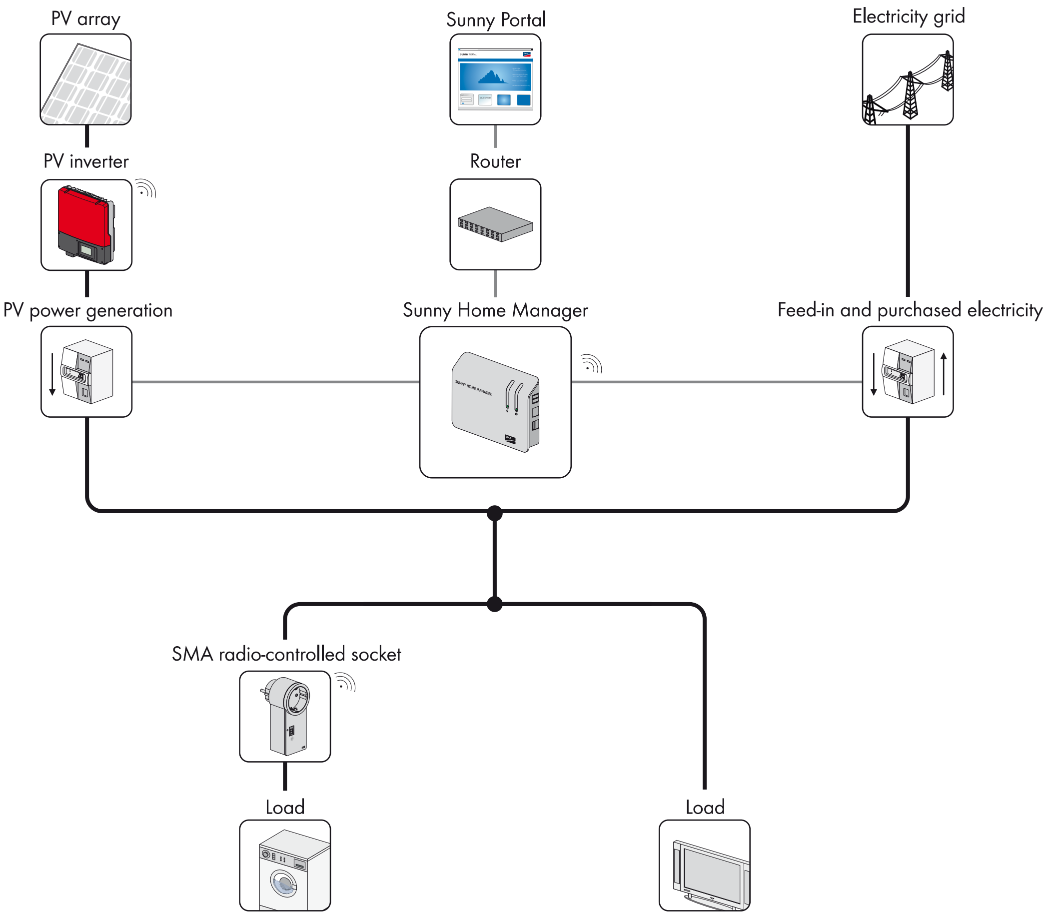

Figure 1: PV plant with Sunny Home Manager (example)

Through Sunny Portal, the Sunny Home Manager provides various aids for manual load control, such as output of status messages, forecasts and recommended actions. Connected loads can also be automatically switched on and off by the Sunny Home Manager via SMA radio-controlled sockets according to an intelligent plan.

The Sunny Home Manager implements load control by means of the following measures.

Measure	Implementation
Creation of a PV yield forecast	The Sunny Home Manager continuously logs the energy generated by the PV plant. It also receives local weather forecasts via the Internet. Based on this information, the Sunny Home Manager creates a PV yield forecast for the PV plant.
Creation of a load forecast	The Sunny Home Manager logs the amount of PV energy generated, grid feed-in and electricity purchased from the grid. To capture grid feed-in and purchased electricity, the Sunny Home Manager can use two meter constellations: • One feed-in meter and one purchased electricity meter **or** • One bidirectional meter for grid feed-in and grid purchase The Sunny Home Manager obtains the PV production data from the connected SMA inverters or from an optionally connected PV production meter. Based on PV yield, grid feed-in and purchased electricity, the Sunny Home Manager determines how much energy is typically consumed in a household at certain times and uses this to create a load forecast for the coming hours. In this forecast, the energy demand of the controllable loads is automatically deducted, as their load profiles will already have been captured by the measuring function of the SMA radio-controlled sockets.
Targeted control of loads	Based on the PV yield forecast and the load forecast, the Sunny Home Manager determines the times best suited for increased self-consumption. With free access to Sunny Portal, the Sunny Home Manager enables detailed plant monitoring, a display of the PV energy available over the course of the day and a live display of all energy flows taking place in the household. The Sunny Home Manager provides the following two options for switching loads on and off: • Specific loads connected to SMA radio-controlled sockets can be automatically switched on and off by the Sunny Home Manager. • Alternatively, you can manually switch the loads in your household on and off. This deliberate management of the household energy also results in increased self-consumption.
Limitation of active power feed-in	The network operator may stipulate the permanent limitation of active power feed-in for your PV plant, i.e., the limitation of the active power fed into the electricity grid to a fixed value or to a percentage of the nominal power of the PV array. If this is the case, please contact your network operator. The Sunny Home Manager monitors the active power being fed into the electricity grid via a feed-in meter. If the active power feed-in exceeds the prescribed limit, the Sunny Home Manager will limit the PV production of the inverters. The Sunny Home Manager prevents yield losses caused by unnecessarily strong limitation of PV generation by taking the current self-consumption of the household into account.

2.2 System for Buffering PV Energy

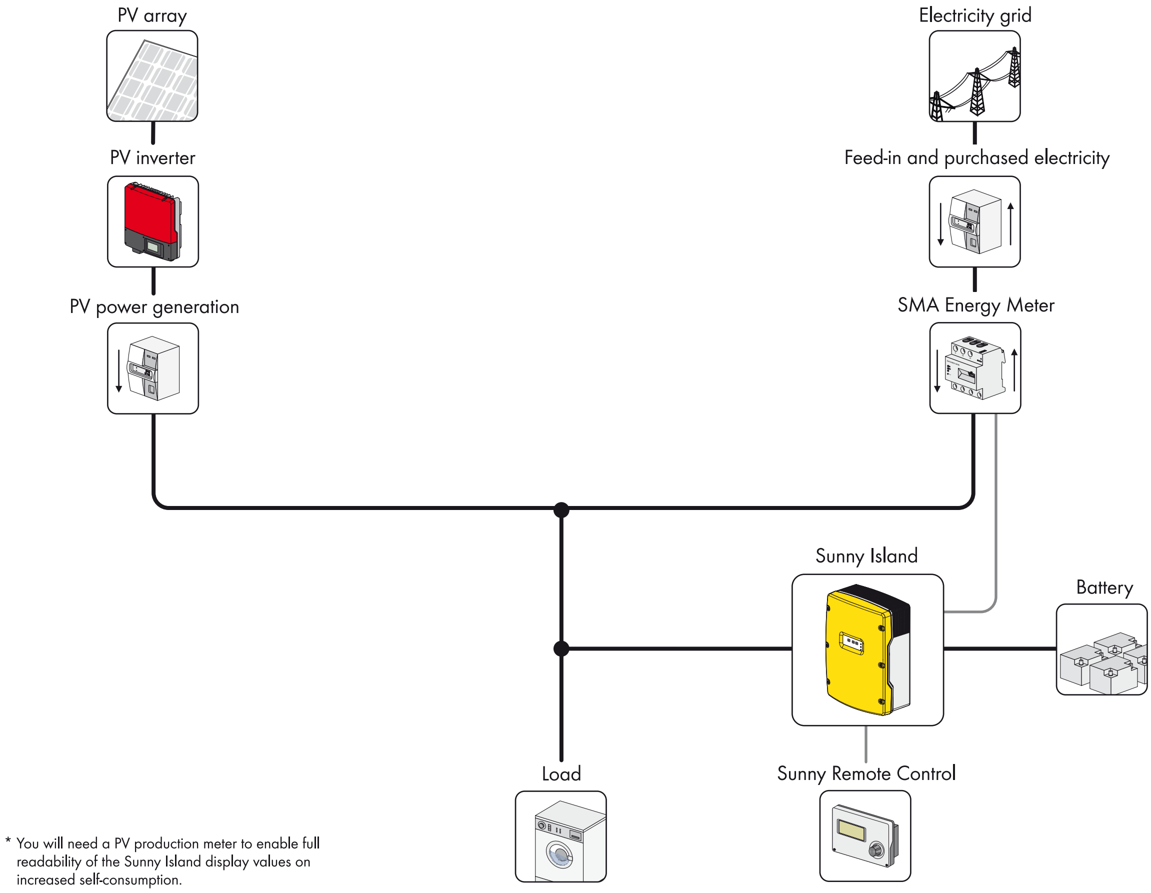

Figure 2: PV plant with Sunny Island and SMA Energy Meter (example)

The Sunny Island captures the data on feed-in and purchased electricity via the SMA Energy Meter. Based on this data, the Sunny Island battery management regulates the charging and discharging of the connected battery as follows:

- If excess PV energy is available, it is stored in the battery.
- If there is not enough PV energy available, the Sunny Island activates battery discharge and this energy is made available for the loads on site.

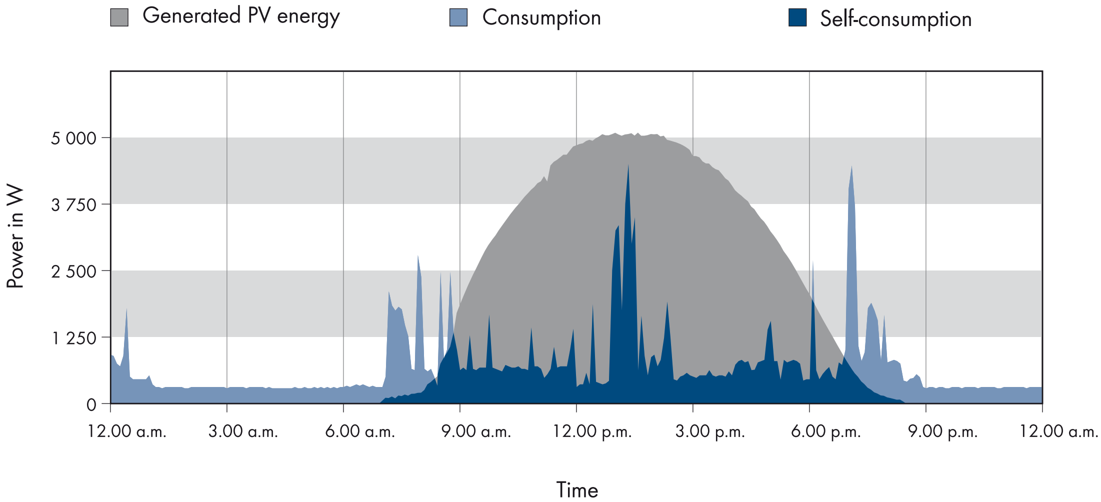

Figure 3: Daily profile of a PV plant, power consumption and self-consumption without buffering (example)

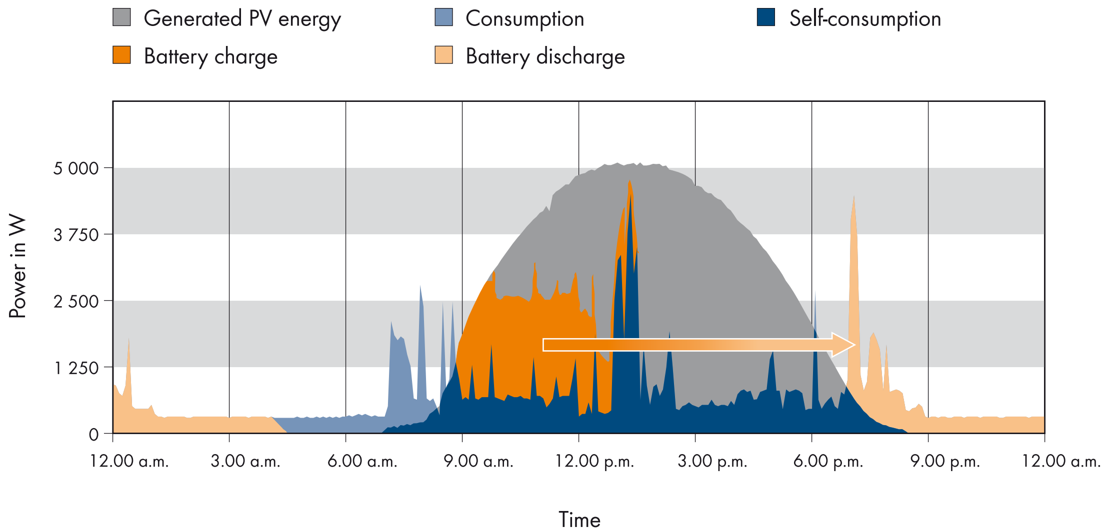

Figure 4: Daily profile of a PV plant, power consumption and self-consumption with buffering (example)

With this strategy, PV energy is always available whenever required, even after sunset.

With a Sunny Island, the self-consumption of the entire household is optimised, regardless of whether or not the individual loads are controlled. For increased self-consumption, the Sunny Island takes three-phase and single-phase loads on different phase conductors into account (see Section 4.2 "Power Control for Energy Buffering", page 26).

SMA Solar Technology AG proposes the following solutions for capturing grid feed-in and purchased electricity on the Sunny Island:

- SMA Energy Meter
- Sunny Home Manager with SMA Energy Meter or existing energy meters with S0 or D0 interface

SMA Solar Technology AG recommends using the SMA Energy Meter, as this measuring device captures the data for feed-in and purchased electricity far more accurately than traditional energy meters with S0 or D0 interface.
The SMA Energy Meter will be available in June 2013.

2.3 System for Load Control and Buffering of Energy

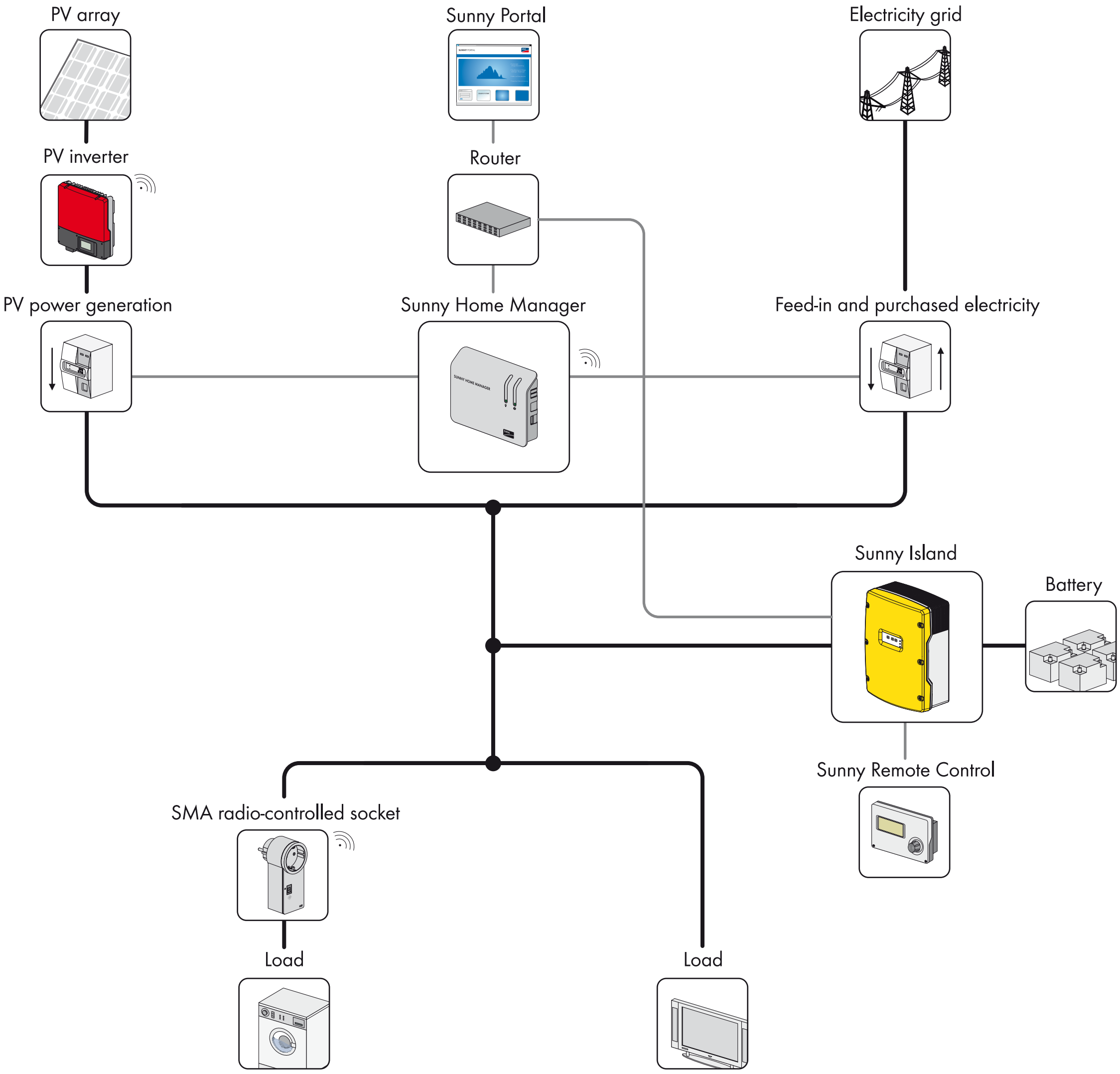

Figure 5: PV plant with Sunny Home Manager and Sunny Island

If the SMA Speedwire data module is installed in the Sunny Island, the Sunny Home Manager will be able to transfer energy meter data to the Sunny Island. Thus, load management is combined with temporary storage of PV energy.

The possible gains achieved in the self-consumption rate, however, do not add up to a sum total.

3 Products for Increased Self-Consumption

3.1 SMA Products for the Specific Systems

Depending on your specific system, you can use the following SMA products for increasing self-consumption.

	Load control	Buffering of PV energy	Load control and buffering of PV energy
Sunny Home Manager	✓	–	✓
SMA radio-controlled socket	●	–	●
Communication interface for PV inverters* • *Bluetooth* interface integrated in the PV inverter • SMA *Bluetooth*® Piggy-Back (*Bluetooth* Piggy-Back) • Speedwire interface integrated in the PV inverter • SMA Speedwire/Webconnect Piggy-Back • SMA Speedwire/Webconnect data module	✓	–	✓
Sunny Island system	–	✓	✓
SMA Speedwire data module Sunny Island	–	✓	✓
SMA Energy Meter**	●	✓	✓
Sunny Remote Control	–	✓	✓
BatFuse B.01	–	✓	✓

* To communicate with the Sunny Home Manager, PV inverters need a communication interface: optionally via SMA *Bluetooth*® Wireless Technology (*Bluetooth*) or SMA Speedwire field bus (Speedwire). This communication interface can be integrated in the PV inverter or retrofitted as an external device.

** The SMA Energy Meter will be available in June 2013. SMA Solar Technology AG recommends using the SMA Energy Meter even if you have installed the Sunny Home Manager, as this measuring device captures the data for feed-in and purchased electricity far more accurately than traditional energy meters with S0 or D0 interface.

✓ Required – Not required ● Optional

Sunny Home Manager

The Sunny Home Manager is a device for monitoring PV plants and for controlling loads in households with PV plants (see Section 2.1 "Load Control System", page 7).

Sunny Portal

Sunny Portal is the user interface of the Sunny Home Manager. The Sunny Home Manager sends data to the Sunny Portal, e.g. the read-out data from the energy meter or the PV inverters. The Sunny Home Manager establishes the connection to the Sunny Portal via a router.

SMA Radio-Controlled Socket

Loads connected to SMA radio-controlled sockets can be switched on and off automatically by the Sunny Home Manager. Alternatively to using SMA radio-controlled sockets, you can switch the loads on and off manually.

Bluetooth Piggy-Back

The *Bluetooth* Piggy-Back enables *Bluetooth* communication between the Sunny Home Manager and PV inverters that do not have their own *Bluetooth* interface.

SMA Speedwire/Webconnect Piggy-Back

The SMA Speedwire/Webconnect Piggy-Back is a Speedwire communication interface for inverters.
The SMA Speedwire/Webconnect Piggy-Back is available as a retrofit kit.

SMA Speedwire/Webconnect Data Module

The SMA Speedwire/Webconnect data module is a Speedwire communication interface for inverters.
The SMA Speedwire/Webconnect data module is available as a retrofit kit or is pre-installed in the inverter.

Sunny Island

The Sunny Island is a battery inverter which controls the electrical energy balance in off-grid systems, backup systems or systems for increased self-consumption. You can combine backup systems and systems for increased self-consumption with the Sunny Island.

Sunny Island System for Increased Self-Consumption

The principal components of the Sunny Island system for increased self-consumption are the Sunny Island, the external control unit Sunny Remote Control, the battery fuse BatFuse and a battery.

To increase self-consumption, the Sunny Island activates the charging or discharging of the battery as follows:

- If excess PV energy is available, the Sunny Island system stores this PV energy in the battery.
- If the energy demand in the household exceeds the available PV energy, the Sunny Island system activates battery discharge and makes the buffered energy available.

Speedwire Data Module for Sunny Island

The Speedwire data module for Sunny Island is a Speedwire communication interface for the Sunny Island. If a Speedwire data module is installed in the Sunny Island, the SMA Energy Meter can transmit data to the Sunny Island and the Sunny Home Manager can exchange data with the Sunny Island.

SMA Energy Meter

The SMA Energy Meter is a meter which detects electricity values at the connection point and makes them available via Speedwire. The SMA Energy Meter transfers the measured values to SMA Solar Technology AG products equipped with the Speedwire function.

Sunny Remote Control

By means of the Sunny Remote Control display, you can configure and control the Sunny Island.

BatFuse

The battery fuse box BatFuse B.01 is a fuse switch-disconnector which protects the battery connection cable of the Sunny Island. The BatFuse also enables DC-side disconnection of the Sunny Island.

3.2 PV Inverters

3.2.1 PV Inverters Supported by the Sunny Home Manager

All the SMA PV inverters listed below can transmit their PV production data directly to the Sunny Home Manager. If these PV inverters are connected to the Sunny Home Manager, you can connect the PV production meter to the Sunny Home Manager at your own discretion.

Maximum number of supported devices

The Sunny Home Manager supports no more than 16 SMA devices. Of these 16 devices, the Sunny Home Manager supports a maximum of 12 SMA inverters or 10 SMA radio-controlled sockets.

PV Inverters with *Bluetooth* Interface

The Sunny Home Manager supports the following PV inverters by SMA Solar Technology AG. If the Sunny Home Manager function "limitation of active power feed-in" is to be used, the firmware version specified is the minimum requirement which must be installed on the inverters. If no limitation of active power feed-in is required, these PV inverters can also be operated with older firmware versions.

- Sunny Boy (SB) with integrated *Bluetooth* interface:
  - SB 3000TL-20 from firmware version 3.01.00.R
  - SB 4000TL-20 / SB 5000TL-20 from firmware version 3.01.02.R
  - SB 3600TL-20 from firmware version 3.25.01.R
  - SB 3000TL-21 / 4000TL-21 / 5000TL-21/ SB 3600TL-21 from firmware version 2.00.00.R
  - SB 2500TLST-21 / SB 3000TLST-21 from firmware version 2.00.27.R
  - SB 2000HF-30 / 2500HF-30 / 3000HF-30 from firmware version 2.30.06.R*
- Sunny Tripower (STP) with integrated *Bluetooth* interface:
  - STP 8000TL-10 / STP 10000TL-10 / STP 12000TL-10 / STP 15000TL-10 / STP 17000TL-10 from firmware version 2.33.02.R
  - STP 15000TLEE-10 / 20000TLEE-10 / STP 15000TLHE-10 / STP 20000TLHE-10 from firmware version 2.10.20.R
  - STP 5000TL-20 / STP 6000TL-20 / STP 7000TL-20 / STP 8000TL-20 / STP 9000TL-20 from firmware version 2.00.15.R
- PV inverters with *Bluetooth* Piggy-Back

  You will find further information at www.SMA-Solar.com in the following documents:

Title	Document type	Information
Bluetooth Piggy-Back	Mounting instructions	PV inverters suitable for retrofitting with *Bluetooth* Piggy-Back
Power Reducer Box - Compatibility List	Technical description	PV inverters which support the "limitation of active power feed-in" function

PV Inverters with Speedwire Interface

- Sunny Tripower (STP) with integrated Speedwire interface:
  - STP 5000TL-20 / STP 6000TL-20 / STP 7000TL-20 / STP 8000TL-20 / STP 9000TL-20 from firmware version 2.0
- Sunny Boy (SB) with Speedwire/Webconnect Piggy-Back
  - SB 1300TBTL-10 / SB 16000TL-10 / SB 2100TL from firmware version 4.3
  - SB 3300-11 / SB 3800-11 from firmware version 4.02
- Sunny Mini Central (SMC) with Speedwire/Webconnect Piggy-Back
  - SMC 6000A-11
- Sunny Boy (SB) with SMA Speedwire/Webconnect data module
  - SB 2500TLST-21 / SB 3000TLST-21 from firmware version 2.53
  - SB 3000TL-21 / SB 3600TL-21 / SB 4000TL-21 / SB 5000TL-21 from firmware version 2.53
- Sunny Tripower (STP) with SMA Speedwire/Webconnect data module
  - STP 10000TL-10 / STP 12000TL-10 / STP 15000TL-10 / STP 17000TL-10 from firmware version 2.53
  - STP 15000TLEE-10 / STP 20000TLEE from firmware version 2.53
  - STP 15000TLHE / STP 20000TLHE from firmware version 2.53

i Connecting PV inverters to the communication

If communication with the PV inverters is to take place via Speedwire, the inverters must be equipped with a Speedwire interface. The PV inverters should be connected to the Sunny Home Manager via a network cable and network switch or a router with integrated switch. Additional information is available at www.SMA-Solar.com in the following documents:

- PV inverter manuals

  or
- Manual of the SMA Speedwire/Webconnect Piggy-Back / SMA Speedwire/Webconnect data module

  or
- Quick reference guide "Increased Self-Consumption with Sunny Island and Sunny Home Manager".

3.2.2 PV Inverters Supported by the Sunny Island System

If you want to retrofit an existing PV plant with the Sunny Island system for increased self-consumption, but do not require active power limitation, you can use PV inverters by any manufacturer. Active power limitation may be stipulated by the network operator or may bring financial rewards due to local legislation (e.g., a storage subsidy).

3.3 Energy Meters

3.3.1 SMA Energy Meter

The SMA Energy Meter is a meter which detects electricity values at the connection point and makes them available via Speedwire. The SMA Energy Meter is a bidirectional meter with either three-phase or single-phase connection.

Type	Counting direction	Interface	Sunny Home Manager		
		Speedwire	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
SMA Energy Meter	PV generation, purchased electricity or grid feed-in	✓	✓	✓	✓

The SMA Energy Meter is **NOT** an active electrical energy meter as defined in the EU Directive 2004/22/EG (MID). The SMA Energy Meter should not be used for billing purposes. The SMA Energy Meter will be available in June 2013.

3.3.2 Information on Selecting Energy Meters with S0 or D0 Interface

Design and Counting Direction

In systems for increased self-consumption, unidirectional and bidirectional meters are used in different ways:

- An energy meter designed as a unidirectional meter can record either the PV yield, the feed-in or the purchased electricity.
- An energy meter designed as a bidirectional meter can record both feed-in and purchased electricity.

Transmission Behaviour and Accuracy

The suitability of an energy meter for use in a system for increased self-consumption depends essentially on the transmission behaviour and the accuracy of its data interface:

Energy meter with S0 interface:

Energy meters with S0 interface in accordance with DIN EN 62053-31 Class A transmit the measured energy on the basis of counting pulses. The energy meters transmit between 250 and 10,000 pulses per measured kilowatt hour, and this rate determines how up-to-date the displayed energy values are. The higher the pulse rate, the better suited the energy meter.

Energy meters with S0 interface must meet the following requirements:

- Bidirectional meters with S0 interface must be equipped with two S0 interfaces.
- The pulse length of energy meters with S0 interface must be at least 20 ms and the pulse rate approximately 1,000 pulses per kWh.
- To comply with the Sunny Home Manager's "limitation of active power feed-in" function, the pulse rate of energy meters with S0 interface must be at least:
  - At a maximum permitted feed-in of more than 1,500 W: at least 250 pulses per kWh
  - At a maximum permitted feed-in of less than 1,500 W: at least 500 pulses per kWh

Output of net values at the S0 interface

Energy meters with S0 interface must output net values at the S0 interface. A net value is the total power aggregated over all three phase conductors. It does not permit any conclusion to be drawn about the state of each individual phase.

- If necessary, contact the manufacturer of the energy meter to clarify whether your meter outputs net values.

Energy meters with S0 interface can only be used with the Sunny Home Manager. To connect an energy meter with S0 interface to the Sunny Home Manager, you will need a four-pole plug and a connection cable (see Section 3.4.3 "Material for Energy Meter with S0 Interface", page 23).

Energy meter with D0 interface:

Energy meters with D0 interface in accordance with IEC 62056-21 Part 4.3 issue a transmission protocol in which the measured kilowatt hours are indicated with differing numbers of digits after the decimal point. The more digits after the decimal point an energy meter can transmit, the better it is suited for increasing self-consumption.

Energy meters with D0 interface must meet the following requirements:

- The resolution of energy meters with D0 interface must be at least 10 Wh.
- To comply with the "limitation of active power feed-in" function, the resolution of energy meters with D0 interface must be at least 1 Wh.

To connect an energy meter to the Sunny Island system or the Sunny Home Manager via a D0 interface, you will need one optical reading head per energy meter (see Section 3.4.2 "Material for Energy Meter with D0 Interface", page 23).

Installing an additional energy meter

Unsuitable energy meters can distort the measured energy values. These distorted energy values compromise the accuracy of the displayed diagrams and detract from the quality of the self-consumption increase with the Sunny Home Manager and Sunny Island system. These limitations especially affect the automatic activation of loads via SMA radio-controlled sockets, the limitation of active power feed-in and the control of buffering by the Sunny Island system.

If the energy meter used by the local network operator is not adequate for the specified requirements, it is advisable to install an additional energy meter. This additional energy meter must provide the required quality of meter values.

For this purpose, SMA Solar Technology AG recommends the **SMA Energy Meter**. The SMA Energy Meter will be available in June 2013.

The following energy meters have been tested by SMA Solar Technology AG and are also deemed suitable as house meters (see Section 3.3.3 "Energy Meters Tested by SMA with S0 or D0 Interface", page 18):

- Professional 3/75 from EMU Elektronik AG/MBS AG
- Allrounder 3/75 from EMU Elektronik AG/MBS AG

3.3.3 Energy Meters Tested by SMA with S0 or D0 Interface

SMA Solar Technology AG has tested the energy meters listed in this Section for use with the Sunny Home Manager or the Sunny Island system. However, these energy meters may have been configured differently by the manufacturer. Therefore, the energy meters sometimes behave differently despite having the same or a similar type designation to the energy meters tested by SMA Solar Technology AG. For this reason, in certain unfavourable cases, the energy meters might not be compatible with the Sunny Home Manager or the Sunny Island system.

Marking of the tested energy meters in the following tables

If the transmission behaviour and accuracy of the tested energy meter are adequate to support increased self-consumption, the relevant characteristic is marked with a ✓ for the energy meter in question.

Suitability of the tested meters for top-hat rail mounting

The vast majority of the energy meters listed in the following tables can only be mounted in the meter field of a junction box. Those energy meters which are suitable for top-hat rail mounting are accompanied by a footnote.

CIRCUTOR SA

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
CVM-1D*	Purchased electricity (single-phase**)	–	✓	✓	–	○

* This meter is only suitable for top-hat rail mounting.
** This meter is only suitable for single-phase home connections.

EasyMeter GmbH

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
Q3DA1004 v3.03	PV generation or purchased electricity	✓	–	✓	✓	–
Q3DA1024 v3.03	Feed-in and purchased electricity	✓	–	✓	✓	–
Q3DA1034 v3.03	PV generation or feed-in	✓	–	✓	✓	–

✓ Yes – No ○ Not tested

EMH Metering GmbH & Co. KG

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
ED300L W2E8-0N-E00-D2-000000-E50/L1	PV generation or feed-in	✓	–	✓	✓	✓
ED300L W2E8 -0N-E00-D2-000002-E50/Q2	Feed-in and purchased electricity	✓	–	✓	✓	○
eHZ-HW8E2AW L0EQ2P	Feed-in and purchased electricity	✓	–	✓	✓	✓
eHZ-HW8E2A5L 0EQ2P	Feed-in and purchased electricity	✓	–	✓	✓	○
MIZ*	Purchased electricity (single-phase**)	–	✓	✓	✓	○

* This meter is only suitable for top-hat rail mounting.
** This meter is only suitable for single-phase home connections.

EMU Elektronik AG/MBS AG

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
Allrounder 3/75*	PV generation or feed-in	–	✓**	✓	✓	–
Professional 3/75*	Feed-in and purchased electricity	–	✓ **	✓	✓	–

* This meter is only suitable for top-hat rail mounting.
** Configure the pulse rate of the S0 interface to 1,000 pulses/kWh.

✓ Yes – No ○ Not tested

Hager Vertriebsgesellschaft mbH & Co. KG

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
EHZ361D5T	PV generation or purchased electricity	✓	–	✓	✓	✓
EHZ361WA	PV generation or purchased electricity	✓	–	✓	✓	✓
EHZ361W5	PV generation or purchased electricity	✓	–	✓	✓	○
EHZ361Z5	Feed-in and purchased electricity	✓	–	✓	✓	○
EHZx61LA	PV generation or feed-in	✓	–	✓	✓	✓
EHZx61ZA	Feed-in and purchased electricity	✓	–	✓	✓	✓
EHZx62Zx	Feed-in and purchased electricity	✓	–	✓	✓	✓
EHZx63Lx	PV generation or feed-in	✓	–	✓	✓	✓
EHZx63Zx	Feed-in and purchased electricity	✓	–	✓	✓	✓

ISKRAEMECO GmbH Energiemess- und Regeltechnik

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
MT171-D2A52-V12G22-K0	Feed-in and purchased electricity	✓	✓	✓	✓*	–
MT174 D2A52-G22-M3K0	Feed-in and purchased electricity	✓	✓	✓	✓ *	–

* Only functions via the S0 interface. The value for limiting active power feed-in must be over 1,500 W.

x: placeholder for numbers 0 to 9 ✓ Yes – No ○ Not tested

Itron GmbH

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
ACE1000-280	Grid purchase (single-phase*)	✓	✓	✓	✓	○
ACE1000-280	Feed-in and purchased electricity (single-phase*)	✓	–	✓	✓	○
ACE3000 260-C21D-R1-A	PV generation or purchased electricity	✓	✓	✓	✓**	–
ACE3000 260-C41D-R2-A	Feed-in and purchased electricity	✓	–	✓	–	–
ACE3000 260-C40D-R1-A	Feed-in and purchased electricity	✓	–	✓	–	–

* This meter is only suitable for single-phase home connections.
** Only functions via the S0 interface.

Kamstrup A/S

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
382Jx3 684-38B-J1-31-070	PV generation or purchased electricity	✓	✓	✓	–	–

✓ Yes – No ○ Not tested

Landis+Gyr GmbH

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
ZMD120APEr53	PV generation or purchased electricity	✓	✓	✓	✓*	–
ZMD120APTr53	Feed-in and purchased electricity	✓	–	✓	–	–
ZME120ACdr53A	Feed-in and purchased electricity	✓	–	✓	–	–
ZMF120ACds2	Feed-in and purchased electricity	✓	–	✓	✓	–
ZMR120ACdS1	PV generation or purchased electricity	–	✓	✓	✓	–

* The value for limiting active power feed-in must be over 1,500 W.

NZR Nordwestdeutsche Zählerrevision

Type	Counting direction	Interfaces		Sunny Home Manager		
		D0	S0	Display of meter values in Sunny Portal	Automatic load control and active power limitation	Power control by the Sunny Island for energy storage
eHZ GW8E2A500AK2	PV generation or purchased electricity	✓	–	✓	✓	✓

✓ Yes – No ○ Not tested

3.4 Material for Connecting Energy Meters

3.4.1 Material for SMA Energy Meter

The SMA Energy Meter should be connected via a network cable to a network switch or a router with integrated switch. In systems for energy buffering, the SMA Energy Meter is connected directly to the Sunny Island.

3.4.2 Material for Energy Meter with D0 Interface

To connect an energy meter with a D0 interface to the Sunny Home Manager, you will need one optical reading head per energy meter.

SMA Solar Technology AG can supply an optical reading head with a cable and four-pole plug for the Sunny Home Manager. You can order the optical reading head as an accessory (SMA order number: HM-D0-METERADAPTER).

Reading head incompatible with Easy Meter GmbH energy meters

The energy meters from Easy Meter GmbH tested by SMA Solar Technology AG are not compatible with the reading heads supplied as an accessory by SMA Solar Technology AG.

- Use the optical reading head EASYCOM from co.met GmbH, or equivalent.
- Wire the four-pole plug included in the delivery of the Sunny Home Manager to the reading head COM-IR Q3D (see installation manual of the Sunny Home Manager at www.SMA-Solar.com).

3.4.3 Material for Energy Meter with S0 Interface

To connect an energy meter with S0 interface to the Sunny Home Manager, you will need a four-pole plug and a connection cable.

- The four-pole plug can be found in the scope of delivery of the Sunny Home Manager.
- The connection cable must meet the following requirements:
  - At least two insulated conductors per cable
  - Conductor cross-section: 0.2 mm^2 to 1.5 mm^2.
  - Maximum cable length: 30 m

3.5 Router

The router enables the Sunny Home Manager to connect to the Sunny Portal via the Internet.

When using the Sunny Home Manager, SMA Solar Technology AG recommends a permanent Internet connection and the use of a router which supports the dynamic assignment of IP addresses (DHCP – Dynamic Host Configuration Protocol).

4 Buffering of PV Energy with Sunny Island

4.1 Wiring Overview

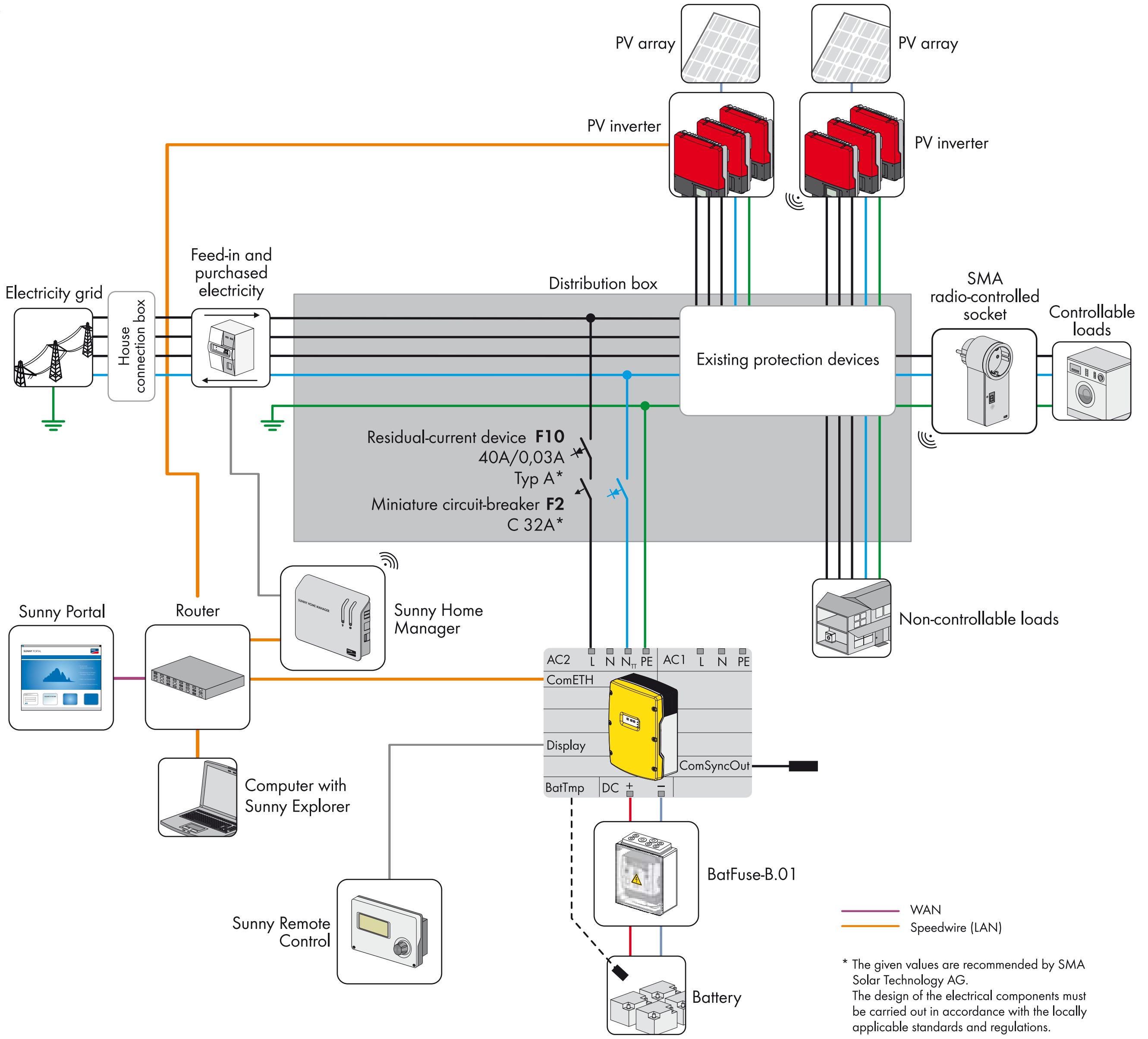

Figure 6: System for load control and energy buffering – with Speedwire and *Bluetooth* communication, using lead batteries (example)

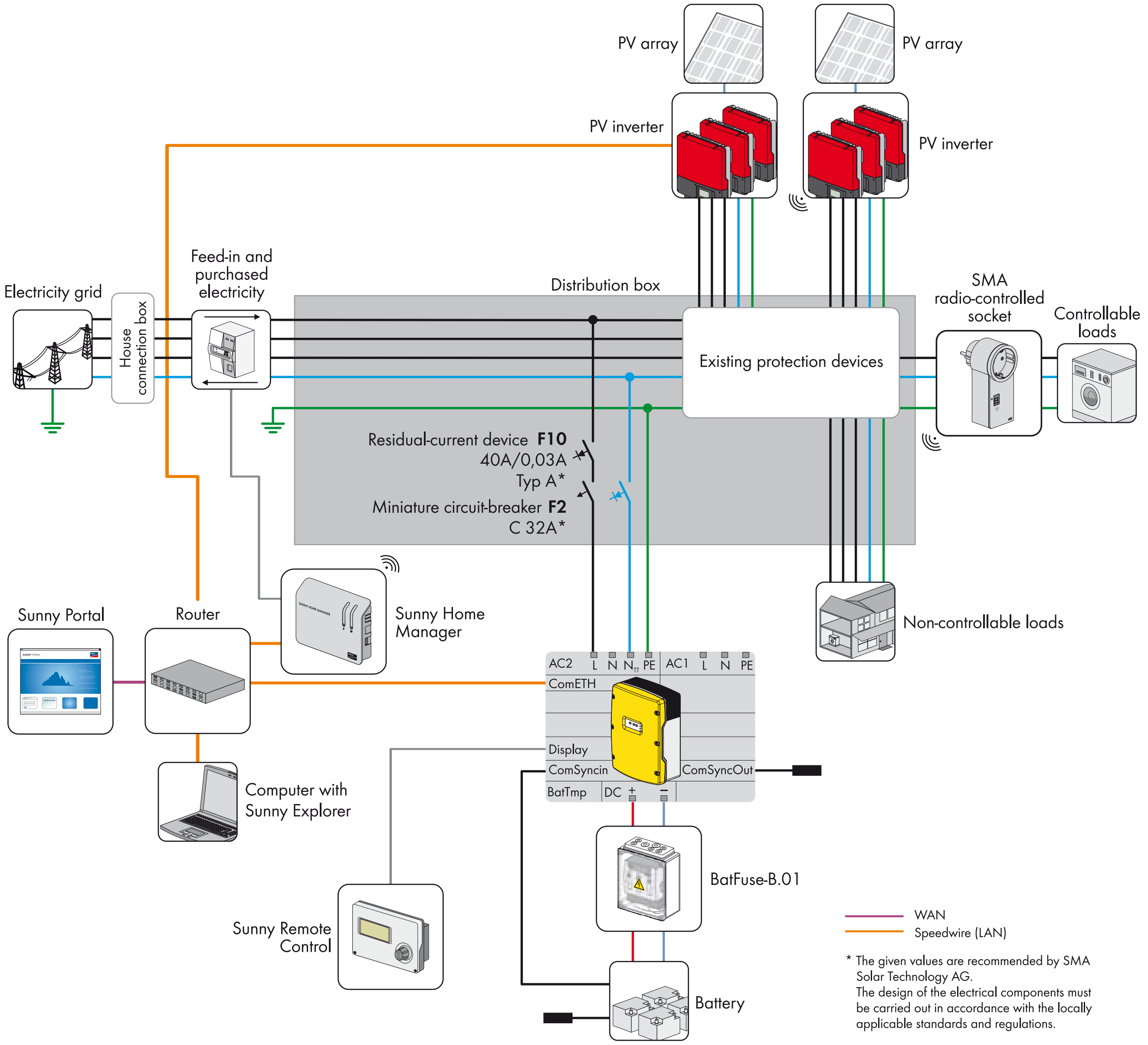

Figure 7: System for load control and intermediate energy storage – with Speedwire and *Bluetooth* communication, using lithium-ion batteries (example)

Wiring Diagram

A wiring diagram will be supplied with the delivery of the Sunny Island system.

4.2 Power Control for Energy Buffering

Net meters

The Sunny Island controls the buffering of electricity according to the values dictated by the bidirectional meter for grid feed-in and purchased electricity. The precondition for this is that the bidirectional meter for grid feed-in and purchased electricity only outputs net (offset) power values. A net value is the total power aggregated over all three phase conductors. It does not permit any conclusion to be drawn about the state of each individual phase.

Principle of Power Control

State of charge of the battery limits power control

Power control for the buffering of PV energy calls for frequent charging and discharging of the battery. This frequent charge/discharge cycle limits the battery service life. For this reason, the Sunny Island prescribes a minimum battery discharge limit, e.g., 50% of total battery capacity.

Power control for buffering only runs at levels above this discharge limit.

In a three-phase system, the Sunny Island controls increased self-consumption over all three phase conductors. To do this, the Sunny Island uses the values transmitted by the bidirectional meter for grid feed-in and grid purchase. These values result from the feed-in of the PV plant and the power consumed by the loads. Depending on the given situation, the bidirectional meter transmits a value for grid feed-in, grid purchase or a total power value of 0 kW to the Sunny Island. In the interests of achieving optimum self-consumption, the Sunny Island strives whenever possible to keep the total power stable at 0 kW.

- When electric power is fed into the electricity grid, the Sunny Island uses this excess power for charging the battery.
- When electric power is drawn from the electricity grid, the Sunny Island reduces the amount of purchased electricity by using the energy stored in the battery.

This principle is explained below by considering three exemplary situations.

Situation 1:

In the morning. At sunrise, the PV inverter starts feeding power to the grid and after a time reaches a feed-in capacity of 4 kW. The loads are still switched off.

The total power at the bidirectional meter for grid feed-in and grid purchase is reflected in the following equation:

$$P_{\text{Total power}} = 4\text{ kW} + 0\text{ kW} + 0\text{ kW} = 4\text{ kW}$$

The PV inverter is feeding its total PV power to the electricity grid via phase conductor 1. Power control now intervenes: the Sunny Island uses the PV power of 4 kW to charge the battery.

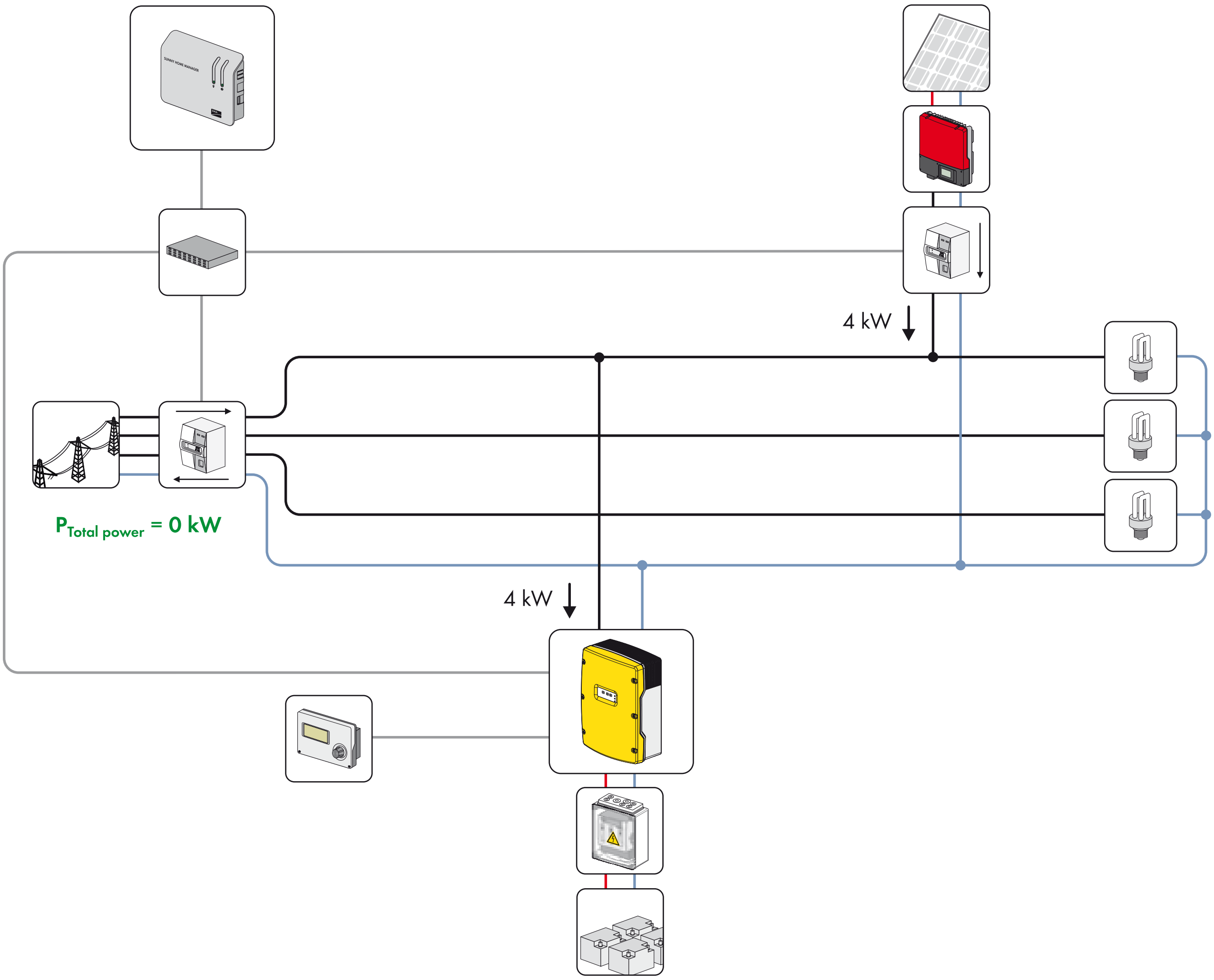

Figure 8: The Sunny Island is charging the battery.

The effect of this intervention on total power at the bidirectional meter is shown in the following equation:

$$P_{\text{Total power}} = 0\text{ kW} + 0\text{ kW} + 0\text{ kW} = 0\text{ kW}$$

Grid feed-in is no longer taking place.

Situation 2:

At midday. The battery is now fully charged. The PV inverter is still feeding in 4 kW of power. The loads are switched on and are drawing 2 kW of electric power on phase conductor 1, 1 kW on phase conductor 2 and 1 kW on phase conductor 3. The load on phase conductor 1 is using the power generated by the PV inverter directly, so that the inverter is consequently now only feeding 2 kW into the electricity grid. The loads on phase conductor 2 and 3 are drawing their power from the electricity grid.

The total power at the bidirectional meter for grid feed-in and grid purchase is reflected in the following equation:

$$P_{\text{Total power}} = 2\text{ kW} - 1\text{ kW} - 1\text{ kW} = 0\text{ kW}$$

Hence, there is in fact no grid feed-in and no grid purchase taking place. No intervention by the power control is necessary. The Sunny Island leaves the current state of charge of the battery unchanged.

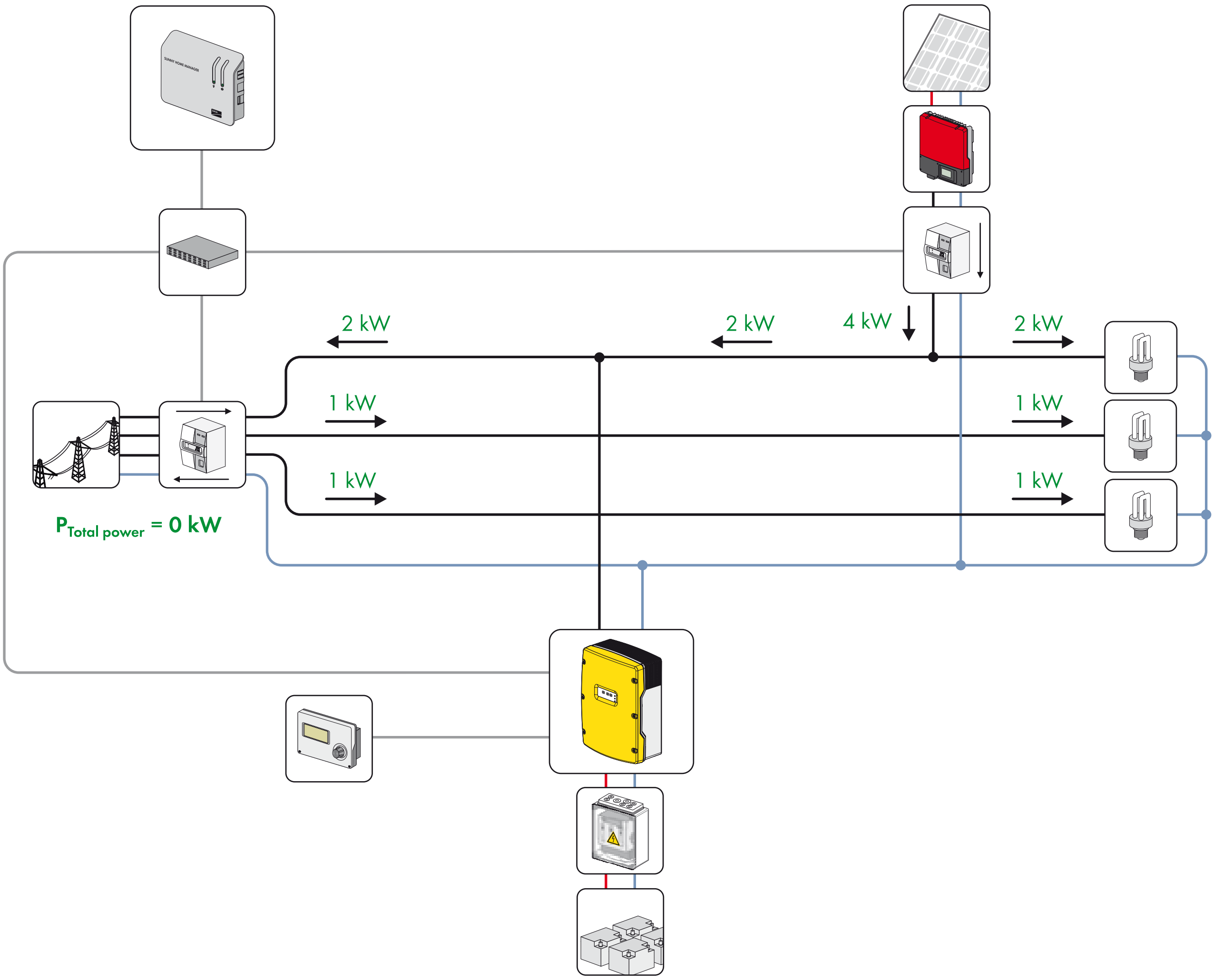

Figure 9: The loads are using the total PV power.

Situation 3:

In the evening. The PV inverter is no longer feeding in. The loads are still switched on and are drawing 2 kW of electric power on phase conductor 1, 1 kW on phase conductor 2 and 1 kW on phase conductor 3. All loads are now drawing their power from the electricity grid.

The total power at the bidirectional meter for grid feed-in and grid purchase is reflected in the following equation:

$$P_{\text{Total power}} = -2\ \text{kW} - 1\ \text{kW} - 1\ \text{kW} = -4\ \text{kW}$$

The electricity grid is the sole energy source for the loads supplying the with 4 kW. Power control now intervenes: the Sunny Island uses the buffered energy to supply the loads with the necessary power of 4 kW.

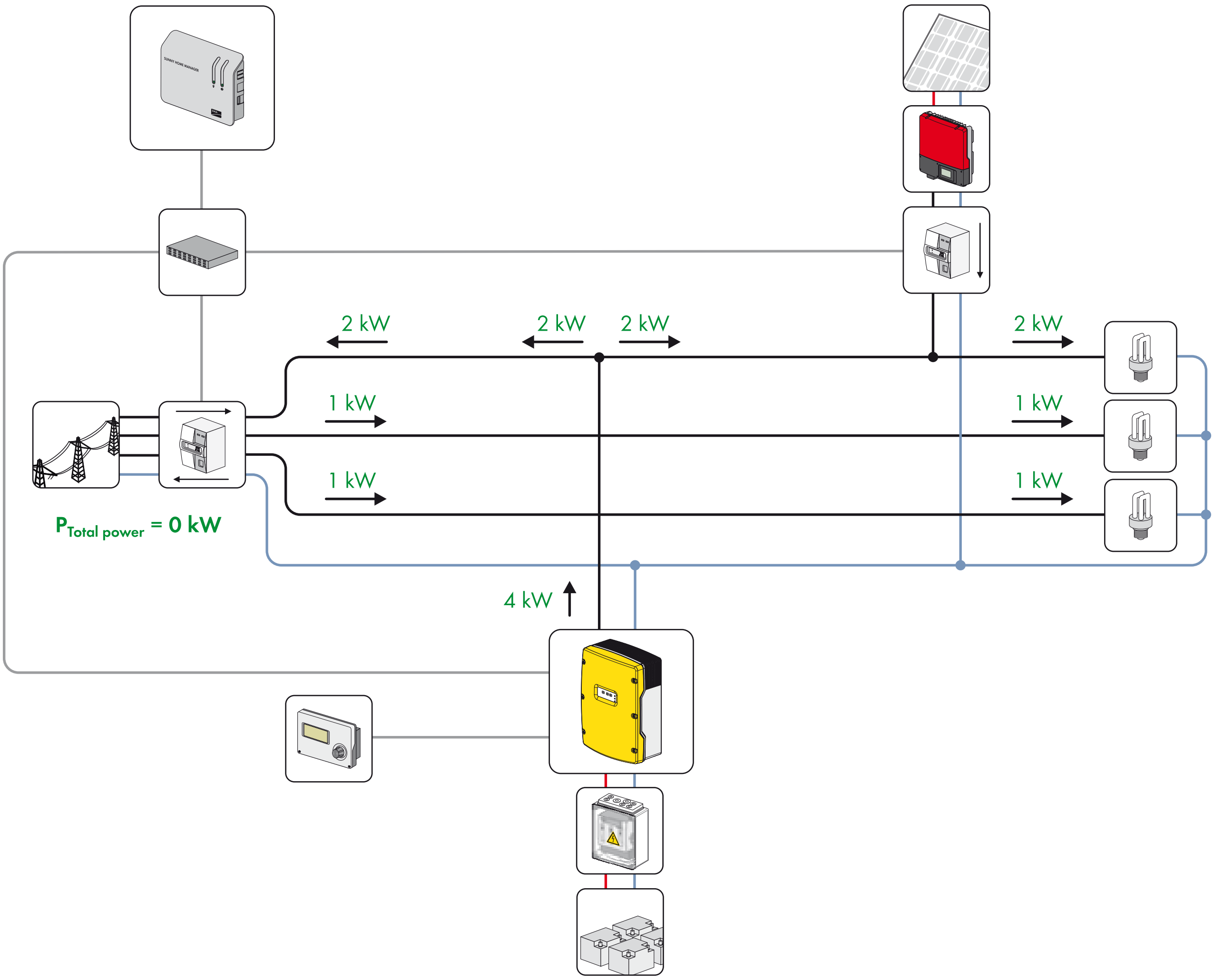

Figure 10: The Sunny Island is supplying the loads with buffered energy.

The effect of this intervention on total power at the bidirectional meter is shown in the following equation:

$$P_{\text{Total power}} = 2\ \text{kW} - 1\ \text{kW} - 1\ \text{kW} = 0\ \text{kW}$$

The buffered energy stored by the Sunny Island in the battery is sufficient to supply the loads. Energy is no longer being drawn from the grid.

As the above situations demonstrate, a single-phase Sunny Island system is capable of controlling increased self-consumption over all three phase conductors.

4.3 Material for Wiring the Sunny Island System

The following wiring material is required for the Sunny Island system for increased self-consumption:

Material	Number of units	Description
Miniature circuit-breaker for protection of the Sunny Island	1	32 A, C rating, 1-pole
Residual-current device	1	40 A/0.03 A, 1-pole + N, Type A

4.4 Batteries supported by the Sunny Island

Sunny Island supports lead batteries of types FLA and VRLA, and various lithium-ion batteries. Batteries with a capacity of 100 Ah to 10,000 Ah can be connected. The key criterion in systems for increased self-consumption is the battery cycle stability.

Lithium-ion batteries are especially suited for buffering of PV energy due to their high cycle stability. Lithium-ion batteries must be compatible with the Sunny Island.

Lithium-ion batteries from the following manufacturers are compatible with the Sunny Island:

- Akasol
- Dispatch Energy
- Leclanché
- LG Chem
- SAFT
- Samsung
- Sony

The battery management of lithium-ion batteries regulates the operation of the battery. To enable battery management, the lithium-ion battery must be connected to the Sunny Island via an RJ45 data cable. During configuration of the Sunny Island, set the battery type to lithium-ion battery in the Quick Configuration Guide. This deactivates the battery management of the Sunny Island and replaces it with the battery management of the lithium-ion battery.

SMA Solar Technology AG has only tested the communication between the Sunny Island and the battery management of compatible lithium-ion batteries. If you require information concerning other technical characteristics of the batteries, please contact the respective manufacturer.

5 Methods for Designing Sunny Island Systems

5.1 Plant Design using Charts

The design serves as an orientation and a starting point for in-depth plant planning.

Plant Planning without Sunny Home Manager

The considerations on plant planning put forward in this section refer exclusively to the buffering of PV energy and hence only to the design of a Sunny Island system with the Sunny Island 6.0H.

Charts for Plant Design

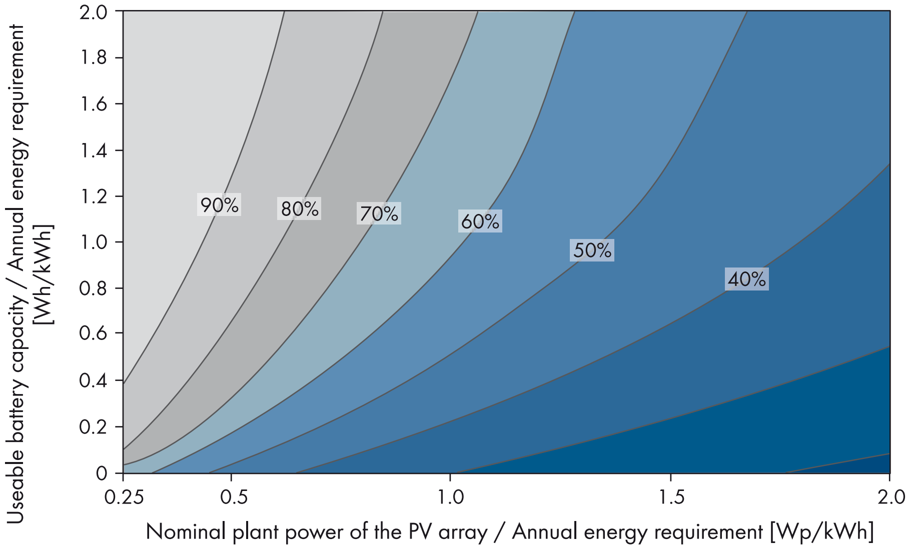

Figure 11: Estimate of self-consumption rate

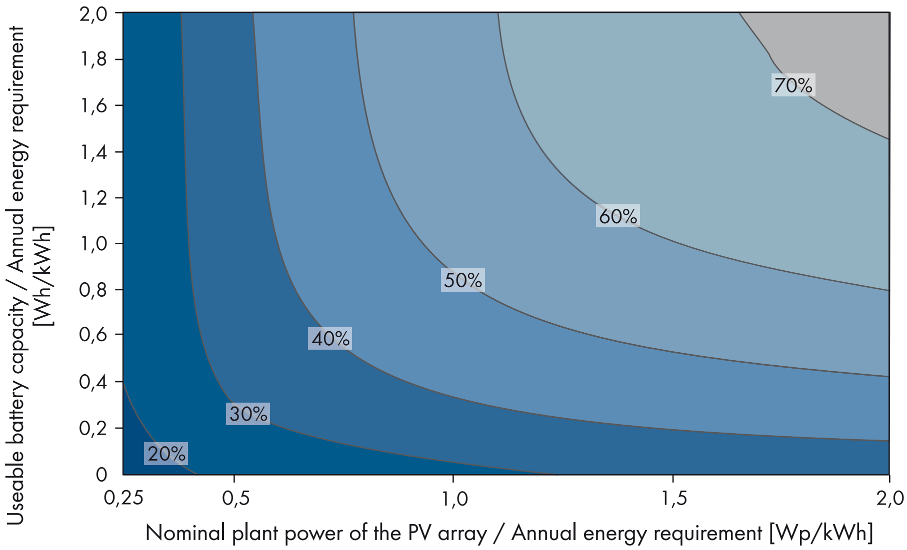

Figure 12: Estimate of the degree of self-sufficiency

In order to carry out plant design by means of these charts, the following starting parameters must be known:

- Nominal power of the PV array
- Useable battery capacity
- Annual energy requirement of the loads

From these three starting parameters, you should calculate the values for the horizontal and vertical axes of each chart, according to the axis legend. The two values meet at one point. The curve for self-consumption rate or the curve for degree of self-sufficiency is described by this point.

Step 1: Estimating the Self-Consumption Rate without Buffering

In the first step of designing a Sunny Island system for increased self-consumption, you will need to estimate the self-consumption without buffering. The useable battery capacity is not taken into account here. The natural self-consumption attainable in one year is dependent on the annual energy requirement and the nominal power of the PV array.

Example:

Input data:

- Nominal power of the PV array: 5,000 Wp
- Annual energy requirement: 5,000 kWh
- Useable battery capacity: 0, as in Step 1 the self-consumption rate is estimated without buffering.

$$\frac{\text{Nominal power of the PV array}}{\text{Annual energy requirements}} = \frac{5{,}000\ \text{Wp}}{5{,}000\ \text{kWh}} = 1\ \text{Wp/kWh}$$

$$\frac{\text{Useable battery capacity}}{\text{Annual energy requirement}} = \frac{0\ \text{Wh}}{5{,}000\ \text{kWh}} = 0\ \text{Wh/kWh}$$

Transfer the calculated values to the chart to estimate the self-consumption rate.

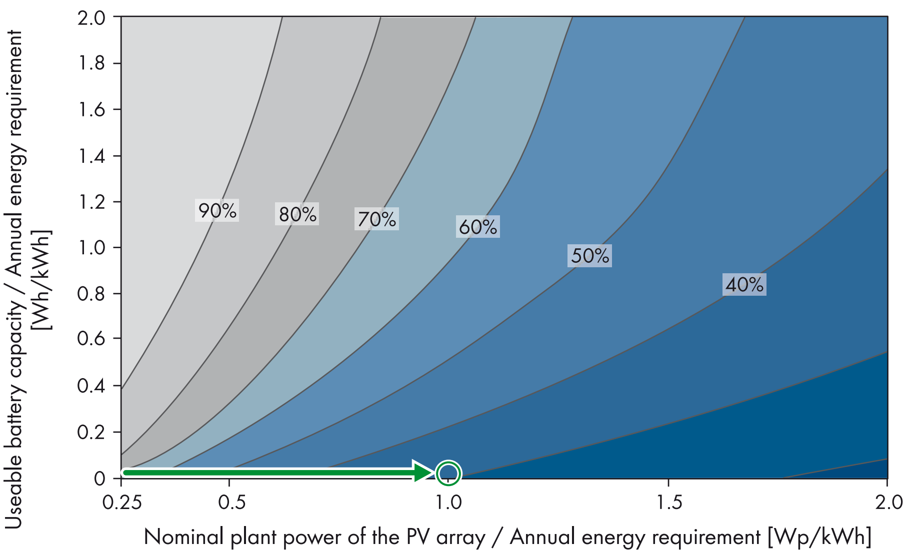

Figure 13: Estimate of self-consumption rate without buffering

The estimate reveals that without buffering measures, the on-site loads use 30% of the PV energy produced.

Step 2: Estimating the Self-Consumption Rate with Buffering

When buffering PV energy, you can influence the self-consumption rate by changing the battery capacity. Here, you must bear in mind that buffering requires frequent charging and discharging of the battery. This frequent charge/discharge cycle limits the battery service life. To prevent premature failure of the battery, the Sunny Island only uses a part of the total battery capacity for buffering purposes. This part will be referred to in the following as useable battery capacity, and can be configured in the Sunny Island. For lead batteries, the useable battery capacity is approximately 50% of the total battery capacity, and for lithium-ion batteries it is approximately 80%.

Example:

Input data:

- Nominal power of the PV array: 5,000 Wp
- Annual energy requirement: 5,000 kWh
- Total battery capacity: 10,000 Wh, of which the Sunny Island uses 50% for increasing self-consumption

Hence the useable battery capacity amounts to 5,000 Wh.

$$\frac{\text{Nominal power of the PV array}}{\text{Annual energy requirements}} = \frac{5{,}000\ \text{Wp}}{5{,}000\ \text{kWh}} = 1\ \text{Wp/kWh}$$

$$\frac{\text{Useable battery capacity}}{\text{Annual energy requirement}} = \frac{5{,}000\ \text{Wh}}{5{,}000\ \text{kWh}} = 1\ \text{Wh/kWh}$$

Transfer the calculated values to the chart to estimate the self-consumption rate.

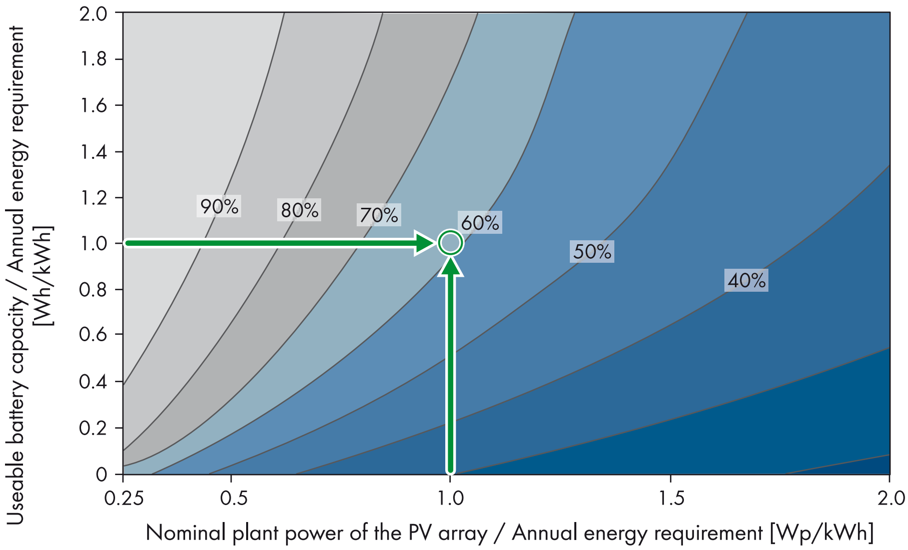

Figure 14: Estimate of self-consumption rate with buffering

The estimate reveals that the self-consumption rate with buffering is approximately 60%.

Step 3: Calculating the Increase in Self-Consumption through Buffering

Example:

Input data:

- Self-consumption rate without buffering: 30%
- Self-consumption rate with buffering: 60%

$$\text{Self-consumption rate with buffering} - \text{Self-consumption rate without buffering} = 60\% - 30\% = 30 \text{ percentage points}$$

In this example, the self-consumption rate has been increased by 30 percentage points due to buffering of energy.

Schritt 4: Estimating the Battery Service Life

Taking the guaranteed 20-year period for PV feed-in tariff as a basis, the battery will need to be replaced at least once due to its calendar life expectancy. To make the most efficient use of the battery, we therefore recommend replacement after approximately ten years.

The first step in sizing the battery consists of establishing the number of annual battery cycles. In one battery cycle, the battery is fully charged and discharged once. The number of annual battery cycles can be calculated as follows:

$$\text{Annual battery cycles} = \frac{\text{Generated PV energy x increased self-consumption}}{\text{Total battery capacity}}$$

You can calculate the battery life from the total number of battery cycles (100% cycles) specified by the battery manufacturer, as follows:

$$\text{Battery life} = \frac{\text{Total number of battery cycles}}{\text{Annual battery cycles}}$$

Example:

Input data:

- Generated PV energy: 4,500 kWh (assumed value for a PV plant in central Germany with nominal power of the PV array 5,000 Wp)
- Increased self-consumption (step 3): 30%
- Total battery capacity: 10 kWh
- Total number of 100% battery cycles: 1,200 (lead battery, OPzV, from the datasheet of a battery manufacturer)

$$\text{Annual battery cycles} = \frac{4{,}500 \text{ kWh} * 0.30}{10 \text{ kWh}} = 135$$

$$\text{Battery life} = \frac{1{,}200}{135/a} = 8.89 \text{ years} \sim 9 \text{ years}$$

Influence of battery capacity on battery life

To increase an inadequate battery life, you can select a larger battery capacity. Changing the battery capacity also results in a change in increased self-consumption (step 2).

Step 5: Estimating the Degree of Self-Sufficiency without Buffering

Example:

Input data:

- Nominal power of the PV array: 5,000 Wp
- Annual energy requirement: 5,000 kWh
- Useable battery capacity: 0, as in Step 5 the degree of self-sufficiency is estimated without buffering.

$$\frac{\text{Nominal power of the PV array}}{\text{Annual energy requirements}} = \frac{5{,}000\ \text{Wp}}{5{,}000\ \text{kWh}} = 1\ \text{Wp/kWh}$$

$$\frac{\text{Useable battery capacity}}{\text{Annual energy requirement}} = \frac{0\ \text{Wh}}{5{,}000\ \text{kWh}} = 0\ \text{Wh/kWh}$$

Transfer the calculated values to the chart to estimate the degree of self-sufficiency.

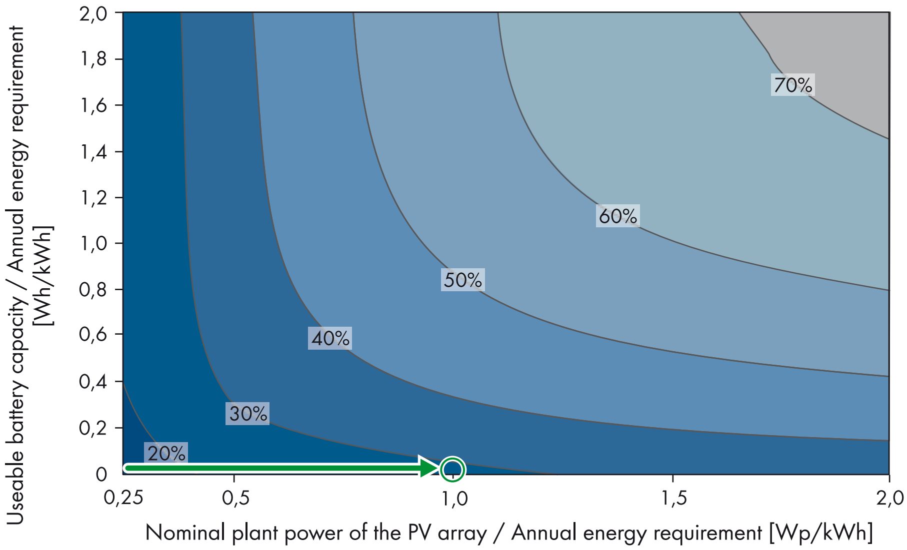

Figure 15: Estimate of the degree of self-sufficiency without buffering

The estimate reveals that without buffering a degree of self-sufficiency of approximately 28% is achieved.

Step 6: Estimating the Degree of Self-Sufficiency with Buffering

Example:

Input data:

- Nominal power of the PV array: 5,000 Wp
- Annual energy requirement: 5,000 kWh
- Total battery capacity: 10,000 Wh, of which the Sunny Island uses 50% for increasing self-consumption

Hence the useable battery capacity amounts to 5,000 Wh.

$$\frac{\text{Nominal power of the PV array}}{\text{Annual energy requirements}} = \frac{5{,}000\ \text{Wp}}{5{,}000\ \text{kWh}} = 1\ \text{Wp/kWh}$$

$$\frac{\text{Useable battery capacity}}{\text{Annual energy requirement}} = \frac{5{,}000\ \text{Wh}}{5{,}000\ \text{kWh}} = 1\ \text{Wh/kWh}$$

Transfer the calculated values to the chart to estimate the degree of self-sufficiency.

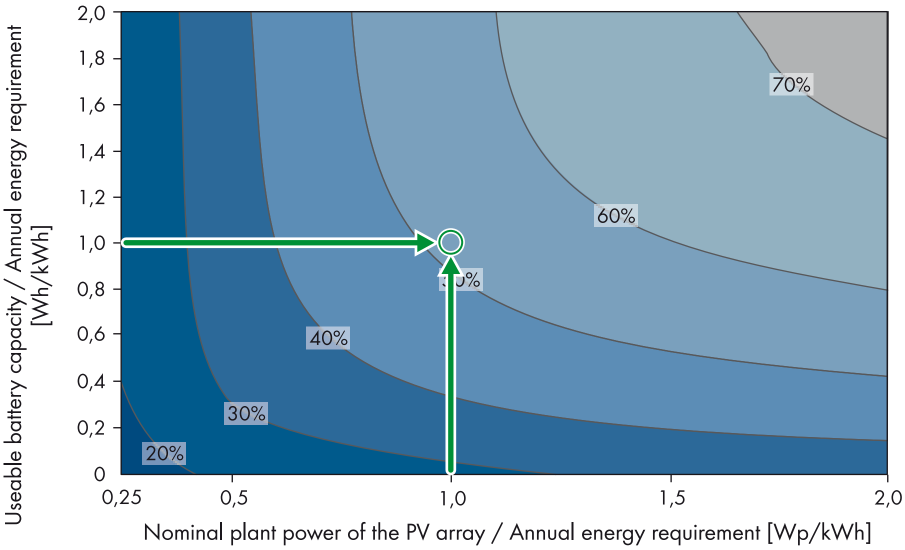

Figure 16: Estimate of the degree of self-sufficiency with buffering

The estimate reveals that with buffering a degree of self-sufficiency of approximately 52% is achieved.

5.2 Plant Design with Sunny Design Web

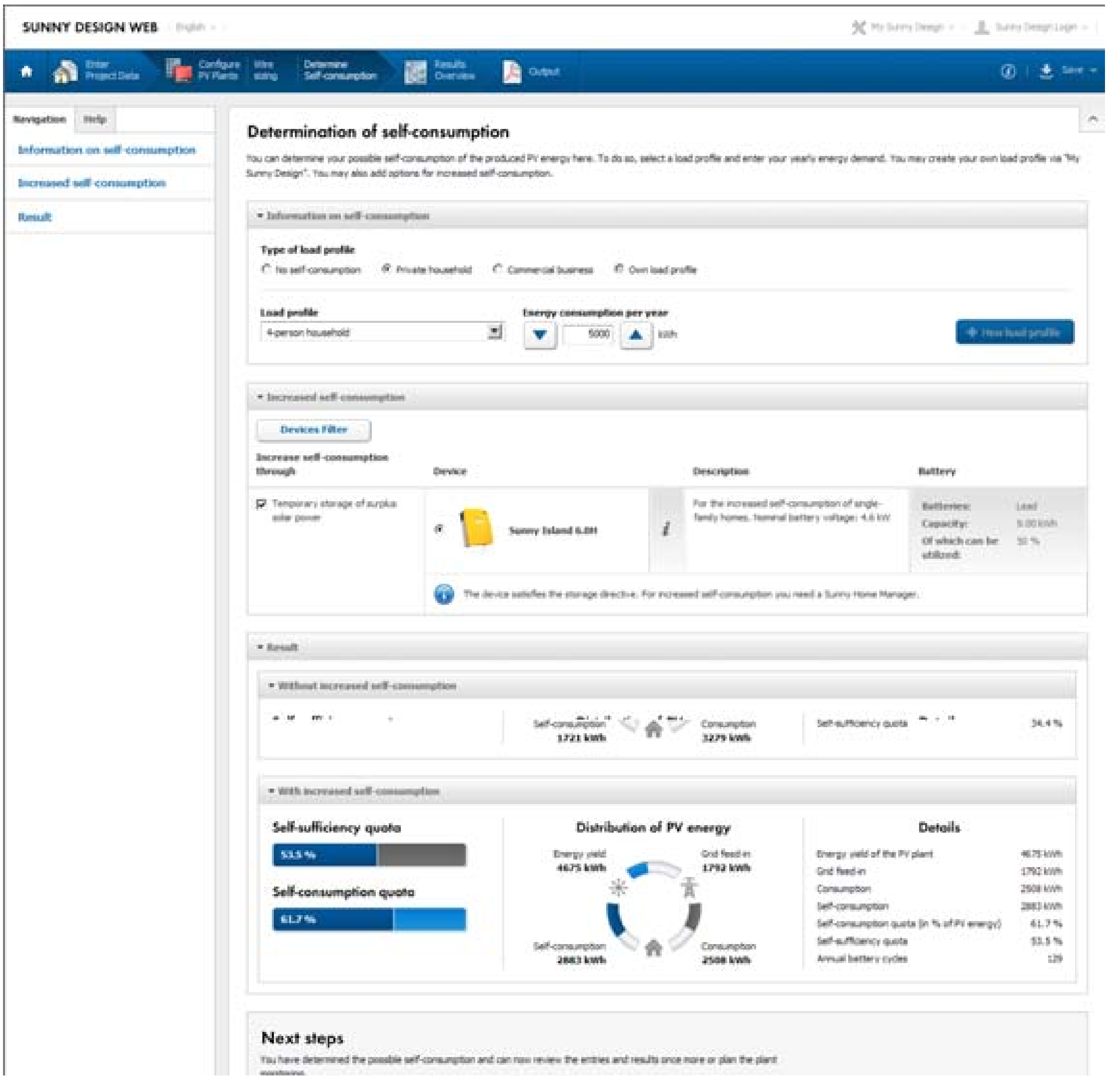

Figure 17: Example of plant design with Sunny Design Web based on an estimate of self-consumption

Sunny Design Web is a software for planning and designing PV plants. Sunny Design will provide a recommendation for a possible design option for your PV plant, including an estimate of the self-consumption rate and the degree of self-sufficiency achievable by buffering PV energy (see design software "Sunny Design Web" at www.SunnyDesignWeb.com).

5.3 Example: Data from a Real Sunny Island System

Characteristics of a real Sunny Island system after one year of data monitoring:

- Nominal power of the PV array: 3.24 Wp
- Annual energy requirement: approximately 4,200 kWh
- Useable battery capacity: 3.5 kWh

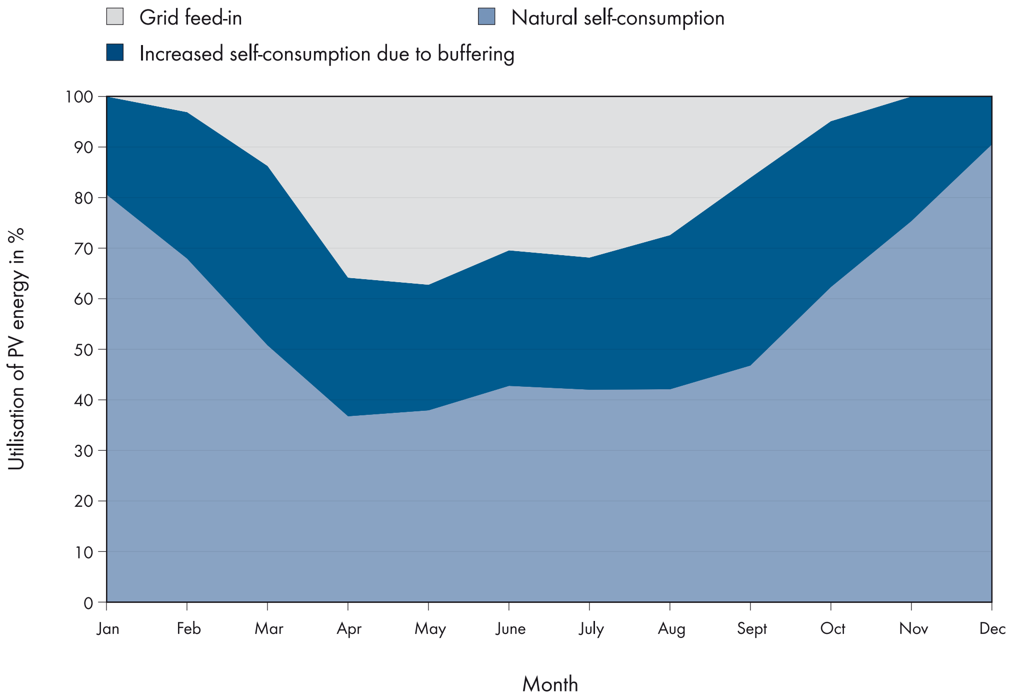

Figure 18: Percentage of self-consumption of PV energy in a real Sunny Island system

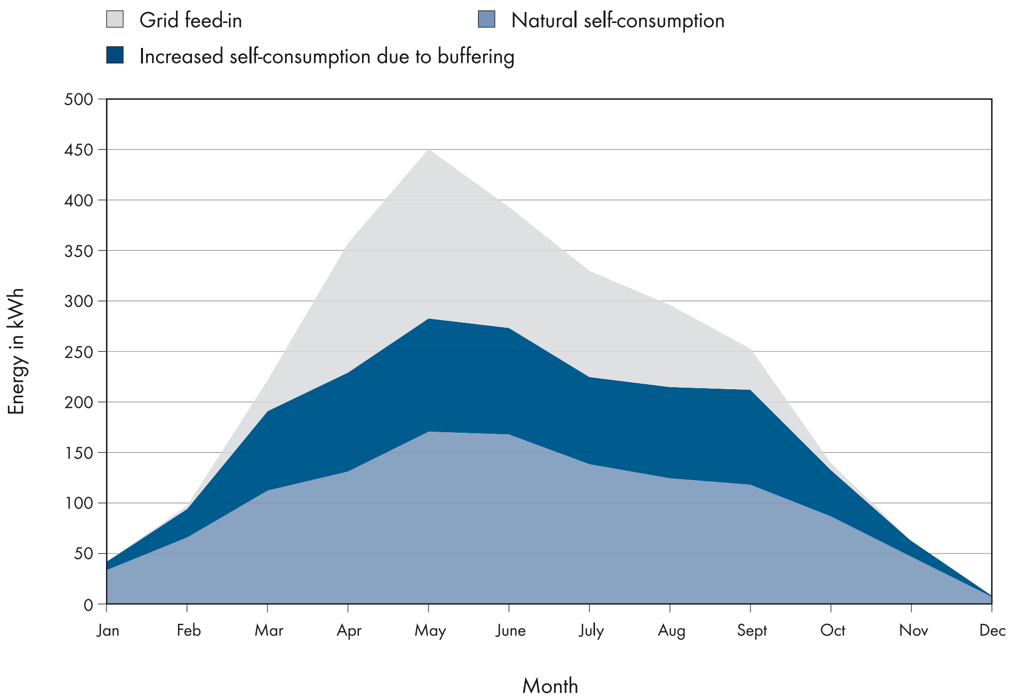

Figure 19: Absolute values for feed-in and self-consumption of a real Sunny Island system

6 Frequently Asked Questions

Is it possible to retrofit existing PV plants with the load control or energy buffering system?

Yes. New and existing PV plants can be retrofitted with the load control and energy buffering systems.

Do any limitations apply to the PV plant when using the energy buffering system?

No. The energy buffering system is technically independent of the nominal power of the PV array in the plant. Whether an energy buffering system makes economic sense will need to be evaluated in each individual case.

- Use Sunny Design Web to design and evaluate a system for energy buffering (for Sunny Design see www.SMA-Solar.com).

  or

  Use the method described in this document to design and evaluate the system for energy buffering (see Section 5.1 "Plant Design using Charts", page 31).

Can PV inverters from other manufacturers be installed in the system for buffering PV energy?

Yes. Any PV inverter, regardless of the manufacturer, can be installed in a system for energy buffering.

Which batteries can be used?

Sunny Island supports all lead batteries of types FLA and VRLA, and various lithium-ion batteries. The crucial factor for energy buffering systems is the cycle stability of the battery (see Section 4.2 "Power Control for Energy Buffering", page 26).

What battery capacities are permitted for a Sunny Island system?

The battery capacity can be freely selected within a wide range. Batteries with a capacity of 100 Ah to 10,000 Ah can be connected to a Sunny Island. This corresponds to a maximum storage capacity of 480 kWh if a battery with 48 V and 10,000 Ah is used.

Is it possible to integrate other energy sources apart from the PV plant in the energy buffering system?

Yes. You can install other AC sources, e.g., a CHP plant. However, if you are combining energy buffering and load control, you should note the following:

i The Sunny Home Manager does not support wind power inverters or CHP plants

The Sunny Home Manager only supports PV inverters. If your Sunny Island system combines various AC sources (e.g., a PV plant and a small wind turbine system), the Sunny Home Manager will only be able to detect the PV inverters and limit their power. In the Sunny Home Manager plant, no wind power inverters or CHP plants will be displayed in Sunny Portal. Since the data from wind power inverters or CHP plants cannot be taken into account by the Sunny Home Manager, the data calculated in Sunny Portal and the displayed charts may be inaccurate.

What if the network operator uses different energy meters?

Due to different energy meter protocols, it cannot be guaranteed that energy meters other than those tested by SMA Solar Technology AG will be supported. If an energy meter installed on site does not work, install an additional energy meter as house meter and use its data for evaluation, (see Section 3.3.1 "SMA Energy Meter", page 16) and (see Section 3.3.2 "Information on Selecting Energy Meters with S0 or D0 Interface", page 16).

Is it possible to connect a single-phase system for energy buffering to a three-phase PV inverter?

Yes. Single-phase systems for energy buffering can be connected to three-phase PV inverters.

What happens if there is a power cut?

The Sunny Island disconnects from the electricity grid. In this case, the Sunny Island reacts just like a PV inverter.

Will I receive information on the Sunny Island in Sunny Portal?

Yes, providing that the Sunny Island is connected to a communication device, e.g., the Sunny Home Manager.

If this is the case, you will, for instance, be able to view charts on the state of charge/discharge of the battery or information on the current self-consumption rate via Sunny Portal..

What is the output power of the Sunny Island?

The output power of the Sunny Island 6.0H is 6 kW for 30 minutes. For buffering of PV energy, the output power of the Sunny Island is limited to 4.6 kW due to the standard requirements.

Is it possible for two Sunny Islands to feed in via a single phase?

No. Only one Sunny Island can feed in per phase conductor.

How much maintenance work does the system involve?

The Sunny Island is largely maintenance-free (see operating manual of the Sunny Island). Information on battery maintenance can be obtained from the battery manufacturer.

Legal Provisions

The information contained in this document is the property of SMA Solar Technology AG. Publishing its content, either partially or in full, requires the written permission of SMA Solar Technology AG. Any internal company copying of the document for the purposes of evaluating the product or its correct implementation is allowed and does not require permission.

SMA Manufacturer's Warranty

The current warranty conditions come enclosed with your device. These are also available online at www.SMA-Solar.com and can be downloaded and are available on paper from the usual sales channels if required.

Trademarks

All trademarks are recognised even if these are not marked separately. Missing designations do not mean that a product or brand is not a registered trademark.

The *Bluetooth*® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by SMA Solar Technology AG is under licence.

QR Code® is a registered trademark of DENSO WAVE INCORPORATED.

SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Tel. +49 561 9522-0
Fax +49 561 9522-100
www.SMA.de
E-Mail: info@SMA.de

SMA Solar Technology

www.SMA-Solar.com