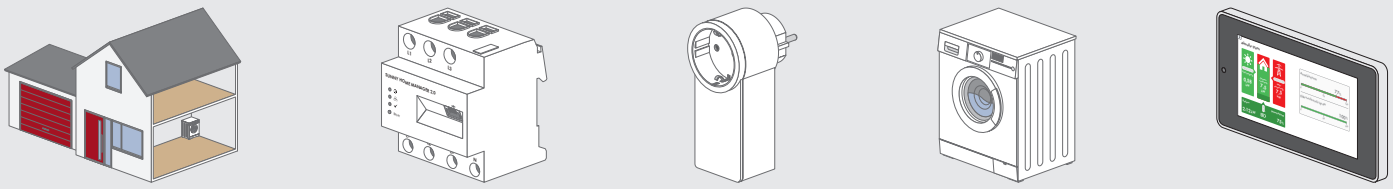
Technical Information

SMA SMART HOME - Load Control via MUST Time Period
Example: Washing Machine



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1 Application

A load in the SMA Smart Home needs to be switched on and operated for a specified minimum duration. The load, in other words, MUST run for the specified duration. You want Sunny Home Manager to automatically switch the load on and off during a configured time period so that the load mostly consumes PV energy and incurs the lowest-possible energy costs during operation.

Requirements for controlling loads in the SMA Smart Home:

☐ The load must have a defined operating duration (e.g., a washing machine has a typical program run time of 150 minutes, or a heating rod must heat water for at least 90 minutes a day).

☐ The load does not have to run exactly at a specific time. The load can be operated at any time within a user-defined time period.

Length of time period

The time period within which the load is supposed to be operated must be significantly longer than the actual operating duration so that Sunny Home Manager has enough leeway within the time period to be able to identify the times when energy is the cheapest.

Loads that have to start up immediately after being switched on (e.g., a toaster or vacuum cleaner) do not lend themselves to being controlled by Sunny Home Manager.

Background information

The SMA Smart Home distinguishes between two types of loads:

- Non-program-controlled loads
- Program-controlled loads

Non-program-controlled loads

These loads must be able to switch on and off as needed. Typical non-program-controlled loads include pool pumps or heating rods in hot water storage tanks.

When loads are controlled by Sunny Home Manager, they can optionally be switched on whenever there is enough PV energy or whenever the actual energy costs fall below the configured maximum threshold. The load can also be switched off quickly if the switch-on condition is no longer met, as when the weather suddenly changes. To prevent loads from being switched on and off too frequently, you can configure a minimum switch-on time and a minimum switch-off time when configuring the load characteristics on Sunny Portal.

To see an application example that uses a non-program-controlled load in the SMA Smart Home, see the "SMA SMART HOME - Load control via CAN time period (example: pool pump)" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com.

Program-controlled loads

A program-controlled load runs through a preset program during operation. The program is typically selected by the user prior to operation and started by pressing the start button on the load. Once the program has started, the load should no longer be interrupted. Typical program-controlled loads include washing machines, dishwashers and clothes dryers.

Sunny Home Manager can only control a program-controlled load if, after an interruption in the power supply, the load's program picks up at the point where the power supply was interrupted.

Example: Using a washing machine in the SMA Smart Home

A washing machine is a program-controlled load. We make the following assumptions for our washing machine:

- The typical wash program lasts **150 minutes**.
- The washing machine has a typical power consumption of **1000 W** (according to the type label).
- **Wednesday and Friday** are "laundry days" for this family. The washing machine is not normally used on the other days.
- On a laundry day, the washing machine is typically filled with laundry **at 8:00 am** and then put on standby.
- The laundry does not have to be done **before 5:00 pm** on the same day.

Here is how to find out if Sunny Home Manager can control your washing machine (or similar appliance):

1. Fill the washing machine with laundry and press the start button on the washing machine.
   ☑ The washing machine will start.
2. Unplug the washing machine's power plug from the outlet in order to interrupt the power supply.
3. Wait approx. 30 seconds and then insert the power plug back in the outlet.
   ✓ If the washing machine resumes running on its own and ends the program properly, it can be controlled by Sunny Home Manager.
   ✖ If you have to press the start button again or if the program starts again from the beginning, the washing machine cannot be effectively controlled by Sunny Home Manager.

2 Connection

The washing machine is integrated into the SMA Smart Home as a load by connecting it to a radio-controlled socket. The radio-controlled socket is placed right between the wall socket and the power plug for the load.

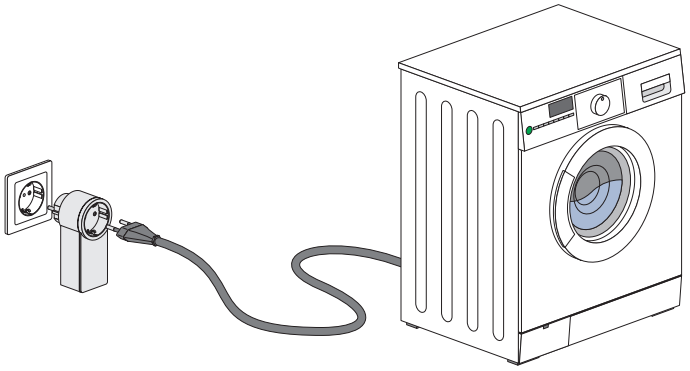


Figure 1: Connecting the washing machine to the radio-controlled socket

3 Configuration

3.1 Configuring Load Characteristics

Once the washing machine has been integrated into your SMA Smart Home with a radio-controlled socket, you will have to configure the load characteristics and time periods for operating the load in your Sunny Home Manager system on Sunny Portal. Sunny Portal is the user interface for Sunny Home Manager (for registration and login information, see the Sunny Home Manager installation manual).

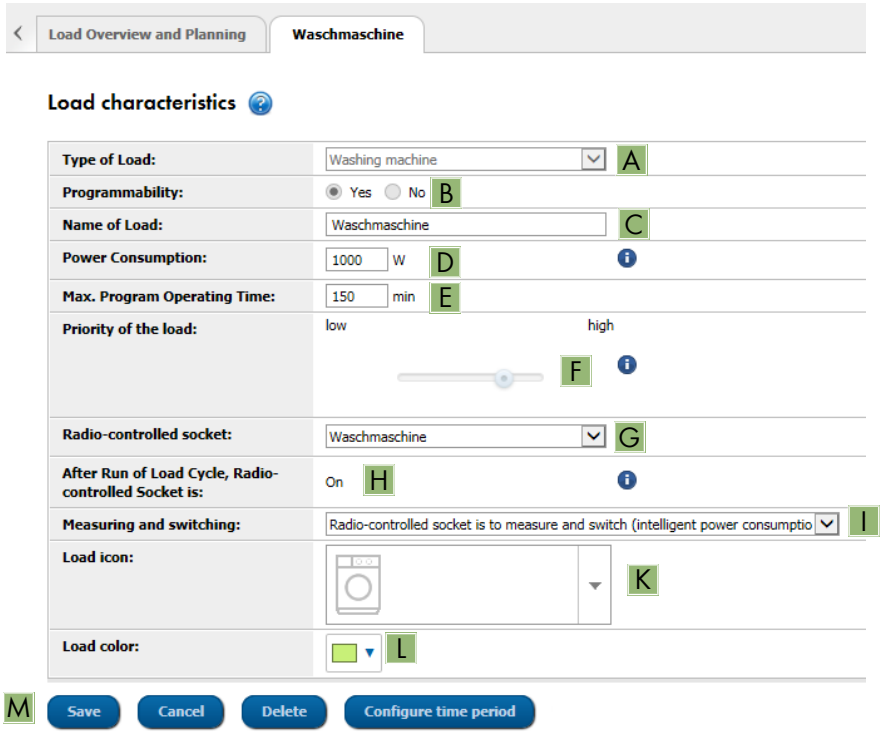


Figure 2: Configuring load characteristics

Position	Setting/Explanation
–	Enter a new load called "Washing machine" on Sunny Portal.
A	**Type of load** Select **washing machine** as the type of load. Sunny Portal already has a preconfigured load profile for this type of load in which certain settings are already selected by default (see Position B).
B	**Load is program-controlled** The washing machine is program-controlled so **Yes** is pre-selected and cannot be changed.
C	**Name of load** You can name the load here, e.g. "Washing_machine_basement 1". Maximum number of characters: 24
D	**Power consumption** Enter the average power consumption of the washing machine (see manufacturer's information on the type label for the washing machine). This value must be stated in watts (1 kW = 1,000 W).
E	**Max. program operating time** Enter the maximum operating time, in minutes, of the wash program that you typically use. Example: A 90 °C wash program runs 150 minutes, so you enter **150** in this field.

Position	Setting/Explanation
F	**Priority of the load** Enter the priority that Sunny Home Manager should give to the washing machine when planning loads. Information on energy allocation: • Loads with MUST time periods receive surplus PV energy first. • Any surplus PV energy left over will be first allocated to the storage battery of any available Sunny Boy Smart Energy or Sunny Island before any loads with CAN time periods are considered. • If there are several loads with MUST time periods, the lowest-cost energy will be allocated to the load which you have given the higher priority using the slider. • If there is not enough low-cost PV energy for all the loads with MUST time periods, lower-priority loads may use more expensive power from the utility grid.
G	**Radio-controlled socket** Select the radio-controlled socket that the washing machine is plugged into. The drop-down list shows all the available radio-controlled sockets in the system along with their names (generally with several digits from their serial number for identification). Some radio-controlled sockets are already assigned to other loads, as indicated by an asterisk (*) next to their name, and cannot be selected for the current load. You have the following options if the washing machine is not yet connected to a radio-controlled socket: • Connect the washing machine to a new radio-controlled socket and add the new radio-controlled socket to the Sunny Home Manager system as a new device on the **Device Overview > Overview of New Devices** page on Sunny Portal. • Disconnect a radio-controlled socket currently assigned to another load from this other load. To do this, edit the load characteristics for the load and then assign the radio-controlled socket to the washing machine. Then, plug the washing machine into the radio-controlled socket. If needed, you can save the configured load characteristics without assigning a radio-controlled socket. This will render the washing machine inactive, though. It will not be controlled by Sunny Home Manager, nor will it appear in the load diagrams. Once you assign the washing machine to a radio-controlled socket (at a later time), the washing machine will have its energy consumption tracked and will be actively included in energy management.
H	**After Run of Load Cycle, Radio-controlled Socket is...** The washing machine is a program-controlled load, so the setting **On** is selected by default and cannot be changed. The washing machine automatically goes into standby when it is done running. The radio-controlled socket continues to supply the washing machine with power so that certain functions, such as program selection and the start button, can still be used in standby mode. If the radio-controlled socket is unplugged from the wall socket and then plugged back in, the radio-controlled socket will return to the operating state in which it had been prior to being unplugged from the wall socket.

Position	Setting/Explanation
I	**Measuring and switching** Select **Radio-controlled socket is to measure and switch (intelligent power consumption)** if it is not already set by default. Sunny Home Manager "learns" how much power the load typically consumes based on the consumption values measured by the radio-controlled socket. Sunny Home Manager uses this information for load planning.
K	**Load icon** The system has a default icon for washing machines. If you wish, you can upload your own icon from your local hard drive and use that instead. The image will be automatically cropped (supported file formats: JPG, JPEG, PNG, GIF, BMP).
L	**Load color** Select the color to be used when displaying the washing machine's measured values in the energy and power diagrams. The system will automatically assign a color if you do not select one yourself. You can change the color in the load characteristics at any future point in time.
M	**Save** Save the settings after you are done with the configuration. An information message will appear if you have not assigned a radio-controlled socket to the washing machine. Next, you can configure the time period in which you want the washing machine to run the wash program.

3.2 Configuring the Time Period

The "Configure time period" window will show different options depending on the configured load characteristics. The **Load running** setting uses daily time windows by default. In other words, this time period applies to every day of the week in the same way:

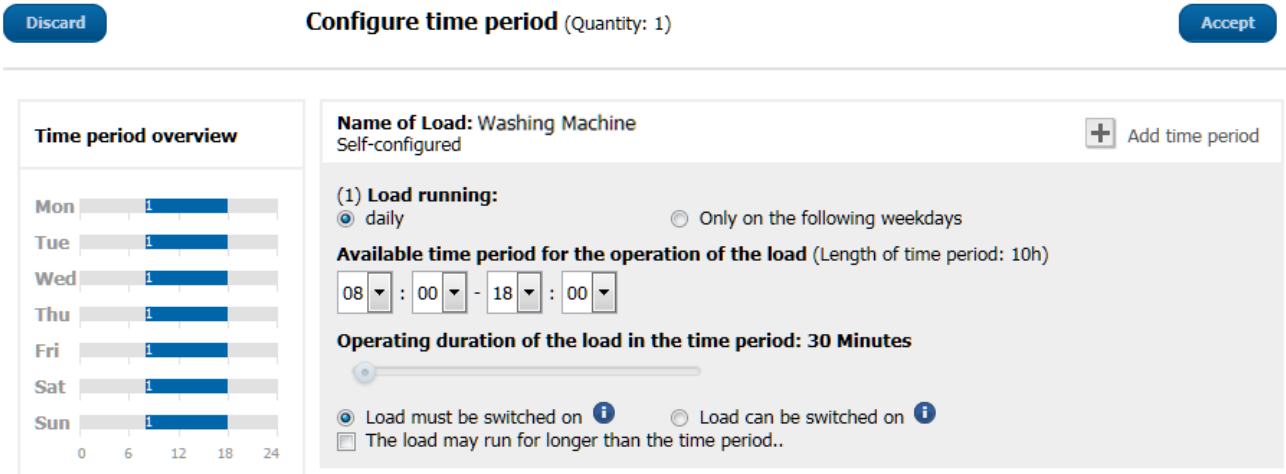


Figure 3: Configuring a time period for every day of the week (example)

Alternatively, you can define day-specific time periods for one or more days of the week (e.g., Wednesday and Friday are "laundry days" for this family):

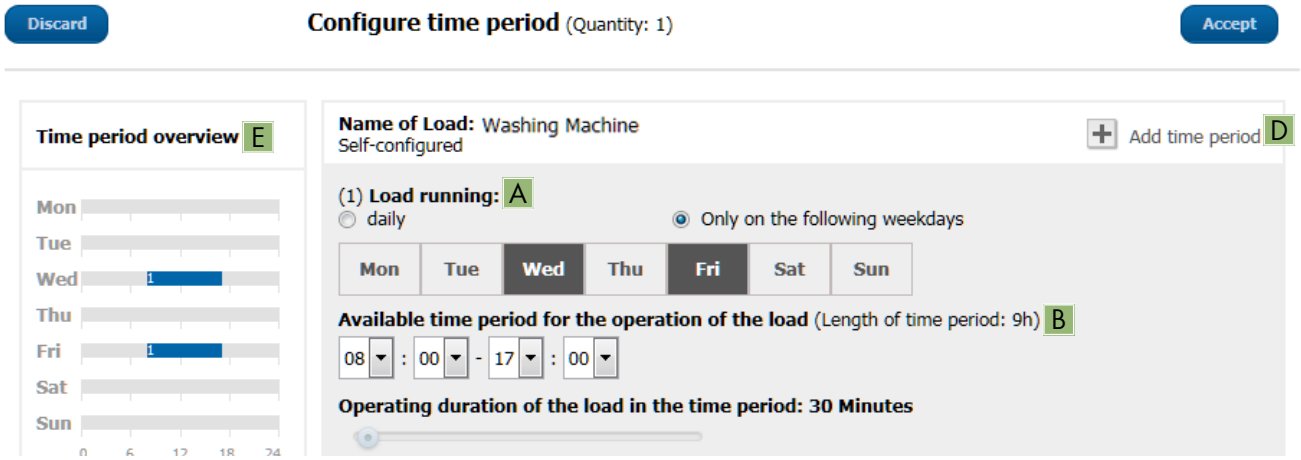


Figure 4: Configuring time periods for certain days of the week (example)

Position	Setting/Explanation
A	**Load running** Decide whether you want the washing machine to run every day or only on certain days of the week.
B	**Available time period for the operation of the load** The default time period is 8:00 am to 6:00 pm. Adjust the times as needed. The length of the time period is automatically calculated from the configured times and displayed in parentheses. **Information:** The time period must be longer than the program operating time specified in the load characteristics for the washing machine. **Example: Setting a time period and activating control via Sunny Home Manager** The washing machine has a typical program operating time of 150 minutes for a 90 °C wash program. You could follow these steps: • You fill the washing machine with laundry at **8:00 am**, but do not need the laundry to be done before **5:00 pm** that day. You set a time period from 8:00 am to 5:00 pm for that day on Sunny Portal. You generally do laundry on Wednesdays and Fridays. • To start the wash program, you press the start button on the washing machine. • Right after the washing machine has started, you activate automatic mode on the radio-controlled socket (see Section 4 "Operation", page 11). This causes the radio-controlled socket to switch off, and the washing machine stops. Sunny Home Manager now controls the washing machine and will switch it on at the time scheduled in its load plan.
C	Select **Load must be switched on**. To learn more about loads set to **Load can be switched on**, see the "SMA SMART HOME - Load control via CAN time window" technical information in the download area of Sunny Home Manager at www.SMA-Solar.com.

Position	Setting/Explanation
D	**[+ Add time period]** If necessary, you can use this button to add more time periods for the same day or for other days of the week. Depending on what you want your load to do, you can also control it with a series of multiple MUST time periods or a combination of MUST and CAN time periods. **Information:** The time periods must not overlap. If they are configured to overlap, the **Time period overview** (see position E) will show the conflicts in red.
E	**Time period overview** This area visualizes the configured time periods using colored bars.

4 Operation

In the SMA Smart Home, you can either run the washing machine in manual mode or have Sunny Home Manager control it automatically.

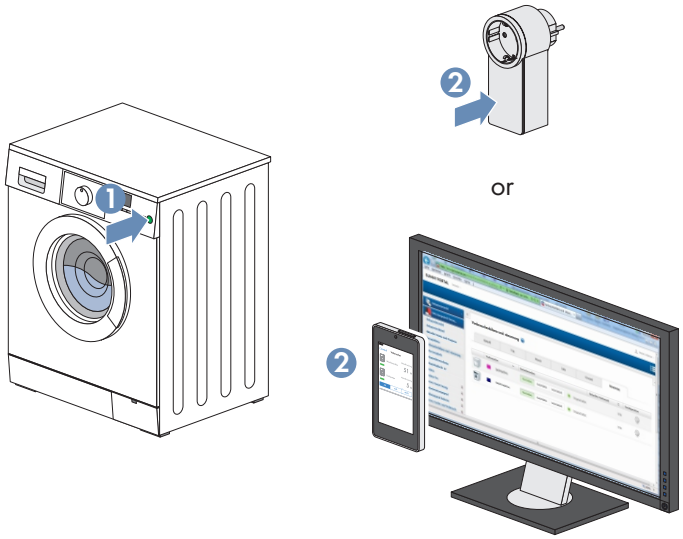


Figure 5: Switching washing machine on or off and selecting an operating mode

Selecting automatic mode

In automatic mode, Sunny Home Manager will control the washing machine based on the configured load characteristics and time periods.

Procedure:

1. Switch on the filled washing machine with the start button.
2. Pull up the free Sunny Portal app (available for iOS and Android at www.sunnyportal.com) or go to Sunny Portal, access the **Load Overview and Planning** page and select the [**AUTO**] button for the washing machine.

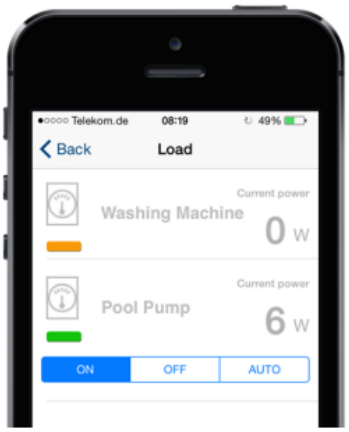
Selecting manual mode

If needed, you can switch the load on or off manually and thus exit automatic control mode by Sunny Home Manager. You will have to reactivate automatic mode if you want Sunny Home Manager to automatically control the load again.

When you have a program-controlled load (such as a washing machine), the radio-controlled socket will normally be switched on and the automatic mode will normally be terminated at the end of the program that is being controlled by Sunny Home Manager. If the radio-controlled socket is switched off or is still in automatic mode, you will have to manually switch on the radio-controlled socket.

Procedure:

1. Switch on the washing machine at the desired time with the start button.
2. Pull up the free Sunny Portal app (available for iOS or Android at www.sunnyportal.com) or go to Sunny Portal, access the **Load Overview and Planning** page, and select the [**ON**] (to activate manual mode) or [**OFF**] button (to deactivate manual mode) for the washing machine.



5 Control via Sunny Home Manager

The washing machine is only controlled by Sunny Home Manager if automatic mode has been selected for the radio-controlled socket connected to the washing machine (see Section 4 "Operation", page 11).

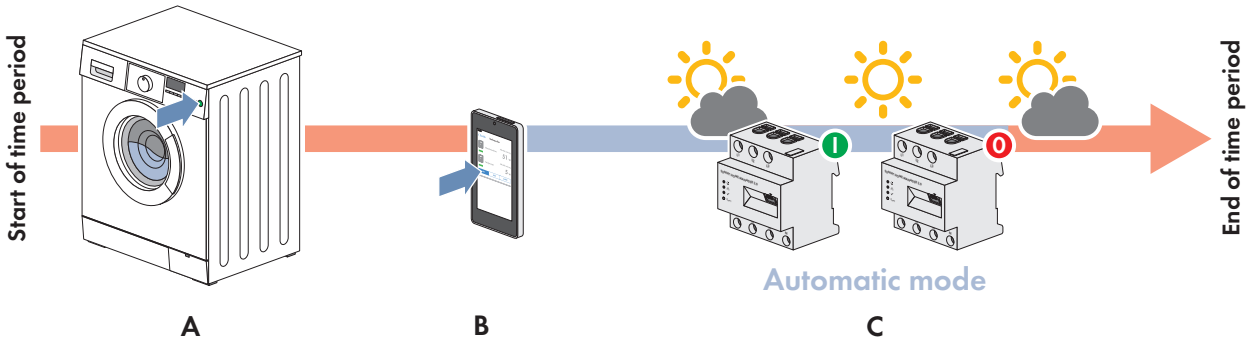


Figure 6: The load control process with Sunny Home Manager

Position	Explanation
A	Fill the washing machine and press the start button
B	Activate automatic control by Sunny Home Manager via Sunny Portal / the Sunny Portal mobile app.
C	Sunny Home Manager controls the washing machine based on the configured load profile and the PV power generation forecast

If automatic mode is active, Sunny Home Manager will determine when the washing machine can be switched on within the configured time period (see Section 3.2, page 8) at the lowest cost based on household consumption patterns and the PV power generation forecast for the PV system. Sunny Home Manager calculates costs using the following three energy categories:

- Energy from the utility grid (25 to 30 ct/kWh depending on the local rates)
- Energy from the PV system (this energy "costs" as much as the local feed-in tariff for PV energy: currently 11 ct/kWh under the 2015 Renewable Energy Sources Act (EEG))
- Energy that would not be fed into the utility grid anyway due to active power limitation requirements (this energy is free (0 ct/kWh))

  For example, Germany's active power limitation of 70% means that the proportion of PV energy that exceeds 70% of the installed nominal PV system power has to be regulated down. This can happen if there is significant irradiation around noon, for example. If a load in your home (e.g. the washing machine) can use the surplus PV energy at this time, the PV system will not have to be regulated down as much.

6 Display on Sunny Portal

6.1 Display of power consumption on the "Load balance" page

The power values measured by the radio-controlled socket are displayed in a diagram on the **Load Balance and Control** page on Sunny Portal.

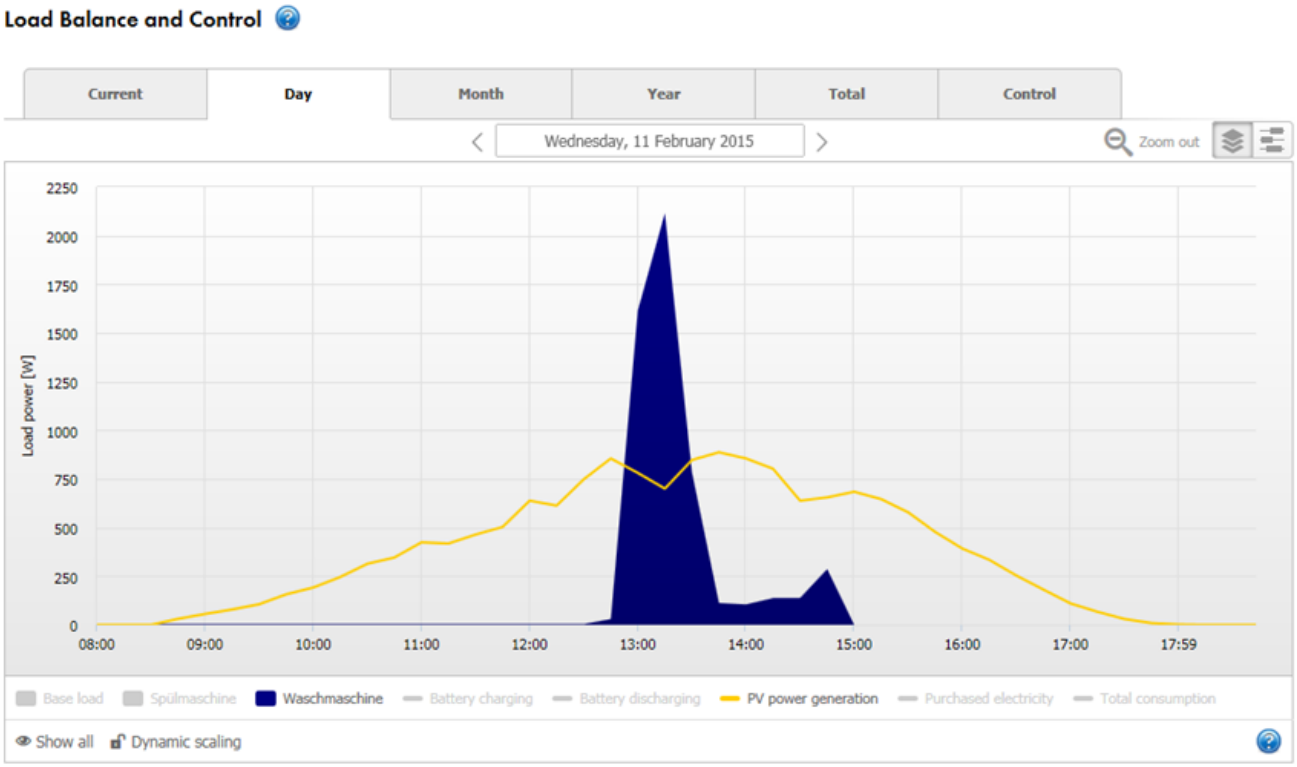


Figure 7: Chart on the **Load Balance and Control** page (example)

The above chart shows a typical power consumption curve for a washing machine as well as the PV power generation curve on a particular day. The washing machine was switched on around 12:45 pm based on Sunny Home Manager's cost-optimized load plan. The washing machine consumes a lot of power at the beginning of the wash program in order to heat up the water. After that, it consumes relatively little power to rotate the drum. More power is consumed at the end for the spin cycle. Except for the high consumption of power needed to heat the water, PV power generation can satisfy all of the washing machine's power needs in this example.

Information: Due to storage space limitations on Sunny Portal, the power consumption diagram uses 15-minute average values. The power curve is thus smoothed out somewhat and does not show maximum power values. You can increase the resolution (one value every five minutes) by purchasing the Sunny Portal Professional Package as an add-on in the SMA Online Store.

6.2 Display of load planning on the "Current Status and Forecast" page

Load planning is displayed in a diagram on the **Current Status and Forecast** page on Sunny Portal.

The time periods for the configured loads are shown as colored lines underneath the bar diagram that shows the hourly power forecast.

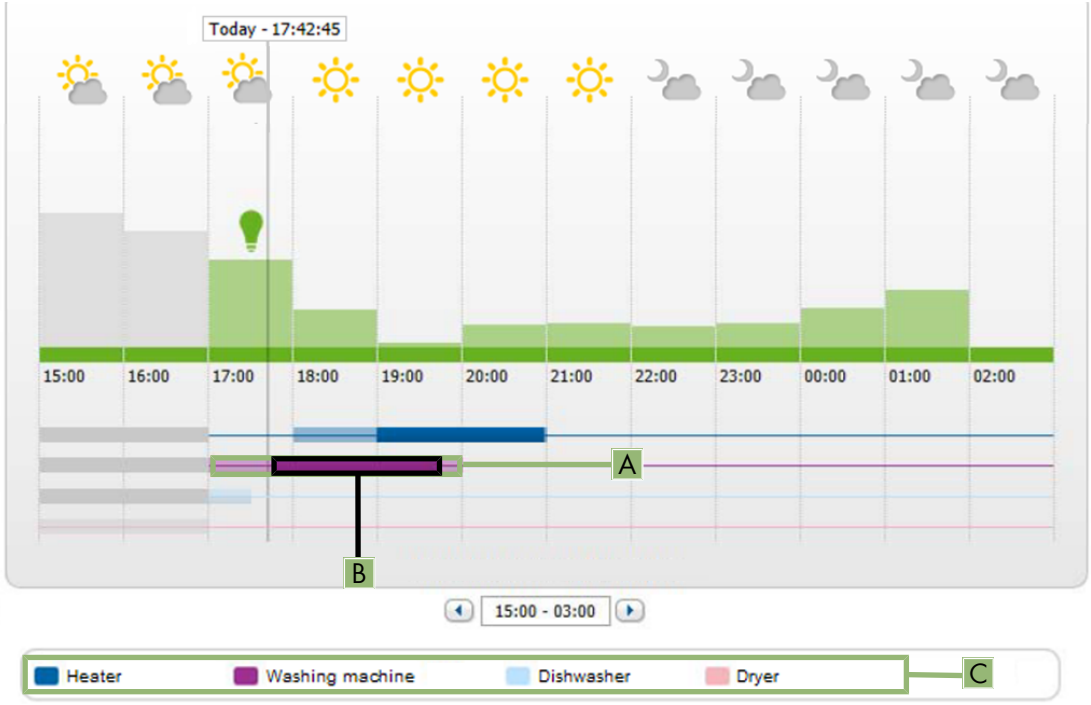


Figure 8: Diagram on the **Current Status and Forecast** page (example)

Position	Explanation
A	The light area shows the time period that you have configured (e.g., from 8:00 am to 8:00 pm).
B	The dark area shows the operating period that Sunny Home Manager has planned for the load (e.g., from 5:45 pm to 7:45 pm for the washing machine).
C	The legend under the diagram shows which load has been assigned which color.

Information:

Depending on when you pull up the **Current Status and Forecast** page on Sunny Portal, the start of the time period may no longer be visible in the diagram. Likewise, a load may have already started up during the planned time period and so the time period diagram already has a dark area. The load will then run until the end of its defined operating duration.

The power forecast is updated every 15 minutes and may change in response to changing weather conditions. This means that, if you wait 15 minutes, you may find that the loads are suddenly planned at a new time and the diagram has automatically changed to reflect the new schedule.

7 Things To Know

Washing machines generally experience significant fluctuations in power consumption during operation, as illustrated by the following description of a typical wash program:

1. **Water intake (< 20 W):** A magnet valve simply opens and water runs into the machine.
2. **Heating cycle (up to 2 kW):** Heating elements heat the water in the washing machine to the temperature defined in the program. The duration of the heating process depends on the target temperature.
3. **Washing cycle (< 250 W):** The rotating drum constantly agitates the laundry in the heated water. Only the drum motor consumes electricity during this cycle.
4. **Spin and drain cycle (up to 1,000 W):** The drum motor and pump consume electricity depending on the spin speed and the amount of the laundry in the drum.

Sunny Home Manager will start out with the power consumption that you entered when configuring the load characteristics and gradually arrive at a more precise value for the washing machine's power consumption (in our example: 1,000 W). Fluctuations in power consumption due to different wash programs are averaged and incorporated into the load profile. After a learning phase (typically 4 weeks with multiple wash programs), Sunny Home Manager can reliably plan the operation of the washing machine based on the PV power forecast and minimize the amount of power that must be purchased from the grid for wash programs.

SMA Solar Technology

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