

xStorage Home Operation Modes Manual

For 4.2 kWh, 6 kWh and 10 kWh systems capacity



Content overview

1	Introduction	3
	Before you start	3
	Technical disclaimer	3
	Legal entity	3
2	Good to know	4
3	How to set-up an operation mode	4
	3.1 Setting an operation mode from the "Dashboard"	4
	3.2 Setting an operation mode from the "Schedule"	4
	3.3 Setting an operation mode from the "General Settings"	5
4	Operation modes	6
	4.1 Manual operating modes	6
	4.2 Intelligent operating modes	6
	4.2.1 Maximize Auto-Consumption (MAC)	7
	4.2.2 Peak-shaving	8
	4.2.3 Variable Grid injection	10
	4.2.4 Frequency Regulation	11

1. Introduction

Thank you for installing and buying the xStorage Home system

This operation modes manual provides guidelines for both the installer and the end-user on how to configure the operation modes in order to optimize the performances of xStorage Home and the usage of electrical energy sources.

This manual is complementary to the xStorage Home installation and user manuals.

Before you start

This manual contains important instructions that must be followed during the installation, operation and maintenance of the xStorage Home system. All instructions must be read before installing and operating the equipment. This manual should be retained for future reference. Please note that the xStorage Home system must only be installed by Eaton certified personnel, i.e. an Eaton technical support representative or an Eaton certified installer. There are no user serviceable parts inside the xStorage Home system. Failure to observe the above will void the warranty provided and Eaton cannot be held legally accountable.

This product is intended for residential application only. The contents of this manual are the copyright of the publisher and may not be reproduced (even in extracts) without the prior written approval of Eaton Corporation. While every care has been taken to ensure the accuracy of the information contained in this manual, Eaton assumes no liability for any error or omission. Eaton reserves the right to modify the designs of its products. The unauthorized copying and lending of this manual is prohibited.

Technical disclaimer

In line with our goal to continuously improve the products and the customer service we provide, all specifications contained in this document are subject to change with due notice. All drawings, descriptions or illustrations contained in this document serve to provide a clear overview and/or technical explanation of the present product and its various components and accessories.

Legal entity

Eaton Energy Storage

Eaton Industries manufacturing GmbH

Address: Place de la Gare 2

1345 Le Lieu

SWITZERLAND

Web: www.eaton.com/xstorage

2. Good to know

To download the latest technical documentation, such as the user manual, the safety documentation and other relevant updates, visit our website www.eaton.com/xstorage. Please note that in order to improve our customer experience we are constantly updating and enhancing the relevant technical and marketing materials.

3. How to set-up an operation mode

From the xStorage Home user interface, there are three ways to set up an operation mode with different levels of priority:

1. From the "Dashboard";
2. From the "Schedule";
3. From the "General Settings".

3.1 Setting an operation mode from the "Dashboard"

From the dashboard click on "Operation mode" and a window will appear (Figure 1). Change the operation mode, set a duration and press on "Save". In this way the system will set the selected operation mode for the chosen duration. This way to set up an operation mode has higher priority compared with an operation mode or an event set-up in "Schedule" and "General Settings". It means that a setting saved in the "Dashboard" takes priority over a setting saved in the "Schedule" and "General Settings". For example, at the end of an event planned in the "Dashboard", priority is given to the settings saved in the "Schedule" and if no operation mode or events are planned in the "Schedule", then priority is given to the operation mode or events saved in the "General Settings".

Figure 1: The setup of the operation mode from the "Dashboard"



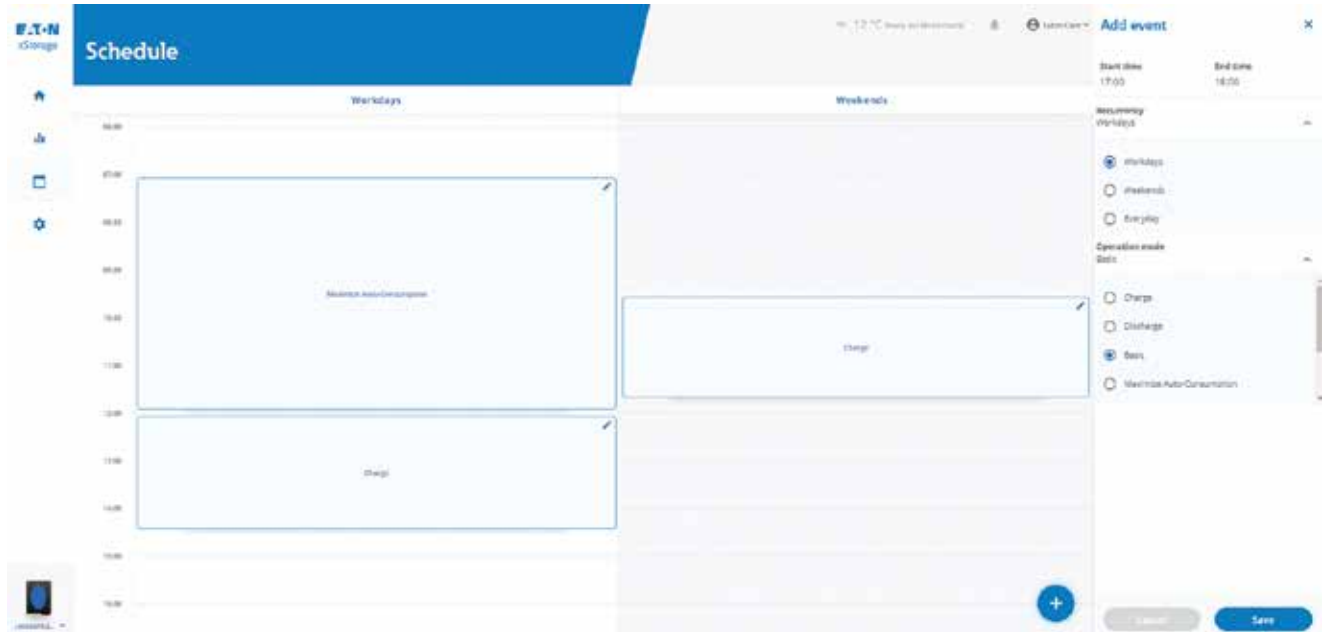
3.2 Setting an operation mode from the "Schedule"

The second way to select an operation mode is from the "Schedule" section of the user interface. In this case it is possible to add an event. Click on the "Add event" icon then a window will appear. Select:

- The start and end time of the event;
- The recurrence (workdays, weekends, everyday);
- The operation mode.

Then click on "Save". A scheduled event will be displayed in the panel, as in Figure 2, and it will occur as planned. This way to schedule an event has higher priority compared with events set-up in "General Settings" and lower priority compared with events scheduled in "Dashboard".

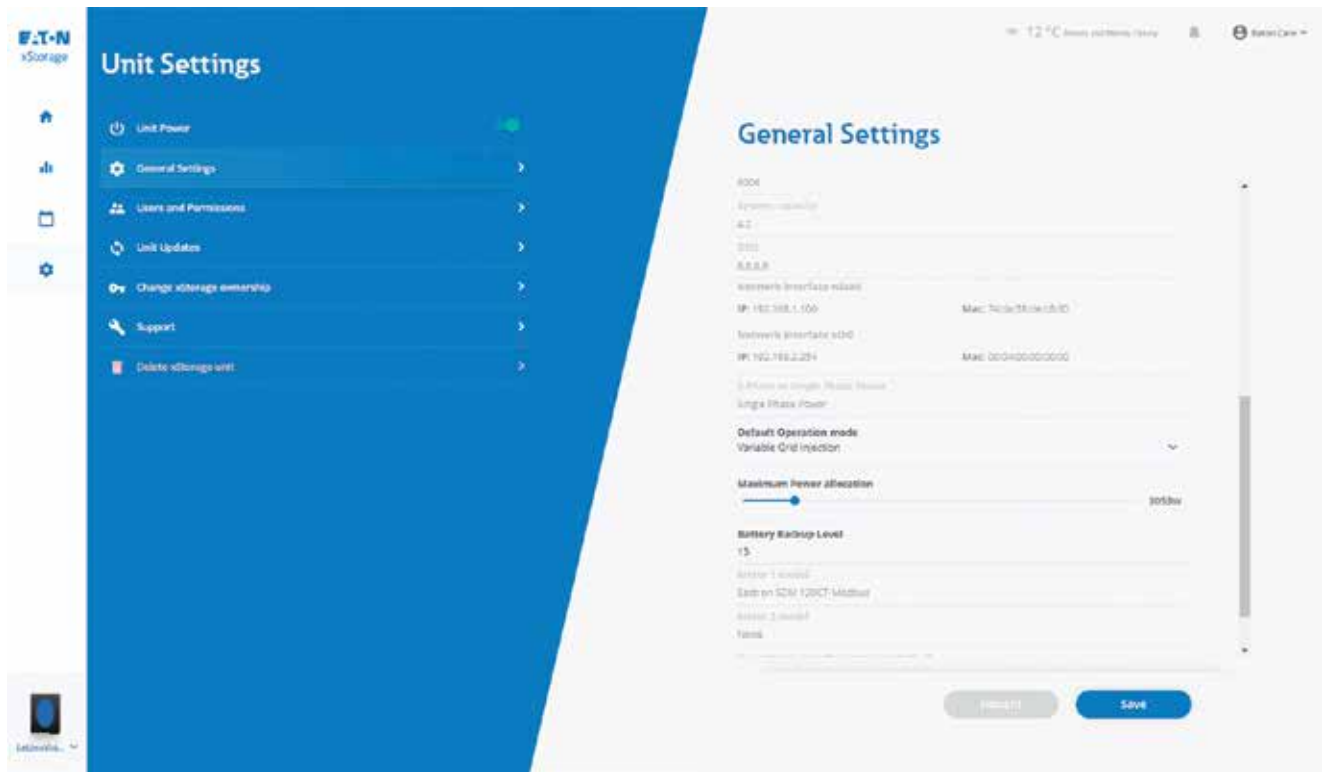
Figure 2: The setup of the operation mode from the “Schedule” session



3.3 Setting an operation mode from the “General Settings”

The third way to setup an operation mode is from the “General Settings”. This is also the default operation mode. Click on “Unit Settings” then go in “General Settings” and select the “Default Operation mode”, then click on “Save”. In the example in Figure 3 the Default Operation mode is Variable Grid injection.

Figure 3: The setup of the operation mode from the “General Settings” section



This way to set up an operation mode has lower priority compared with the settings saved in the “Dashboard” and “Schedule” sections.

4. Operation modes

There are two main operation and functional modes of the xStorage Home system, which are denoted as:

- Manual;
- Intelligent.

These modes can be directly adjusted within the User interface (UI) while the system is being set up. The status of the battery and the operation mode selected are indicated on the dashboard of the user interface (Figure 4). As an example, in the Figure 4, the status of the battery is discharging and the operation mode is Maximize Auto-Consumption.

Please note that some operating modes may not be available in all countries.

Figure 4: Indication of the operation mode and the battery status



Depending on the local installation codes and regulations, some of the operation modes may not be applicable. End users therefore need to discuss with their local Eaton certified installer the applicability of the operating modes listed below.

4.1 Manual operating modes

In this running mode, the xStorage Home system is manually scheduled to provide only:

- Unit on (the hybrid inverter): this will bring the system into basic mode. The system is able to convert energy from the photovoltaic (PV) panels.
- Unit off (the hybrid inverter): this will bring the system into standby mode. The inverter is on standby and there is no energy conversion.
- Charge: The battery pack is charging.
- Discharge: The battery pack is discharging.
- Default Operation Mode: From the “General Settings” of the user interface it is possible to set up the default operation mode.

Please note that the manual modes are applicable to any type of installation of the xStorage Home system, including the AC/DC coupled and the NO-PV configurations, whether they include power meters or not. However, these modes don't contribute to energy usage optimization.

4.2 Intelligent operating modes

Intelligent xStorage Home operating modes are designed to:

- maximize the use of generated solar energy by, for example, storing it during the day and consuming it during the night (in the case of a PV + xStorage Home installation);
- enable cost savings over time, i.e. by reducing the end user's electricity bill.

The aim is to set up an autonomous operating system that requires no further actions on the side of the end user once configured, at least as regards to the optimization of the energy consumption.

In total, there are currently four intelligent operating modes, which are denoted as:

- Maximize Auto-Consumption;
- Peak Shaving;
- Variable Grid Injection;
- Frequency Regulation (for Aggregator or Utility).

One of the main prerequisites for activating the intelligent modes within the xStorage Home UI is the type of installation at hand, as detailed in the installation manual. Table 1 sets out if and to what extent the intelligent operating modes apply to the type of installation at hand. A more detailed explanation of each mode is provided in the following sections.

Table 1 Intelligent modes and installation mapping

Intelligent modes	AC coupled installation	DC coupled installation	NO-PV installation
Maximize Auto-Consumption	Yes ¹	Yes ²	No
Peak Shaving	Yes ³	Yes ³	Yes ³
Variable Grid Injection	Yes ³	Yes ³	Yes ³
Frequency Regulation	Yes ⁴	Yes ⁴	Yes ⁴

1. To fully enable this mode both power meters must be installed.
2. To fully enable this mode Power Meter 1 must be installed and loads be separated to critical and non-critical.
3. To fully enable this mode Power Meter 1 must be installed.
4. No specific type of installation is required to enable this feature.

4.2.1 Maximize Auto-Consumption (MAC)

This mode is relevant for installations where the xStorage Home system is connected to the PV panels in either the AC or DC coupled manner. The aim is to charge and discharge the battery in such a way that it will:

- maximize the utilization of the PV-generated energy;
- minimize the energy consumed from the grid.

Full optimization of the consumed energy is possible only with installations that contain:

- both power meters in the case of AC coupled systems;
- one power meter in the case of DC coupled systems.

These meters will provide the xStorage Home system with a full overview of household energy consumption. If the PV-generated energy is not sufficient to power all household loads, the system will start discharging the battery pack.

This mode can be selected in the UI operation mode window as shown in Figure 5.

Figure 5: Setting the Maximize Auto-Consumption operation mode



As soon as the system starts operating in this mode it will be displayed in the dashboard of the user interface.

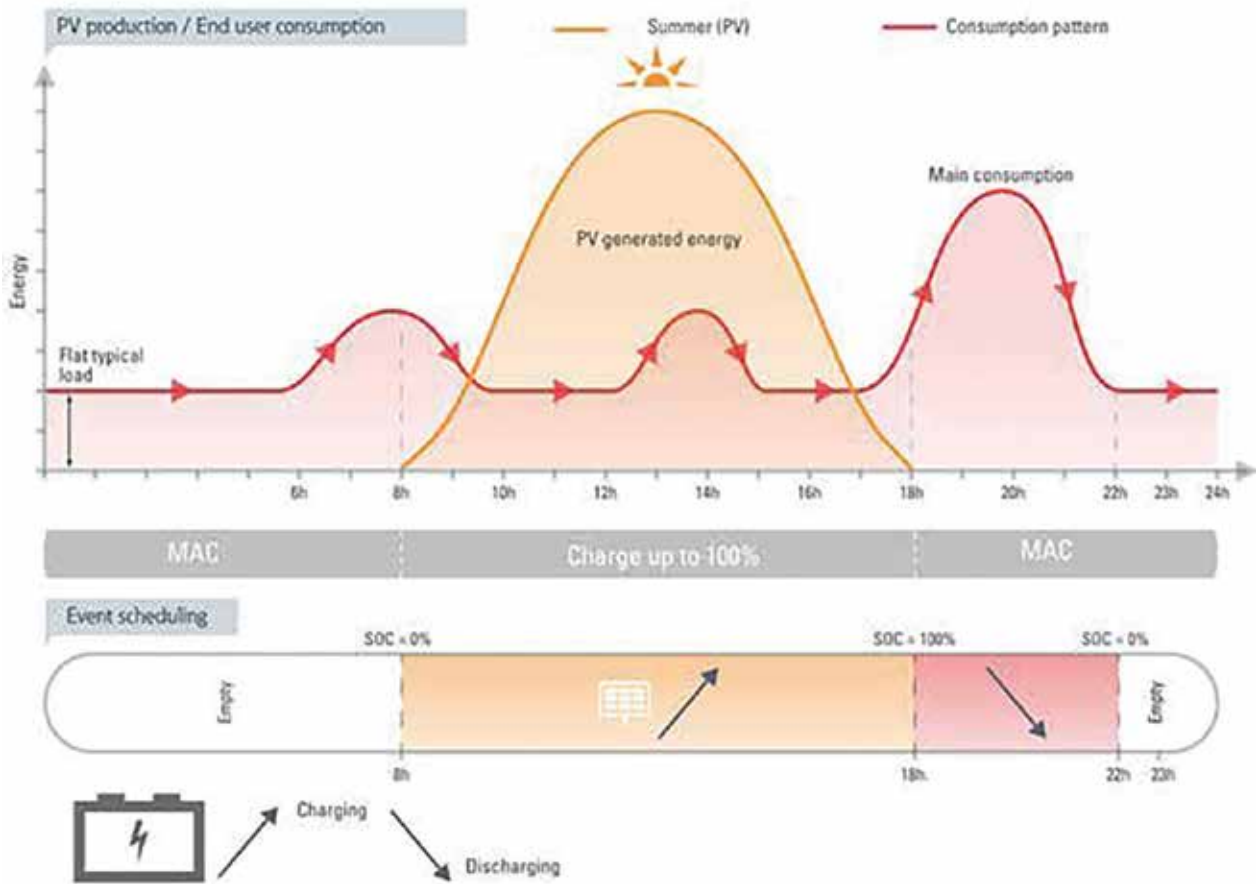
In the case of a DC coupled installation, where the PV is directly connected to the xStorage Home system, Maximize Auto-Consumption (MAC) operation is possible even without a power meter. In this case, MAC operation will apply to the energy consumption of the critical loads, as this is the only consumption directly visible to the xStorage Home system if power meter 1 is not installed.

In addition to setting up this mode as the preferred running mode, the end user can also add a scheduled event. For example, a scheduled event can be added to ensure that the battery is charged at 100 % before 6 pm, so that:

- the energy generated by the PV during the day is automatically stored in the battery pack;
- MAC is used automatically only in the afternoon or during evening hours when electricity prices are typically higher and the PV power generation is low or non-existent.

An illustration of this is provided in the Figure 6.

Figure 6: Illustration of event scheduling



- In this example (Figure 6) “Charge” is selected from the command list for the specified time period [8h, 18h]:
 - The battery pack will be charged from the PV-generated energy;
 - In case the SOC is 100 % before 6 p.m., the surplus of PV-generated energy will be fed directly to the loads.
- After 6 p.m., the system will switch to MAC mode, so that:
 - loads will be powered by PV-generated energy (if any is present);
 - the battery will start intelligent discharge from the 100 % SOC level until 10 p.m. (in the example provided);
 - after 10 p.m., the battery pack will be empty and the “flat typical load” will be powered from the grid (in this example);
 - as the MAC mode is active until 8 am the next day, the battery pack will be automatically charged whenever PV power is available.

Please note that Figure 6 serves as an illustrative example only, since PV generation varies from day to day and from season to season. In addition, each household is able to set preferred event arrangements to support its personalized consumption patterns.

4.2.2 Peak Shaving

This mode is relevant when the maximum power consumption of the household is limited by the energy provider, for example through a utility contract. Any consumption above the contracted maximum peak power consumption will be penalized and the end user will be charged accordingly. With the xStorage Home peak shaving mode, these additional energy costs can be avoided, since the excess energy consumption will be covered automatically by the xStorage Home system, charged either from the PV panels during the day or from the grid during times of low energy demand. Please note that this mode requires the installation of an additional power meter.

When selecting “Peak Shaving” as shown in Figure 7, the “Maximum House Peak Consumption” must be entered. As already pointed out, this value depends on the specific contract with the energy provider and may differ from user to user. If no other event is scheduled, as soon as the xStorage Home system detects that the total household consumption is greater than the maximum allowed, the battery pack will start discharging automatically to compensate for the excess power demand.

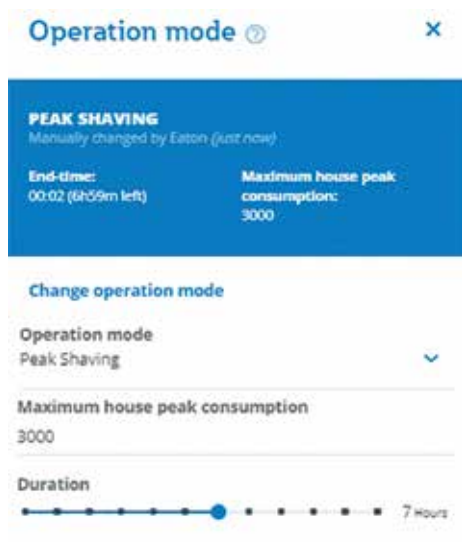
4.2.2.1 xStorage Home and PV panels

During peak power consumption:

- all loads will first be powered by the PV-generated energy;
- if the available PV-generated energy is insufficient, the remaining power will be provided by the battery pack in order to keep the overall power consumption below the peak threshold;
- once the consumption falls below the peak threshold, the battery pack will stop discharging.

If the battery pack is to be charged from the grid during low-tariff times, this must be reinforced by setting a “Charge” event during the low-tariff period using the scheduling feature.

Figure 7: Setting the Peak Shaving operation mode



As soon as the system starts operating in this mode it will be displayed in the dashboard of the user interface.

4.2.2.2 xStorage Home and no PV panels

During peak power consumption:

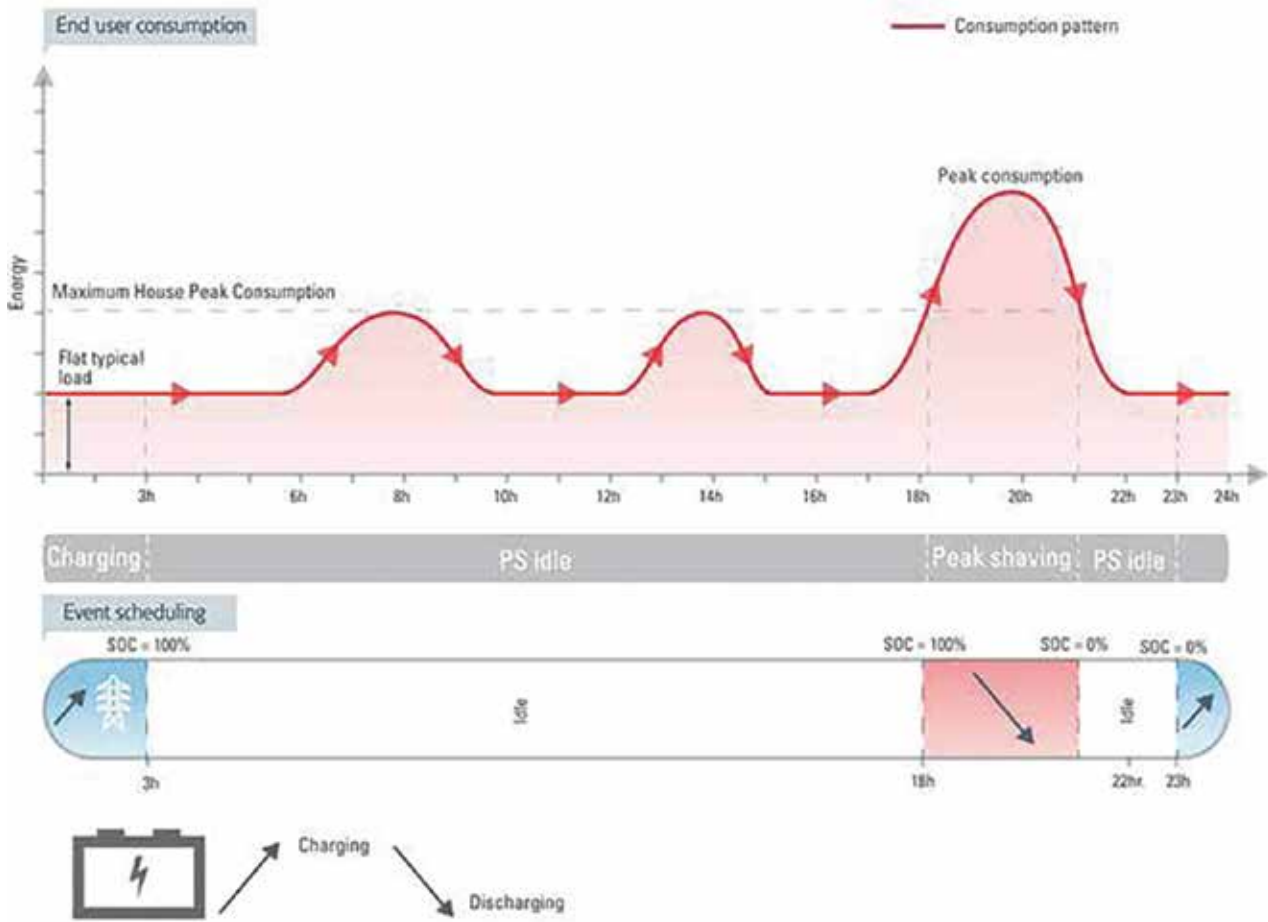
- all loads will be powered by the energy discharged from the battery pack;
- once consumption falls below the peak threshold, the battery pack will stop discharging automatically;
- the charging of the battery pack should be scheduled for off-peak demand hours, e.g. during the night when the system is charged by grid energy at low tariff prices.

An illustration of this is provided in the Figure 8.

- Select “Charge” from the command list for the low-tariff night-time period [23h, 3h];
 - the battery pack will be charged to 100 % from the grid when prices are low;
- after three hours, the system will become idle and will simply monitor the total household consumption;
- once the household consumption exceeds the “Maximum House Peak Consumption”, the battery pack discharge will begin (just after 6 p.m. in the example) to enable peak shaving;
- just after 9 p.m., the discharge will stop, as the total household consumption has by then fallen to below the maximum value (in this example);
- the charging of the battery pack starts at 11 p.m.;
- the “flat typical load” will be powered from the grid.

Note that Figure 8 serves only to illustrate the peak shaving flow. Times of peak shaving will differ from country to country and from season to season. In addition, every household will set preferred event arrangements to support its personalized peak shaving patterns.

Figure 8: Low night-tariff change and peak shaving discharge



4.2.3 Variable Grid injection

When the xStorage Home system is installed together with one power meter, irrespective of the type of the installation, the “Variable Grid Injection” function can be enabled. This mode is relevant for end users who are penalized by the local utility whenever they inject their surplus of PV-generated energy back into the grid. The default energy consumption for this mode is as follows:

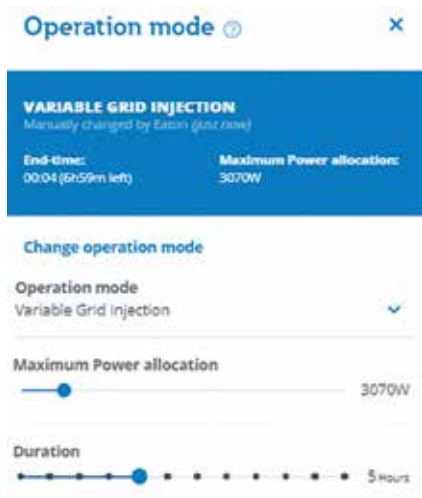
- All loads are at first powered up by the energy generated from the PV as in MAC mode.
- In case of a surplus of PV-generated energy, this will be used for charging the battery pack.
- In case the battery pack is 100 % charged the surplus of the PV-generated energy will be fed into the grid to a maximum value defined by the end-user.

The value can be defined between -1000 W and 3000 W.

Selecting a positive value means that the house will never inject more than specified by the user into the grid. Selecting a negative value means that the house will be forced to consume to a minimum value (i.e. -1000 W) if the battery is not fully charged.

At any time the surplus of the energy injected into the grid, whether from the PV or from the battery pack, will never be above the specified value.

Figure 9: Setting the Variable Grid Injection operation mode



As soon as the system starts operating in this mode it will be displayed in the dashboard of the user interface.

4.2.4 Frequency Regulation

This mode is relevant for aggregators and utilities and is intended to maintain the operating frequency of the local grid. When enabled, this mode will be able to:

- inject energy into the grid from the battery pack should the grid frequency start to decrease (e.g., fall below 50 Hz in Europe) and;
- inject energy from the grid into the battery pack when the frequency is higher than its normal value (e.g., rise above 50 Hz in Europe).

The Frequency Regulation mode will thus enable the battery to vary its power output as a function of the frequency of the grid. The applicability of this mode will depend on the local grid regulations, and if it is activated, the end user will not be able to connect critical loads to the xStorage Home system but will instead be remunerated by the utility or aggregator for frequency stabilization services. Please note that a power meter is not mandatory in this case, since the xStorage Home system can automatically sense grid frequency and communicate with the utility. The battery will maintain its SOC at the value set by the user, or the utility or aggregator, in order to maintain its maximum capacity for up and down power regulation.

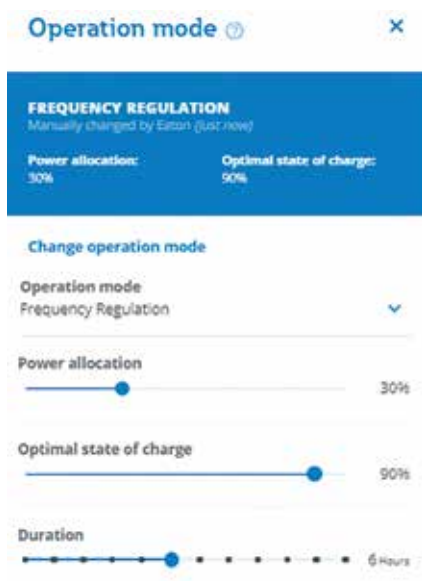
When selecting "Frequency Regulation" as shown in Figure 10, the following information has to be provided:

- "Power Allocation", which indicates how much power can be allocated and injected into the grid on demand;
- "Optimal State of Charge", which determines the SOC that should optimally be maintained by the battery pack.

This value depends on the terms of the frequency regulation contract with the local utility.

Please note that this mode is not available for xStorage Home systems using the 6 kW hybrid inverter.

Figure 10: Setting the Frequency Regulation operation mode



As soon as the system starts operating in this mode it will be displayed in the dashboard of the user interface.

