Installation Manual for PV Optimization

Last Change: 2023-08-14

Introduction

Assumptions

- You run one or two PV installations with Fronius, Kostal Piko Solar converter or any other PV-inverter measured with an additional iWattMeter
- You have a electrical consumption that does not exceed 100 Ampere per phase
- You want to optimize the own power consumption of your PV production, by switching water boiler and electrical heating with the Watt Analytics PV Optimizer
- You have a WiFi reachable with good signal strength in your circuit breaker compartment and the locations where the switchable devices are located
- You optionally have a wall box for electrical vehicle charging of type Go-E or Keba

- You optionally have a battery installed of type Senec or any type connect to Kostal or Fronius PV inverters

Shopping List

You need item 1 from the list below and depending on your PV Inverter and devices you want to control items 2 and 3

1. Package Control S, with Premium IoT Cloud: https://watt-analytics.com/en/general/package3/ consists of iWattController or SmartPi + 4 x Current transformer 100 Amp
2. Shelly Plug, Shelly Plug S or Shelly 1PM for each device
3. Optional for PV-inverters other than Fronius, Kostal Piko: Package S for an additional iWattMeter to measure PV production

Installation for iWattController or SmartPi delivered after July 2021

Install the iWattController or SmartPi hardware according to this installation procedure:

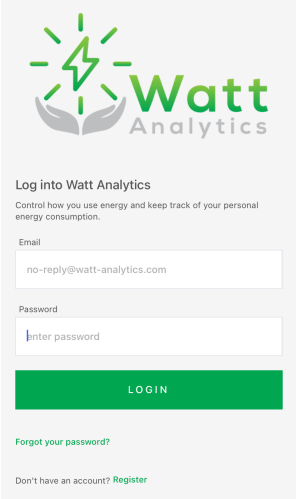
Install the Watt Analytics App on your Apple or Android smart phone

You can find and install Watt-analytics App in App Store (iOS) or Google Play (Android) on your phone.

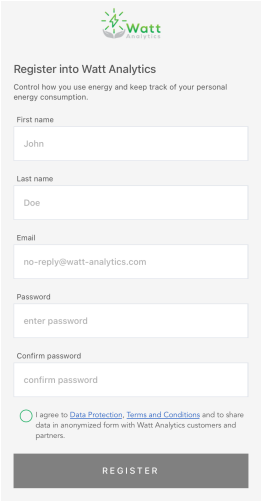
If you have QR code reader on your phone, you can use images below:

Login to Watt-analytics cloud

After app is installed on your phone, you will see the login screen. If you already have a watt-analytics account, fill the form and press login. Otherwise tap on `Register` at the bottom.

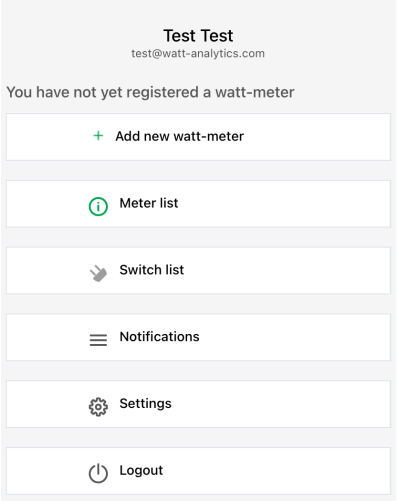


Register a new account:

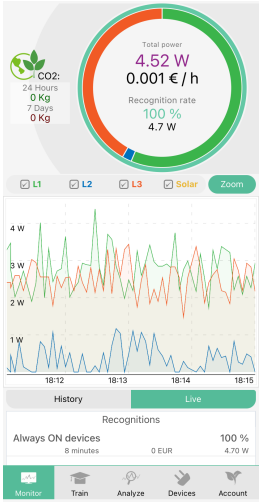


Install meter

After successful login, you need to register your meter under your account. In this regard, tap on `Add new watt-meter` and follow the instructions provided by the app step by step.



When your meter is installed successfully, you can see your consumption and solar production on main graph.



Assign static IP to iWattController or SmartPi

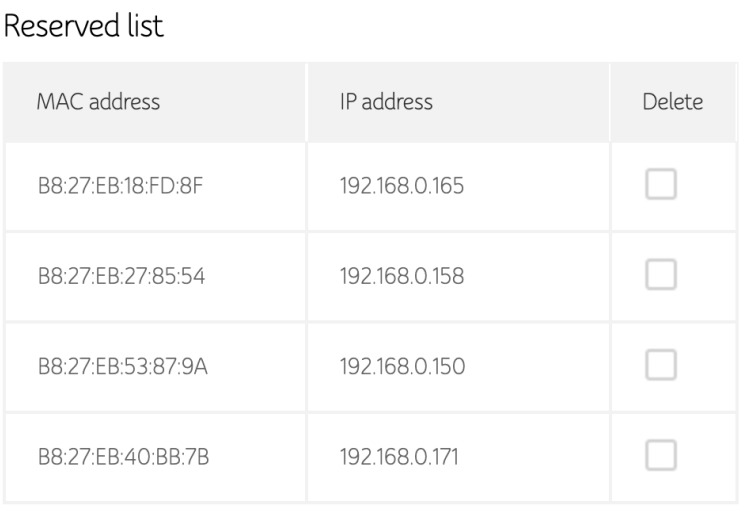
Access the configuration UI of your Internat Modem or router.

In the DHCP or Clients section look up MAC address and current IP address of iWattController or SmartPi, this should look like the following entry:

○	iwattcontroller	B8:27:EB:40:BB:7B	192.168.0.171/24	00:23:45:57

In the DHCP section create a reserved IP address for the iWattController or SmartPi, for most modems you can keep the same IP the iWattController or SmartPi has right now:

After that the entry has to show up in the reserved list:



Configure Solar production measurement

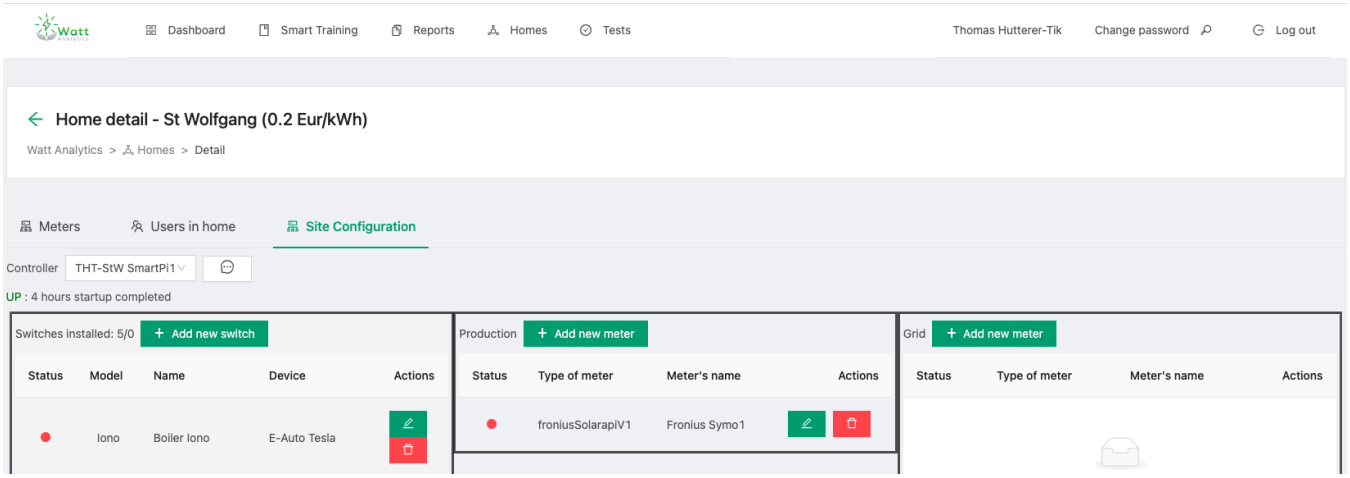
Option 1: 3rd party PV Inverter integration

On the Web app navigate to menu homes, select your home and open the Site-Configuration tab.

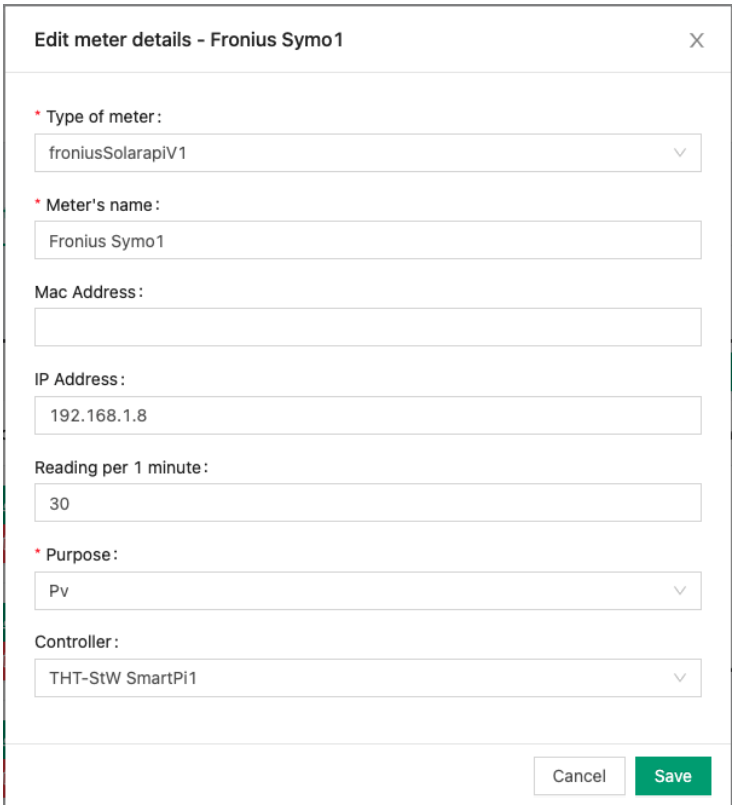
When you make changes on this tab your controller will be notified and automatically reconfigure itself, based on your settings.

You can observe this process with the status indicator, which in the picture "UP: 4 hours startup completed"

The status traffic lights for each switch and meter tell you if the connections work and the meter / switch is sending data = green bubble, no data = red bubble, few data = yellow bubble.



To configure solar production measurement, press Add new meter in the Production section

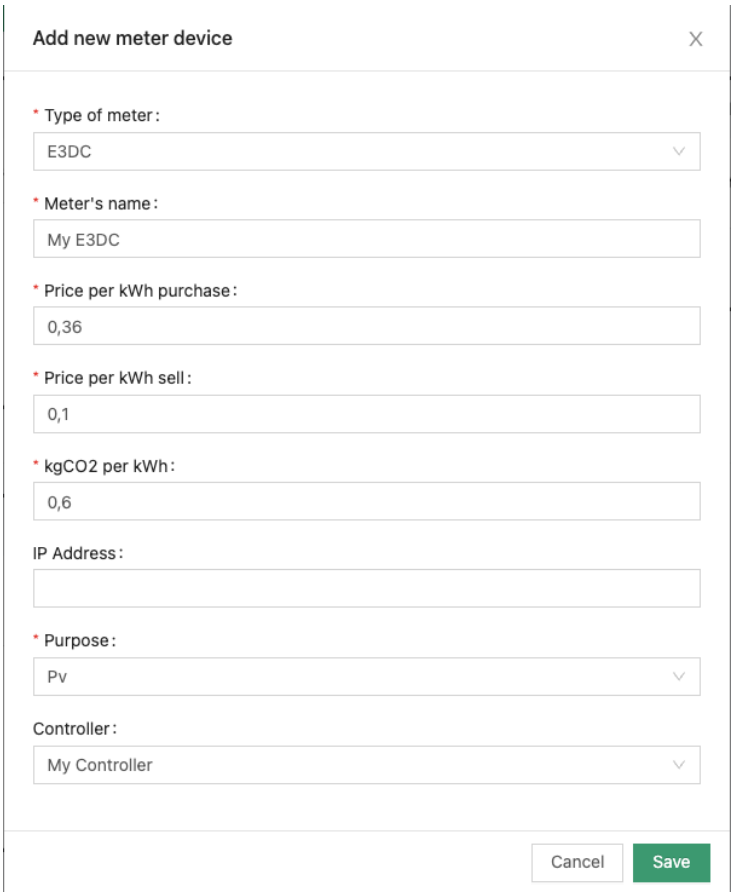


In meter type select the type that matches your PV Inverter type. Please contact support@watt-analytics.com if your PV Inverter type is missing in the list. Enter a name for the meter and the IP address of the PV Inverter. Please make sure that this IP address is also statically assigned.

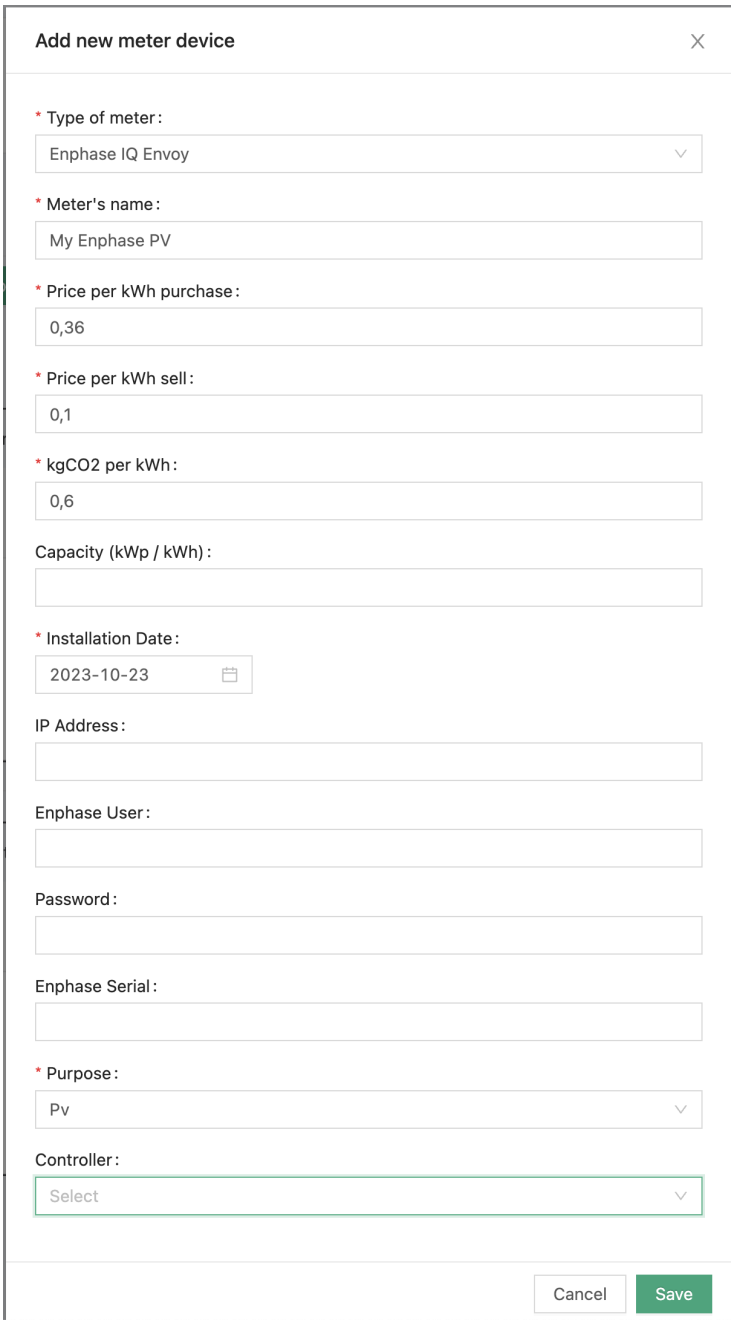
Readings per minute shall be set to 30, Purpose = Pv and Controller to the name of your controller (iWattController or SmartPi)

Supported PV Inverter types

E3DC

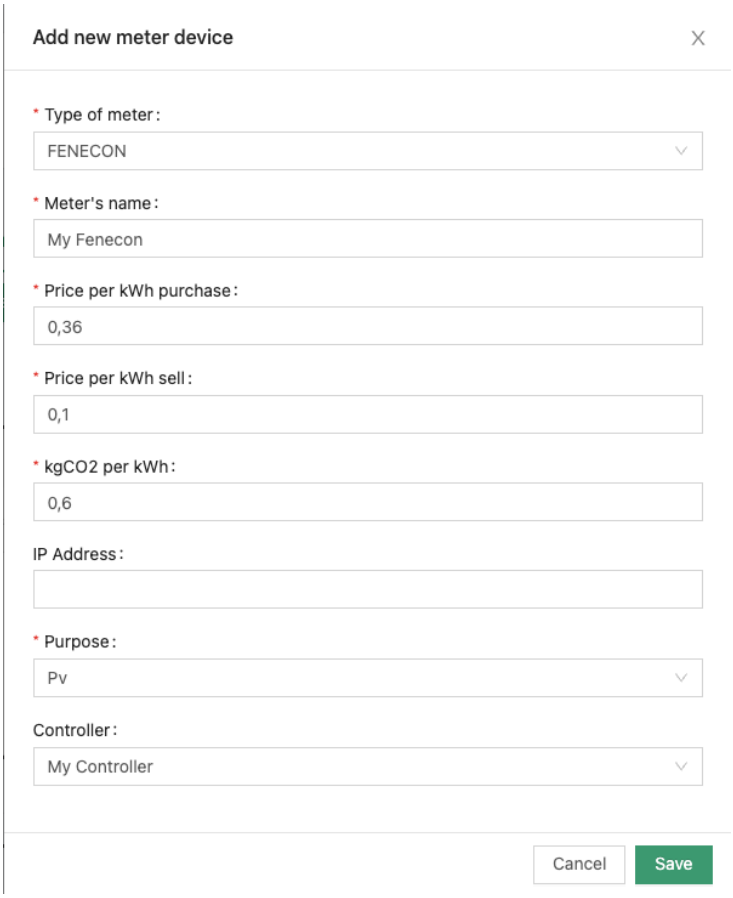


Enphase IQ Envoy

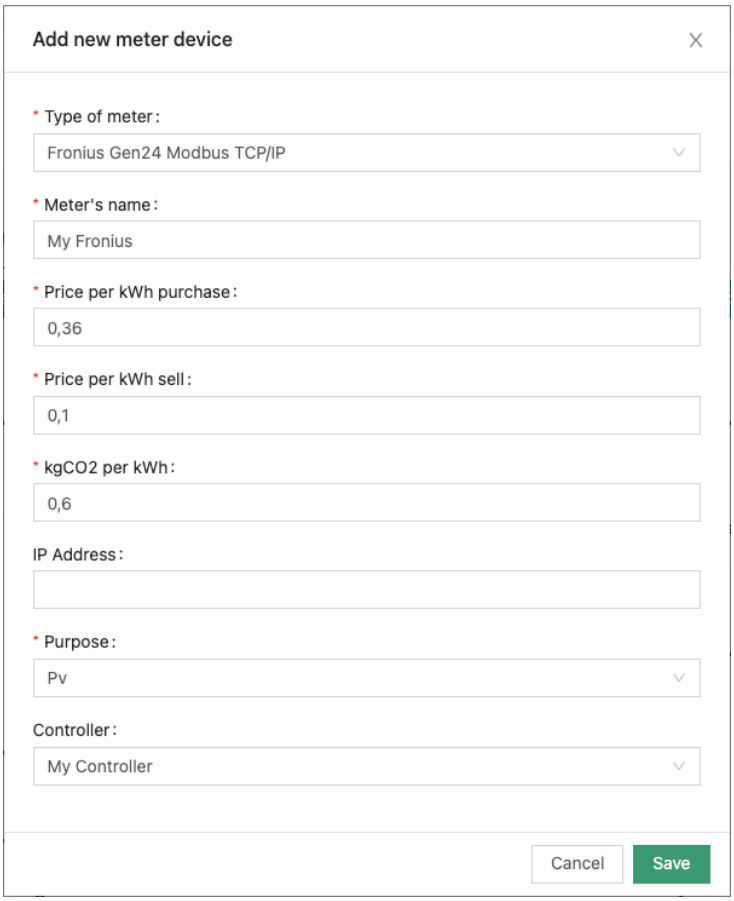


User, password and serial necessary since Envoy Firmware D7.x.xxx. Token is generated by the systems form the credentials entered here.

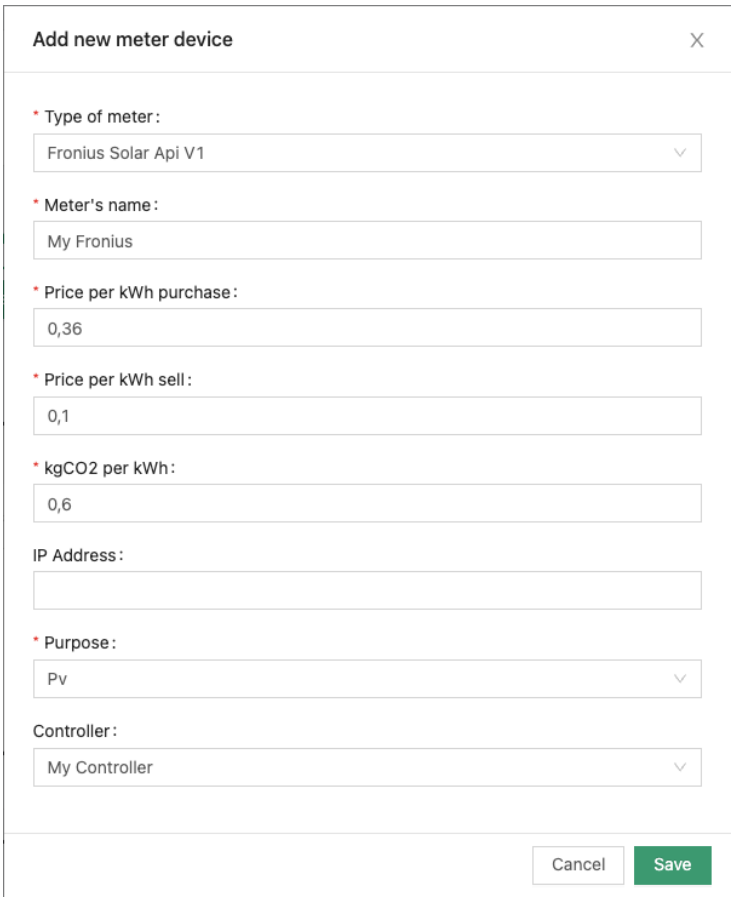
FENECON



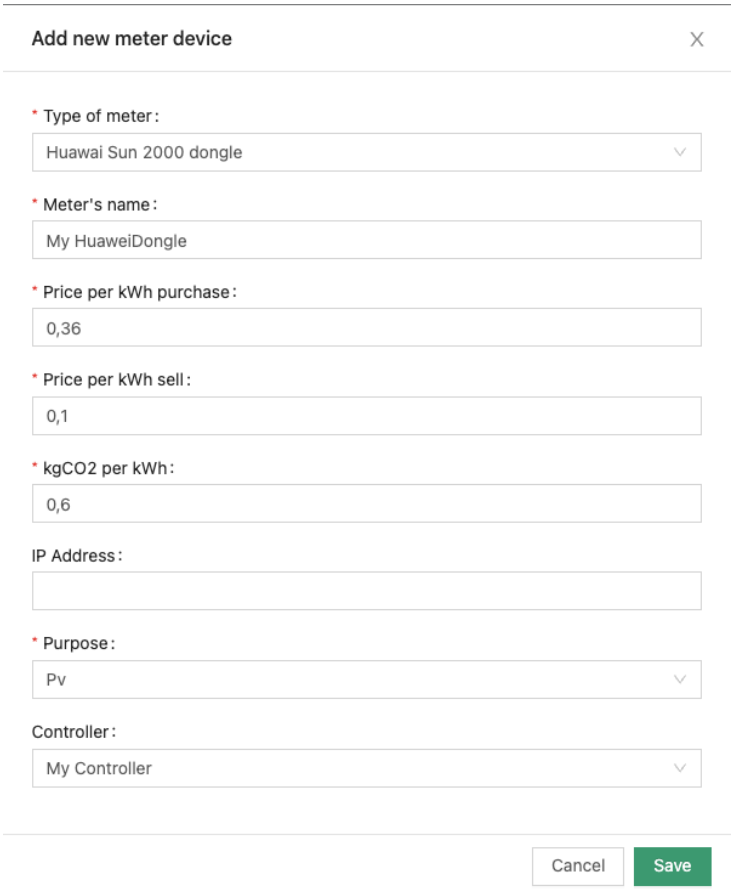
Fronius GEN24 Modbus TCP/IP



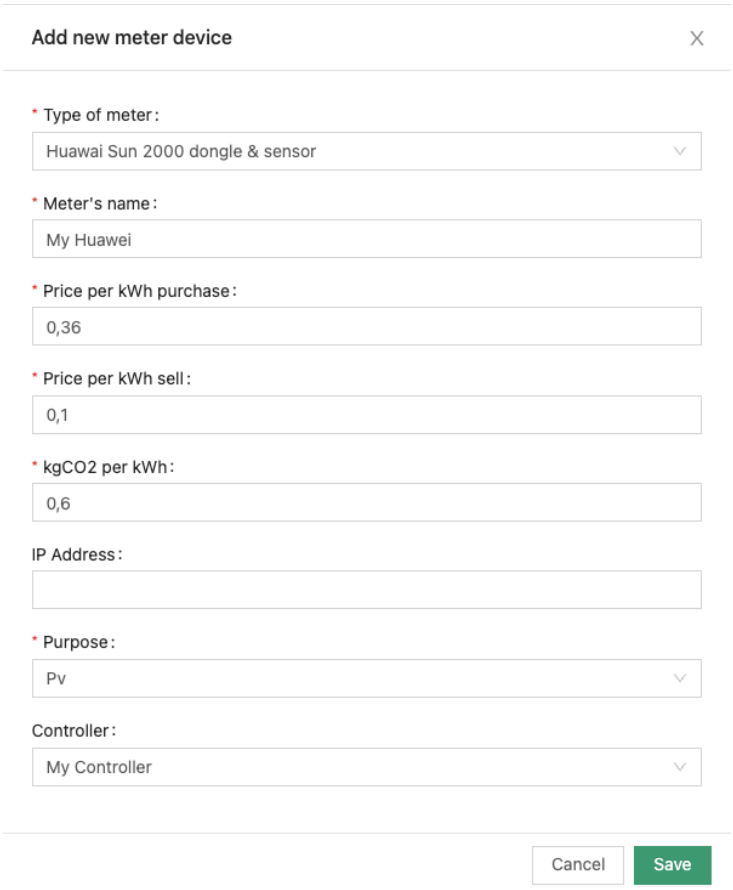
Fronius Solar API V1



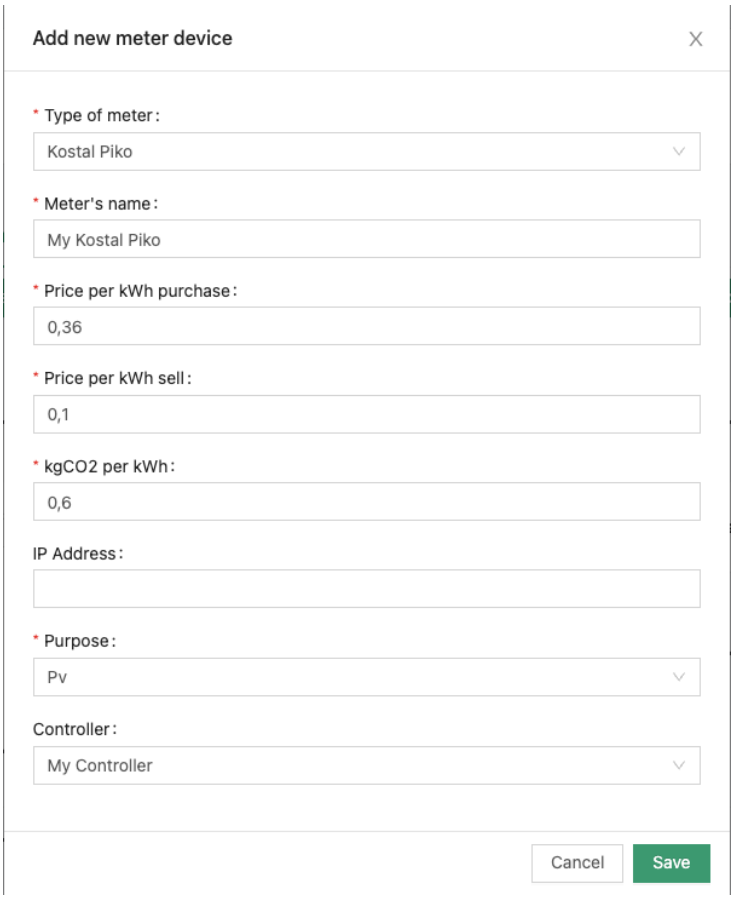
Huawei SUN2000 with SDongle



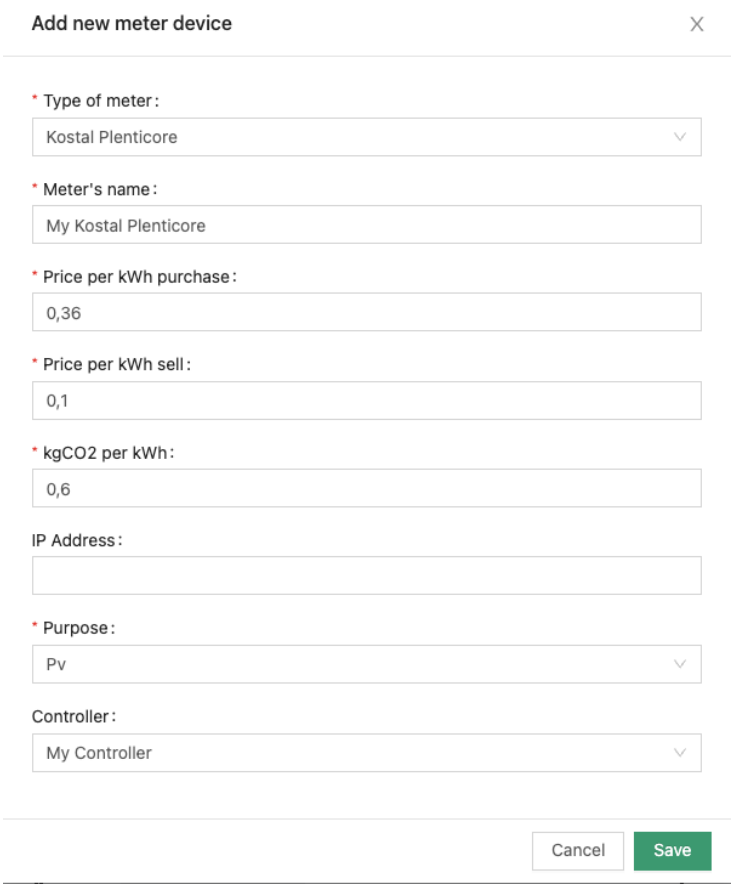
Huawei SUN2000 with SDongle & Power Sensor


Add new meter device
* Type of meter:
Huawai Sun 2000 dongle & sensor
* Meter's name:
My Huawei
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

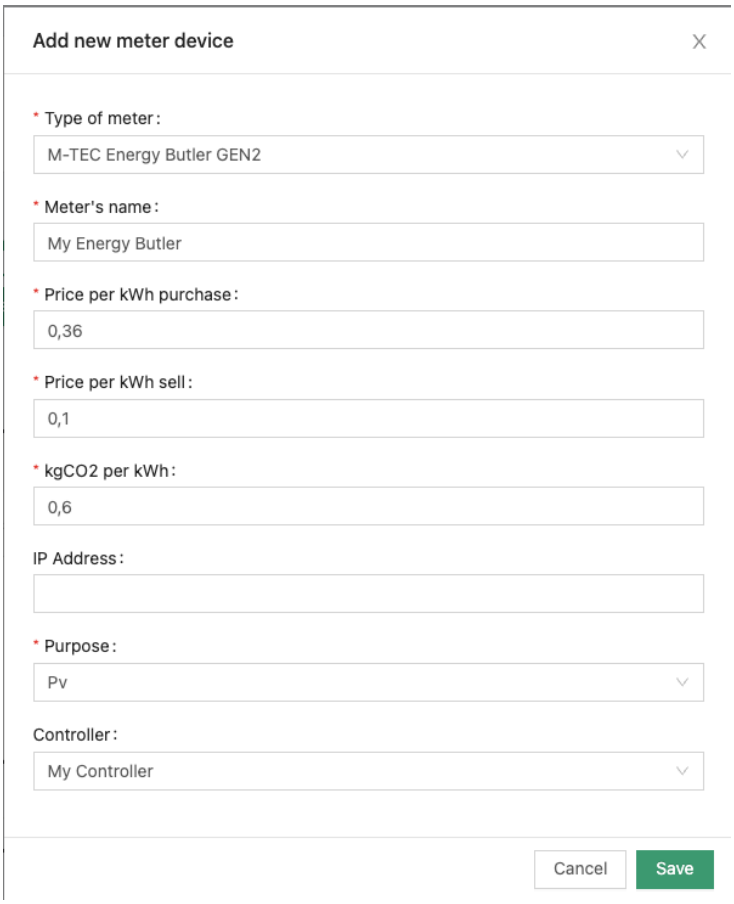
Kostal Piko



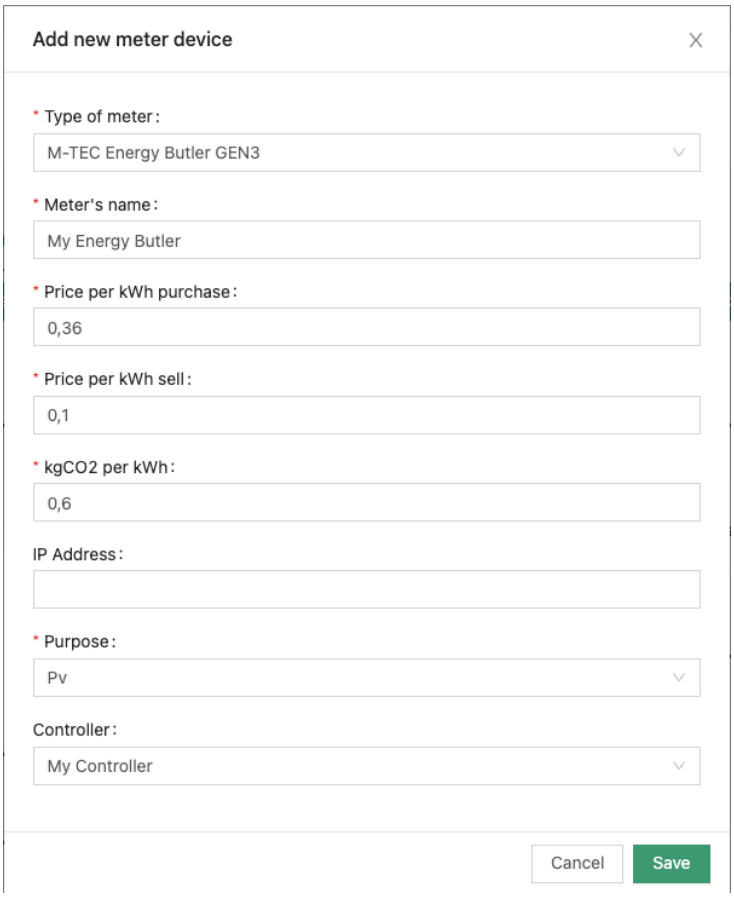
Kostal Plenticore



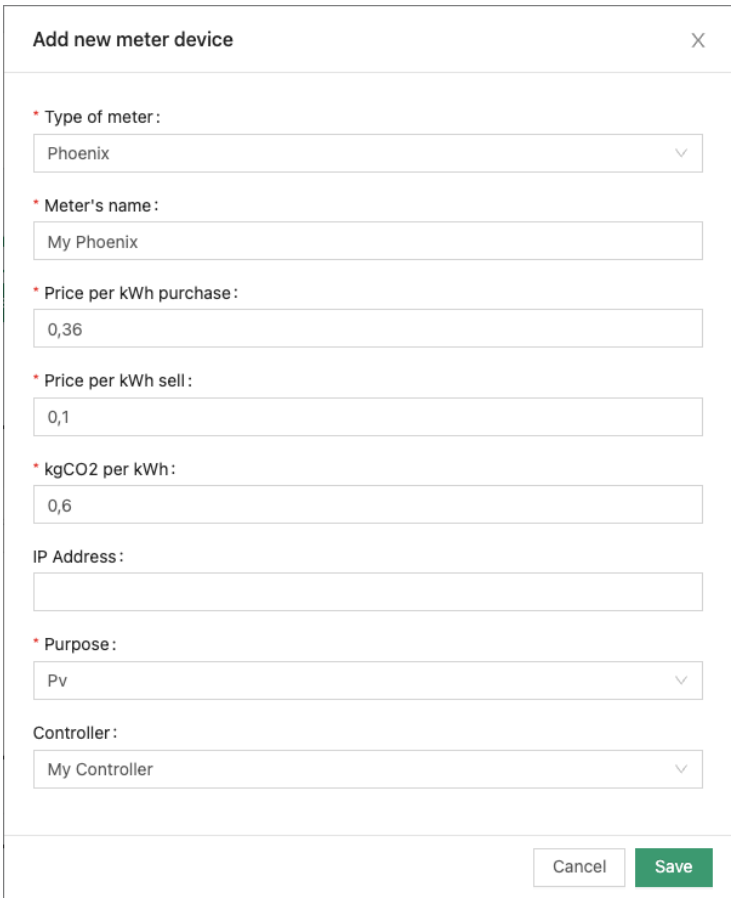
M-TEC Energy Butler GEN2



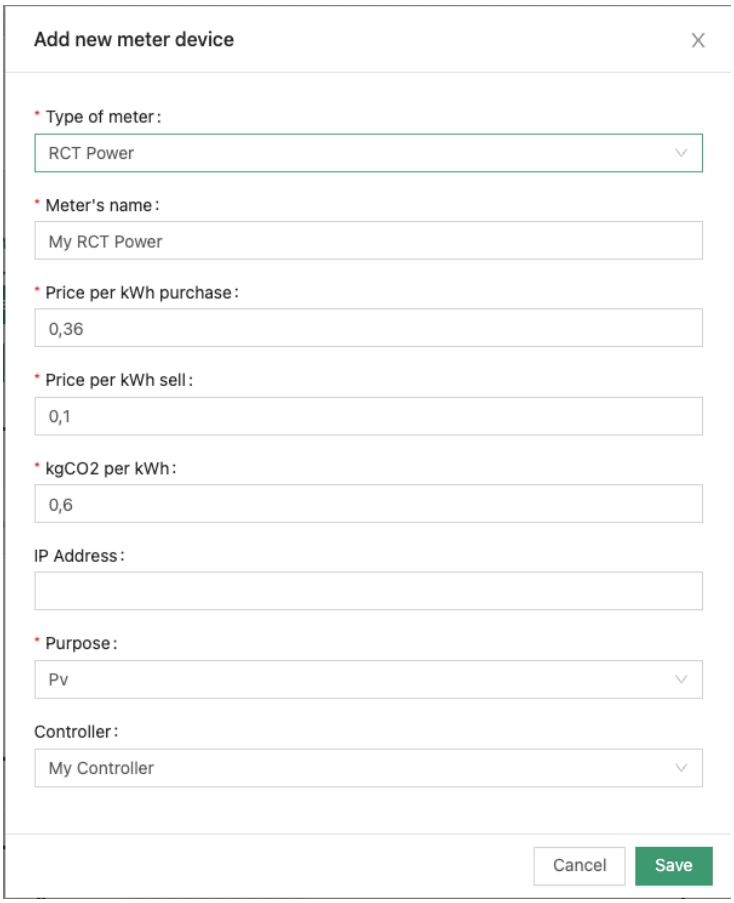
M-TEC Energy Butler GEN3


Add new meter device
* Type of meter:
M-TEC Energy Butler GEN3
* Meter's name:
My Energy Butler
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

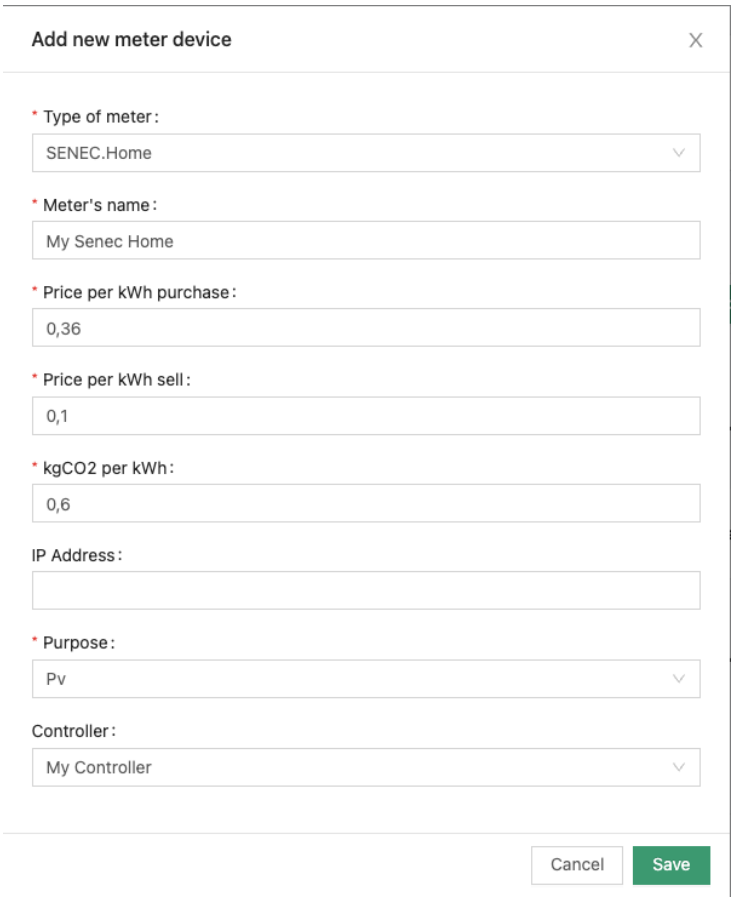
Phoenix


Add new meter device
* Type of meter:
Phoenix
* Meter's name:
My Phoenix
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

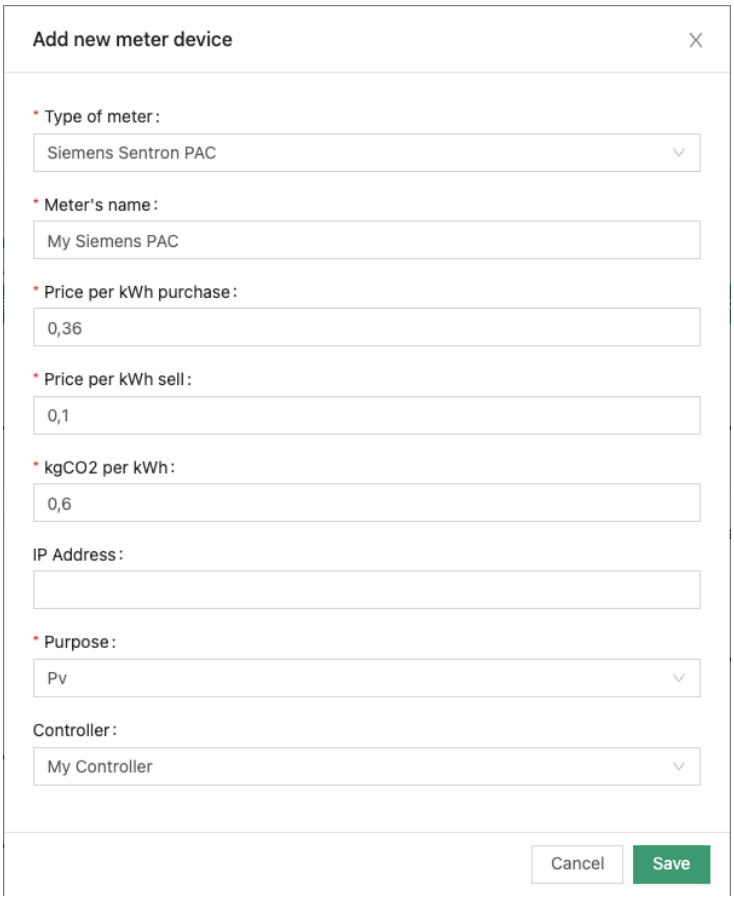
RCT Power


Add new meter device
* Type of meter:
RCT Power
* Meter's name:
My RCT Power
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

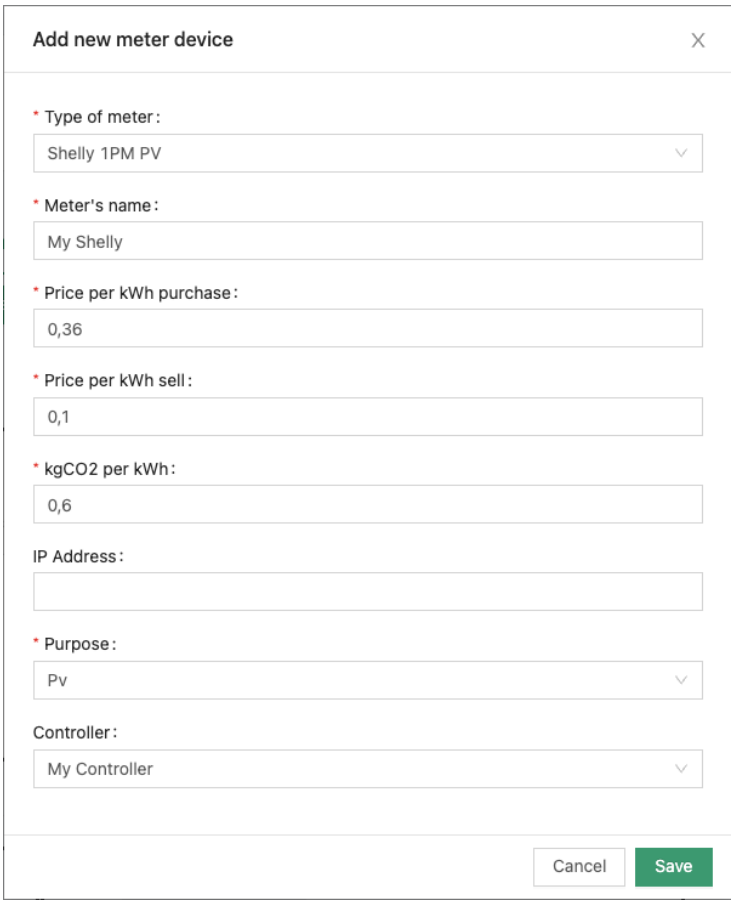
SENEC .Home



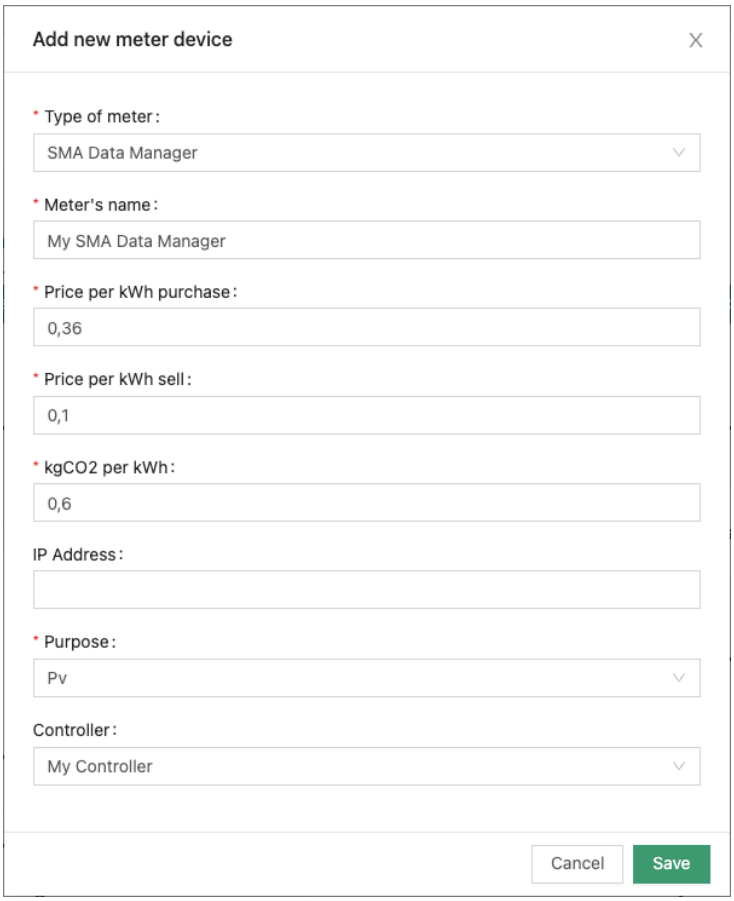
Siemens Sentron PAC



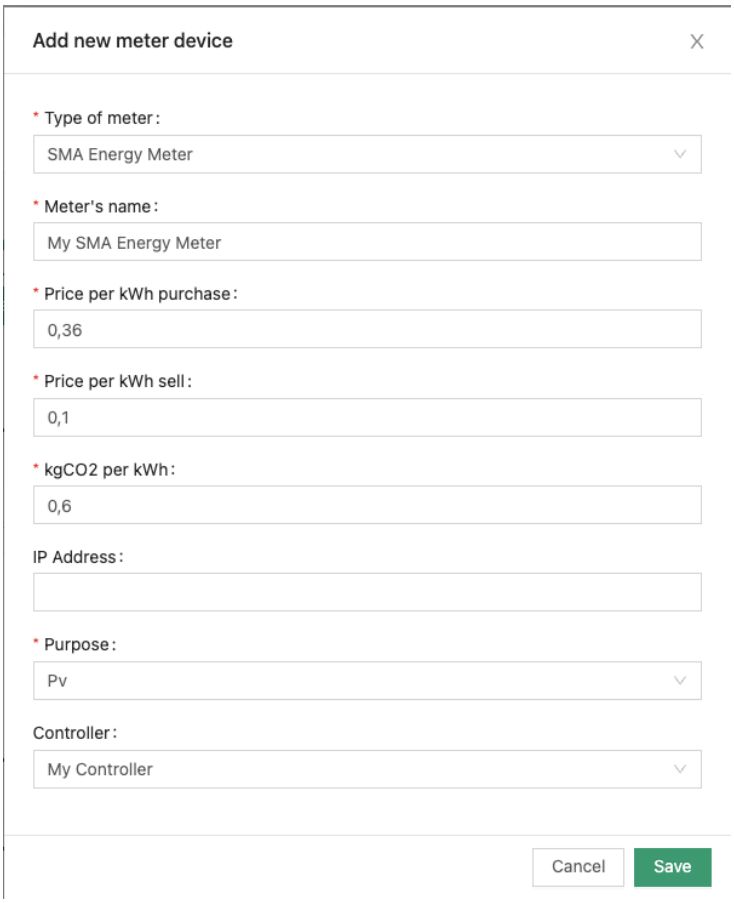
Shelly 1PM PV



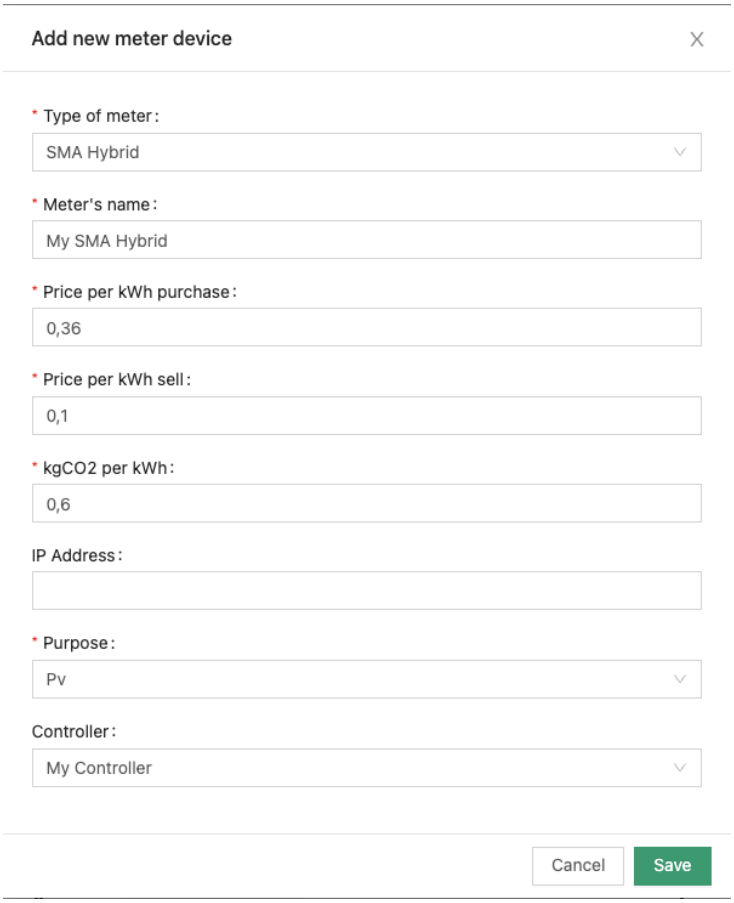
SMA Data Manager



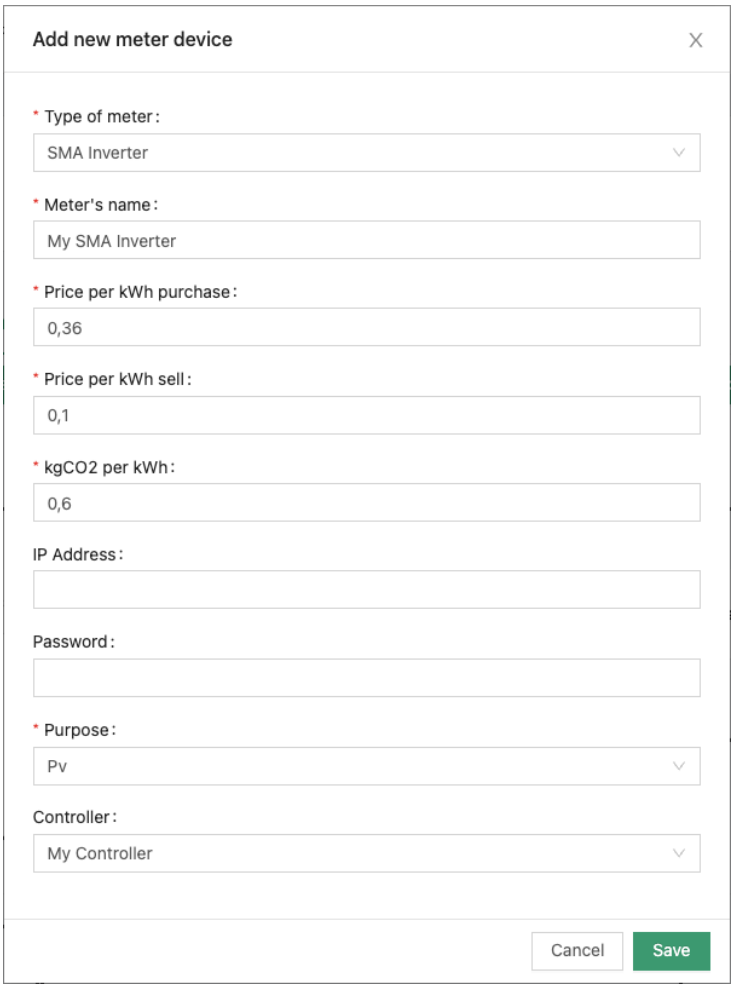
SMA Energy Meter


Add new meter device
* Type of meter:
SMA Energy Meter
* Meter's name:
My SMA Energy Meter
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

SMA Hybrid

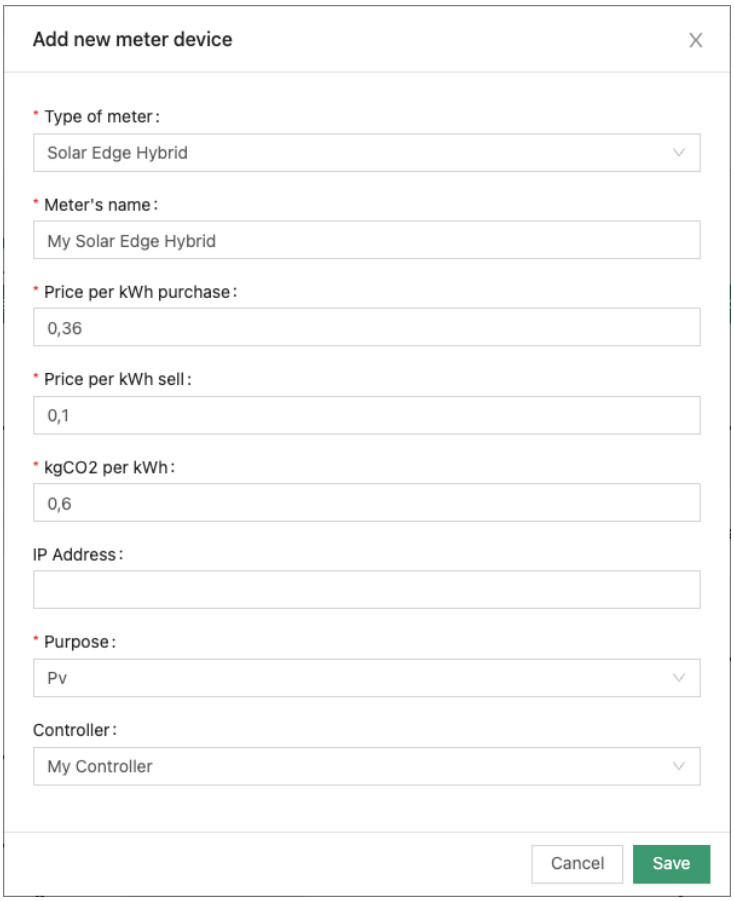


SMA Inverter

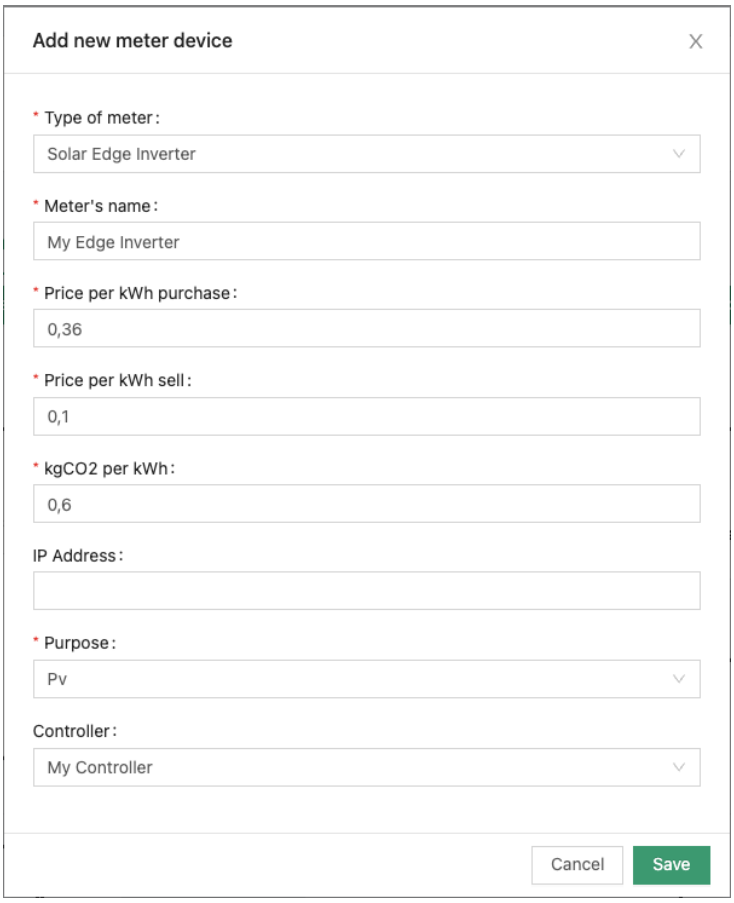


Password is used for user-group user (optional)

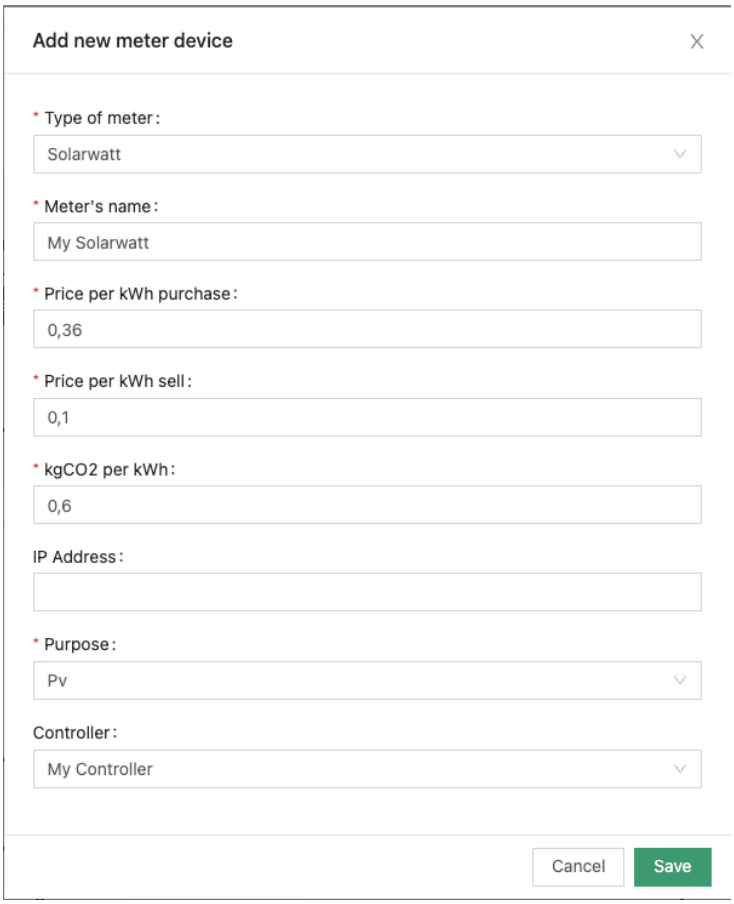
SolarEdge Hybrid



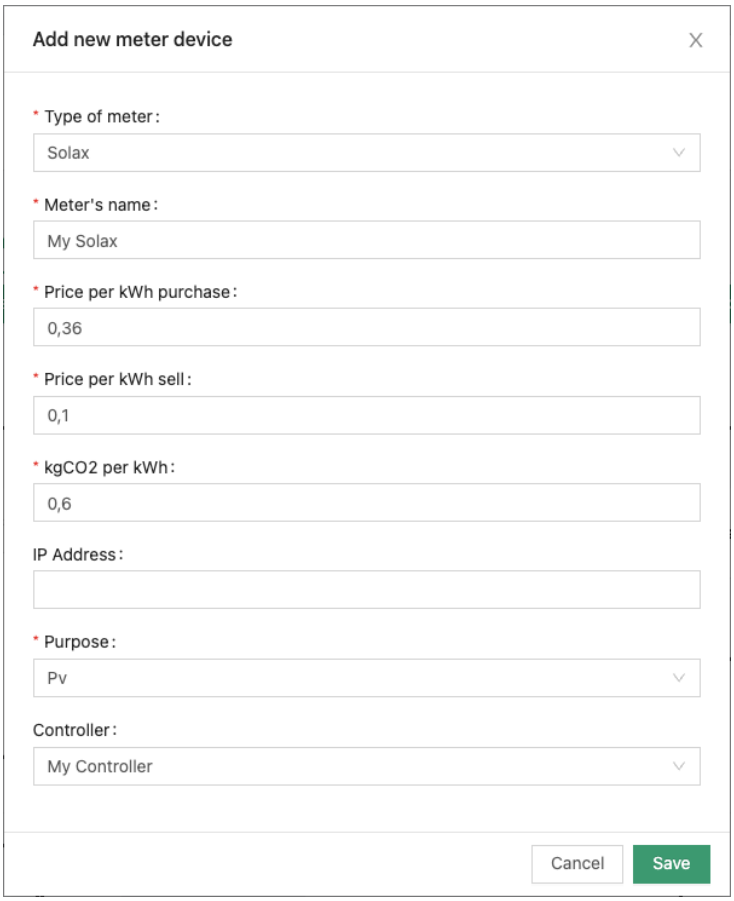
SolarEdge Inverter


Add new meter device
* Type of meter:
Solar Edge Inverter
* Meter's name:
My Edge Inverter
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

Solarwatt

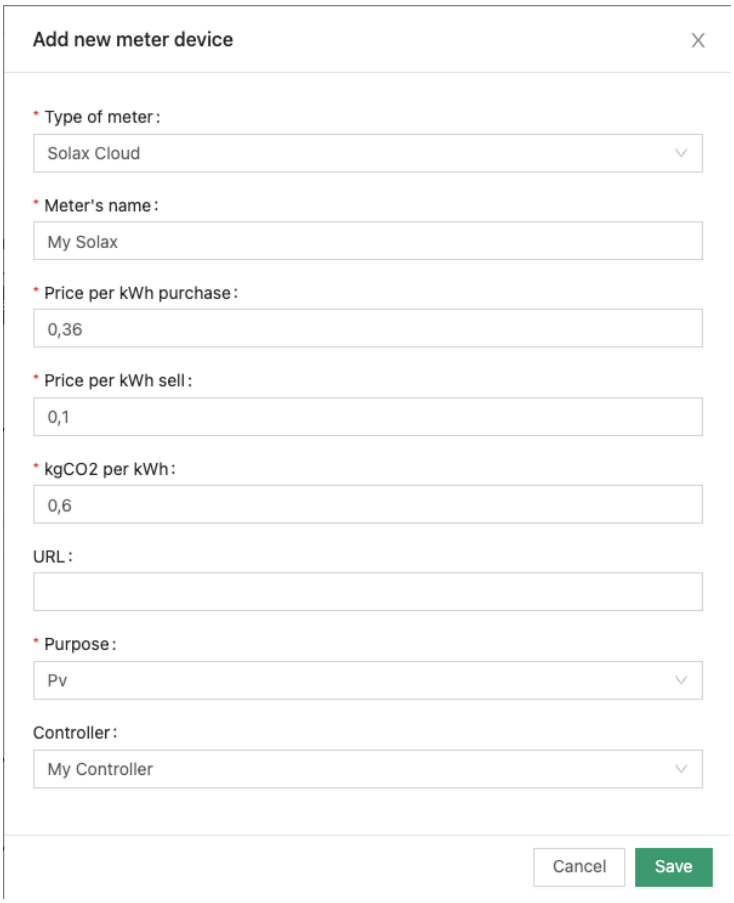

Add new meter device
* Type of meter:
Solarwatt
* Meter's name:
My Solarwatt
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

Solax



Solax Cloud

ATTENTION: Just use this type when there is no direct access possible. The Cloud API can only be called every 150 seconds (and may deliver up to 5 minutes old data). This is also incompatible with our 4hz data which will lead to display problems.

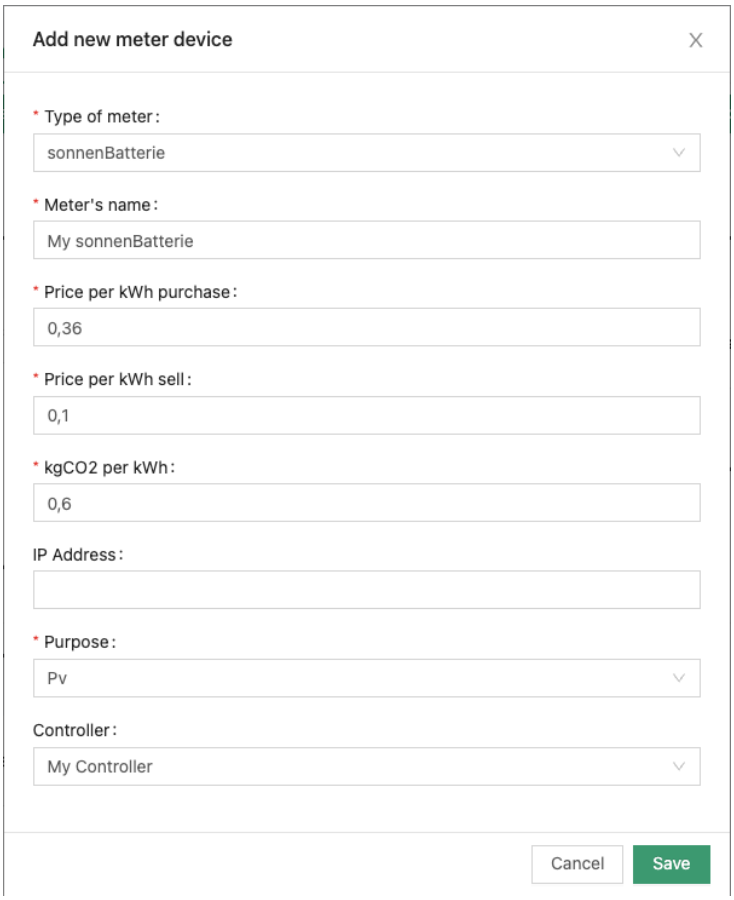


Enter solax cloud API url for authorization. (e.g. https://www.eu.solaxcloud.com:9443/proxy/api/getRealtimeInfo.do?tokenId=?&sn=?)

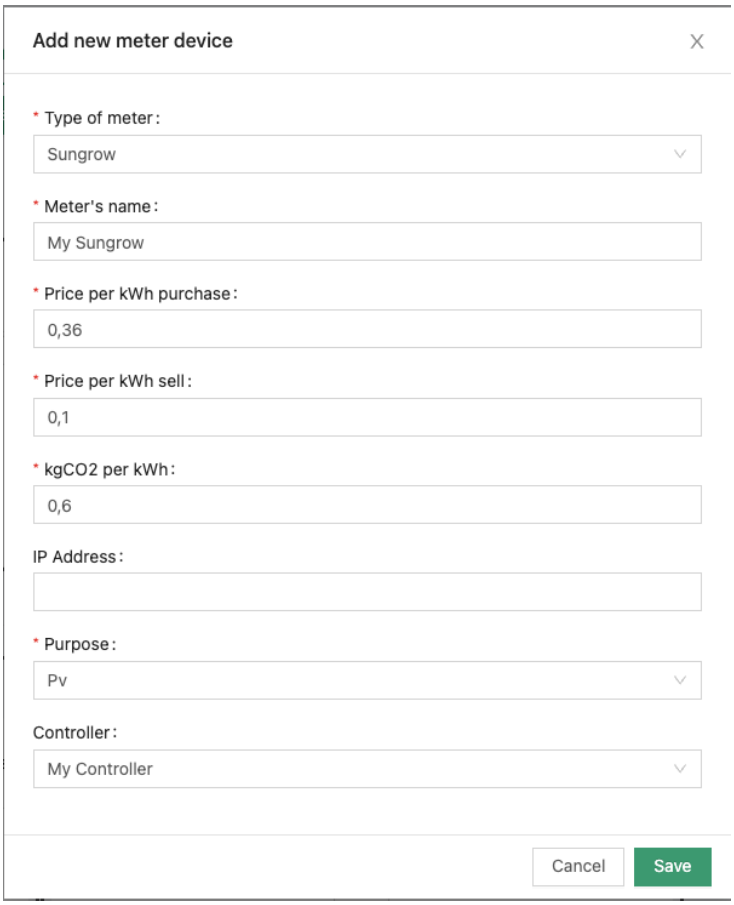
You can retrieve the tokenId at https://www.solaxcloud.com/#/api (Enter 'ObtaintokenID' as parameter).

You can retrieve the serial number at https://www.solaxcloud.com/#/inverter (Enter serial number as parameter).

sonnenBatterie

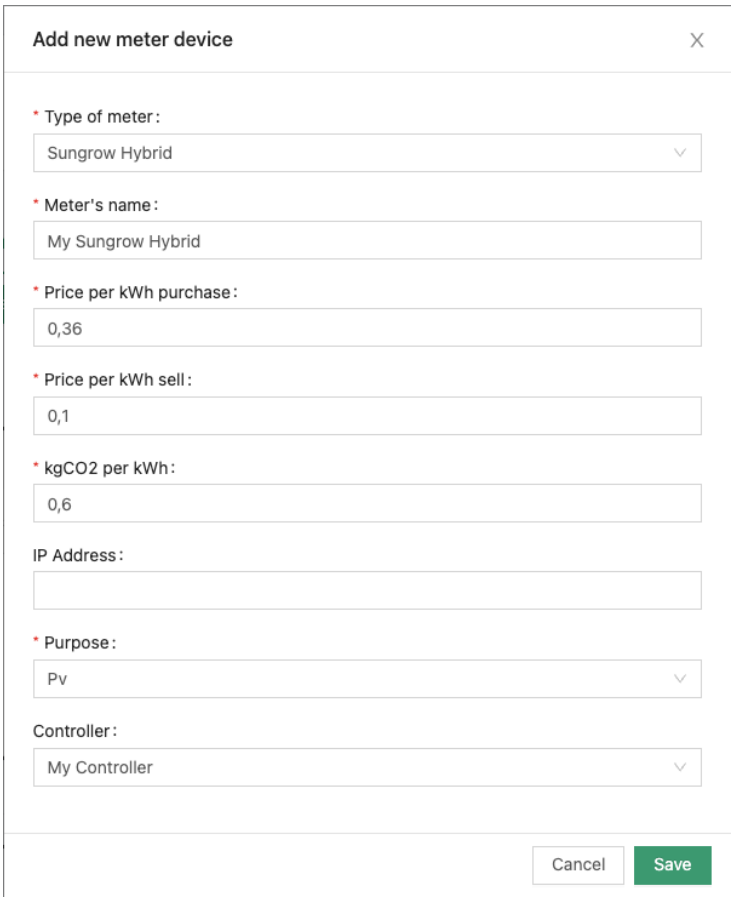

Add new meter device
* Type of meter:
sonnenBatterie
* Meter's name:
My sonnenBatterie
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Pv
Controller:
My Controller
Cancel
Save

Sungrow

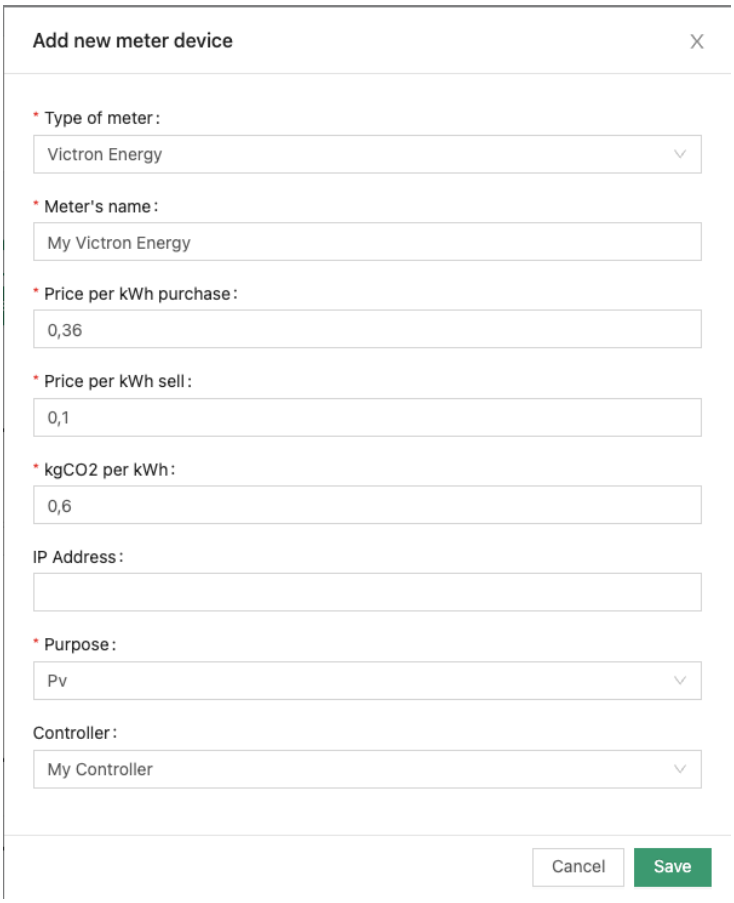


Sungrow Hybrid

Connection possible via LAN or serial connection (RS485)



Victron Energy



Option 2: measurement PV production with iWattMeter

Install the iWattMeter

Get the iWattMeter installed by an electrician to measure your PV Production.

Register the iWattMeter in your Watt Analytics account and verify in the dashboard that the correct values are measured. In many cases this should 1/3 of the total production of your PV System on each of the 3 phases. Make sure that the measured values are positive. Change the CT direction if necessary.

Connect the iWattMeter to the iWattController

For the following section where terminal commands have to be entered you need to open the "Terminal" app in MacOS or the "Cmd" App on Windows and enter the commands like "ssh" there.

Configure the iWattController or SmartPi to read and process the data of your iWattMeter:

set smartpi mqtt credentials

```
ssh pi@<IP of iWattController / SmartPi>
sudo systemctl stop wa-pi.service
java -jar /usr/local/bin/wa-pi.jar pvInverterType=iwattmeter
```

- check the console log that no errors occur
- Press <Ctrl>-C to interrupt the process

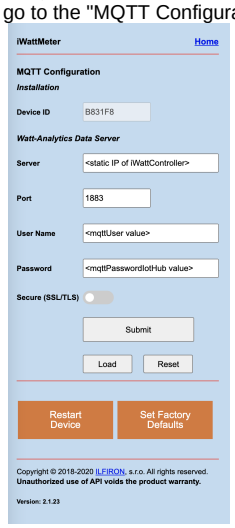
restart wa-pi.service

```
sudo systemctl start wa-pi.service
journalctl -f -u wa-pi.service
```

- check the console log that no errors occur

Configure you iWattMeter to send data to the iWattController or SmartPi. Make sure that you have given your iWattController a static IP address as described above. Find the IP address of the iWattMeter on your router or with a tool like LanScan.

- connect to the web frontend of the iWattMeter with your browser on the IP address you just found. Get login information from support@watt-analytics.com
- go to the "MQTT Configuration" page



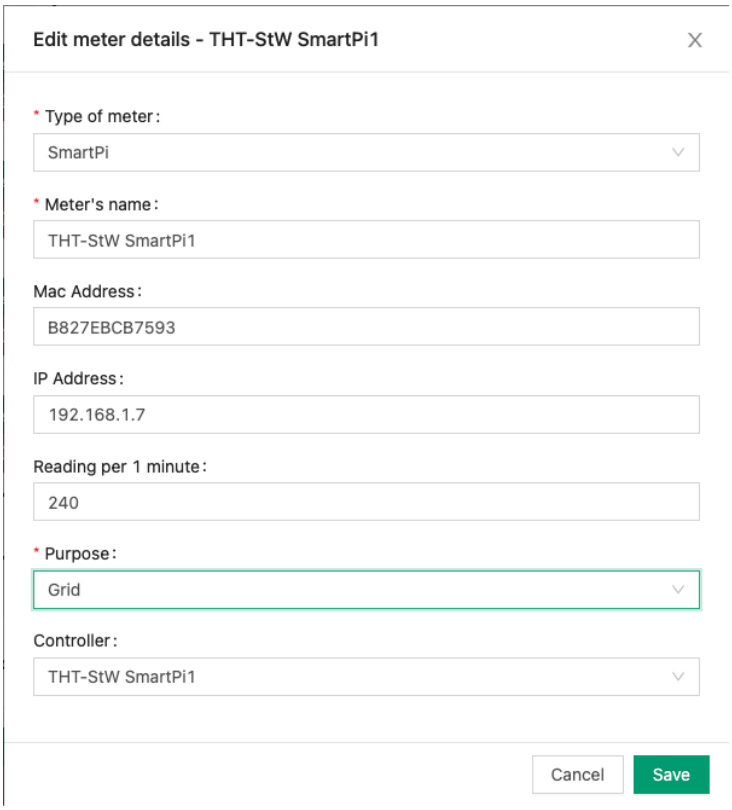
  - Take the above values out of the wa-pi.properties from the iWattController or the WebApp Home menu
  - Make sure the the Secure (SSL/TLS) option is switched OFF
  - Press SUBMIT
  - Press RESTART DEVICE

Check that you solar production is displayed in the web and mobile app after a few seconds

If you are installing the iWattMeter in a network company network or larger home network, please assign a static IP address to the iWattMeter and make sure to use the correct netmask e.g. 255.255.254.0

Controller measures Grid power

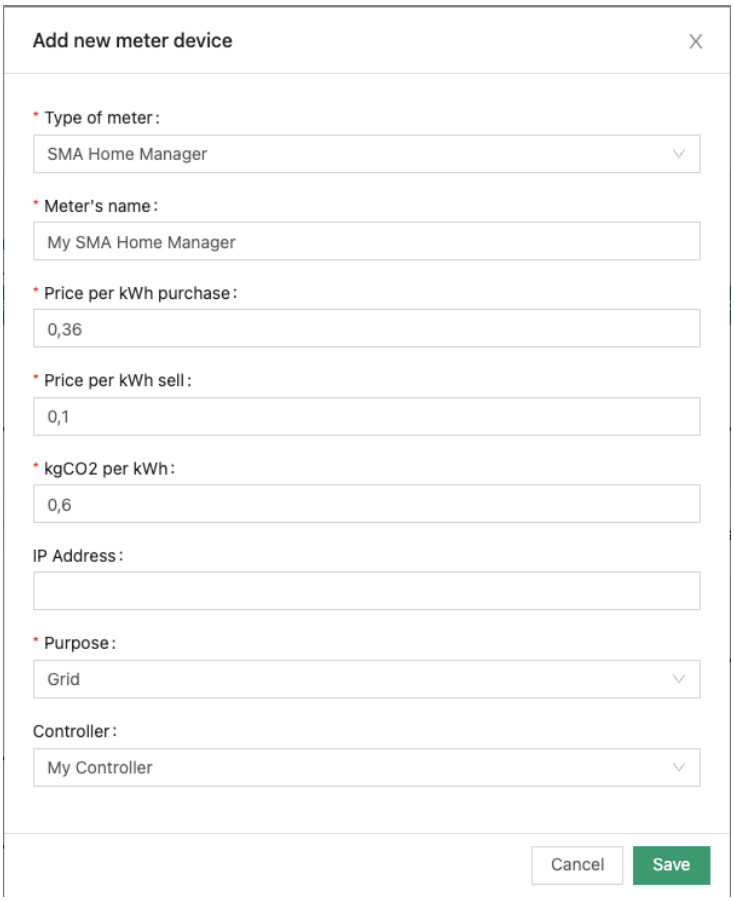
Use this option if you have a solar installation where the solar production is merged into your power network between the consumers. In such a setup it's not possible to measure pure consumption, but your would install the Watt Analytics power meter close to the utility power meter and measure the mix of production and consumption. To be able to see the total consumption independent of your production, you set the Usage field of your controller to Grid:



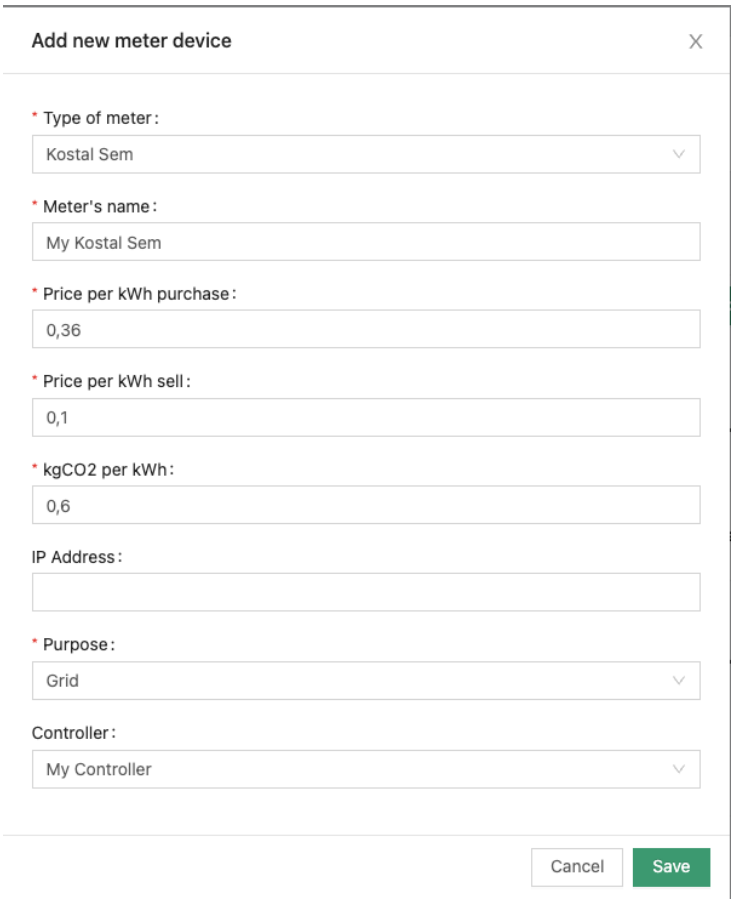
check you consumption curve in the web app, it should show all positive values (before they where negative, when you production was higher than the consumption)

Supported Grid meter types

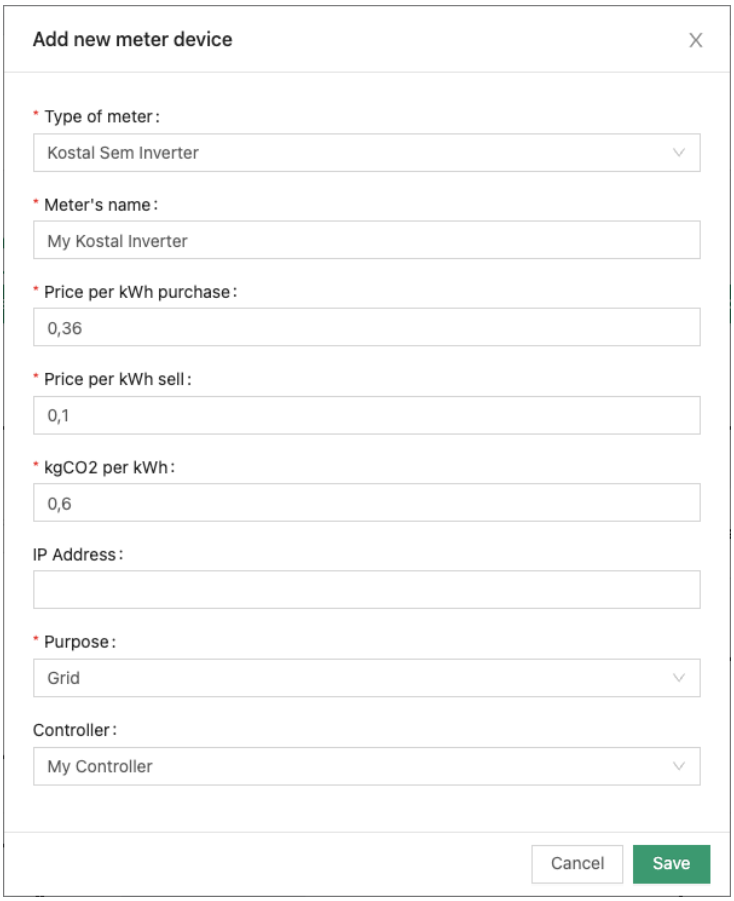
SMA Home Manager


Add new meter device
* Type of meter:
SMA Home Manager
* Meter's name:
My SMA Home Manager
* Price per kWh purchase:
0,36
* Price per kWh sell:
0,1
* kgCO2 per kWh:
0,6
IP Address:
* Purpose:
Grid
Controller:
My Controller
Cancel
Save

Kostal Sem



Kostal Sem Inverter

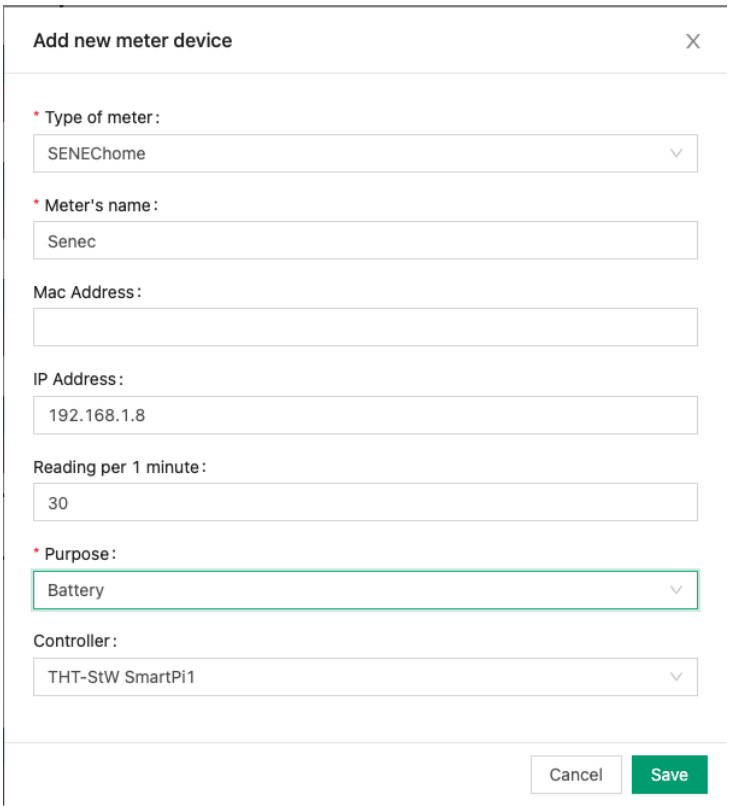


Option: connect multiple PV inverters

Proceed like described above, the sum of the inverters will be displayed in the app.

Battery installation

To configure battery soc and watt measurement, press Add new meter in the Storage section

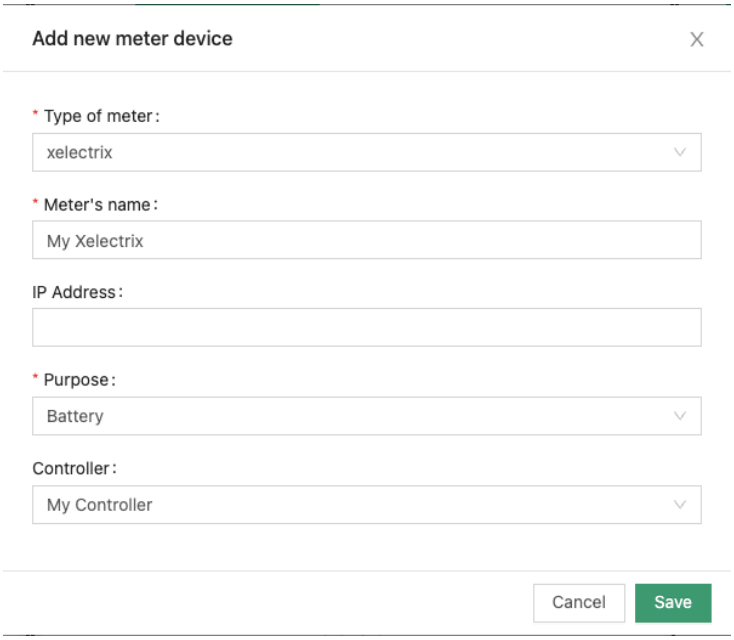


In meter type select the type that matches your battery type. Please contact support@watt-analytics.com if your battery type is missing in the list. Enter a name for the meter and the IP address of the PV Inverter. Please make sure that this IP address is also statically assigned.

Readings per minute shall be set to 30, Purpose = Battery and Controller to the name of your controller (iWattController or SmartPi)

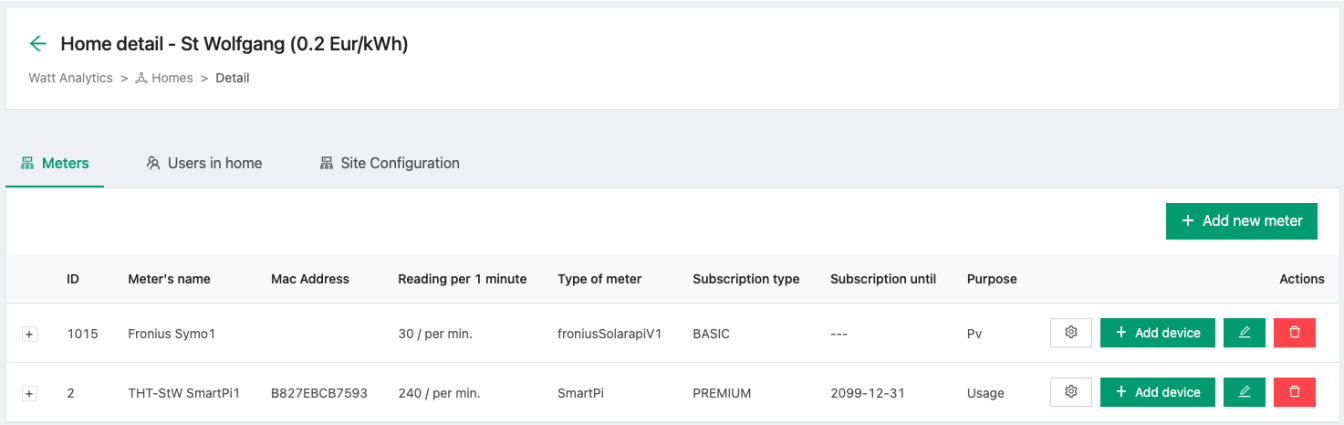
Supported battery types

Xelectrix

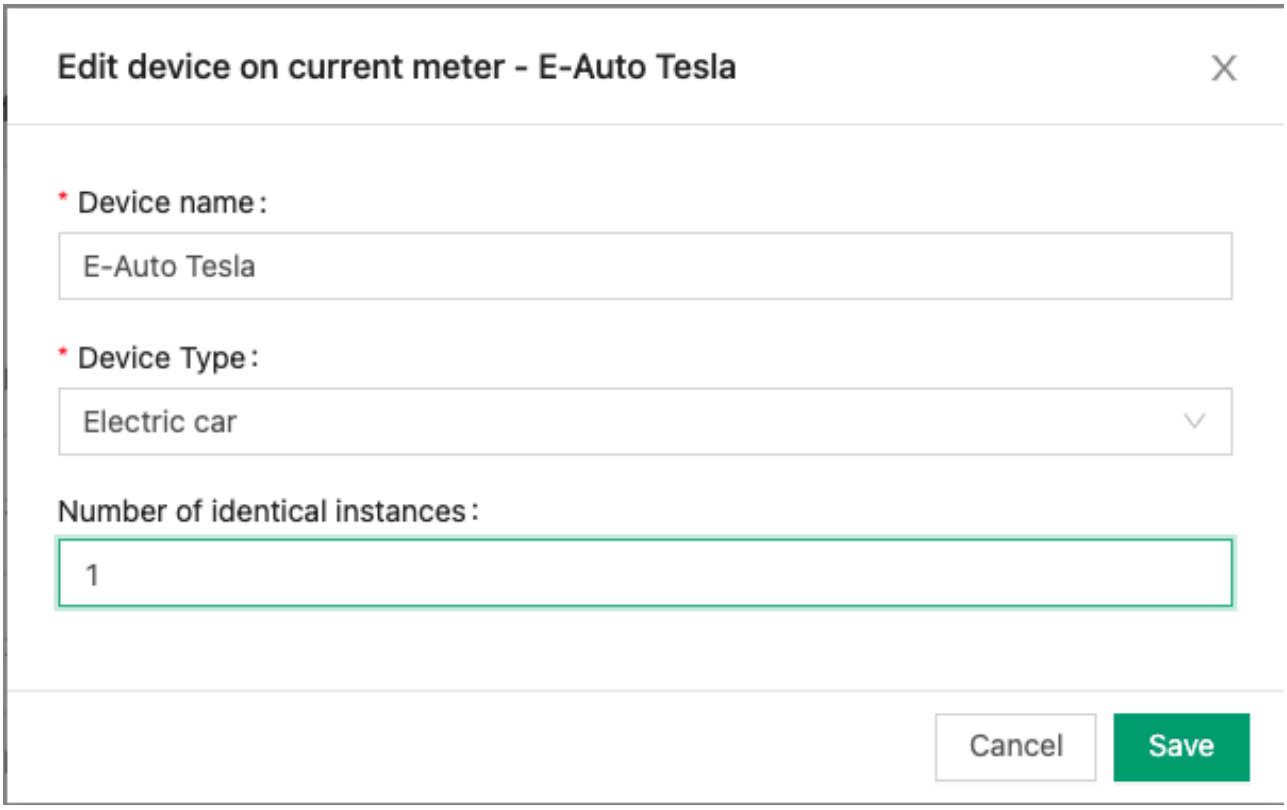


Wallbox installation

Create a device for your vehicle charging power usage



On the Meters List press the "Add Device" button

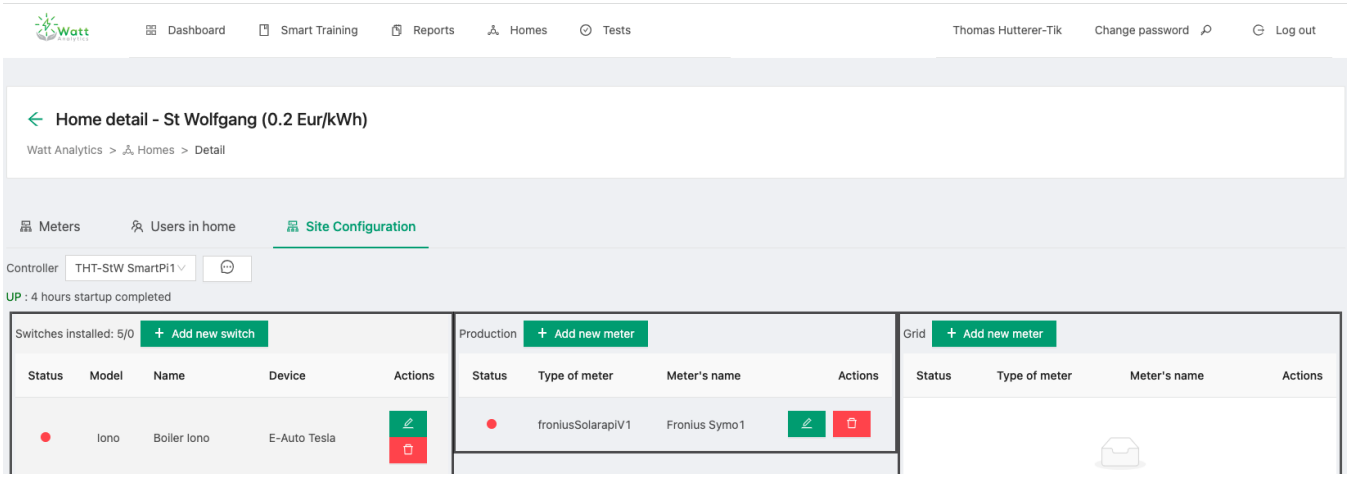


Name the device and select "Electric Car" for the device type.

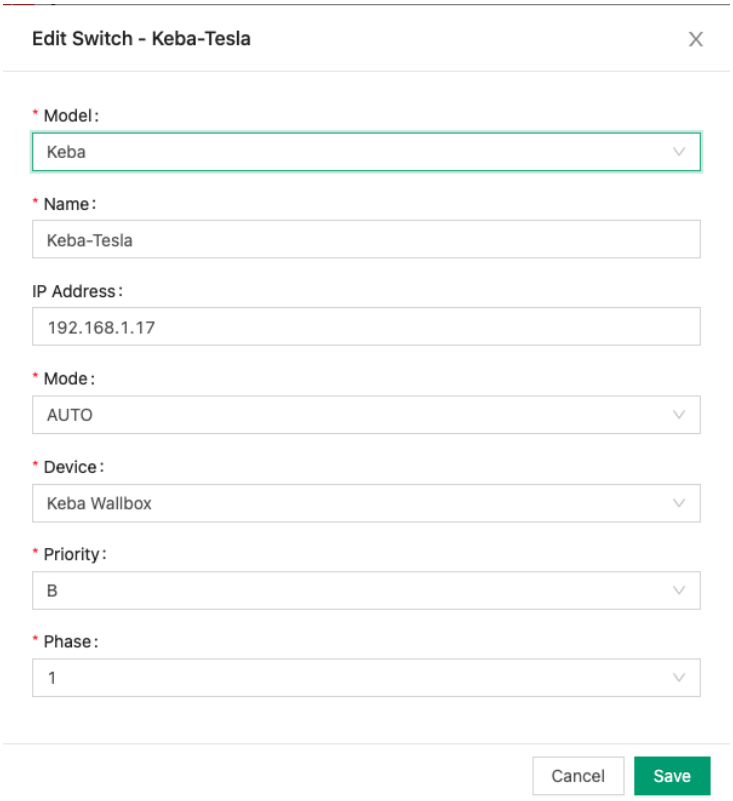
Register the wall-box

Get you wall-box installed by an electrician and make sure that it works properly with the app of the wall-box.

After that navigate to the Site-Configuration



In the Site-Configuration use the "Add new switch" button to register a wall box.



Select the wall-box model you have installed. Please contact support@watt-analytics.com if your wall-box type is missing in the list.
Enter the IP address and make sure, that you have assigned a static IP address to the wall-box.

Choose mode = AUTO to enable loading when you have surplus PV production.

Choose Priority:

- A to enable minimum loading even without PV production
- B to enable loading with PV production only

Choose Phase: depending on the charging speed you want to achieve

- 1 phase: charging with 1,4 kW up to 4,3 kW
- 3 phase: charging with 4,2 kW up to 11 kW

if you have a 5kWp PV installation, the 1 phase is recommended, because you will utilise your production better

Switch Installation

Shelly switch

Install Shelly switch hardware

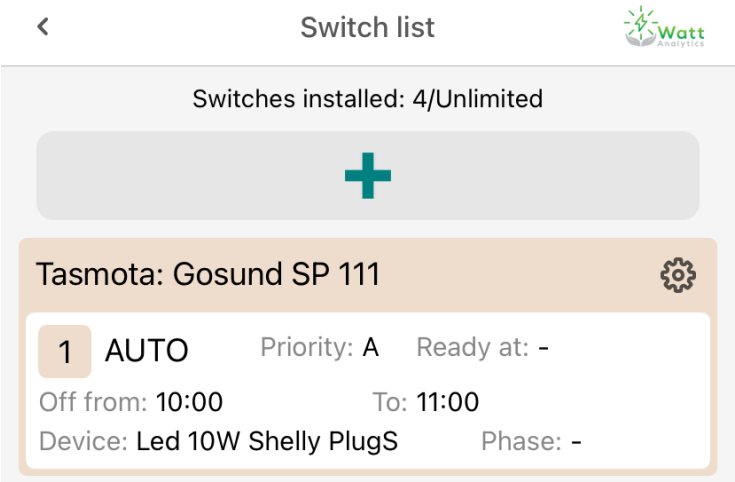
- For Shelly Plug and Shelly Plug S, you can easily connect it to the power socket and use it as an outlet to connect your device.

Shelly Plug	Shelly Plug S
	

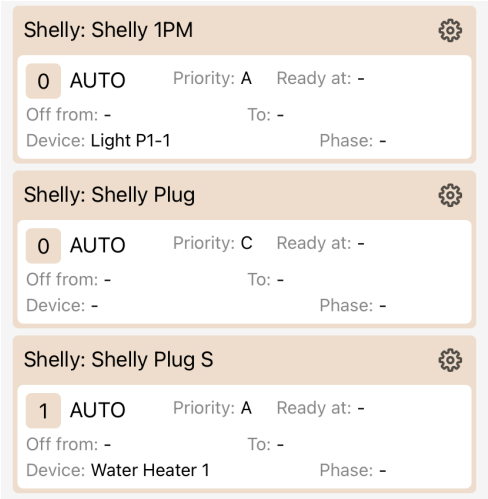
- For Shelly 1PM, ask you your electrician to install it for you.

Shelly 1PM


- Register your Shelly switch in the App
- In watt-analytics app, tap on `Account` button at bottom then `Switch list`.
- With the `+` button on top, you can register your switch by following the instruction provided by the app step by step.



- Configure your switch
- In watt-analytics app, under `Account / Switch list`, you can see list of your registered switches with yellow border containing relays in white. Shelly Plug, Shelly Plug S and Shelly 1PM are single relay switches, so there is only one relay attached to them as you see in the image below:



- Use the button on top right of your switch to reconfigure, rename or remove it.
- To assign a device to a relay or change the PV optimiser behaviour, click on relay (white area).

Modbus-Register Switch

Can be used for variable load water heating which are based on Modbus.

MyPV AC-Thomas 9s is one example with those register definitions:

Modbus TCP control

⚠ Control type of AC-THOR has to be set to Modbus TCP to accept power commands!

⚠ Mentioned register addresses are „real“ addresses. Depending on your data retrieval system it might be required to add 1 to the register addresses (e.g. 1001 instead of 1000)!

Address	R/W	Parameter		Value Unit	Comment
1000	R/W	Power		W	unlimited range of value
			AC-THOR:	0-3.000 M1, 0-6.000 M3	
			AC-THOR 9s:	0-9.000 M1	
				0-18.000 M3	since a0020500
		In Multi-Mode this is the power sum of all devices. The value range can then also be larger depending on the number of devices			
1001	R	Temp1		1/10°C	

For this switch, the following settings are needed:

Schalter bearbeiten - AC-THOR 9s

* Modell:
ModbusRegister

* Name:
AC-THOR 9s

IP Adresse:
10.0.0.99

* Modus:
AUTO

* Gerät:
AC-THOR 9s

* Priorität:
A

Phase:
3

Modbus Functioncode für State:
6

Modbus Register-Startadresse für State:
1000

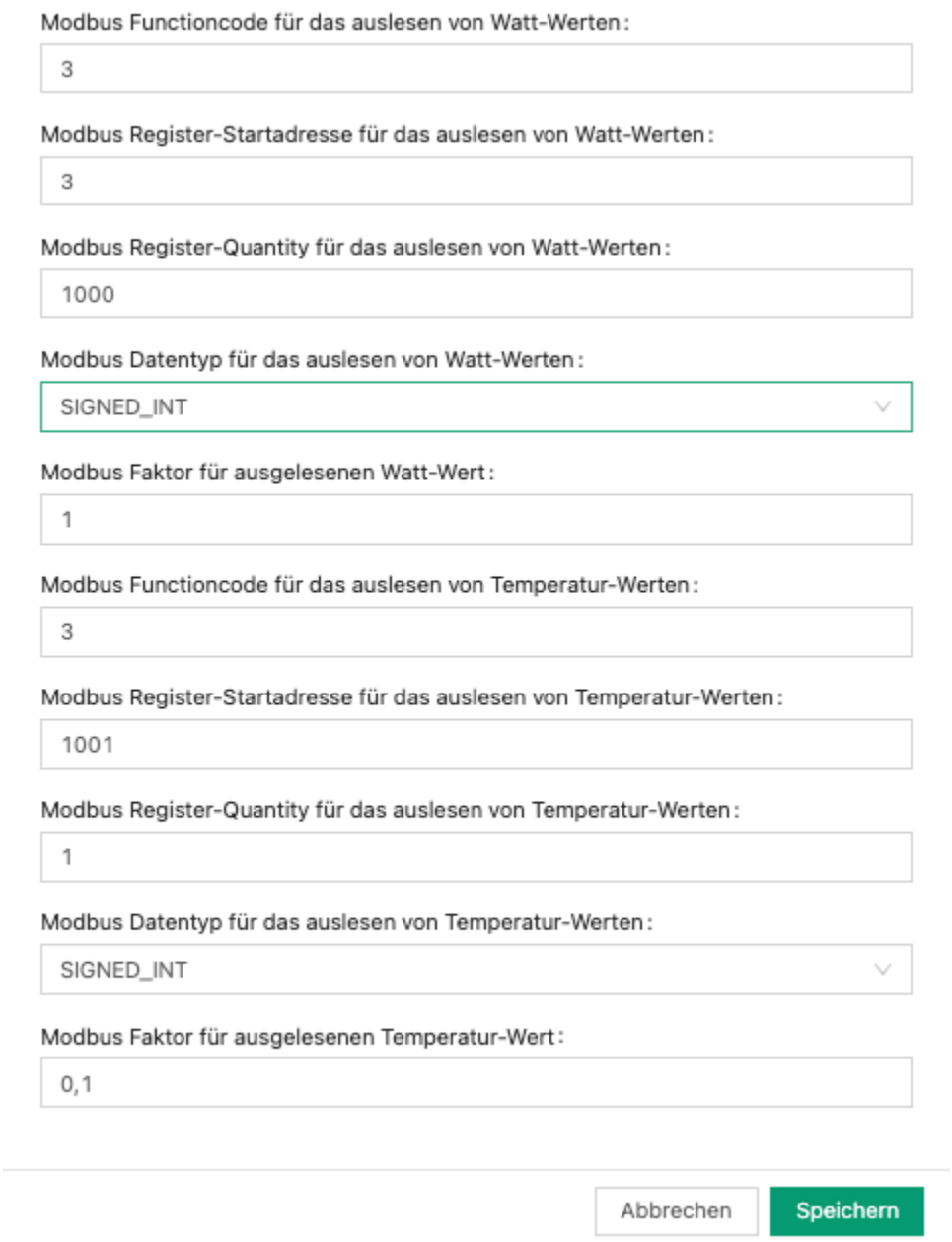
Modbus Register-Quantity für State:
1

Modbus Min-Value für State:
0

Modbus Max-Value für State:
9000

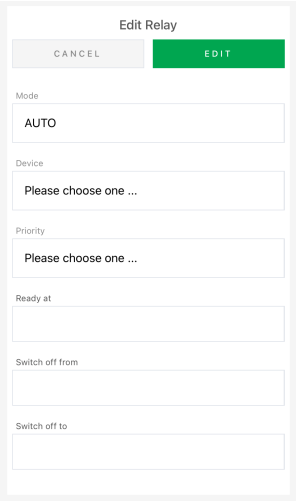
Modbus Datentyp für State:
SIGNED_INT

Modbus Faktor (min- und max-Values werden damit multipliziert) für State:
1



Relay configuration

Each switch may come with 1 or multiple relays depending on the type. In the below setup page you can configure how the Watt Analytics Software will monitor and control your device through the relay.



There are different properties you can set for each relay:

- mode:
  - AUTO: device is being switched on and off automatically by PV-Optimiser based on your solar production
  - ON: device will always have power
  - OFF: device will always be switched off
  - MAN: (MANUAL) PV-Optimiser will not control your device and you can switch it on or off by physical button or another cloud service
- Device:
  - Device you want to be controlled by PV-Optimiser. For example your Water boiler.
- Phase:
  - If your device uses three power lines, the connected phase also need to be defined here otherwise you do not see this property at all.
- Priority:
  - When you have more than one device switchable by PV-Optimiser and solar production is not enough for all of them, it uses this value to power on your priority one.
- Ready at:
  - PV-Optimiser will make sure your device is ready at this time. (Use 24 hour time format like 21:30)
- Switch off from / to:
  - your device will not be switched on at this period. (Use 24 hour time format like 21:30)

Tips

- If you need to reset a Shelly Plug, please connect the plug to a power socket and hold the button for 10 seconds. Then the LED should flash red briefly and then switch to blue