

# FEMS App Power-to-Heat

Version:2023.4.1

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## 1. Introduction

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### 1. Introduction

Dear customer,

Thank you for choosing the "FEMS App Power-to-Heat". You are welcome to send us your suggestions so that we can further improve the quality of our products.

### 2. Installing the app

When you ordered the "FEMS App Power-to-Heat", you received a 16-digit license key. You can use this license key to redeem the app independently in the FEMS App Center.

Eine Anleitung zur Vorgehensweise finden Sie [hier](#).



Für die Integration von mehreren Power-to-Heat-Anwendungen ist jeweils der Kauf einer einzelnen FEMS-App erforderlich.

### 3. SG-Ready heat pump

#### 3.1. Prerequisites

To integrate an SG-Ready heat pump with the "FEMS App Power-to-Heat" is required:

- FENECON Home 10 with two free relay contacts *or*
- FEMS relay board 8-channel TCP with two free relay contacts (note: not included)
- Heat pump with "Smart Grid Ready" label



Depending on the type of heat pump (heat pump for heating purposes vs. heat pump for domestic water), a free relay contact may also be sufficient (see FAQ).

#### 3.2. Integration

The integration of an "SG-Ready" (Smart Grid Ready) heat pump into the energy management system is an advanced form of sector coupling of electricity and heat.

The controller ensures that the heat pump slightly overheats the thermal energy storage at times when excess PV power is available in order to save electrical energy at times when there is no cheap excess power available.

##### 3.2.1. Operating states

Four different switching states have been realized for the SG-Ready control, which correspond to the following list:

[German SG Ready label according to BWP](#)

- **Lockout:** Operating state 1 (1 switching state, with terminal solution: 1:0): This operating state is downward

compatible with the grid operator lockout, which is often switched at fixed times, and comprises a maximum of 2 hours of "hard" lockout time.

- **Normal operation:** Operating state 2 (1 switching state, for terminal solutions: 0:0): In this circuit, the heat pump runs in energy-efficient normal operation with proportionate heat storage filling for the maximum two-hour grid operator block.
- **Switch-on recommendation:** Operating state 3 (1 switching state, with terminal solution 0:1): In this operating state, the heat pump runs within the controller in boosted operation for space heating and domestic hot water preparation. This is not a definitive start-up command, but a switch-on recommendation corresponding to the current boost.
- **Switch-on command:** Operating state 4 (1 switching state, with terminal solution 1:1): This is a definitive start-up command, insofar as this is set in the control settings.

As there is no official standard for heat pump inputs, some manufacturers activate the operating states via a voltage (applied to the inputs). Other manufacturers use a connection between two inputs of the heat pump instead. Due to this fact, the app was designed to be universal. This must now be adapted to the control of the heat pump. This can mean that a control voltage is applied to the relays, which is then forwarded to the respective heat pump input (when the relay is active) (depending on the heat pump).

The table below summarizes the four different operating states, the corresponding designations in the widget and the circuits of the individual relays.

|                    | Name in widget           | Relay 2 | Relay 3 |
|--------------------|--------------------------|---------|---------|
| Operating status 1 | Lock                     | Closed  | Open    |
| Operating state 2  | Normal operation         | Open    | Open    |
| Operating state 3  | Switch-on recommendation | Open    | Closed  |
| Operating state 4  | Switch-on command        | Closed  | Closed  |

As soon as the "FEMS App Power-to-Heat" for integrating an SG-Ready heat pump has been installed on your system, you will see this widget in your monitoring:

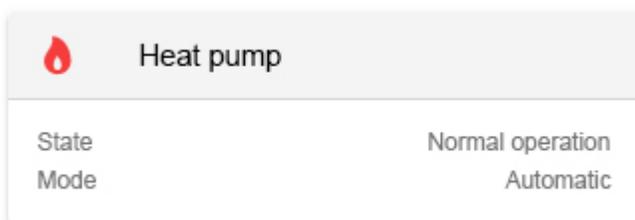


Figure 1. Widget - Overview

Click on the widget to open the detailed view:

### 3.2. Integration

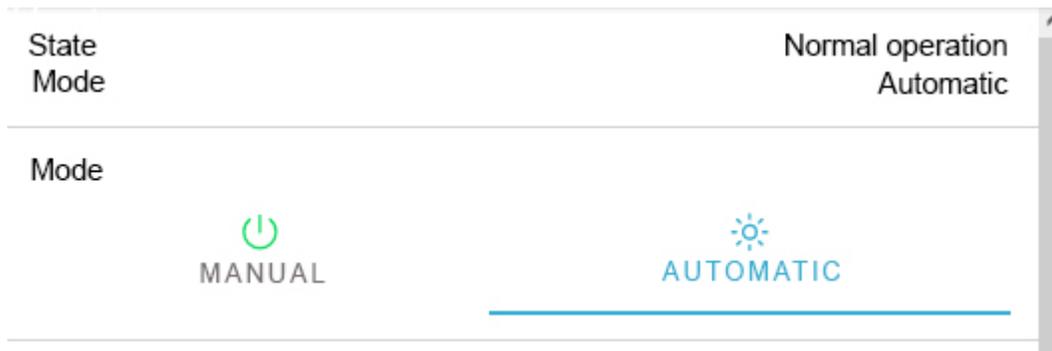


Figure 2. Widget - Detailed view

It displays the current status and mode.

Here you have the option of switching between the two operating modes Manual and Automatic:

- Manual

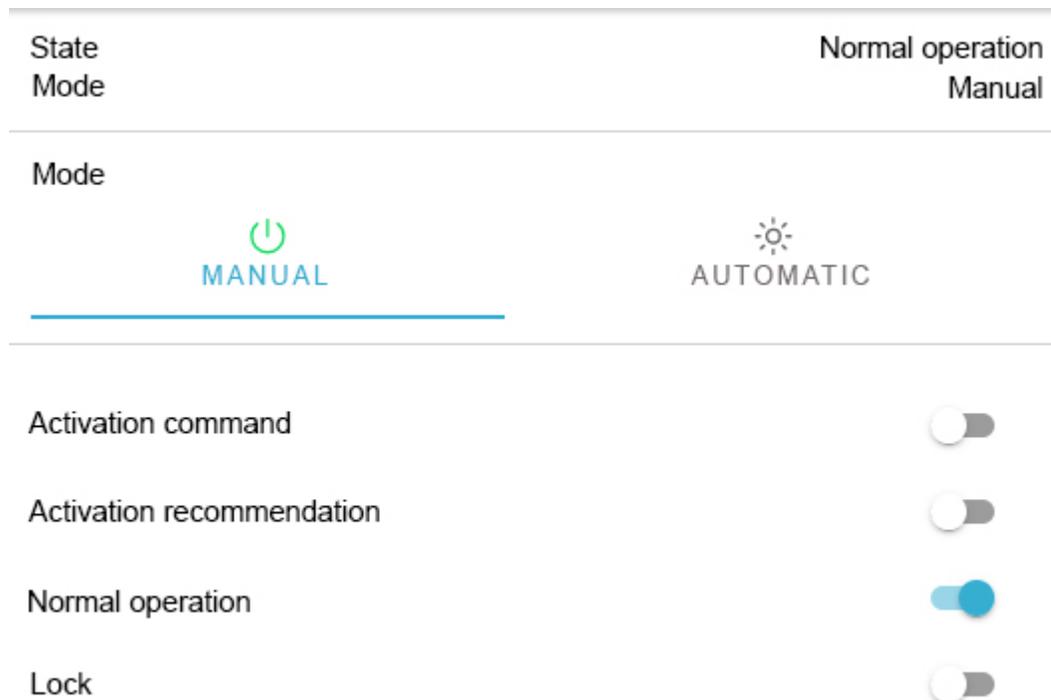


Figure 3. Operating mode "On"

In Manual mode, the operating states of the heat pump can be set manually.

- Automatic

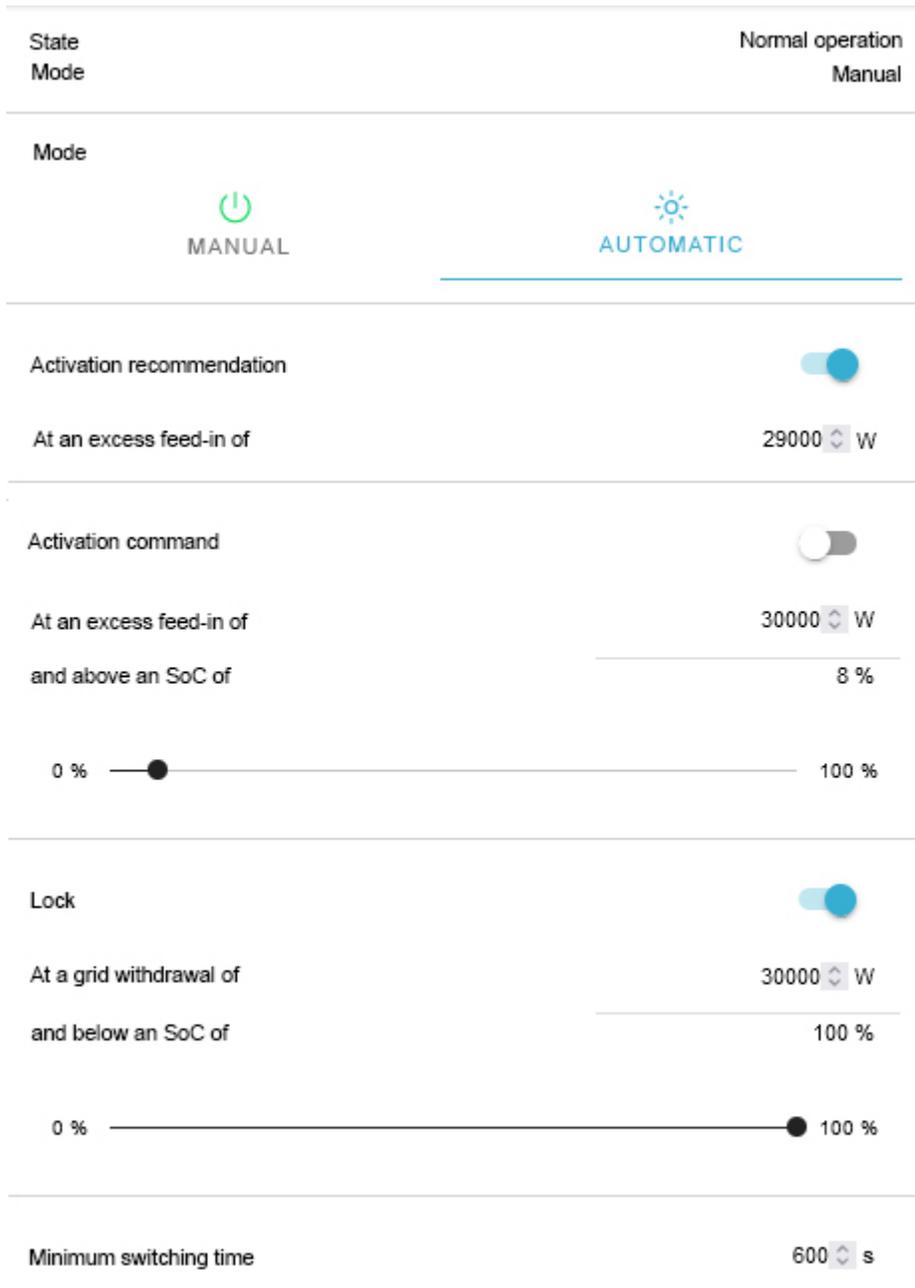


Figure 4. "Automatic" operating mode

In "Automatic" mode, the operating states of the heat pump can be set using the parameters surplus feed-in, mains supply and state of charge of the electrical energy storage. The built-in hysteresis ensures that the relays do not constantly switch on and off. This can be implemented via the minimum switchover time (in seconds).



The value of the excess feed-in (see [Note on surplus feed-in](#)) must not be lower than the maximum output of the heat pump. Otherwise, this state will switch off and on again and again.

3.2. Integration

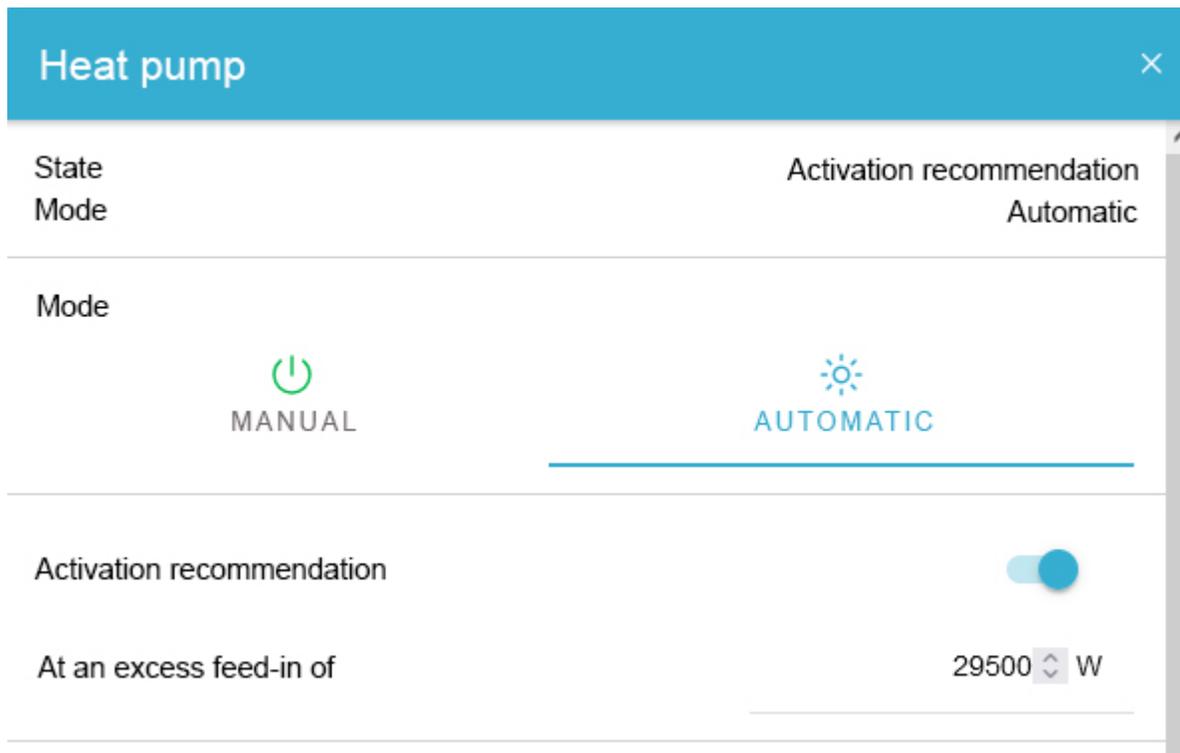


Figure 5. Note on surplus feed-in

The corresponding widget in the historical view displays the behavior of the heat pump over time.

In addition, you can track the duration of the individual operating states of the heat pump used in the historical view in Online Monitoring (see [Widget - Historical view \(1\)](#)):

| Heat pump                 |         |
|---------------------------|---------|
| Normal operation          | 15h 28m |
| Activation recommendation | 8h 31m  |

Figure 6. Widget - Historical view (1)

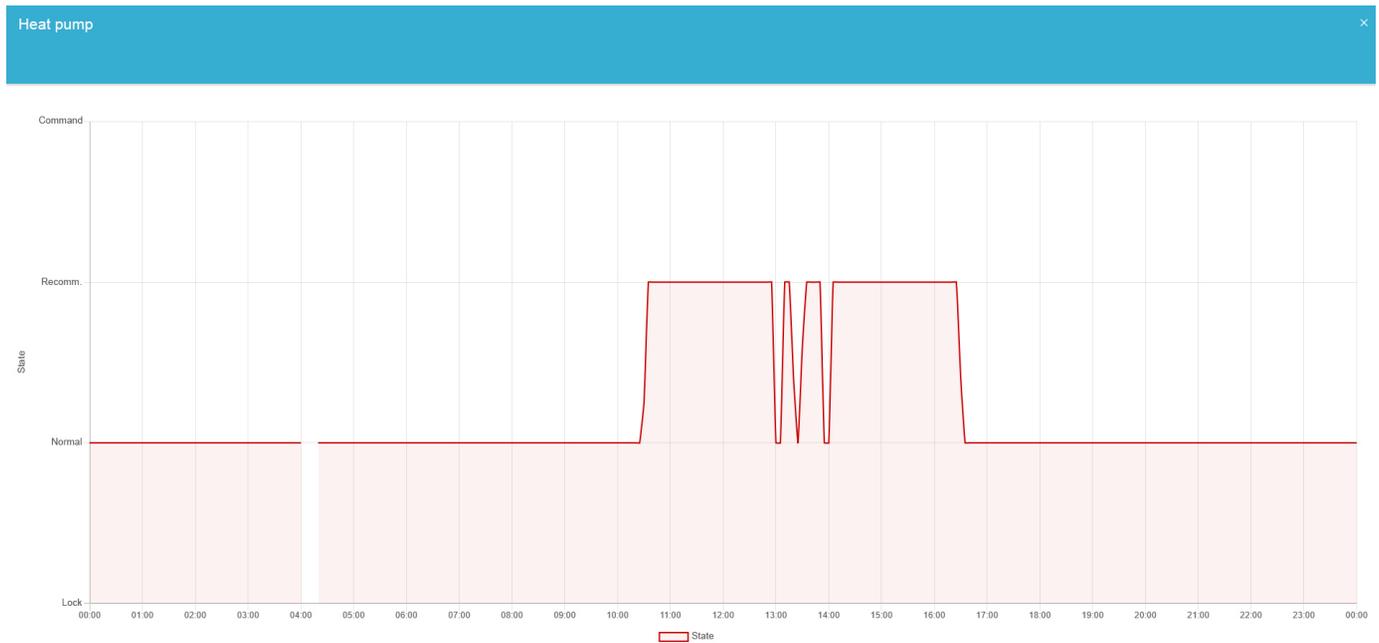


Figure 7. Widget - Historical view (2)

In the example above, only the operating state switch-on recommendation was selected in automatic mode. This is activated at times when excess PV power is available. At other times, the heat pump operated in normal mode.



Find more information about the SG Ready label for heat pumps at <https://www.waermepumpe.de/normen-technik/sg-ready/>

### 3.3. FAQ - Frequently Asked Questions

Below you will find the answers to Frequently Asked Questions about our app

#### 1. I use a heat pump for domestic water with SG Ready label, which only has one controller/potential-free contact. Can I still use the app?

Yes, with these heat pumps the controller is used for automatic control and enables the hot water setpoint temperature to be increased for the purpose of thermal storage. The app can also be used here. However, when using it, it must be noted that only two states (0 or 1) can be switched with only one potential-free contact. We therefore recommend selecting the following two combinations of operating states.

- Switch-on recommendation (0 | 1) or normal operation (0 | 0) *or*
- Switch-on command (1 | 1) or normal operation (0 | 0)

Technically, the combinations above do not differ for the heat pump, as in both cases a contact is switched and the flow temperature is raised. The difference lies purely in the selection of parameterization options in the app. With the first combination, the relay is only switched depending on the surplus feed-in. With the lower combination, the state of charge of the electrical energy storage can be added as an additional threshold value.

The example below shows the use of the app with a *Stiebel Eltron WWK200* heat pump for domestic water. The heat pump is only connected to the EMS box (Harting plug) via a potential-free contact.

## 4. Heating element

Heat pump
×

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Activation recommendation

At an excess feed-in of

---

Activation command

At an excess feed-in of

and above an SoC of

0 % 
0 %
100 %

 100 %

---

Lock

At a grid withdrawal of

and below an SoC of

0 % 
0 %
100 %

 100 %

2000 ⬇ ⬆ ⬇ W

---

5000 ⬇ ⬆ ⬇ W

10 %

---

5000 ⬇ ⬆ ⬇ W

20 %

The upper of the two combinations was chosen here. From an excess feed-in of 2000 W, the potential-free contact of the heat pump is switched. The compressor then increases the flow temperature from 55 °C to 65 °C. Regardless of whether the signal is still present, the heat pump now remains in this increased operating mode for at least 20 minutes. If the signal is still present after 20 minutes, the heat pump remains in this mode. Otherwise, it switches back to normal operating mode (normal operation).

## 4. Heating element

### 4.1. Why should a heating element be integrated into the energy management system?

The integration of an electric heating element into the energy management system is the simplest form of sector coupling of electricity and heat. If the electrical energy storage system is fully charged during the day, the PV surplus must be fed into the public grid with little or no remuneration. Instead, it makes more sense to increase self-consumption and use the PV surplus electricity for heating/cooling the residential building or for hot water preparation (e. g. for hot water buffer storage, pool heating).

The app enables the integration of a heating element dynamically in three power levels.

The [table](#) below shows this as an example for a 6 kW heating element. For a heating element with a different power value, the power levels are adjusted accordingly.

### 4.2. Advantages of a heating element in the energy management system:

- *Flexibility*

Quick and easy activation, depending on the heat requirement.

- *Integration of renewable energies:*

Combined with renewable energy sources such as solar or wind energy, heating elements make surplus energy usable. If more energy is generated than is needed on a sunny day, this surplus energy can be used to heat water or heat rooms.

- *Load management*

When activated at times of lower demand or cheaper tariffs, heating elements can help to control loads on the electricity grid. This can reduce operating costs and increase the efficiency of the energy management system.

- *Energy efficiency*

Heating elements enable a higher overall energy efficiency of the system. They are able to provide heat quickly, even without large storages.

- *Cost efficiency*

Heating elements are relatively inexpensive to purchase and install, making them an attractive option for supplying heat in an energy management system.

Overall, heating elements help increase energy efficiency, reduce costs and promote the integration of renewable energies.

### 4.3. Prerequisites

The following is required to integrate a heating element into "FEMS App Power-to-Heat":

- FENECON Home 10 with **three** free relay contacts *or*
- FEMS relay board 8-channel TCP with **three** free relay contacts (note: not included in the scope of delivery)
- Three-phase electric heating element with neutral conductor, stage-controlled circuit



If a heating element is to be operated with more than 2 kW power per phase, the use of load-shedding relays is also required!

| Level   | Function                     |
|---------|------------------------------|
| Level 0 | Heating element switched off |

#### 4.4. Function and operating modes

|         |              |
|---------|--------------|
| Level 1 | 2000 W power |
| Level 2 | 4000 W power |
| Level 3 | 6000 W power |

Table 1. Power levels (Level) with 6 kW heating element

#### 4.4. Function and operating modes

As soon as the "FEMS App Power-to-Heat" for integrating a heating element has been installed on your system, you will see this widget in your monitoring:



Figure 8. Heating element widget

Click on the widget to open the detailed view:

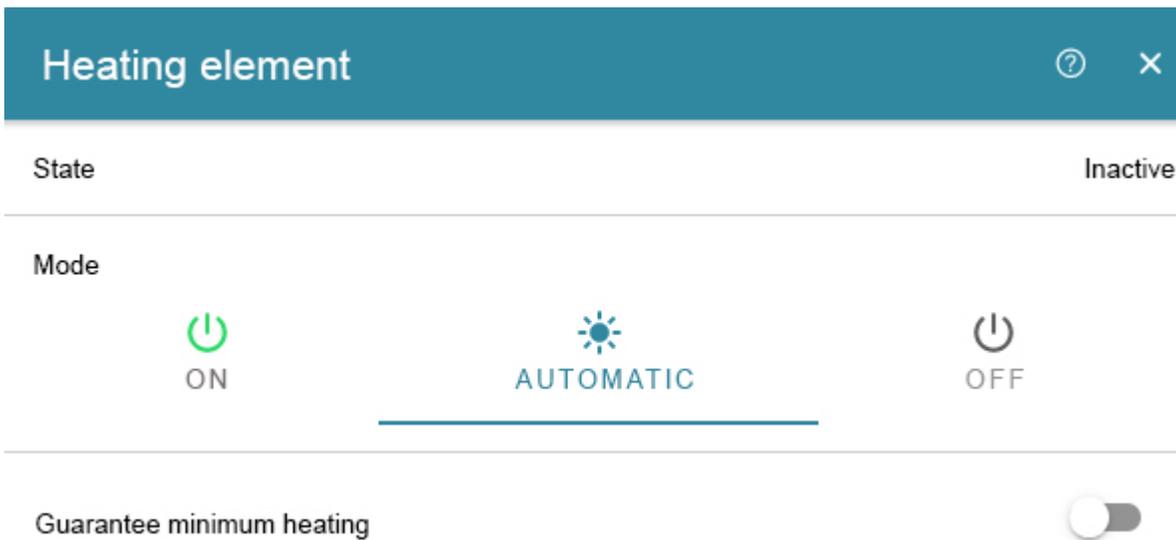


Figure 9. Heating element operating modes

Here you have the option of switching between three operating modes:

- On

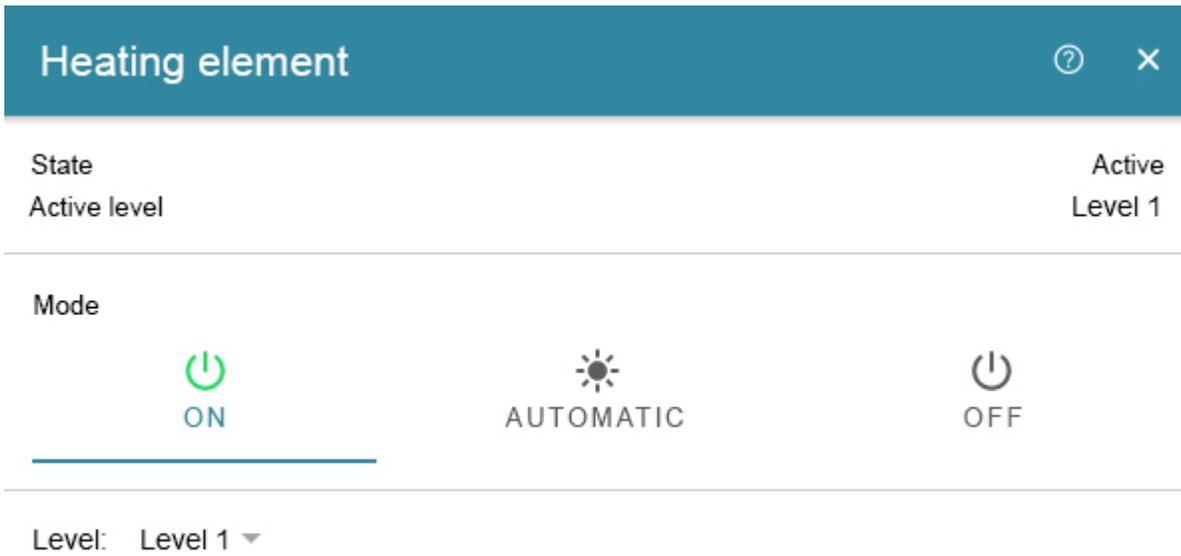


Figure 10. Heating element - "On" operating mode

In "On" mode, you switch the heating element on manually. You can also select the "Level" (see table above) at which the heating element is to be operated.

- Automatic

#### 4.4. Function and operating modes

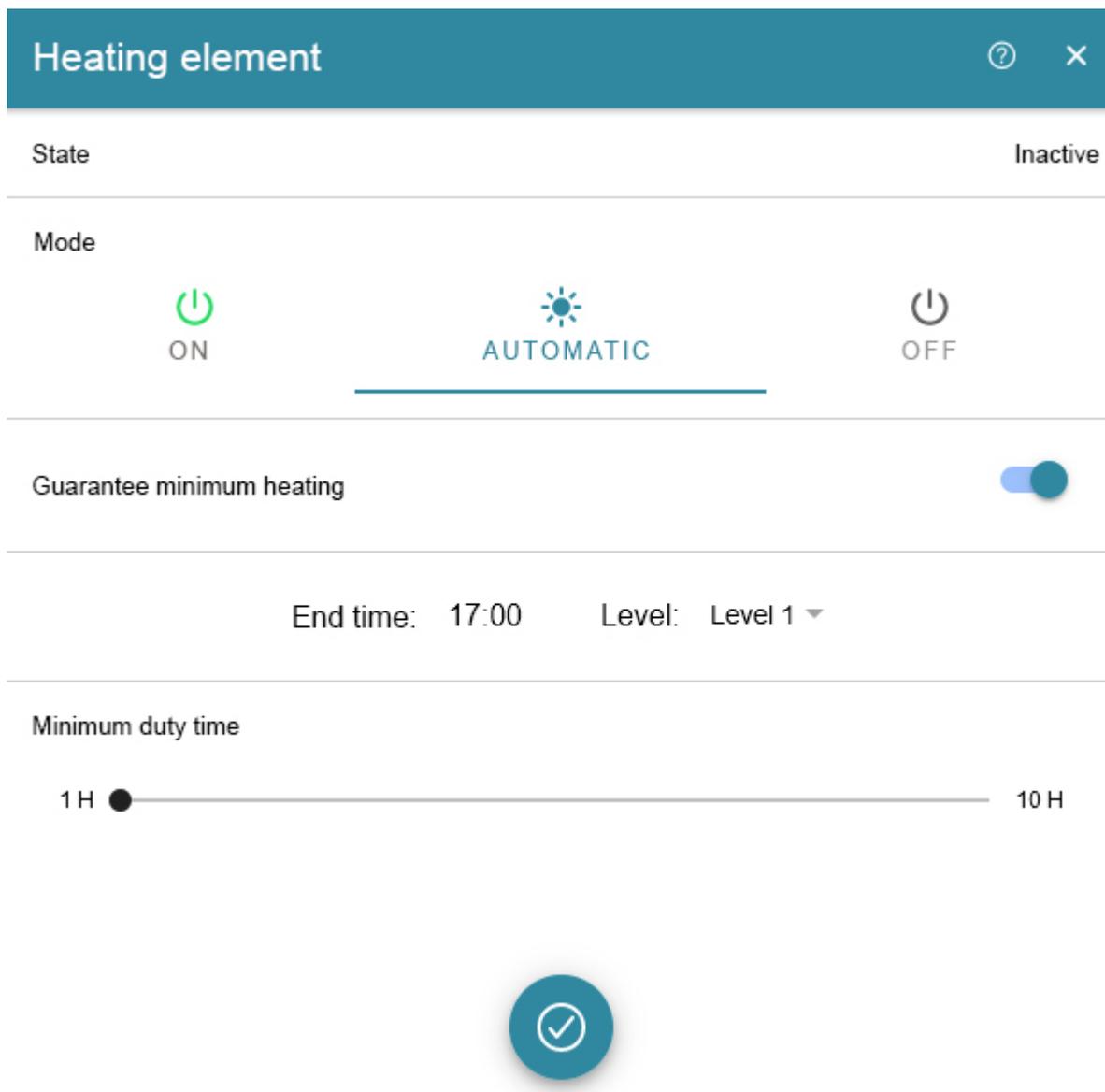


Figure 11. Heating element - "Automatic" operating mode

In "Automatic" mode, the heating element is activated automatically as soon as excess electricity is fed into the grid.

Here you have the option to "Guarantee minimum heating" to ensure that the domestic hot water is heated sufficiently even on days with low PV power generation. To do this, select the "End time" by which the minimum runtime must be fulfilled, as well as the "Minimum runtime". You can also specify the "Level" (see table above) at which this minimum runtime should be achieved.

Function in detail:

- The heating element must be active at the selected level and runtime until the end time, regardless of whether excess PV current is available or not
- **Example:** A minimum runtime of one hour until 5 pm was selected. Due to cloud cover, there is no PV surplus available. However, as the heating element should be active for at least one hour due to the configuration, the heating element is switched on at 4 pm to guarantee a minimum runtime of one hour until 5 pm.



The minimum runtime has no limiting effect on the operation of the heating element, provided there is sufficient surplus PV available. The temperature control on the heating element is ultimately the limiting factor here.

- Off

Heating element

?
×

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**State** Inactive

---

**Mode**

ON

AUTOMATIC

OFF

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Figure 12. Heating element - "Off" operating mode

In "Off" mode, the heating element is switched off permanently.

You can also track the switch-on times of the heating element in the historical view in Online Monitoring (see [Heating element - History \(1\)](#)):

| <span style="color: red; font-size: 1.2em; margin-right: 5px;">🔥</span> Heating element |        |
|---|--------|
| Duty cycle Level 1  | 7:32 h |
| Duty cycle Level 2  | 14 m   |
| Duty cycle Level 3  | 0 m    |

Figure 13. Heating element - History (1)

#### 4.4. Function and operating modes



Figure 14. Heating element - History (2)

The power consumption of the heating element can theoretically be calculated as follows using the switch-on times:

Power consumption = Duty cycle level 1 (in hours) \* 2 kW + duty cycle level 2 (in hours) \* 4 kW + duty cycle level 3 (in hours) \* 6 kW

Calculation for the example above:

Duty cycle level 1: 7.53 hrs \* 2 kW = 15.06 kWh

Duty cycle level 2: 0.23 hrs \* 4 kW = 0.92 kWh

Duty cycle level 3: 0 kWh

Power consumption heating element: 15.06 kWh + 0.92 kWh = 15.98 kWh



In the calculation above, the app is used in combination with a 6 kW heating element. For a heating element with a different power value, the power levels are adjusted accordingly.



If the heating element has a maximum temperature or similar stored, it is possible that no power is drawn, even if the relay contact is switched on. In this case, the direct conversion to kWh would not be correct. Online Monitoring therefore does not use this automatic conversion.



By the way: The 8-channel TCP relay board can switch up to 10 A directly, i. e. no separate contactors are required to control the heating element for a three-phase heating element with 6 kW power (= 3 x 2 kW). You could also operate a more powerful heating element with the "FEMS App Power-to-Heat". In this case, the different power must be configured in the software. Please contact our service department for this.



Note on the stepped switching of the heating element: We deliberately opted for a "simple", three-phase heating element instead of a heating element with stepless control. This solution is technically simpler overall and therefore less prone to errors and cheaper. The supposed disadvantage of less precise control is compensated for in practice by the software algorithm.

## 5. Combined heat and power plant (CHP)

### 5.1. Why a CHP unit?

A CHP unit uses combined heat and power (CHP) to generate electricity and heat at the same time, which can be supplied to heating systems. The relationship with external electricity can be reduced, which saves costs. A CHP therefore makes you less dependent on electricity price providers and electricity price trends. Furthermore, a CHP requires neither sun nor wind to produce electricity and heat. CHPs are available in various designs and sizes and offer a high efficiency of up to 90 % when producing heat and, depending on the operating mode, from 10 to 40 % when generating electricity.

### 5.2. Advantages of a CHP unit

- *Energy efficiency:*

CHP systems generate electricity and heat at the same time (combined heat and power), which increases overall energy efficiency. An EMS can optimize the operation of the CHP system to minimize energy consumption.

- *Cost savings:*

Using waste heat for heating or process heat can reduce energy costs. An EMS helps determine the optimum time to operate the CHP in order to benefit from lower electricity prices.

- *Load management:*

An EMS can identify and control peak loads so that the CHP can be used in a targeted manner to reduce the load on the grid and save costs for grid usage fees.

- *Integrating renewable energies:*

In combination with renewable energy sources (e. g. solar or wind energy), an EMS can better balance generation and consumption, reducing the use of fossil fuels.

- *Flexibility and security of supply:*

A CHP can be ramped up and down quickly, which makes it flexible. An EMS can use this flexibility to respond to fluctuations in energy demand or generation.

- *Reduction of CO2 emissions:*

Thanks to their higher efficiency and the option of integrating renewable energies, CHPs help reduce greenhouse gas emissions.

### 5.3. Prerequisites

The following is required to integrate a CHP with the "FEMS App Power-to-Heat":

## 5.4. Integration

- FENECON Home 10 with one free relay contact *or*
- FEMS relay board 8-channel TCP with one free relay contact (note: not included).
- a CHP that can be switched on and off via relays.

### 5.4. Integration

The integration of a CHP into energy management systems is an advanced form of sector coupling (electricity and heat).

As soon as the "FEMS App Power-to-Heat" for integrating a CHP has been installed on your system, you will see this widget in your monitoring:



Figure 15. Widget

In this view you can see the current operating mode and whether the CHP is currently active or inactive.

Click on the widget to open the detailed view of the app:

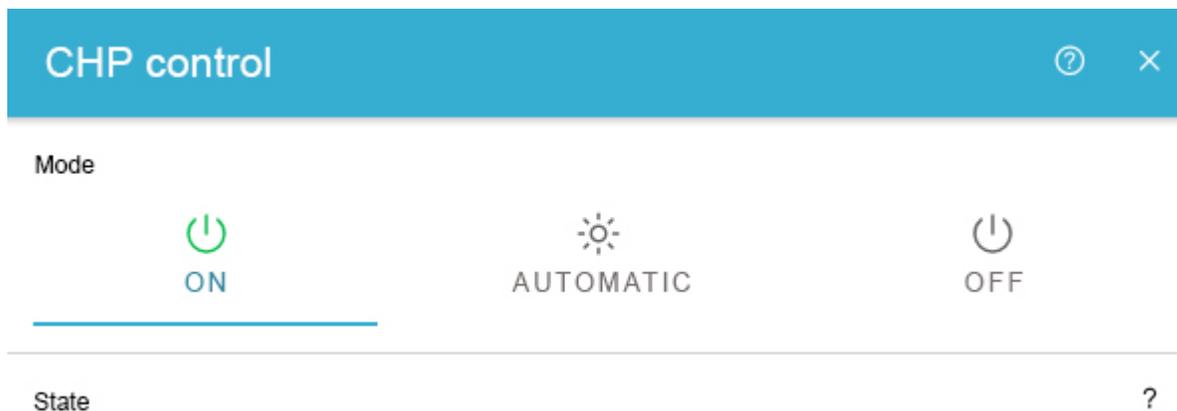


Figure 16. Detailed view

Here you have the option of switching between three operating modes:

- On: Forced switch-on

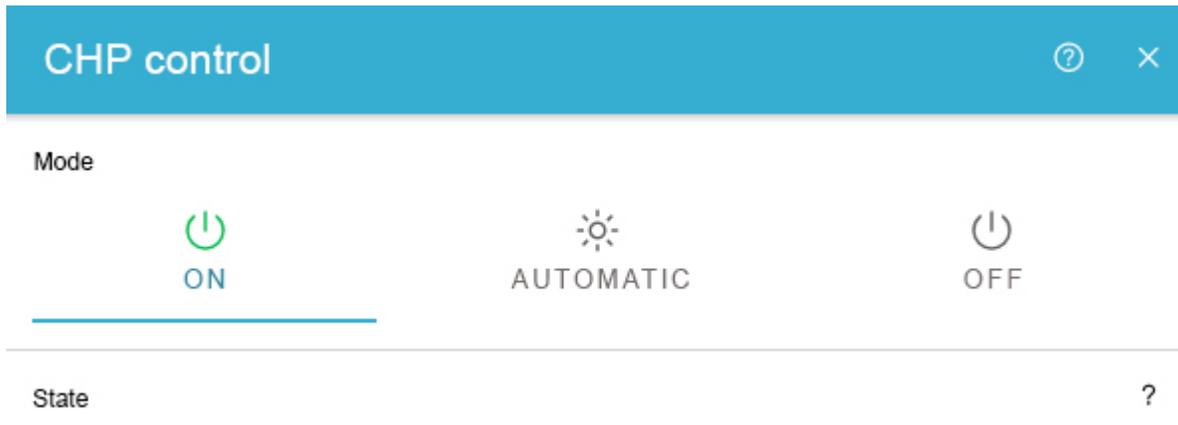


Figure 17. Modus — An

- Automatic

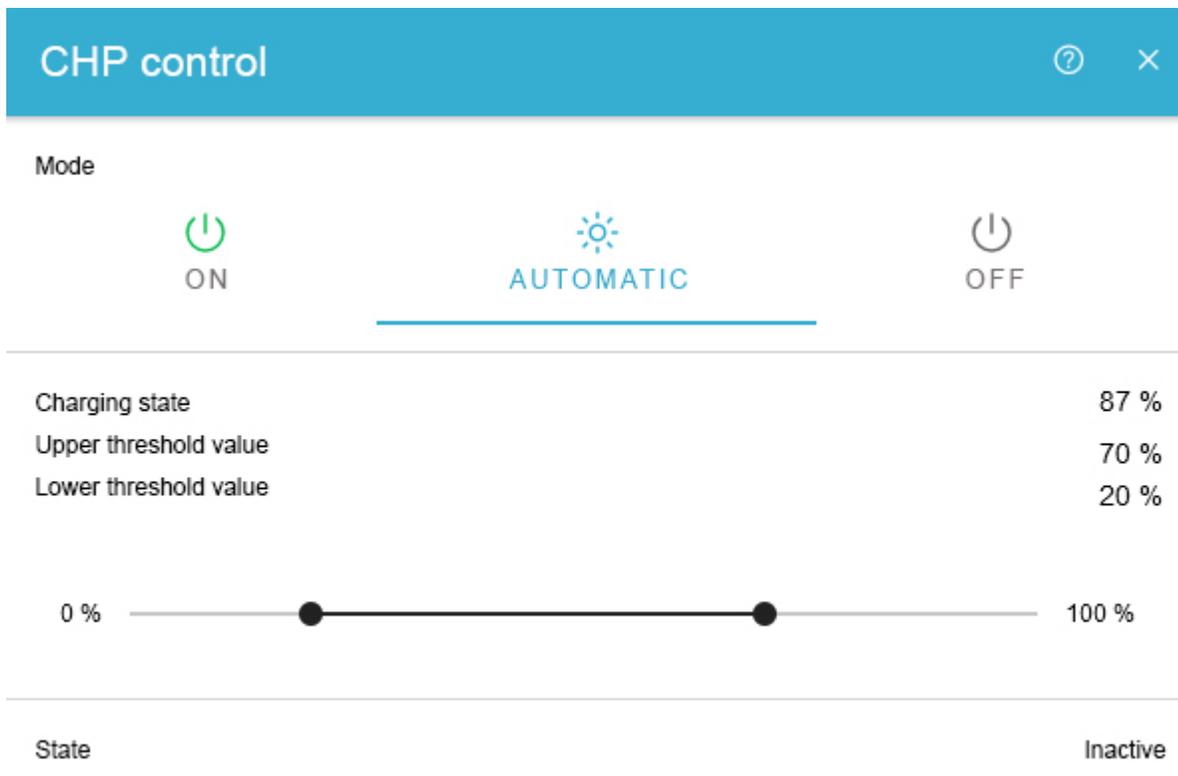


Figure 18. Modus — Automatisch

The "Automatic" operating mode takes advantage of the CHP's ability to generate electricity regardless of the time of day and weather conditions.

- Ladezustand: Momentaner Ladezustand des Speichers.
- Oberer Schwellenwert: Ladezustand des Speichers, über dem das BHKW ausgeschaltet wird.
- Unterer Schwellenwert: Ladezustand des Speichers, unter dem das BHKW eingeschaltet wird.

If the state of charge falls below the lower threshold value, a switch-on signal is sent to the CHP. This prevents more

## 5.4. Integration

expensive electricity from being drawn from the grid. If the state of charge exceeds the upper threshold value, the switch-on signal is withdrawn to prevent unnecessary grid feed-in of CHP electricity.

In der folgenden Tabelle sind die voreingestellten Schaltschwellen angegeben (vgl. [Detailed view](#)):

| Ladezustandsänderung | Schaltzustandsänderung |
|----------------------|------------------------|
| 20 % → 19 %          | Aus → Ein              |
| 70 % → 71 %          | Ein → Aus              |

- Off: Forced switch-off

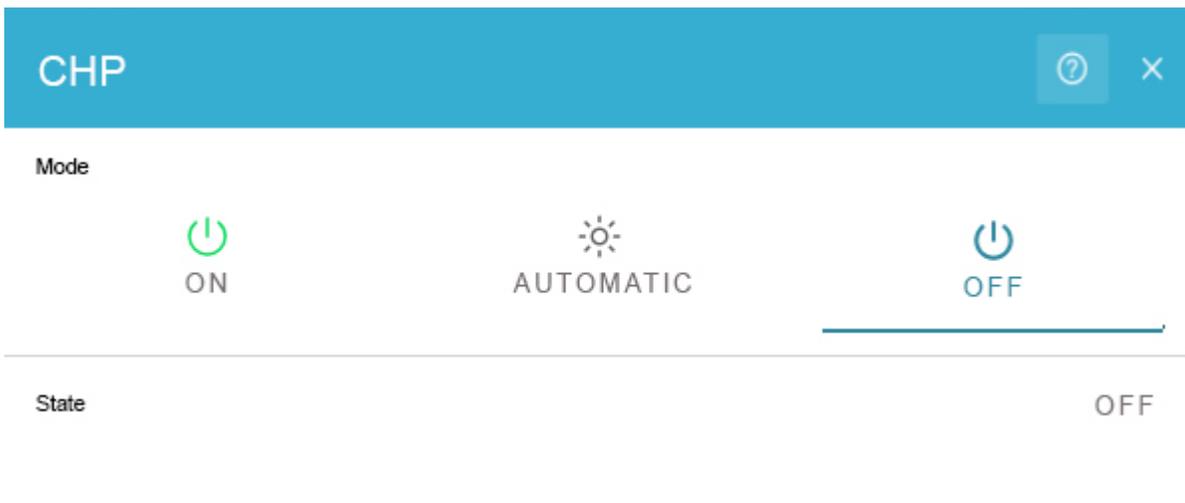


Figure 19. Modus — Aus

The behavior of the CHP over time can be viewed via the associated widget in the historical view.

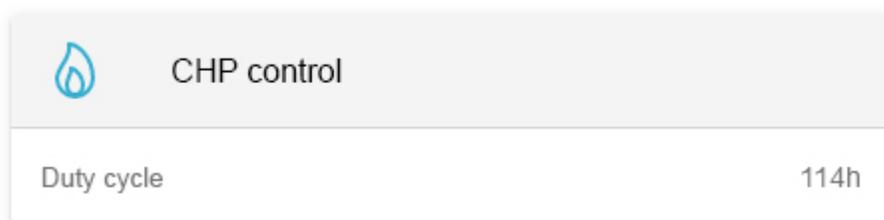


Figure 20. Widget — Historische Ansicht 1

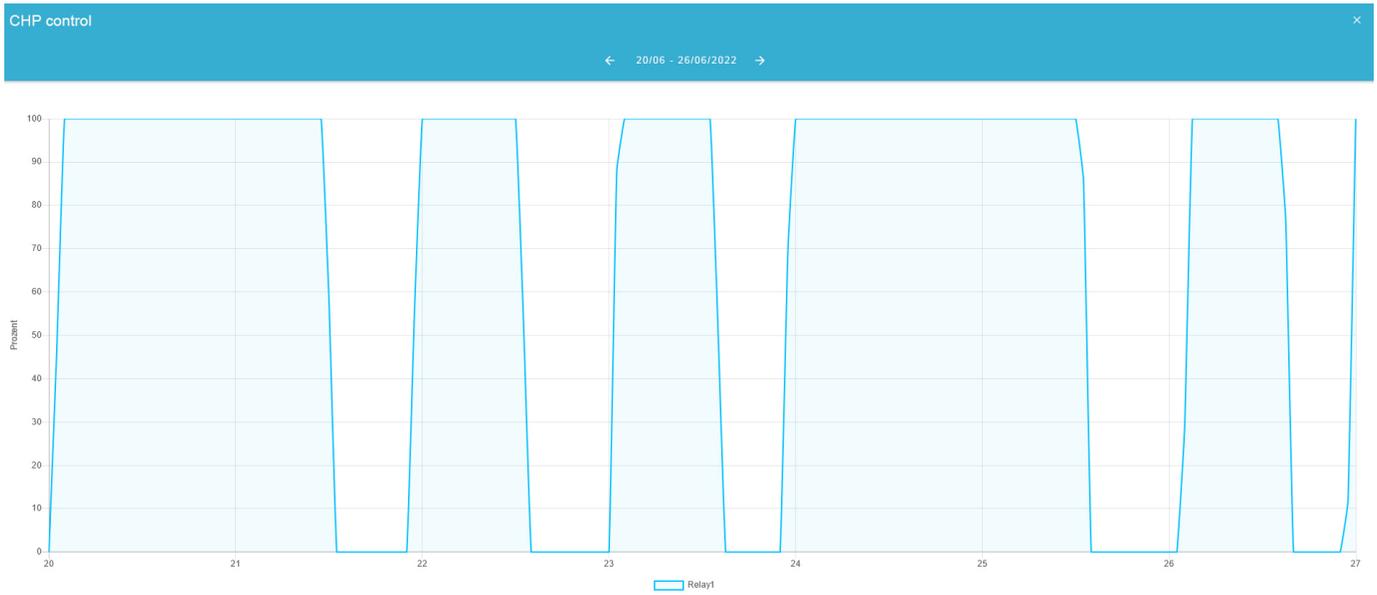


Figure 21. Widget — Historische Ansicht 2

## 6. Contact

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### 6. Contact

For support, please contact:

FENECON GmbH  
Gewerbepark 6  
94547 Iggensbach

Telefon — Service: 0991-648800-33  
E-Mail — Service: [service@fenecon.de](mailto:service@fenecon.de)

## 7. Verzeichnisse

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