User Manual Ecopilot

1 Briefly about Ecopilot in general:

The Ecopilot software creates a coordinated control of the various technical systems on a property to provide optimal energy savings within fixed limits for the room temperature. By continuously calculating the energy balance in the various areas of the property, the property's capacity to store energy is utilised at the same time as each area can join in and affect the systems that serve that particular area.

The set values for ventilation, heating and cooling as well as operating times, blocking cooling, pump stop, night cooling etc. are adjusted continuously by Ecopilot.

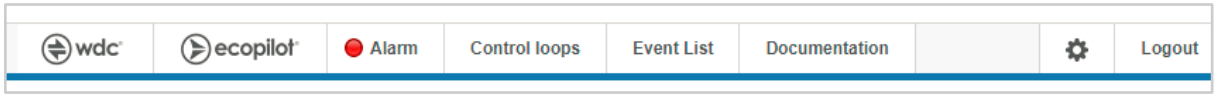
In order for Ecopilot to predict the upcoming days' need for cooling and heating energy, a local weather forecast is used, which is downloaded 2 times/day. The forecast comprises outdoor temperature, precipitation, relative humidity, wind speed, wind direction and sun.

Room temperature sensor and any CO_2 sensor in each operation area are used as reference sensors. Permitted intervals for comfort and economy operation are set in Ecopilot.

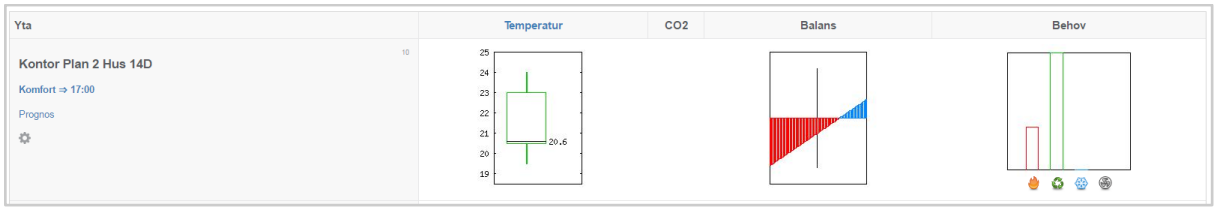
Ecopilot saves very large amounts of energy. By making the optimum use of the internal heat and solar incident radiation, a significant decrease is obtained in the load on the heating system. For the operating cases when the property needs cooling during the day, Ecopilot takes extra care when supplying heat energy during the night. The greater the permitted temperature interval in each operation the greater the energy savings.

2 Summary Ecopilot

The summary is reached by clicking on *Ecopilot* at the top of the menu.

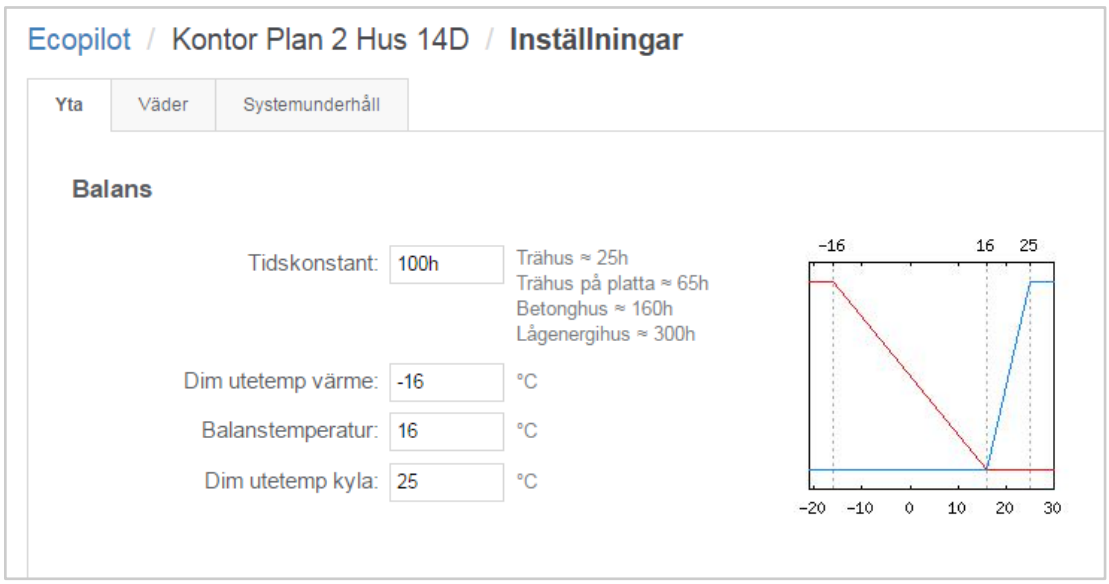


The operation areas in the building are listed in the summary.
For each area, you can see how the building is positioned in terms of temperature, CO_2, balance as well as the needs that exist for the various systems.



3 Settings Ecopilot

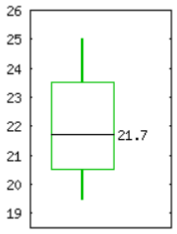
Under Area, click on the *cogwheel* (or settings). In order to access the following, service login is required at the minimum.



Above, we set the time constant and balance temperature as well as the design outdoor temperature for heating and cooling. A higher time constant gives larger energy savings. The balance temperature is when we do not need to supply any heating or cooling to keep within the comfort limits. A low balance temperature gives a larger energy saving on the heating side.

Rumstemperatur

Ekonomi max:	25	°C
Komfort max:	23.5	°C
Komfort min:	20.5	°C
Ekonomi min:	19.5	°C



Rumstemperatur LB01-EB1-ZON11: 21.6 °C
GTR104 - Temperatur: 21.4 °C
GTR108 - Temperatur: 22 °C
GTR111:1 - Temperatur: 22.1 °C

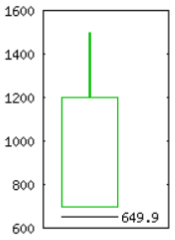
Rumstemperatur: 21.7 °C

Nattkyla

Start innan komfort:	5h	Tidigaste tillåtna start av nattkyla innan komfortdrift (0-10h, 0 inaktiverar nattkyla)

CO2

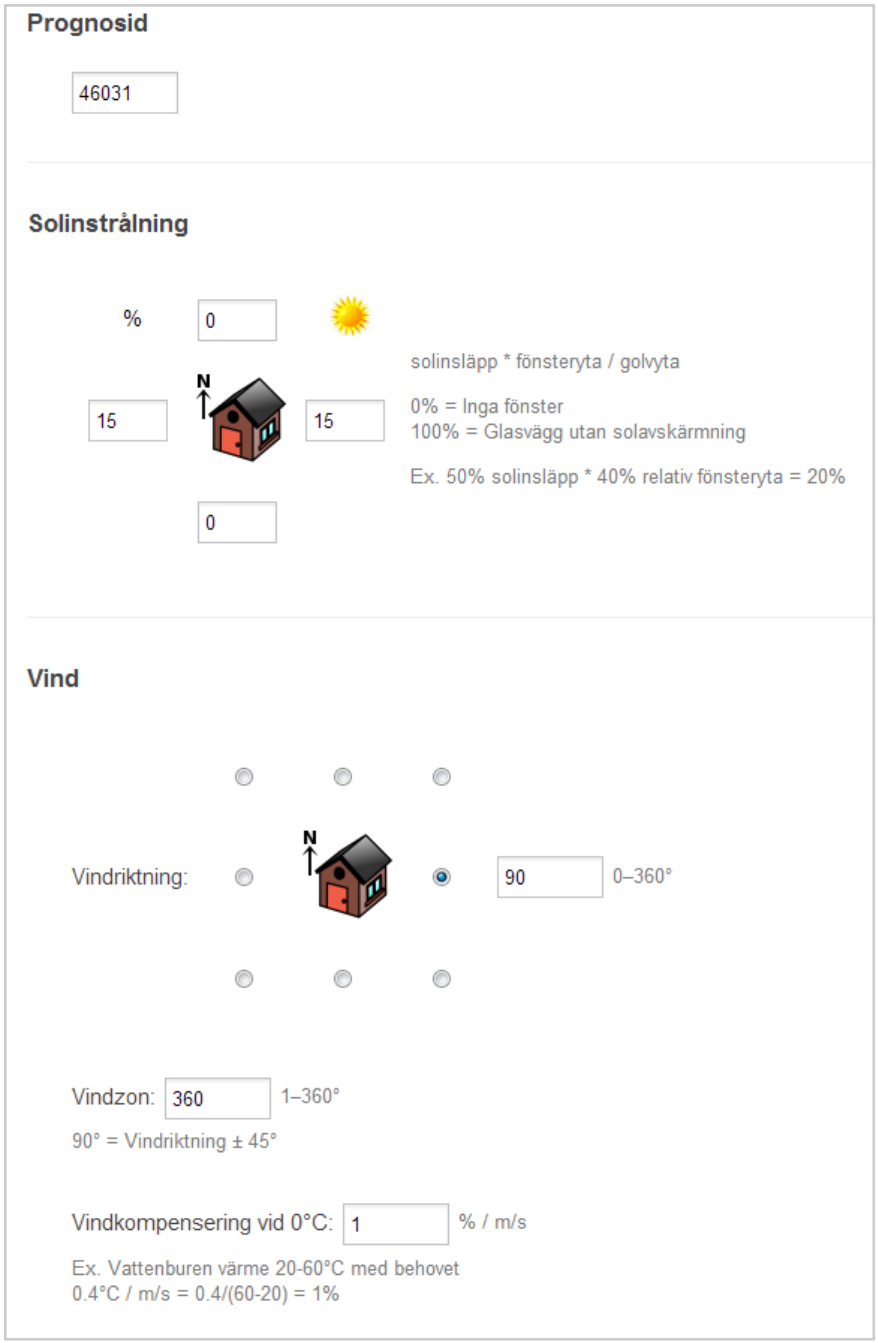
Ekonomi max:	1500	ppm
Komfort max:	1200	ppm
Komfort min:	700	ppm
Ekonomi min:	700	ppm



CO2 LB01-EB1-ZON11: 653 ppm

CO2: 649.9 ppm

Above, the comfort and economy limits, which will apply for the operation areas, are set. On the right, the room sensors that are located in the operation area are shown. The greater the temperature difference permitted, the greater the energy saving that can be expected.



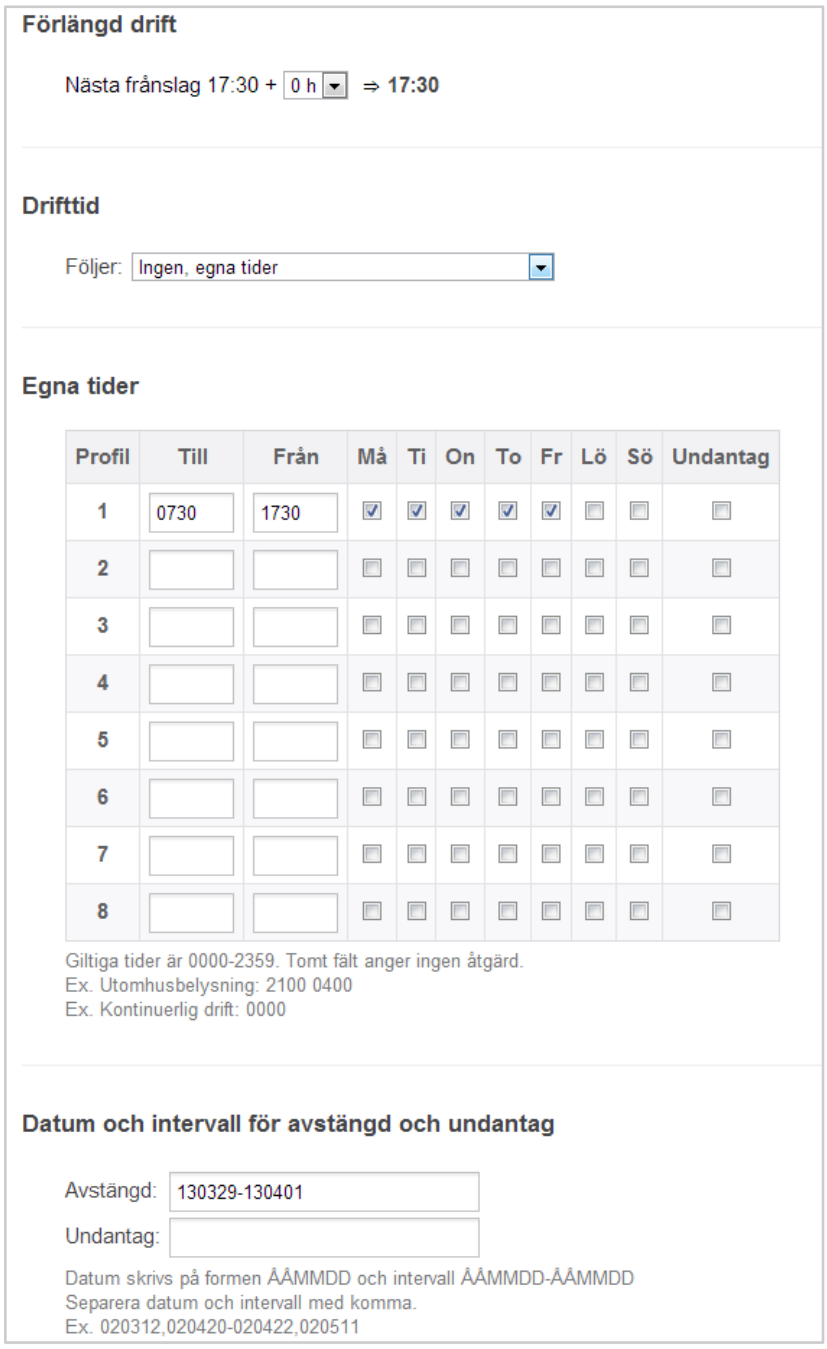
Under the *weather* tab, the forecast ID that applies for the local position as well as how the sun and wind affect the building are set.

Bear in mind that a facade that is exposed to the sun, but lacking windows, shall even so have some solar compensation. A rule of thumb could be that a completely freestanding building, completely without shade, with a time constant of 100h should have 30% solar compensation.

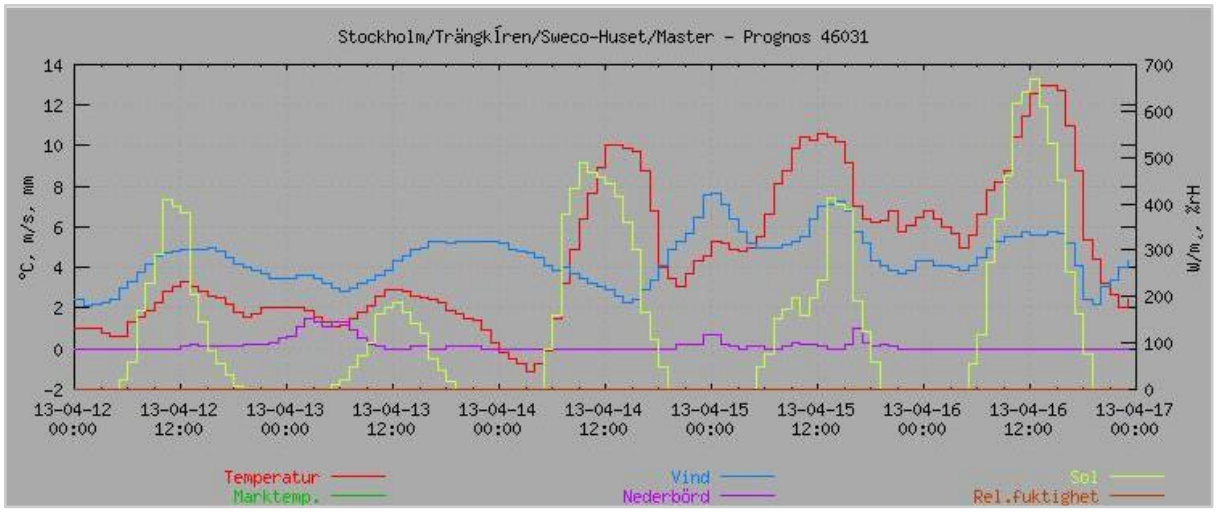
For wind compensation, reasonable values are between 0.5-1.5$\frac{\%}{m/s}$ for most properties.

Under Area, click on *Comfort* or *Economy operation* (appears differently depending on which mode we are in). To access the following, *user* level is required at the minimum.

The time channel is set when comfort time has to prevail. The time channel over-modulates the unit's time channels.

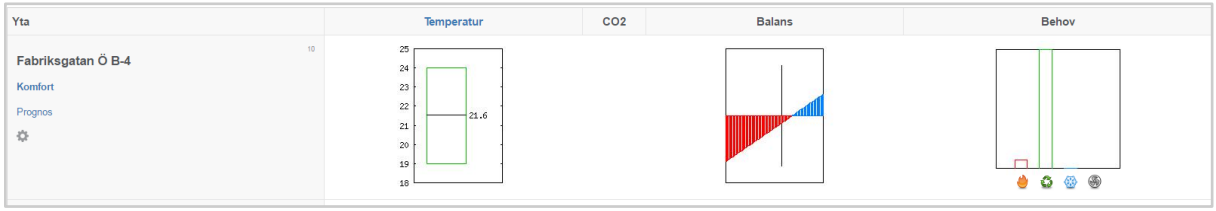


Under *closed dates*, we have constant economy operation for the area.
Exception permits operation during days that the system would otherwise have been in economy operation.
If *Exception* is filled in, all *exceptions* must be given a time channel in the list above.
Under Area, click on *forecast*, and a graph of the forecast for the location in question is shown.



4 Setting the set values in Ecopilot

Navigate to the summary in Ecopilot.
Settings for heating, cooling and ventilation for the systems that act on the area in question are made by clicking on the relevant *need bar* (or on the place where the need bar should be) under needs.
heating = flame.
cooling = snowflake.
ventilation = the fan symbol.
For access, *service level* is required at the minimum.



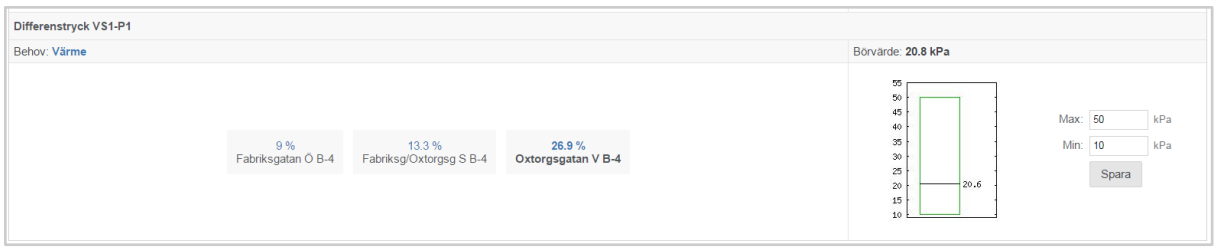
4.1 Heating

Under need, click on the *need bar for heating* (the flame). To access the following, *service level* is required at the minimum.

4.1.1 Temperature control, heating

If Ecopilot is installed, Ecopilot displaces the old heating curve or the set value. Ecopilot also manages start and stop of the pump, see below. Above, min and max for the supply temperature are changed. Ecopilot works completely freely between these values depending on a number of parameters. A few examples are balance temperature, design outdoor temperature, time constant, weather settings, forecast etc.
When several areas are served by the same heating system, the highest heating need determines pump start and supply temperature. However, the pump for heating can also start if an area drops below the current temperature min-limit.
The pump stops again, if the long-tern heating need disappears and it is no longer cold in the area.

4.1.2 Pressure control, pump



For controlling pressure on pump, the settings are accessed in the same menu as heating (alternatively cooling) by clicking on the *need bar for heating* (alternatively *cooling*) under area.

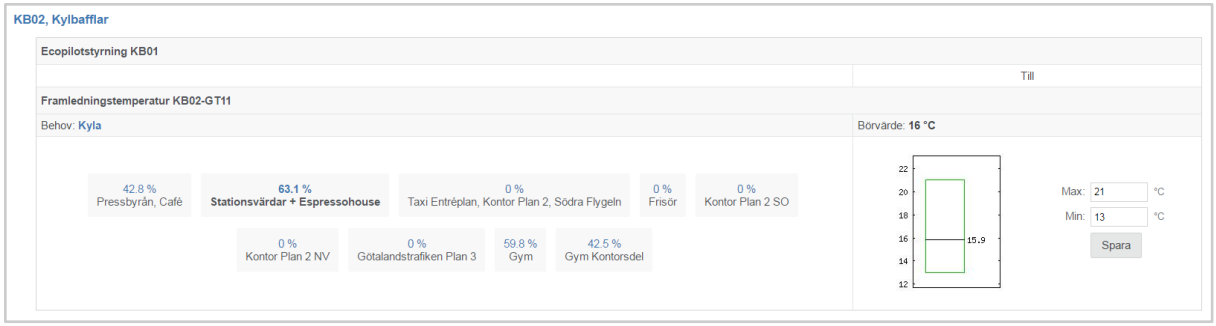
By running the pumps with low differential pressure, involuntary leakage and noise problems at lower output requirements are minimised. Moreover, the pumps consume less energy.

Above, min and max pressure are changed. Ecopilot works completely freely between these values depending on a number of parameters. A few examples are balance temperature, design outdoor temperature, time constant, weather settings, forecast etc.
When several areas are served by the same pump, the highest heating need determines the pressure.

4.2 Cooling

Under need, click on the *need bar for cooling* (the snowflake). To access the following, *service* login is required at the minimum.

4.2.1 Temperature control, cooling



If Ecopilot is installed, Ecopilot displaces the old cooling curve or the set value. Ecopilot also manages start and stop of the pump, see below. Above, min and max for the return temperature are changed. Ecopilot works completely freely between these values depending on a number of parameters. A few examples are balance temperature, design outdoor temperature, etc.
When several areas are served by the same cooling system, the highest cooling need determines pump start and supply temperature. However, the set value can be limited from PLC/DUC by the current dew point.

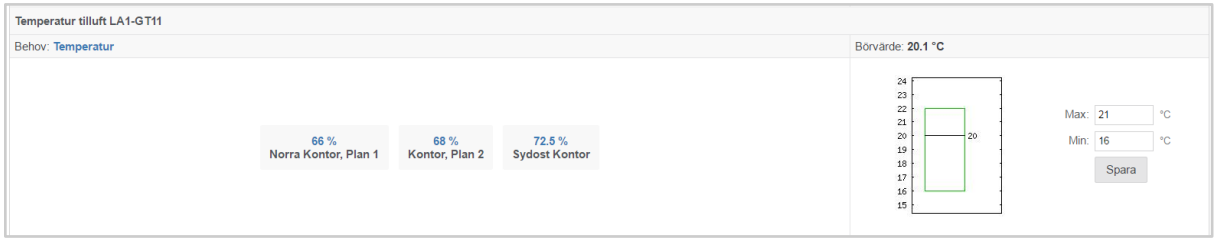
At high median temperature, i.e. in the upper part of the comfort zone, the brine pump starts independently of the balance temperature.
This function is activated by default in all Ecopilots, but can be switched off or changed. To switch off the function, change *eco.coolpump.recirc.cfg*, which you find under the Eco menu below, to "*1*"
[ECOPILOT-IP]/cgi-bin/wdc.cgi?WDC-FUN=363&SYSTEM=eco#?wdc-system=maintenance
For these first two functions, the cooling pump is switched off if the long-term cooling need disappears or if the temperature in all areas has dropped into the lower part of the temperature interval.
To change this, so the cooling pumps start instead when the median temperature goes over the max permitted temperature, change the variable to "*2*". The cooling pump then switches off when the median temperature for all areas has dropped below the upper part of the temperature interval

If, apart from the above conditions, you want it only to be possible for the cooling system to be active during comfort times, the name of this pump can be changed from *coolpump.xxx* to *day.tc.sw.*

4.3 Ventilation

Under need, click on the *need bar for ventilation* (the fan symbol). To access the following, *service level* is required at the minimum.

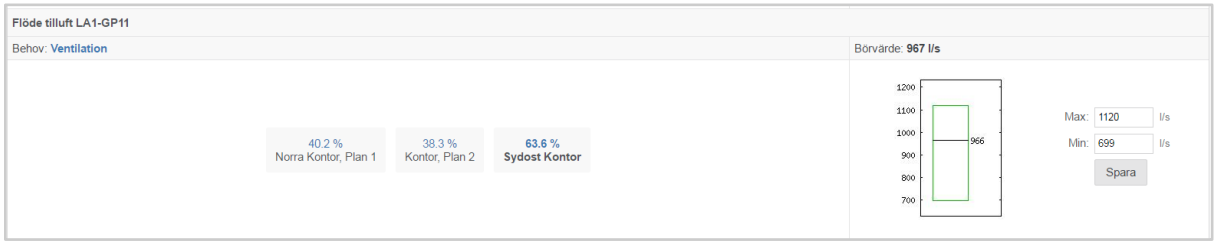
4.3.1 Temperature control, ventilation



If Ecopilot is installed, Ecopilot displaces the old temperature curve or the set value. Ecopilot also manages start and stop of the ventilation. Above, min and max for the supply air temperature are changed. Ecopilot works completely freely between these values depending on a number of parameters. A few examples are balance temperature, design outdoor temperature, etc.
When several areas are served by the same ventilation system, the average value of their needs constitutes the set value for the supply air temperature.

4.3.2 Air quantity, ventilation

The pressure, flows or frequencies between which the ventilation system is permitted to work are also set. The Ecopilot works completely dynamically between these values depending on a number of parameters. A few examples are comfort temperature, balance temperature, time constant etc.
If there is a CO_2 sensor in the area, however, this also affects the quantity of ventilation. The effect is then linear between the min and max set permitted CO_2 level, where a current value equivalent to the max permitted CO_2 level will result in the highest permitted pressure, flow or frequency.
When several areas are served by the same ventilation system, the one with the highest ventilation need or, alternatively, the highest relative CO_2 level determines the ventilation flow



5 Functions in Ecopilot

5.1 Summer compensation

To prevent heating the property with warm outdoor air when there is a need for cooling, Ecopilot calculates a lower ventilation flow.
The function *Summer compensation*, is part of Ecopilot and does not have any indication in the interface.

In day operation, Ecopilot modifies the pressure or flow set values for the reduced flow.

Please note that the *need* for ventilation remains at 100%.

Cause:
If there are no cooling coils, the heat supply via warm outdoor air is simply reduced (the supply air temperature is warmer than room temperature).

If there are cooling coils, the flow is reduced to increase the cooling over the cooling coils. (A lower quantity of cold air gives a greater cooling effect than a greater quantity of warm air).

5.2 Night cooling (free cooling)

The night cooling function in the unit has to be deactivated during master control from Ecopilot.
For start of night cooling to be permitted in Ecopilot, a long-term cooling need is required, the median temperature must be in the upper part of the temperature range, it must be at least 4°C cooler outdoors than indoors and it must not be too warm or too cold outdoors.
The operating time can be limited by the number of hours before night cooling is permitted to start. This setting is available for each area and affects all of the area's ventilation systems. Setting this value to [0h] in all areas that affect a specific ventilation system switches off the Ecopilot's night cooling function for the system.

During night cooling, Ecopilot starts the unit in day operation and modifies the set value based on the conditions.
The set value starts at an adjustable number of degrees from the outdoor temperature (set by *xxx.ecopilot.nightcool.dsp*).
After this, the set value is changed in order to find a working point with as little recovery and cooling as possible.
A correct outdoor sensor is thus essential for correct start of night cooling.

Night cooling in Ecopilot has two different operating cases. These are presented below.

5.2.1 When we have comfort operation next day

Night cooling starts if there is cooling value in the outdoor air and the indoor temperature is in the top part of the comfort zone.
Night cooling is suspended when the indoor temperature is in the bottom part of the comfort zone or, alternatively, if the difference between the indoor temperature and the outdoor temperature is less than 3°C or if it becomes too warm or too cold outdoors.

5.2.2 When we do not have comfort operation next day (weekends/public holidays)

Night cooling starts if there is cooling value in the outdoor air and the indoor temperature is above the upper limit of the economy zone. Night cooling is suspended before the indoor temperature reaches the bottom part of the comfort zone or, alternatively, if the difference between the indoor temperature and the outdoor temperature is less than 3°C or if it

becomes too warm or too cold outdoors.

An operating case that is often mistaken for night cooling is when the median temperature for an area exceeds the temperature economy-max. This starts when the unit, regardless of time, with the aim of maintaining the set temperature settings. The unit turns itself off again when the median temperature has dropped below half of the comfort range, as long as the ordinary night cooling criteria are not attained.

5.3 Night heating

Night heating is a function that must exist in the unit.
In order for Ecopilot to modify the start and stop conditions for night heating, it is a requirement that the operation area in question does not have any other heating. However, the unit will still only be selected as a ventilation system in the Ecopilot areas.
E.g. LB01 supplies the operation areas Offices and Stores.
If Offices have radiator heating but not Stores, Offices will not affect the settings for night heating, just Stores alone.

If an area has night heating, Ecopilot will synchronise start and stop temperature, *nightwarm01.mn* and *nightwarm01.mx* respectively.
If the point, *nightwarm01.idt*, also exists, the operation area's temperature will be written there.
During transition from economy to comfort operation, *.mn* and *.mx* will not be modified (since these are saved as the set values), instead, the indoor temperature, *nightwarm01.idt*, will be modified (i.e. lowered).

5.4 Extended operation via push button

If the indication *xxx.day.tcc* is allowed, extended comfort operation is activated in the operation area(s) where the ventilation system acts.
Extended comfort operation is activated for 2h, with exception for when there is less than 1h remaining before ordinary comfort, in which case there is no stop.

5.5 Extended operation via CO_2 sensor

If the CO_2 level passes the set max economy, extended operation is activated in the operation area for 2h, with exception for when there is less than 1h remaining before ordinary comfort, in which case there is no stop.

To prevent extended operation in the case of sensor fault, or incorrectly set economy max, it is necessary for the CO_2 level to pass economy max.
This means that economy max must be set at a higher value than that achieved by ventilation in comfort in order for the unit not to run unnecessarily at night.

5.5.1 What happens, step by step

The ventilation will switch off during transition to economy.

If the CO_2 level passes economy max, extended operation starts which results in the level dropping. After extended operation, the ventilation switches off again.
If there is still operation in the areas, the level will once again pass economy max, with new extended operation as a consequence.

5.6 Forced ventilation

There is the option to force the ventilation in a unit by the push of a button.
As long as *xxx.forcevent.di* is on, Ecopilot will use the max set air quantity as set value in the ventilation system, whatever the need.

5.7 Control of pumps for heating and cooling (from version 3.3.0)

5.7.1 Temperature control

The heating system's min set value and the cooling system's max set value.
It is important that the heating system's min set value is set to at least 1°C above min comfort temperature. (e.g. at 20-23, 21°C is set as min set value). The cooling system's max value is preferably set around the comfort range's minimum value (in this case, 19-20°C).

5.7.2 Differential pressure control

By running the pumps with low differential pressure, involuntary leakage and noise problems at lower output requirements are minimised. Moreover, the pumps consume less energy.
As max pressure, constant pressure was use previously (e.g. 30 kPa). The min pressure that is possible must be verified by investigating in practise how different pressures affect the heat given off at the extremities of the heating system circuit.

Note! following points.

- The min pressure should never be set lower than 80% of the max pressure.
- The min pressure should never be set lower than 10 KPa.
- Pumps with frequency converter should not run at lower than approx. 20%, as this can damage the pump.
- Pumps that have to guarantee flow across heat pumps or coolers must not have variable pressure set value.

6 Additional modules

6.1 Effektpilot

6.1.1 General

Effektpilot is a function that, by borrowing and returning energy from one or more systems when the load is large, tries to level out the daily output. Effektpilot achieves this by changing the set values for the circuits that are permitted to be affected and thus, the control will appear different from that during operation with Ecopilot alone.
A more uniform power consumption reduces the energy consumption in interaction with Ecopilot, which has a positive effect on the energy production, which has a positive effect on the environment.
Effektpilot benefits the customer financially, if they have energy agreements with power tariffs, because power peaks are then levelled out continuously and there is also the option to limit max daily average power.
If the customer has an agreement with an energy provider that does not have a power tariff, there is no direct financial gain but there is a positive effect on the environment.

6.1.2 Requirements

- connected energy meter with energy signature
- license for Ecopilot, Analysis and Effektpilot.
- systems integrated in Ecopilot, where it is permitted to decrease and increase the power consumed.

Suitable systems in Effektpilot:

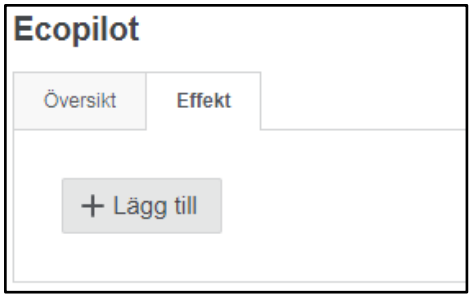
- waterborne radiator heating
- under-floor heating

Unsuitable systems in Effektpilot:

- heating systems that serve ventilation
- hot tap water systems

6.1.3 Installation

Effektpilot is activated by means of a license that is downloaded in Ecopilot.
After restart, the tab, *Power*, appears in the summary in Ecopilot.



6.1.4 Commissioning

Under *Ecopilot*, click on *Power* and choose add. A page with settings opens.

- Enter name for the Effektpilot.
- Select controlling energy meter in the drop-down list (NOTE! this meter need to provide data in real time!).
- Select the system or systems from which Effektpilot can borrow energy to reduce the power consumption.
- Voluntary Power Restriction
    - Tick the box *Activate energy restriction*
    - Enter peak power, if such restriction is to be used (this value can be, at the minimum, 50 % of the expected power as presented in the E-signature). Start from the expected power that is shown below, this is taken from the green curve in the energy signature. Then subtract a reasonable percentage of the value in consultation with the property owner.
- Save.
- The value has then to be fine-tuned.