SOKRA therm®

Dimensioning of CHP units up to 2 MW_{el}

Following information helps to determine approximate values for a first estimate of the appropriate CHP dimension. They are based on long experience, cover a wide spectrum of applications and apply for gas engine CHP units which work at a heating water level of 90/70°C.

Before installing a CHP unit, however, a thorough analysis of the surrounding factors and a sound profitability calculation should be conducted by an experienced planning office.

This calculation should also examine if the CHP unit could be additionally employed for spare current supply, since this has positive effects on the profitability.

1. Natural gas powered CHP units

The power dimension of natural gas powered units can roughly be defined by the heat demand of the supplied object. Electricity, which is not consumed in the object itself, can usually be fed into the mains at cost covering prices.

CHP units must normally reach at least 5.000 operating hours per year to gain profits. They are therefore not dimensioned at the level of the nominal heat demand (which usually is needed only a few hours per year) but at the heat baseload level.

For several types of objects, we have experience values which allow the application of a "thumb rule" to determine the optimal power range of the CHP unit. To apply this rule, the nominal heat demand of the object is required. If this value is not available, the installed boiler power can be used as an auxiliary value. When doing this, keep in mind that boilers have frequently been overdimensioned in the past.

If, in singular cases, a part of the nominal heat demand is required on a higher termperature level than 90/70°C, this high temperature share (Q_{HTA}) needs to be deducted since it can not be provided by the CHP units described here.

The optimal thermal power range of the CHP unit is defined by

$$\mathbf{P_{th,\ Min/Max} = (Q_{Nenn} - Q_{HTA}) \times F_{Min/Max}}$$

The factor $F_{Min/Max}$ depends on the type of supplied object (see following table). One should not calculate with a mean value but with minimum and maximum values. With the resulting power range, one can subsequently define the CHP from the different CHP types available.

Object Type	Factor $F_{Min/Max}$	Reachable operating hours per year
Local district heating (residential)	0,12 - 0,20	7.000 - 5.000
Large residential buildings	0,08 - 0,15	7.000 - 5.000
Homes for the elderly	0,12 - 0,20	7.500 - 5.000
Hospitals	0,18 - 0,28	7.500 - 5.000
Hotels	0,15 - 0,22	7.000 - 5.000
Swimming pools (indoor and leisure)	0,18 - 0,28	7.500 - 6.000
Office buildings Office buildings with absorption chilling	0,08 - 0,18 0,15 - 0,25	6.500 - 5.000 6.500 - 5.000
School and sports centers	0,10 - 0,18	6.500 - 5.000
Industrial schemes without / with process heat demand	0,08 - 0,15 0,15 - 0,28	6.000 - 5.000 8.000 - 5.000

If the heat output of the available CHP units is not known, one can estimate the required electric CHP power range with the (at natural gas CHP units usual) power to heat ratio of 0,65:

$$\mathbf{P_{el,\ Min/Max} = P_{th,\ Min/Max} \times 0,65}$$

The result is the electric power range of suitable CHP units.

A good isolation standard of the object raises the baseload share (warm water) of the nominal heat demand, therefore generally a larger CHP unit can be selected here. This also accounts for objects with process heat load, for example drying plants, tempered bathes on production sites and absorption chillers.

In case of doubt, the less powerful should be selected from the delivery chart to reach a maximum of operating hours and high profitability.

For better adjustment to the object's heat demand, it can be reasonable to split larger (> 200 kW_{el}) CHP plants into several CHP modules. At CHP plants smaller than 200 kW_{el}, the power adjustment of a single unit is often the most cost-efficient solution.

2. CHP units for renewable fuels (sewage gas, biogas)

The dimenisioning criterion for CHP units powered by renewable fuels is mostly the amount and energy value of the fuel available.

A part of the generated heat can usually be used to heat the digestion tower (sewage gas) or the fermenters (biogas). In order to raise the profitability, the remaining heat should be sold or used for other purposes. It may also be discharged with an emergency cooler.

In order to avoid fluctuations of the fuel availability, a gas storage is often installed and / or the CHP unit has a power reserve.

Large renewable fuel CHP plants (> 200 kW_{el}) can also be split into several CHP modules to adjust to the gas supply. With smaller CHP plants, an adjustment via power modulation of the single unit is usually more profitable.

The following formula can be used to calculate the minimal and maximal electric power of each CHP module:

$$el.\ power\ \ per\ unit_{\min/\max} = \frac{Gas\ amount\ \times Gas\ energy\ content}{operating\ hours_{\max/\min} \times Number\ of\ units} \times \eta_{el}$$

The definition of the formula's content:

Gas amount:	Sewage gas production in m³/a
Gas energy content:	The amount of energy contained in the gas (kWh/m³). Usually, it's the percentage of the methane content divided by ten.
Operating hours $_{max/min}$:	At 8.500 to 6.500 operating hours per year and module, the CHP unit reaches the most profitable level.
η_{el}:	The electric efficiency of renewable gas CHP units offered by SOKRATHERM ranges between 32% and 39%.

To reach best operating hours and profitability, in case of doubt the CHP unit with less power should be chosen from the delivery chart.