

Software Information

- Please check, whether your inputs, the equations applied and the characteristics are displayed correctly.
- You are welcome to send your feedback via <https://github.com/oemof/tespy/issues>.
- L^AT_EX packages required are:
 - graphicx
 - float
 - hyperref
 - booktabs
 - amsmath
 - units
 - cleverref
- To suppress these messages, call the model documentation with the keyword draft=False.

TESPy Version: 0.4.3 - dev
Commit: b8e11e11@dev
CoolProp version: 6.4.0
Python version: 3.7.6 (default, Jan 8 2020, 20:23:39) [MSC v.1916 64 bit (AMD64)]
Documentation generated: Februar 24, 2021

1 Connections in offdesign mode

1.1 Specified connection parameters

label	p in bar (1)	T in °C (2)	v in m³/s (3)
consumer back flow:out1_district heating pump:in1	10.000	50.000	-
condenser:out2_consumer:in1	-	90.000	-
ambient air:out1_pump:in1	1.000	8.000	0.167
splitter:out1_superheater:in1	-	-	0.105
evaporator:out1_sink ambient 1:in1	1.000	-	-

Table 1: Specified connection parameters

1.2 Equations applied

$$0 = p - p_{\text{spec}} \quad (1)$$

$$0 = T(p, h) - T_{\text{spec}} \quad (2)$$

$$0 = \dot{m} \cdot v(p, h) - \dot{V}_{\text{spec}} \quad (3)$$

1.3 Specified fluids

label	NH3 (4)	air (5)	water (6)
coolant cycle closer:out1_condenser:in1	1.000	0.000	0.000
consumer back flow:out1_district heating pump:in1	0.000	0.000	1.000
ambient air:out1_pump:in1	0.000	0.000	1.000

Table 2: Specified fluids

1.4 Equations applied

$$0 = x_{\text{NH3}} - x_{\text{NH3,spec}} \quad (4)$$

$$0 = x_{\text{air}} - x_{\text{air,spec}} \quad (5)$$

$$0 = x_{\text{water}} - x_{\text{water,spec}} \quad (6)$$

1.5 Referenced values for mass flow

label	reference	factor in -	delta in kg/s
evaporator recirculation pump:out1_evaporator:in2	valve:out1_drum:in1	1.250	0

Table 3: Referenced values for mass flow

1.6 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \quad (7)$$

1.7 Referenced values for pressure

label	reference	factor in -	delta in bar
consumer:out1_consumer feed flow:in1	consumer back flow:out1_district heating pump:in1	1	0

Table 4: Referenced values for pressure

1.8 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \quad (8)$$

1.9 Referenced values for enthalpy

label	reference	factor in -	delta in kJ/kg
consumer:out1_consumer feed flow:in1	consumer back flow:out1_district heating pump:in1	1	0

Table 5: Referenced values for enthalpy

1.10 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \quad (9)$$

2 User defined equations in offdesign mode

3 Components in offdesign mode

3.1 Components of type CycleCloser

3.1.1 Mandatory constraints

$$0 = p_{\text{in},i} - p_{\text{out},i} \quad \forall i \in [1] \quad (10)$$

$$0 = h_{\text{in},i} - h_{\text{out},i} \quad \forall i \in [1] \quad (11)$$

3.2 Components of type Condenser

3.2.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1, 2] \quad (12)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1, 2] \quad (13)$$

$$0 = \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) + \dot{m}_{\text{in},2} \cdot (h_{\text{out},2} - h_{\text{in},2}) \quad (14)$$

3.2.2 Inputs specified

label	pr1 (15)	zeta2 (16)	kA_char (17)	subcooling (18)
condenser	0.990	68800.601	True	True

Table 6: Parameters of components of type Condenser

3.2.3 Equations applied

$$0 = p_{\text{in},1} \cdot pr1 - p_{\text{out},1} \quad (15)$$

$$0 = \begin{cases} p_{\text{in},2} - p_{\text{out},2} & |\dot{m}_{\text{in},2}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\text{in},2} - p_{\text{out},2}) \cdot \pi^2}{8 \cdot \dot{m}_{\text{in},2} \cdot |\dot{m}_{\text{in},2}| \cdot \frac{v_{\text{in},2} + v_{\text{out},2}}{2}} & |\dot{m}_{\text{in},2}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (16)$$

$$\begin{aligned} 0 = & \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) \\ & + kA_{\text{design}} \cdot f_{\text{kA}} \cdot \frac{T_{\text{out},1} - T_{\text{in},2} - T_{\text{sat}}(p_{\text{in},1}) + T_{\text{out},2}}{\ln \frac{T_{\text{out},1} - T_{\text{in},2}}{T_{\text{sat}}(p_{\text{in},1}) - T_{\text{out},2}}} \end{aligned} \quad (17)$$

$$f_{\text{kA}} = \frac{2}{\frac{1}{f(X_2)} + \frac{1}{f(X_1)}}$$

$$0 = h_{\text{out},1} - h(p_{\text{out},1}, x = 0) \quad (18)$$

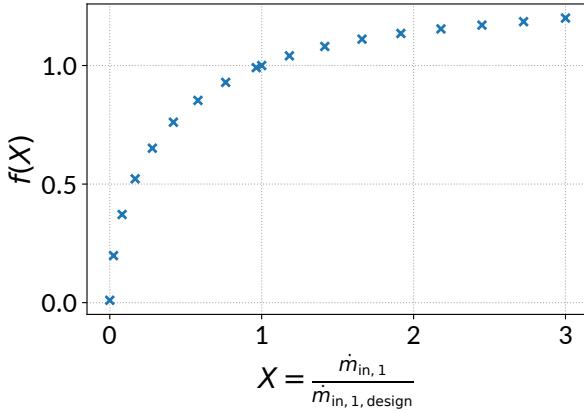


Figure 1: Characteristics of condenser (eq. 17)

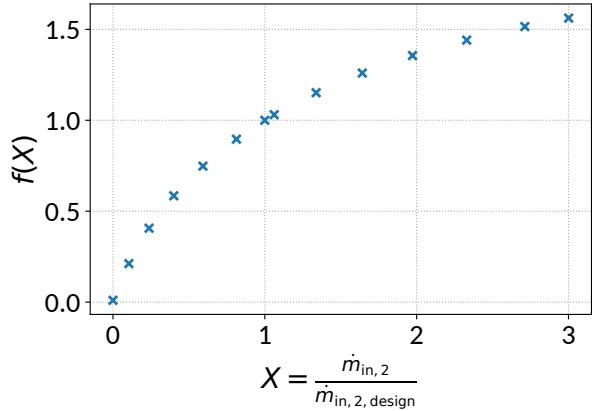


Figure 2: Characteristics of condenser (eq. 17)

3.3 Components of type Pump

3.3.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1] \quad (19)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (20)$$

3.3.2 Inputs specified

label	eta_s_char (21)
district heating pump	True
evaporator recirculation pump	True
pump	True

Table 7: Parameters of components of type Pump

3.3.3 Equations applied

$$0 = (h_{\text{out}} - h_{\text{in}}) \cdot \eta_{s,\text{design}} \cdot f(X) - (h_{\text{out},s} - h_{\text{in}}) \quad (21)$$

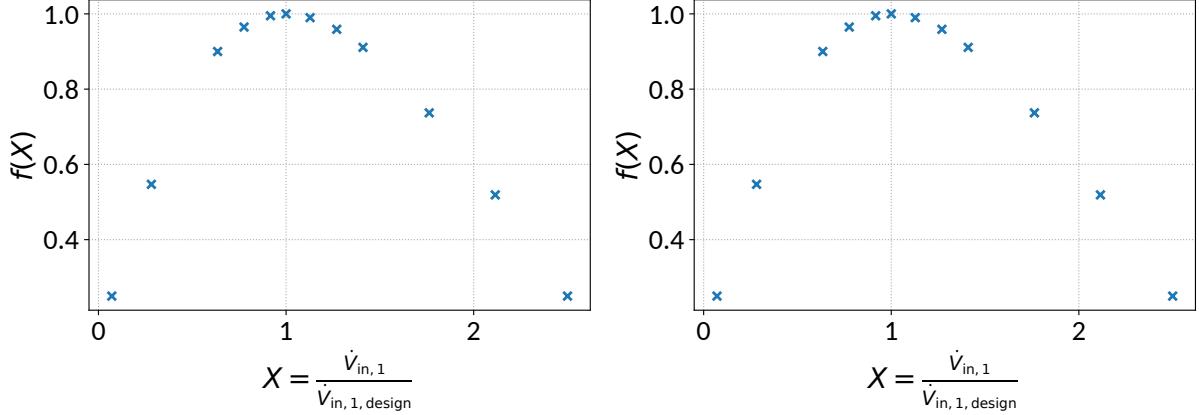


Figure 3: Characteristics of district heating pump
Figure 4: Characteristics of evaporator recirculation pump (eq. 21)

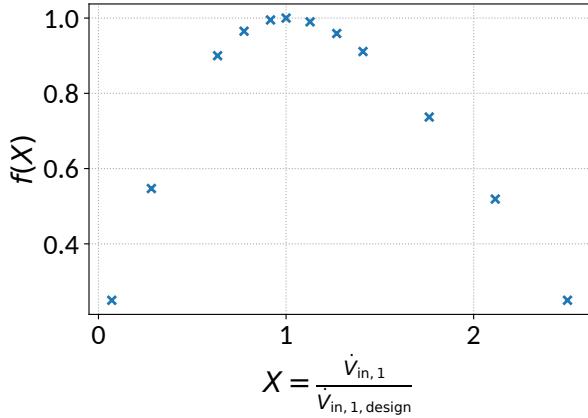


Figure 5: Characteristics of pump (eq. 21)

3.4 Components of type HeatExchangerSimple

3.4.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1] \quad (22)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (23)$$

3.4.2 Inputs specified

label	zeta (24)
consumer	68112.323

Table 8: Parameters of components of type HeatExchangerSimple

3.4.3 Equations applied

$$0 = \begin{cases} p_{in,1} - p_{out,1} & |\dot{m}_{in,1}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{in,1} - p_{out,1}) \cdot \pi^2}{8 \cdot \dot{m}_{in,1} \cdot |\dot{m}_{in,1}| \cdot \frac{v_{in,1} + v_{out,1}}{2}} & |\dot{m}_{in,1}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (24)$$

3.5 Components of type Valve

3.5.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1] \quad (25)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (26)$$

$$0 = h_{in,i} - h_{out,i} \quad \forall i \in [1] \quad (27)$$

3.6 Components of type Drum

3.6.1 Mandatory constraints

$$0 = \sum \dot{m}_{in,i} - \sum \dot{m}_{out,j} \quad \forall i \in \text{inlets}, \forall j \in \text{outlets} \quad (28)$$

$$0 = x_{fl,in,1} - x_{fl,out,j} \quad \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \quad (29)$$

$$0 = \sum_i (\dot{m}_{in,i} \cdot h_{in,i}) - \sum_j (\dot{m}_{out,j} \cdot h_{out,j}) \quad \forall i \in \text{inlets} \quad \forall j \in \text{outlets} \quad (30)$$

$$\begin{aligned} 0 &= p_{in,1} - p_{in,i} \quad \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{in,1} - p_{out,j} \quad \forall j \in \text{outlets} \end{aligned} \quad (31)$$

$$\begin{aligned} 0 &= h_{out,1} - h(p_{out,1}, x=0) \\ 0 &= h_{out,2} - h(p_{out,2}, x=1) \end{aligned} \quad (32)$$

3.7 Components of type HeatExchanger

3.7.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1, 2] \quad (33)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1, 2] \quad (34)$$

$$0 = \dot{m}_{in,1} \cdot (h_{out,1} - h_{in,1}) + \dot{m}_{in,2} \cdot (h_{out,2} - h_{in,2}) \quad (35)$$

3.7.2 Inputs specified

label	kA (36)	pr2 (37)	zeta1 (38)	zeta2 (39)	kA_char (40)
evaporator	-	0.990	227.824	-	True
superheater	9066.160	-	232.460	3350.244	-
intercooler	-	-	56517.828	680.633	True

Table 9: Parameters of components of type HeatExchanger

3.7.3 Equations applied

$$0 = \dot{m}_{in,1} \cdot (h_{out,1} - h_{in,1}) + kA \cdot \frac{T_{out,1} - T_{in,2} - T_{in,1} + T_{out,2}}{\ln \frac{T_{out,1} - T_{in,2}}{T_{in,1} - T_{out,2}}} \quad (36)$$

$$0 = p_{in,2} \cdot pr2 - p_{out,2} \quad (37)$$

$$0 = \begin{cases} p_{in,1} - p_{out,1} & |\dot{m}_{in,1}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{in,1} - p_{out,1}) \cdot \pi^2}{8 \cdot \dot{m}_{in,1} \cdot |\dot{m}_{in,1}| \cdot \frac{v_{in,1} + v_{out,1}}{2}} & |\dot{m}_{in,1}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (38)$$

$$0 = \begin{cases} p_{in,2} - p_{out,2} & |\dot{m}_{in,2}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{in,2} - p_{out,2}) \cdot \pi^2}{8 \cdot \dot{m}_{in,2} \cdot |\dot{m}_{in,2}| \cdot \frac{v_{in,2} + v_{out,2}}{2}} & |\dot{m}_{in,2}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (39)$$

$$\begin{aligned} 0 = & \dot{m}_{in,1} \cdot (h_{out,1} - h_{in,1}) \\ & + kA_{\text{design}} \cdot f_{kA} \cdot \frac{T_{out,1} - T_{in,2} - T_{in,1} + T_{out,2}}{\ln \frac{T_{out,1} - T_{in,2}}{T_{in,1} - T_{out,2}}} \end{aligned} \quad (40)$$

$$f_{kA} = \frac{2}{\frac{1}{f(X_1)} + \frac{1}{f(X_2)}}$$

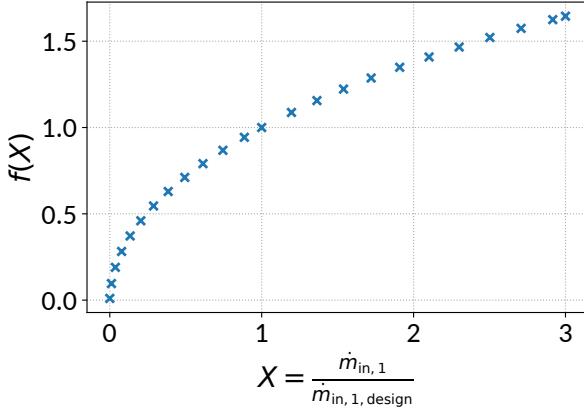


Figure 6: Characteristics of evaporator (eq. 40)

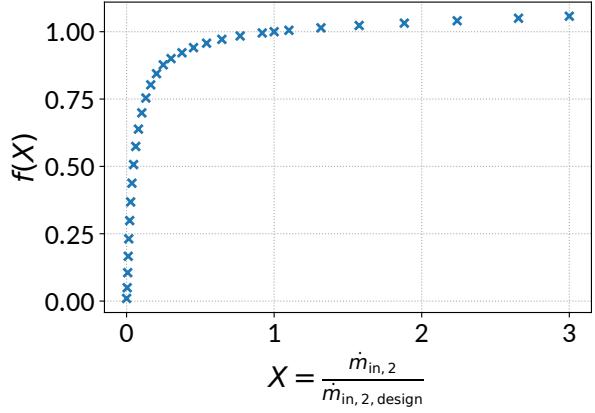


Figure 7: Characteristics of evaporator (eq. 40)

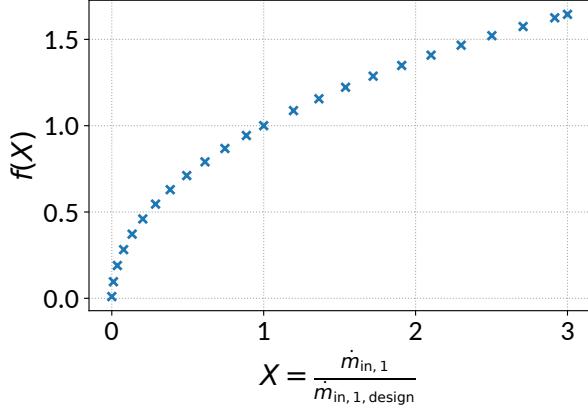


Figure 8: Characteristics of intercooler (eq. 40)

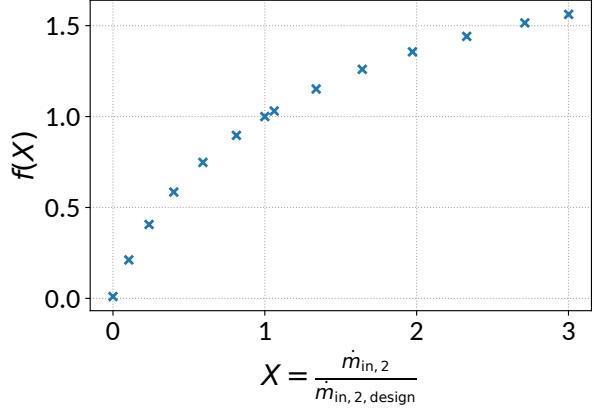


Figure 9: Characteristics of intercooler (eq. 40)

3.8 Components of type Splitter

3.8.1 Mandatory constraints

$$0 = \sum \dot{m}_{in,i} - \sum \dot{m}_{out,j} \quad \forall i \in \text{inlets}, \forall j \in \text{outlets} \quad (41)$$

$$0 = x_{fl,in} - x_{fl,out,j} \quad \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \quad (42)$$

$$0 = h_{in} - h_{out,j} \quad \forall j \in \text{outlets} \quad (43)$$

$$\begin{aligned} 0 &= p_{in,1} - p_{in,i} \quad \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{in,1} - p_{out,j} \quad \forall j \in \text{outlets} \end{aligned} \quad (44)$$

3.9 Components of type Compressor

3.9.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1] \quad (45)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (46)$$

3.9.2 Inputs specified

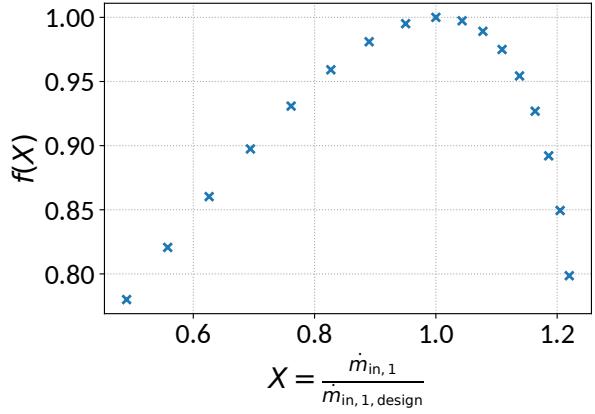
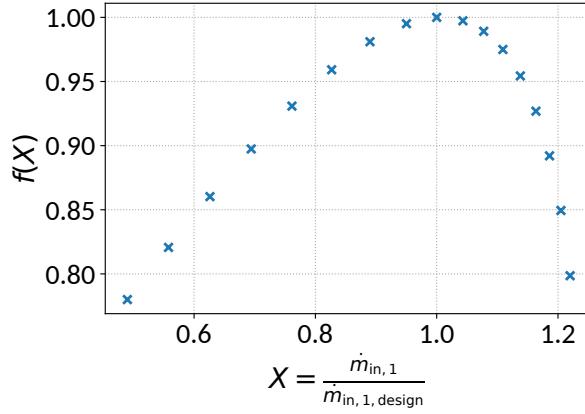
label	eta_s_char (47)	pr (48)
compressor 1	True	-
compressor 2	True	3.000

Table 10: Parameters of components of type Compressor

3.9.3 Equations applied

$$0 = (h_{out} - h_{in}) \cdot \eta_{s,design} \cdot f(X) - (h_{out,s} - h_{in}) \quad (47)$$

$$0 = p_{in,1} \cdot pr - p_{out,1} \quad (48)$$



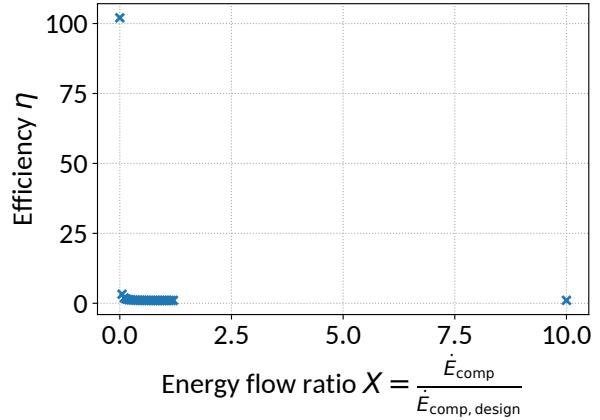
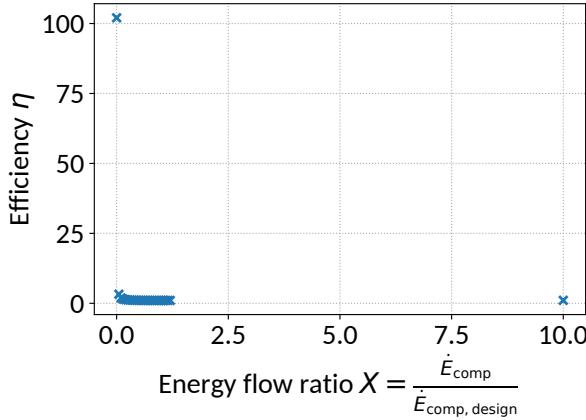
4 Busses in offdesign mode

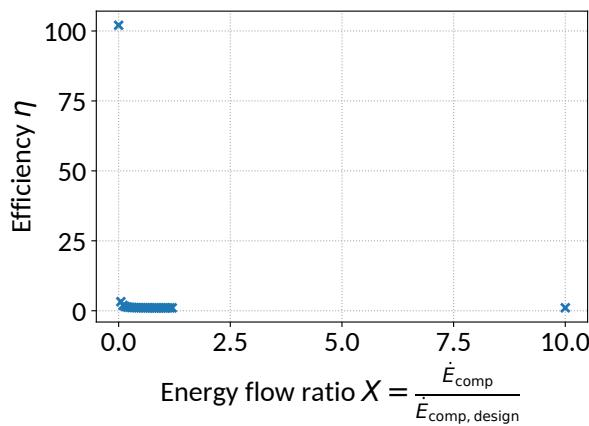
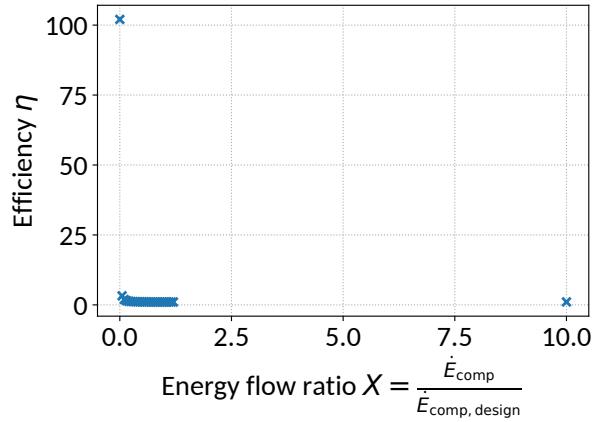
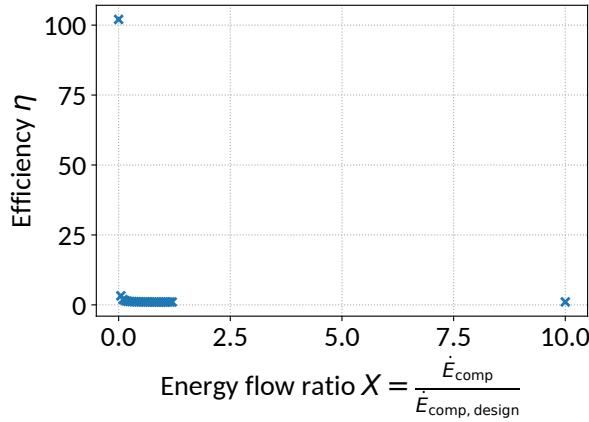
4.1 Bus “total compressor power”

This bus is used for postprocessing only.

label	\dot{E}_{comp}	\dot{E}_{bus}	η
compressor 1	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	$\dot{E}_{\text{comp}} \cdot \eta$	$f(X)$ (12)
compressor 2	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	$\dot{E}_{\text{comp}} \cdot \eta$	$f(X)$ (13)
pump	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	$\dot{E}_{\text{comp}} \cdot \eta$	$f(X)$ (14)
district heating pump	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	$\dot{E}_{\text{comp}} \cdot \eta$	$f(X)$ (15)
evaporator recirculation pump	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	$\dot{E}_{\text{comp}} \cdot \eta$	$f(X)$ (16)

Table 11: total compressor power





4.2 Bus “total delivered heat”

Specified total value of energy flow: $\dot{E}_{\text{bus}} = -2240000.000 \text{ W}$

$$0 = \dot{E}_{\text{bus}} - \sum_i \dot{E}_{\text{bus},i} \quad (49)$$

label	\dot{E}_{comp}	\dot{E}_{bus}	η
condenser	$\dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1})$	$\dot{E}_{\text{comp}} \cdot \eta$	1.000

Table 12: total delivered heat