AHU supply air+AHU return air: Economy with CC-System		Definition	Outside air	Return air
Station		Bern (Switzerland)		
Height over sea level	m	540.00		
Pressure	hPa	949.65		
Definition: Temp.	°C		20.00	20.00
Definition: Rel. humidity	%		40.00	40.00
Definition: Volume flow humid	m3/h		25000.00	25000.00
Fan: Static pressure without CC-System	Pa		1200.00	900.00
Fan: Efficiency	%		70.00	70.00

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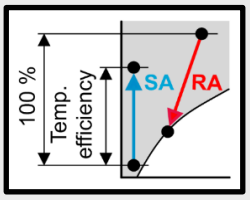
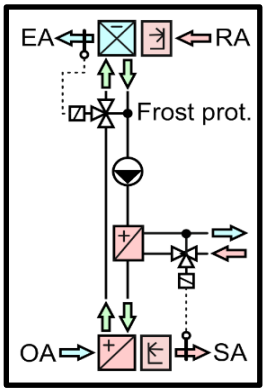
Tube rows on the depth 12.44	Service ---	Temp.-Eff. %	Air-Part %	Service h	Air-Pre. %
CC-System - Winter	Day 1	70.00	100.00	2000.00	100.00
	Day 2	74.16	50.00	2000.00	25.00
	Day 3	76.02	25.00	380.00	6.25
	Ø Day	**72.42**	**70.66**	**4380.00**	**57.62**
	Night 1	76.02	25.00	4380.00	6.25
	Night 2	0.00	0.00	0.00	0.00
	Night 3	0.00	0.00	0.00	0.00
	Ø Night	**76.02**	**25.00**	**4380.00**	**6.25**



Outside air - Supply air Winter - Summer		Outside air Winter	Supply air Winter	Outside air Summer	Supply air Summer
Temp.	°C	-18.00	22.00	32.00	16.00
Rel. humidity	%	100.00	40.00	53.30	80.00
Abs. humidity	g/kg	0.81	6.99	17.00	9.66

Return air - Exhaust air Winter - Summer		Return air Winter	Exhaust air Winter	Return air Summer	Exhaust air Summer
Temp. (Summer: Return air 26.00 °C)	°C	20.00	0.48	18.78	27.24
Rel. humidity (Summer: Return air 51.40 %)	%	40.00	81.42	100.00	60.00
Abs. humidity (Summer: Return air 11.50 g/k	g/kg	6.18	3.40	14.50	14.50



Need of energy without Energy recovery		Heater & Humidifier Winter	Cooler Summer	Reheater Summer	Supply air Current	Return air Current	Total ---
SFP (Specific Fan Power < 1500 Recom.)	W/(m3/s)						**1001.492**
Service / Year	h/a	6623.00	2137.00	1942.00	8760.00	8760.00	**8760.00**
Max. Capacity	kW	434.58	300.40	27.49	11.90	8.93	**---**
Need of energy	MWh/a	439.89	129.97	48.04	33.30	24.98	**676.18**
Energy costs	EUR/MWh	65.00	80.00	60.00	100.00	100.00	**70.54**
Energy costs	EUR/a	28592.83	10397.87	2882.42	3330.36	2497.77	**47701.25**

CC-System Energy recovery / Need of energy		Heater Winter	Cooler Summer	Glycol Current	Supply air Current	Return air Current	Total ---
Temp. efficiency / Pump efficiency	%	70.00	63.68	80.00	---	---	---
Return air: Pressure drop	Pa	79.82	79.82	---	---	79.82	---
Supply air: Pressure drop	Pa	67.61	67.61	---	67.61	---	---
Glycol: Volume flow	m3/h	7.97	7.97	7.97	---	---	---
Glycol: Pressure drop	bar	6.00	6.00	6.00	---	---	---
Service / Year	h/a	6533.00	2227.00	8760.00	8760.00	8760.00	**8760.00**
Max. Capacity	kW	207.94	67.85	1.66	0.67	0.79	**---**
Energy recovery / Need of energy	MWh/a	247.73	27.63	2.68	1.08	1.28	**---**
Energy costs	EUR/MWh	60.00	80.00	100.00	100.00	100.00	**---**
Energy recovery / Energy costs	EUR/a	14864.07	2210.27	267.95	108.25	127.79	**---**

Need of energy with Energy recovery		Heater & Humidifier Winter	Cooler Summer	Reheater Summer	Supply air Current	Return air Current	Total ---
SFP (Specific Fan Power < 1500 Recom.)	W/(m3/s)						**1042.052**
Service / Year	h/a	6623.00	2137.00	1942.00	8760.00	8760.00	**8760.00**
Max. Capacity	kW	226.64	232.54	27.49	12.58	9.72	**---**
Need of energy	MWh/a	192.16	102.34	48.04	34.39	26.26	**403.18**
Energy costs	EUR/MWh	65.00	80.00	60.00	100.00	100.00	**73.48**
Energy costs	EUR/a	12490.09	8187.60	2882.42	3438.61	2625.56	**29624.27**

AHU supply air+AHU return air: Economy with CC-System

Investment costs		
Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00
without CC-System	EUR	75000.00
with CC-System	EUR	126000.00
Additional costs	EUR	**51000.00**

Overheads		
Support costs (+)	EUR/a	2550.00
Energy costs (-)	EUR/a	47701.25
Energy costs (+)	EUR/a	29624.27
Net useful ratio	EUR/a	**18076.98**

Amortization		
BEP (Break even point)	Years	**3.31**

Summer		
Adiabatic return air cooling	Hours	**2227.00**

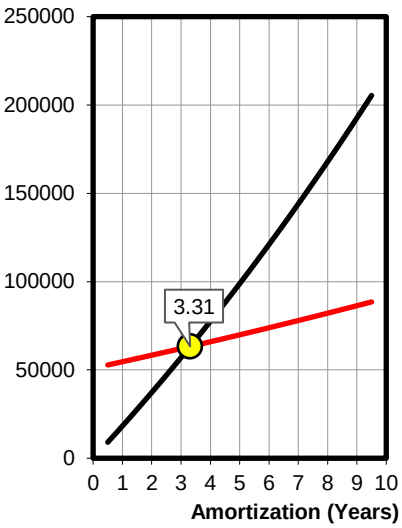
Capital costs		
Life cycle	Years	15.00
Investment costs	EUR	126000.00
Energy costs	EUR	29624.27
Support costs	EUR	6300.00
Overheads	EUR	35924.27
Capital costs	EUR	**53445.96**

Costs	%	EUR
Energy costs without CC-System	92.71	47701.25
Support costs without CC-System	7.29	3750.00
Overheads without CC-System	100.00	51451.25
Energy costs with CC-System	57.58	29624.27
Support costs with CC-System	12.24	6300.00
Overheads with CC-System	69.82	35924.27
Net useful ratio with CC-System	**30.18**	**15526.98**

Need of energy	%	MWh
Need of energy without CC-System	100.00	676.18
Need of energy with CC-System	59.63	403.18
Net useful ratio with CC-System	**40.37**	**273.00**

CO2 reduction	MWh	t CO2
Energy brown coal (400 kgCO2/MWh)	273.00	**109.20**
Energy hard coal (330 kgCO2/MWh)	273.00	**90.09**
Energy heating oil (270 kgCO2/MWh)	273.00	**73.71**
Energy natural gas (200 kgCO2/MWh)	273.00	**54.60**

Incomes (EUR)
Expenses (EUR)



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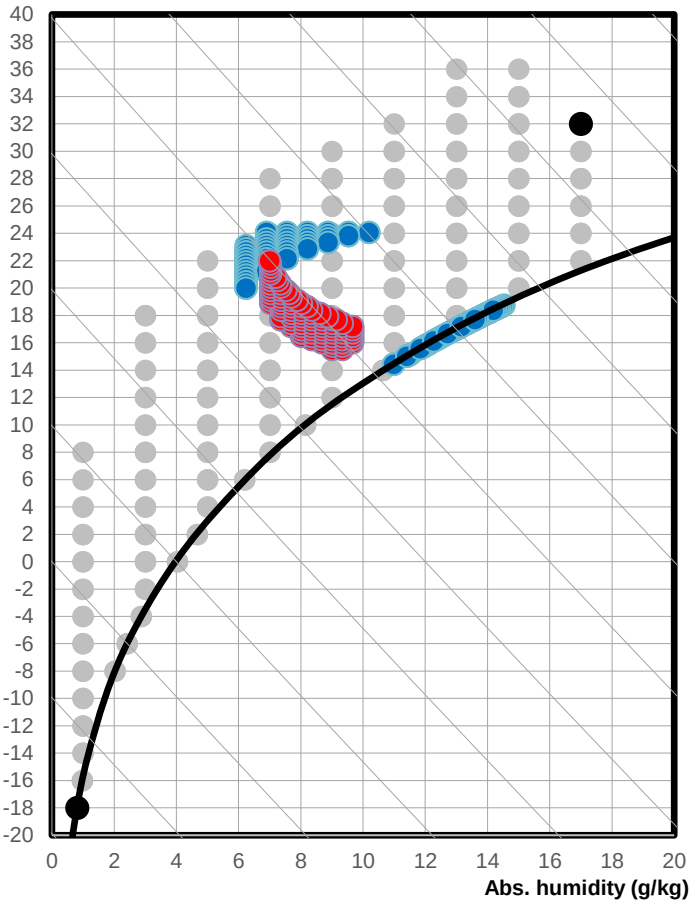
Outside air-Enthalpy (Max. Summer / Min. Winter)
Outside air (°C)
Supply air (°C)
Return air (°C) - (Adiabatic return air cooling = Yes)



Sorbent		Glycol pump	Frost conduc.	Total
Need of energy	MWh/a	2.68	60.64	403.18
Need of energy	%	0.66	15.04	100.00
Energy costs	EUR/a	267.95	6064.16	29624.27
Energy costs	%	0.90	20.47	100.00

Circulation composite systems with efficiencies of 70 % and more were planned and used until 2018 only in German-speaking countries. Other designers apparently don't know the pumps, e.g. Grundfos CRE type, for which pressure drops of 6 bar are no problems. The same "engineers" plan air handling units with air speeds up to 3.5 m/s, no matter how much energy the fans need.

Factor: Frost conduc. / Glycol pump = 22.63 !!!

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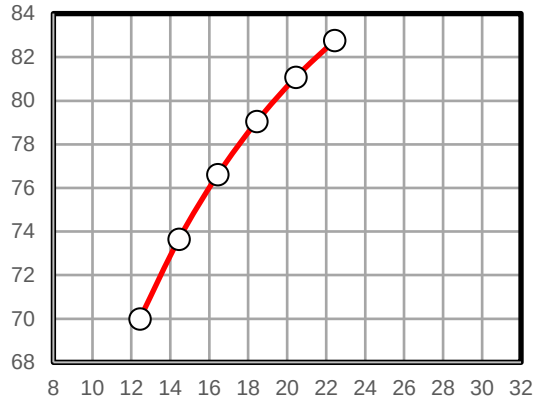
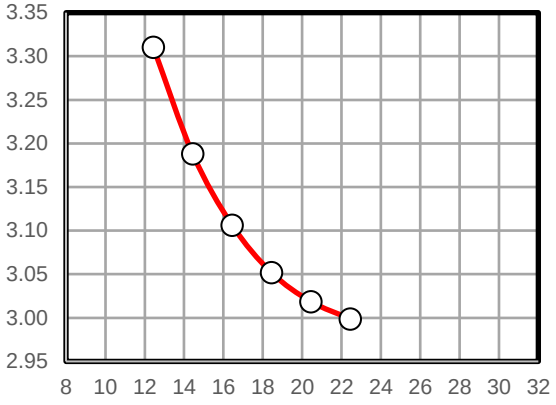
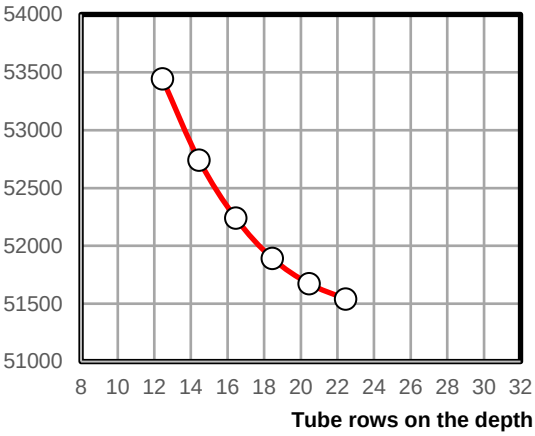
Temp.-Eff. (%)



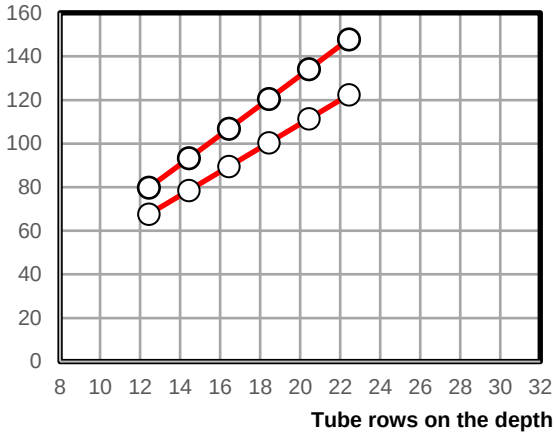
BEP =Break even point (Years)



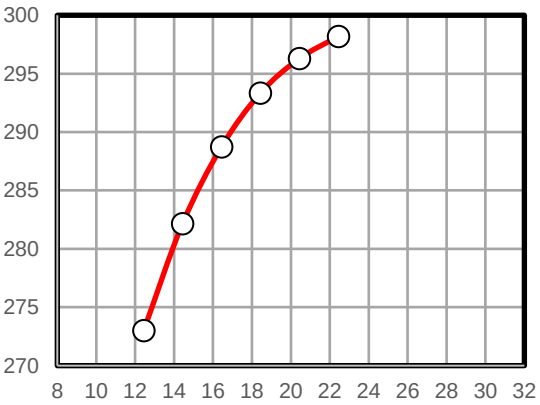
Capital costs (EUR)



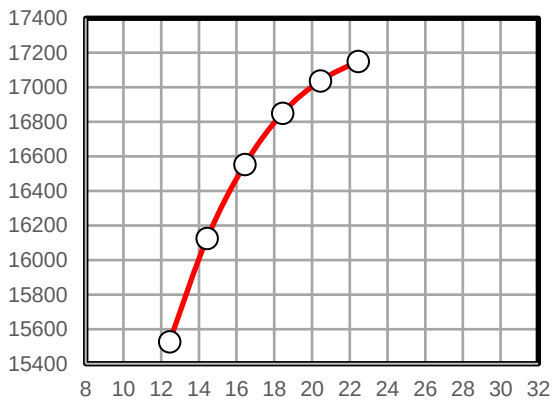
CC-System (Pa)



Net useful ratio with CC-System (MWh)



Net useful ratio with CC-System (EUR)



Tube rows on the depth	Piece	12.44	14.44	16.44	18.44	20.44	22.44
Temp.-Eff.	%	70.00	73.65	76.61	79.05	81.07	82.77
CC-System - Supply air	Pa	67.61	78.54	89.49	100.44	111.41	122.38
CC-System - Return air	Pa	79.82	93.30	106.87	120.52	134.20	147.91
Additional costs	EUR	51000.00	51000.00	51000.00	51000.00	51000.00	51000.00
Energy costs without CC-System	EUR/a	47701.25	47701.25	47701.25	47701.25	47701.25	47701.25
Energy costs withCC-System	EUR/a	29624.27	29024.64	28597.33	28299.90	28113.53	28000.18
Net useful ratio	EUR/a	18076.98	18676.61	19103.92	19401.35	19587.72	19701.07
BEP (Break even point)	Years	3.31	3.19	3.11	3.05	3.02	3.00
Life cycle	Years	15.00	15.00	15.00	15.00	15.00	15.00
Capital costs	EUR	53445.96	52742.85	52241.79	51893.03	51674.50	51541.59
Net useful ratio with CC-System	%	30.18	31.34	32.17	32.75	33.11	33.33
Net useful ratio with CC-System	EUR	15526.98	16126.61	16553.92	16851.35	17037.72	17151.07
Net useful ratio with CC-System	%	40.37	41.73	42.70	43.38	43.82	44.10
Net useful ratio with CC-System	MWh	273.00	282.16	288.73	293.34	296.29	298.19