HEAT PUMP COP PARAMETRIC STUDY: RESIDENTIAL SPACE HEATING

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LOCATION

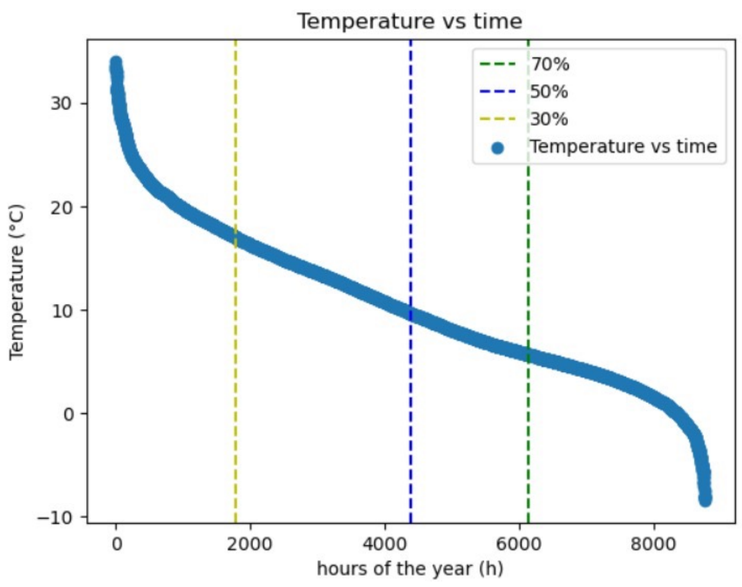
Parameter	Value
Location	Oldenburg, Germany
Latitude	53.143452
Longitude	8.214552
Ambient temperature average 2019 [1]	10.4 °C
Apartment area	60 m^2
Number of residents	2 adults
Q_{SH} Annual Space Heating Demand [2]	16150 kWh

HEAT PUMP [3]

Decarbo ECO030 For Heating: Water Temp. Outlet 35 °C

Parameter	Value
Decarbo ECO030	
Fluid	R290
Input Power Range (kW)	0.63 - 0.68
COP Range	1.7 - 5.04

DURATION CURVE



HEAT PUMP MODEL

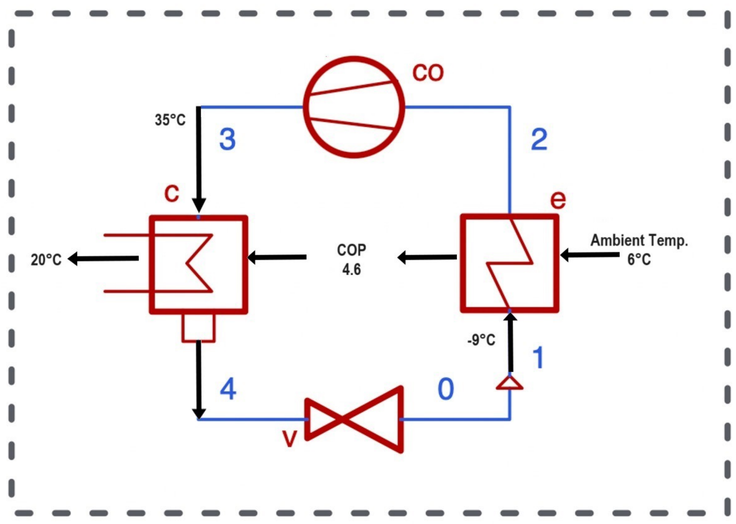


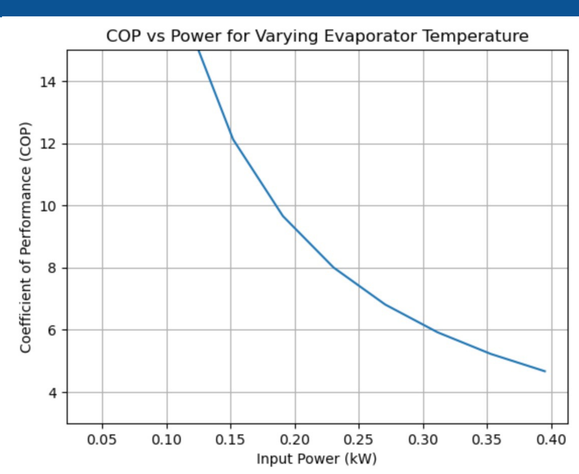
Figure 1: Heat Pump Modelling Concept [4]

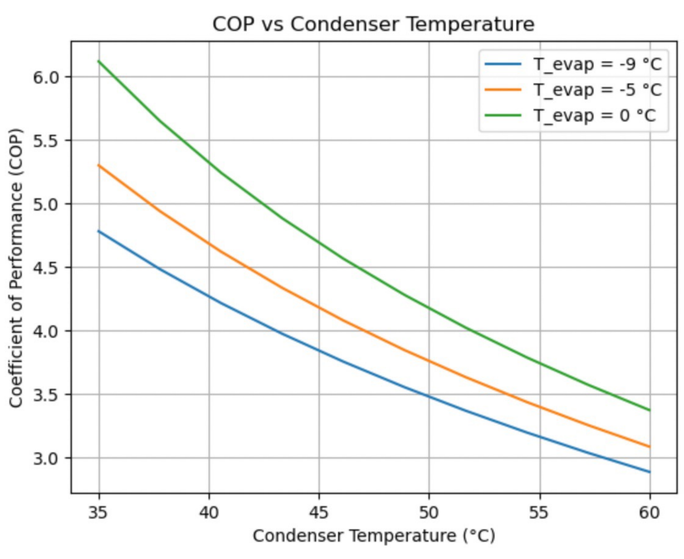
Assumptions

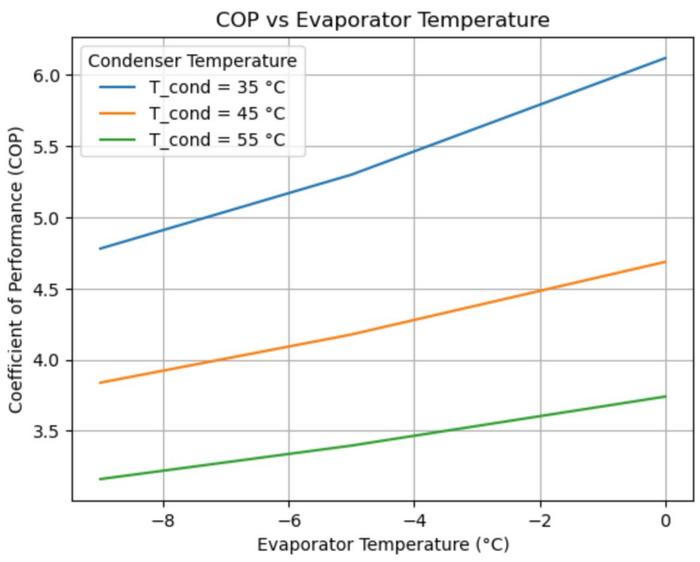
Parameter	Value
Condenser Outlet Refrigerant State	Liquid
Evaporator Outlet Refrigerant State	Vapor
ETA Compressor Constant	0.8
ΔT Evaporator	15°C
ΔT Condenser Water	15°C

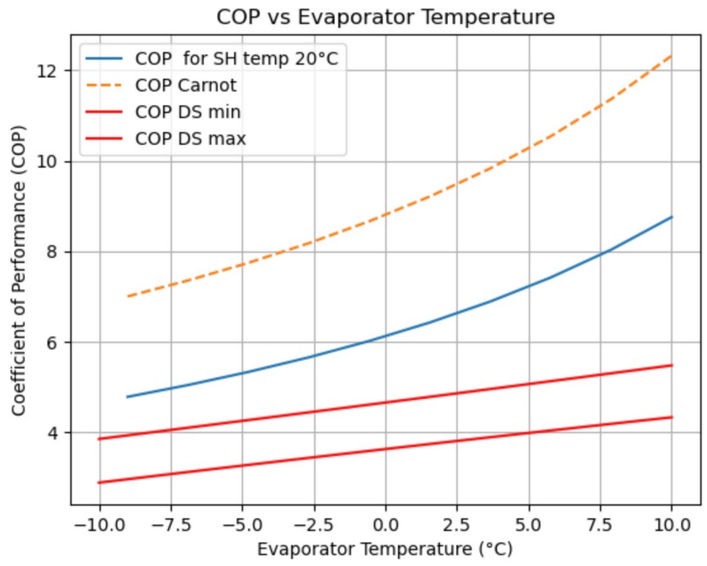
RESULTS AND ANALYSIS

Scenario / Temperature	T Amb. - source (°C)	T Evap. (°C)	T Demand-sink (°C)	T Cond. (°C)	COP
Case 1 (70%)	6	-9	20	35	4.6
Case 2 (50%)	10	-5	20	35	5.3
Case 3 (30%)	15	0	20	35	6.1









CONCLUSIONS

- Developed Python code for air source heat pump modelling, considering refrigerant choice, compressor efficiency, heating load, and heat exchanger temperatures.
- In winter, the COP decreased (worst case scenario) due to seasonal source temperature values, while in summer, the opposite trend was observed. Validation with real heat pump data showed COP within manufacturer's range.
- DHW's impact on COP was minimal; omitted due to space constraints, along with the compressor efficiency curve.
- Investigation of COP variations with different fluids revealed flashing issues with CoolProps.
- Future model could integrate P-h or T-s diagrams and include detailed heat exchanger analysis for both condenser and evaporator components.

REFERENCES

[1] https://www.renewables.ninja/

[2] https://app.npro.energy/en

[3] https://frigopartners.com/media/b5/92/c7/1700648662/Decarbo_product_brochure_v2.2.pdf

[4] https://fwitte.github.io/introduction-to-heat-pump-modeling/model/exercise-sm.html