Thermal heating for a movie theatre

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Winter semester 2023/2024
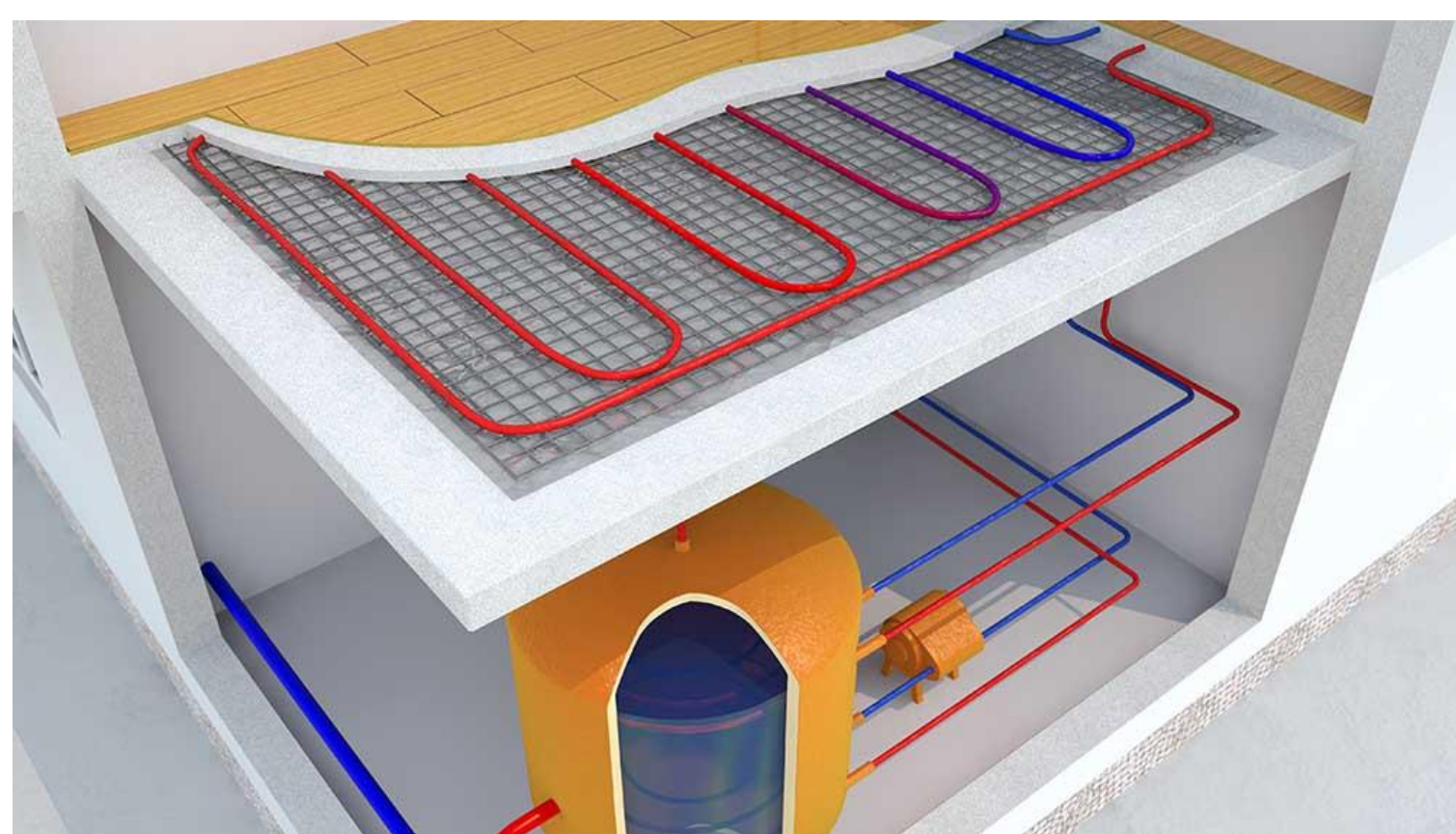
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Location and demand

- Cines Aragonia, Zaragoza (Spain)
- Space of heating: cinema room of 300 m².
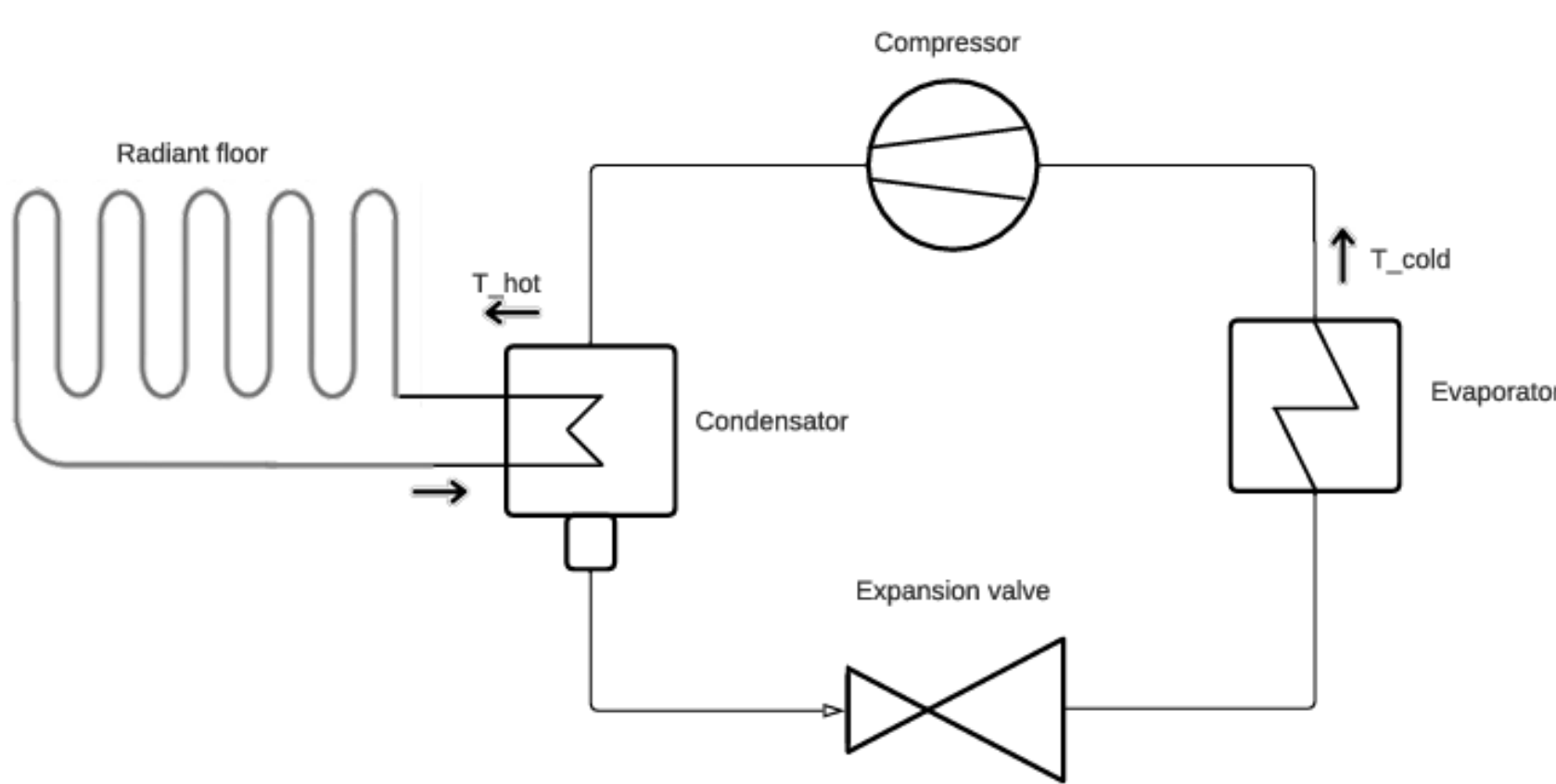- The room temperature demand is of 21ºC, so we need a water temperature of around 40ºC.

Radiant floor system

Heat pump design and parameters

| Model	Vitocal 150-A 150-A08 230
Refrigerant	R290
η_s	0.7
Performance data heating (A7/W35, spread 5 K):	
COP	4.9
Output range [kW]	3.3 – 14.9

T_{hot} [ºC]	40

Q_{demand} as a function of temperature

- We are supplying the demand for the cold sessions of the year. In Zaragoza, the temperaures, T_{cold}, go from -5ºC to 15ºC.

- We asume that the initial room temperature is the same as outside, so the heat transfer will vary as a function of T_{cold}, this is
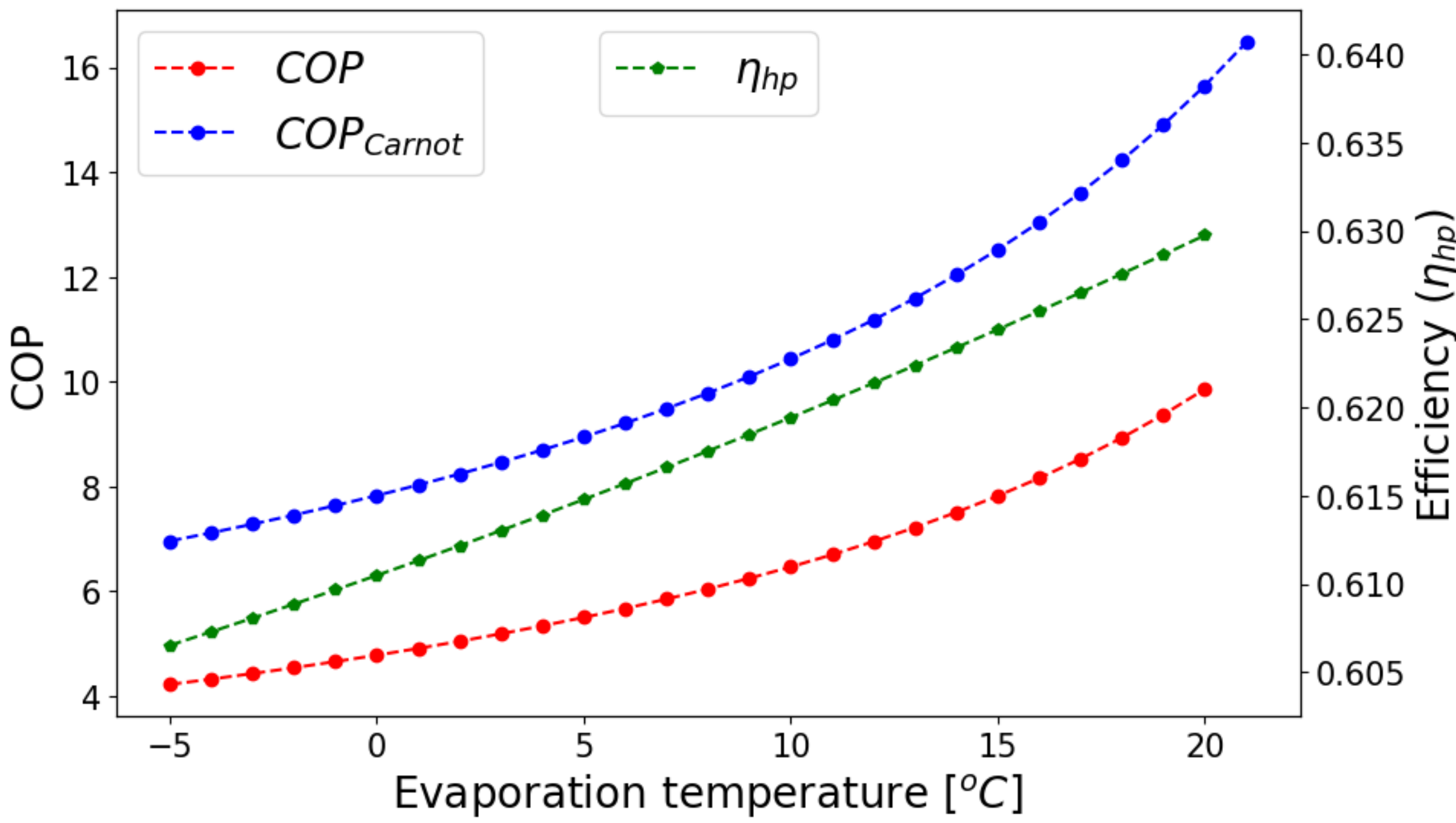
$$Q_{demand} = h \cdot A_{room} \cdot \Delta T$$

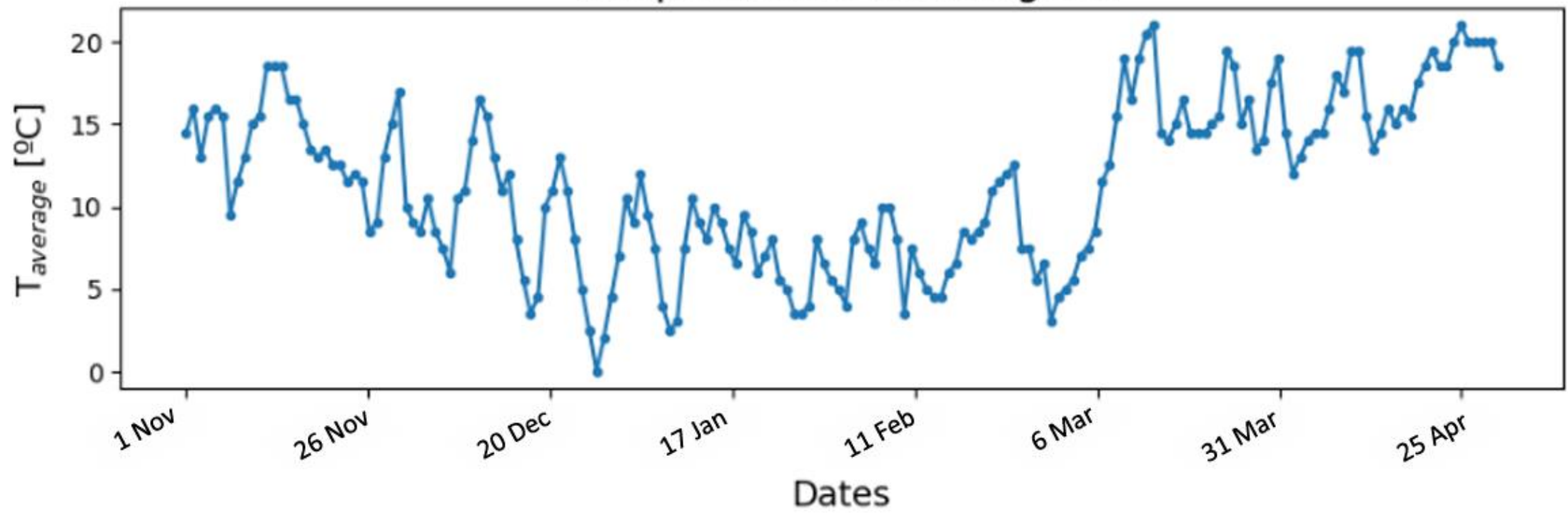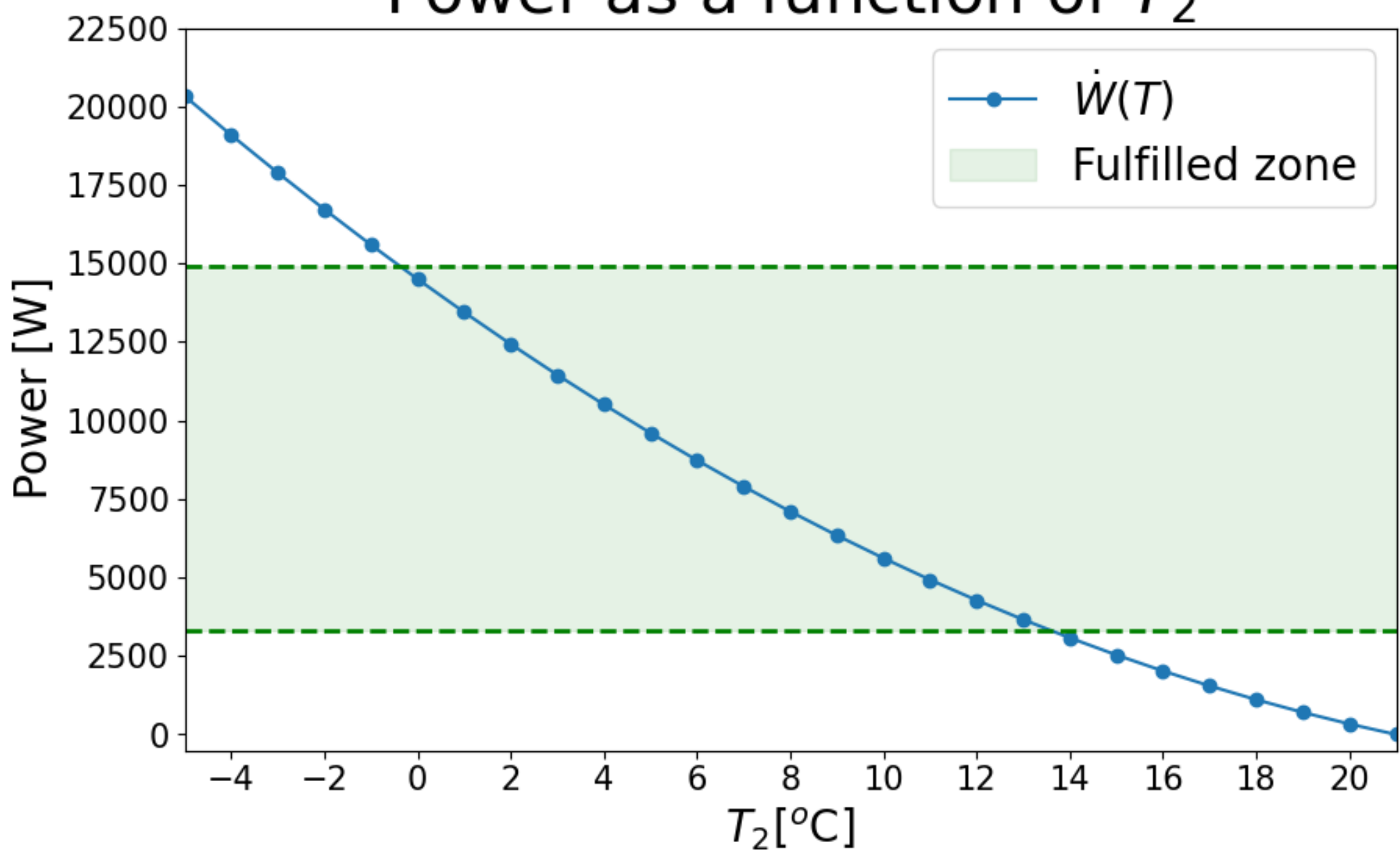where h is the transmission coefficient of the floor and $\Delta T = 21^o C - T_{cold}$

Heat transfer as a function of T_2
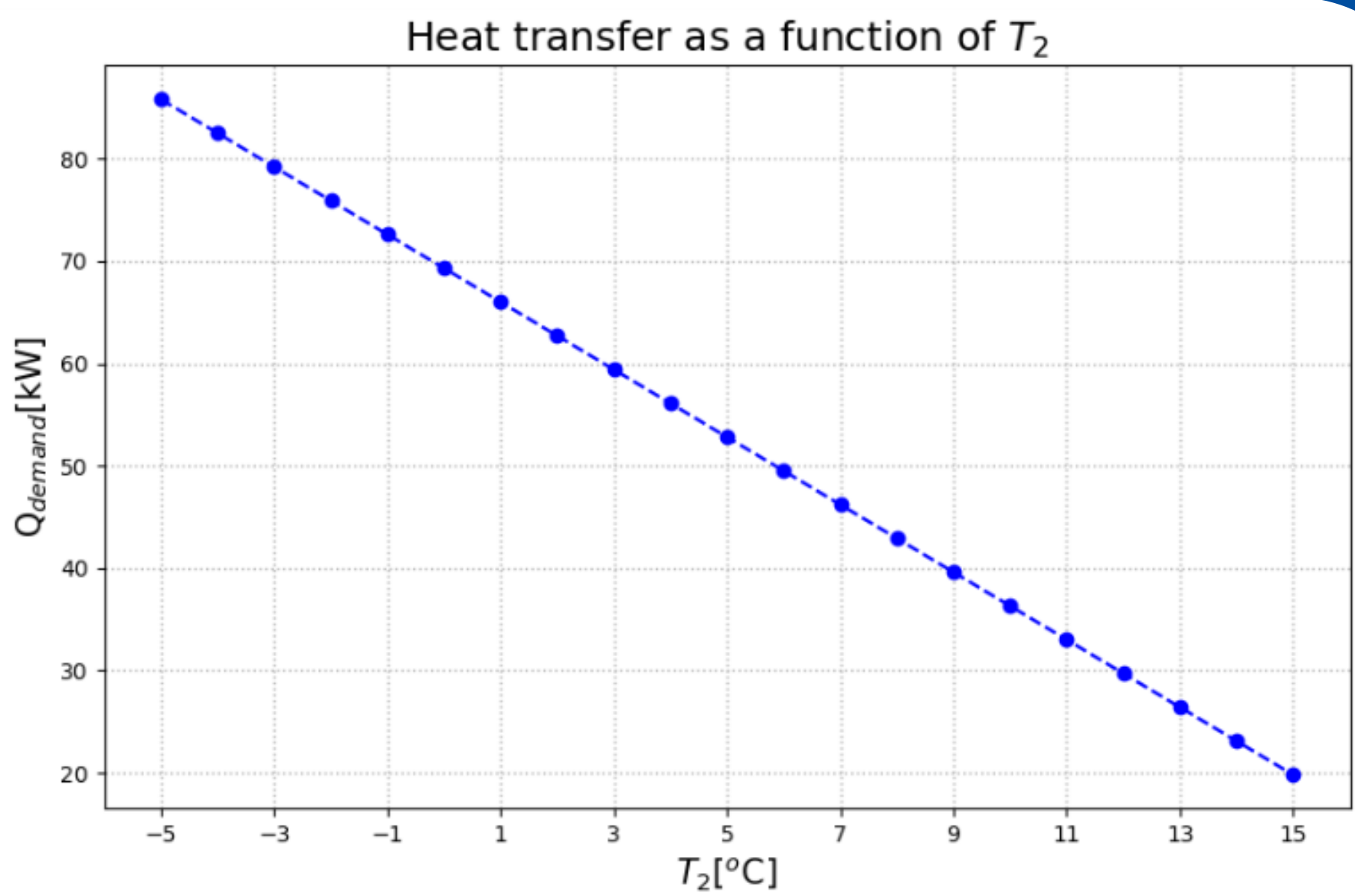
Parametric study

COP vs T_2

Power as a function of T_2
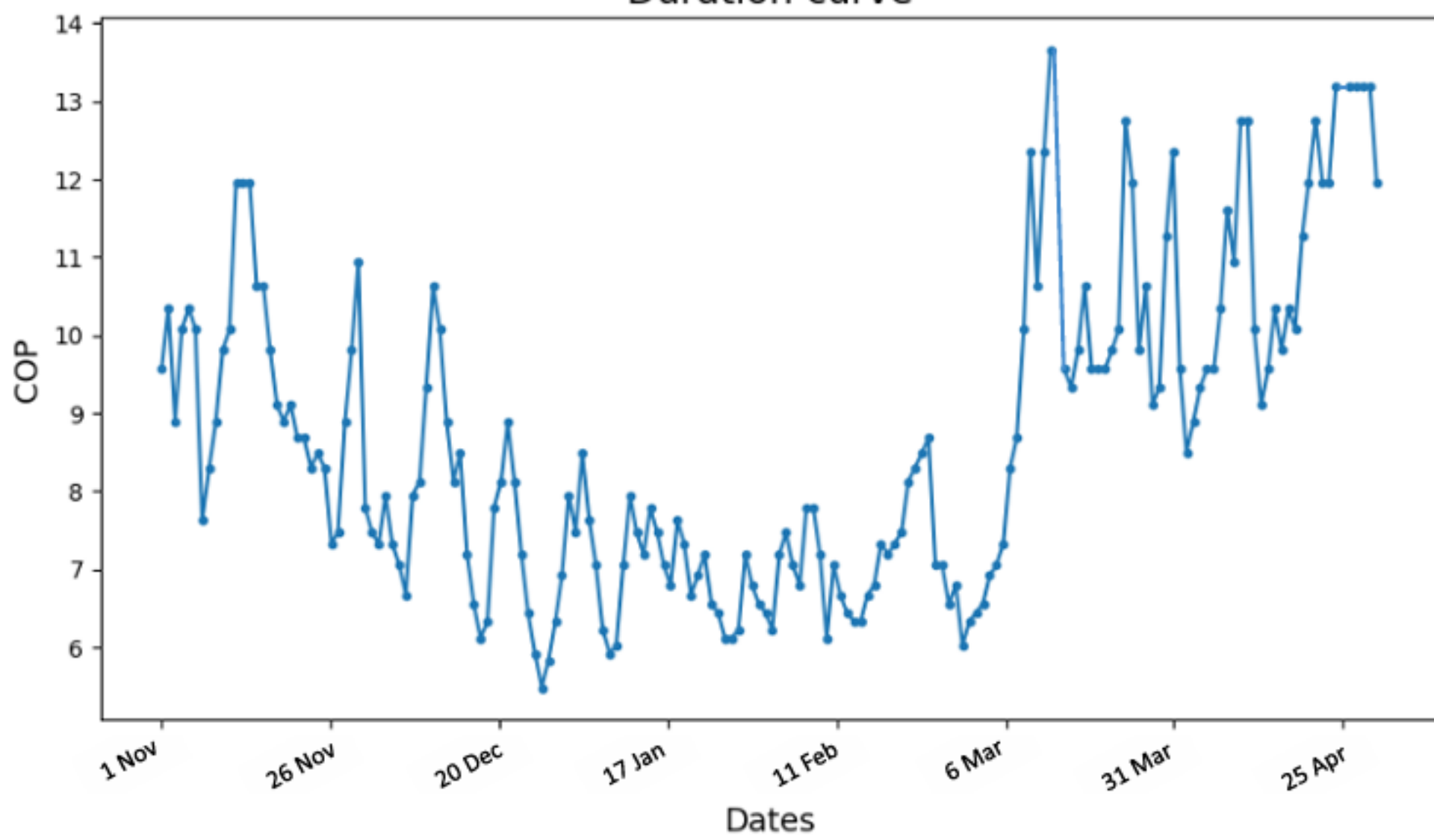
Temperatures in Zaragoza

Duration curve

Conclusions

- This system can supply most of our demand in the chosen zone, due to the not very low winter temperatures.
- The more efficient period starts in mid-March.

References

- https://cielowigle.com/blog/radiant-cooling/
- https://cinegoza.blogspot.com/2009/09/cines-aragonia-16-nuevas-salas-de-cine.html
- https://www.viessmann.co.uk/content/dam/public-brands/gb/products/heat-pump/vitocal-151-a/Vitocal%20150-A_151-A%20brochure.pdf