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amazon

Greening the Giant: Space Heating with Heat Pumps at Amazon Antwerp

- Iván Campos Zamora
- Muhammad Zubair
- Adeela Mohsin

Antwerp, Belgium

The research site was situated at coordinates 51.2213° N, 4.4051° E , as identified on Google Maps (Google, n.d.) [4].

Historic Port City: Antwerp is a historic port city situated along the Scheldt River.

Economic Hub: A significant economic hub in Europe, with a strategic location facilitating trade and commerce.

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Amazon Antwerp: Delivering Growth Sustainably

Strategic:

- **Demand & Expansion:** Amazon chose Antwerp to meet growing customer demand and enhance its European delivery network capacity.
- **Strategic Location:** Antwerp's central European location ensures efficient distribution across the continent.
- **Logistical Efficiency:** Packages from European centers will be shipped to Antwerp, improving overall logistical efficiency [2].

Sustainable:

- **Renewable Energy Commitment:** Amazon aims for 100% renewable energy by 2025 and is a leading global corporate buyer in this sector.
- **Net-Zero Carbon Pledge:** Committed to The Climate Pledge, Amazon targets net-zero carbon across its business by 2040, exceeding Paris Agreement goals.
- **Environmental Focus:** The Antwerp building prioritizes energy efficiency, featuring solar panels, LED lighting, and rainwater reuse for sustainability [2].

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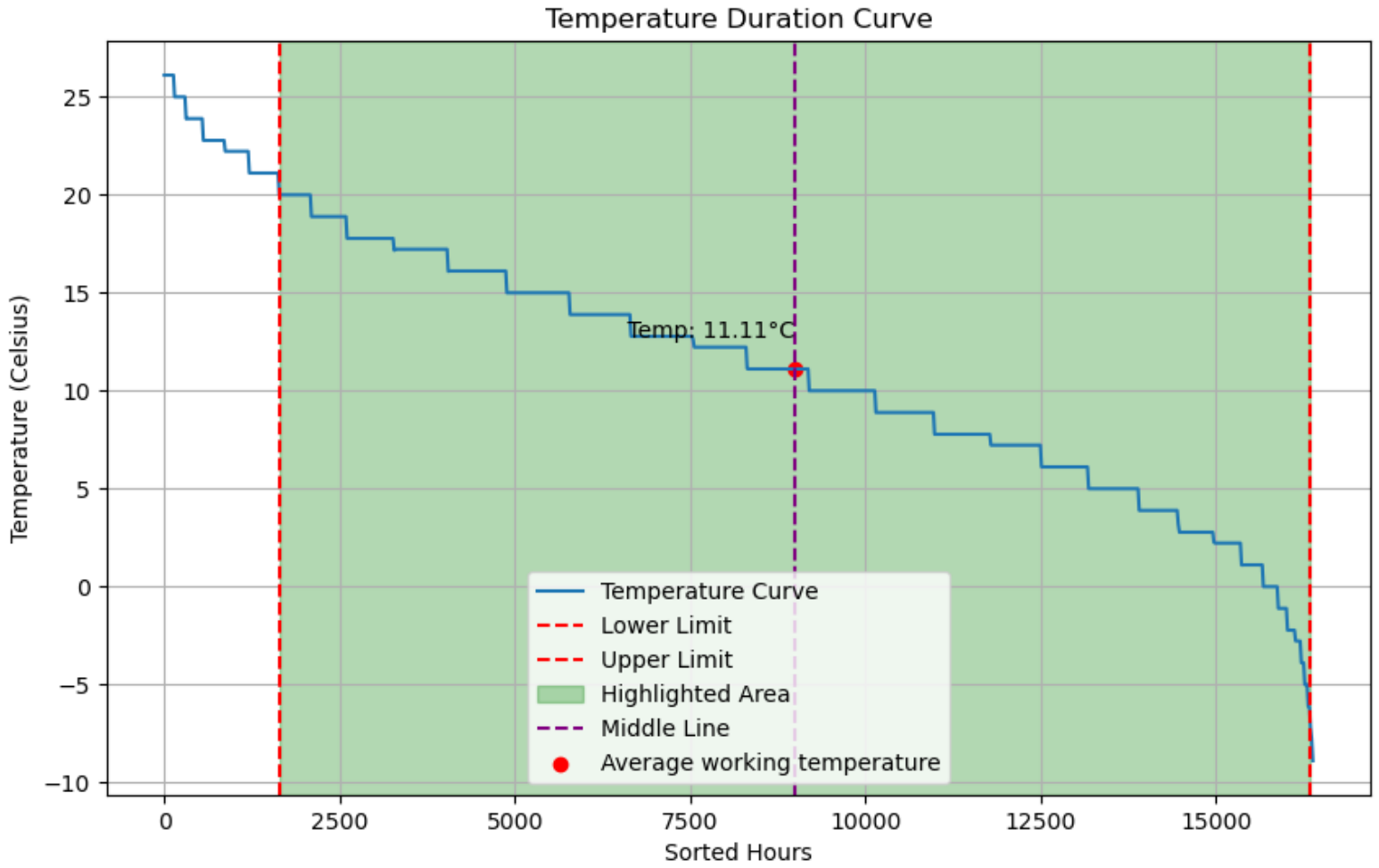
Duration Curve

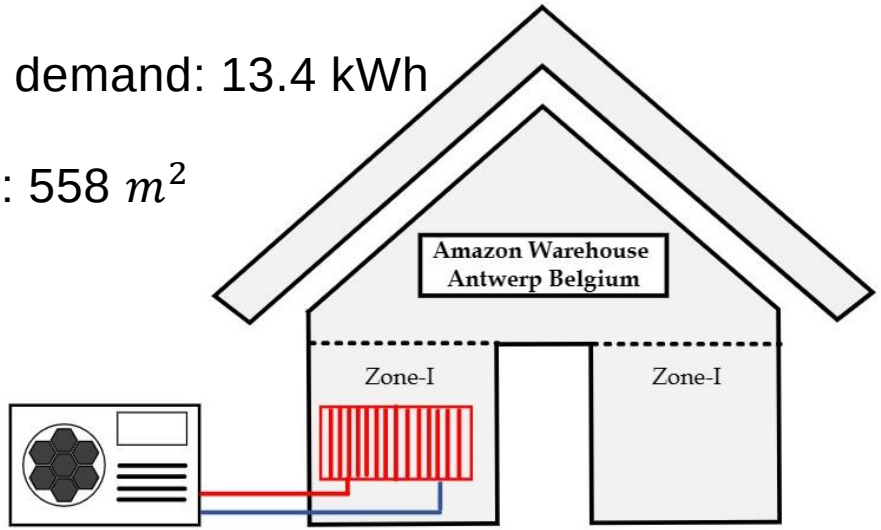
– During this period, our average working temperature will be 11.11°C.



Source: www.wunderground.com/history/daily/be/antwerp/EBAW/date/ + Web-scrapping using Chat GPT

Heat Requirements

- Maximum heat output provided by system: 20 kW
- Heat demand: 13.4 kWh
- Area: 558 m^2



A-Series

Air Source *AS01-R32* *AS02-R32* *AS03-R32*

WARMFLOW

High Efficiency Variable Speed Air Source Heat Pumps

Table 1 Product data

Product Data		AS01-R32	AS02-R32	AS03-R32
Dimensions (mm)	Width	1002	953	997
	Depth	490	460	437
	Height	805	915	1315
Weight (kg)		90	108	140
Electrical Supply		230V Single Phase @50Hz	230V Single Phase @50Hz	230V Single Phase @50Hz
Maximum Current (Amps)		13	22	33
Nominal Sound Level (dBA)*		37 - 54	42 - 55	44 - 58
Performance	COP @ A7W35	4.58	4.35	4.67
	COP @ A2W30	4.18	3.46	3.74
	COP @ A7W27	6.10	5.76	5.37
	COP @ A12W24	8.58	8.39	7.37
	COP @ A-7W34	3.11	2.95	2.71
	COP @ A7W55	2.68	2.67	2.51
	COP @ A-10W55	1.90	1.69	1.94
	Heat Output Range	2 - 8kW	5 - 12kW	7 - 20kW
	ErP Efficiency Class (35°C / 55°C)^	A+++ / A++	A++ / A++	A++ / A++
Operating Temp. (°C)	Ambient Air, min/max	-25/43	-25/52	-25/52
	Heating Flow, min/max	20/65	20/65	20/65
Flow Rates (l/m)	Heating, min/max	10/20	16/30	28/60
Fluid Content (l)		1.0	1.53	2.51
Refrigerant	Type	R32	R32	R32
	Charge (kg)	1.30	1.70	2.00
Connections	Heating Flow & Return	1" female BSP	1" female BSP	1 ¼" female BSP

*Nominal Sound Levels have been independently tested in accordance with EN 12102.

^ ErP ratings have been independently tested in accordance with EN 14825.

Warmflow. *Manual for AS03-R32*. [5]

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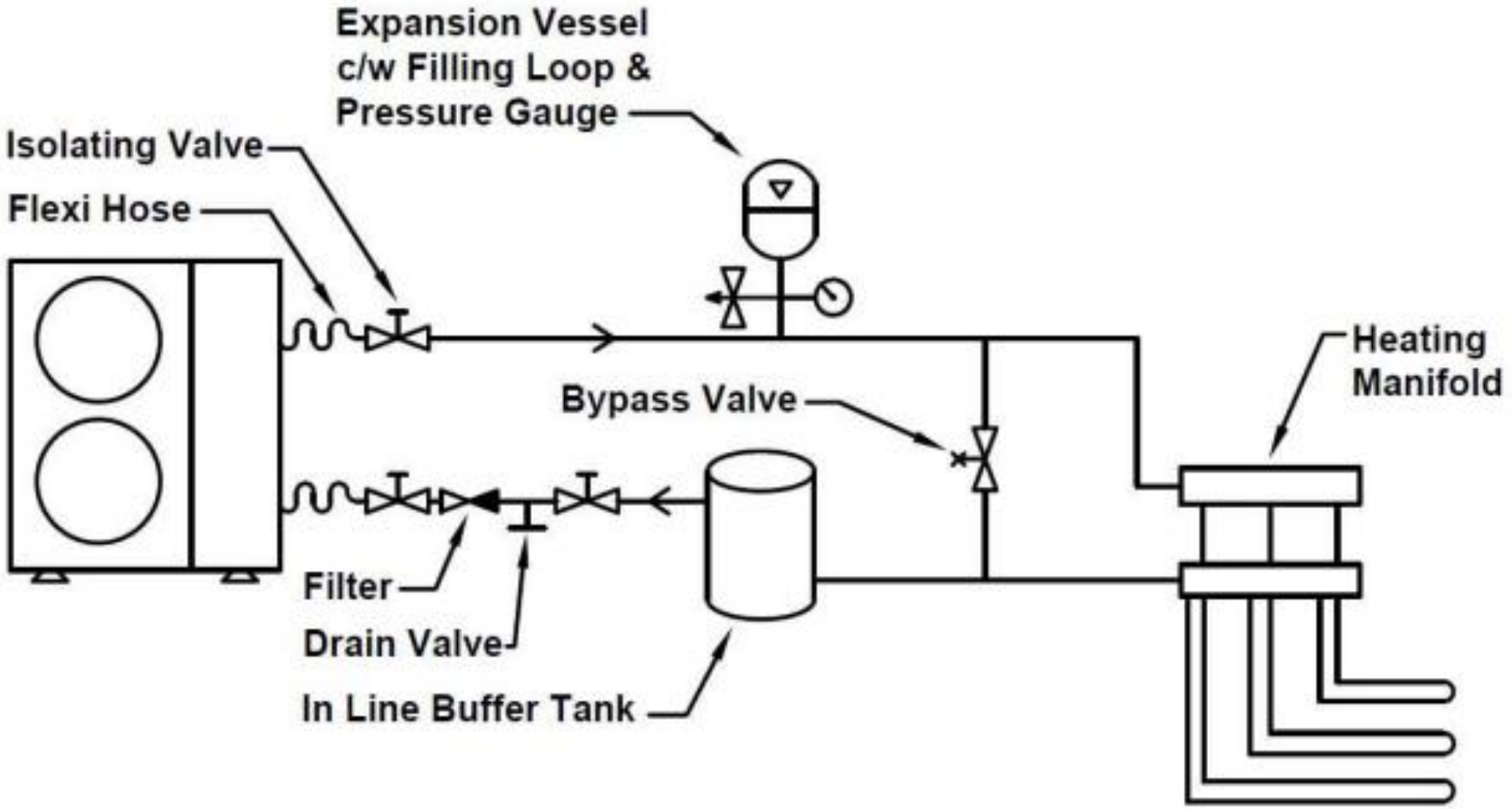
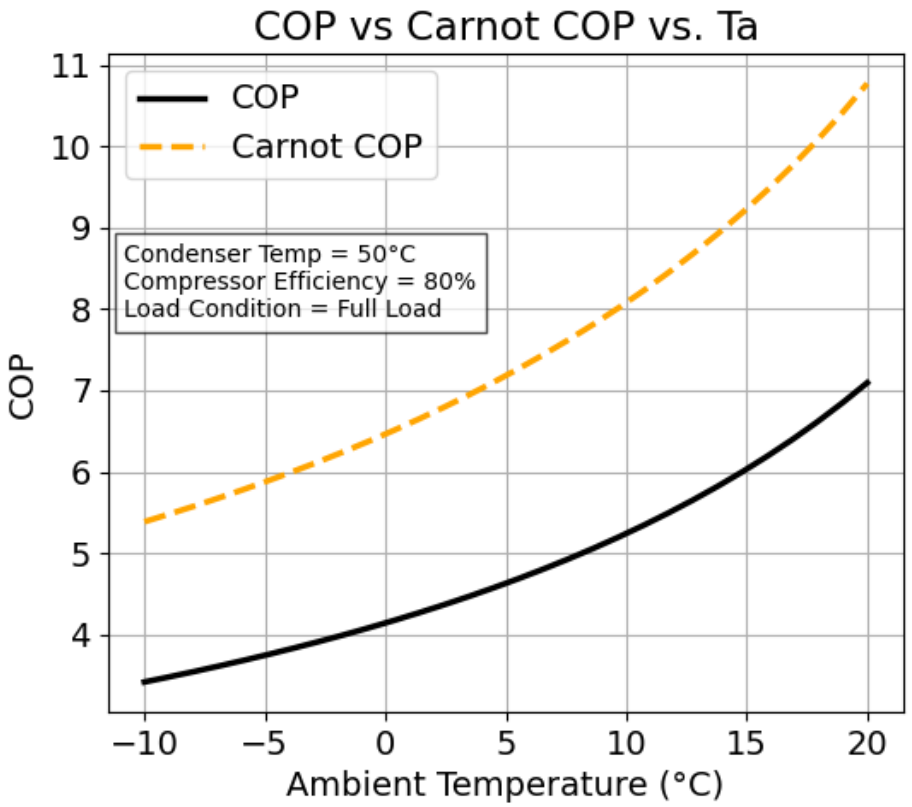
Heat Schematic:

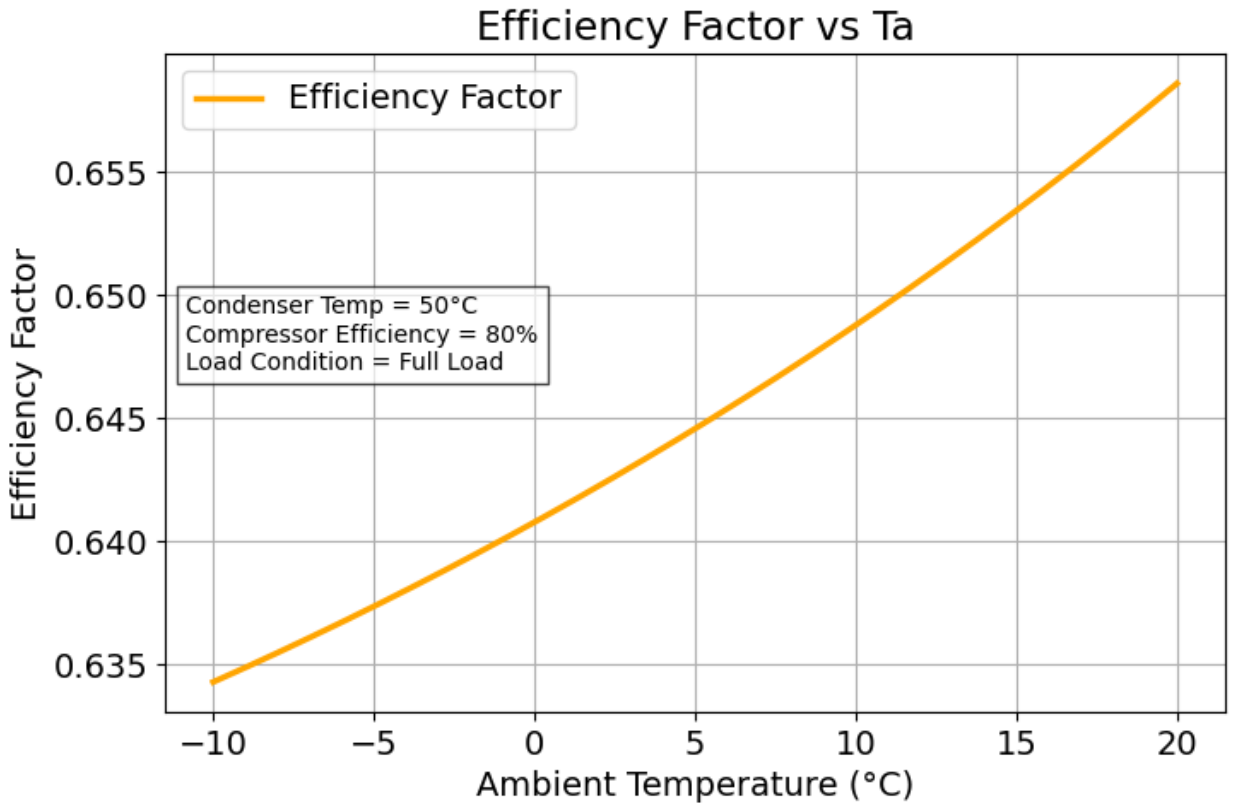


Carnot efficiency and efficiency factor:

System Input Parameters:

- Ambient Temperature Range= -10°C to 20°C
- Condenser Fluid Temperature= 50°C
- Compressor Efficiency =80%
- Efficiency Factor @ 11.11°C=0.648

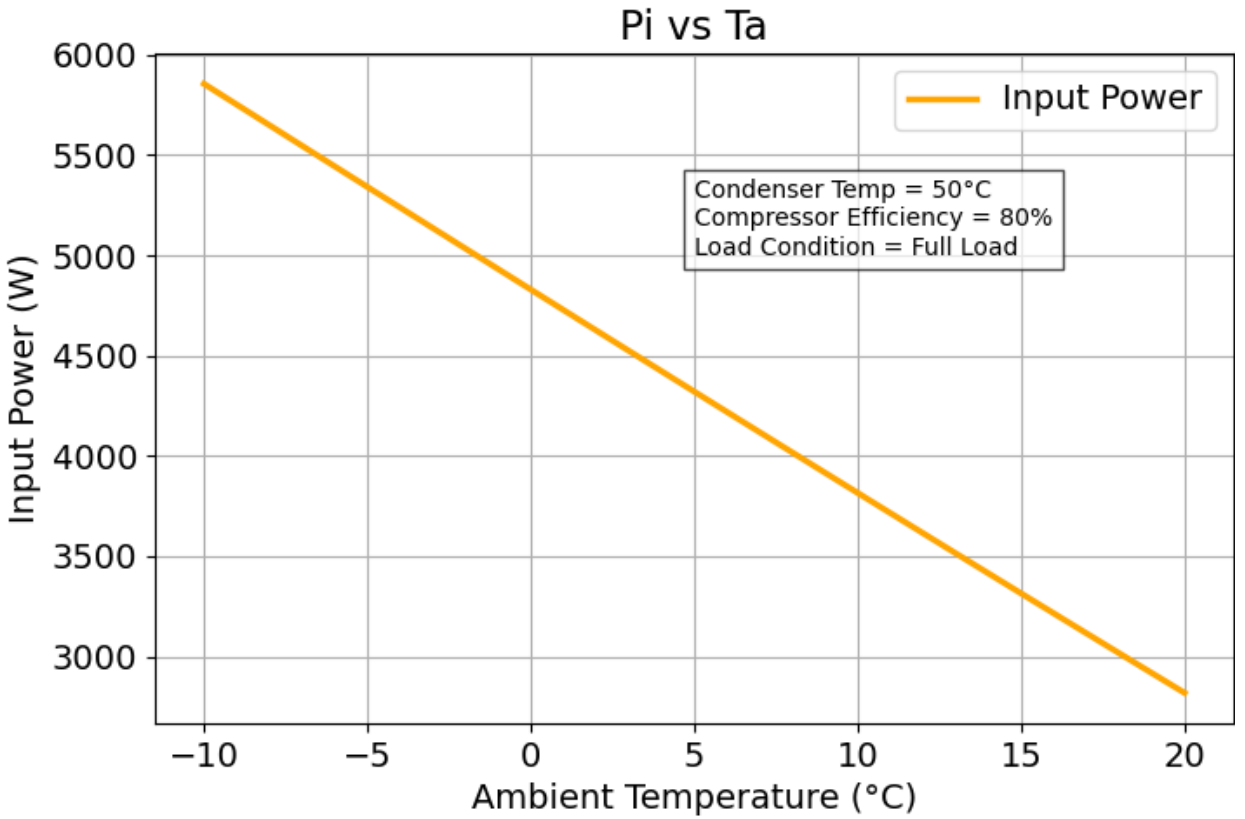


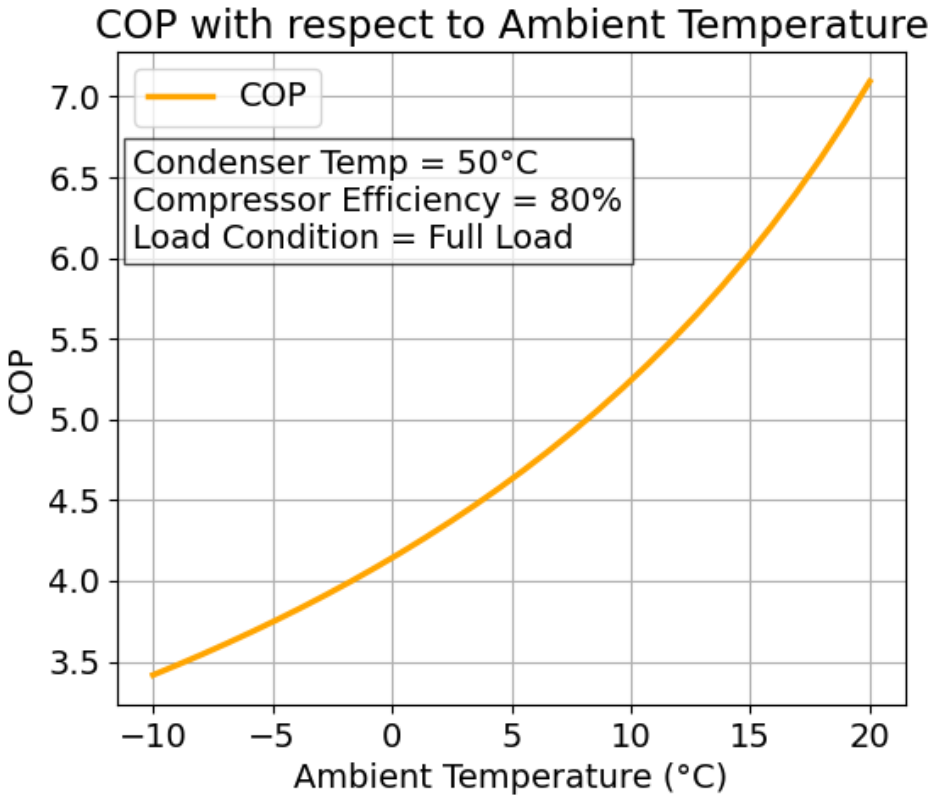


COP and Input Power:

System Output Parameters:

- Average ambient temperature =11.11°C
- COP @ 11.11°C= 5.35
- Input power @11.11°C=3700 W





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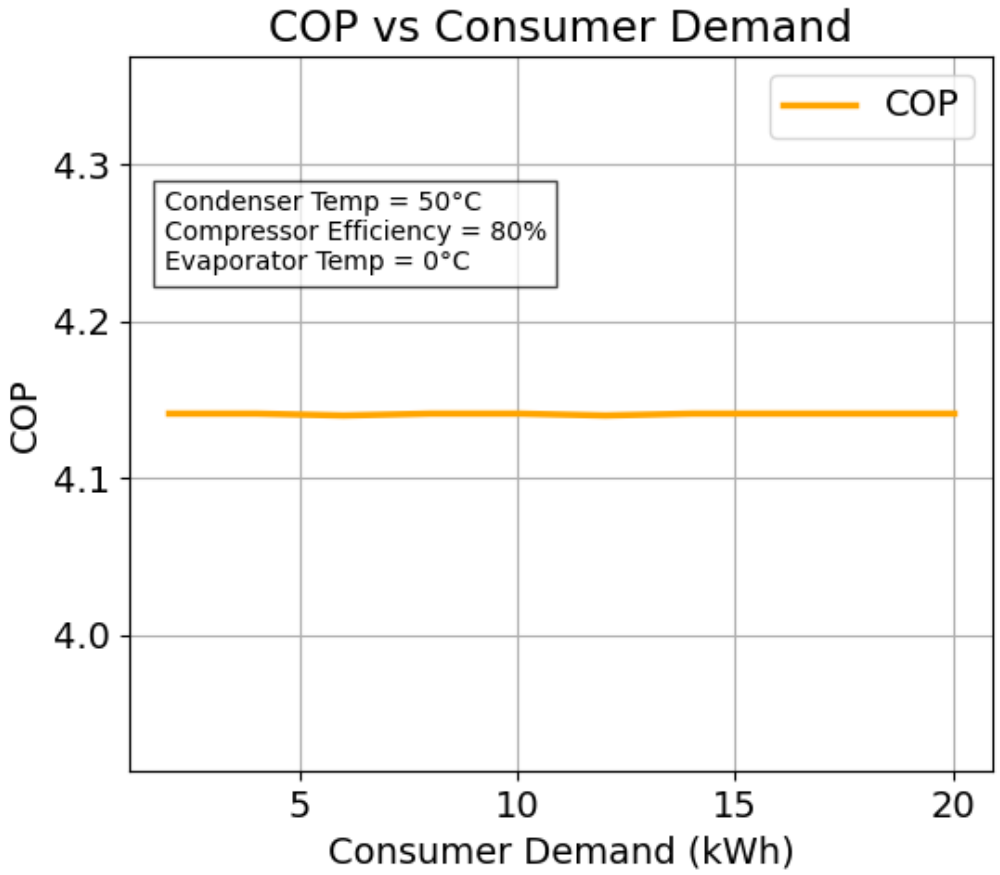
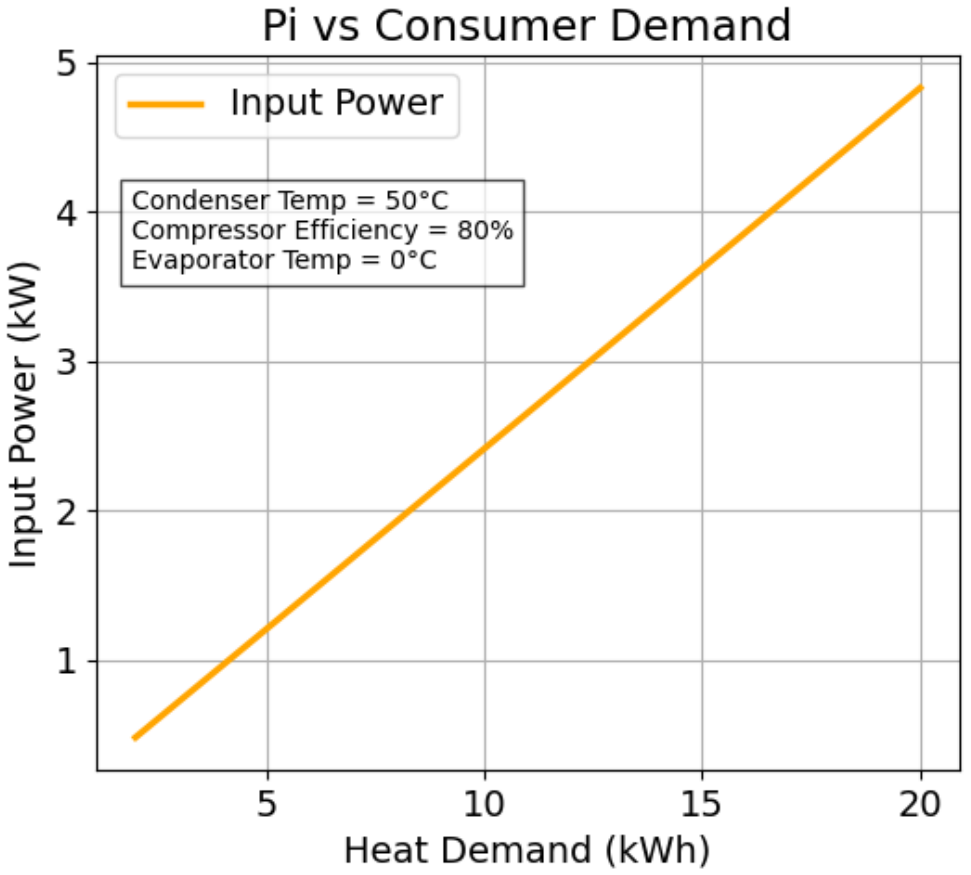
COP and Input Power vs Consumer Demand





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Conclusions:

- The system can meet 100% of the space heating demand consistently throughout the year.
- Suitable for reducing reliance on traditional heating methods like gas boilers or solar collectors.
- The constant energy demand for space heating makes the system well-suited for year-round use.
- Higher ambient temperatures result in a reduced power input demand for the system compressor, indicating increased efficiency.
- The system is particularly efficient when maintaining smaller lift temperatures.
- COP Factors: Efficiency depends on outdoor air temperature and heating flow temperature.
- Outdoor Temperature Impact: Higher outdoor temperatures result in a higher COP, indicating better heat transfer with less electrical energy input.
- Compressor Efficiency: Improved efficiency with higher ambient temperatures, reducing the electrical input power needed for the same heating or cooling effect.
- Continuous evaluation of the system's efficiency and exploration of renewable energy integration are advisable for long-term sustainability.

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[2] Amazon. (2022). Amazon plans to open a delivery station at Bluegate in Antwerp by the end of 2022. Amazon. URL: https://www.aboutamazon.eu/news/press-lounge/amazon-plans-to-open-a-delivery-station-at-bluegate-in-antwerp-by-the-end-of-2022

[3] Oregi, X., Hermoso, N., Prieto, I., Izkara, J. L., Mabe, L., & Sismanidis, P. (2018). Automatised and georeferenced energy assessment of an Antwerp district based on cadastral data. In Energy and Buildings (Vol. 173, pp. 176–194). Elsevier BV. https://doi.org/10.1016/j.enbuild.2018.05.018

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[5] Warmflow. (2022). Manual for [AS03-R32]. Retrieved from [https://warmflow.fra1.cdn.digitaloceanspaces.com/uploads/Warmflow-ZENO-R32.pdf]