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CARDIFF UNIVERSITY
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Transmission of heat over long-distance

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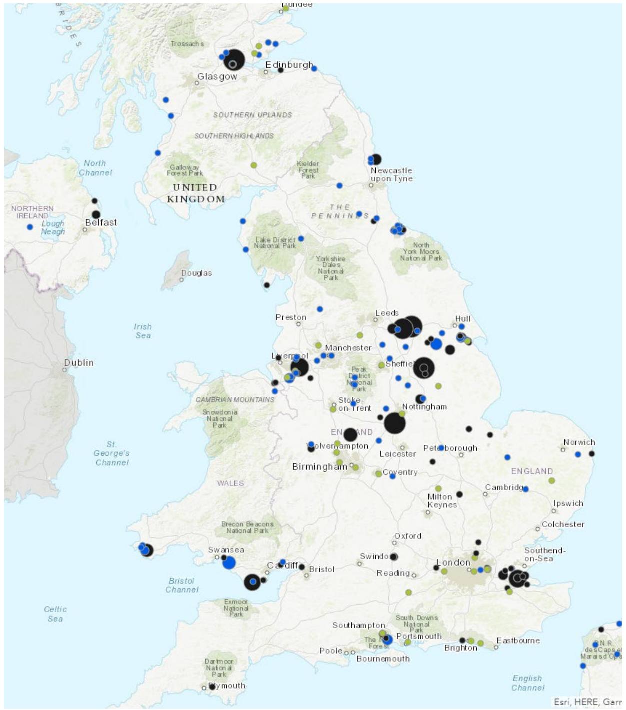
4DH
4th Generation District Heating Technologies and Systems

Context

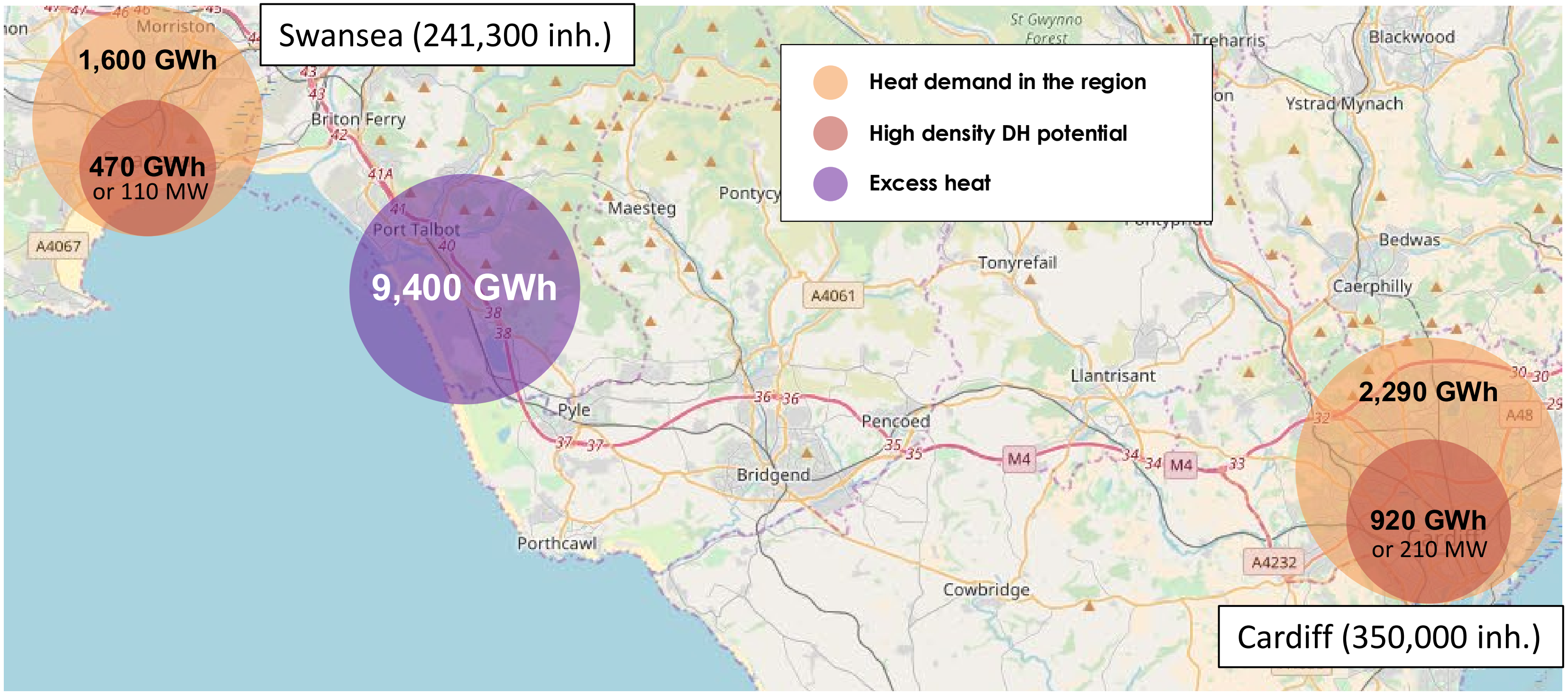
- Decarbonisation of heat
- Many councils are looking at district heating
- Waste heat recovery is getting a lot of attention in the UK

➔ How to tap into these resources?



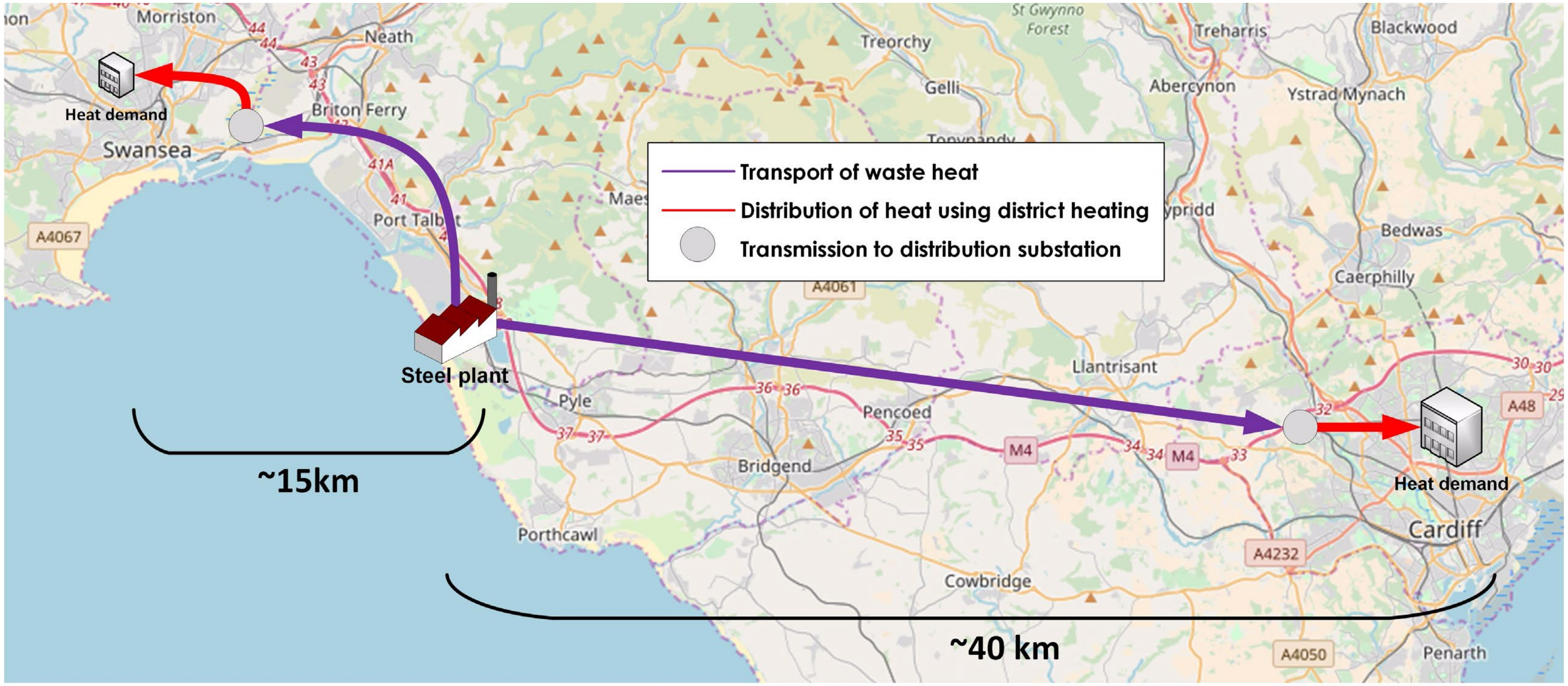
Map of excess heat activities (source: heatroadmap.eu/peta4)

Potential for waste heat recovery: The case study of South Wales



Note: assuming a demand over 180 days to represent heating season for the average load demand (MW).

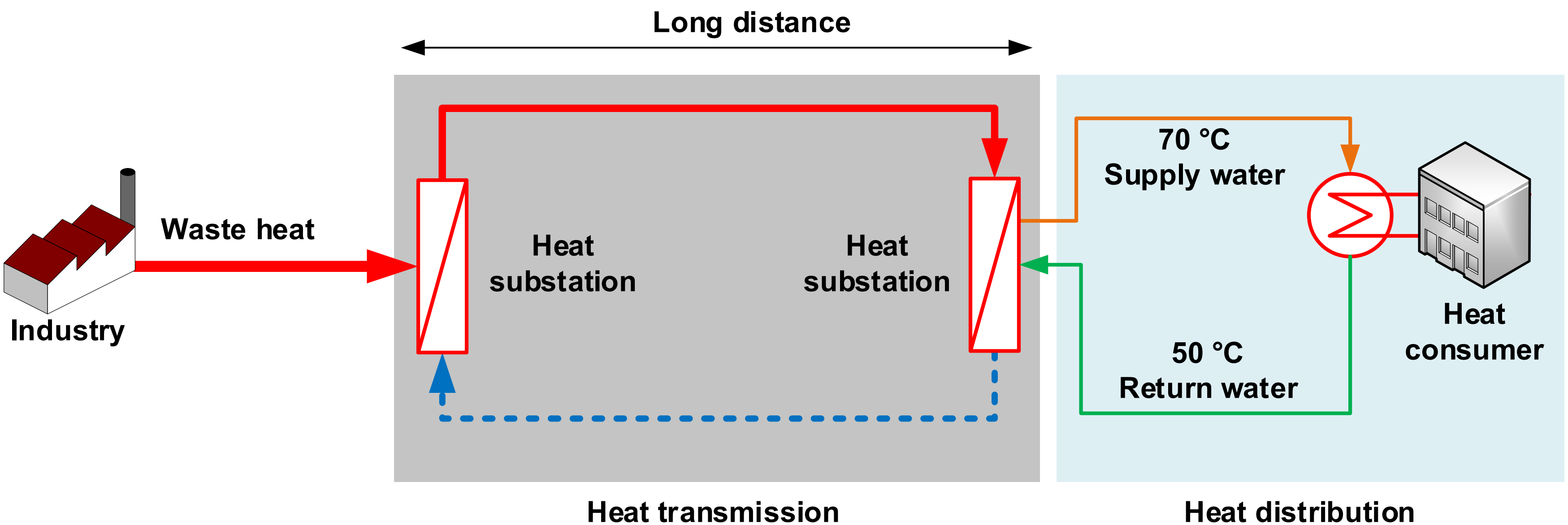
Potential for waste heat recovery : The case study of South Wales



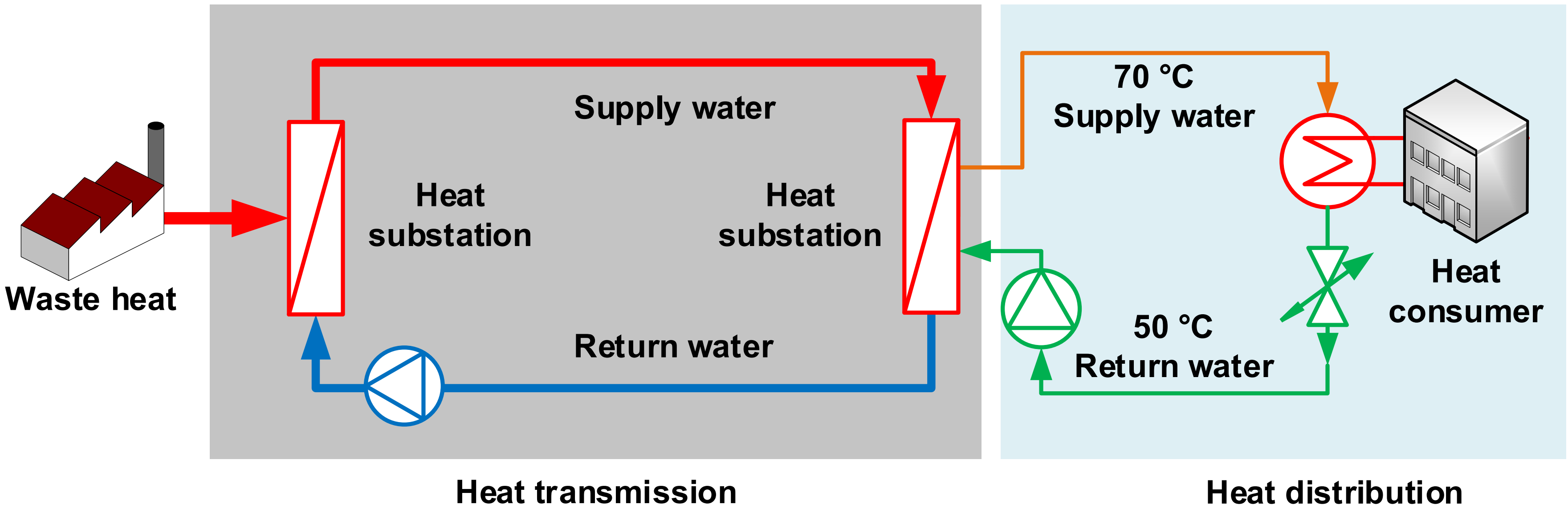
Potential solutions

1. Pipeline using water
2. Pipeline using a refrigerant (e.g. CO_2)

Objective: To compare solutions to transport waste heat from an industrial plant to a remote demand area.



1- Water based scenarios

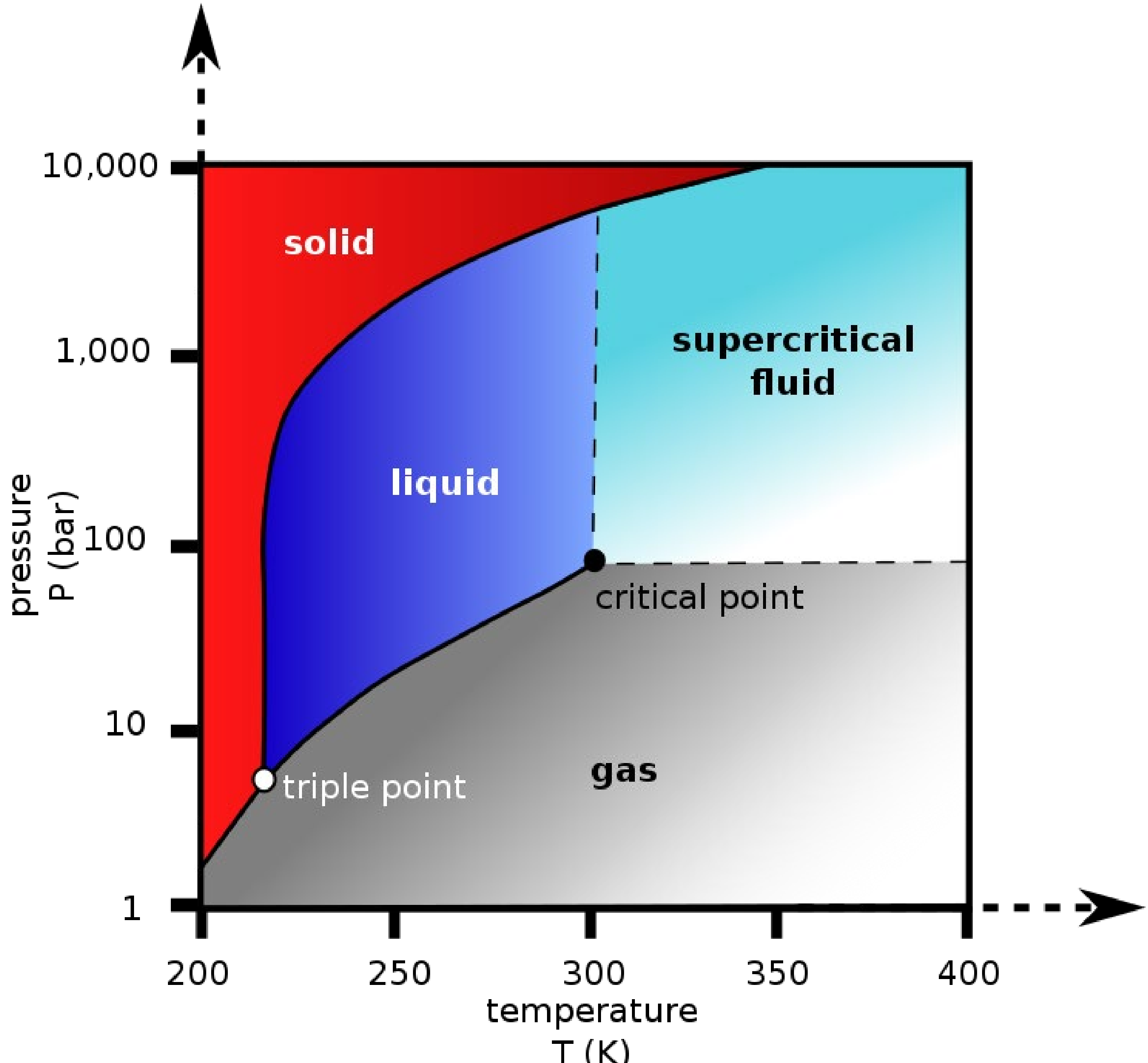


Scenario	Supply water	Return water
1.1	Liquid 120°C	Liquid 60°C
1.2	Liquid 120°C	Liquid 20°C

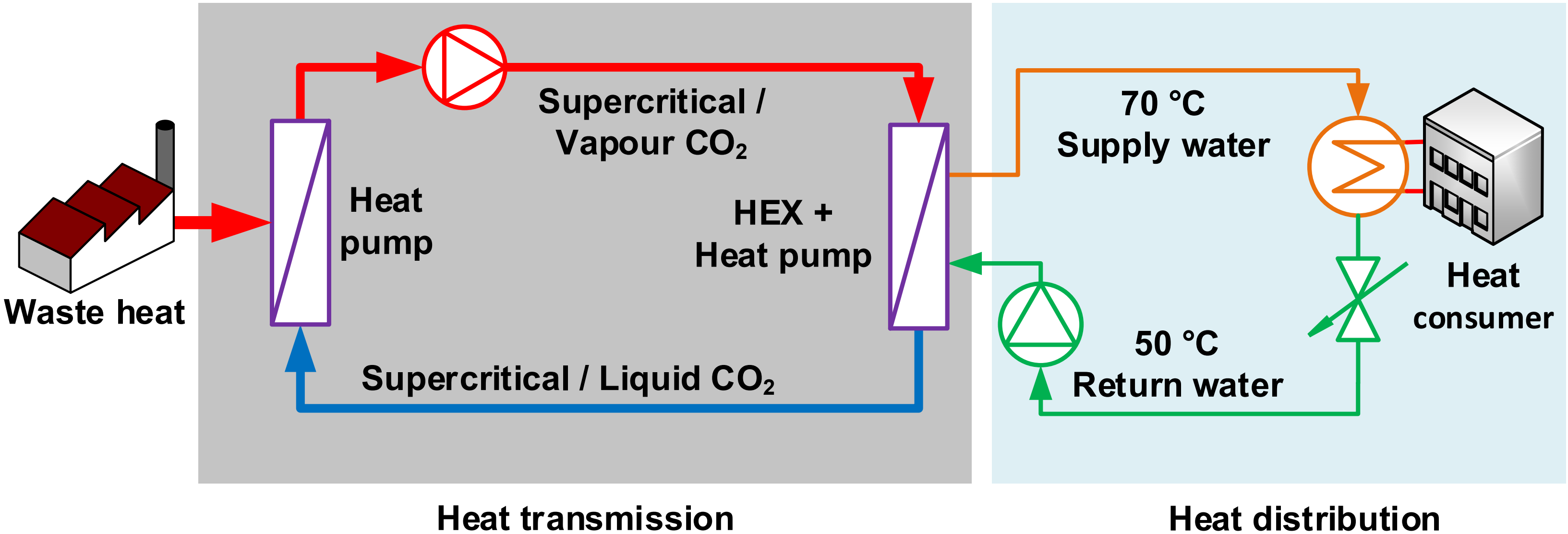
Supercritical fluid

Characteristics:

- Viscosity of a gas
- Density of a liquid

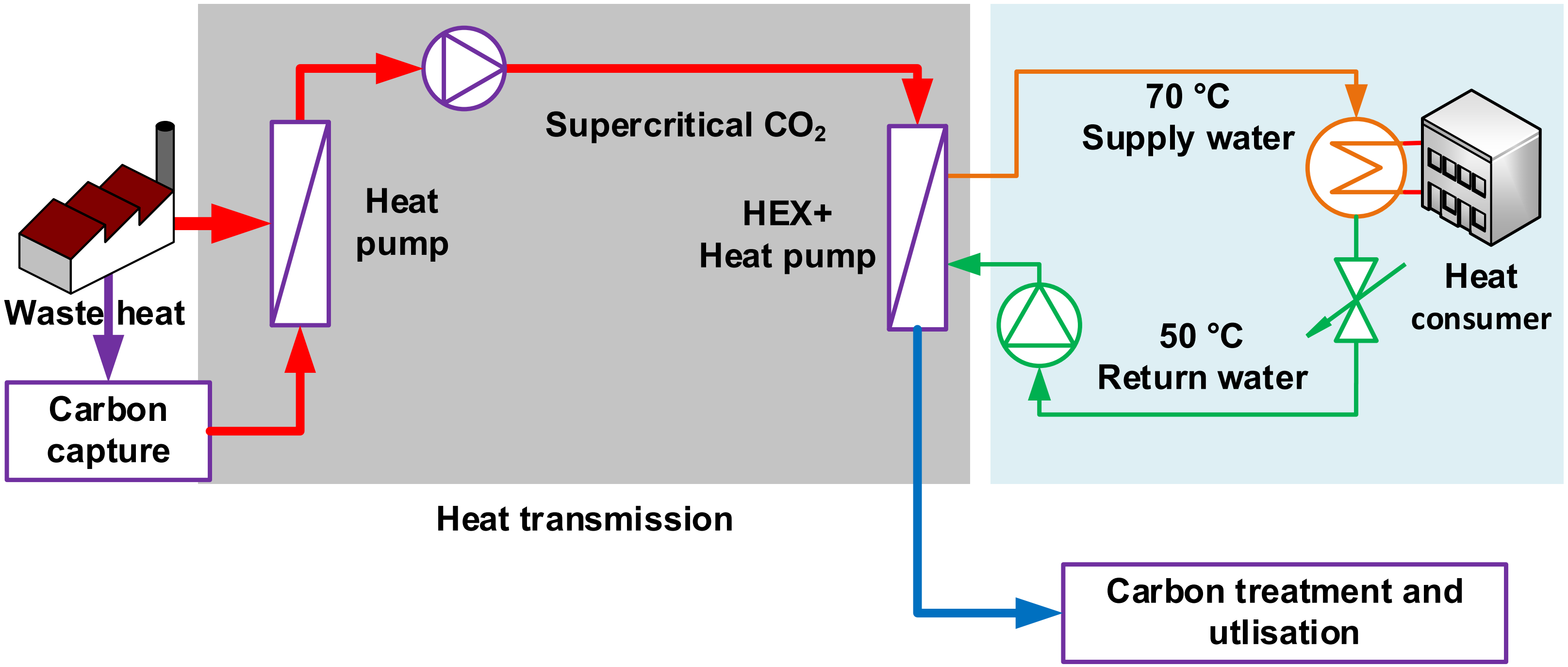


2- CO2 based scenarios – closed loop



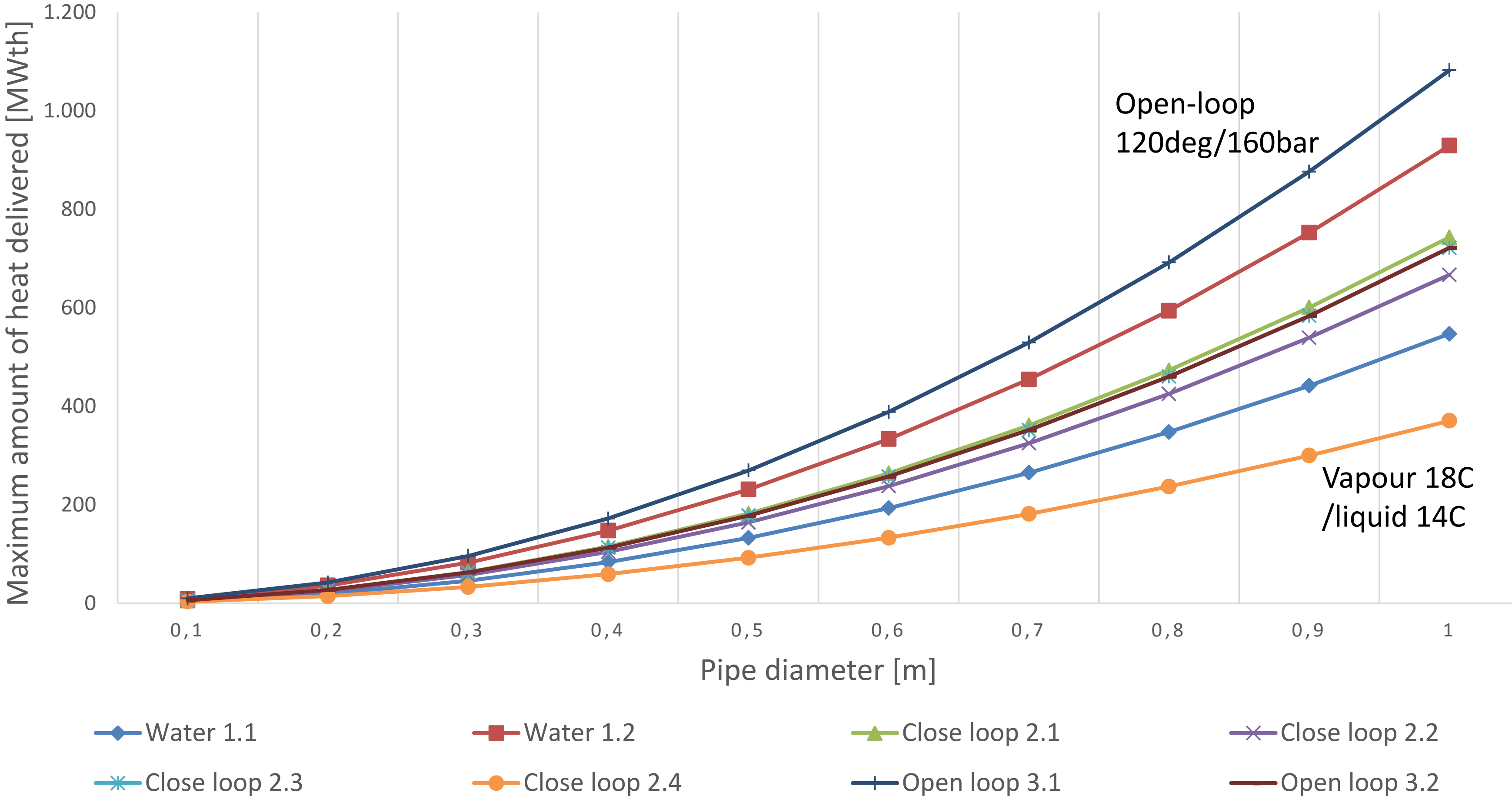
Scenario	Supply	Return
2.1	Supercritical 120°C	Supercritical 34°C
2.2	Supercritical 80°C	Supercritical 34°C
2.3	Supercritical 80°C	Liquid 0°C
2.4	Vapour 18°C	Liquid 14°C

3- CO2 based scenarios – open loop

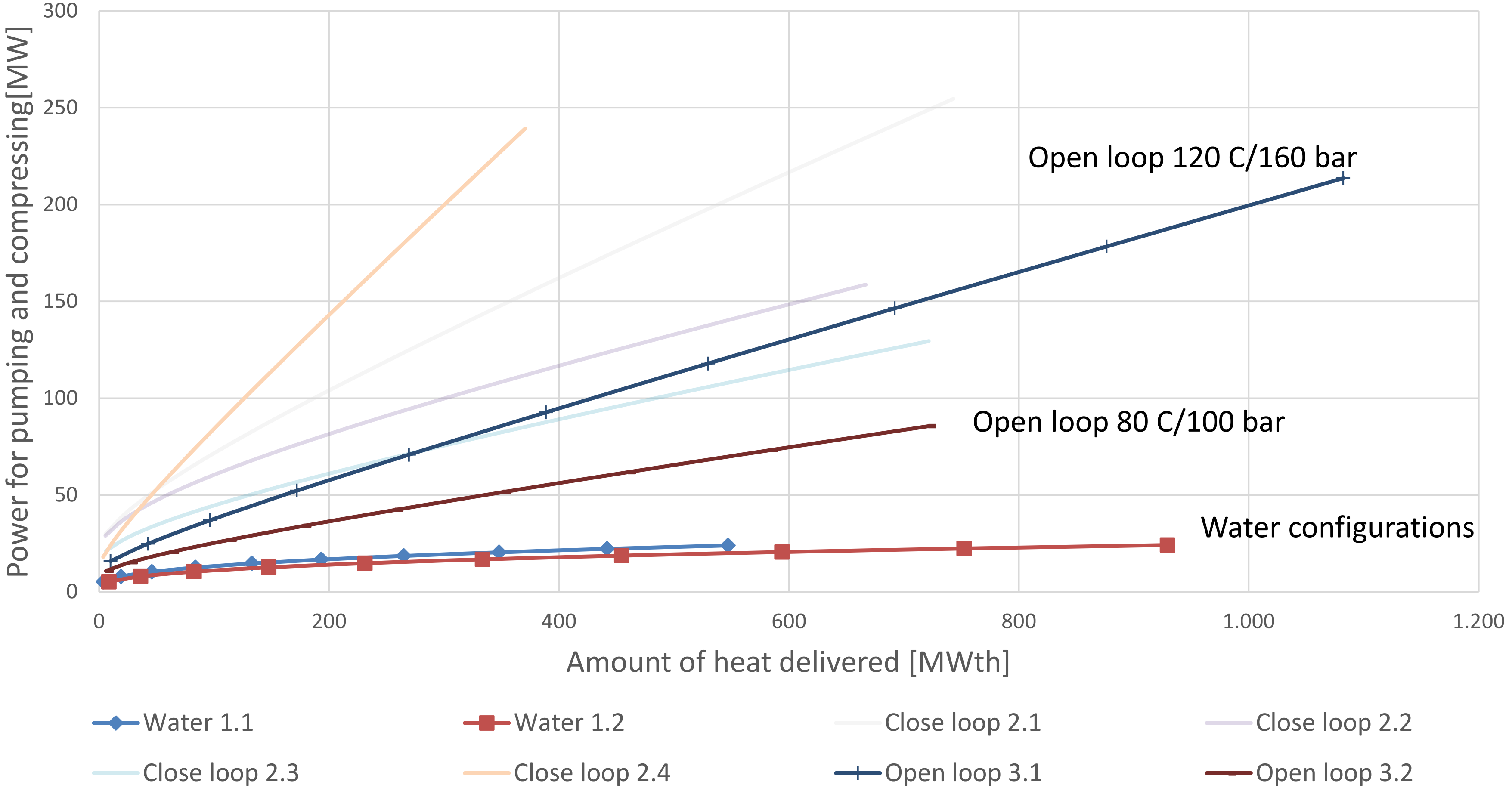


Scenario	Supply CO2	Output
3.1	Supercritical 120°C	Liquid 0°C/No return
3.2	Supercritical 80°C	Liquid 0°C/No return

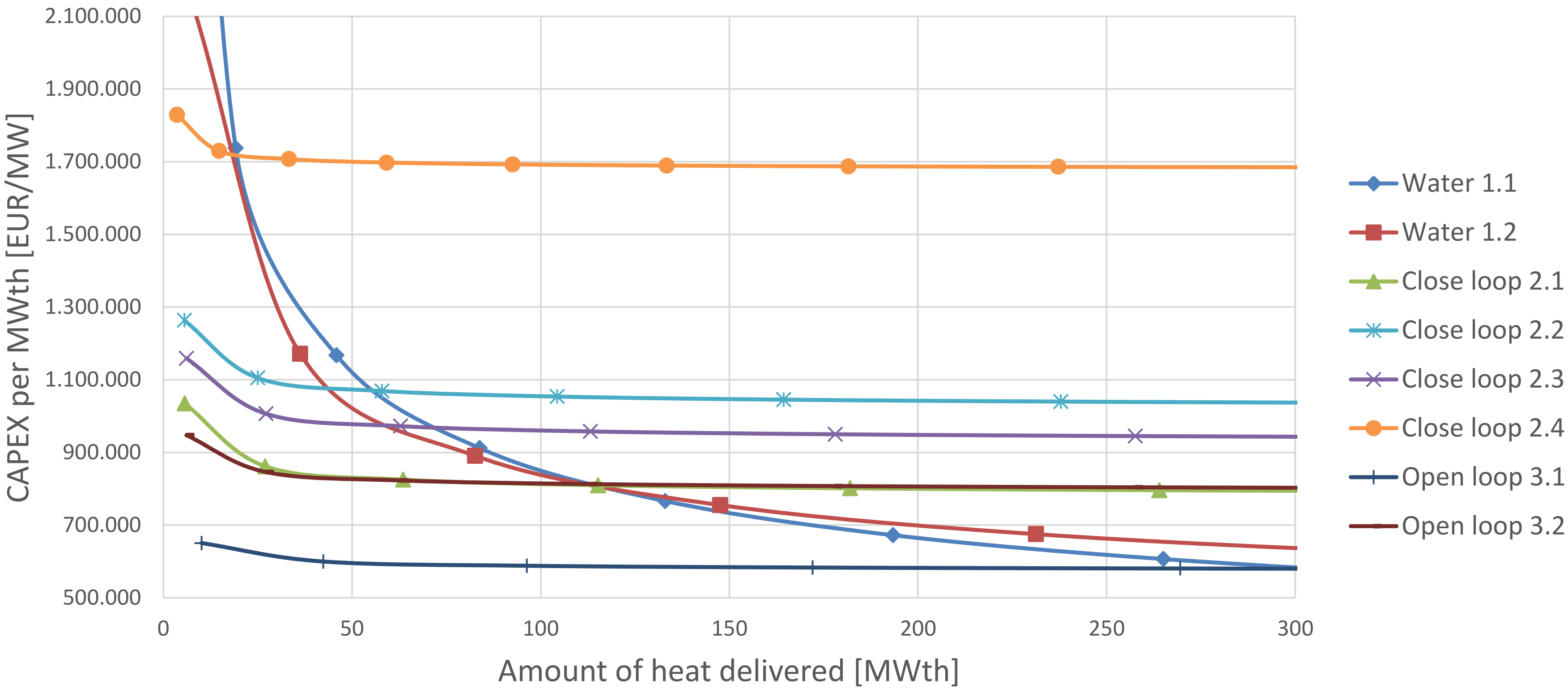
Maximum amount of heat delivered and pipe diameter



Power consumption and heat delivered – 40km



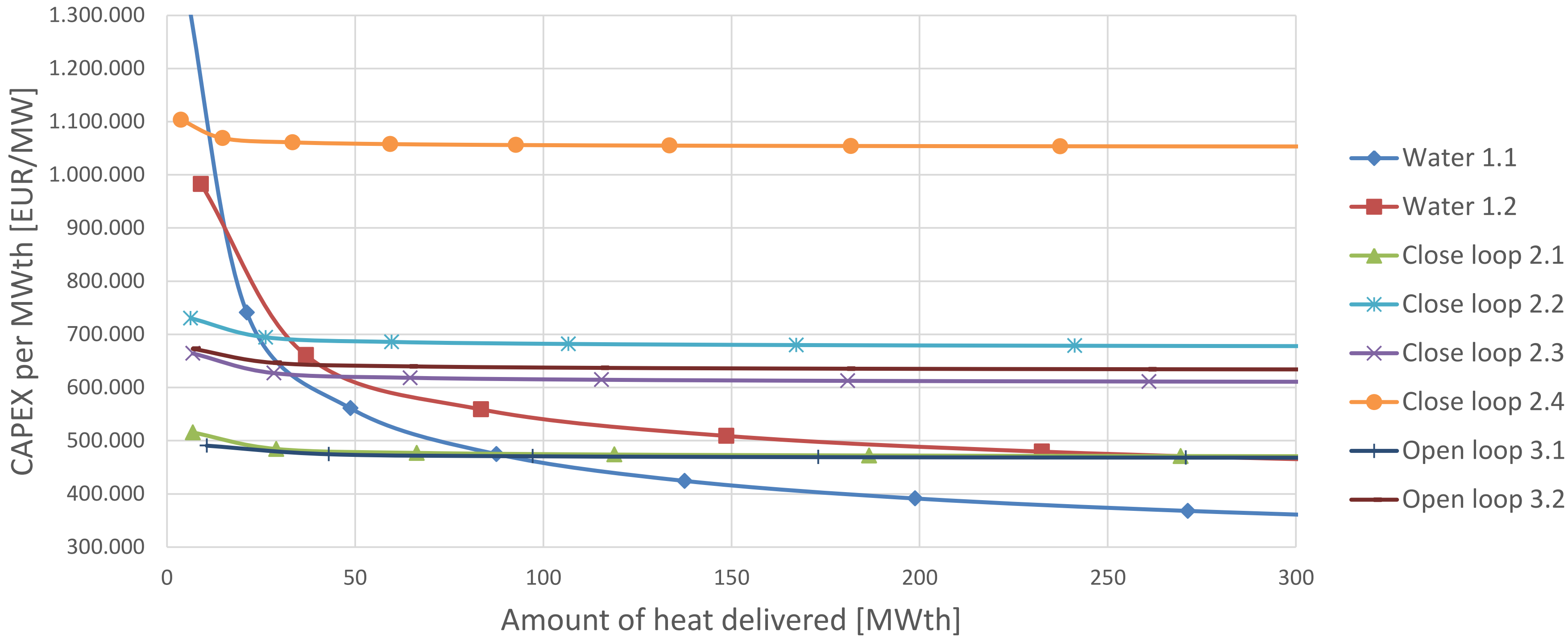
CAPEX and heat delivered 40 km



- CO_2 configurations have stable capital cost per unit
- Water configurations benefit from some economy of scale

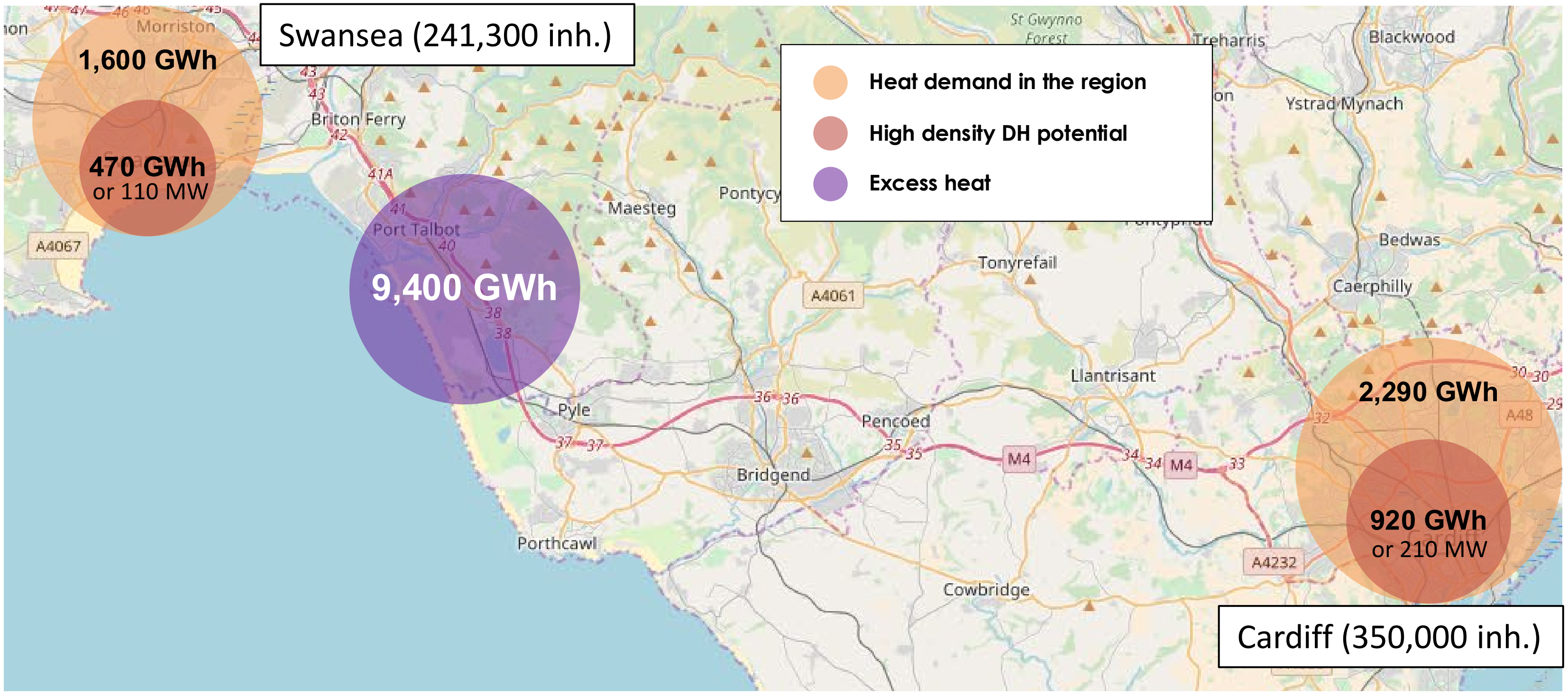
Note: CAPEX includes the cost of pipe+insulation+installation, the cost of substations and the cost of pumping substations

CAPEX and heat delivered 15km



- The distance impacts the viability of open loop configurations
- Threshold between basic water configuration and CO2 open/close loop is around 90MW

The case study of South Wales



Note: assuming a demand over 180 days to represent heating season for the average load demand (MW).

Conclusion

- The open loop configuration followed by the two water configurations for the 40km/210MW case.
- The 120/60°C water configuration for the 15km/110MW case.
- Operating costs will impact the final results as well as the choice of pressure/temperature for CO2.
- The open loop require to implement carbon capture technology at the industry side and some carbon utilisation industry at demand side.

Thank you

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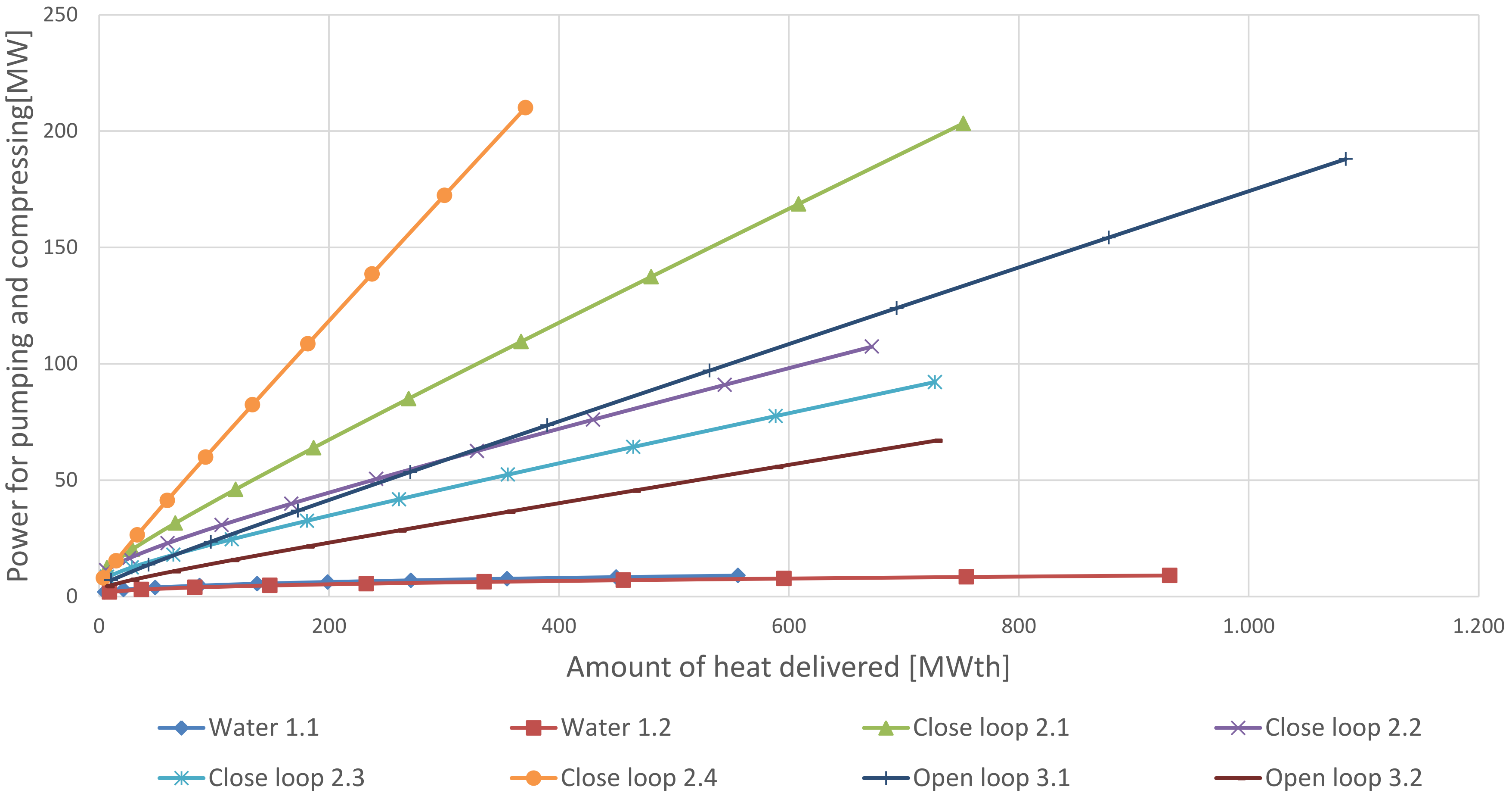
Appendix

Power consumption and heat delivered – 15km



CAPEX and amount of heat delivered – 15km