LoT-NET

Low Temperature Heat Recovery &
Distribution Network Technologies

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REFRIGERATION AIR CONDITIONING HEAT PUMPS

sirach

Recoverable Heat Potential

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DECARBONISING HEAT

District heating can unlock the potential for heat recovery in cities

Decarbonising heat will be crucial on our path towards **net zero** in 2050

Heating represents **1/2** of energy consumption

Accounting for **1/3** of carbon emissions in the UK

Electrification Opportunity

Average **grid carbon intensity** fell by **66%** from **2013** to **2020** (nationalgridESO, 2021)

- Heat pumps and district heating: economies of scale
- Green Heat Network Fund and zoning policy

From **2%** to **20%** of demand

Is the potential growth for heat networks by **2050** according to the UK Government, reaching up to **95 TWh** annually (DESNZ, 2021)

- Recoverable heat: higher efficiencies and local
- Reduced demand and higher energy security

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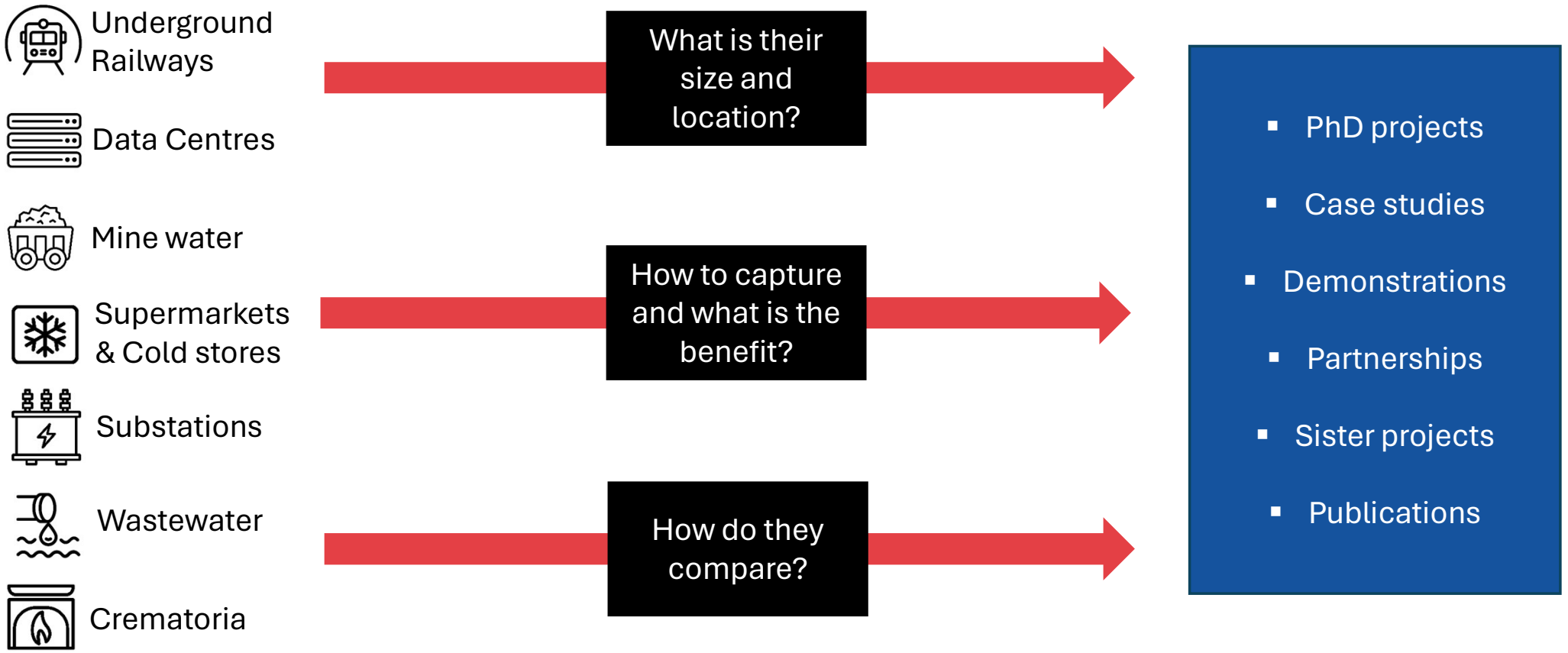
THE LOT-NET STRATEGY

Addressing the big questions to identify the recoverable heat potential



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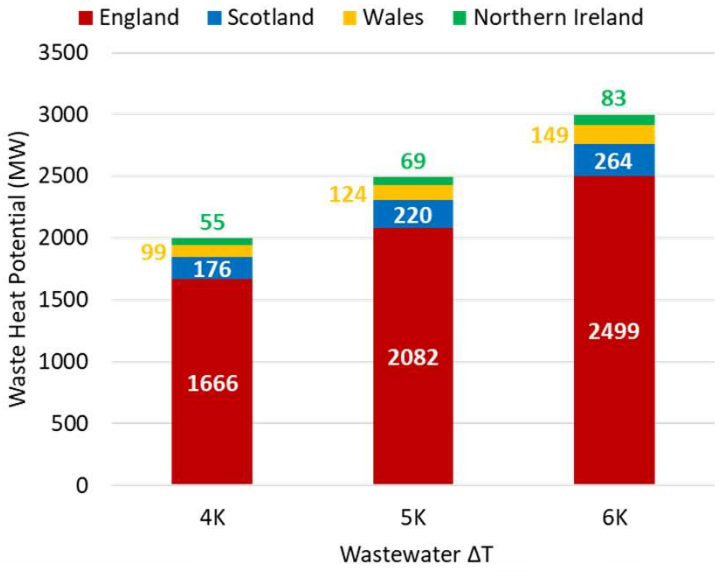
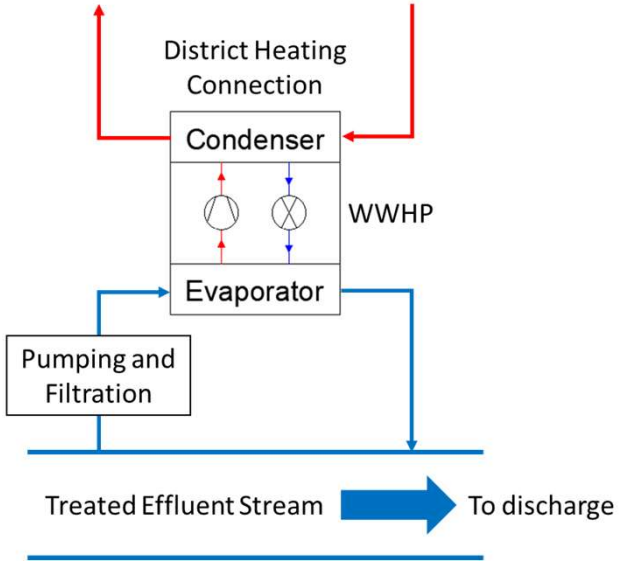
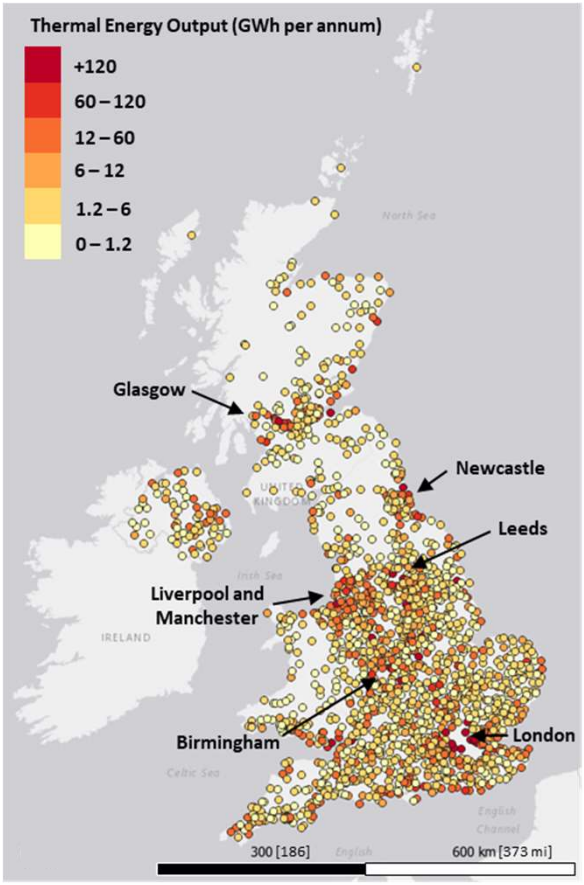
WASTEWATER TREATMENT PLANTS

A large and stable heat source, suitable for meeting base-loads

- 1,876 WWTPs in the UK serving agglomerations > 2,000 PE
- Typical effluent temperatures from 13 to 22°C (average 15°C during winter)
- 22.5 TWh per annum of potential for effluent ΔT of 5 K (64% in urban areas)







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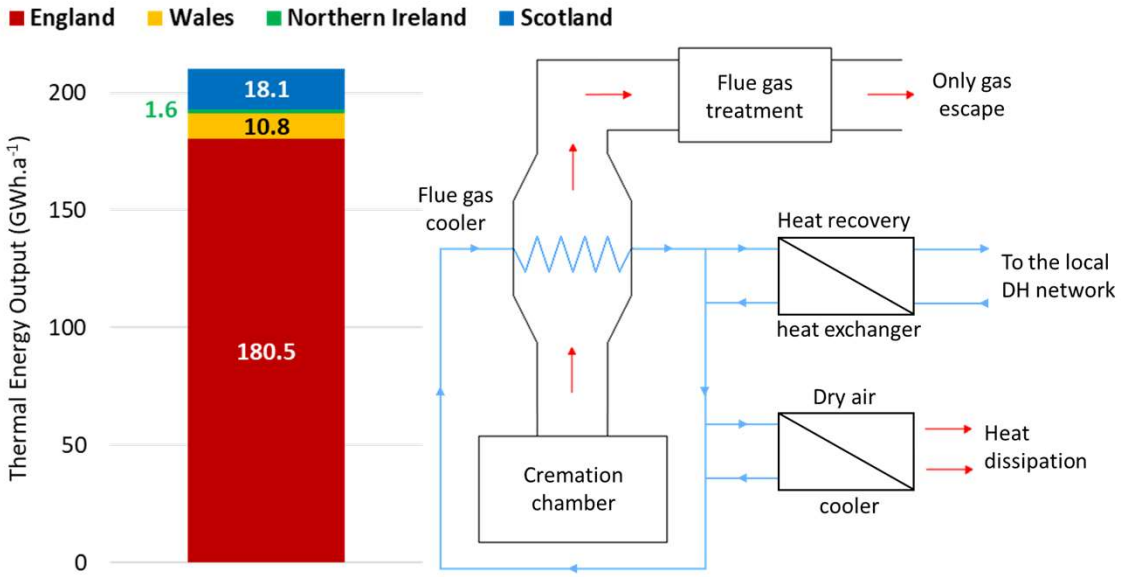
CREMATORIA

Small potential, but higher temperatures suggest a lower cost for heat



From **35%** to **78%**

is the percentage growth of cremation as the chosen post-funeral rite since 1960

From **200** to **400 kW**

is the range of waste heat released during a typical 80-minute cremation process

- All UK crematoria had to eliminate mercury emissions by 2020, and flue gas treatment process involves cooling
- Flue gas temperatures reduced from over 800°C to around 150°C, leading to water temperatures from 80 to 90°C
- Warwick case study showed local crematorium could only meet 1.5% of demand, but reduce peak gas use by 33%

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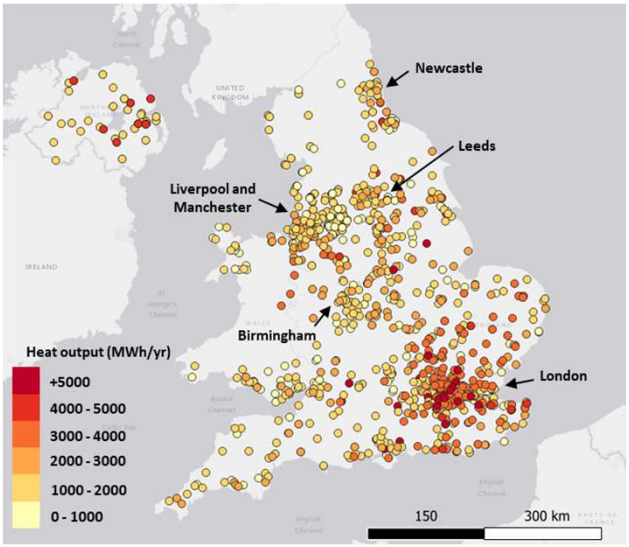
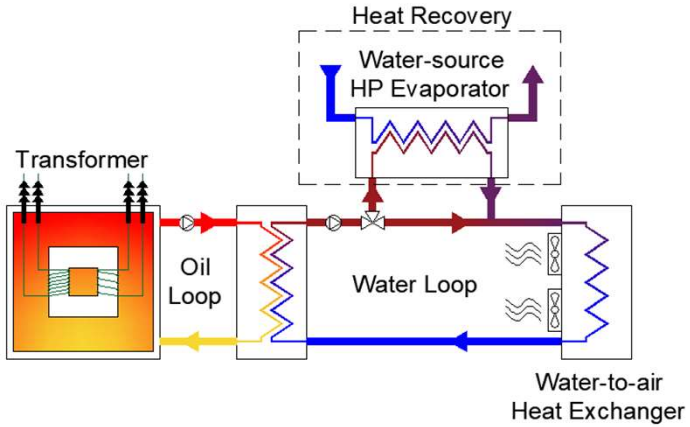
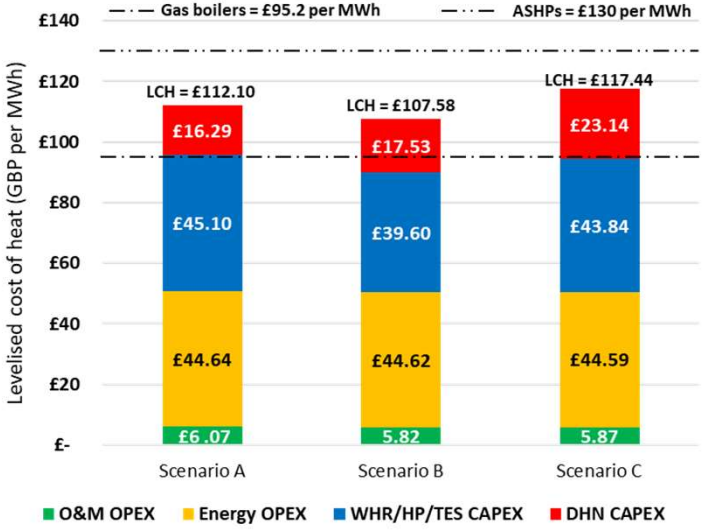
ELECTRICAL TRANSFORMERS

Higher temperatures, but significant variations in output

- 1,391 sites >60 MVA, temperature ranging from 20 to 70°C (load dependent)
- Concept for heat recovery from a water-cooled substation transformer
- Levelised costs dependent on peak coincidence and linear heat densities
- Heat recovery system could achieve a SCOP of 3.40 and 80% carbon savings





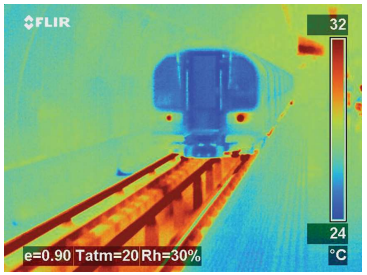


Country	Number of sites >60MVA	Recoverable heat (TWh)
England	1,181	3.52
Wales	78	0.18
Northern Ireland	77	0.30
Scotland*	55	0.32
Total	**1,391**	**4.32 (58% urban)**

*Obtained from an investigation by Sinclair & Unkaya (2020)

UNDERGROUND RAILWAYS

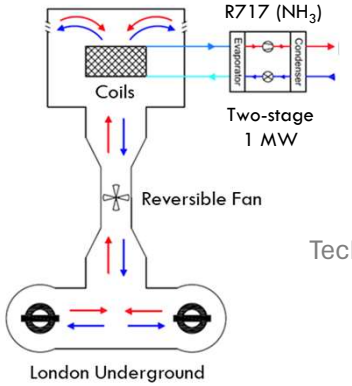
Opportunity to integrate heating and cooling via district-scale heat pumps



40°C

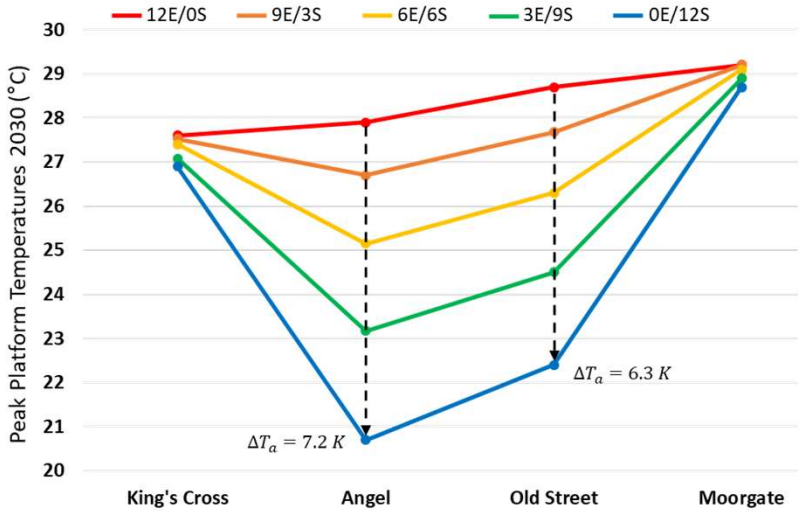
highest temperature ever recorded in the UK

Overheating: growth in cooling demand and heat recovery potential



Extract vs Supply

- Energy modelling
- Technology comparison
- Cooling potential

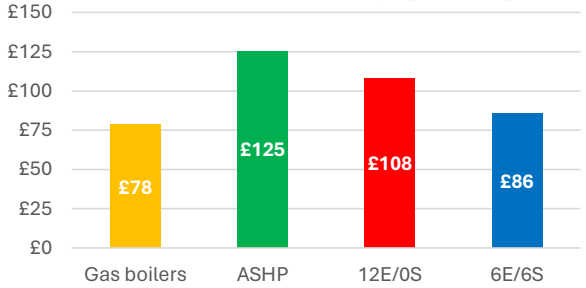


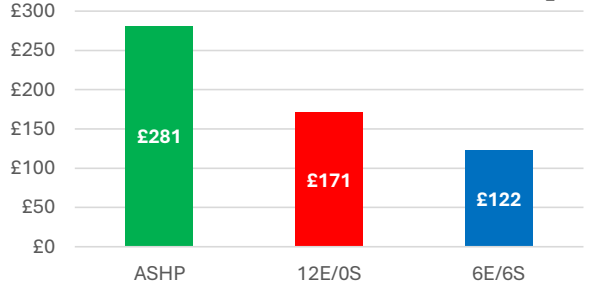
3 K

ΔT for Angel Station in a 6E/6S condition

5.4

bivalent SCOP
May - October
(3.4 for heating only)





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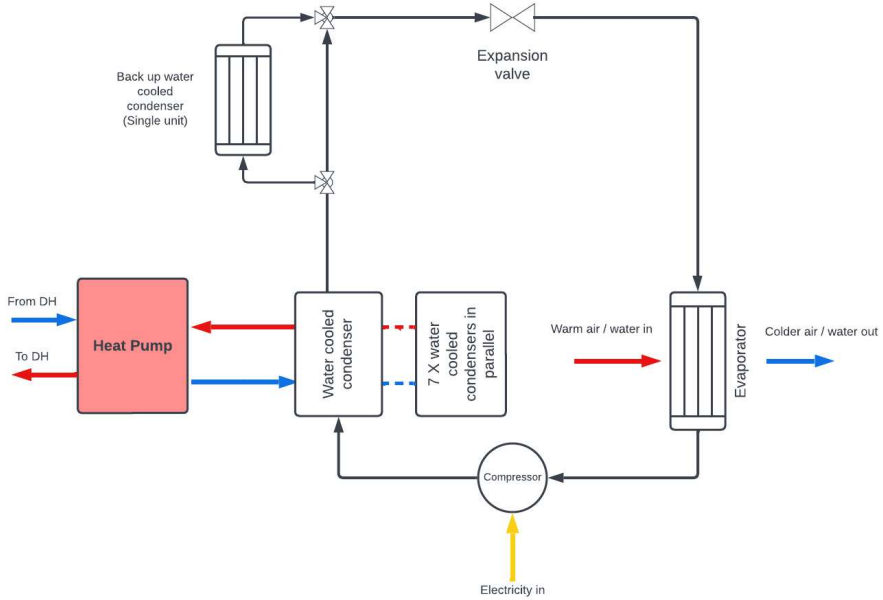
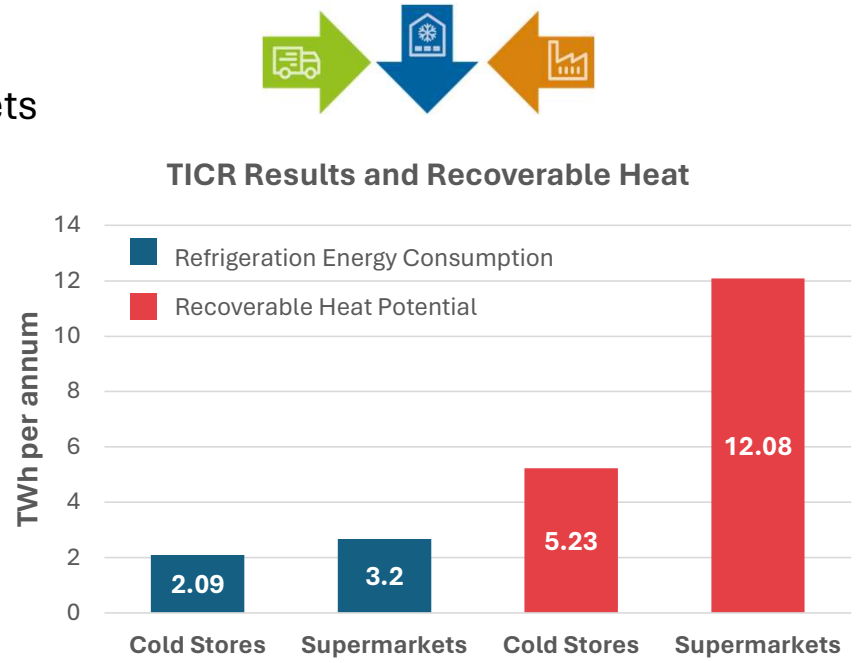
COLD STORES AND SUPERMARKETS

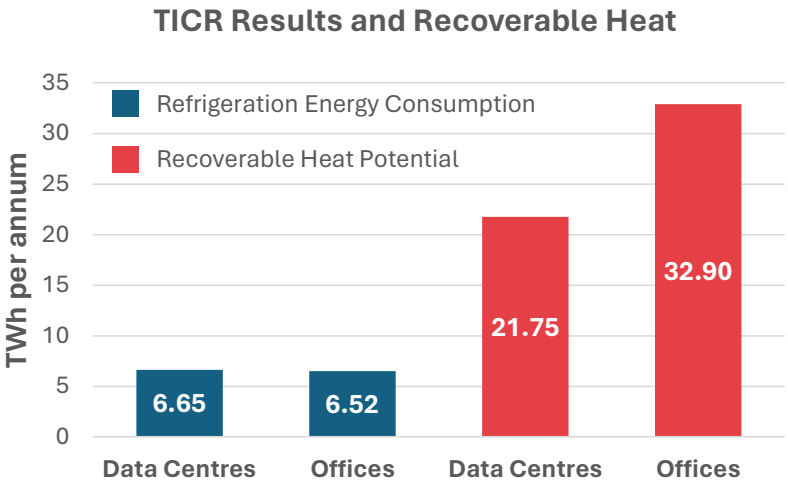
- Data gathered for 7,400 supermarkets and 607 cold stores
- Analysis suggest greater number of sites in the UK
- Energy figures can be used to assess waste heat potential
- Assuming SCOPs of 1.5 for cold stores and 3.52 for supermarkets





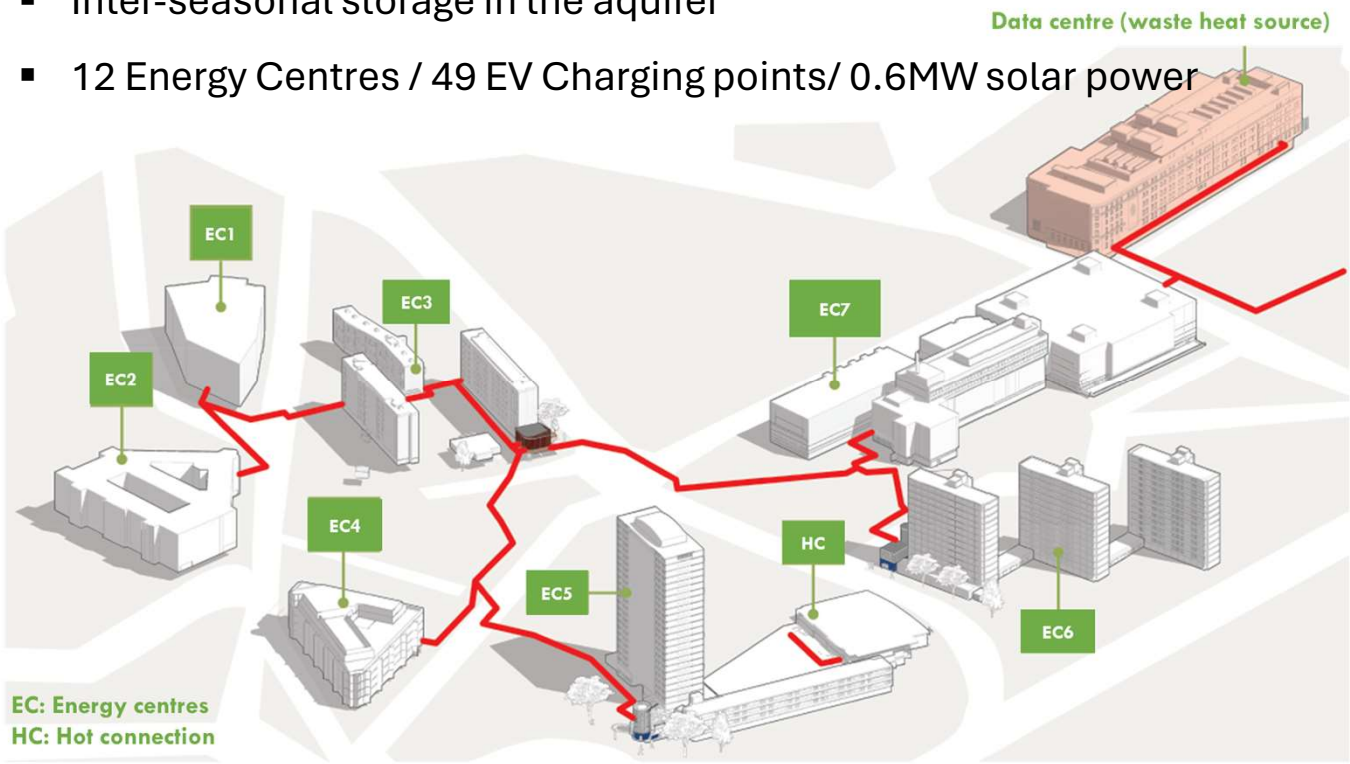
DATA CENTRES

- Data gathered for 521 data centres and 1584 office buildings
- Main datasets are the VOA rating lists and CCAs
- Energy figures can be used to assess waste heat potential



Ambient Loop Network : Heat, power, e-mobility integration

- Prosuming (sharing heat); 3 Social Housing Estates / University/etc.
- Inter-seasonal storage in the aquifer
- 12 Energy Centres / 49 EV Charging points/ 0.6MW solar power



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MINE WATER

CIBSE JOURNAL

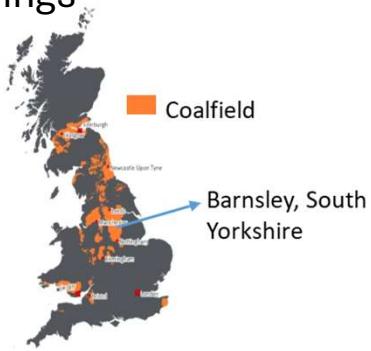
Minewater study wins symposium prize

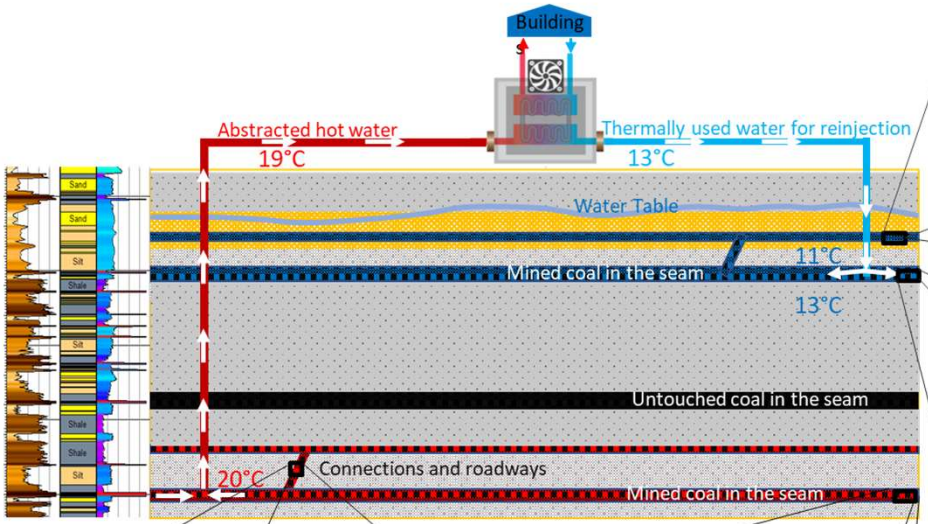
The presentation of a case study on the integration of minewater into smart cooling and heating network systems has been voted the 'Most significant contribution to the art and science of building services engineering' at the annual CIBSE ASHRAE Technical Symposium.

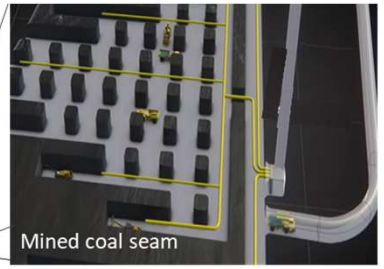
- 23,000 abandoned coal mines in the UK beneath 25% of UK buildings

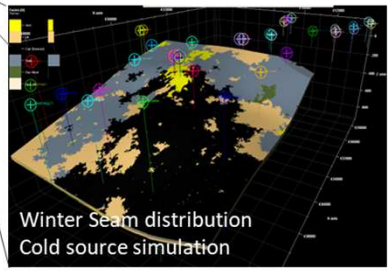
Integration of waste heat and mine water:

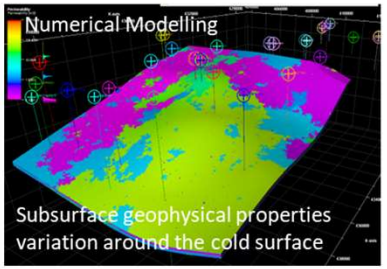
- Saving 7MW of waste heat.
- Heating nearly 2000 buildings.
- Inter-seasonal heat storage.
- Economically efficient.











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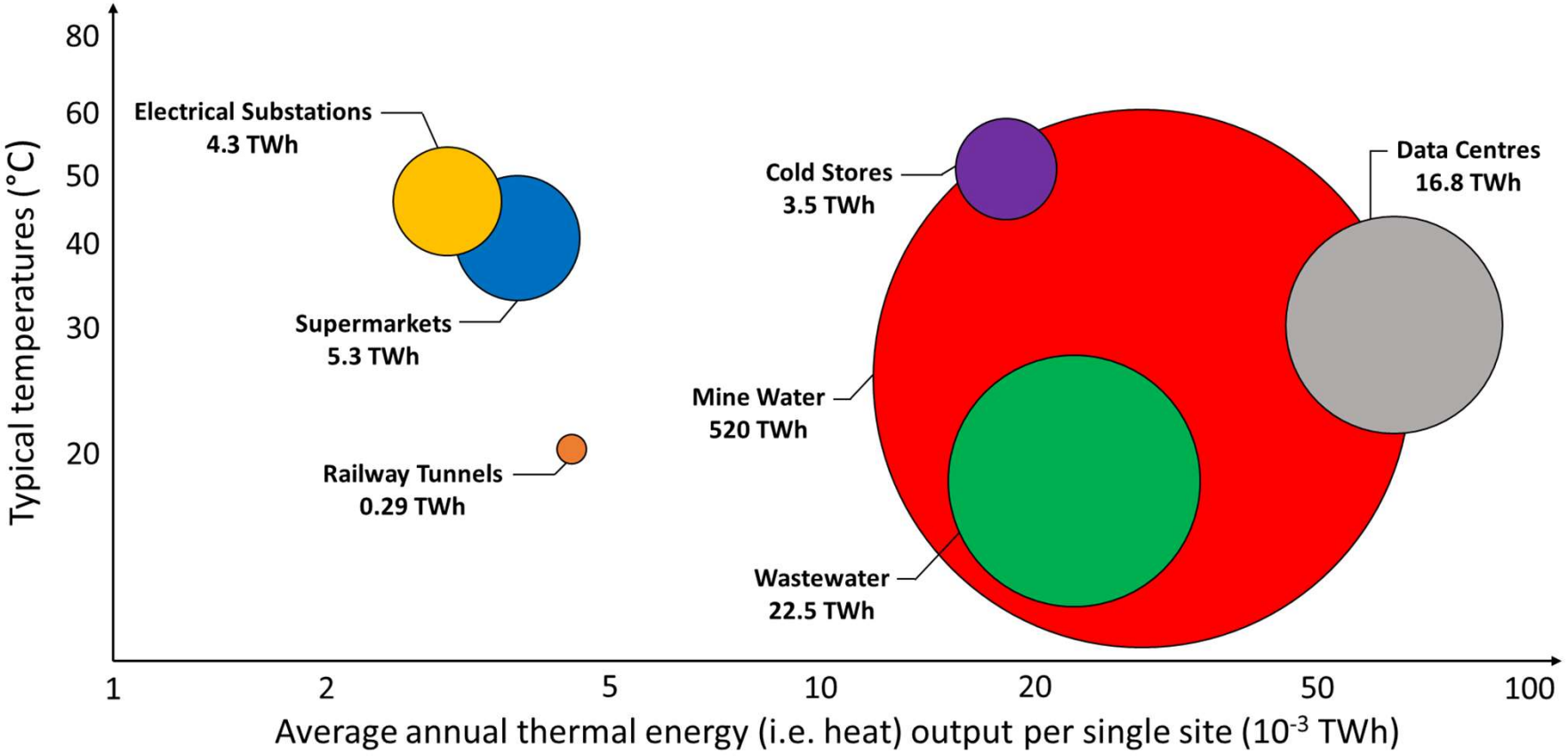
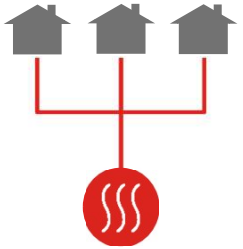
LOW-GRADE RECOVERABLE HEAT

Overall, significant opportunities for efficient capture and reuse across the UK



53 TWh

released annually from low-grade heat sources

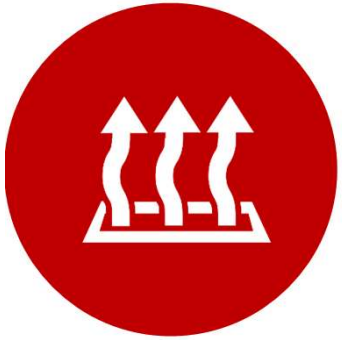


65%

of the projected increase in annual heat demand for district heating in 2050

CONCLUSIONS AND FURTHER STUDIES

Recoverable heat is a valuable resource for the energy system, but there are still challenges



RECOVERABLE HEAT

Widespread resource in the UK
Diverse merits and applications
Can support DH development
Lower decarbonisation costs

BENEFITS

Additional value streams
Integrating heating & cooling
Wider impacts (grid, pollution)
Unlocking the full potential

CHALLENGES

Electrification: higher costs
Highest spark gap in Europe
Align levies/taxes and reforms
Policies such as zoning are key

FURTHER STUDIES

Analysis of levelised costs
Behaviour and practicalities
Business/commercial models
Industrial collaboration

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Questions?

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