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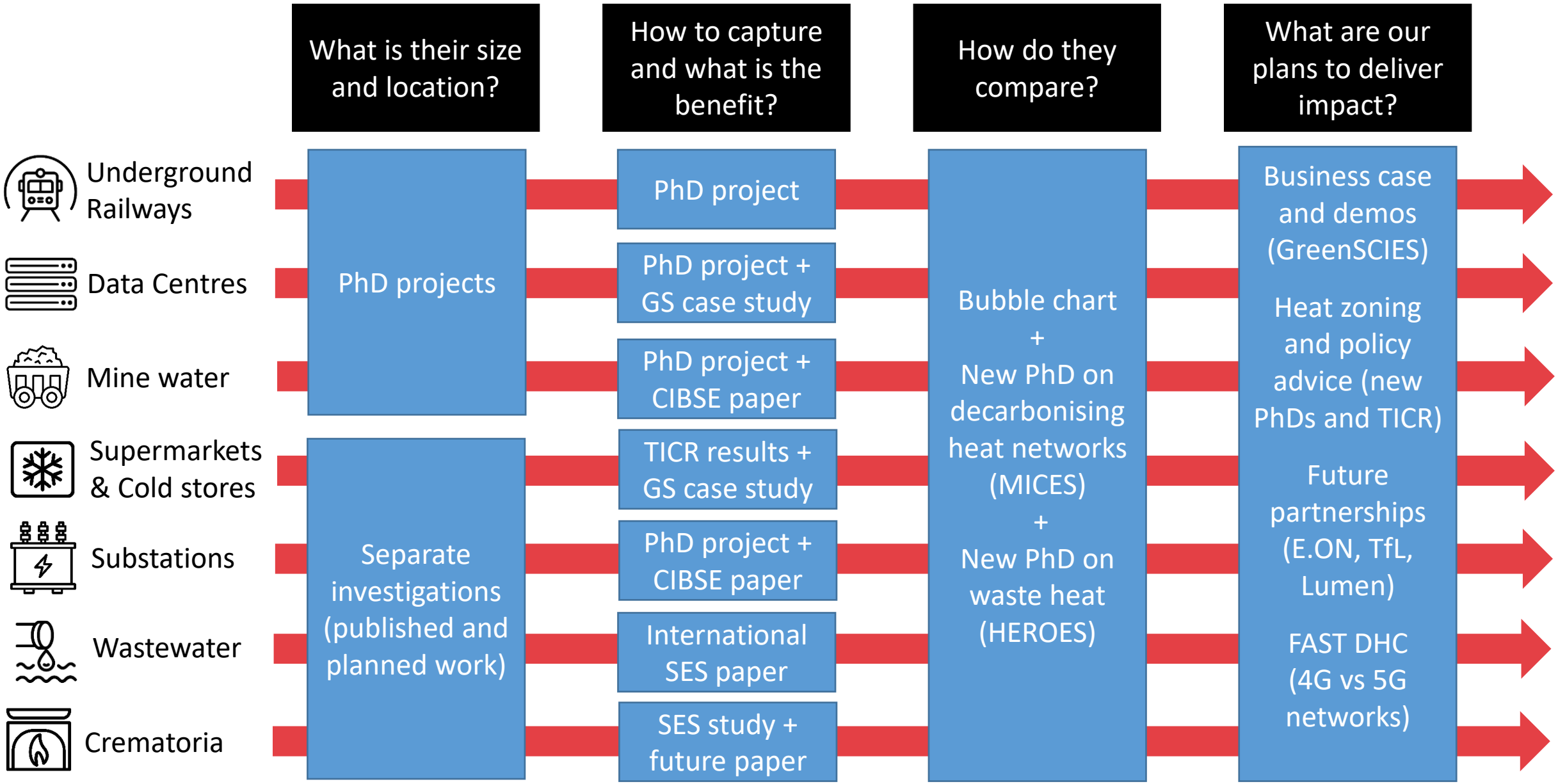
Advisory Board Meeting
19 October 2023
Heat Capture

LSBU Team – Aya, Cat, Eshagh, Gareth, Helen, Henrique, Judith, Matt & Graeme

Low Temperature Heat Recovery and Distribution Network Technologies

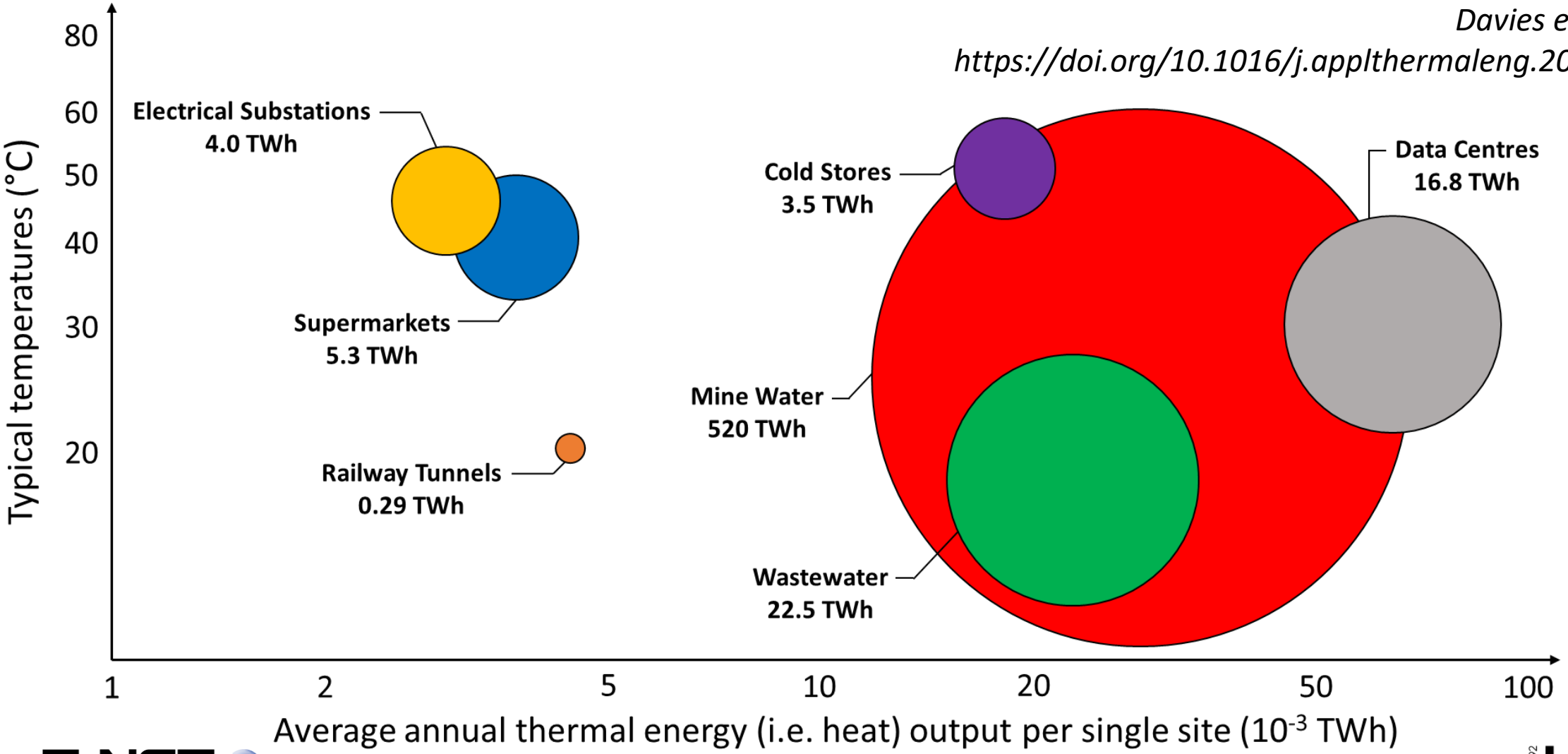
Addressing the big questions to identify the opportunity



LOW TEMPERATURE WASTE HEAT

Recently published paper compares different sources of low-grade waste heat in the UK

Davies et al. (2023)
https://doi.org/10.1016/j.applthermaleng.2023.121283



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DETAILED ASSESSMENTS OF WASTE HEAT SOURCES

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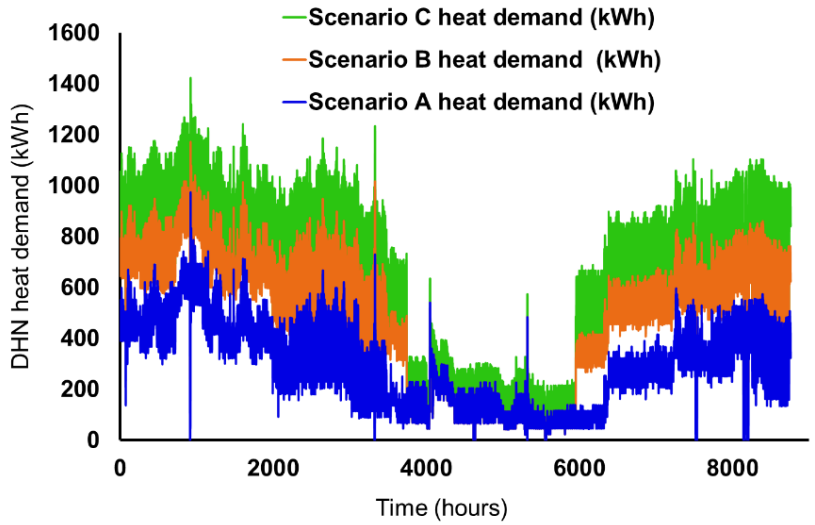
ELECTRICAL TRANSFORMERS

Lagoeiro et al. (2023)
https://doi.org/10.1016/j.egyr.2023.09.074

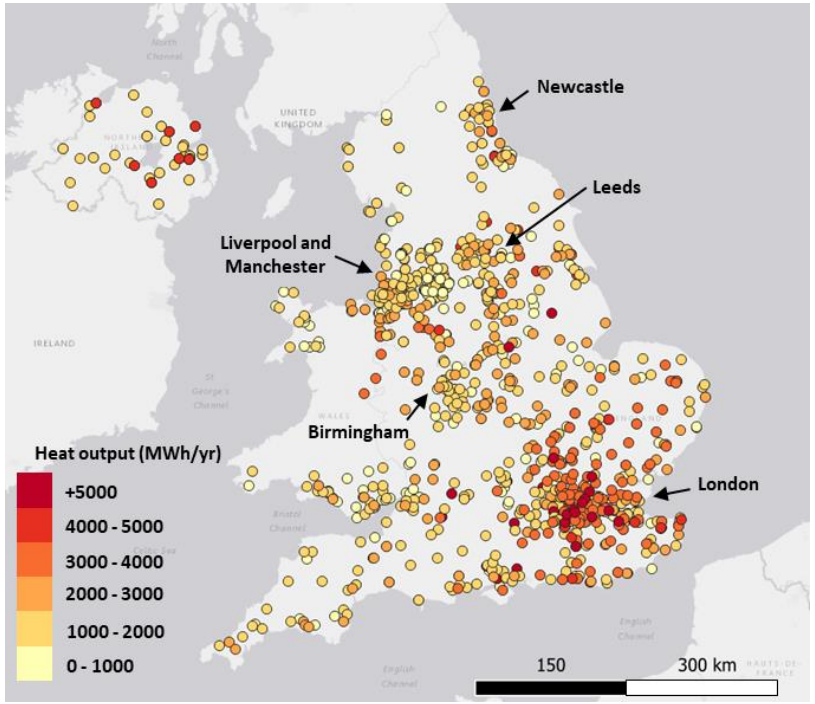
Mapping potential and investigating benefits

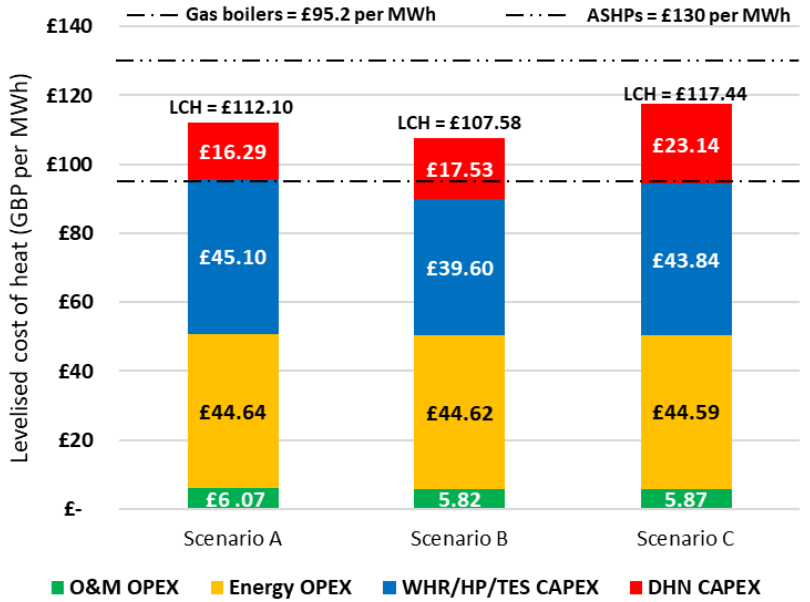
- Use of waste heat increases if connected to larger DHNs
- Levelised cost of heat varied from £107.56 to £117.44 per MWh
- Highly dependent on peak coincidence and linear heat densities
- WHR system could achieve a SCOP of 3.40 and 80% carbon savings



Country	Number of sites	Waste heat output (TWh)
England	1,181	3.52
Wales	78	0.18
Northern Ireland	77	0.30
Scotland*	55	0.32
Total	**1,391**	**4.32**

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





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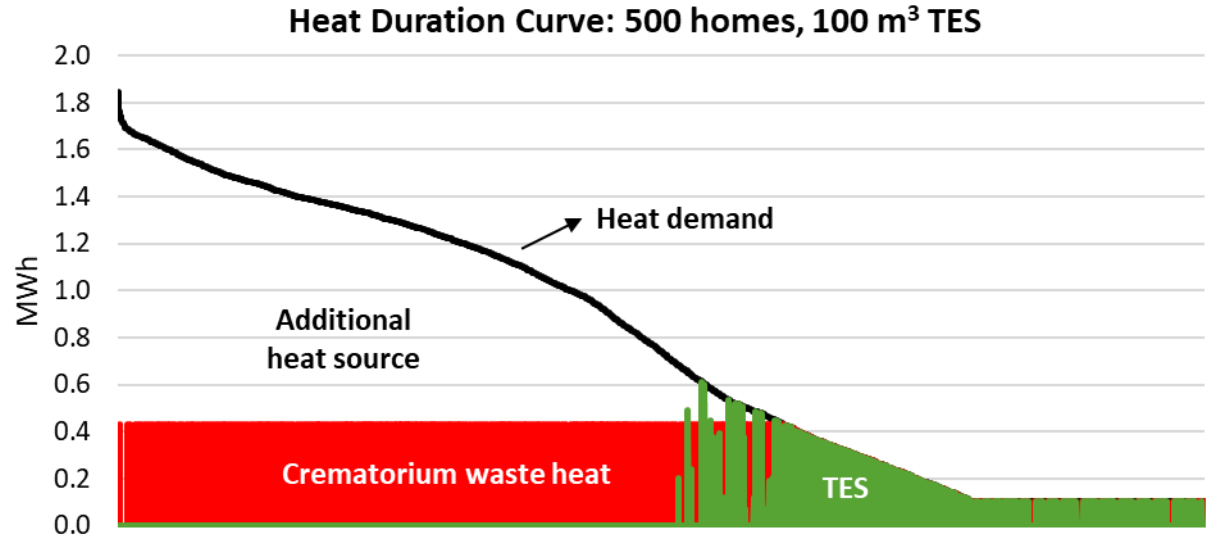
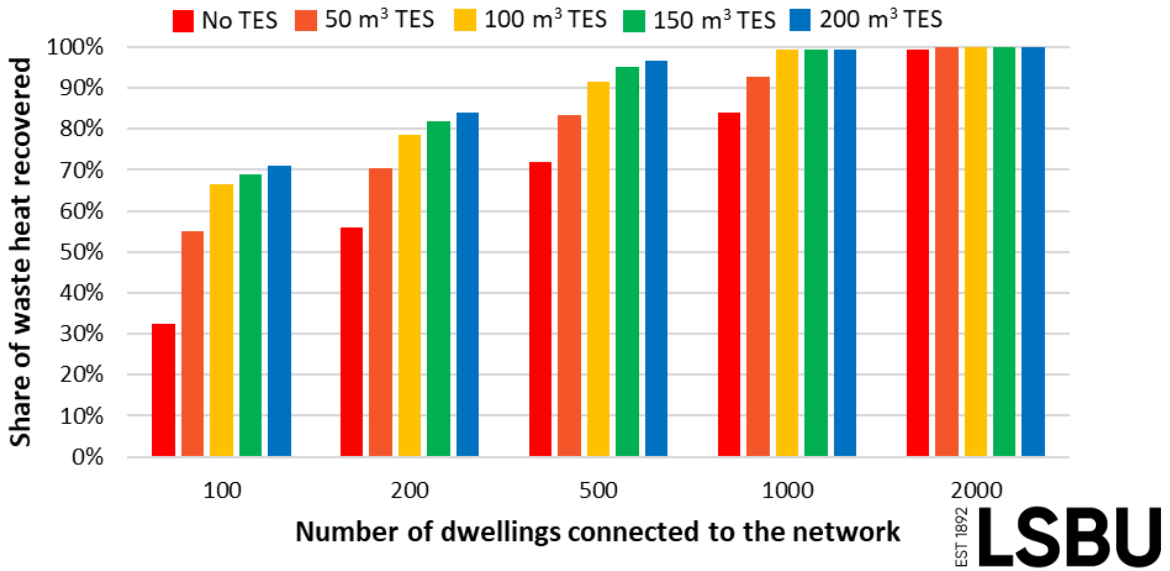
CREMATORIA

Lagoeiro, Marques & Maidment (2023)
Smart Energy Systems
INTERNATIONAL CONFERENCE

Waste heat output of up to 281 GWh/year was estimated for crematoria

- Canley Crematorium case study: 979 MWh per annum
- TES and larger networks enable greater integration
- Levelised cost of capture of £25.9 per MWh at 80-90°C
- Cost savings: 29.6% (90% boilers) and 34.4% (HPs COP = 3.5)





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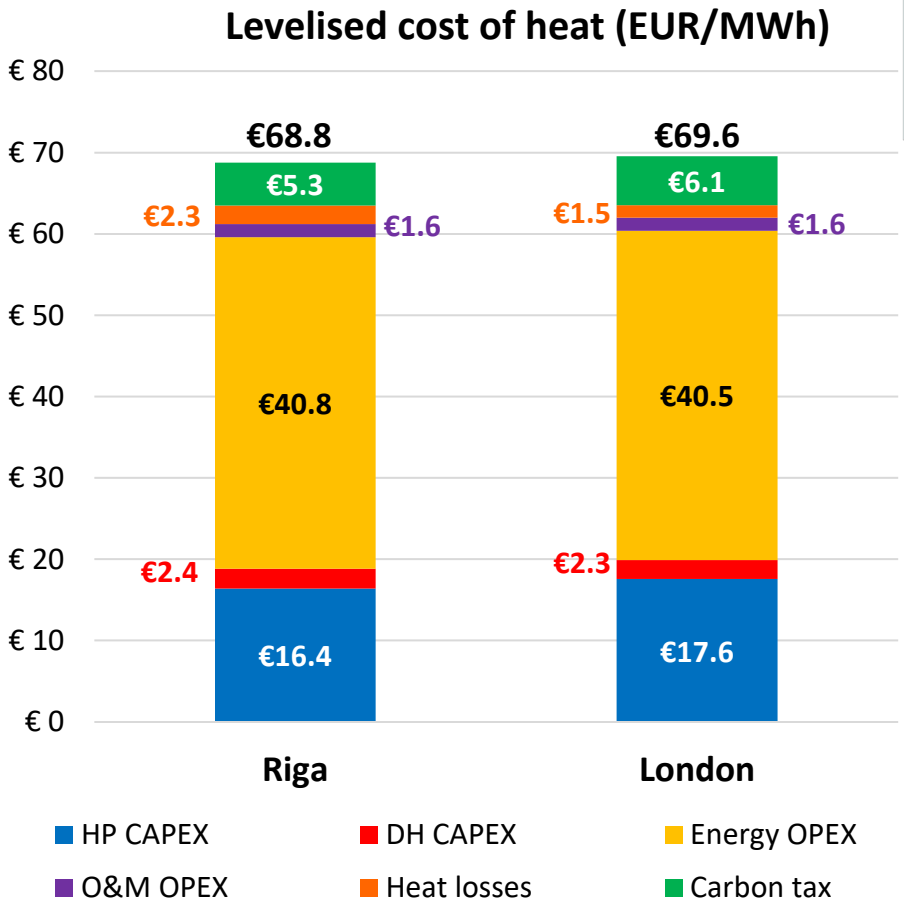
TREATMENT PLANTS

Ziemele, Lagoeiro & Maidment (2023)
Smart Energy Systems
INTERNATIONAL CONFERENCE

International collaboration on competitiveness and social benefit of waste heat



4 step: A multi-factorial assessment of potential of treated WW, KPIs

Energy: PEF, Recovered energy share (%)	**Environmental**: CO_2 savings (%)	**Economy**: Cost of avoided CO_2 (EUR/tCO_2)	**Social**: Share of avoided heating costs (%)

Parameters	Riga	London
Initial Primary Energy Factor	1.22	1.26
Primary Energy Factor with WHR	0.45	0.46
Recovered energy share in DH (%)	65%	70%
Carbon savings (%)	77%	72%
NG Production Tariff (EUR/MWh)	128.42	119.12
LCOH for WHR system (EUR/MWh)	68.77	69.56
Price differential (EUR/MWh)	59.64	49.55
Annual cost of avoided emissions (EUR/tCO_2e)	47.49	116.00
Savings in relation to annual household income (%)	2.67%	1.04%

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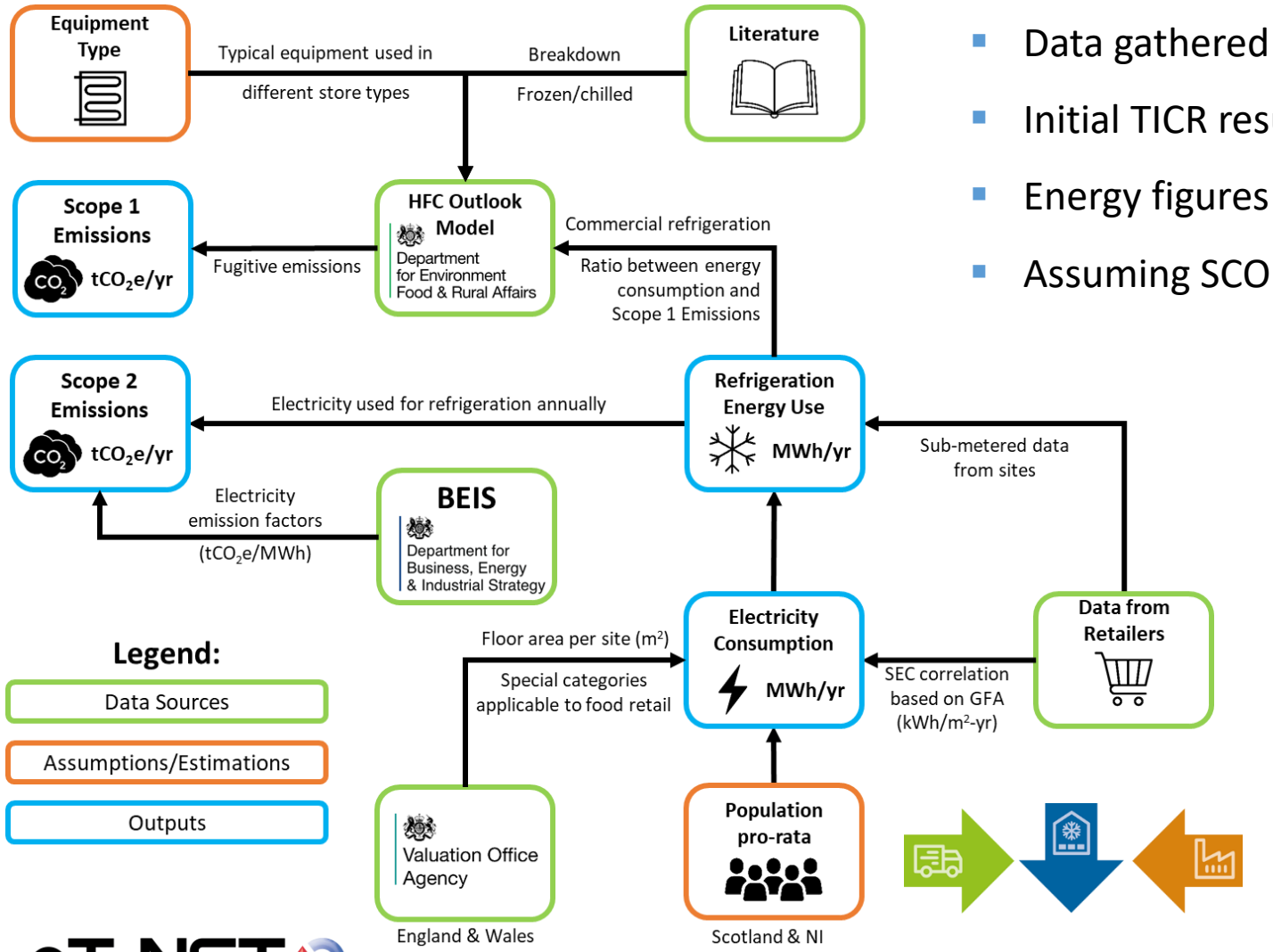
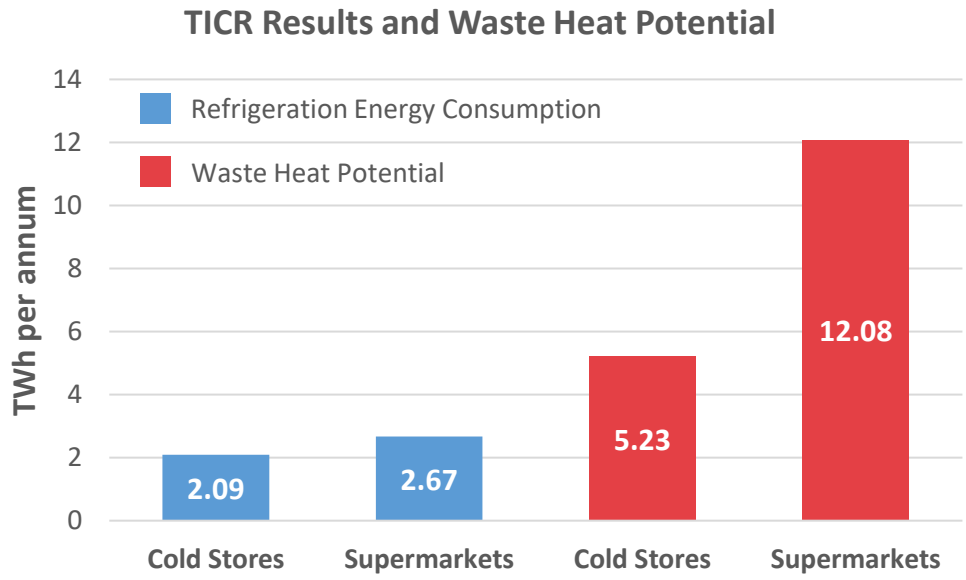
COLD STORES AND SUPERMARKETS

Investigation of refrigeration emissions can be used to estimate waste heat potential



- Data gathered for 7,400 supermarkets and 607 cold stores
- Initial TICR results suggest greater number of sites and energy
- Energy figures can be used to assess waste heat potential
- Assuming SCOPs of 1.5 for cold stores and 3.52 for supermarkets



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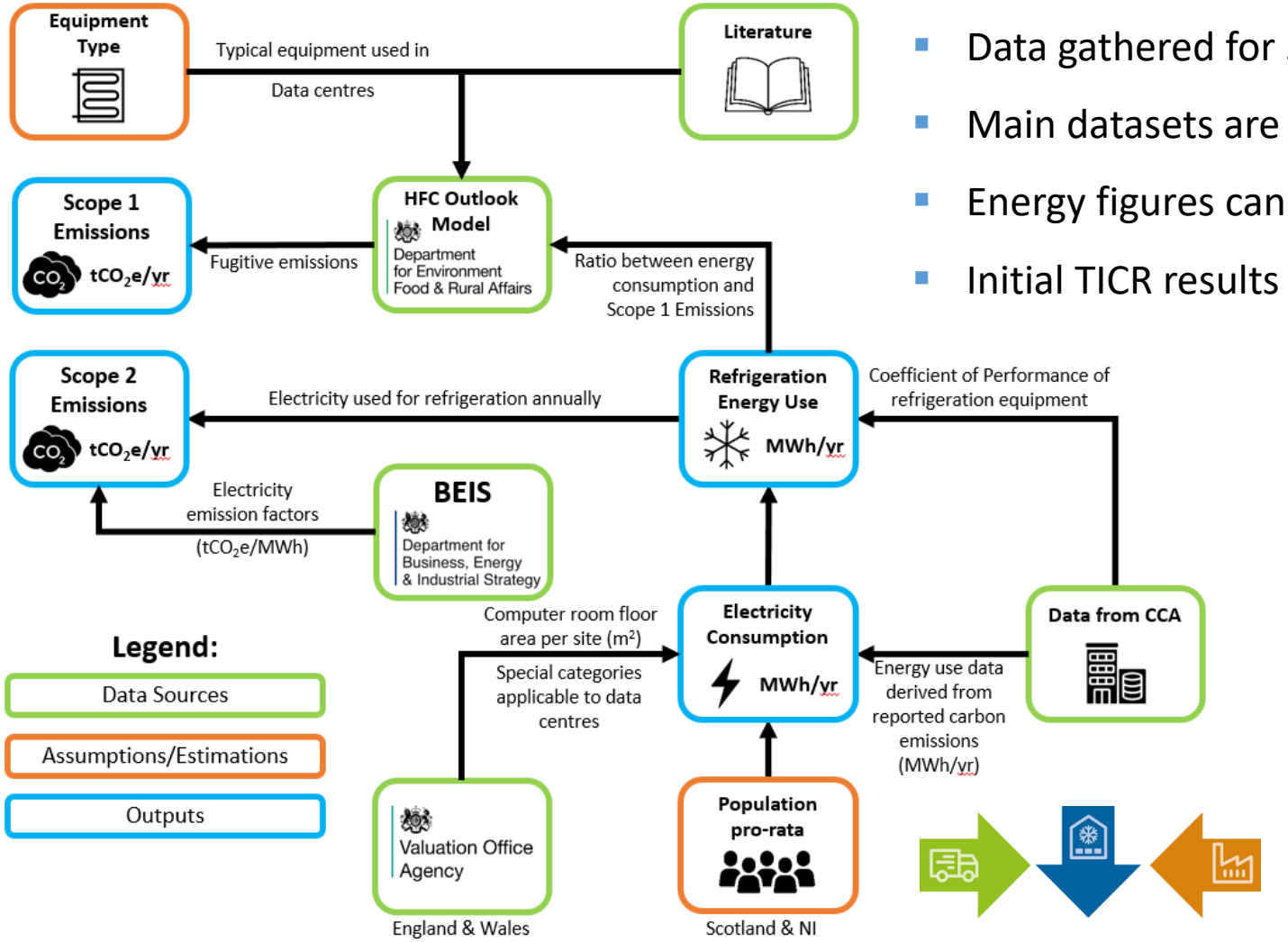
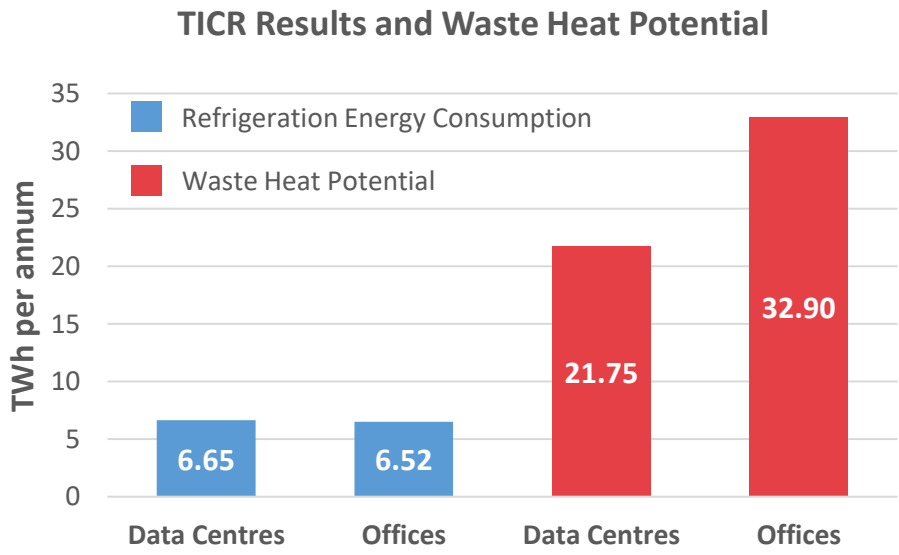
DATA CENTRES

PhD project is supporting TICR and estimating waste heat potential from UK DCs



- 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
- Initial TICR results suggest greater number of sites and energy



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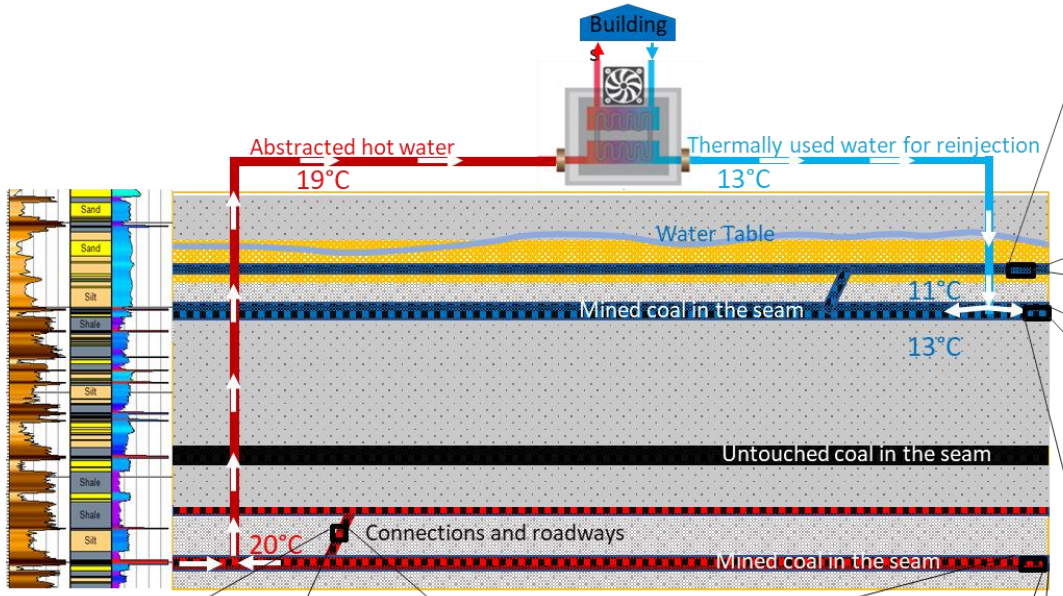
MINE WATER

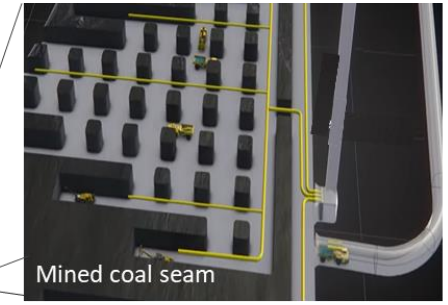
PhD project: mine water as resource for heat supply and storage

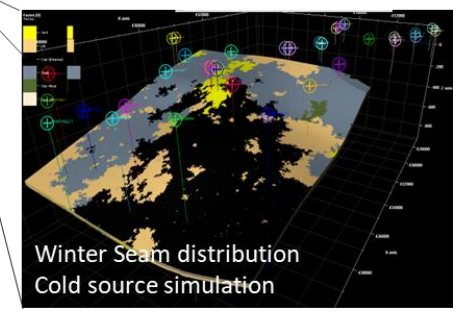
CIBSE JOURNAL

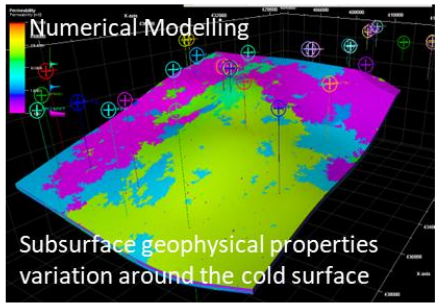
Minewater study wins symposium prize

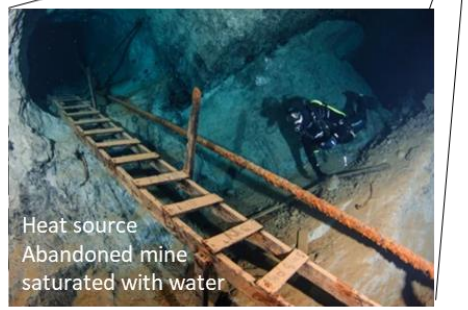
The presentation of a case study on the integration of minewater into smart cooling and heating network systems has been voted the 'Most significant contribution to the art and science of building services engineering' at the annual CIBSE ASHRAE Technical Symposium.





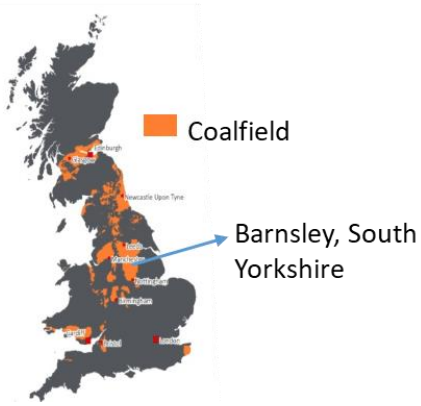






Integration of waste heat and mine water:

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



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DEMONSTRATIONS AND RELATED INVESTIGATIONS

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DEMONSTRATIONS

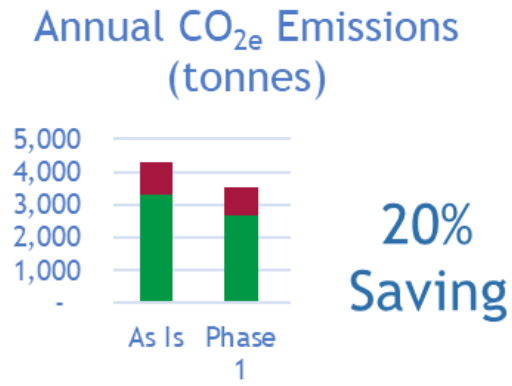
Thermal integration at a yoghurt producer

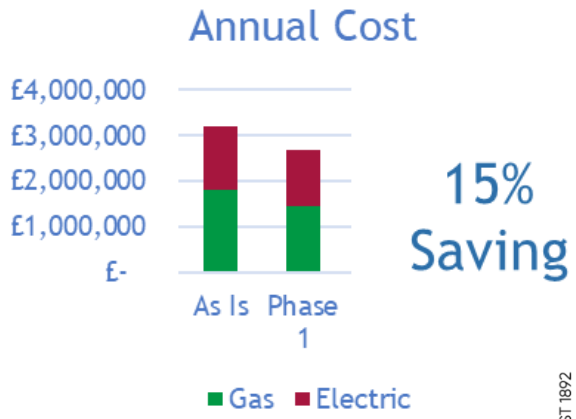
- Yeo Valley
- Thermal integration at a yoghurt producer (Yeo Valley)
- Using a HTHP to upgrade waste heat from a refrigeration plant
- Currently steam (gas) for pasteurisation/yoghurt processing
- Ice bank chiller for cooling
- Facilities next to each other on the Blagdon site
- Need to identify concurrence in demand
- Idea is to integrate of heating and cooling using vapour compression systems for providing all thermal services
- Use of HTHP to upgrade waste heat from chiller
- Considerable savings identified, divided into 4 stages (to make changes simpler and less disruptive)

DEMONSTRATIONS

Thermal integration at a yoghurt producer

- 18,000,000 kWh per year of gas used
- Gas is used only to raise steam for CIP and pasteurisation
- 120,000 tonnes of Yogurt produced
- Gas price ~£0.1/kWh
- Electricity Price ~£0.3/kWh
- Stage 1: Extracting 3,200,000 kWh from chilled water
- Stage 1 savings of 20% energy and carbon (see right), 15% cost (up to 70% energy and carbon, 40% cost for stage 4)





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DEMONSTRATIONS

Advanced retail refrigeration: demand side response and thermal energy storage

- ASDA, City Engineering
- Demand Side Response (DSR) optimised at a concept
- TES by using the grid/refrigeration plant during surplus will be used to generate a cold thermal store
- Reduce summer condensing temperatures
- Prevent outages due to high condensing temperatures
- Work in progress on TES potential (size, material, location)

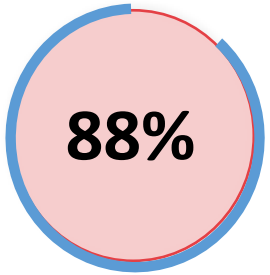
DEMONSTRATIONS

Heat recovery from a regional distribution centre (cold storage)

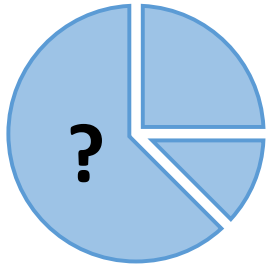
- Star, ASDA, City Engineering
- Demonstrate the feasibility (from a technical, carbon reduction and financial case) of reclaiming heat from regional distribution cold store refrigeration systems
- Use it on site and locally to meet the heat demands currently supplied from natural gas and other resources
- Assessing store at Avonmouth
- Additional data logging applied by Star
- Good data on refrigeration plant and heat available
- Analysing data on heat sinks which have just received

MICES PROJECT

Modifying Intensive Carbon Energy Systems (in particular, heat networks)



of networks use gas CHP and boilers



chaotic and fragmented market

Understand the complex landscape of the UK's heat network market and **identify signature archetypes**

Define the unique **decarbonisation needs and challenges** of these high-carbon signatures

Develop decarbonisation strategies tailored for each archetype, with focus on systems that are difficult to transition

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DASHBOARD

900
heat networks across the UK

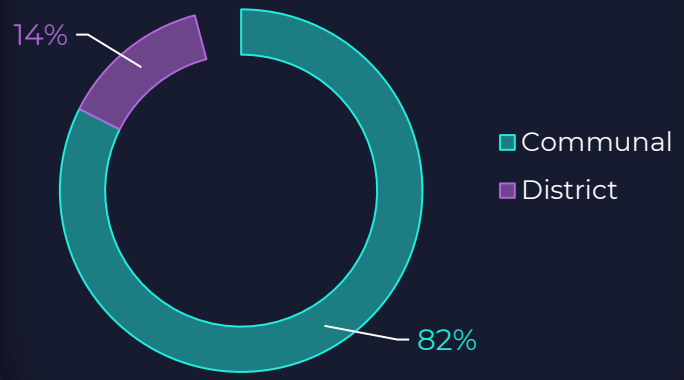
More than
10
data sources

Factors considered

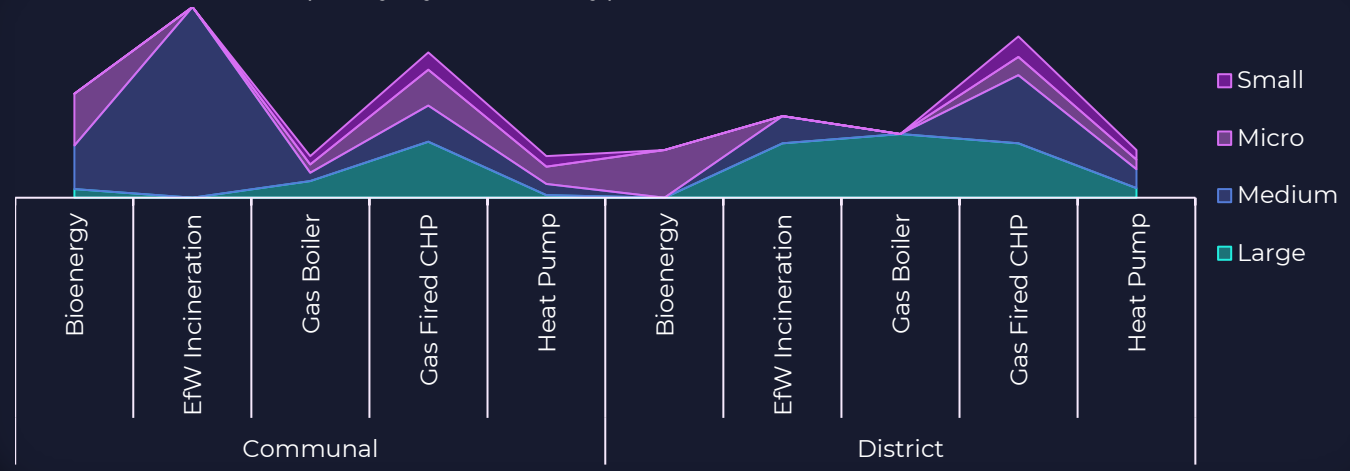
- Type of area
- Type of buildings connected
- Type of network
- Served sector
- Type of technology
- Scale of technology

BY: AYA HEGGY

Network type



Heat source capacity by network type



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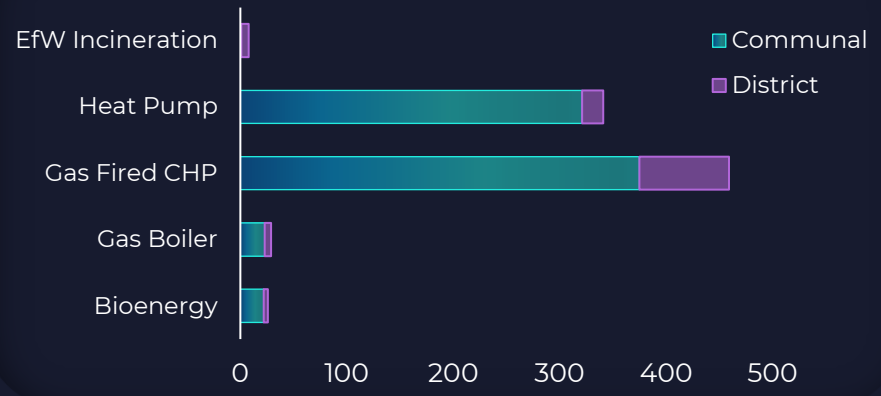
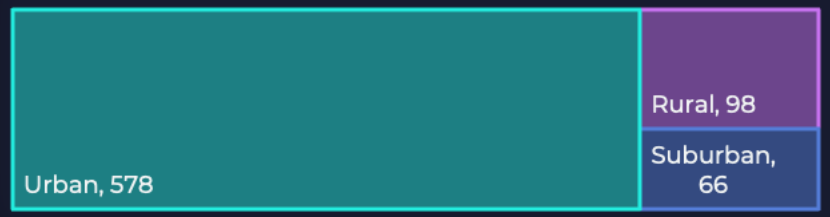


Number of networks in each area



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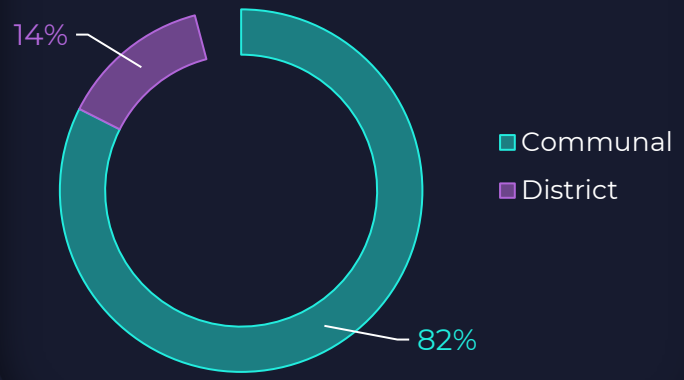
BY: AYA HEGGY

Network type



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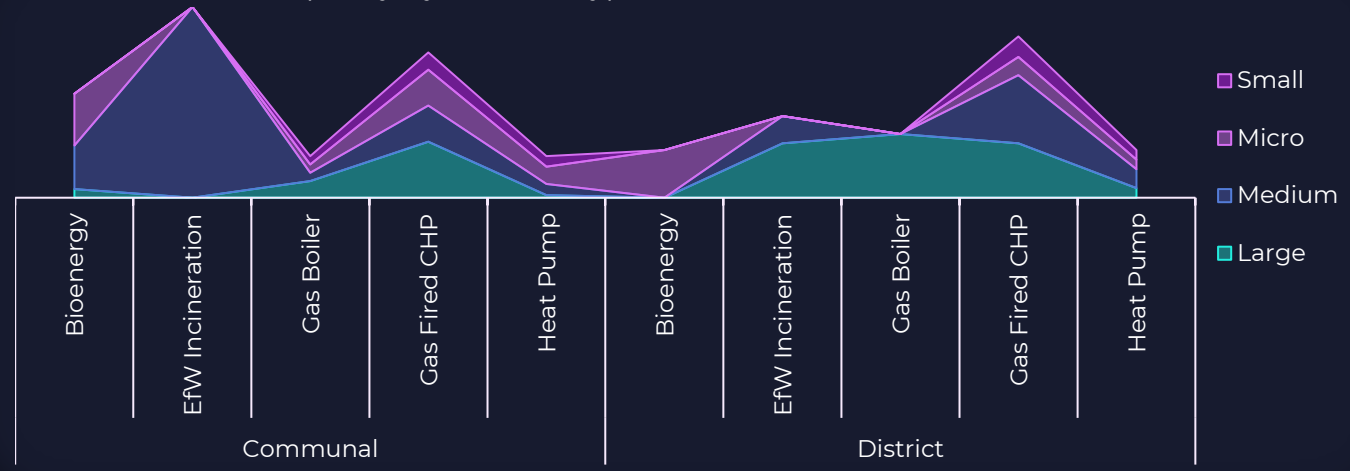
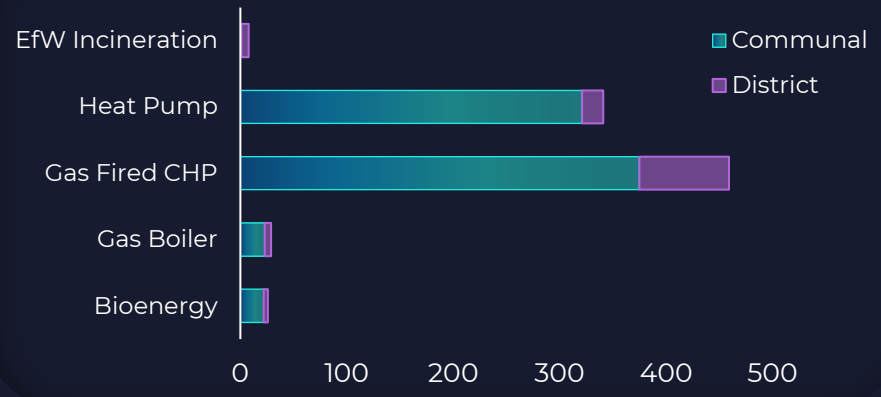


Heat source by network type



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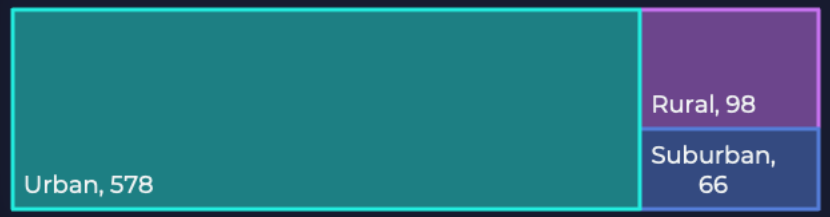
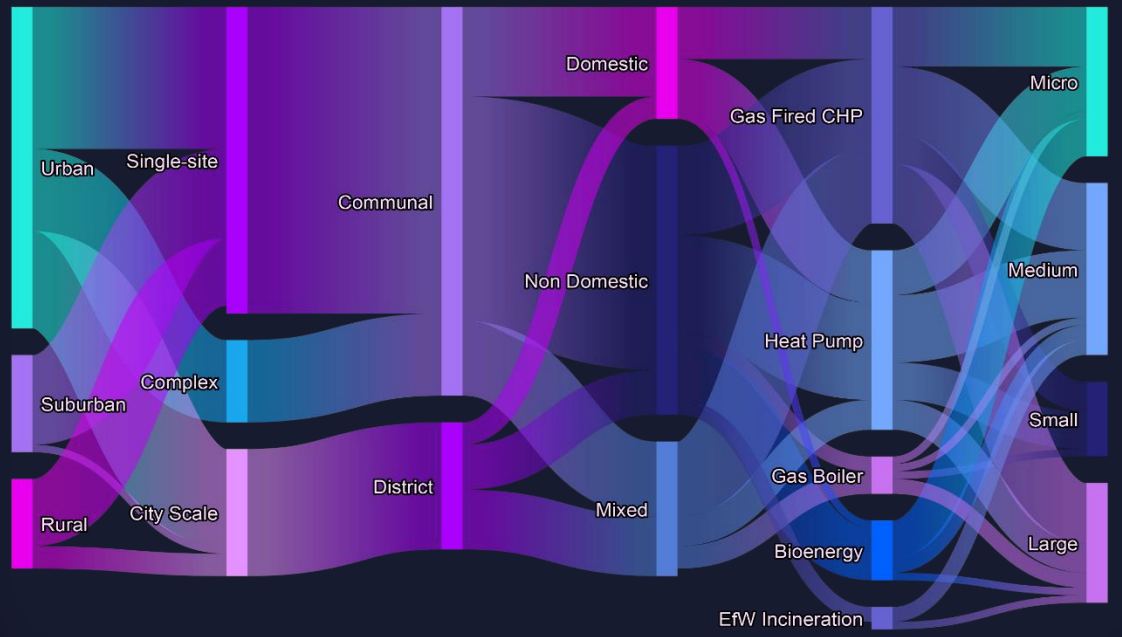


Sankey diagram showing number of systems

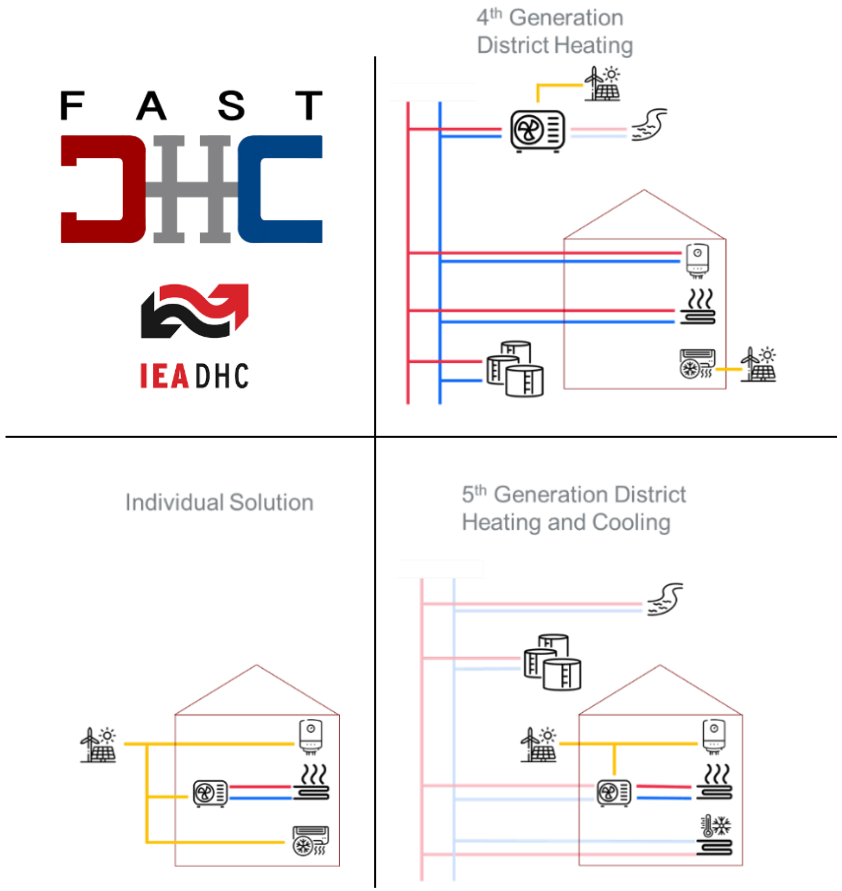


FUTURE/POTENTIAL PROJECTS

Better understanding of DHC, waste heat, and their potential applications (also in Ukraine!)

FAST DHC

IEA DHC



UKRI Innovate UK

REBUILD ZHYTOMYR ЖИТОМИР

PHD

E.ON

PROJECT HEROES

- Heat source behaviour
- Practical challenges
- Environmental impacts
- Business models

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