LoT-NET

Advisory Board meeting
13th October 2022

Low Temperature Heat Recovery and Distribution Network Technologies

Update on Mission Innovation projects

Comfort and climate box (Ulster)

Aim – State of the Art Air Source Heat Pump and Thermal Storage in Single Family Homes (IEA HPT Annex 55)

Final Report

1. Market Status
   Halime Paksoy, Ayşegül Çetin, Çukurova University, Turkey
2. Field Trial Results
   Alessia Arteconi, Università Politecnica delle Marche. Italy
3. Technical Boundary Conditions
   Neil Hewitt, Ulster University, UK
4. Research Projects
   Neil Hewitt, Ulster University, UK
5. Standards
   Alessia Arteconi, Università Politecnica delle Marche. Italy
6. Roadmap
   Caroline Haglund Stignor and Maarten Hommelberg, RiSe, Sweden

CCB – Field Trials

What are we doing? Implementing Oil and Gas Hybrid heat pumps, heat pumps, along with heating storage via heat batteries for ten homes in Omagh.

Aim:

a. **Reduce the carbon footprint of the homes heating demand.**
b. **Affordable for the tenant,**
c. **Thermal Comfort.**

How: Retrofit of older homes by improving the insulation value of the walls and windows, while electrifying a portion of the heating demands.

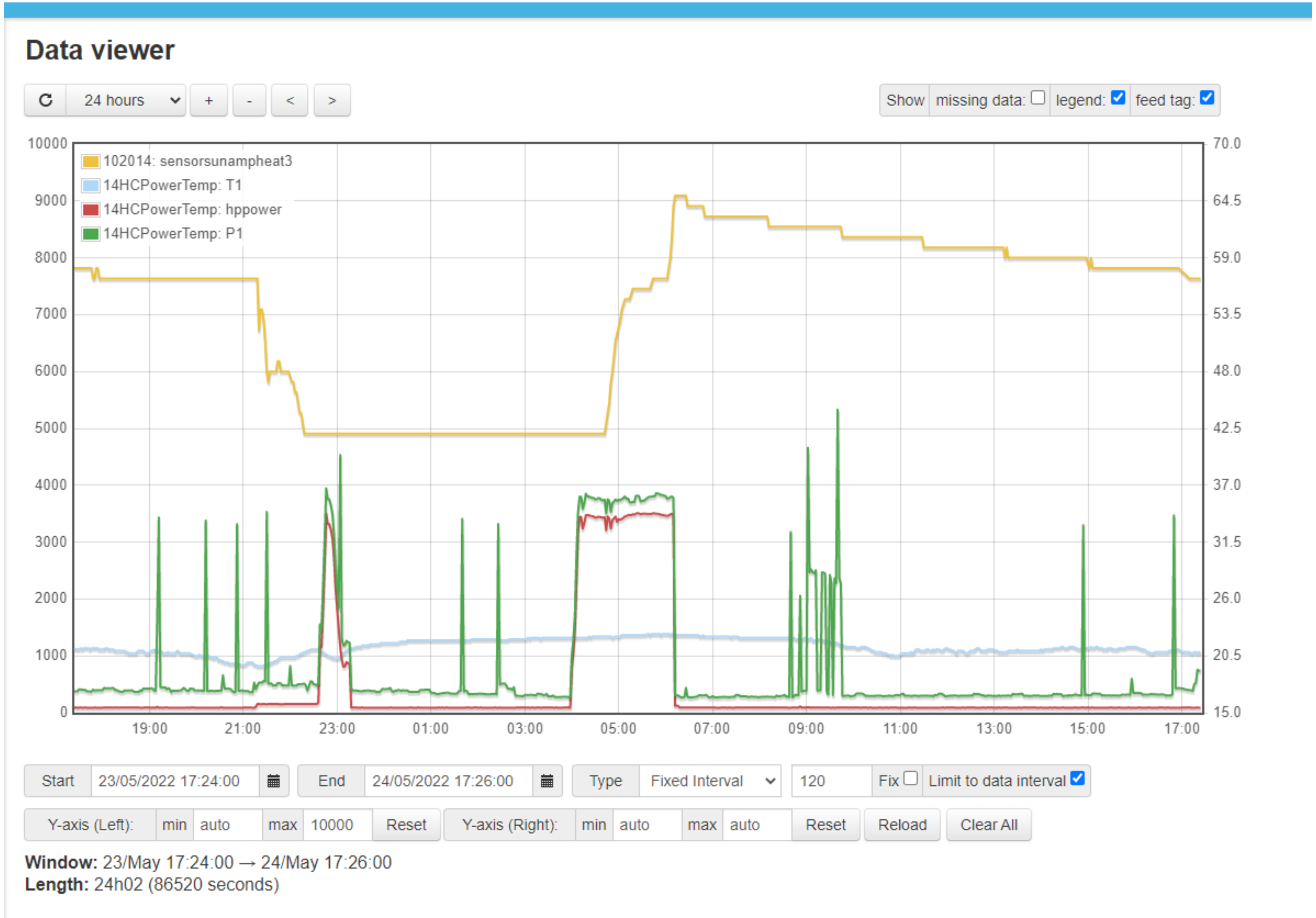
HYBRID SYSTEM Either Oil or Gas Boiler with Heat Pump

HEAT PUMP ONLY

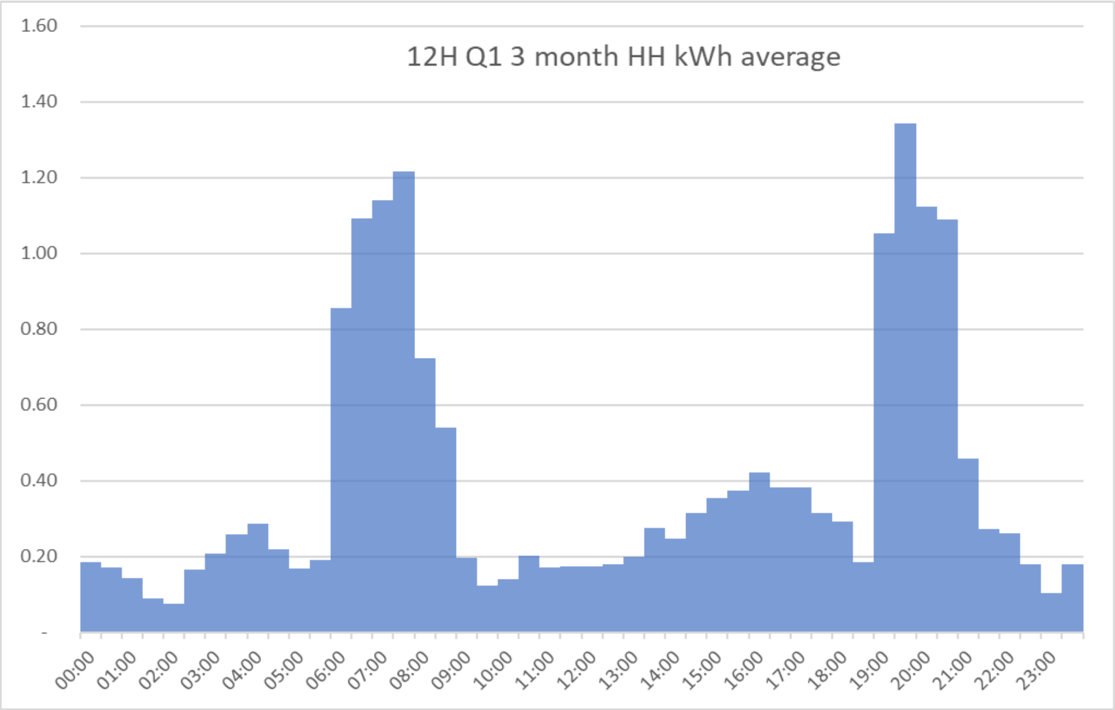
Vaillant Heat Pump as Part of Sunamp Installation

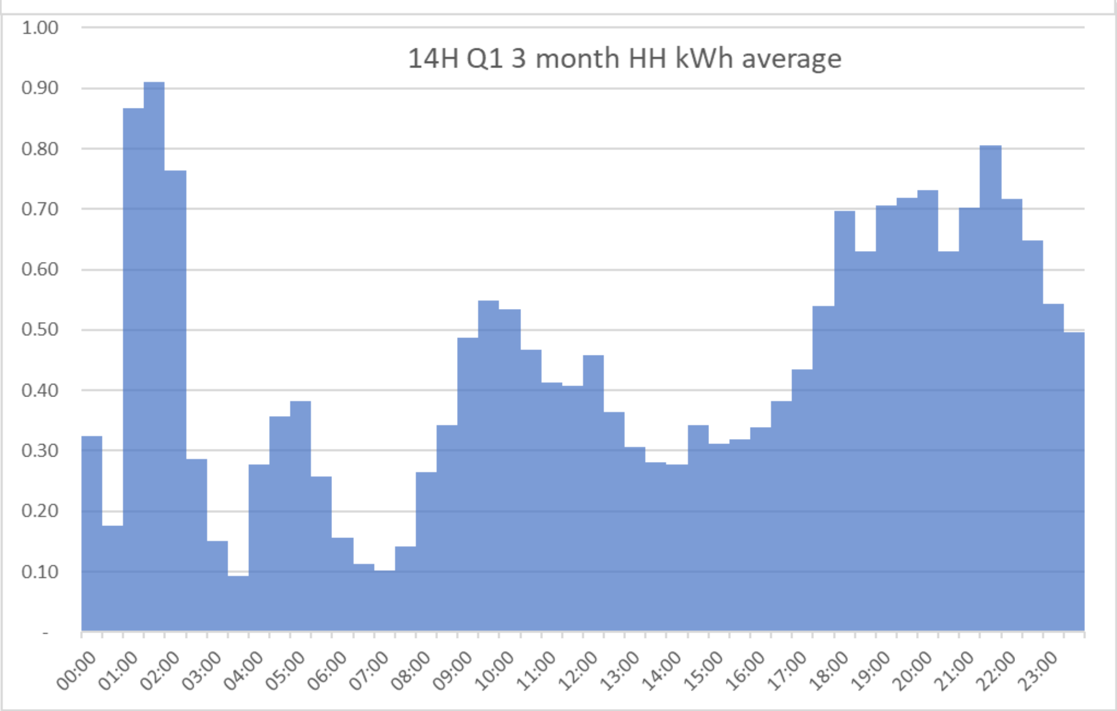
Sunamp Heating Battery Installation

CCB – Field Trials

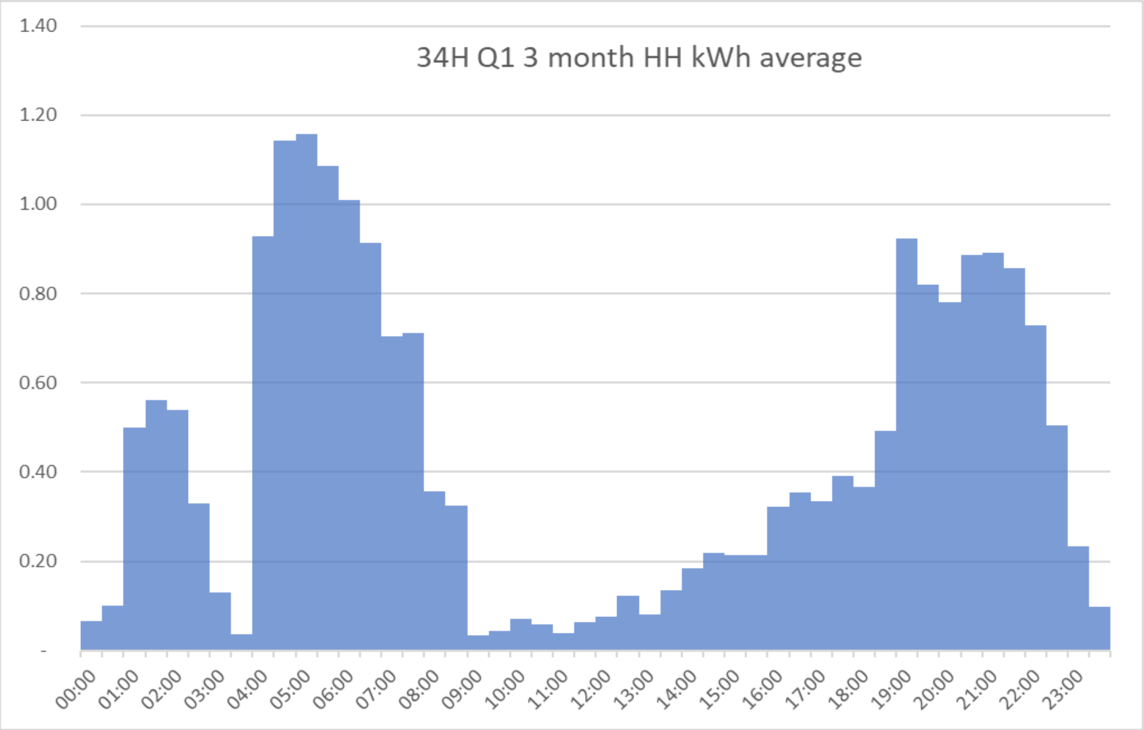


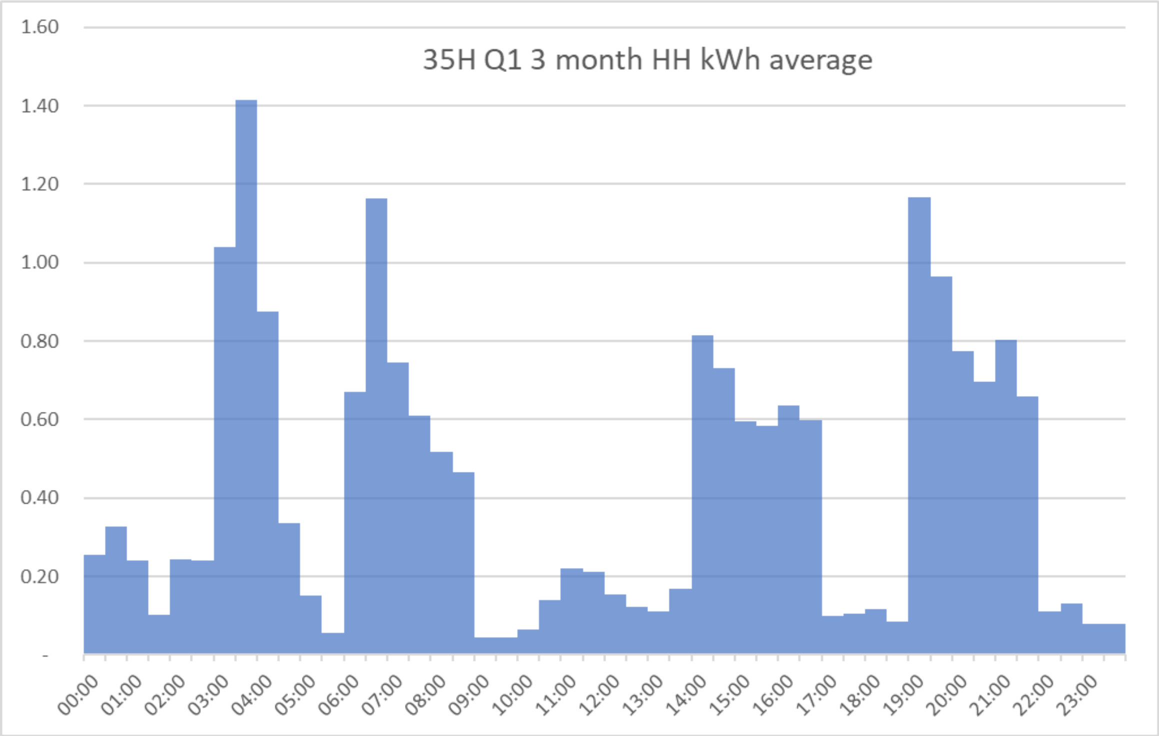
CCB – Field Trials





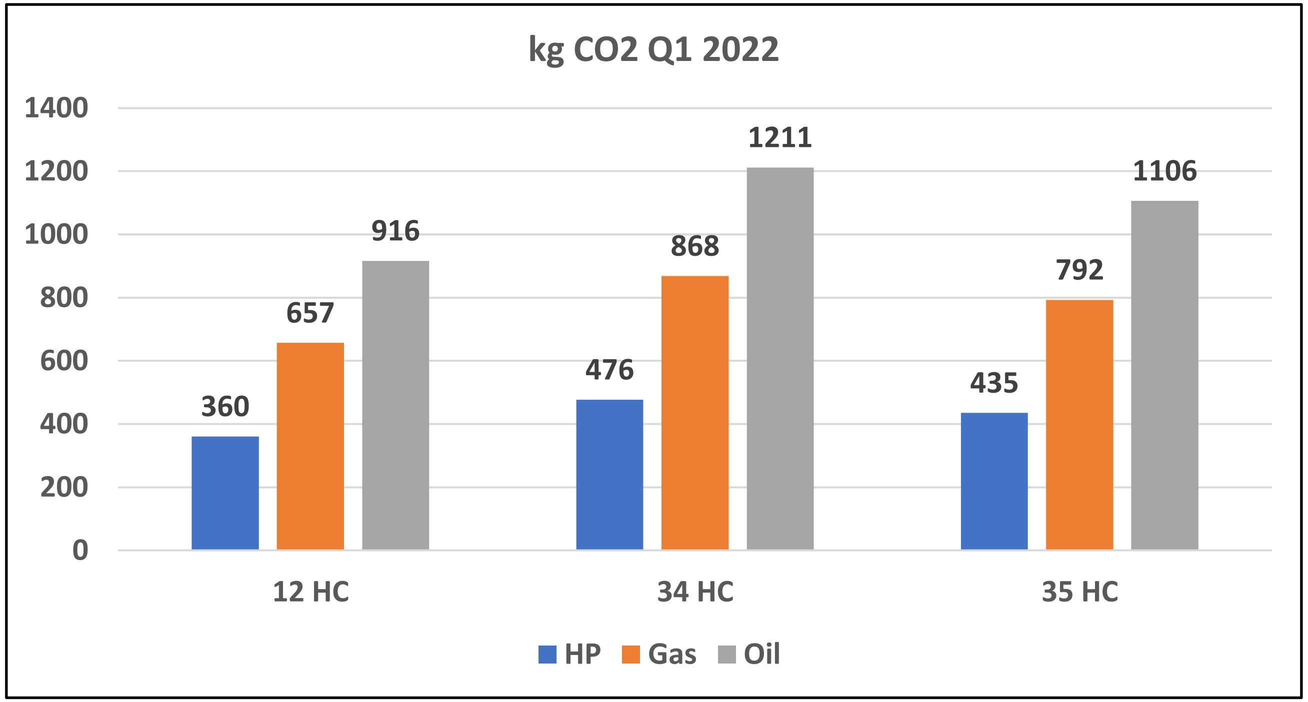
CCB – Field Trials



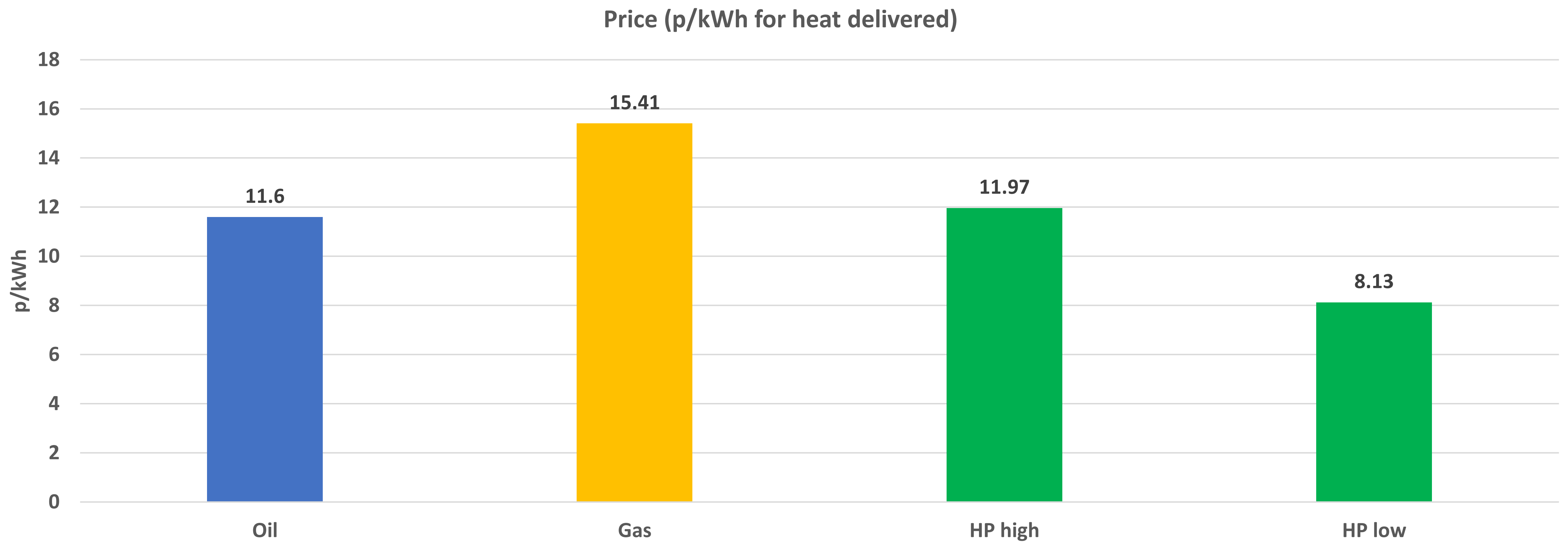


CCB – Field Trials

	Oil	Gas	HP CoP 2.5
CO_2 intensity (g/kWh)	300	215	118
Average CO_2 reduction %	-61%	-45%	0
Average CO_2 reduction kg	-650 kg	-350 kg	0



CCB – Field Trials



CIBSE Symposium potential contributions

CIBSE Symposium potential contributions:

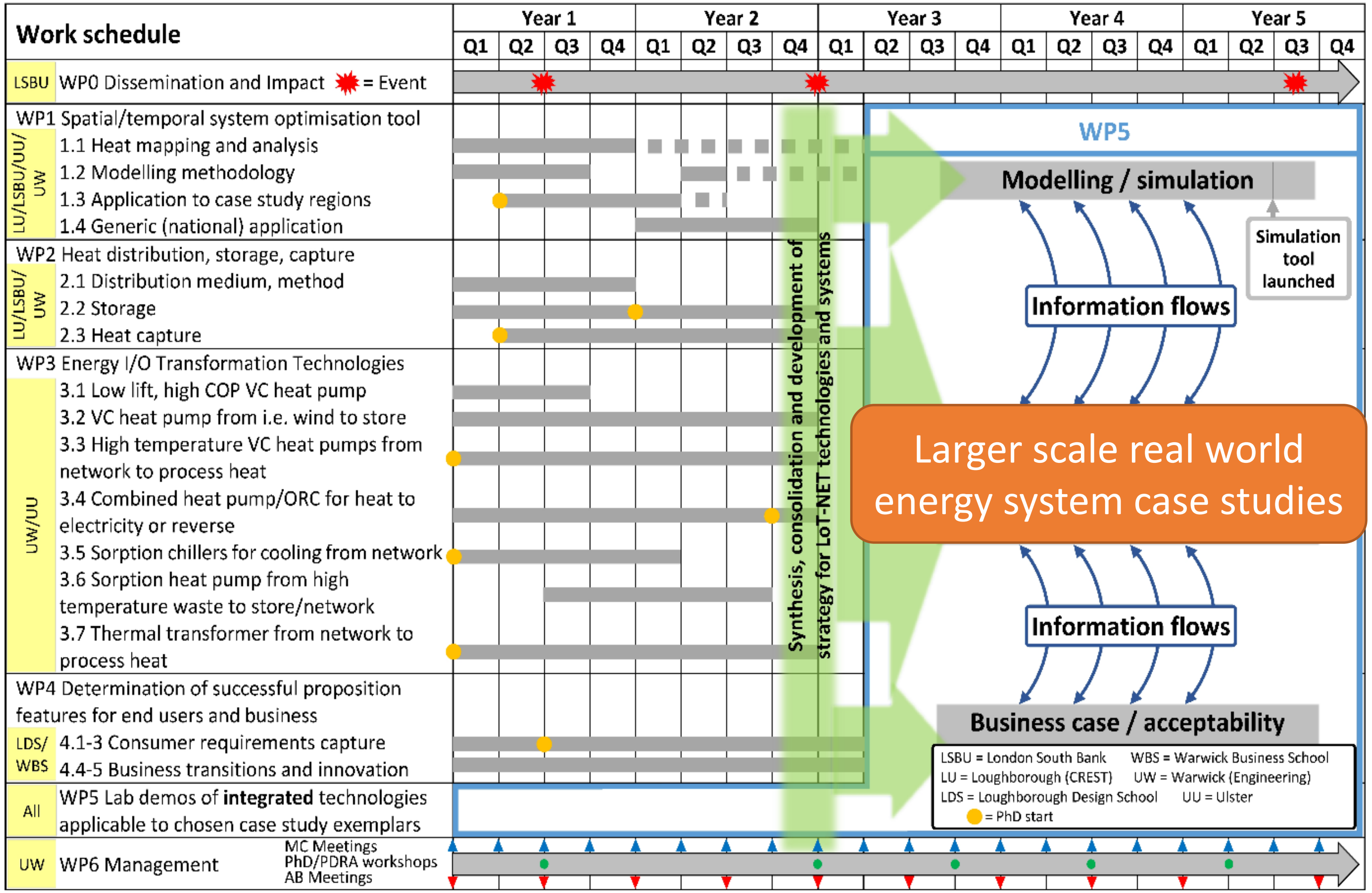
- Heat loss from cylindrical horizontal direct-contact thermal energy storage – Loughborough University
- Simulation of a district heating system with heat supplied by only renewable heat sources and thermal energy stores – Loughborough University
- Case study of the Smart Square area of the University of Warwick – University of Warwick
- Experimental study of a small-scale reversible heat pump – Organic Rankine Cycle system for industrial waste heat recovery – Ulster University
- Hight temperature heat pumps research and development at Ulster University – Ulster University
- Integration of minewater into smart cooling and heating network systems, a case study – LSBU
- Conflation of energy as a means of overcoming energy inflation – LSBU
- District Heat Networks in London: A Review of the Current Status, Potential, Barriers, and Opportunities – LSBU
- The Potential of Crematoria as Resources for Waste Heat in the UK – LSBU
- Residential retrofit opportunities in Conservation Areas. A central London case study – LSBU
- Effective integration of EVs and low carbon technologies into Smart Local Energy Systems – LSBU

- Heat pump readiness – University of Warwick (if late submission OK)

LoT-NET

Case studies

Phase 2: Including larger scale real world energy systems



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Case Studies – How can they demonstrate LoT-NET's ongoing work and how do they accelerate LoT-NET's impact?

- **The University of Warwick** campus is a multi-vectoral energy system with an electricity network, heating network, cooling network and rising transport demand from EVs. The challenge is to decarbonise the existing CHP system to achieve net zero for scope 1&2 emissions by 2030 and add scope 3 by 2050.
- **Islington: GreenSCIES** is a case study investigating an integrated, Smart, Local Energy System (SLES) for a large community in the London Borough of Islington. The system is based around a 5th generation ambient-temperature heat network loop with distributed energy assets such as heat pumps, solar photovoltaic and the flexible integration of electric vehicles.
- **Loughborough town.** A modelling approach to assess different network options that can deliver a net zero heating solution for the domestic dwellings in the town of Loughborough. Assesses a range of network typologies including shared thermal storage.

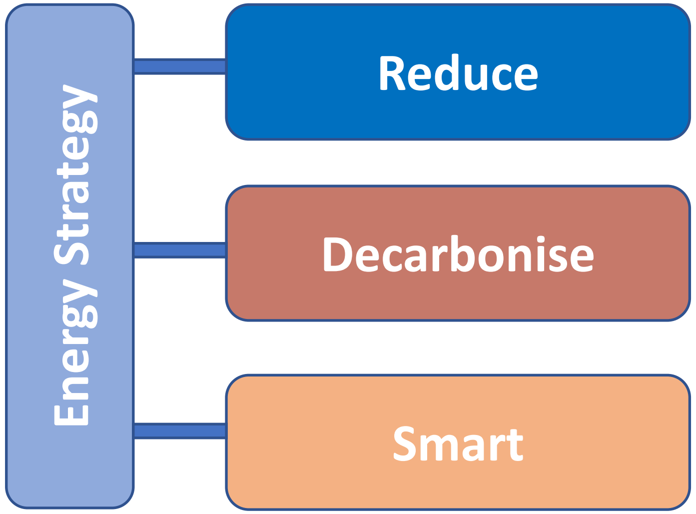
Case Studies: How LoT-NET can inform…..

- What will the CCC's 20% of heating from heat networks actually be?
- How can LoT-NET help heat networks be part of smart local energy systems?
- How can heat networks make local energy systems smarter and more flexible?

- Any other questions LoT-NET's cases can help answer?

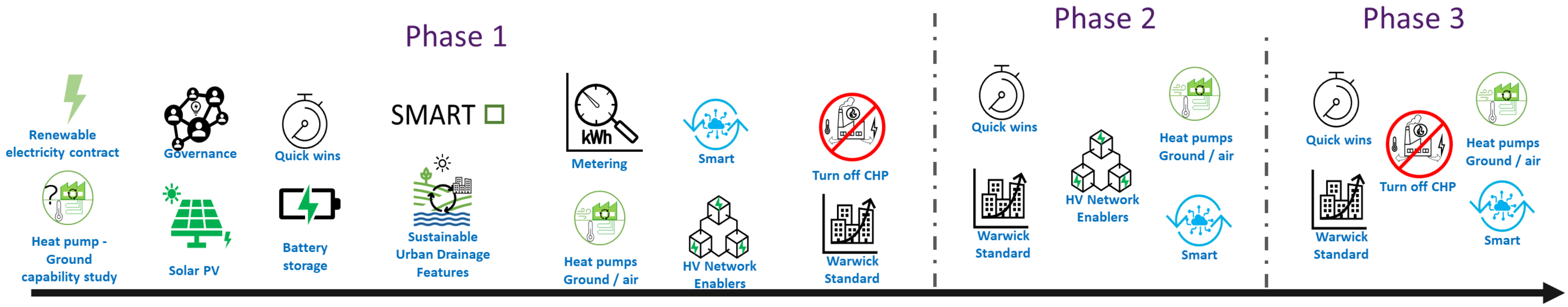
Case study: Warwick campus

Case Study Warwick – The Integrated Campus Case



- University of Warwick Campus
  - Community of 34,000; ~£10pa spend now rising to ~£30-40M
  - Net Zero for Scope 1&2 by 2030
  - Net Zero for Scope 3 by 2050
- Energy & Infrastructure Strategy
- Projects
  - The Warwick Standards – better buildings; new and retrofit
  - Energy 2020 – campus level solutions that decarbonise supply
  - Smart Square – smart, integrated system using a LoT-NET
  - Management of Energy Networks – becoming a local DSO offering flexibility
- Now encompasses **Work Package 4.5** – Low temperature heat networks in Smart Local Energy Systems

The role of heat and a LoT-NET in Warwick's 2030 Net Zero Goal



- The Warwick Standard
  - Reducing heat demand through better building standards – new 2022 Warwick Standard due December – "near passiv"
- Energy 2020
  - Heat: Replacing CHPs with a low temperature network and HPs both central and local
  - Electricity: Campus scale PV projects and more local, rooftop PV
- Smart Square/WBS
  - Smart Square HP study – what local heat pumps would be needed to "top-up" a LoT-NET for Smart Square
  - Going inside the buildings Part 1: Smoothing out heat demand with thermal mass
  - Going inside the buildings Part 2: Metering and monitoring to lower temperatures

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Decarbonising Warwick's Smart Local Energy Network - Heat

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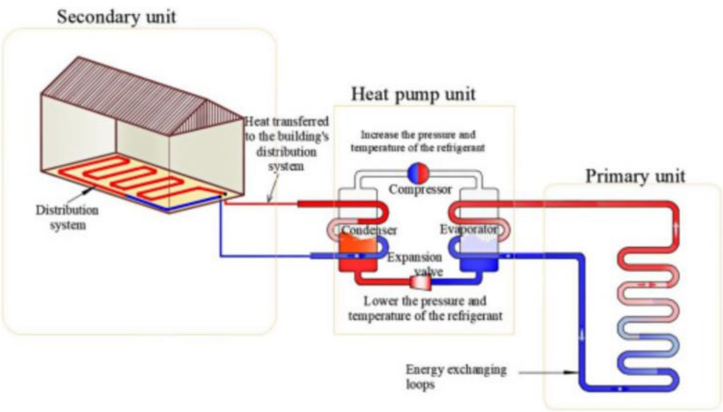
BEIS Study on Campus Heat Network - adopting recommendations → Campus Low Temperature Network with assumed building upgrades

CPW Report on Smart Square – final output December 2022 → Building improvements for low temp network plus ASHP "top-ups"

PSDS Study at Computer Science → Building-specific improvements necessary to join low temperature network



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Decarbonising Warwick’s Smart Local Energy Network - Heat

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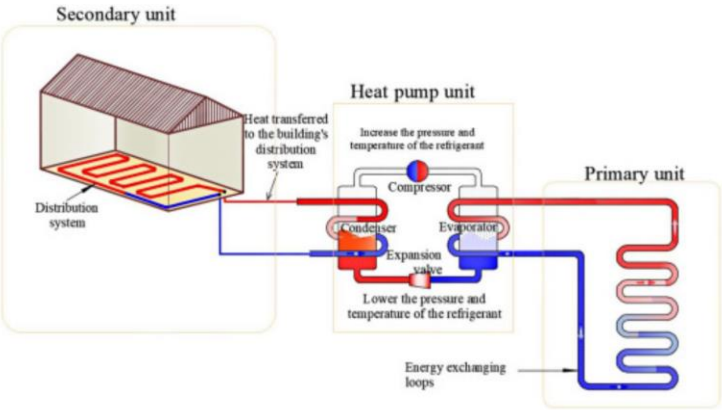
Activities ongoing…

Desktop study of Geothermal potential on campus	→	Outcomes due December ‘22
Integration of heat pump technology into c£900M Capital Programme	→	Standards already applied in 3 Major Capital Projects
Identified 4 sites for large scale heat pumps campus wide c.10MW capacity	→	Implementation of Masterplan; Phase 1: 2 New Heat Pump Energy Centres



Decarbonising Warwick Smart Local Energy Network
On-Site Electrical Generation

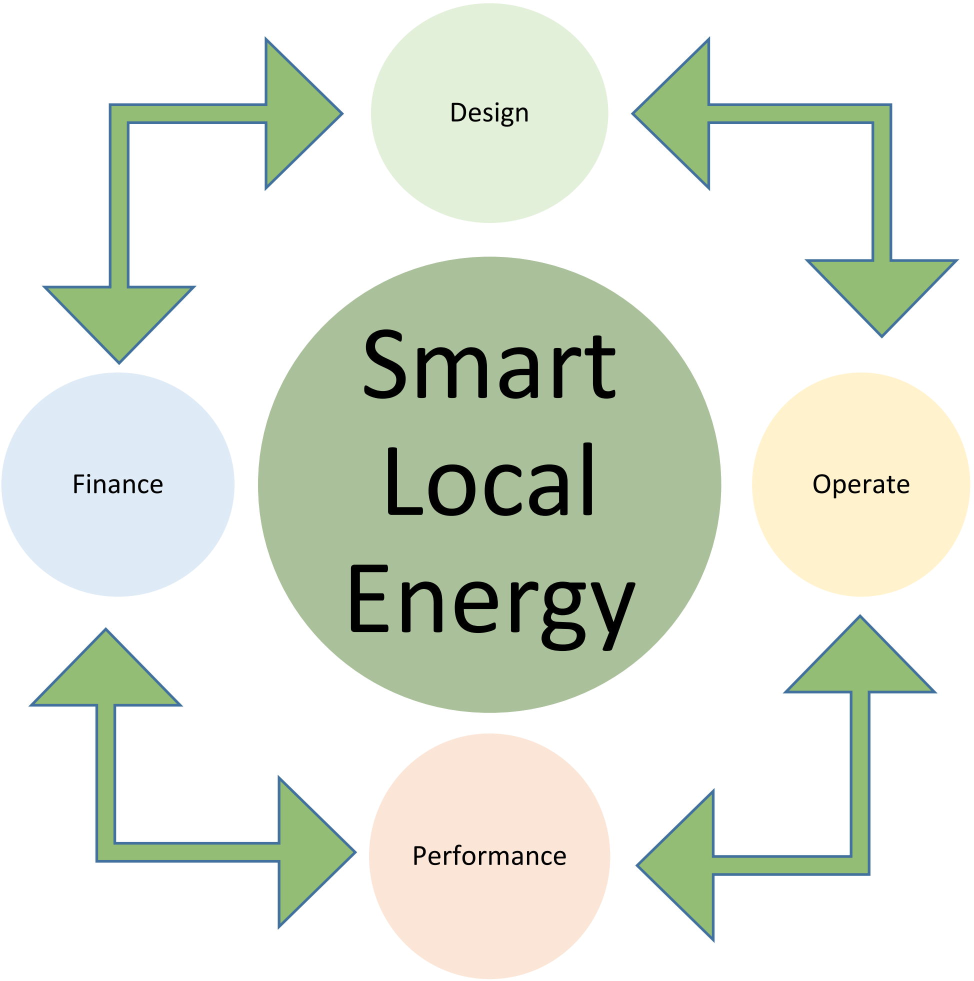
Identified 2 sites for large scale photovoltaics – Ph.1 c6MW

Potential for further PV Farms and connection to wider networks

Fully modelled Warwick's HV Network, and understand impacts

Liaising with Local Authority and WPD

Warwick - Smart Local Energy Network - Team



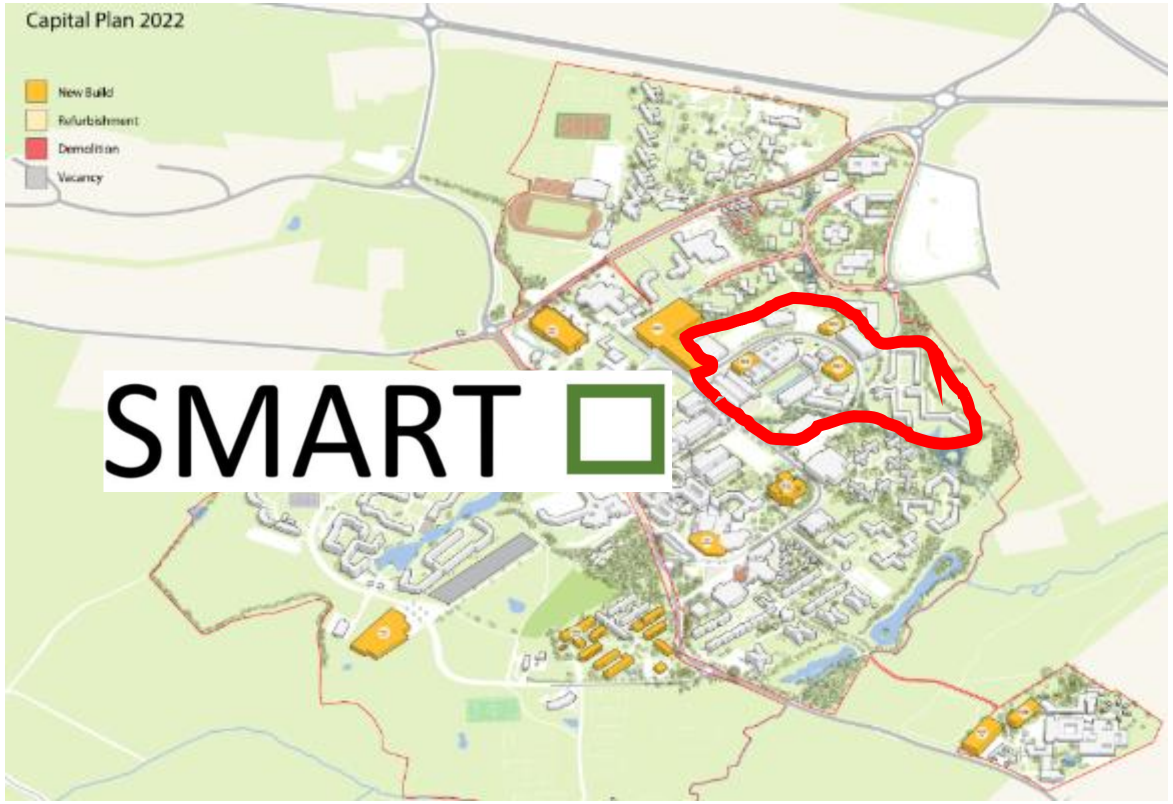
Benefits...

- Supports the Net Zero Carbon strategy
- Informs and supports financial planning
- Raises engineering standards
- Reduces reactive and disruptive maintenance
- Improve Estates service delivery...

- Structured Approach
- Defined Roles and Responsibilities
- Target setting
- Performance monitoring
- Collaborative working
- Alignment of Estates outputs
- Focus group to develop strategy (similar to EIG)

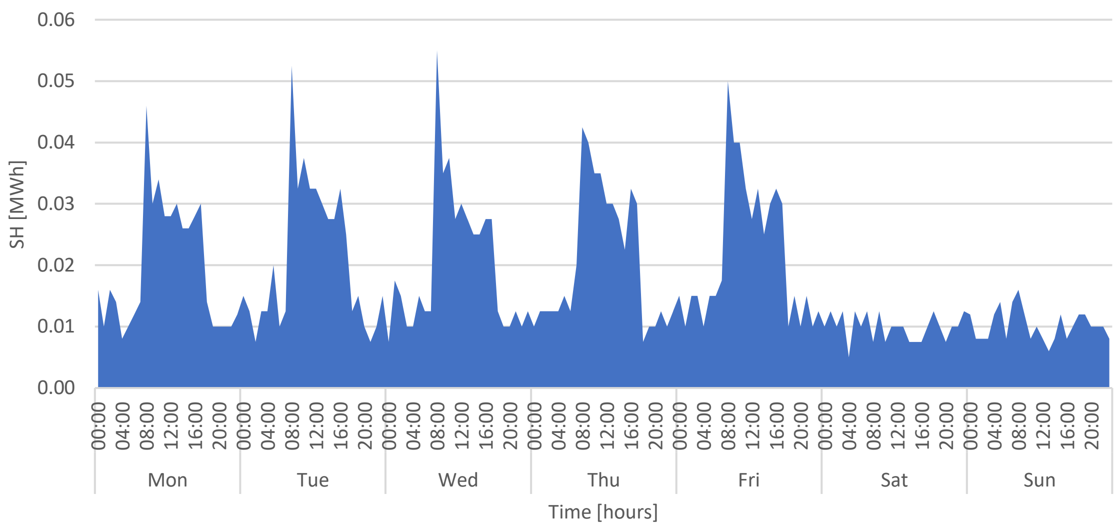
Case Study: Warwick – Smart Square

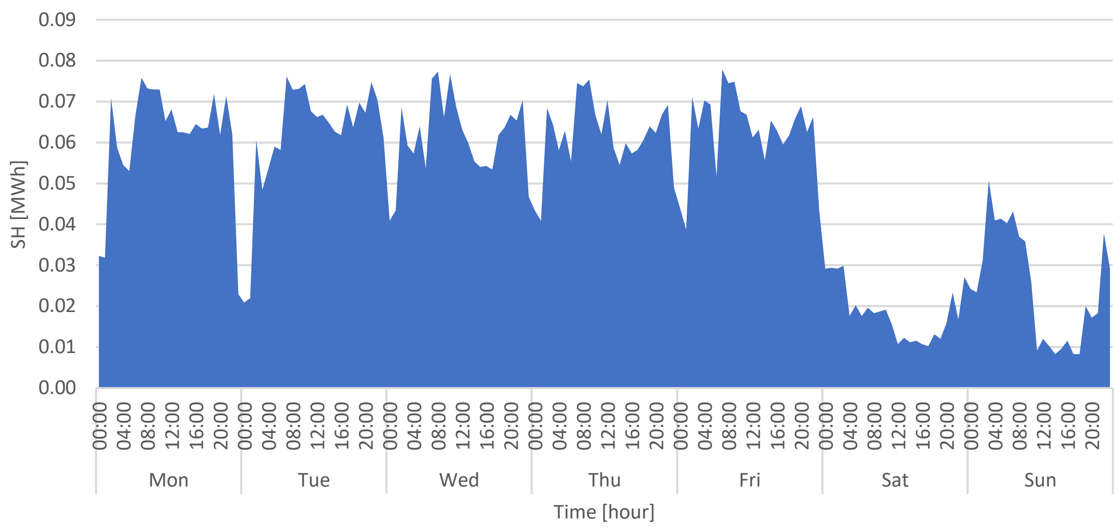
- Upgrades 10% of campus:
  - Lower temperature heat network
  - Integrated management across power, heating, cooling and transport
  - Smart building demonstrators
  - Opportunities for a transactive energy platform.
  - Significant levels of monitoring and control in place that provides actual building and network performance.
- Achieving a smart, flexible, local energy system
  - Cost and carbon
  - To be rolled out across Warwick, and beyond…

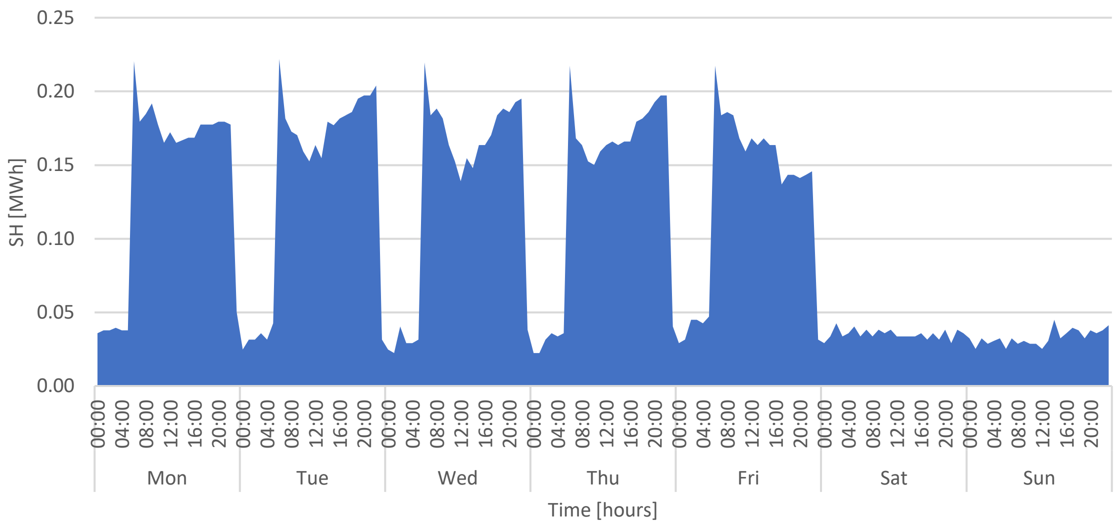


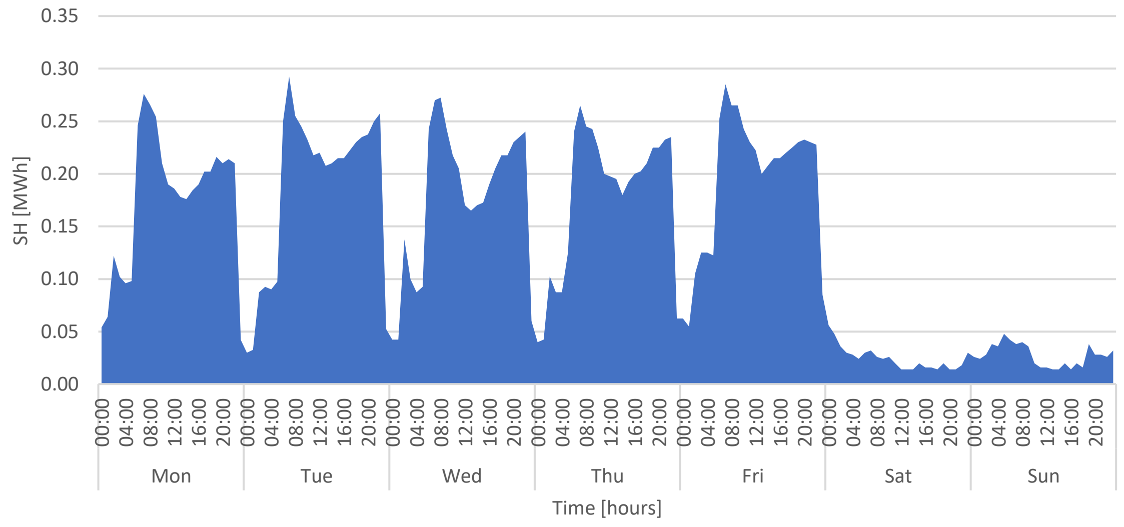
Case Study: Warwick – Smart Square: inside the buildings

- With the studies for making Smart Square a low temperature network nearing completion, the LoT-NET work looks inside the buildings
- Can the thermal mass of buildings be used to smooth out heat loads?
  - Smoothing to reduce heat peaks at campus level avoids £1-2M capital expenditure on decarbonised energy capacity
- What is the effect of lowering overall building temperatures?
  - Highly topical in the current energy cost crisis
- Do we know enough about energy use within buildings to target action?
  - Resetting existing control systems that have drifted
  - Avoiding hot/cold spots, especially as overall temperatures are lowered









↓ Peaks ↑ Heating time

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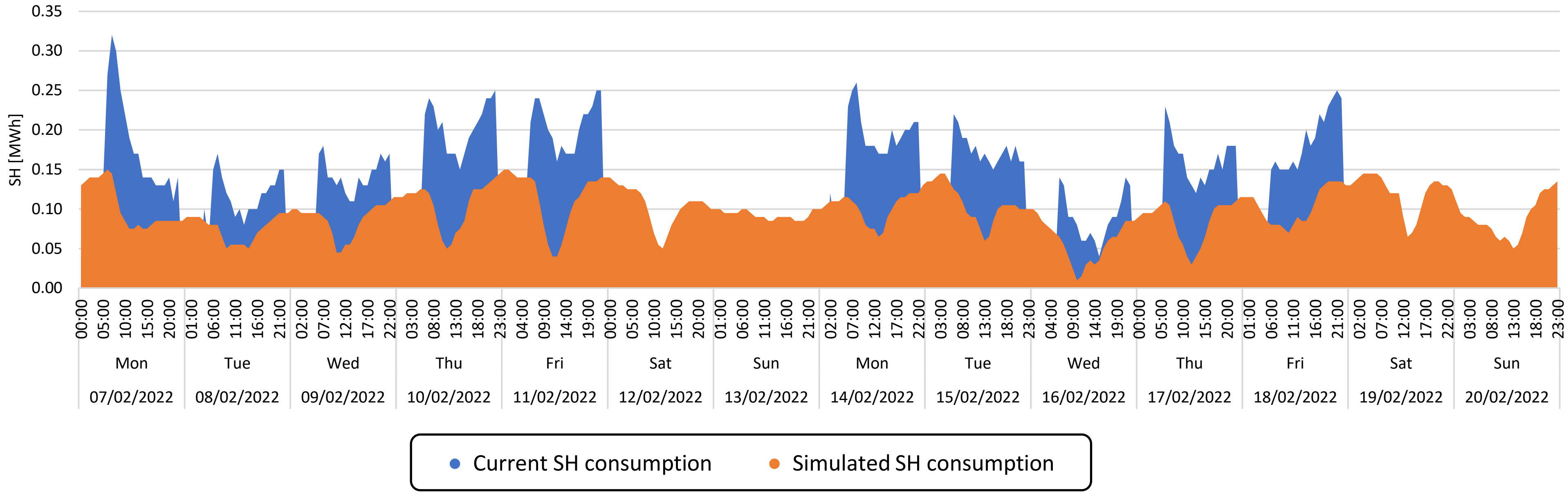
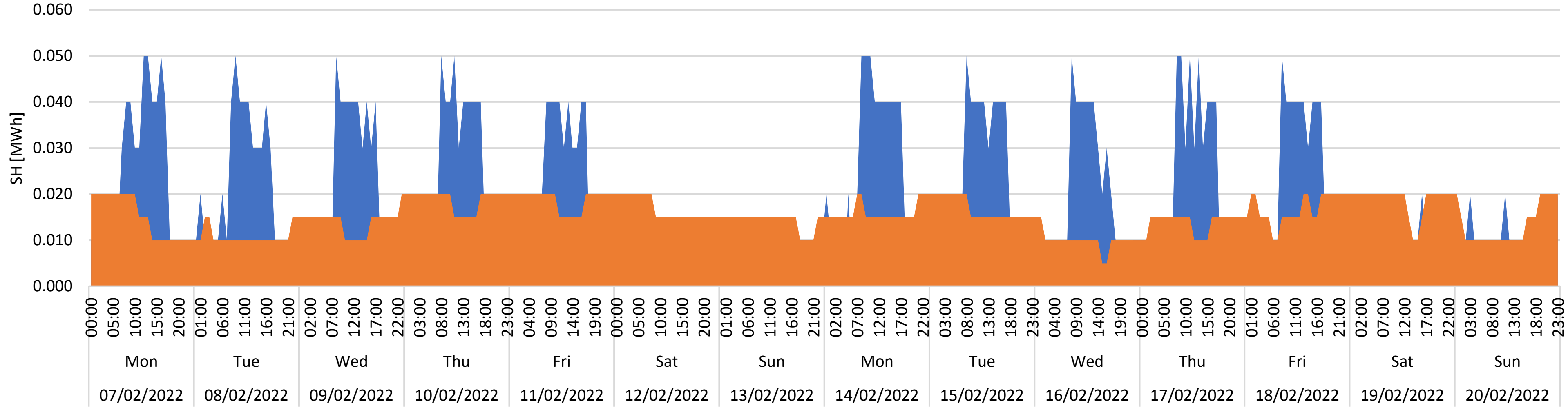


Current max SH [MW]
0.350
Simulated max SH [MW]
0.155



Current max SH [MW]
0.07
Simulated max SH [MW]
0.02

↓ Peaks ↑ Heating time

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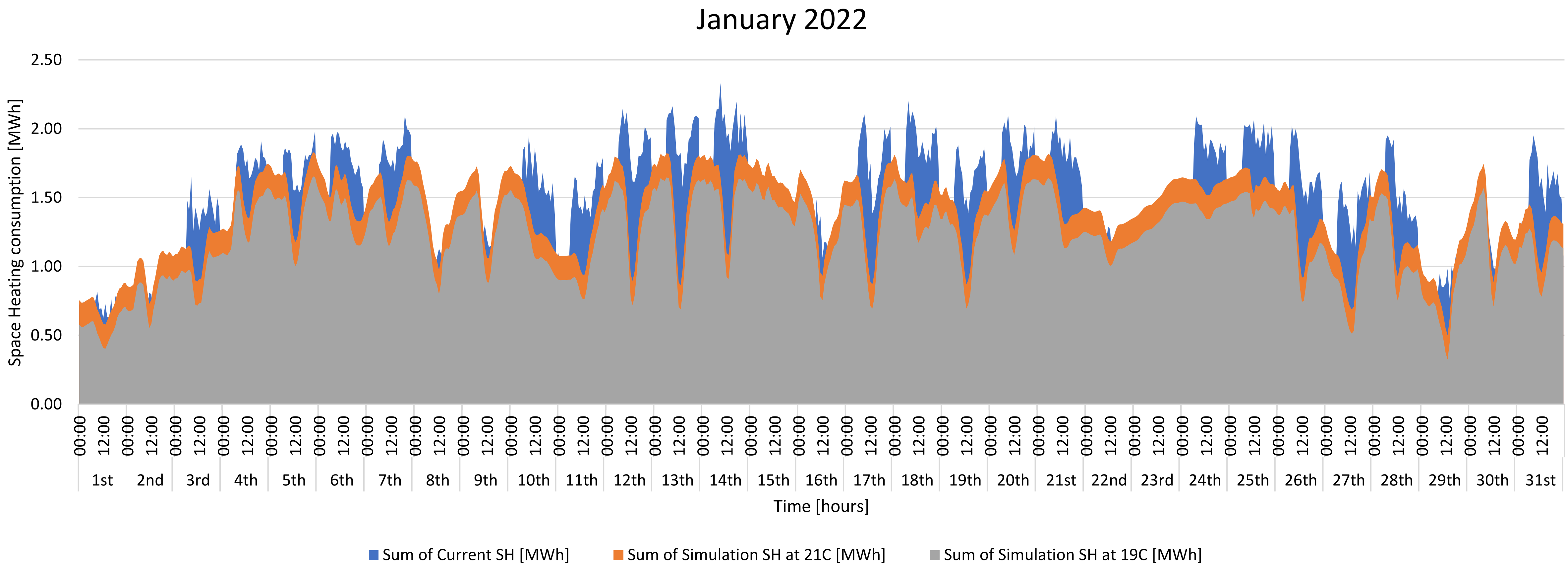
Current SH [MWh]	Simulation SH at 21°C [MWh]	Simulation SH at 19°C [MWh]
1071	1036	905
Current max SH [MW]	**Simulation max SH at 21°C [MW]**	**Simulation max SH at 19°C [MW]**
2.33	1.83	1.65

Drop of 7.5% energy per °C



Space temp. reduction

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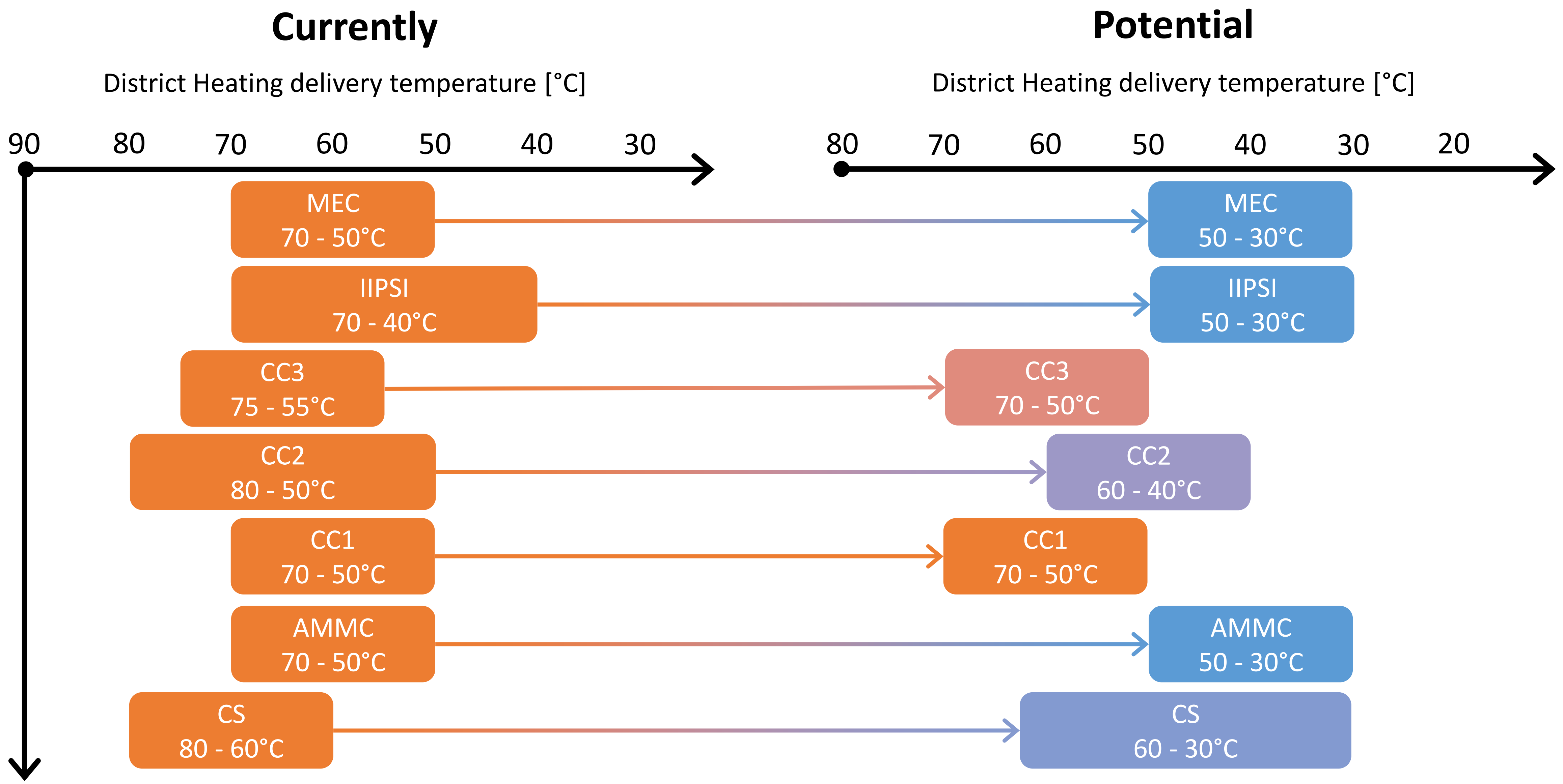


↓ DH delivery temperature

“Smart Square”: Inside the WBS building

Consumption Types	Energy Consumption (KWh)	KGCO2e	Percentage of CO2e	Percentage of Consumption
District Heating	1,539,870	362,177	46	44
Unknown Electrical Load	726,291	168,907	21	21
HVAC	301,300	70,071	9	9
Gas Heating	332,419	60,899	8	10
Plug Sockets	171,265	39,830	5	5
Lighting	152,236	35,404	4	4
Servers	87,218	20,284	3	3
Chillers	80,875	18,808	2	2
Kitchen	55,503	12,908	2	2
Electric Heating	9,515	2,213	0	0
External Lighting	4,757	1,106	0	0

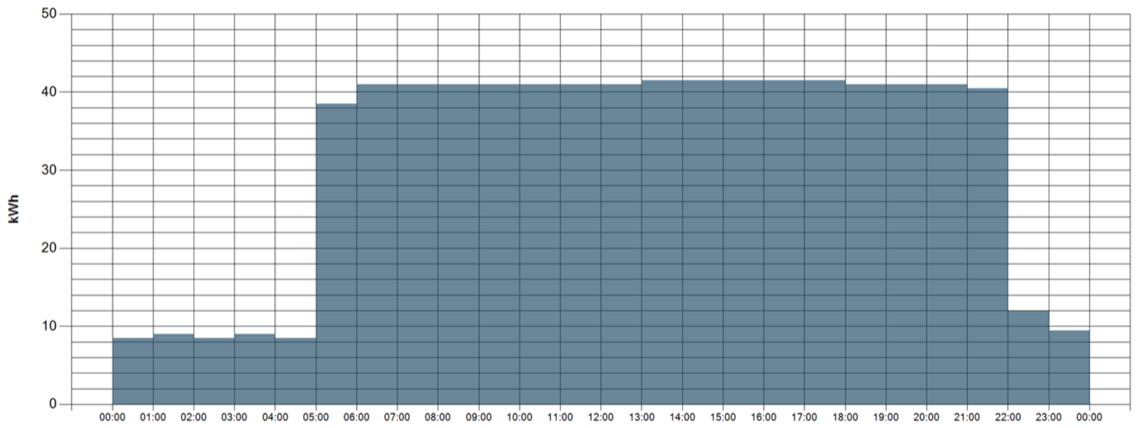
“Smart Square”: Inside the WBS building

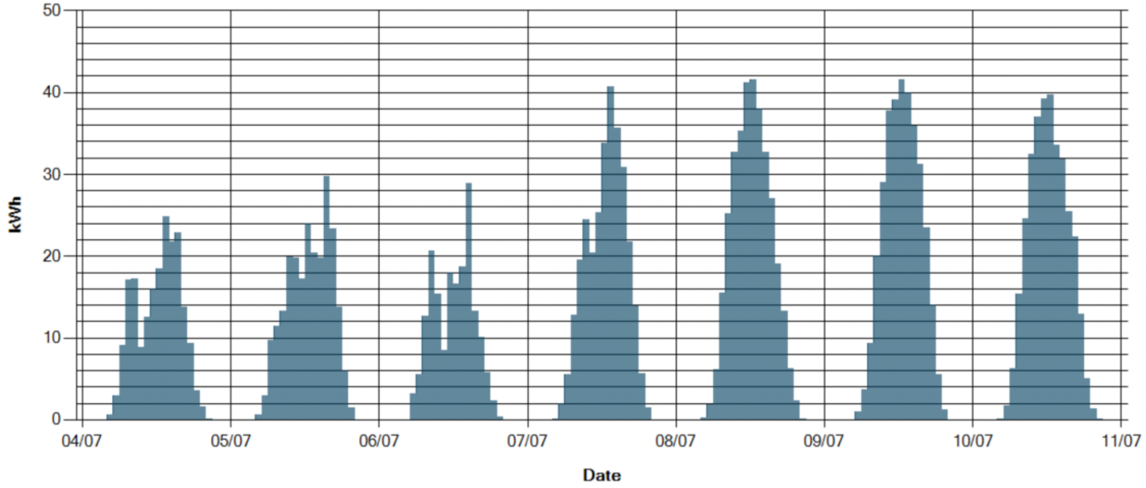
HVAC/Heating: Settings & Monitoring

<u>Settings</u>
- On maximum from 5am – 10pm
- Set to 21^{o}C throughout the year

<u>Controls</u>
- No sub-metering in Phase 1 & 2
- Limited heat control in Phase 1
- Single Thermostat in Phase 2

<u>Maintenance</u>
- Heating system has not been recommissioned despite numerous changes





LoT-NET SMART

“Smart Square”: Inside the WBS building

- Proposed changes: Estimated cost £5,000.
  - Heating & Cooling
    - Reduce heat setting to 18°C during the day and 16°C at night.
    - Increase cooling setting to 25°C.
  - HVAC
    - Change from on during the day to CO_2 & motion sensor controlled.
  - Monitoring
    - Install Wifi-enabled thermometers in Phases 1&2.
  - Maintenance
    - Recommission Heating System to improve efficiency.
- Annual Carbon Reduction = 138,373 – 160,214 KgCO2e (17-20%)
- Annual Cost Reduction: £73,000 (2022 prices)

Getting to Net Zero: Category A, B, C

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BEMS Controls Improvements (Ph.1)

Software, setpoints, timeschedules etc…

Target Carbon Saving = **1,800t pa**

Heat Pumps (Cryfield + Smart Square)

Smart Square and Cryfield Energy Centre

Target Carbon Saving = **6,600t pa**

BEMS Controls Improvements (Ph.2)

Controls strategies, efficiency investments

Target Carbon Saving = **900t pa**

Smart Local Energy Infrastructure - Opportunities

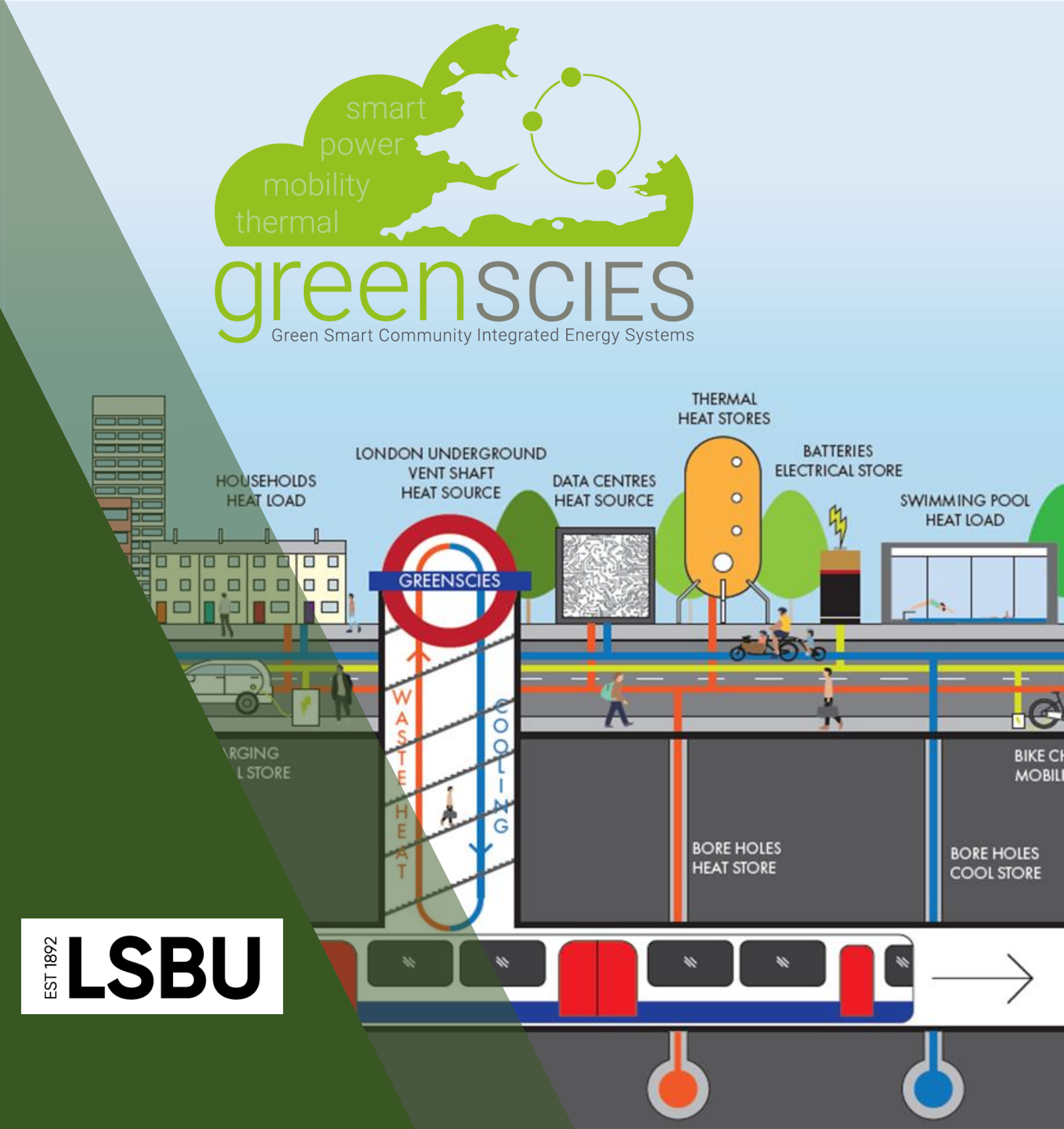
Heat Network – System Efficiencies feasibility **c£60k**

(PHE separation / pump efficiencies / network balancing / system pressure / system temperature / hot water demands / thermal storage strategy / system hydraulics / ventilation impact / network control strategy)

Case study: Islington

GreenSCIES

Graeme Maidment & Akos Revesz- London South Bank University



EST 1892 LSBU

GreenSCIES

greenSCIES

Green Smart Community Integrated Energy Systems

smart power mobility thermal

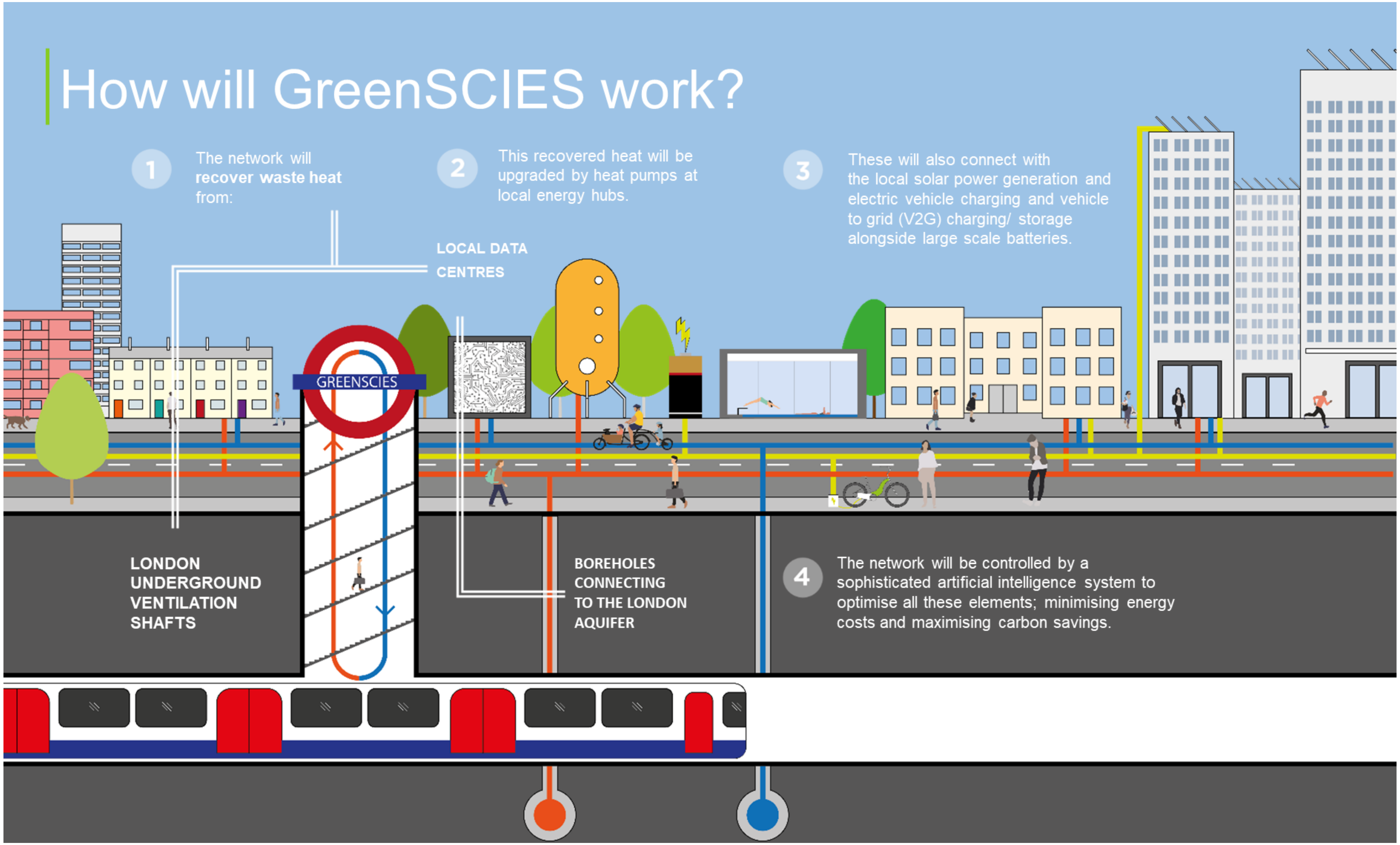
The GreenSCIES Project

- A ground-breaking project for a unique, investable and local energy system
- A consortium of 15 partners
- Developing innovative technical/ business approaches to minimize carbon emissions, and local pollution. limit consumer bills
- A community-based project with wide stakeholder engagement including local residents, businesses and policymakers.
- Funded by Innovate UK.
- Focus on the LBI with a clear path for replication elsewhere in the UK.

Community

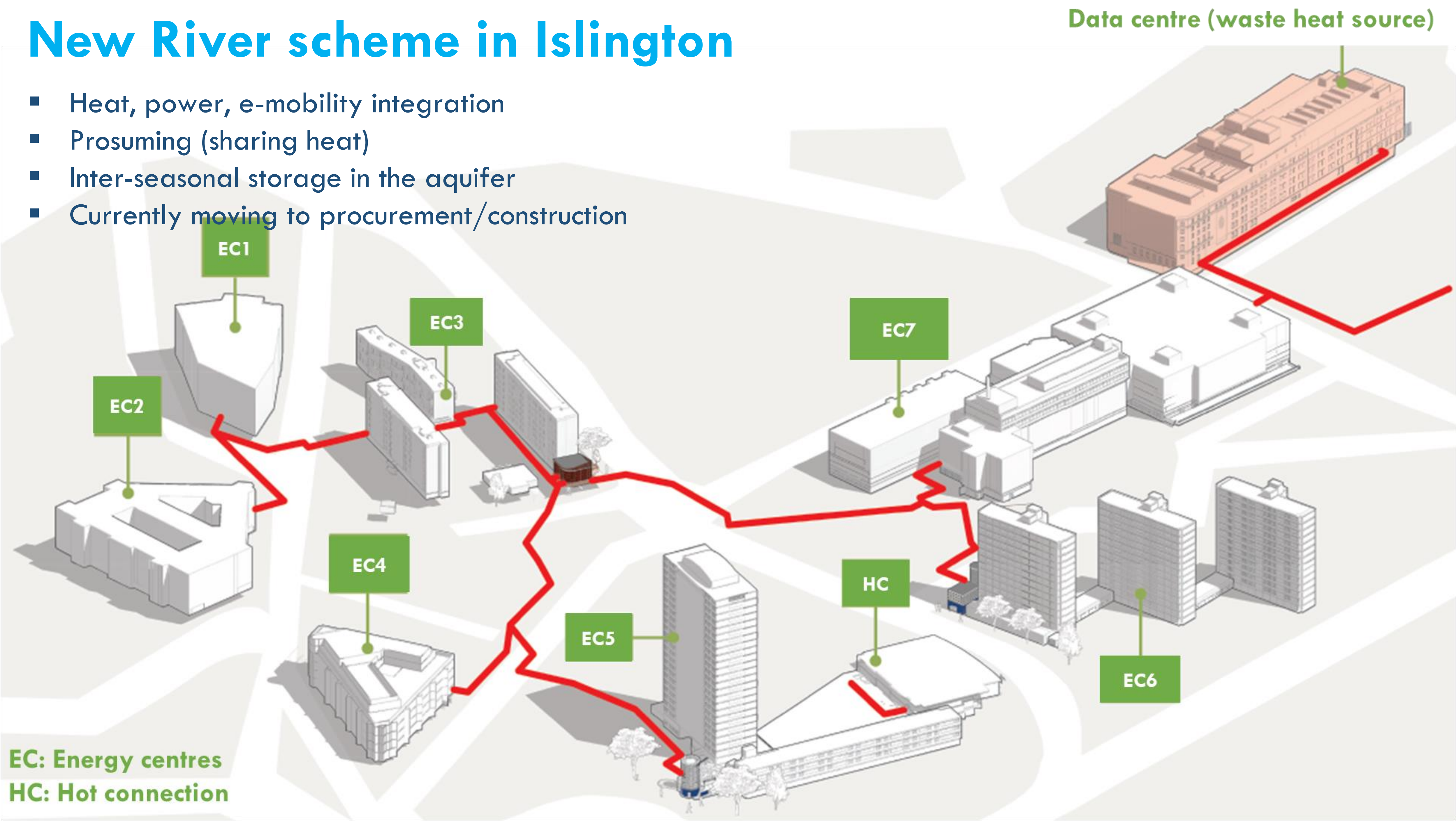
Cost

Clean



New River scheme in Islington

- Heat, power, e-mobility integration
- Prosuming (sharing heat)
- Inter-seasonal storage in the aquifer
- Currently moving to procurement/construction



GreenSCIES Dashboard – New River

2,208 households/
8,832 people
connected locally

£16m
investment

44,026 MWh/yr
Low carbon energy
supply

10 businesses and other
organisations connected

Fuel poverty mitigation
for 242 households

5,709 Direct CO2 reduction t/yr

5489 MWh/yr
Total Energy Use
Reduction

440-1,342 kW EV Charging capacity
enabled by GreenSCIES

Direct Economic Impact
£2m

50 Jobs

REPLICATING GREENSCIES

- Construction in Islington
- 5 new feasibility studies
- Borough wide decarbonisation in Islington

Delivery of New River Scheme

Community Participation

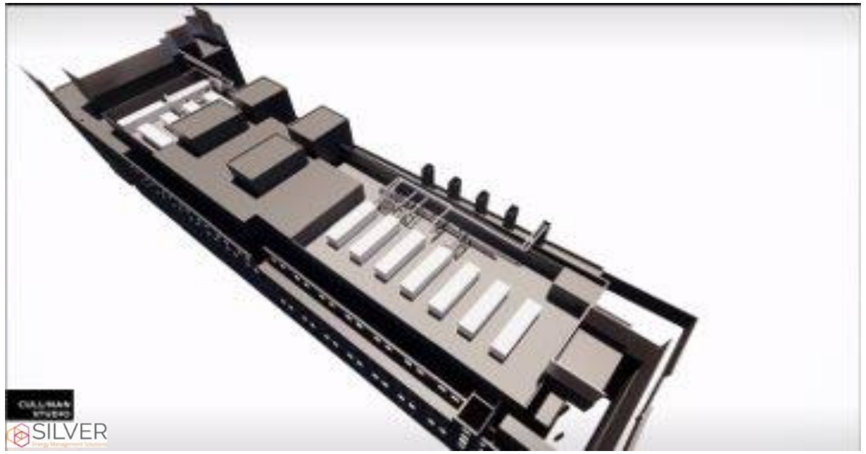
Key Features

- Part of a wider effort to accelerate movement towards net zero
- Carbon Savings (5,000 Tonnes CO_2 per annum)
- Affordable energy (23,000 MWh heat per annum, plus cooling)
- Place Making – improvements to the public realm
- Community engagement and delivering social value
- Designed to grow – design provides for load of up to 8MW from data centre and anticipates expansion and connection to a wider network over time.

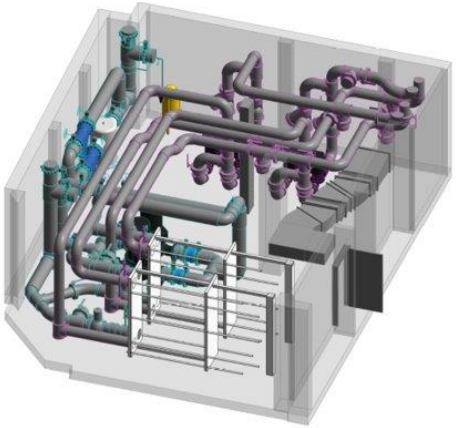
Addressing Key Challenges

- Resilience
  - Short term operational
  - Long term (additional heat sources)
- Growth and Master Planning
  - Responding to demand
  - Realising the wider ambition
- Commercialisation & Delivery
  - Supply chain appetite and capability to deliver
  - Customer Uptake
  - Planning and spatial integration
- Value Proposition
  - Navigating external factors & uncertainty
  - Confirming the long term return on investment

Energy Centres



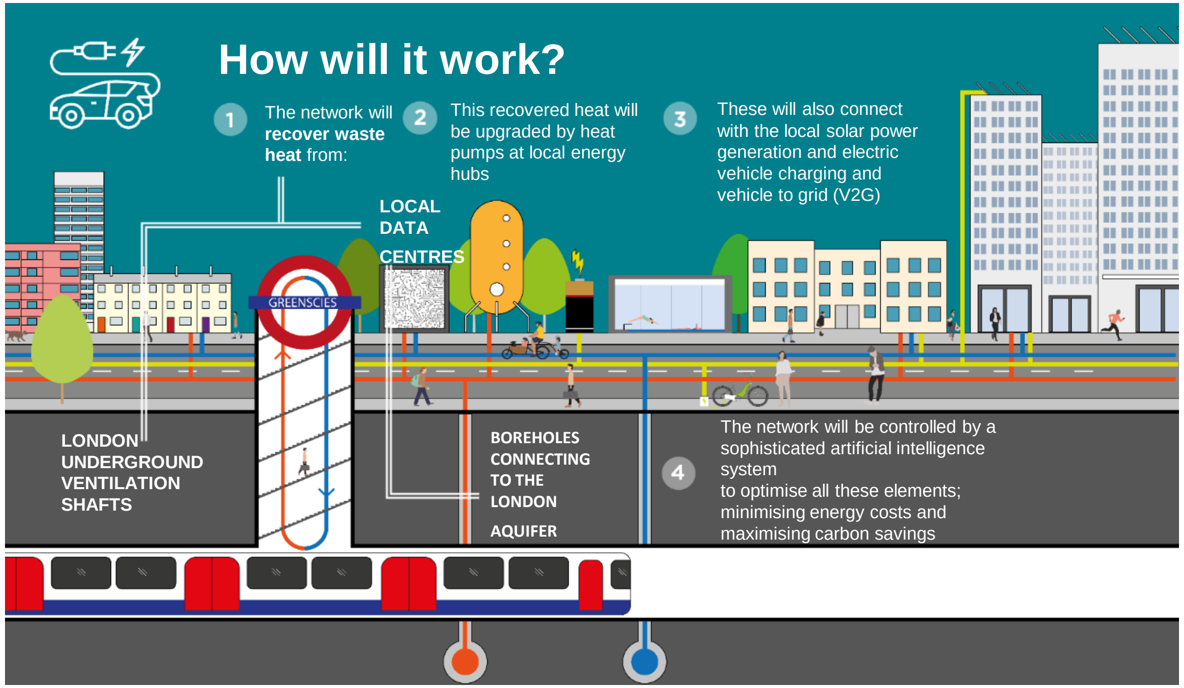
Design development

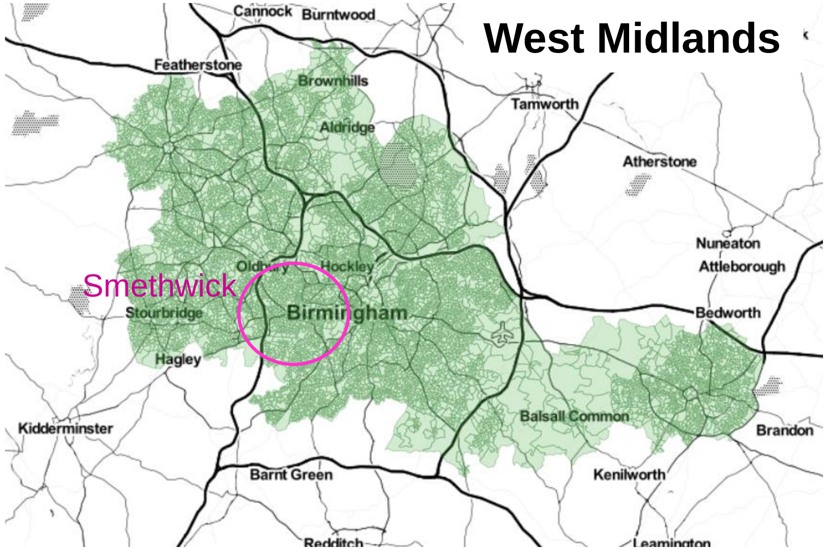


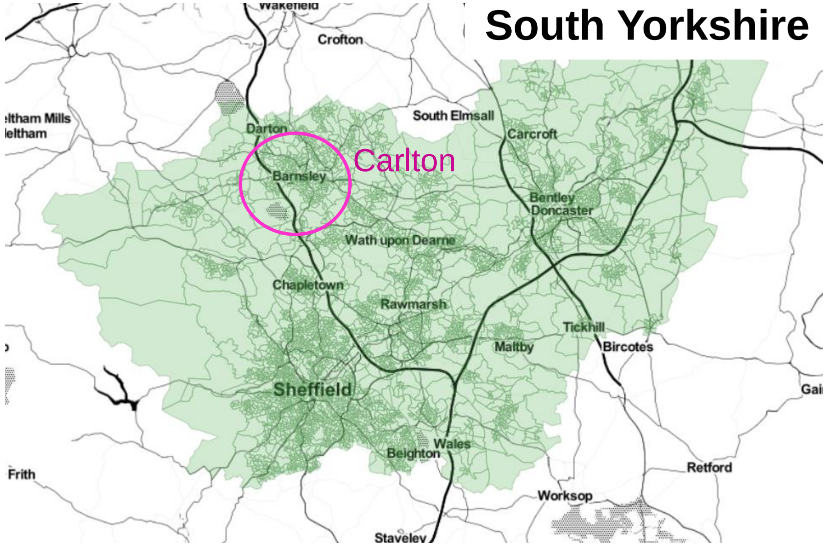
Detailed Technical Studies

Replicating the GreenSCIES Concept

SLES with integrated heat, power and transport







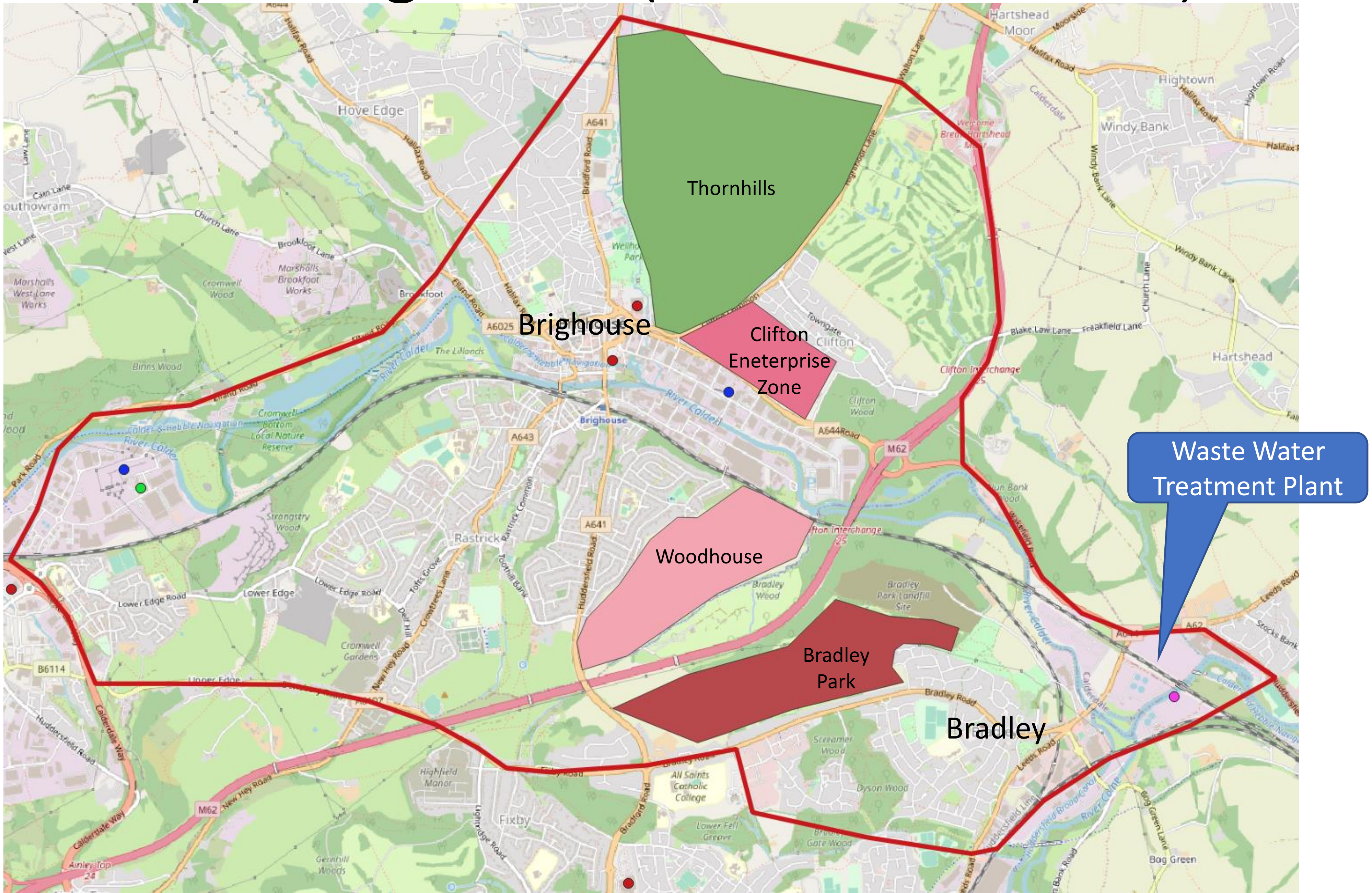
Case Study - ASDA Supermarket (Bedminster Bristol)

Factory No 1 development

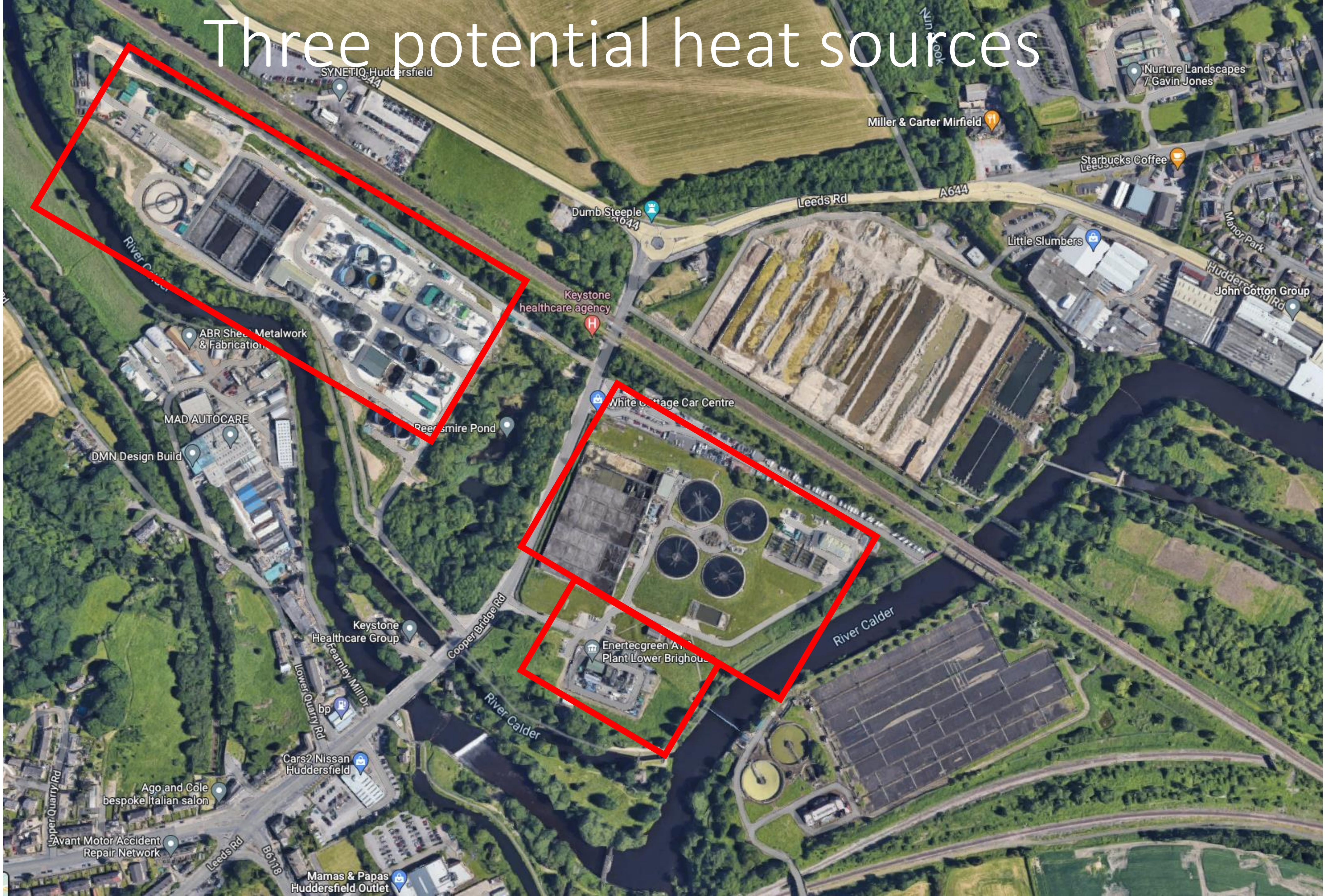
- 284 dwellings in 8 blocks
- Gas boiler Communal heating
- Right next to Asda (to South)

https://www.cityandcountry.co.uk/find-a-home/factory-no-1-bristol

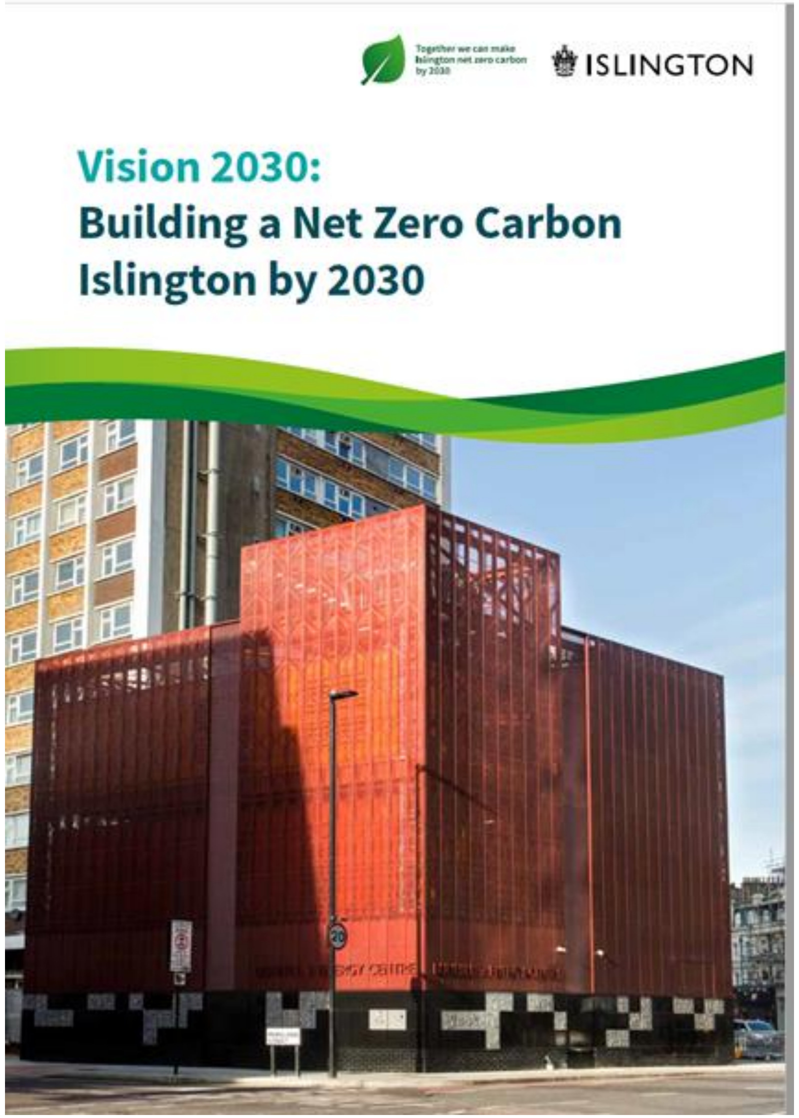
Case Study – Brighouse (Calderdale MBC)



Three potential heat sources



GreenSCIES Influencing Vision 2030



- Options appraisal
- A blueprint trial opportunity to inform the Council
- Influencing the Islington Zero Carbon Supplementary Planning Document (SPD)

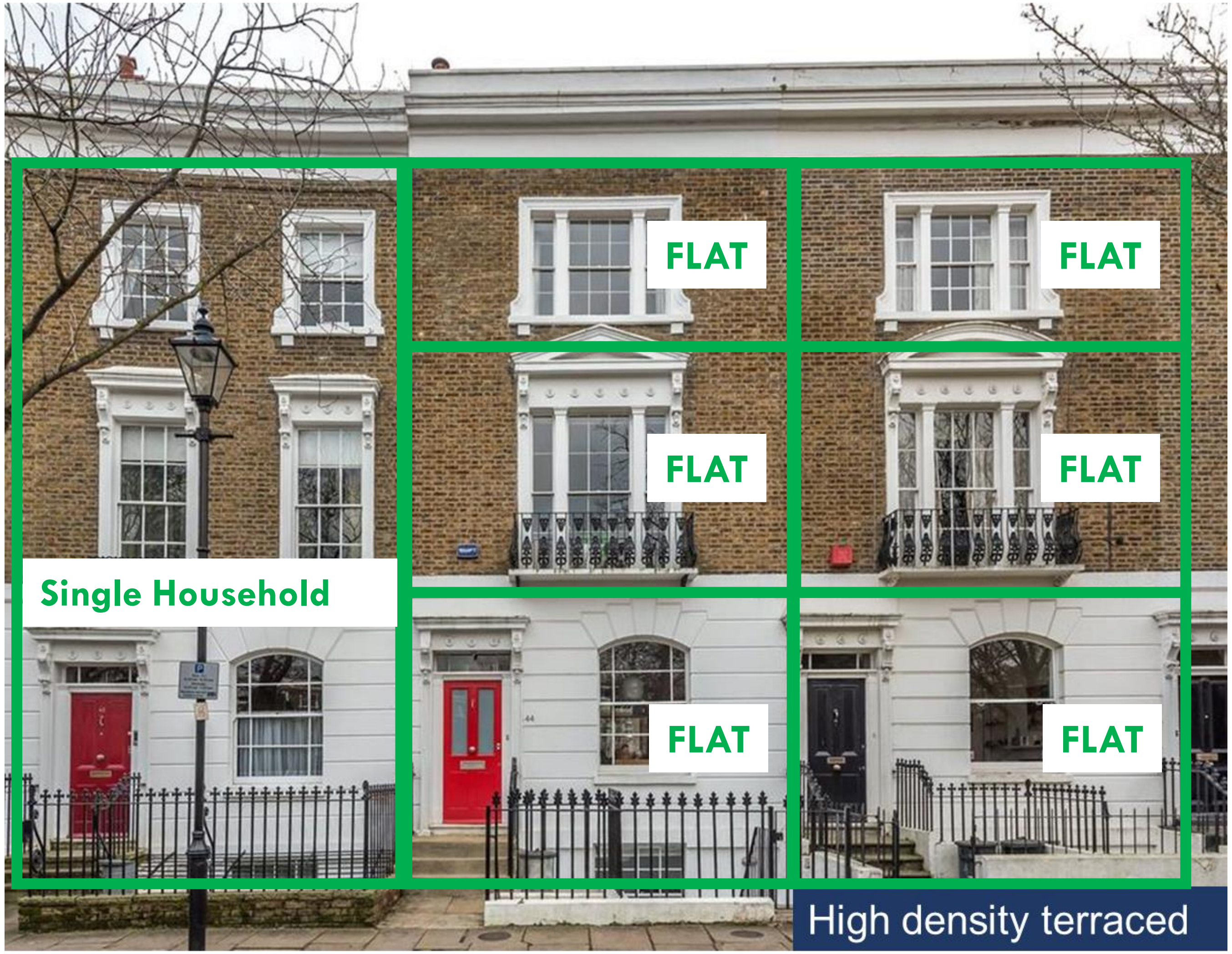
Influencing the wider Islington decarbonisation

- Great opportunity to investigate decarbonisation opportunities within the residential sector
  - Focus on residential stock (owner occupied & private rented)
  - Focus on terraced houses (both individual houses & converted flats)
  - Predominantly pre-1945 (~50% are in conservation areas)
  - How to influence private residents and landlords (able to pay & fuel poor)
- "Private residential sector is a challenging area to decarbonise!"



Where to focus?

Age & type of dwellings in high density terraces in LBI



Age

- Together ~ 39% of all residential properties
- Majority are pre -1945 (mostly pre-1919)

Location

- Predominantly in central and NE of LBI
- ~ 50 % are in conservation areas

Type of property

- Individual terraced houses: 13,402
- Converted flats: 24,650

Ownership

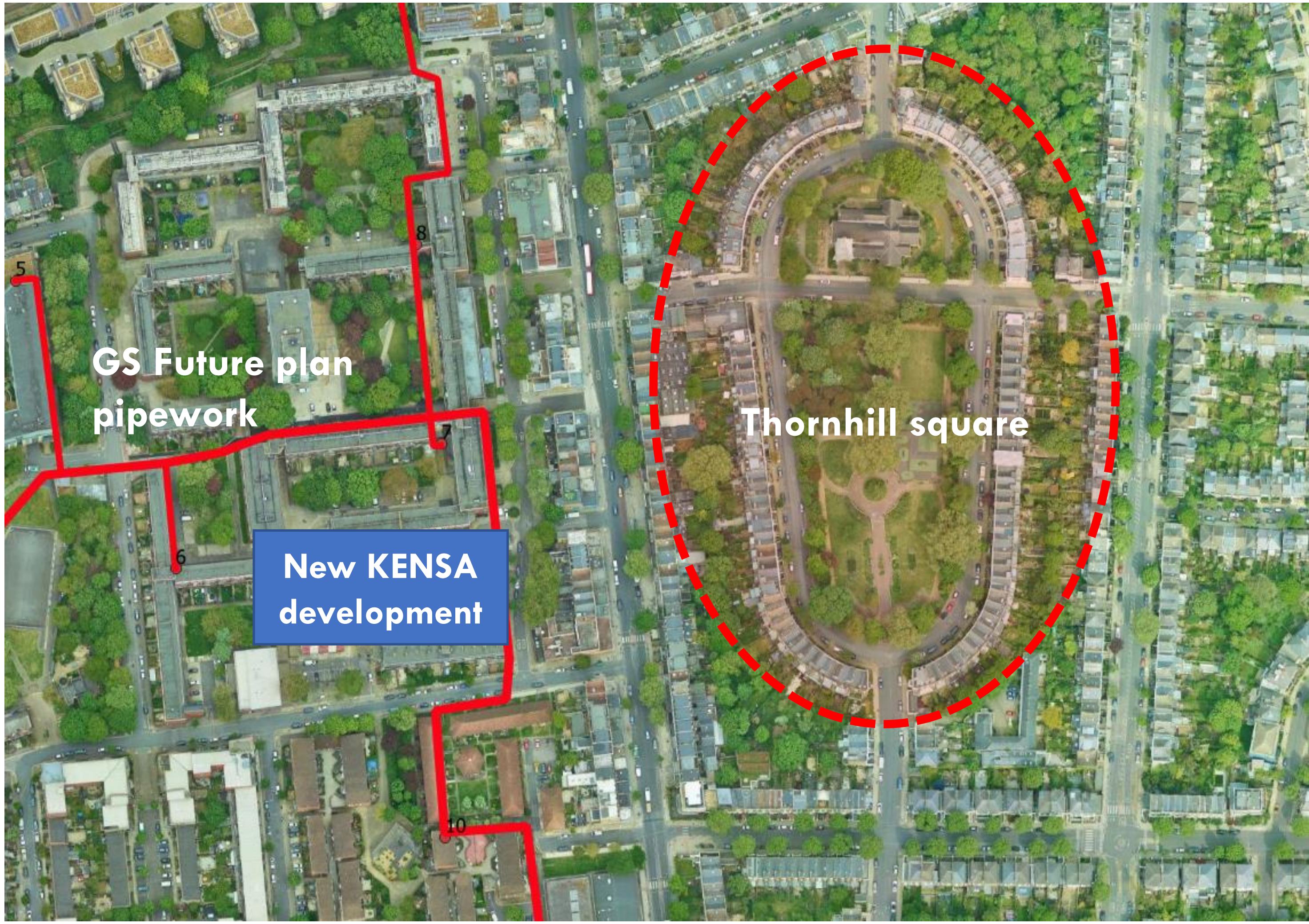
- Council owned
- Owner occupied
- Privately rented
- Housing association/Social landlord

Customer segment

- Able to pay
- Fuel poor

Potential focused study area: Thornhill square

- Pre-1919 Georgian terraces
- Conservation area
- High heritage value properties
- Poor energy efficiency
- Significant opportunity for improvements!
- A good representative street:
  - Both individual houses & converted flats
  - Both private and social housing
  - Both able to pay and fuel poor segments
- Lots of greenspace for shared infrastructure
- Nearby heat network opportunities (GS Future Plan, KENSA)



Conclusions

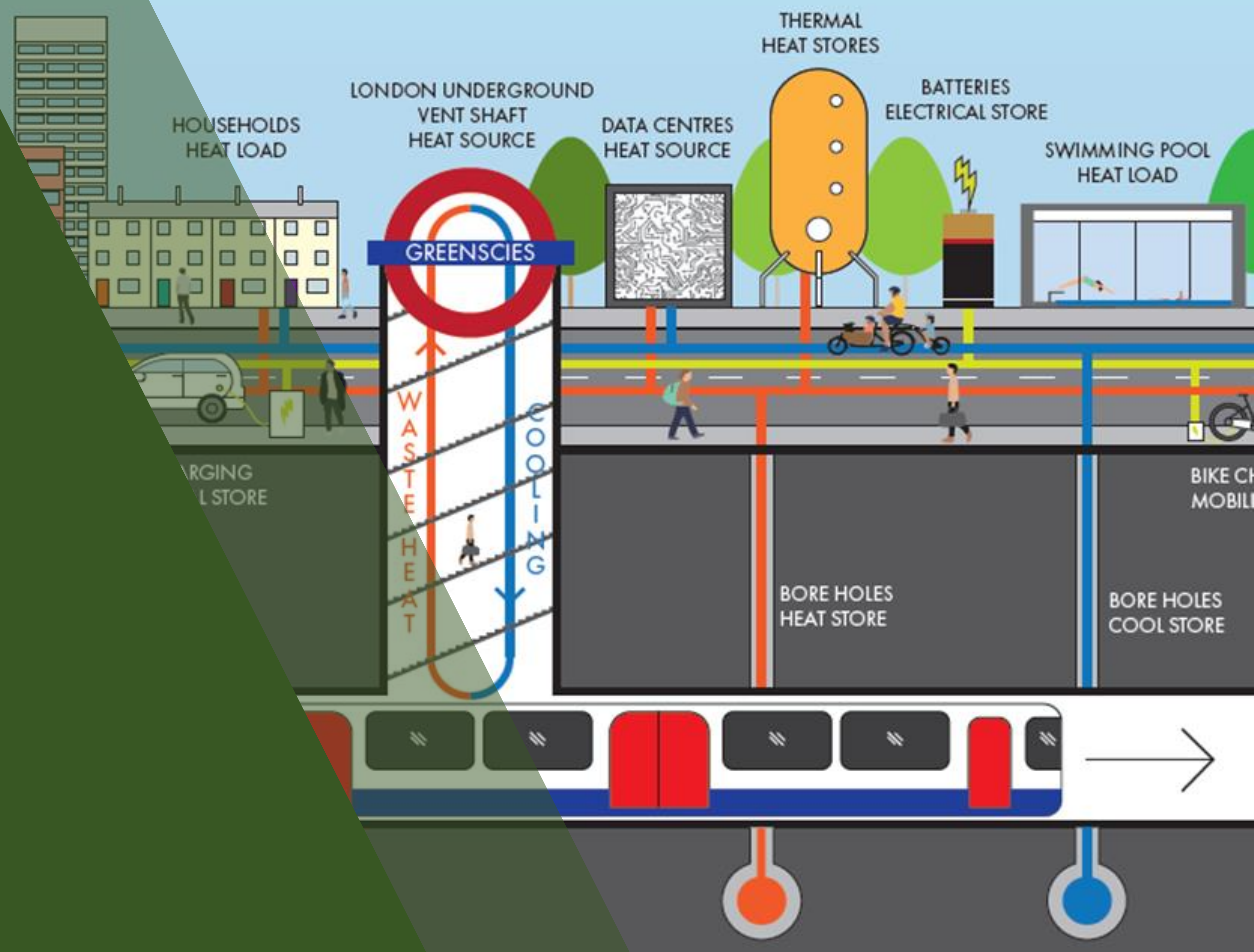
- The New River Scheme will demonstrate practical application of the GreenSCIES approach and provide the foundation for wider expansion of local energy networks across the borough
- In parallel GreenSCIES 3 has initiated work to support Islington's wider vision to achieve net zero – with a focus on parts of the complex urban landscape which are most difficult to address
- GreenSCIES 3 provides a catalyst for wider replication, building momentum and pace on a wide front

GreenSCIES

maidmegg@Lsbu.ac.uk

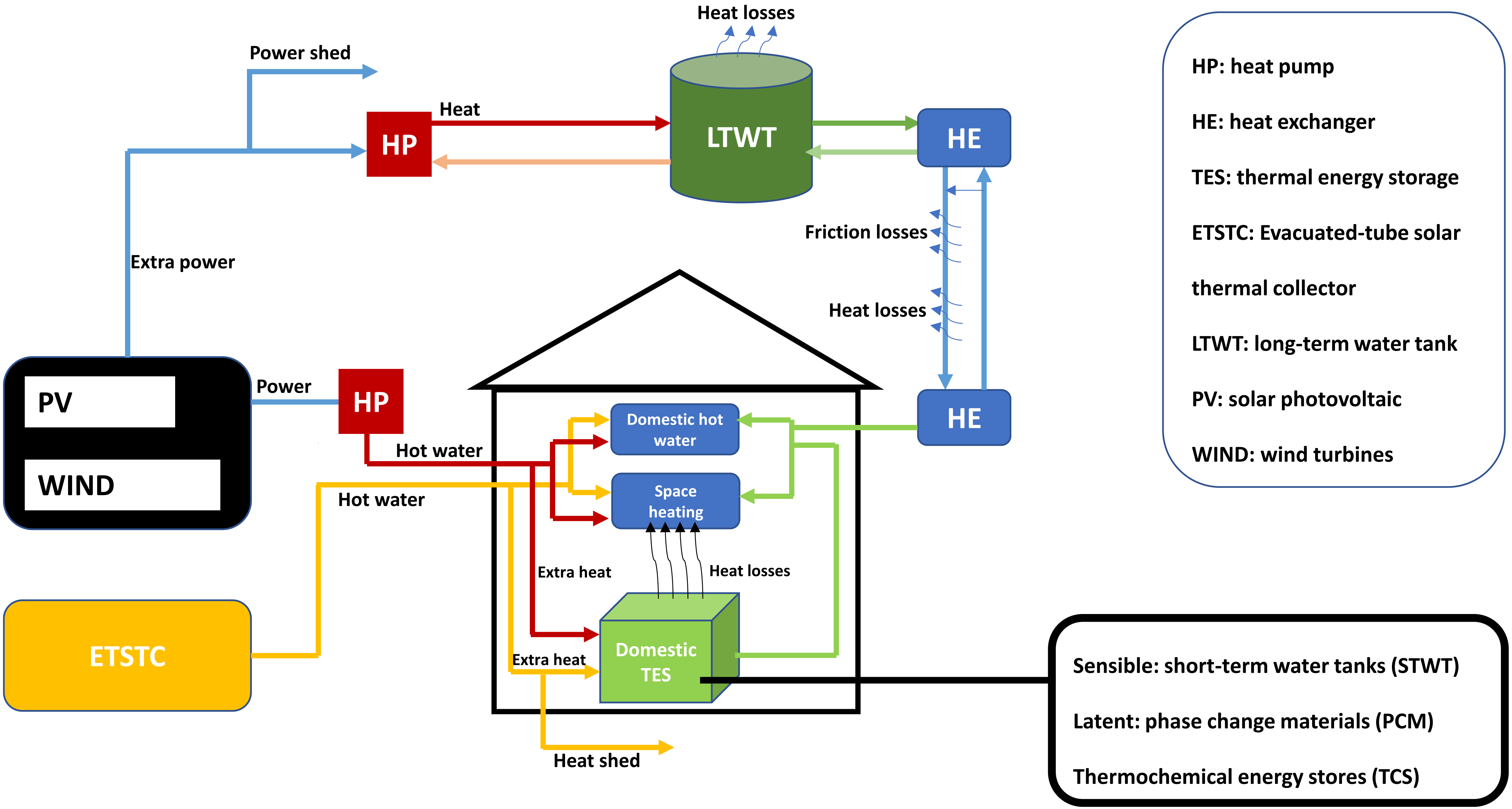
revesza2@lsbu.ac.uk

smart
power
mobility
thermal
greenSCIES
Green Smart Community Integrated Energy Systems

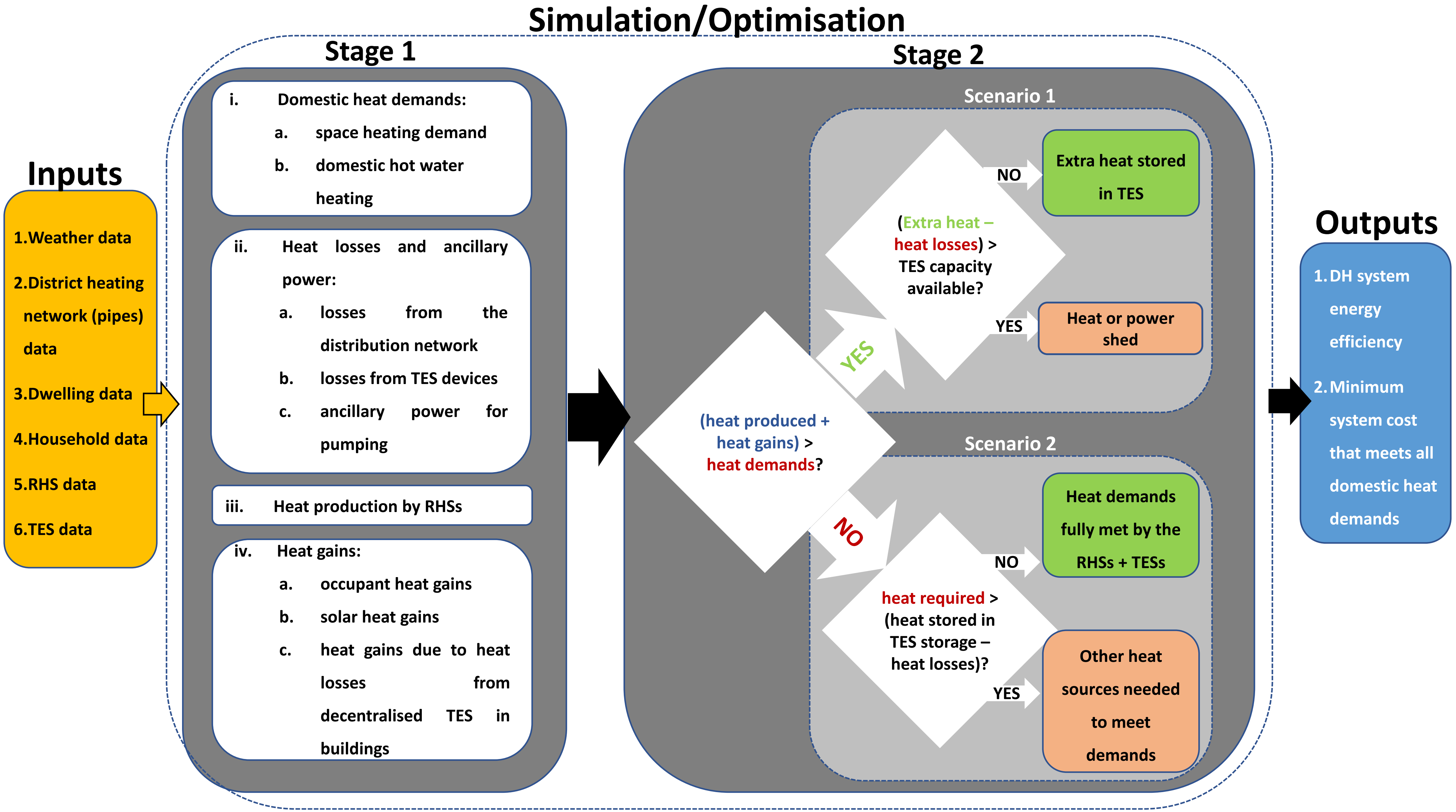


Case study: Loughborough

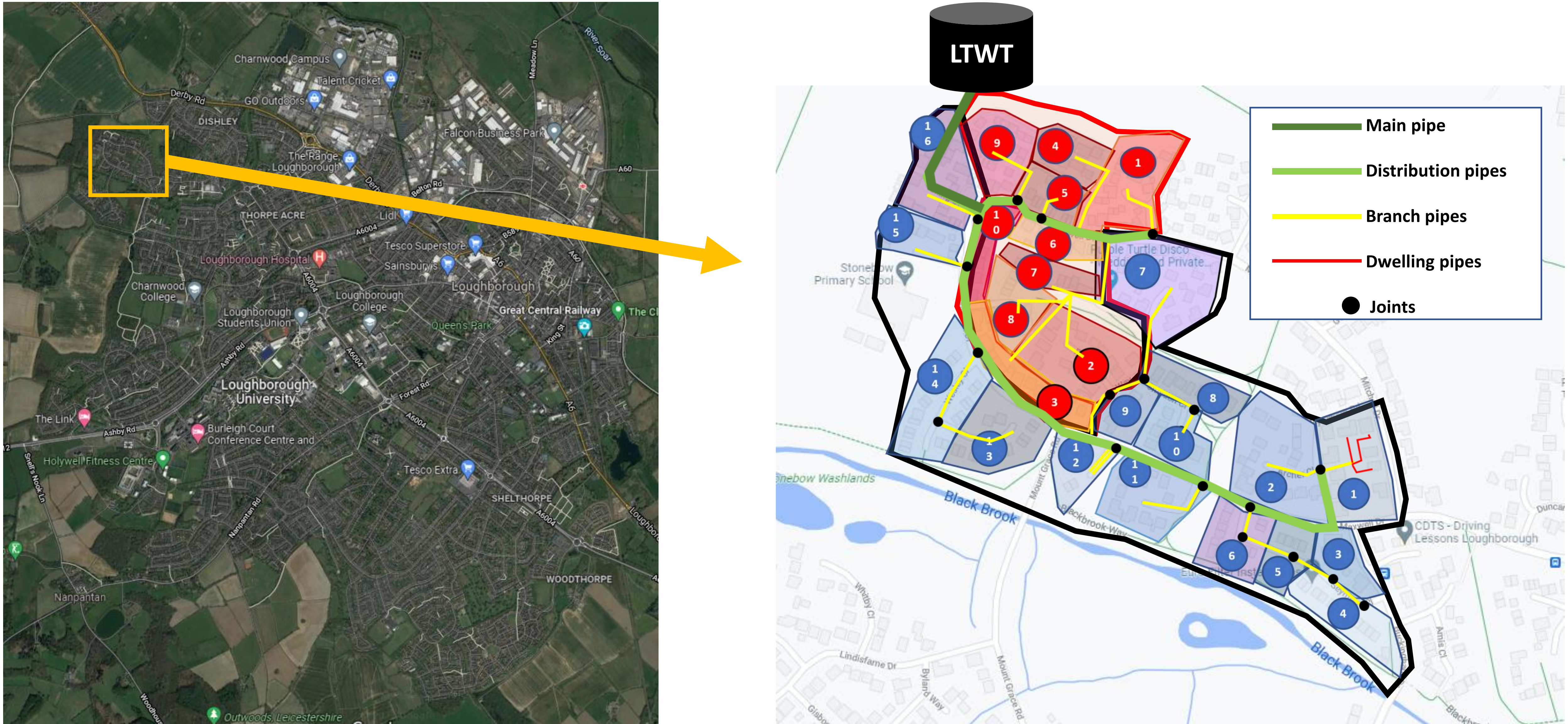
Methodology: schematic diagram illustrating the components and operating mode proposed for a fully renewable DH network.



Methodology: two-stage modelling approach adopted to determine the minimum cost system that ensures all domestic heat demands are met and the associated DH system energy efficiency.



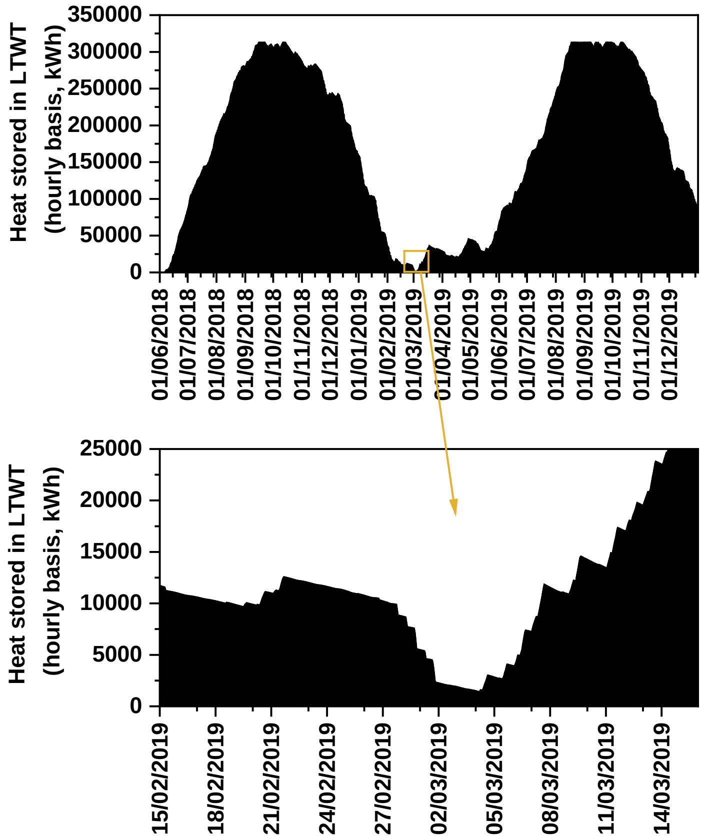
Methodology: Residential areas of the town of Loughborough considered for the simulations performed, illustrating the proposed layout of the DH network and the location of the LTWT.



Methodology: DH system optimisation.

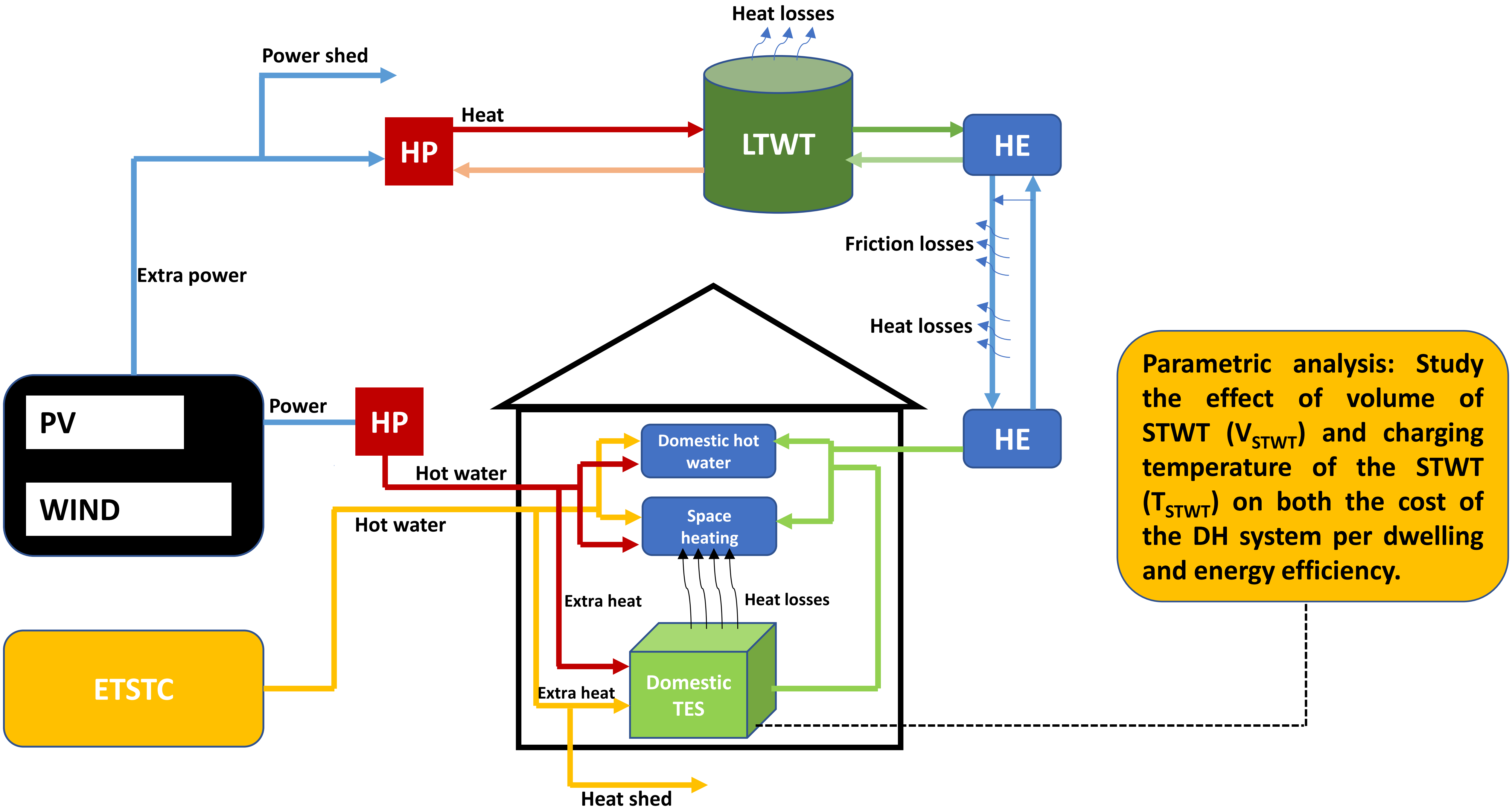
The optimisation was performed using the Microsoft Excel add-in program Solver. The Solver parameters introduced were:

- **Objective: Minimum cost per dwelling.**
- **Variables: the optimisation was performed by varying the following parameters:**
    1. **Installed capacity of PV.**
    2. **Installed capacity of Wind.**
- **Constraints: the following constraints were applied:**
    1. **Domestic heat demands to be met at every hour for the whole time-period simulated ($\Delta_{dem-prod} \leq 0$ kWh).**
    2. **$0.05\ LTWT_{max} \geq LTWT_{min} > 0$, where $LTWT_{min}$ is the minimum accumulated heat stored in the LTWT between 01/09/2018 00:00:00 and 30/06/2019 23:00:00, and $LTWT_{max}$ the maximum heat storage capacity of the LTWT**



Methodology

Results: Effect of volume of STWT (V_{STWT}) and charging temperature of the STWT (T_{STWT}) on both the cost of the DH system per dwelling and energy efficiency.

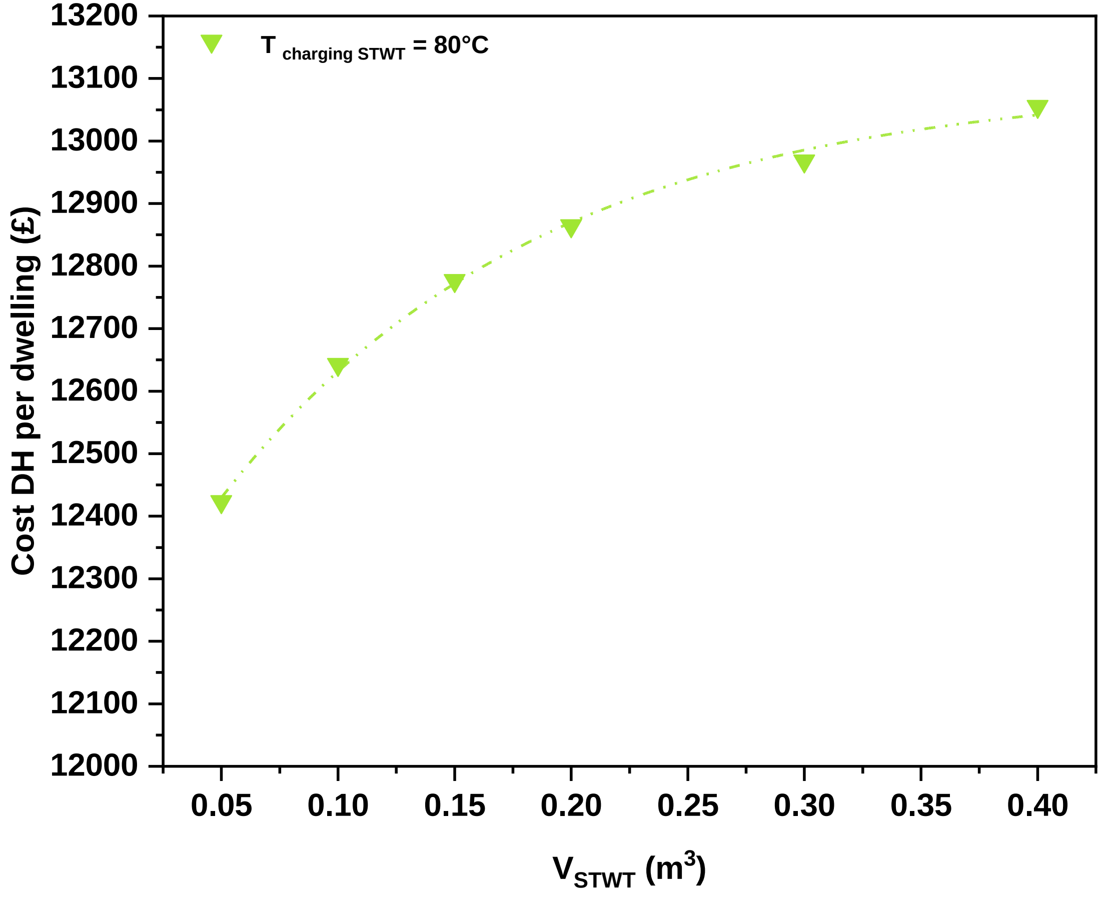

Heat losses
Power shed
Heat
HP
LTWT
HE
Friction losses
Extra power
Heat losses
PV
WIND
Power
HP
HE
Domestic hot water
Hot water
Space heating
Hot water
Extra heat
Heat losses
ETSTC
Extra heat
Domestic TES
Heat shed
Parametric analysis: Study the effect of volume of STWT (V_{STWT}) and charging temperature of the STWT (T_{STWT}) on both the cost of the DH system per dwelling and energy efficiency.

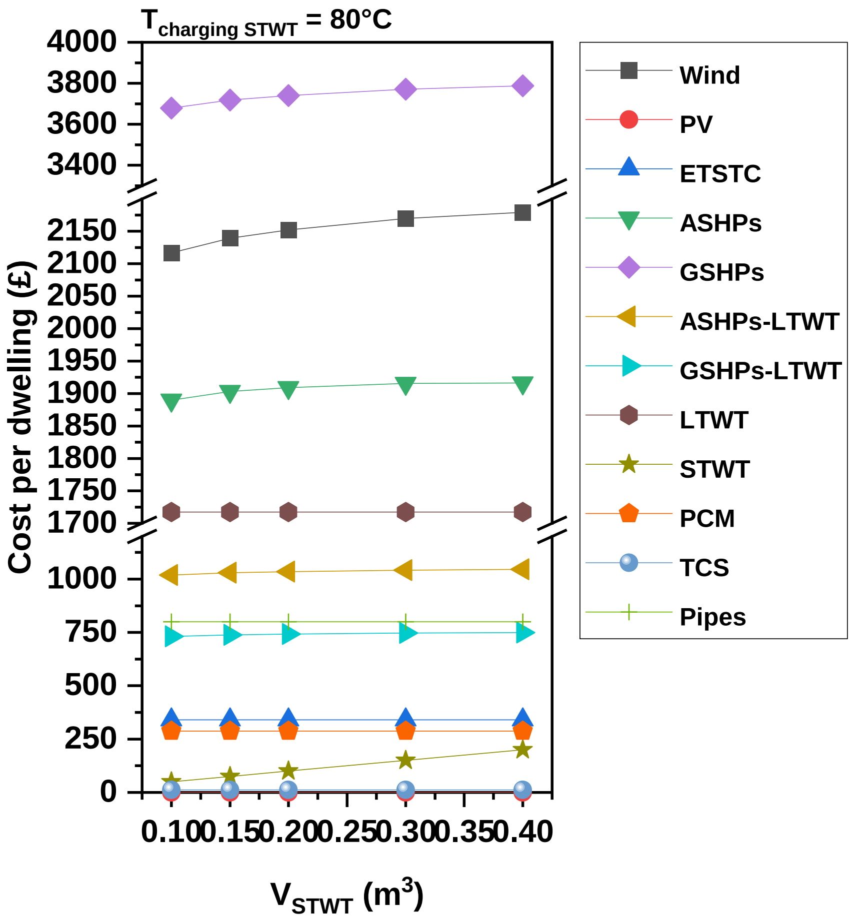
Main fixed parameters specified for the simulation.

Heat sources main parameters	
Renewable power sources used to power domestic HPs	
Wind installed capacity (MW)	Variable
Solar PV installed capacity (MW)	Variable
ETSTCs	
Area of ETSTC per dwelling (m^2)	2
HPs	
%ASHP	50%
%GSHP	50%
ASHPs capacity per unit (kW)	5
GSHPs capacity per unit (kW)	5
HTHPs capacity per unit (kWh)	15

TES system main parameters	
Deployment (% of dwellings with stores)	
STWT	50%
PCM	30%
TCS	20%
Charging temperature (°C)	
STWT	Variable (50 – 90°C)
PCM	50
TCS	120
LTWT	60
Volume	
STWT volume per dwelling (m^3)	Variable (0.1 – 0.4)
PCM volume per dwelling (m^3)	0.2
TCS volume per dwelling (m^3)	0.2
LTWT (m^3)	15000

Results: Effect of V_{STWT} on the average cost of DH system per dwelling.



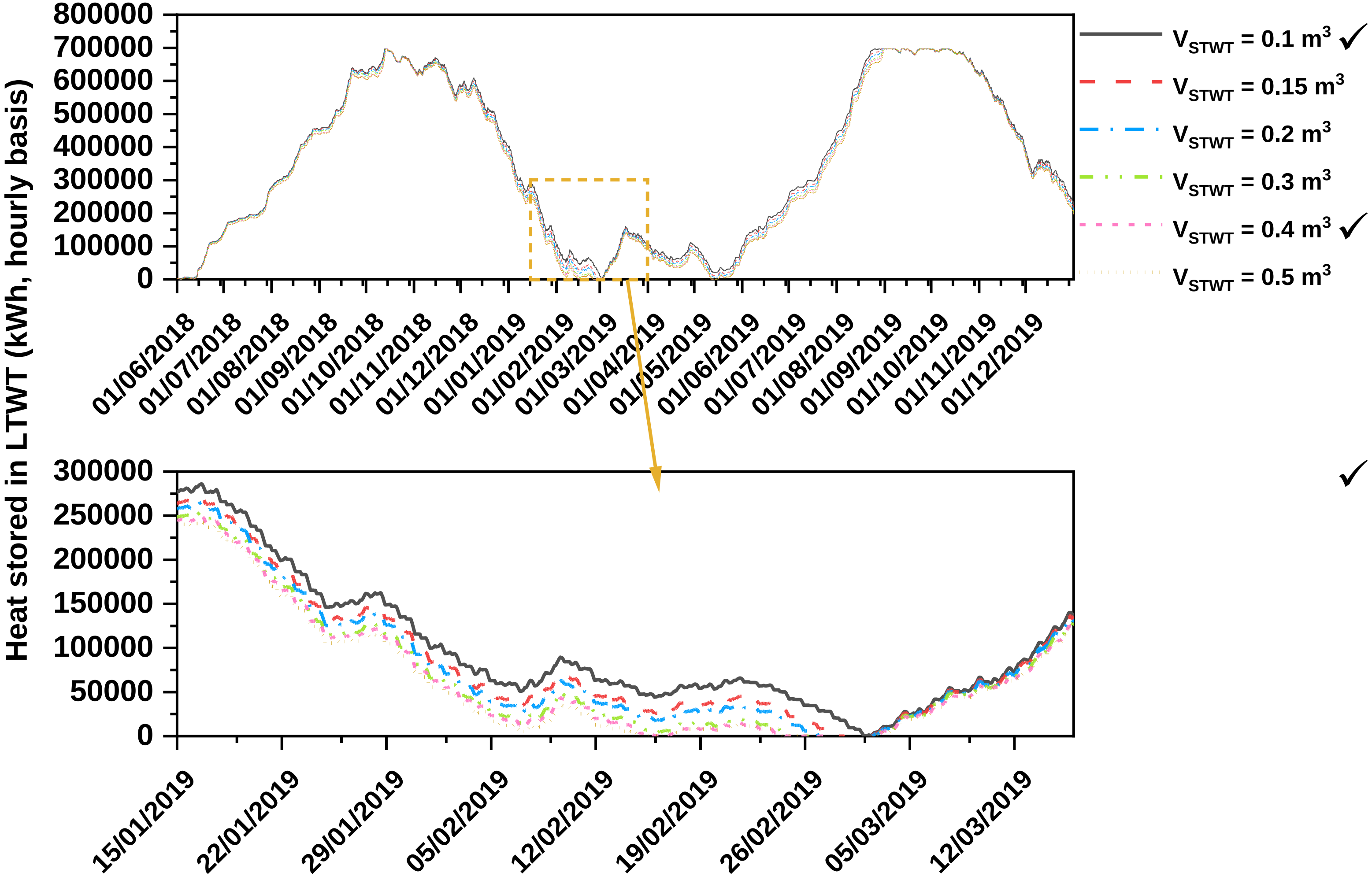


Larger volumes, V_{STWT} and/or $T_{charging\ STWT}$ lead to an increase in the cost per dwelling due to:

- ✓ **An increase in the cost of the store**
- ✓ **An increase in the Wind capacity and number of HPs needed to meet demands**

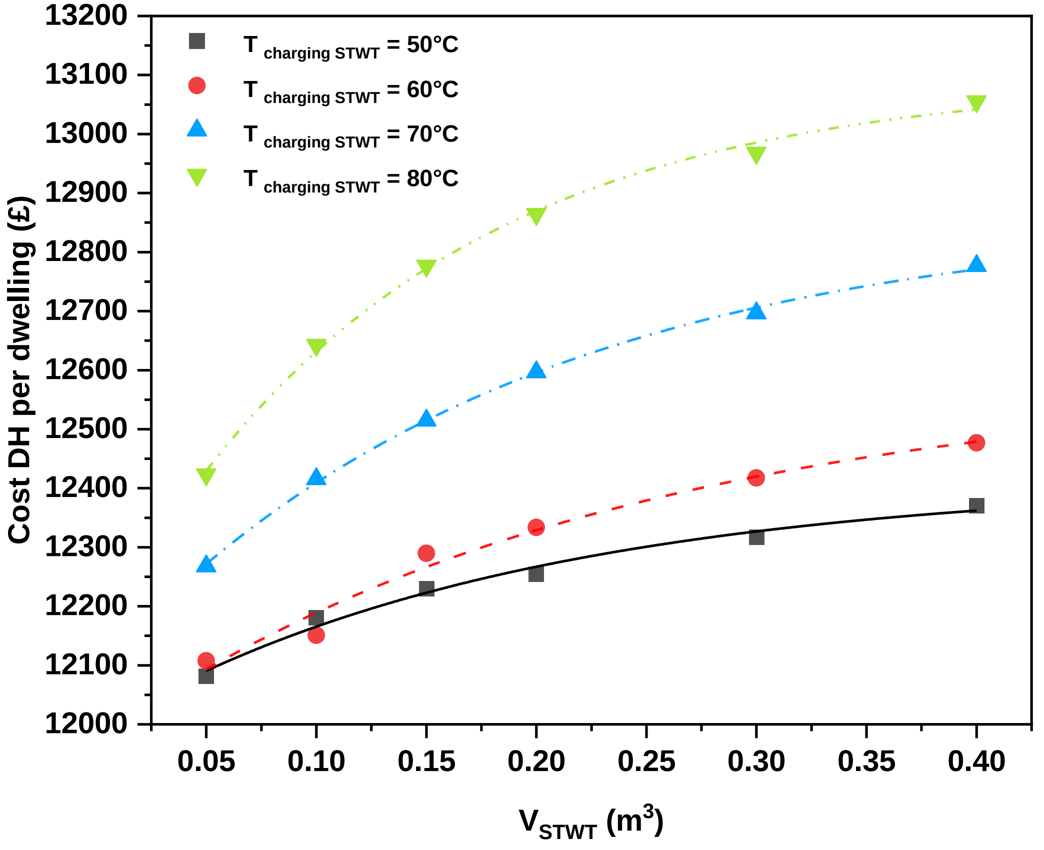
No short term water tank leads to the lowest cost.

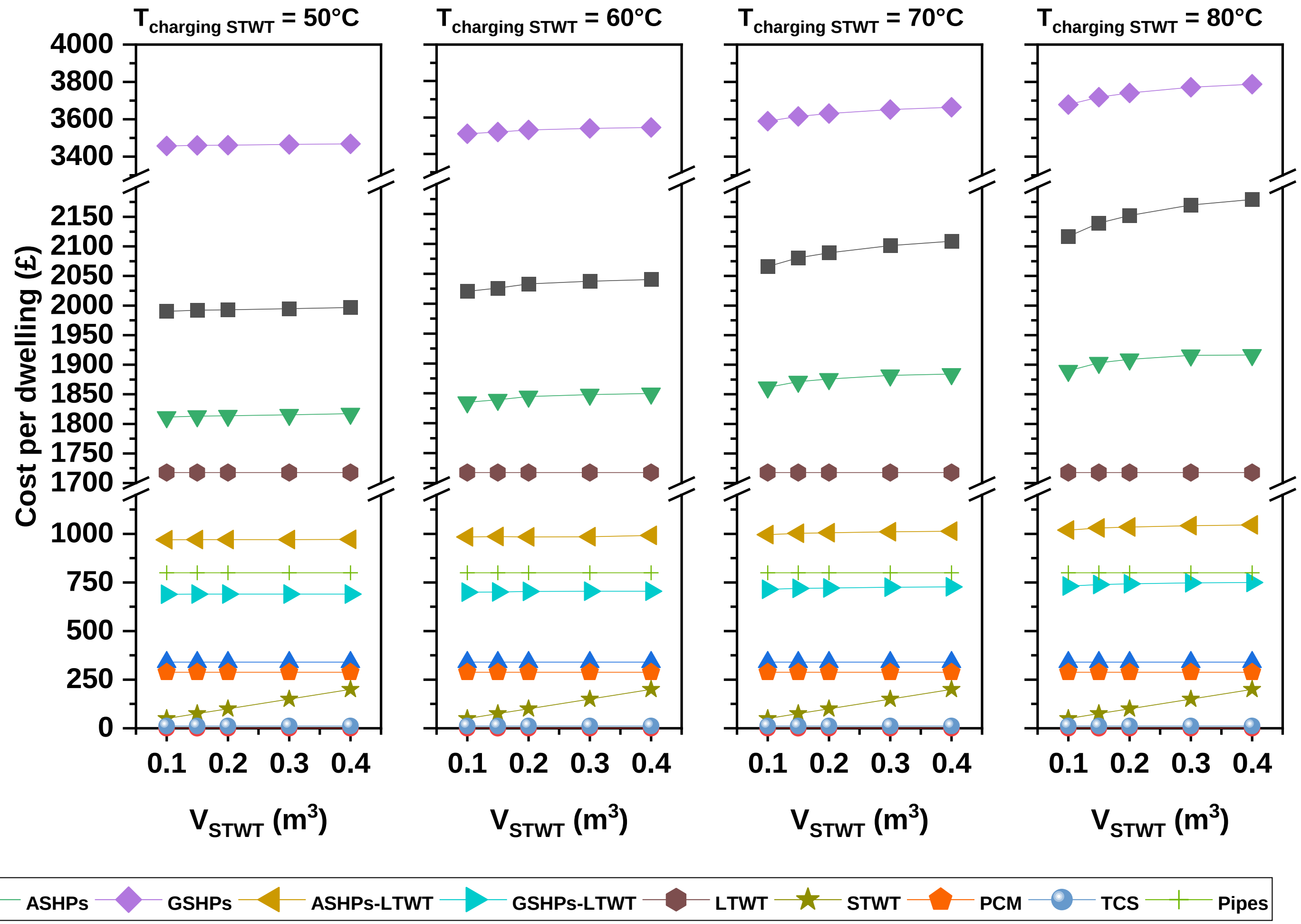
Results: Effect of V_{STWT} on the average cost of DH system per dwelling.



- ✓ Increasing V_{STWT} means that more heat can be stored in the STWT and as a consequence less heat is stored in the LTWT.
- ✓ This leads to a shortage of available heat from the LTWT at certain times of the year with a greater Wind capacity and number of HPs needed to meet demands.
- ✓ The shortage of available heat in LTWT can be explained by the lower heat losses from heat stored in the LTWT that those happening in the STWT (due to the greater surface area to volume ratio of the STWT and higher temperature of the water inside the store).

Results: Effect of $T_{charging\ STWT}$ on the average cost of DH system per dwelling.

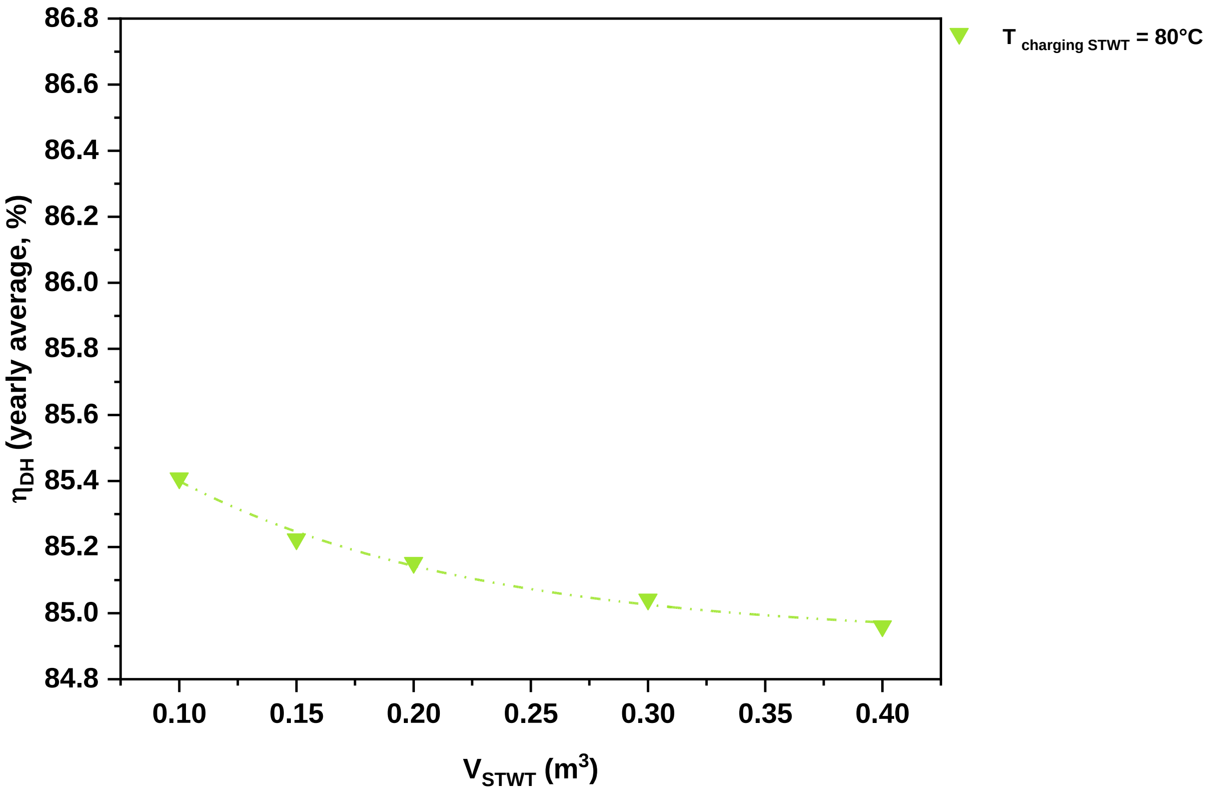


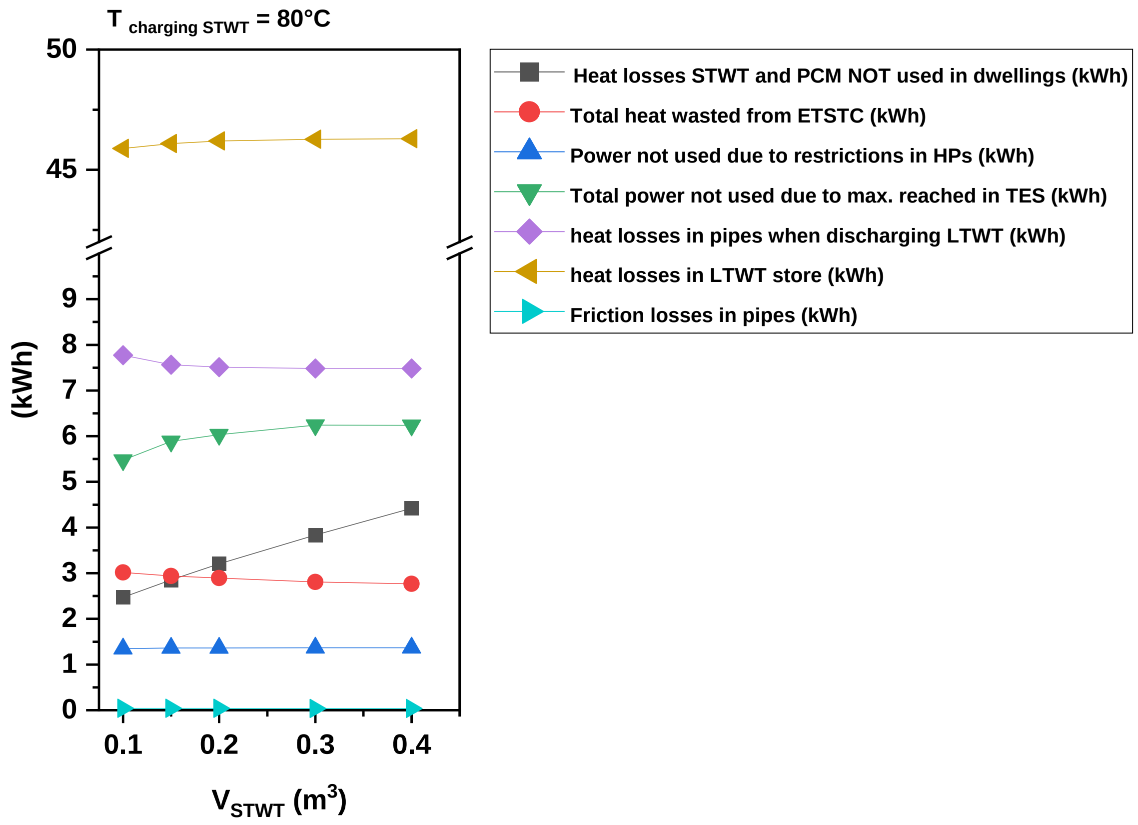


When $T_{charging\ STWT}$ increases the efficiency of both HPs and ETSTC decrease which leads to less heat delivered and stored in the STWT. Due to this, the charging of the STWT store is slower and consequently at certain dates and times higher Wind capacity is required.

Results: Effect of V_{STWT} and $T_{charging\ STWT}$ on η_{DH}.

$$\eta_{DH\,(t)}\,(\%) = \frac{Useful\ heat_{(t)}}{Energy\ delivered_{(t)}} \cdot 100$$

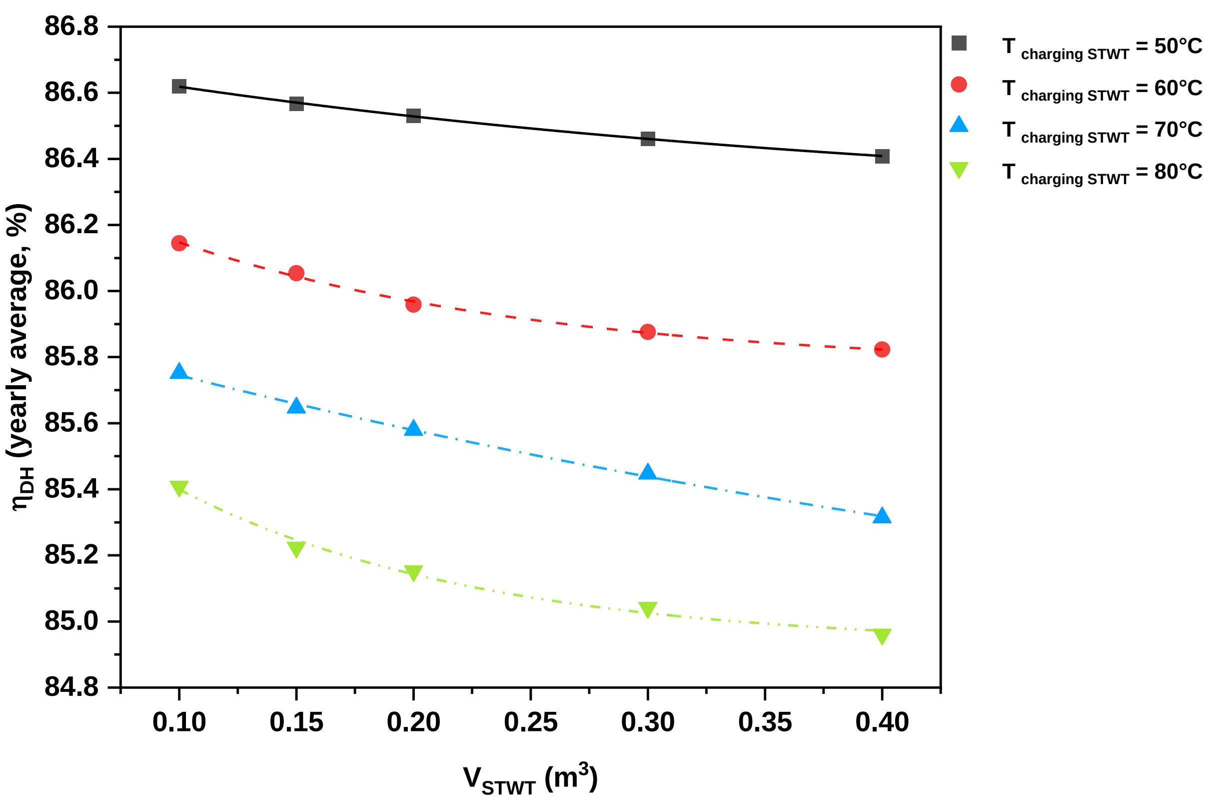


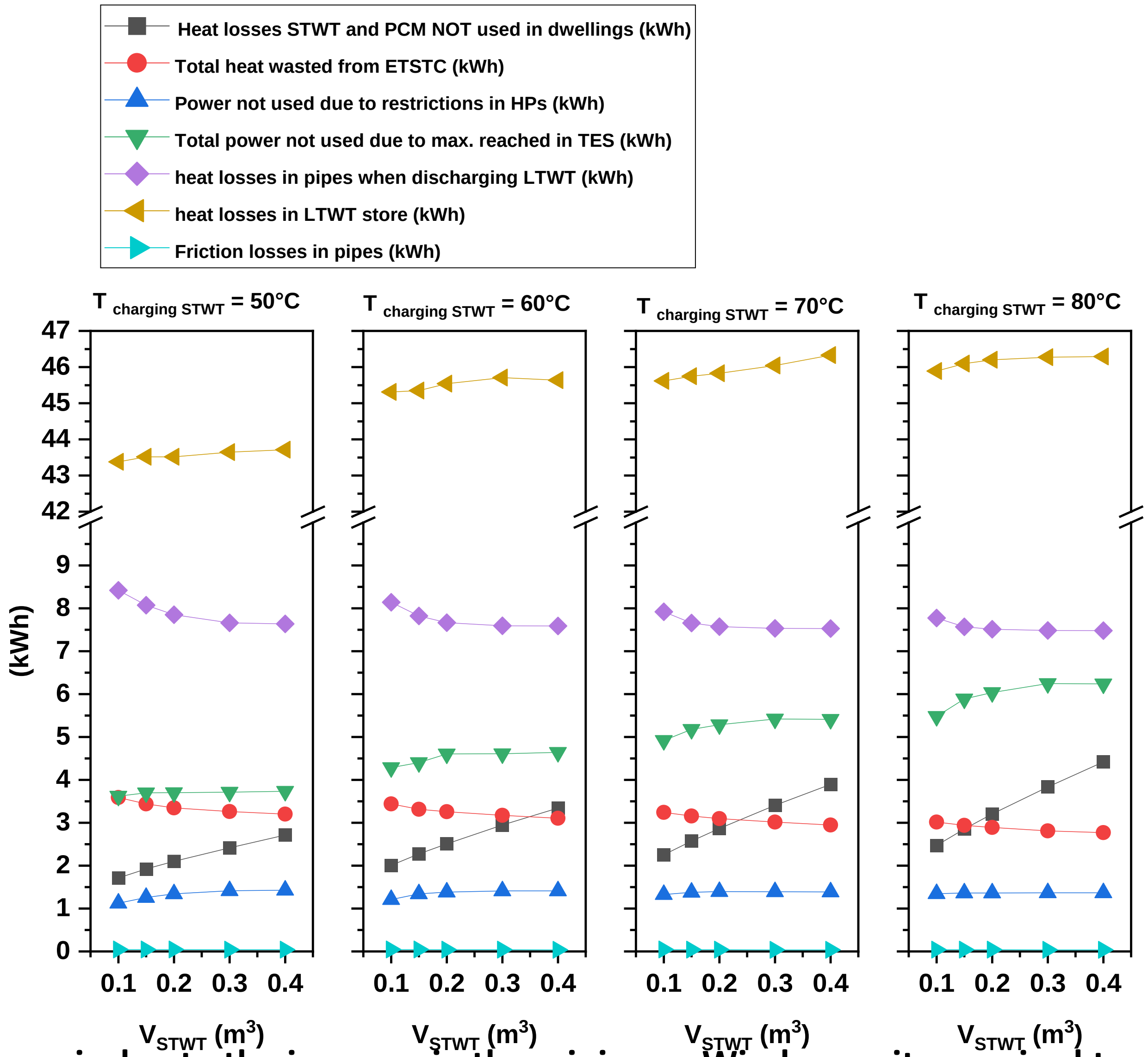


- ✓ **Both V_{STWT} and/or $T_{charging\ STWT}$ have little effect on predicted η_{DH}, with a maximum difference of ca. 1.8 percent.**
- ✓ **When V_{STWT} and/or $T_{charging\ STWT}$ increases the overall energy efficiency of the DH system decreases, due mainly to the increase in both the power shed and the heat losses from the STWT devices.**

Results: Effect of V_{STWT} and $T_{charging\ STWT}$ on η_{DH}.

$$\eta_{DH\,(t)}\ (\%) = \frac{Useful\ heat_{(t)}}{Energy\ delivered_{(t)}} \cdot 100$$





- ✓ The increase in the power shed with increasing V_{STWT} and/or $T_{charging\ STWT}$ is due to the increase in the minimum Wind capacity required to fully meet the domestic heat demands.

- ✓ The greater heat losses from the LTWT obtained when increasing $T_{charging\ STWT}$ can be explained again by the higher Wind capacity needed at higher $T_{charging\ STWT}$, which results in higher levels of heat stored in the LTWT at certain times of the year (and as a consequence higher heat losses).

Methodology

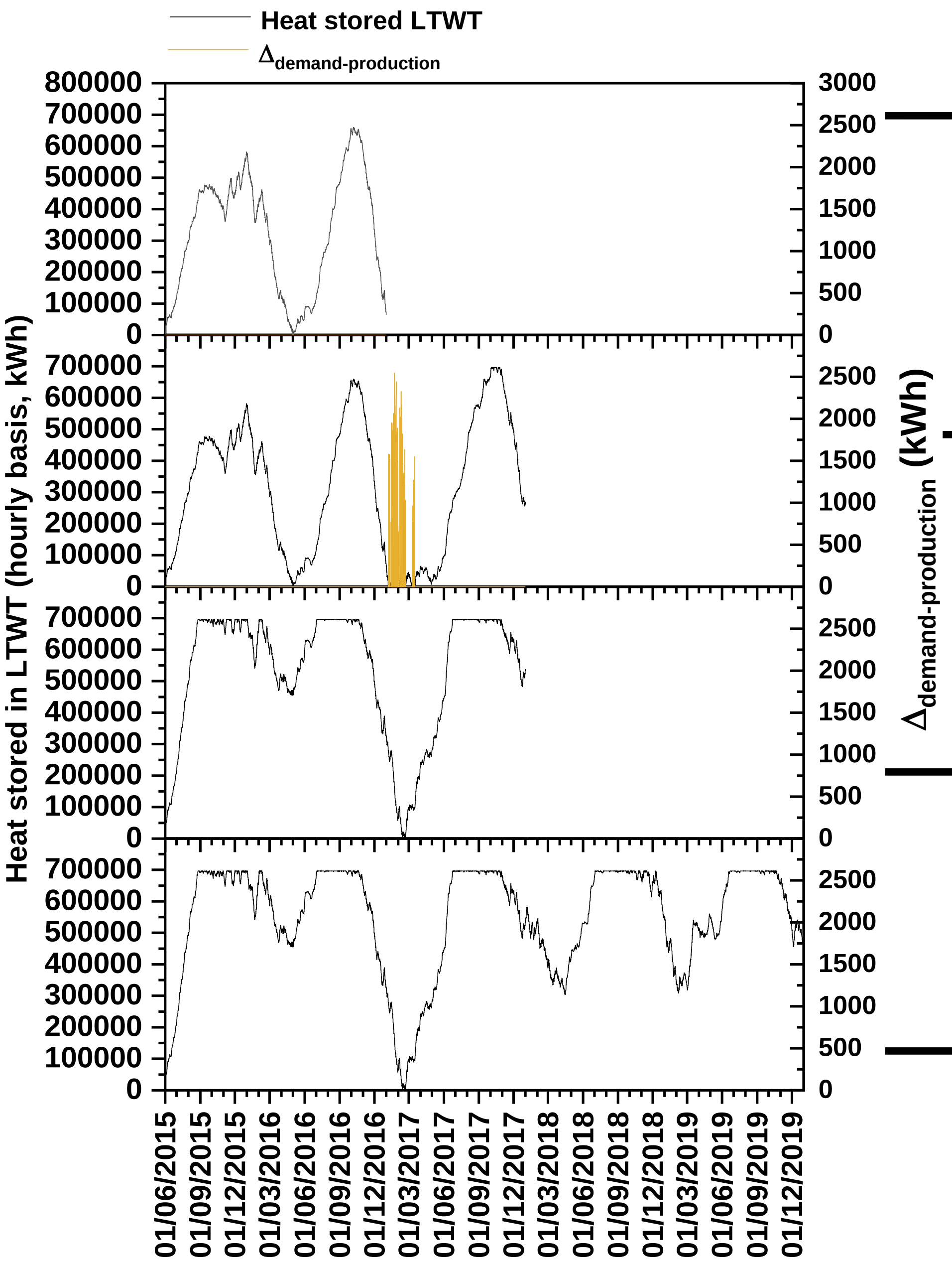
Simulations for 2, 3, 4 and 5 years and effect of the volume of LTWT (V_{LTWT}) on both the cost of the DH system per dwelling and energy efficiency.

Main fixed parameters specified for the simulation.

Heat sources main parameters	
Renewable power sources used to power domestic HPs	
Wind installed capacity (MW)	Variable
Solar PV installed capacity (MW)	Variable
ETSTCs	
Area of ETSTC per dwelling (m^2)	2
HPs	
%ASHP	50%
%GSHP	50%
ASHPs capacity per unit (kW)	5
GSHPs capacity per unit (kW)	5
HTHPs capacity per unit (kWh)	15

TES system main parameters	
Deployment (% of dwellings with stores)	
STWT	50%
PCM	30%
TCS	20%
Charging temperature (°C)	
STWT	50
PCM	50
TCS	120
LTWT	60
Volume	
STWT volume per dwelling (m^3)	0.2
PCM volume per dwelling (m^3)	0.2
TCS volume per dwelling (m^3)	0.2
LTWT (m^3)	Variable

Results: Effect of time-period on the Wind capacity needed to meet domestic heat demands.



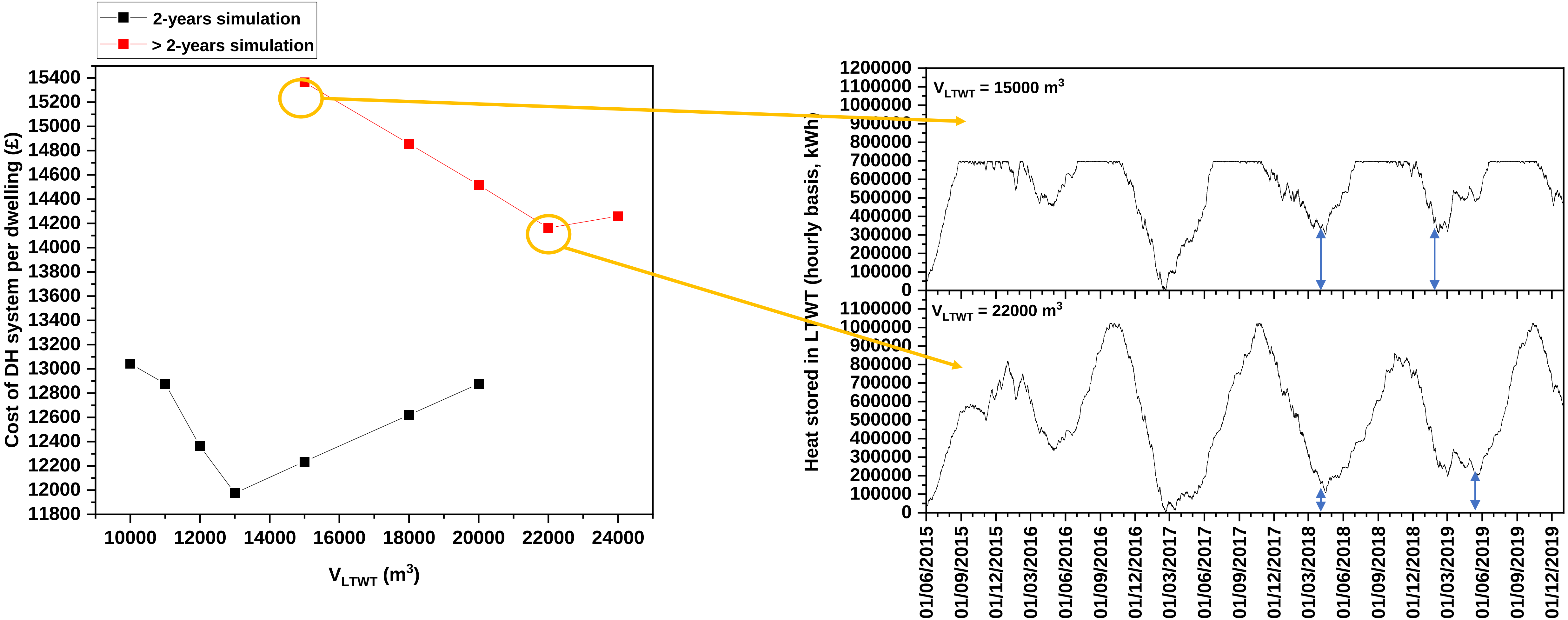
Time-period for simulation = 2 years (2015-2016)
V_{LTWT} = 15000 m^3
Wind capacity = 0.3566 MW
$\Delta_{demand\text{-}production}$ = 0 kWh

Time-period for simulation = 3 years (2015-2017)
V_{LTWT} = 15000 m^3
Wind capacity = 0.3566 MW
$\Delta_{demand\text{-}production}$ > 0 kWh

Time-period for simulation = 3 years (2015-2017)
V_{LTWT} = 15000 m^3
Wind capacity = 0.4859 MW
$\Delta_{demand\text{-}production}$ = 0 kWh

Time-period for simulation = 5 years (2015-2019)
V_{LTWT} = 15000 m^3
Wind capacity = 0.4859 MW
$\Delta_{demand\text{-}production}$ = 0 kWh

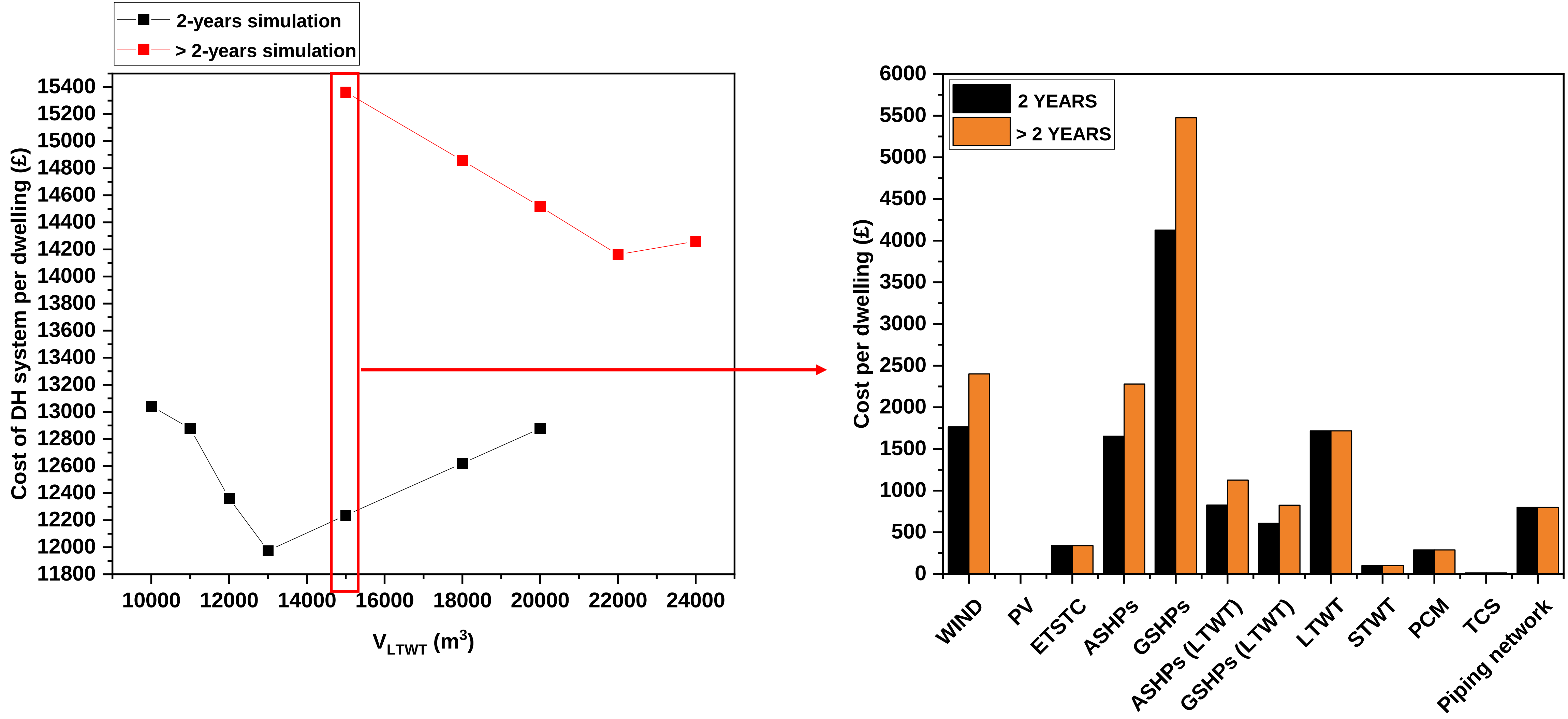
Results: Effect of V_{LTWT} on the cost of DH system per dwelling for different time-periods.



- ✓ **A considerable increase of the cost of the DH system per dwelling was predicted when increasing the number of years simulated from 2 years to 5 years for same V_{LTWT} values.**

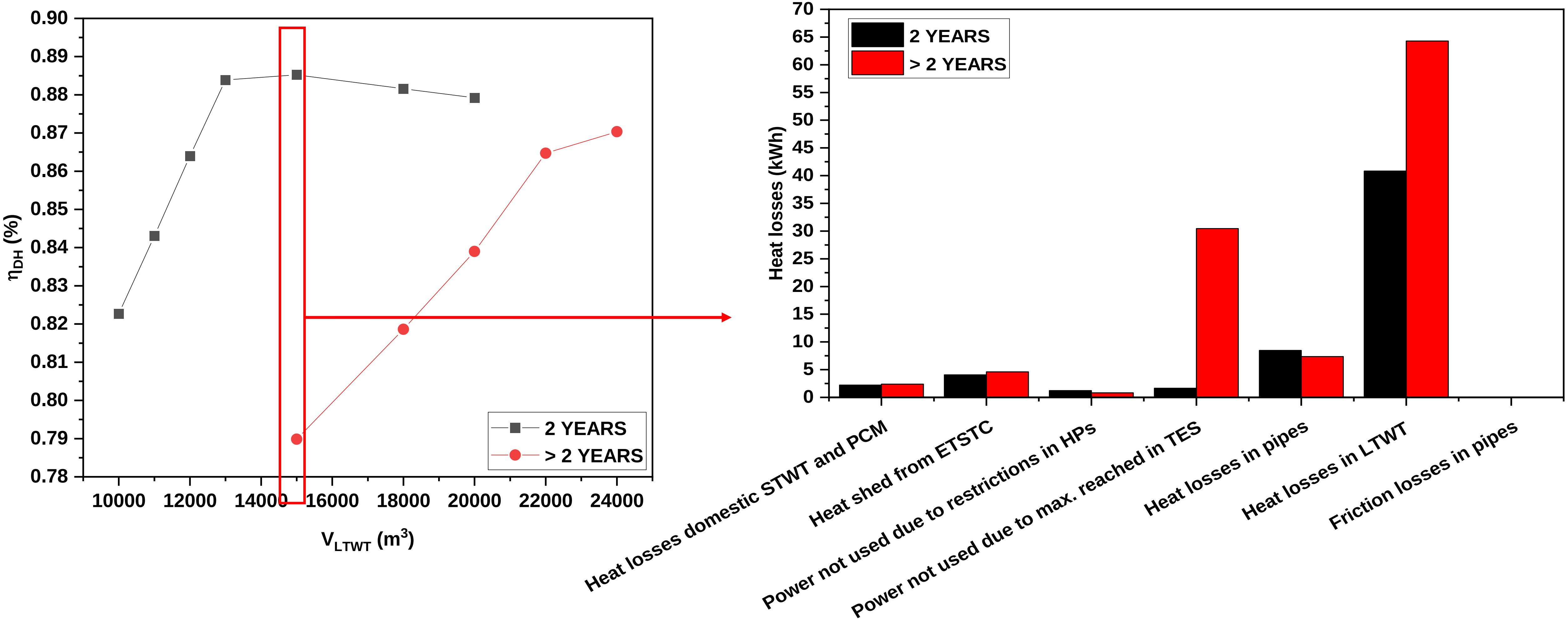
- ✓ **The cost per dwelling obtained at the optimum conditions for 5 years was £14162, obtained when using a V_{LTWT} = 22000 m^3.**

Results: Effect of V_{LTWT} on the cost of DH system per dwelling for different time-periods.



✓ **The increase of the cost when increasing simulations from 2 to 5 years is due to the increase of the Wind capacity required (and the subsequent increase in the number of HPs) needed to meet all domestic heat loads, due to the high heat demands in the 3rd year (2017).**

Results: Effect of V_{LTWT} on the energy efficiency of the DH system for different time-periods.



- ✓ **For given LTWT volume, $V_{LTWT,\ c}$onsiderable differences in predicted efficiency obtained for a 2-year simulation and for >2-year simulations (up to 9 percentual points for a V_{LTWT} = 15000 m^3).**
- ✓ **The power generated but not used due to maximum capacity reached in all TES and heat losses from the LTWT are the main causes of the differences in the efficiency.**
- ✓ **At the optimum V_{LTWT} values (13000 m^3 for a 2-year simulation and 22000 m^3 for a >2-year simulation) the difference between efficiencies were ca. 2 percentual points.**

Summary and main conclusions: Effect of volume of STWT (V_{STWT}) and charging temperature of the STWT (T_{STWT}) on both the cost of the DH system per dwelling and energy efficiency.

- ✓ **An optimisation study of a simulated DH network for two areas in the town of Loughborough, UK, for the time period from the 01/06/2018 00:00 to 31/12/2019 23:00 was undertaken.**

- ✓ **A parametric analysis of the effect of V_{STWT} and $T_{charging\ STWT}$ on the DH system cost per dwelling and the overall η_{DH} was undertaken.**

- ✓ **For each simulated case the results were obtained by modifying the installed capacity of both Wind and PV in order to ensure domestic heat loads were met for the whole time-period.**

- ✓ **The increase of both V_{STWT} and $T_{charging\ STWT}$ lead to an increase in the total cost per dwelling and a decrease in the overall η_{DH} value, due to the greater amount of heat stored in the STWT which leads to a reduction in heat stored in the LTWT. This results in ii) more heat losses and ii) a shortage of heat available from storage in the winter months and thus more $Wind_{capacity}$ needed to meet demands (meaning both more cost and power shed).**

- ✓ **A predicted minimum cost of £12,103 per dwelling and DH network energy efficiency of 86.6% was obtained at the optimum conditions.**

- ✓ **The lowest cost is for the system with no short term water stores**

Summary and main conclusions: Effect of volume of LTWT (V_{LTWT}) on both the cost of the DH system per dwelling and energy efficiency for different simulation time-periods.

- ✓ An optimisation study for a simulated DH network for two areas in the town of Loughborough, UK, for the time period from the 01/06/2015 00:00 to 31/12/2019 23:00 was undertaken.
- ✓ A parametric analysis of the effect of V_{LTWT} on the DH system cost per dwelling and the overall η_{DH} was undertaken for simulation time-periods of 2,3,4 and 5 years.
- ✓ For each simulated case the results were obtained by modifying the installed capacity of both Wind and PV in order to ensure domestic heat loads were met for the whole time-period.

- ✓ **The number of the number of years for which the simulation was applied had a strong effect on both the cost and the efficiency, due to the lower outdoor temperatures in some years (in this case the third year) which leads to a significantly higher installed Wind capacity and number of heat pumps required to meet demands.**

- ✓ **A predicted minimum cost of £14,162 per dwelling and DH network energy efficiency of 86.5% was obtained at the optimum conditions found for a time period of 5 years (2015-2019 inclusive).**

- ✓ **Alternative heat generation may be required to guarantee heat loads can always be met or lower set point temperatures may be required in some years, further cost analysis required.**

Modelling, approaching a digital twin

Improved temporal resolution

Spatial resolution

Influence of thermal mass

Considering:-

- Heating
- Cooling
- Electrical demands

Peak variation of temperatures from building set points.

The influence of building fabric on heating/cooling load profiles.

Network topology, heat/cold/electricity generation system size and location, pipe size, storage size and location.

Integrated energy system evaluation to minimise cost while delivering acceptable performance.

Examine building fabric upgrades.

Explore impacts of different operational temperatures.

LoT-NET

Loughborough University

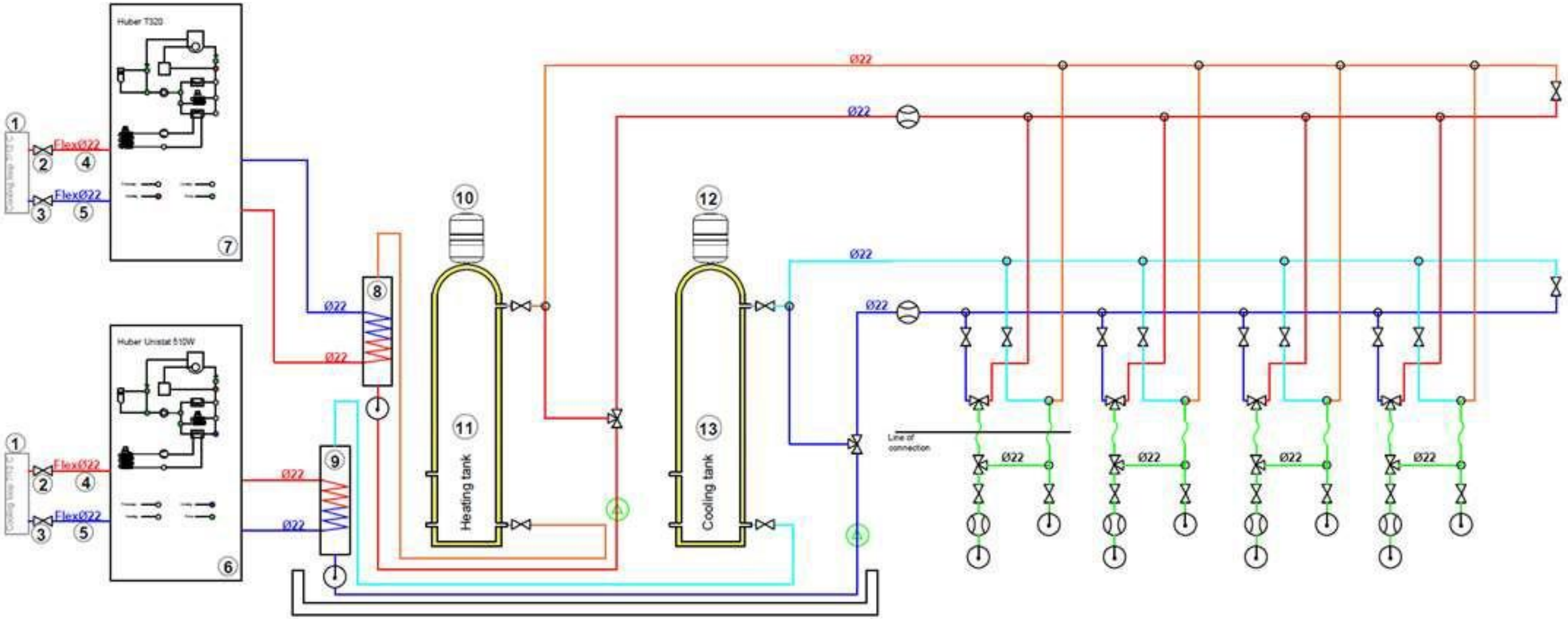
Case Studies: Summary & Discussion

- Three cases:
  - Urban SLES (4,000-33,000): Integration around a LoT-NET, PFER DD
  - Campus SLES (34,000 community): Integration around a LoT-NET, PFER EnergyREV
  - Town (70,000): Modelling capability to deliver net zero heat at minimal cost

- Questions to help answer
  - What will the CCC's 20% of heating from heat networks actually be?
  - How can LoT-NET help heat networks be part of smart local energy systems?
  - How can heat networks make local energy systems smarter and more flexible?

Technical tasks

Thermal energy storage

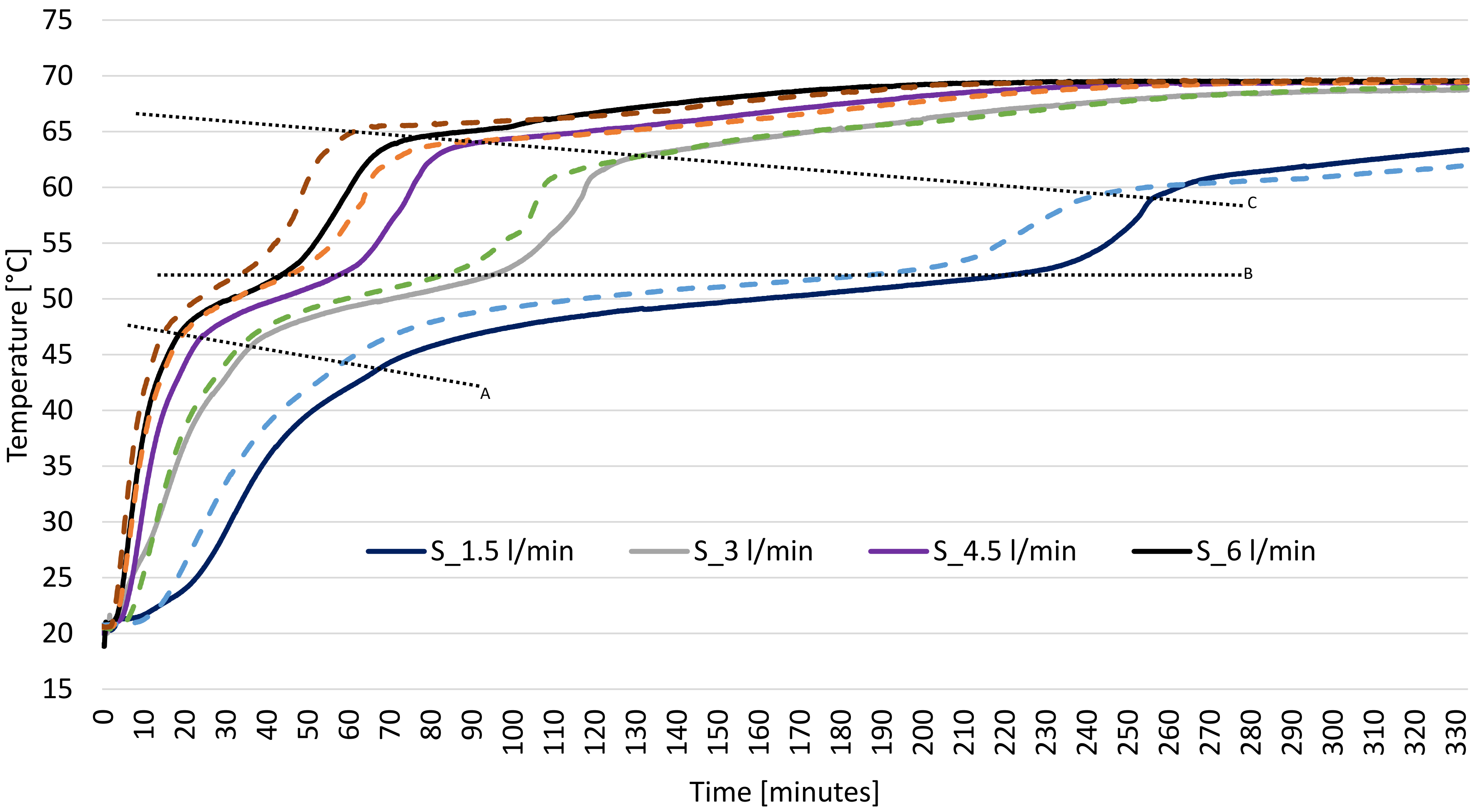


LoT-NET

Loughborough University

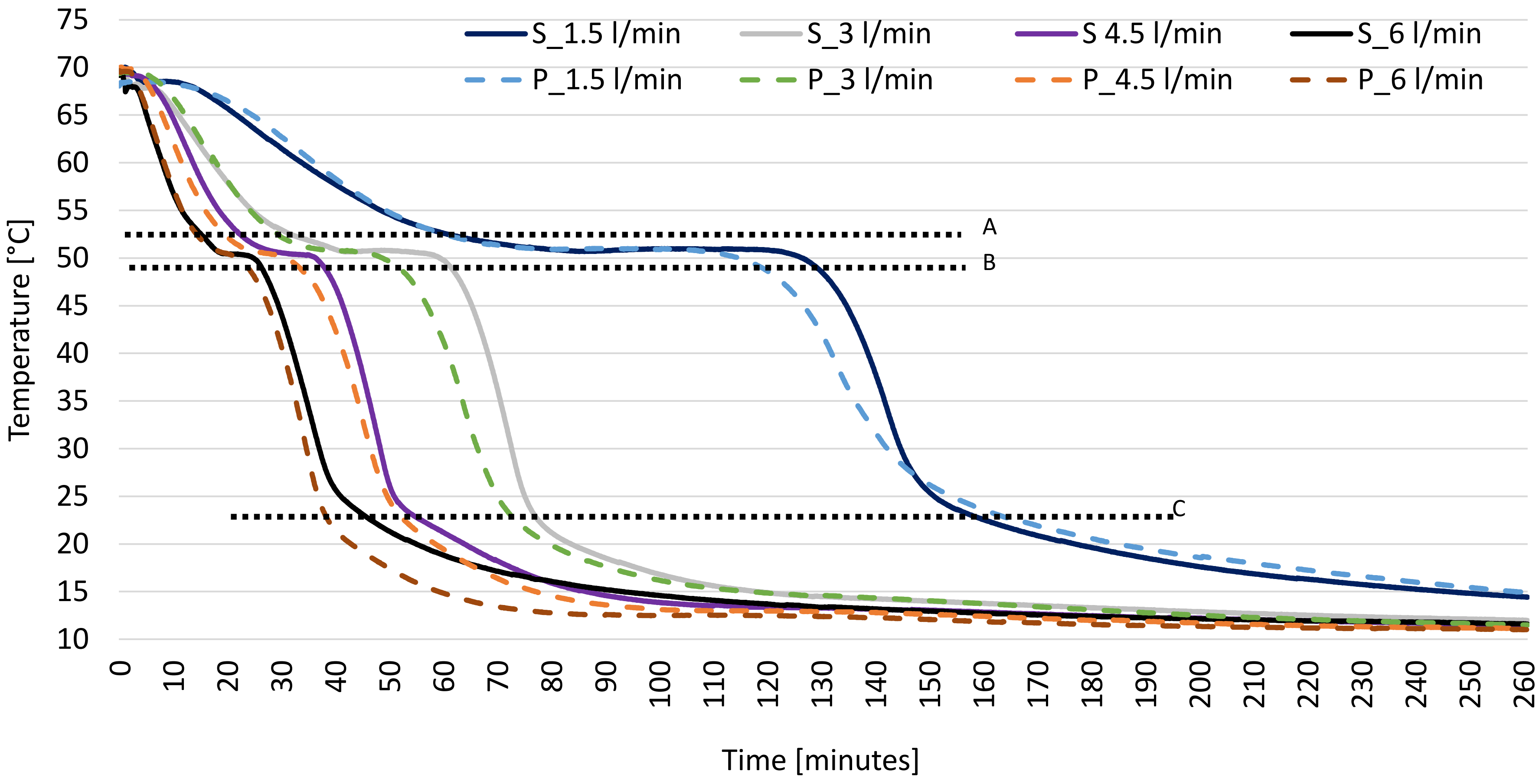
LoT-NET

Loughborough University



LoT-NET

Loughborough University



S_1.5 l/min
S_3 l/min
S 4.5 l/min
S_6 l/min
P_1.5 l/min
P_3 l/min
P_4.5 l/min
P_6 l/min
A
B
C
Temperature [°C]
Time [minutes]
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65
60
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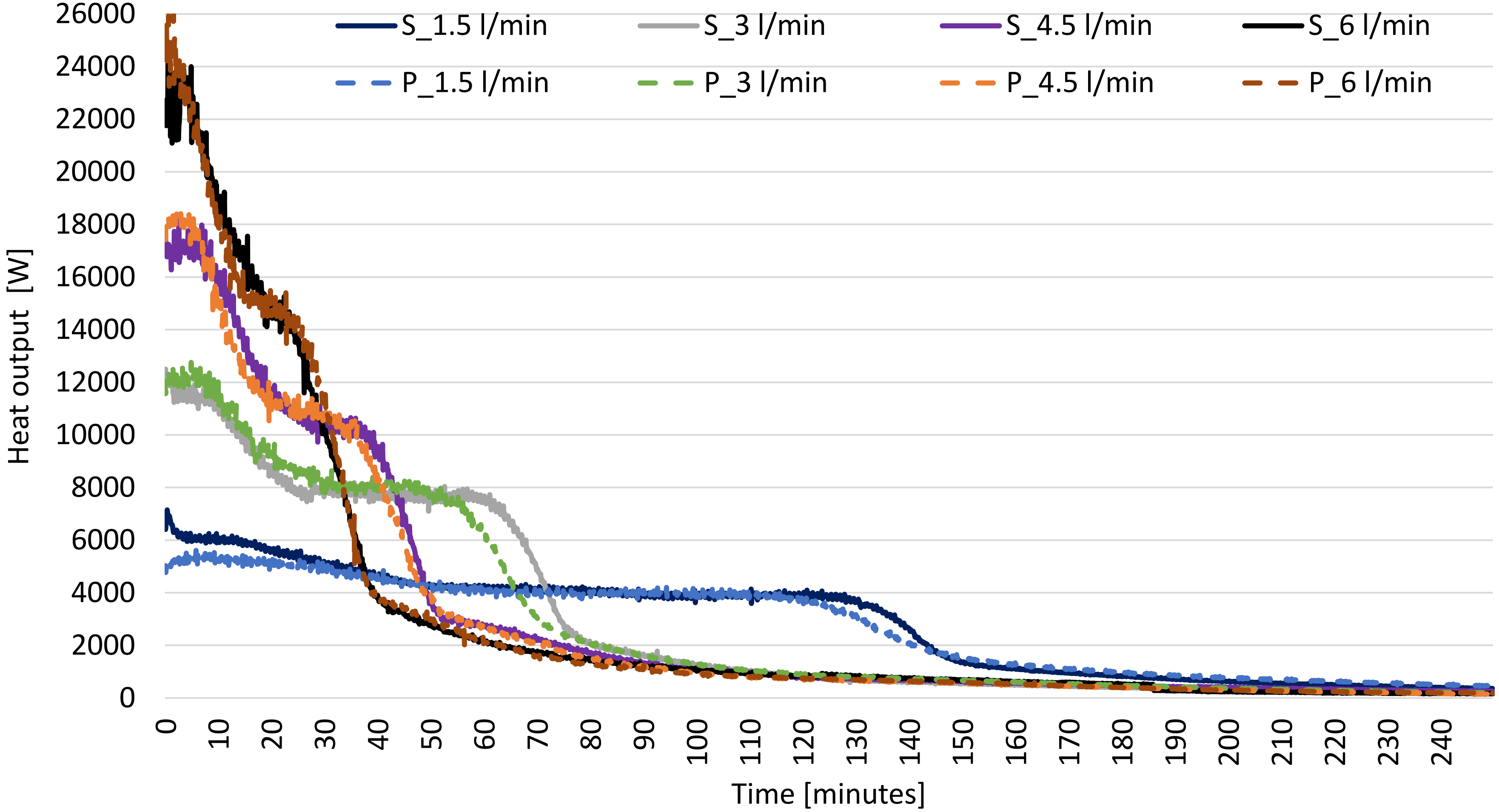


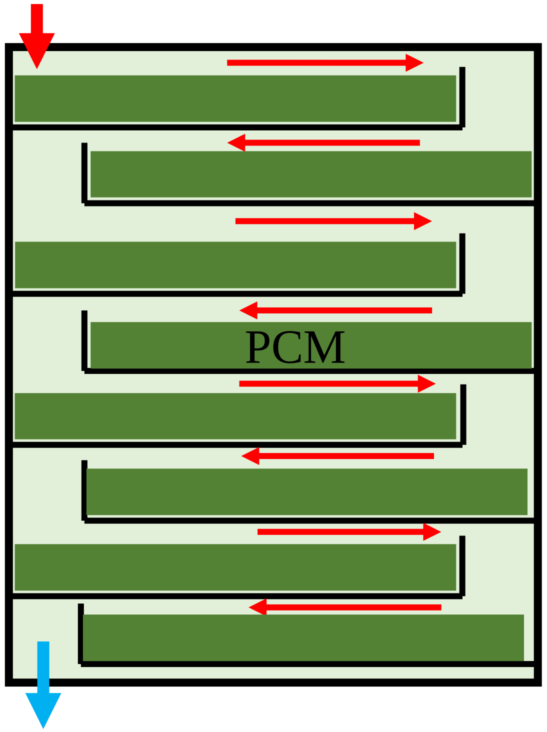
LoT-NET

Loughborough University

Direct contact latent heat thermal energy storage

Blockage

Wang et al. (2015)

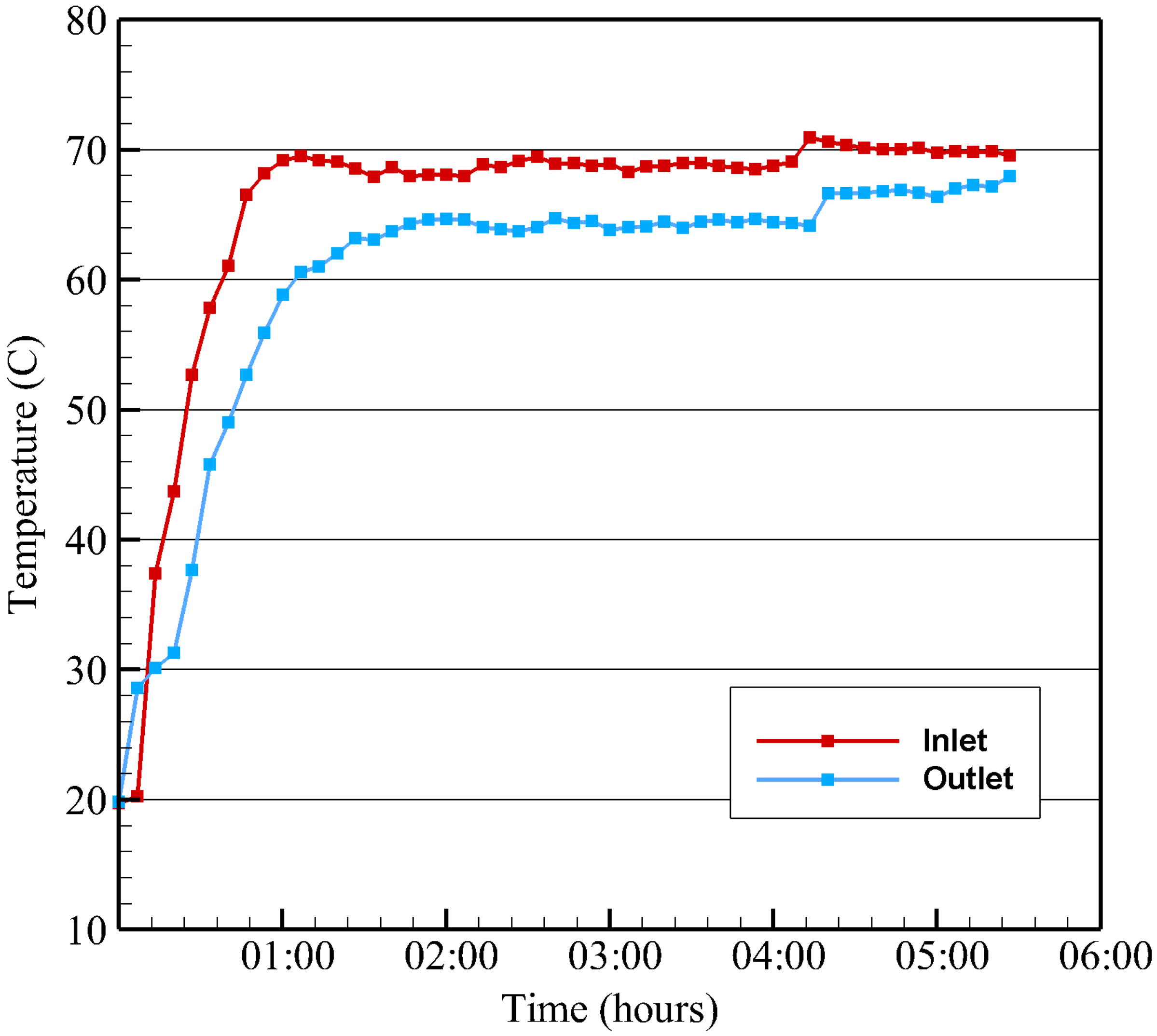


TES configuration design

Loughborough University

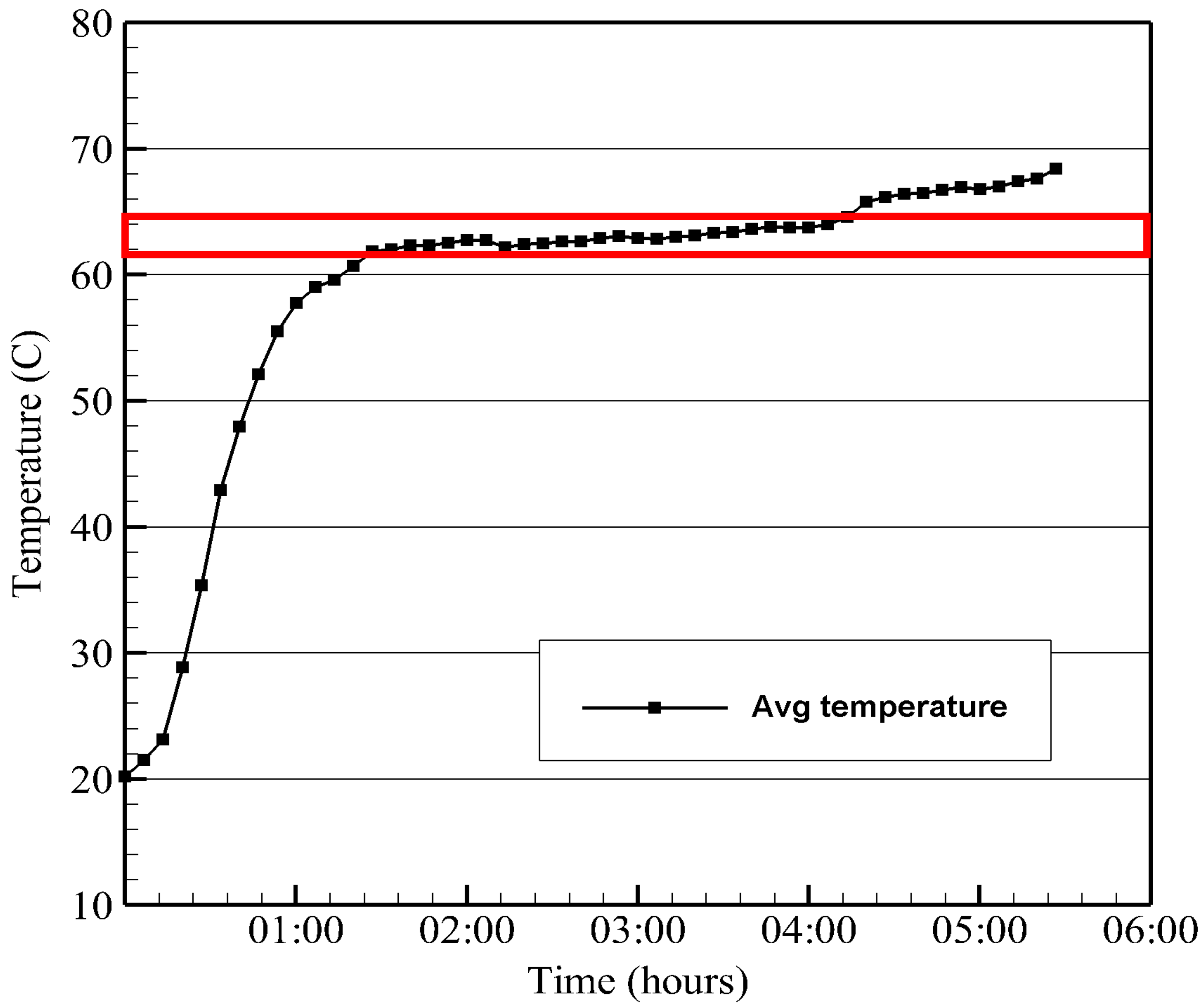
Second experimental setup

Charging cycle of TES



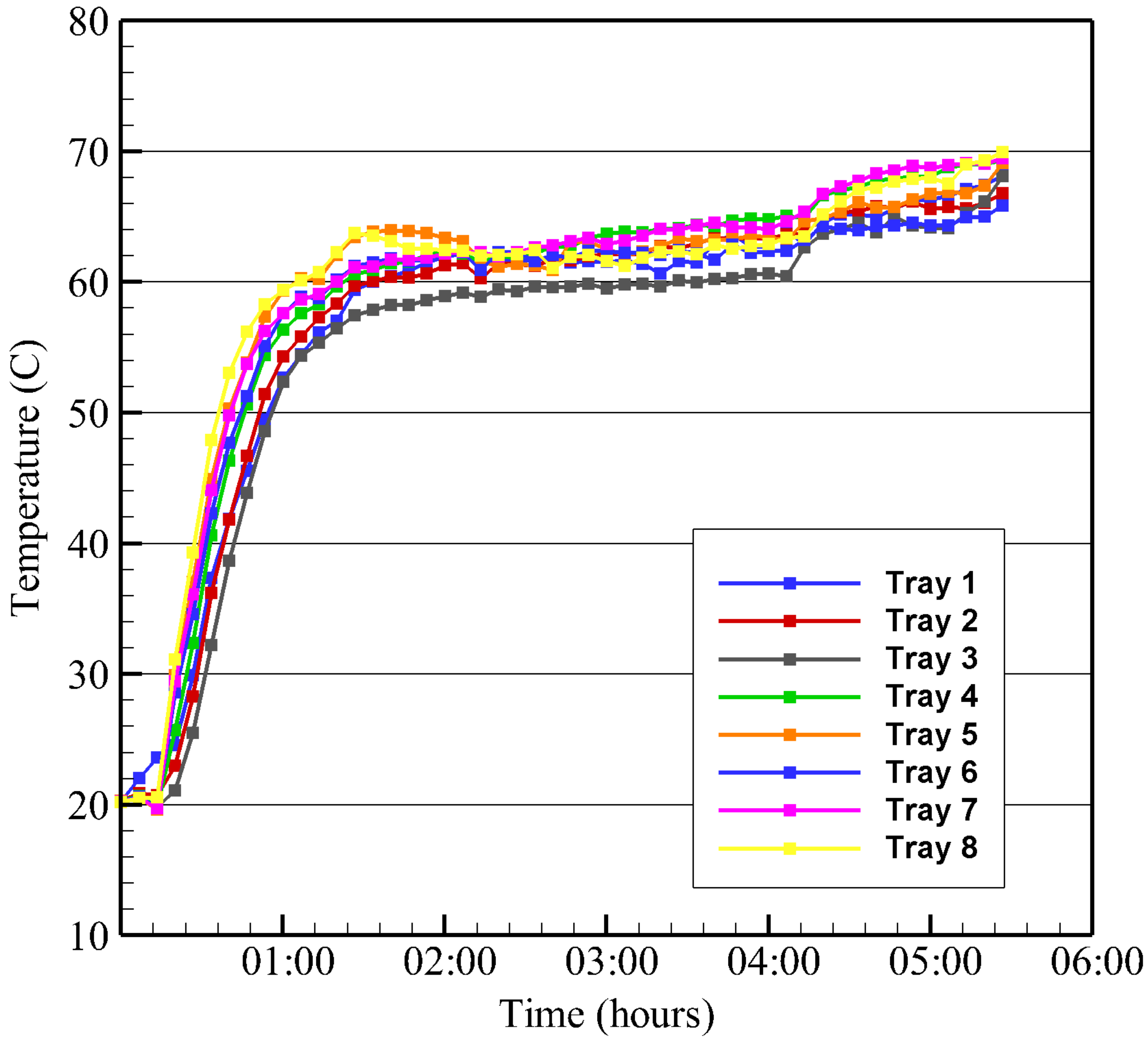
Charging cycle of TES at 70^{o}C and 4L/min

Charging cycle of TES



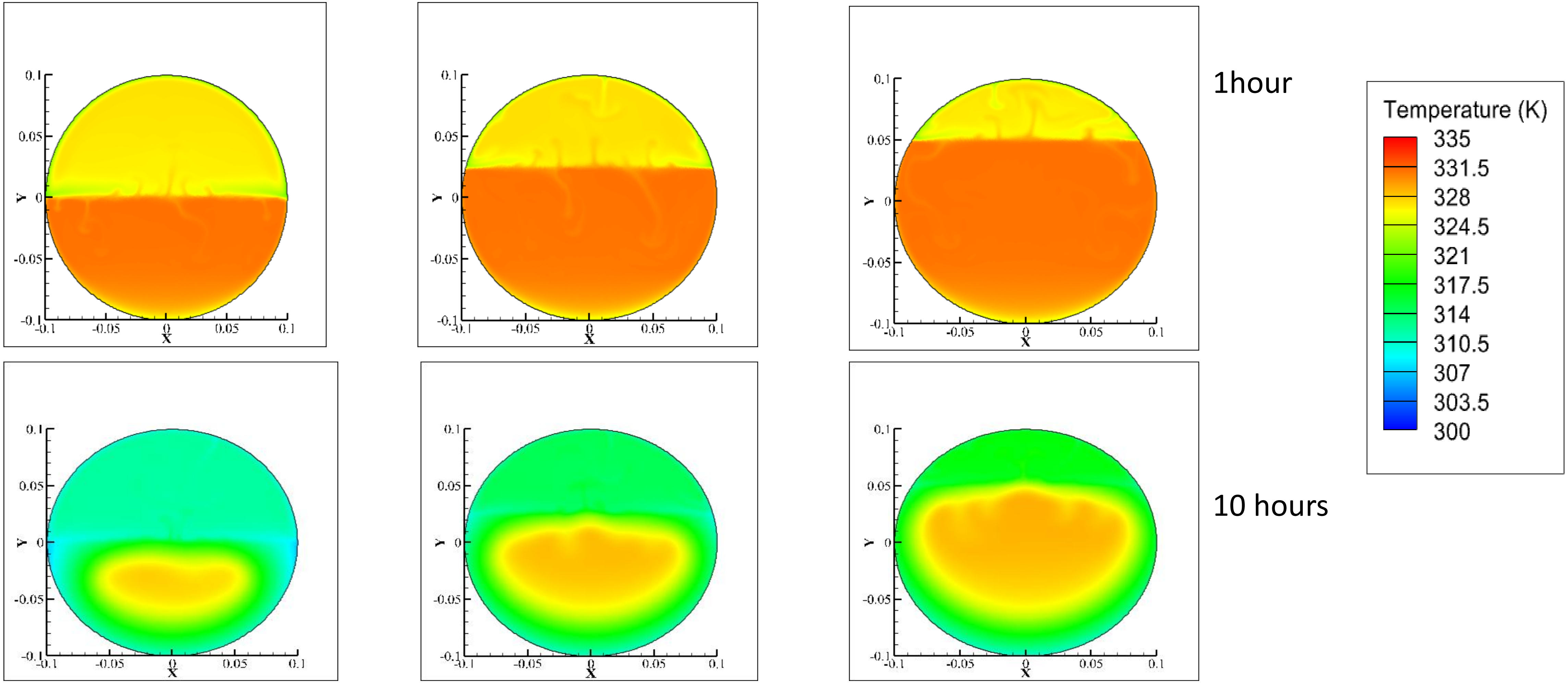
Charging cycle of TES at 70^{0}C and 4L/min

Charging cycle of TES



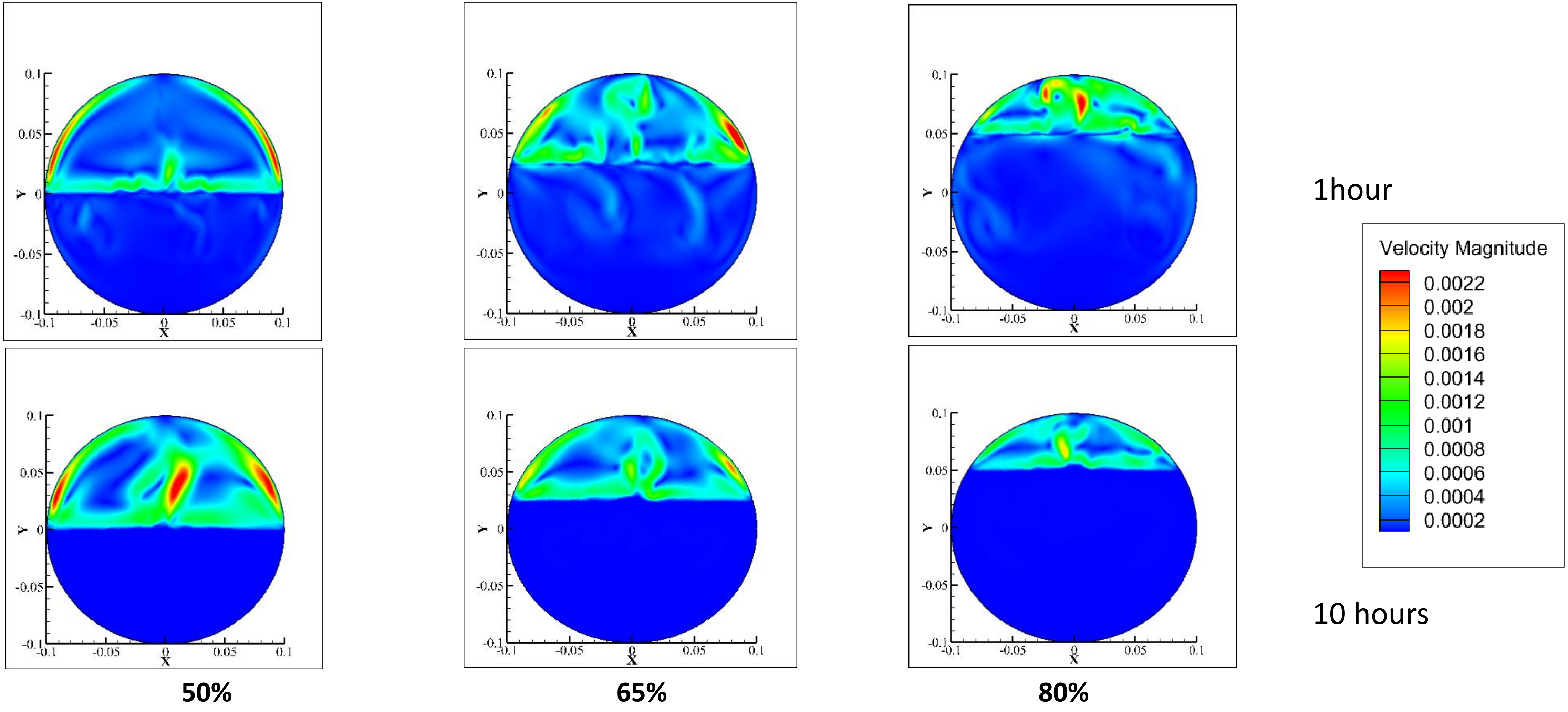
Charging cycle of TES at 70^{0}C and 4L/min

Numerical study on standby heat losses from direct contact thermal energy storage

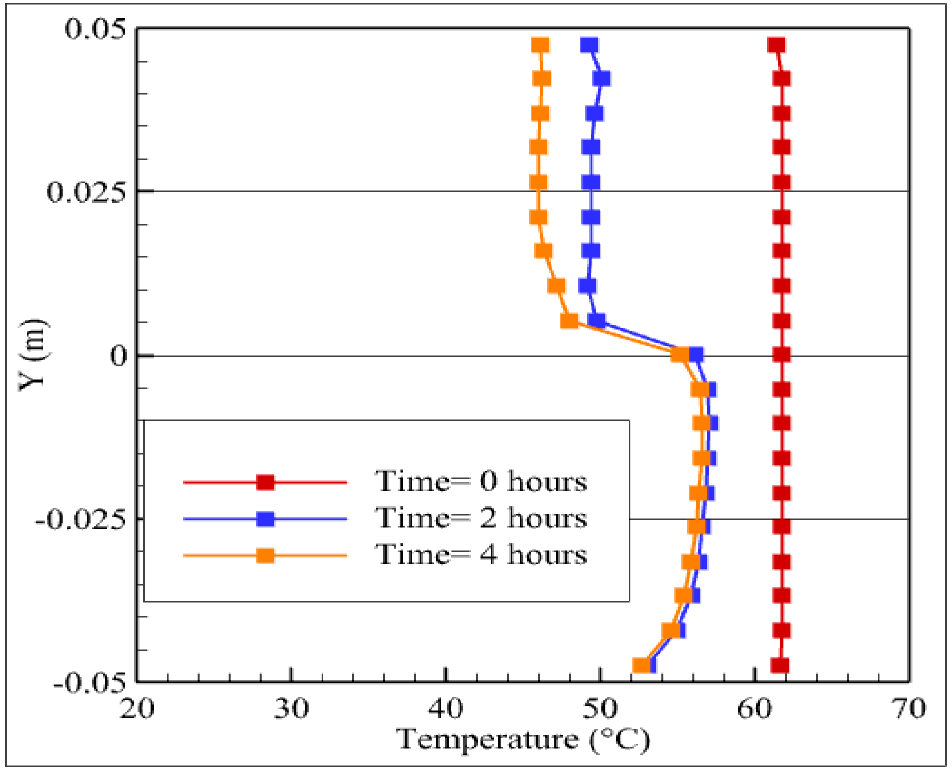


50% | 65% | 80%

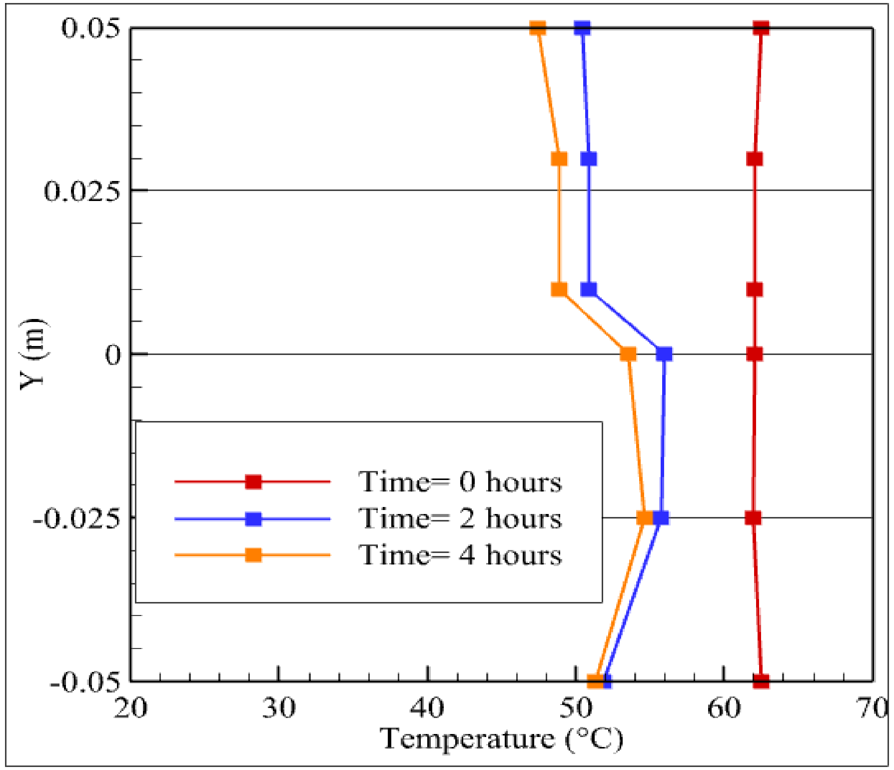
Numerical study on standby heat losses from direct contact thermal energy storage



Validation results



Experimental



CFD

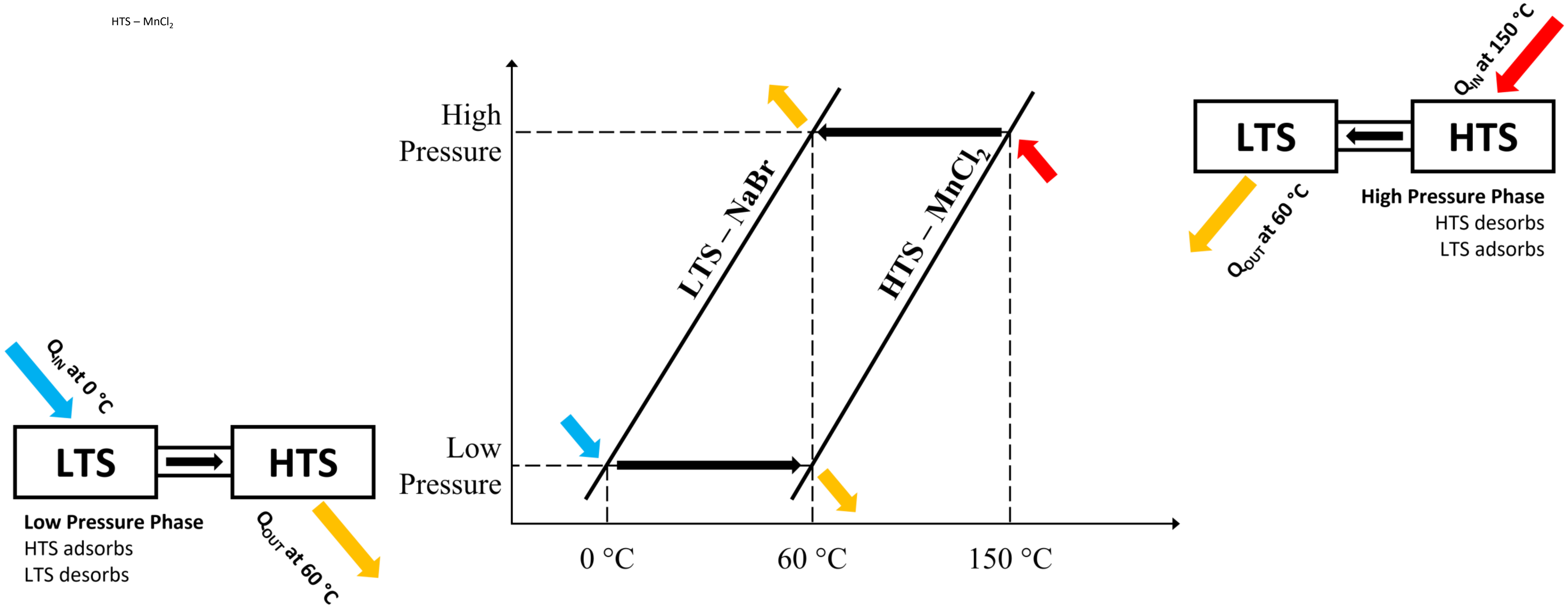
Heat pumps
(University of Warwick)

1. Resorption HP Operation

- Two salt **domestic heat pump** using ammonia-salt

LTS – NaBr

HTS – $MnCl_2$



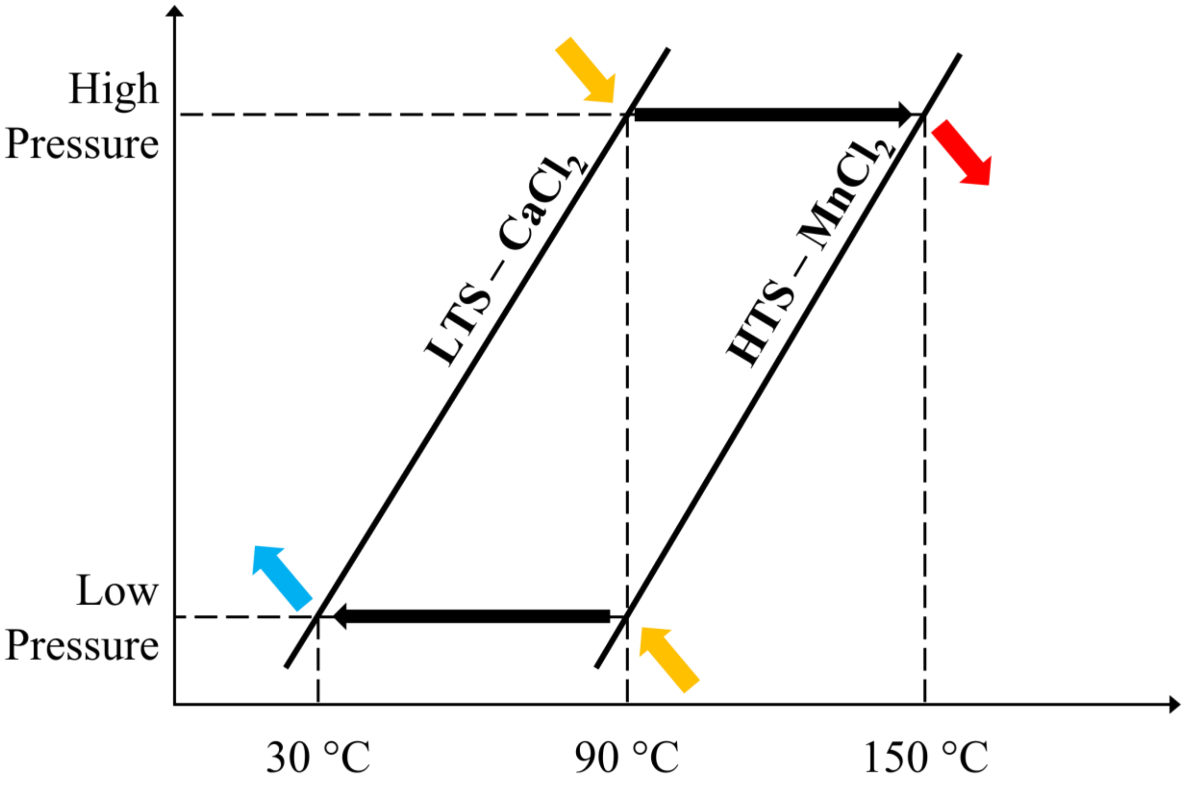
2. Resorption TT Operation

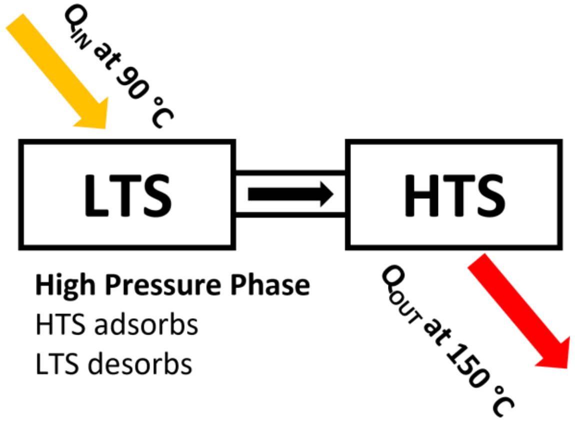
WARWICK
THE UNIVERSITY OF WARWICK

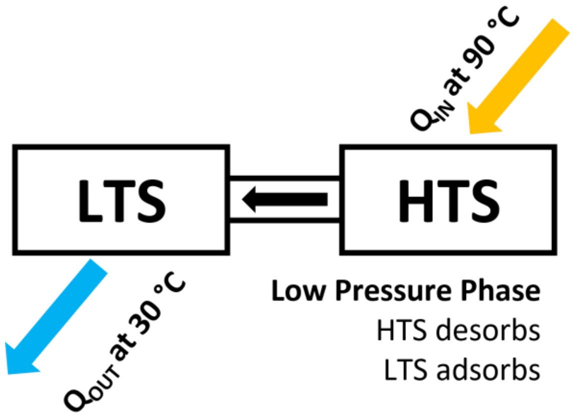
- Two salt **industrial thermal transformer** using ammonia-salt

LTS – $CaCl_2$

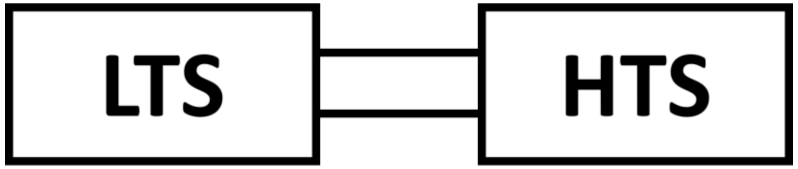
HTS – $MnCl_2$



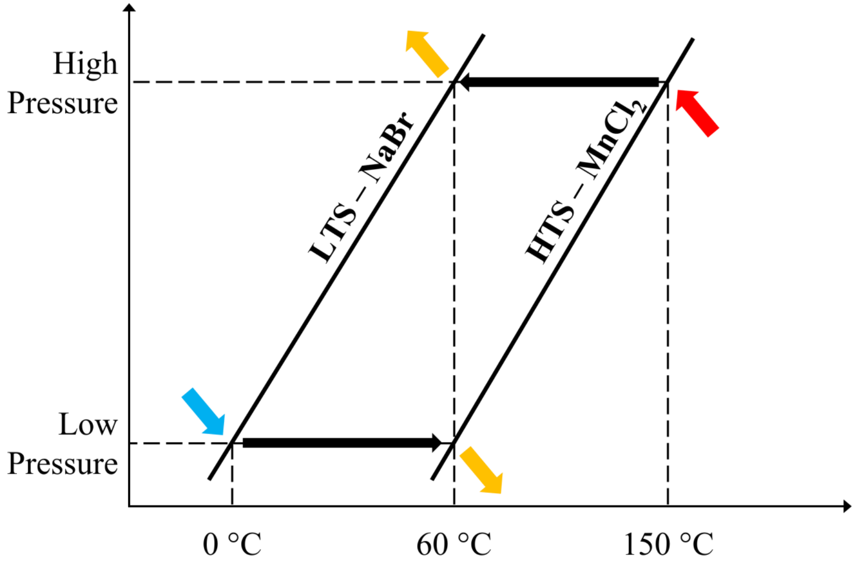


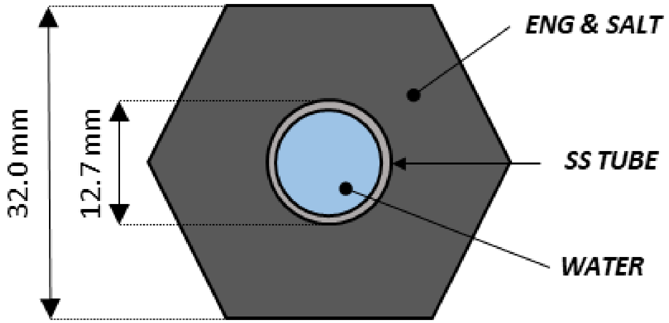


3. Resorption Design



- Two reactors with salt, and an ammonia connection between them (+ some fluid flow to each reactor)





4 . ThermExS

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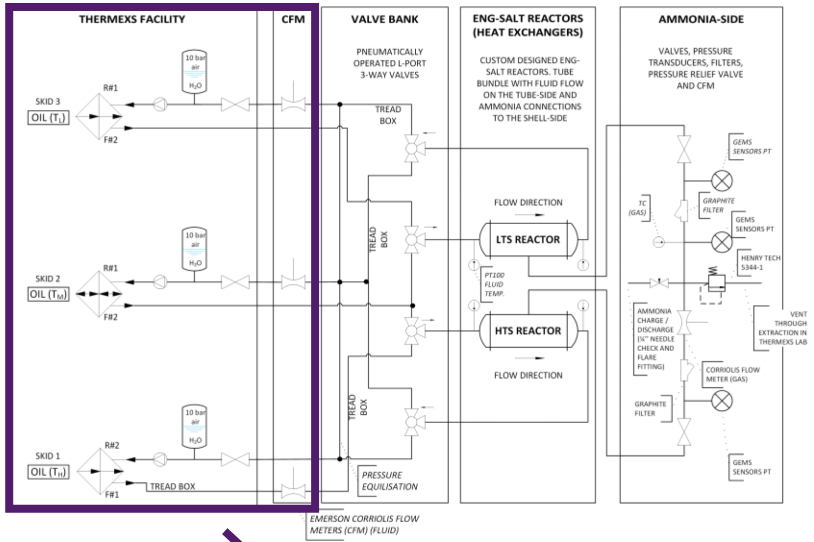
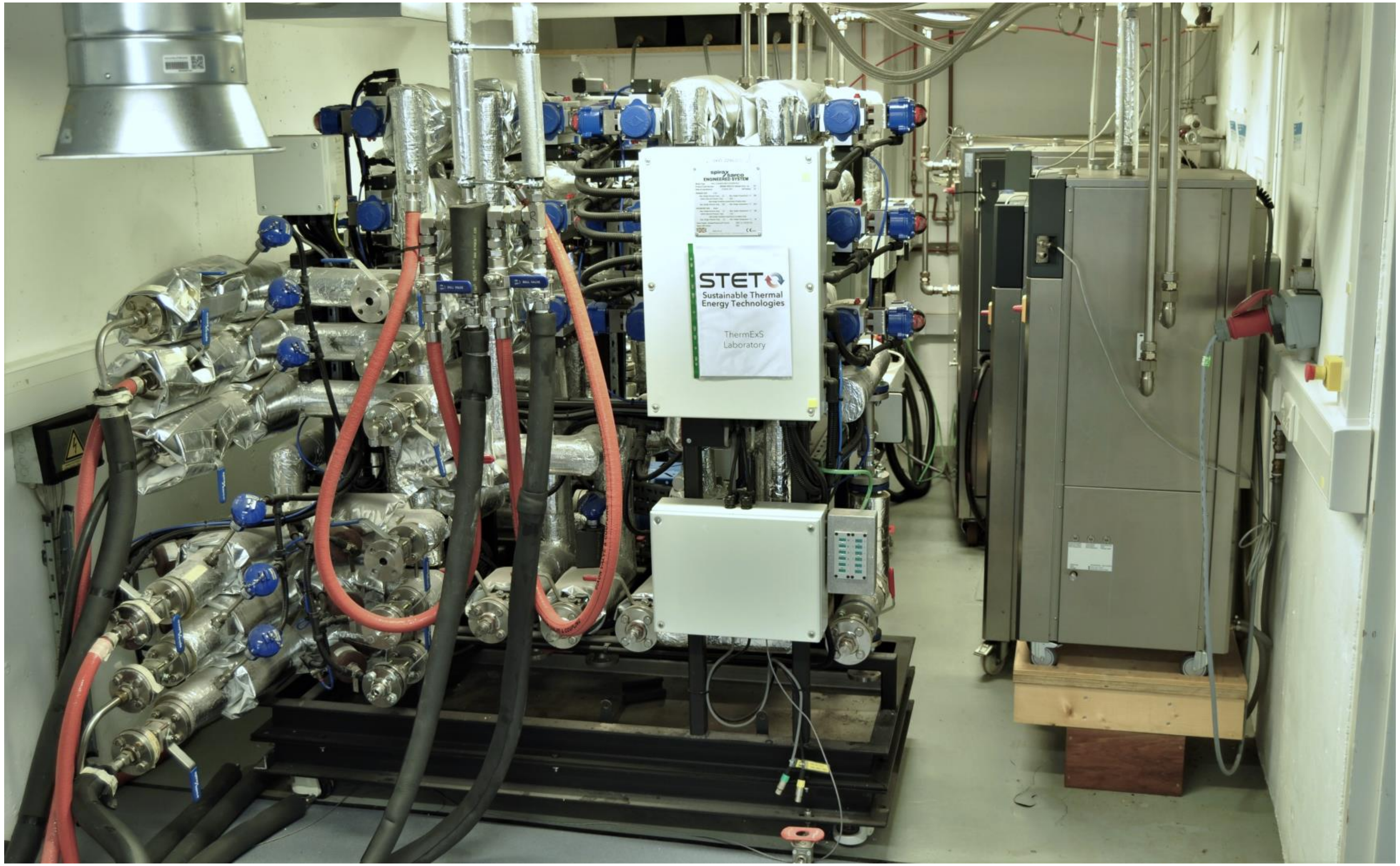
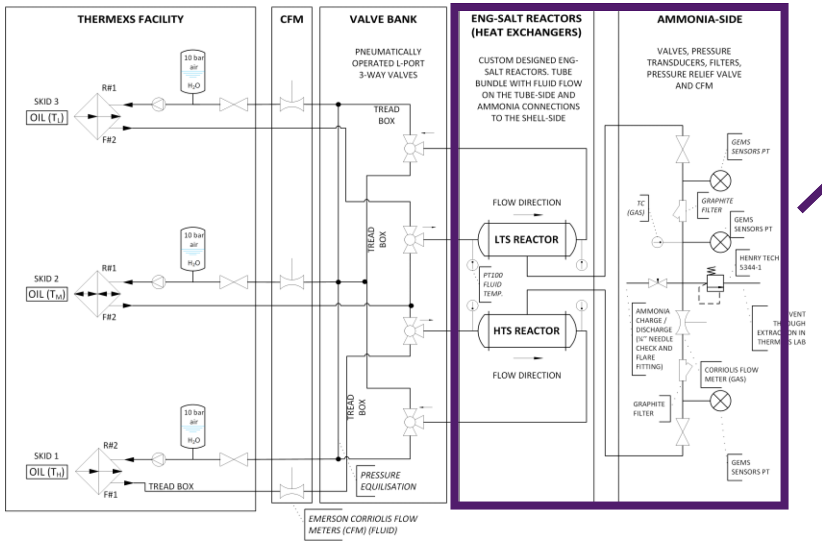
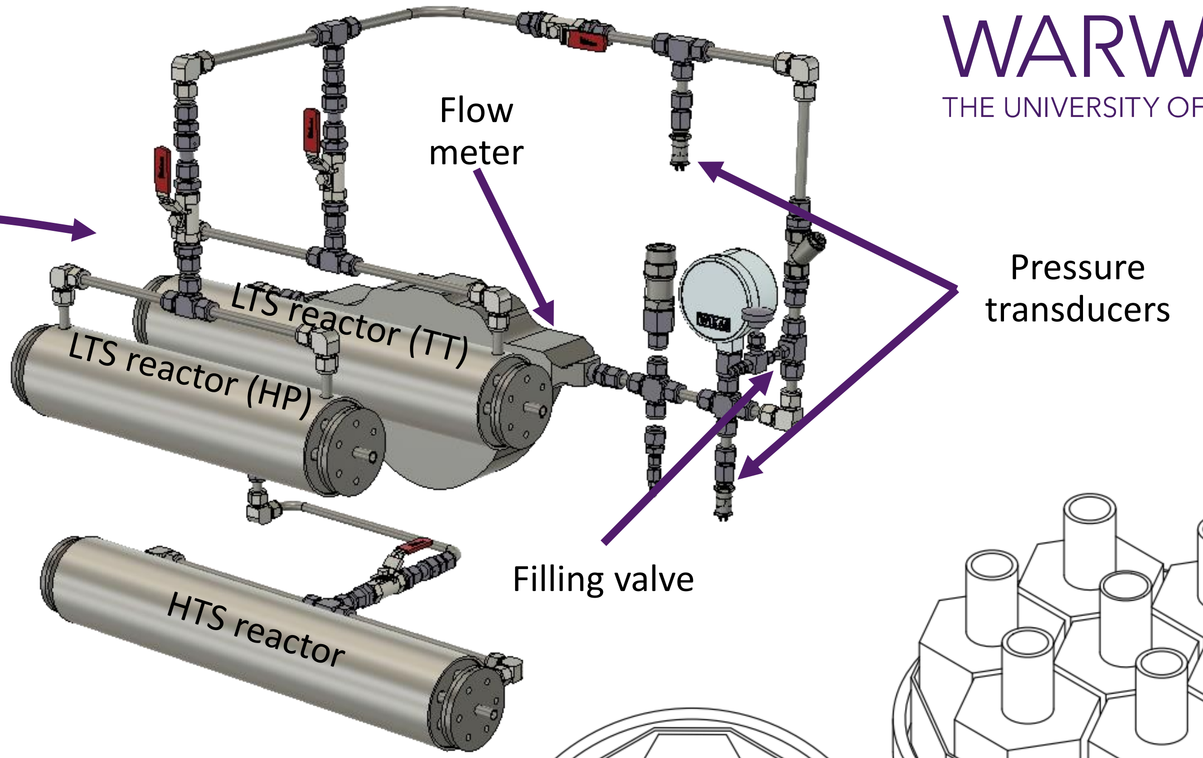


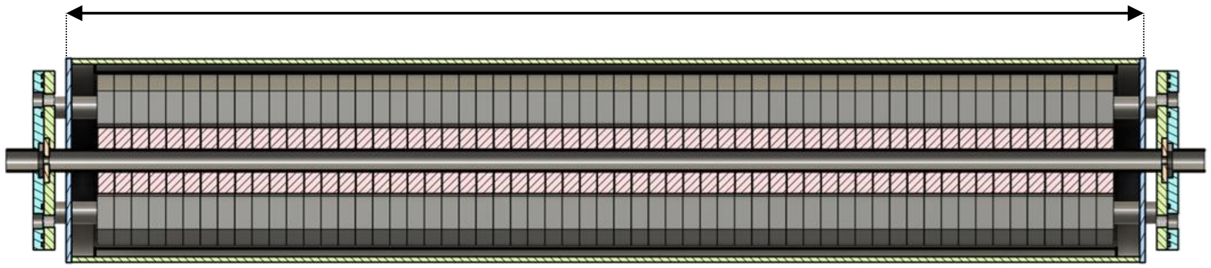


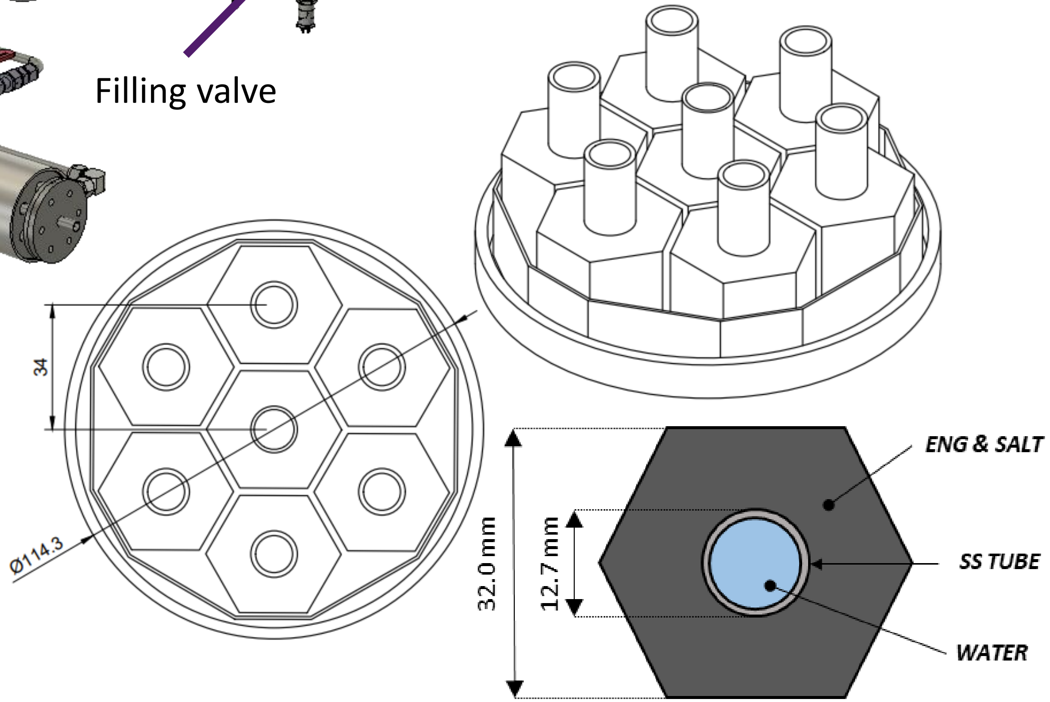
5. Ammonia-side





HTR = 620 mm, LTR (TT) = 535 mm & LTR (HP) = 450 mm





6. NaBr Reactor Build

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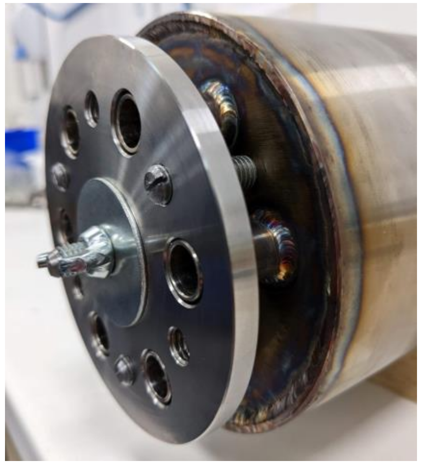
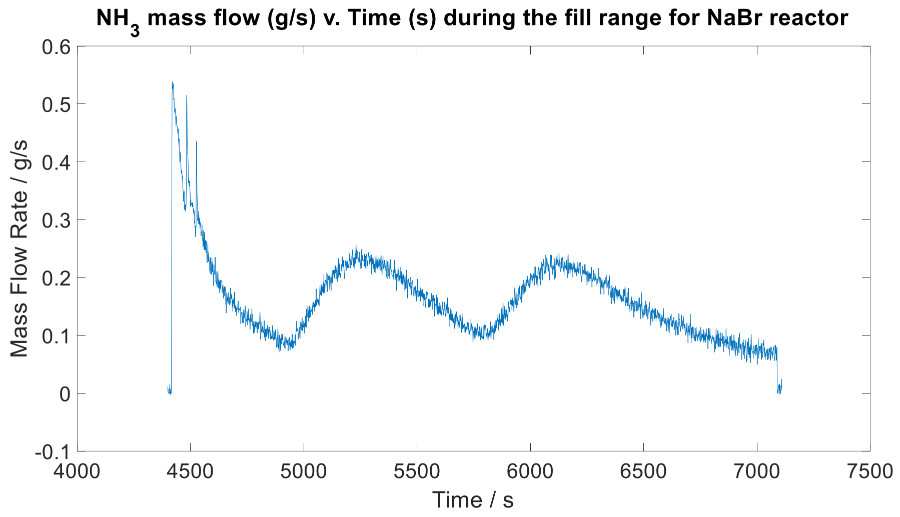
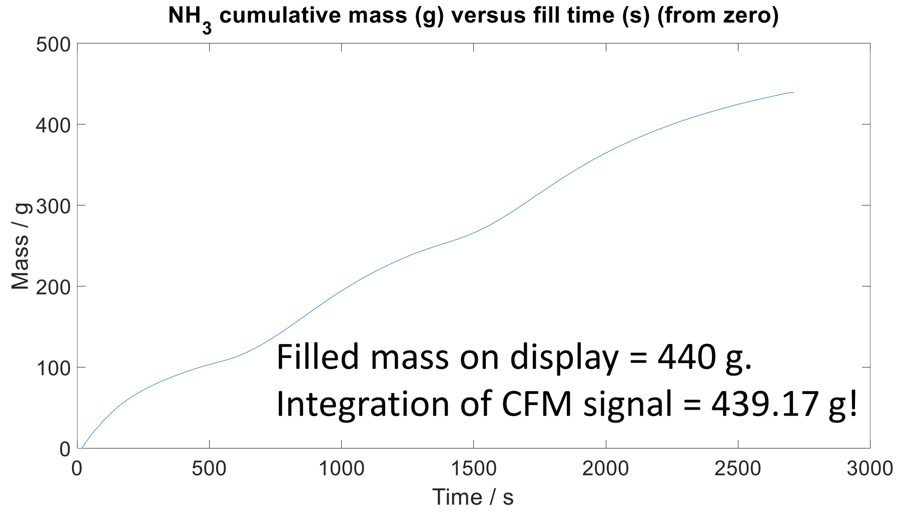
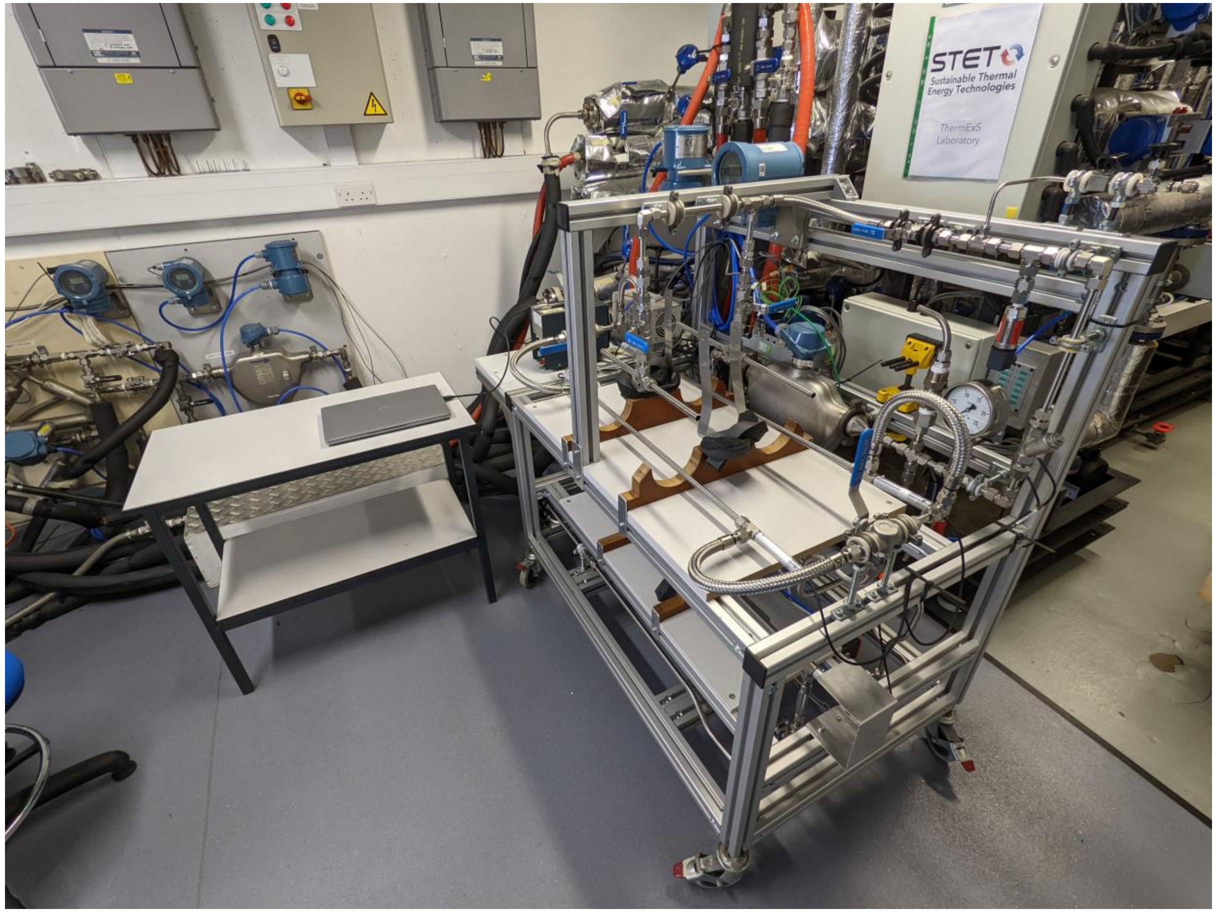


7. NaBr Ammonia Fill





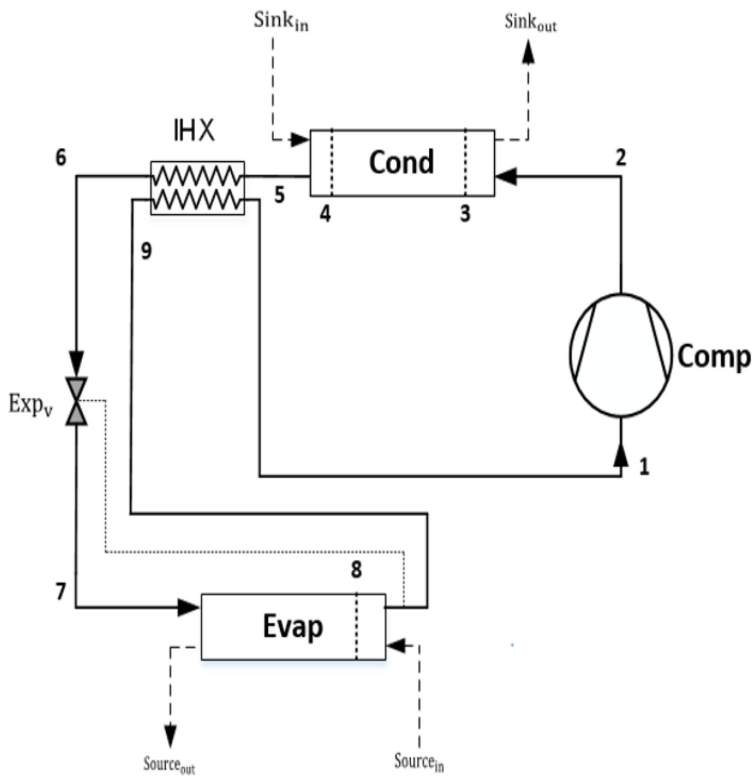
8. Build progress

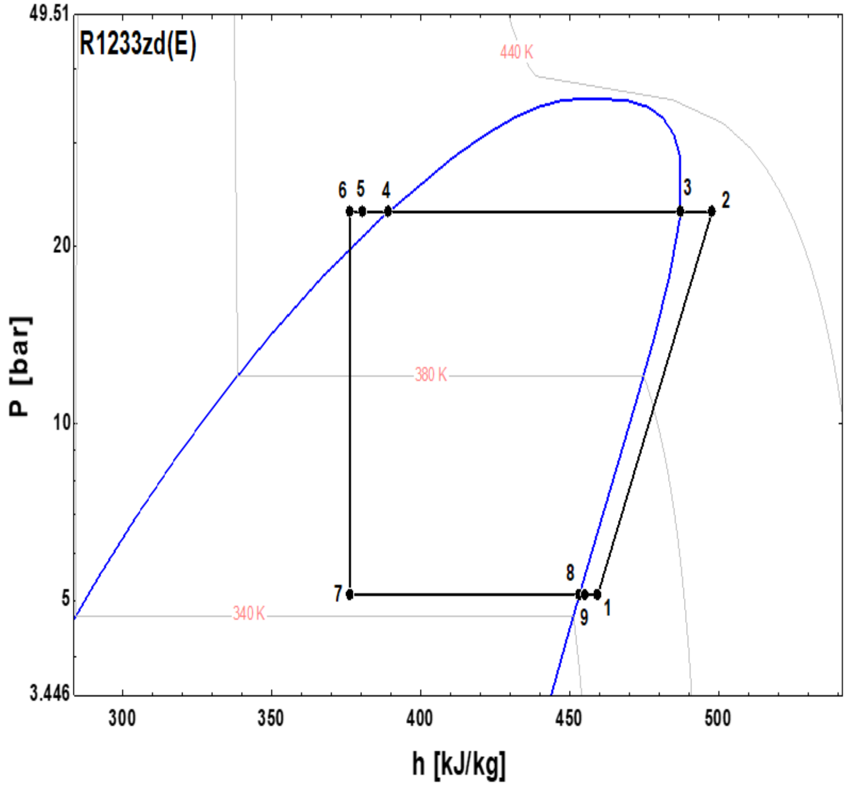


- NaBr reactor installed
- $MnCl_2$ reactor back from welding yesterday
- Fill test this week?
- Operational next week?? ☺☺☺

Heat pumps
(Ulster University)

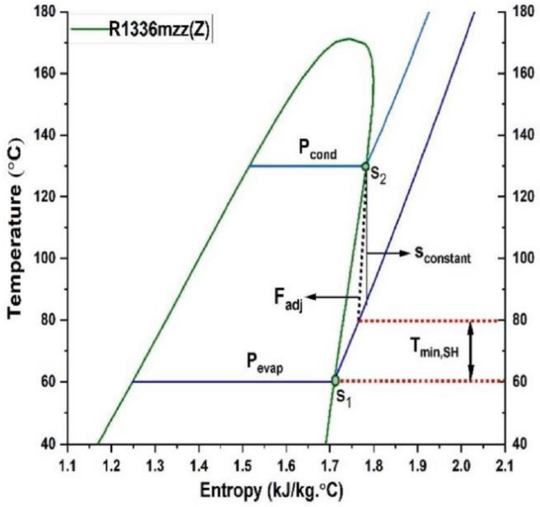
Work Package 3.1 – Low temperature lift, high COP Vapour Compression Heat Pump (Combined with WP 3.3)

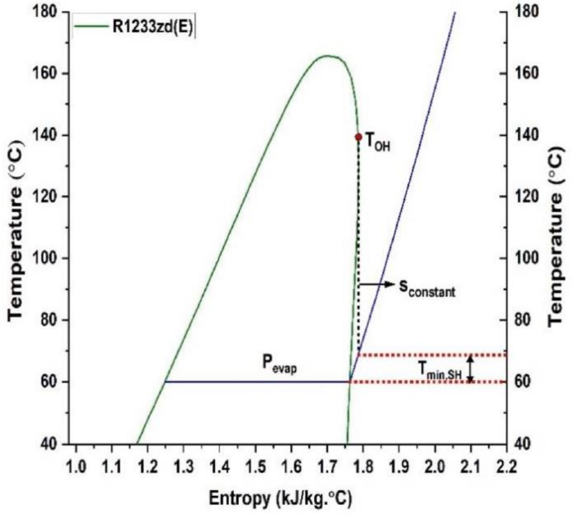




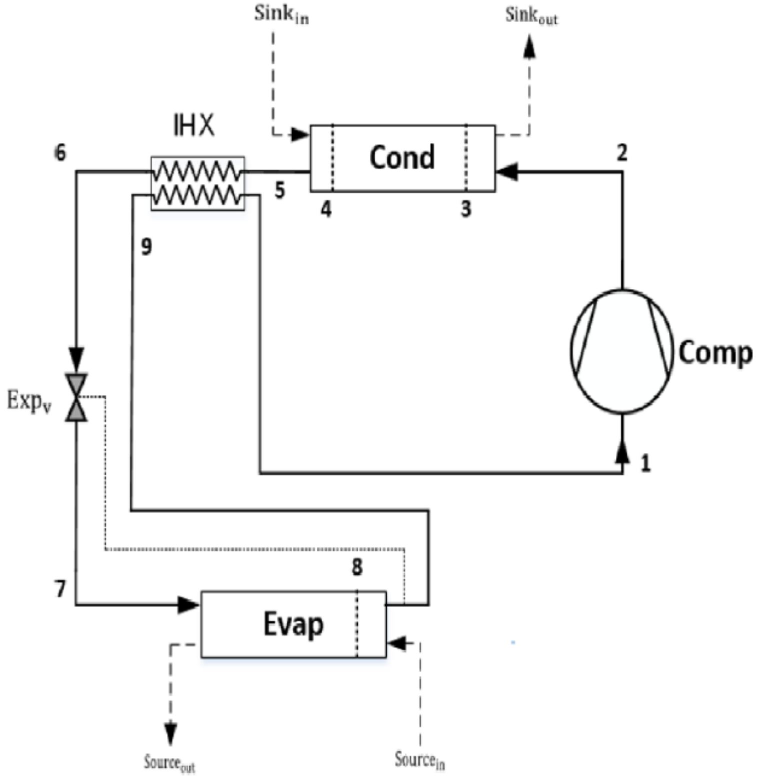
Work Package 3.1 – Low temperature lift, High COP Vapour Compression Heat Pump – Refrigerants

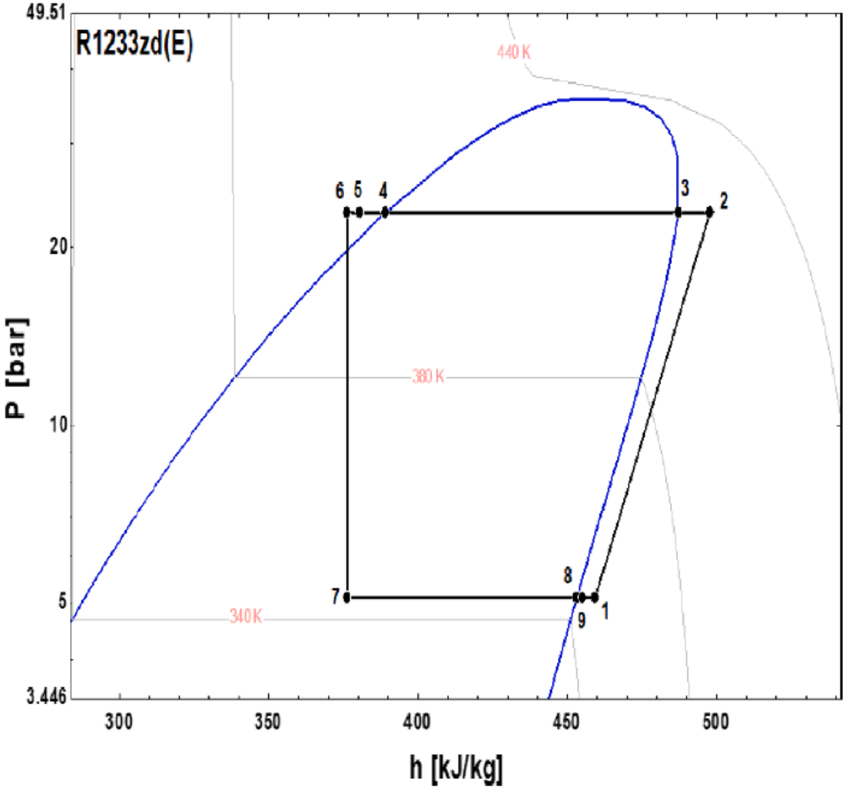
Type	Refrigerant	Composition	ODP	GWP_{100yrs}	Tcr [°C]	Pcr [bar]	NBP	SG
HC	**R600**	C_4H_{10}	0	4	152.01	37.96	0.00	A3
HC	**R601**	C_5H_{12}	0	5	196.56	33.58	36.10	A3
HCFO	**R1224yd(Z)**	C_3HF_4CI	0.00012	1	156.00	33.30	14.00	A1
HCFO	**R1233zd(E)**	$C_3H_2CIF_3$	0.00034	1	166.50	36.20	18.00	A1
HFC	**R245fa**	$C_3H_3F_5$	0	1030	154.05	36.40	15.00	B1
HFC	**R365mfc**	$C_4H_5F_5$	0	794	186.85	32.66	40.00	A2
HFO	**R1234ze(Z)**	$C_3F_4H_2$	0	<10	150.10	35.30	9.80	A2L
HFO	**R1336mzz(Z)**	$C_4H_2F_6$	0	2	171.30	29.00	33.40	A1



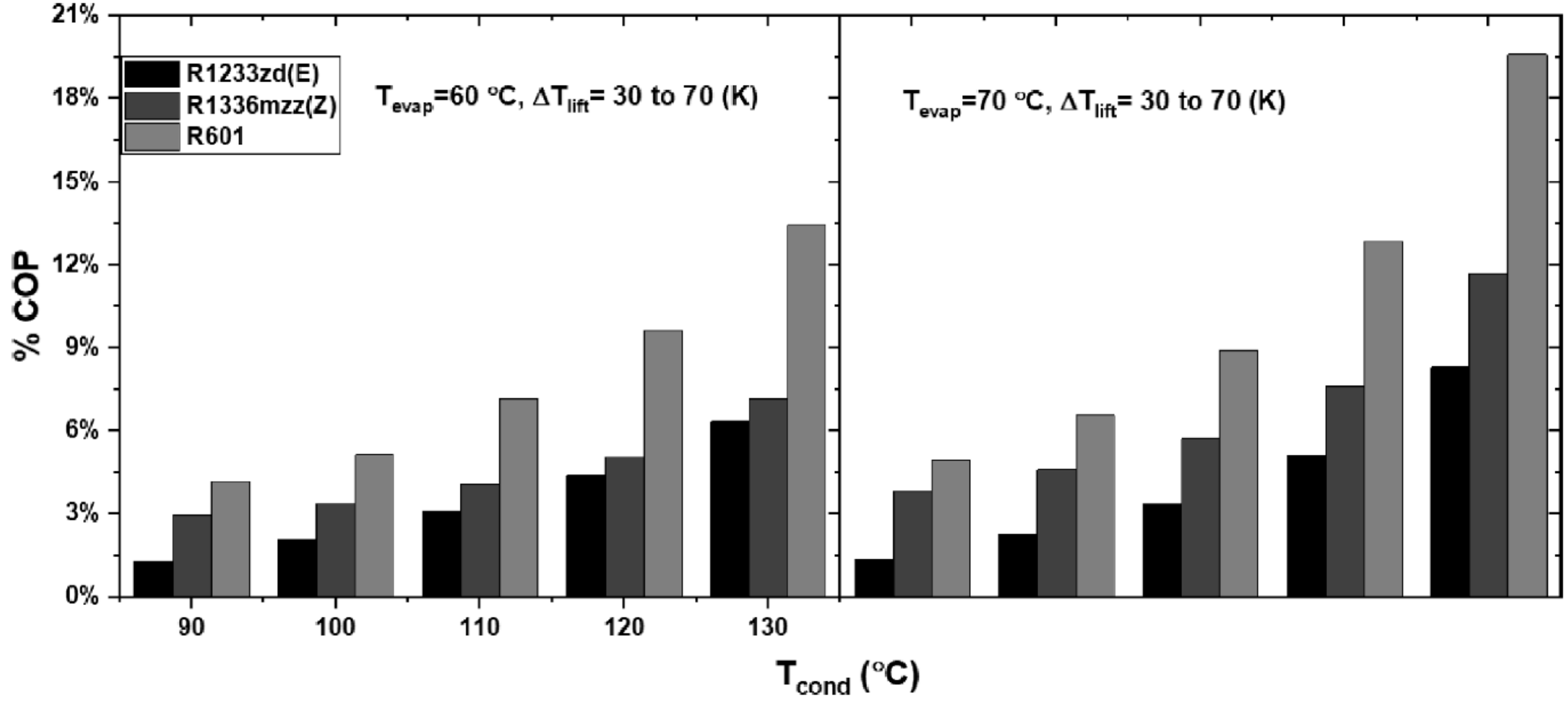


Work Package 3.1 – Low temperature lift, high COP Vapour Compression Heat Pump – Refrigerants



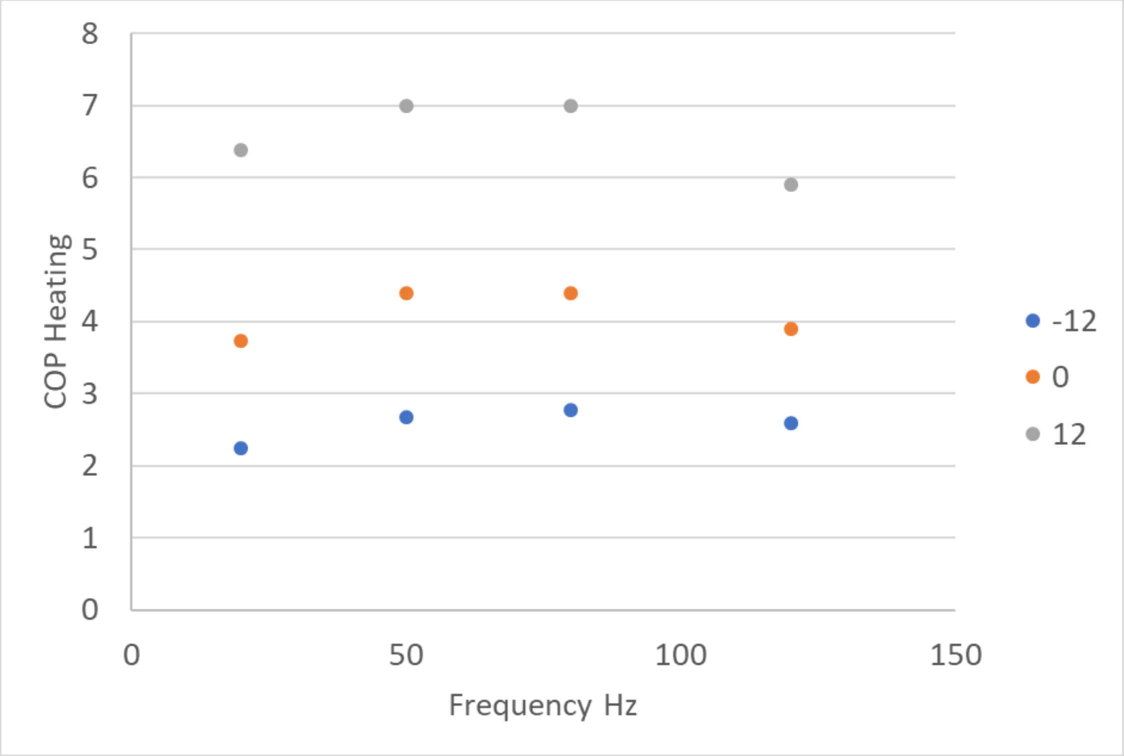


Work Package 3.1 – Low temperature lift, high COP Vapour Compression Heat Pump – Refrigerants



Work Package 3.2 – Vapour Compression Heat Pump for Demand Side Management

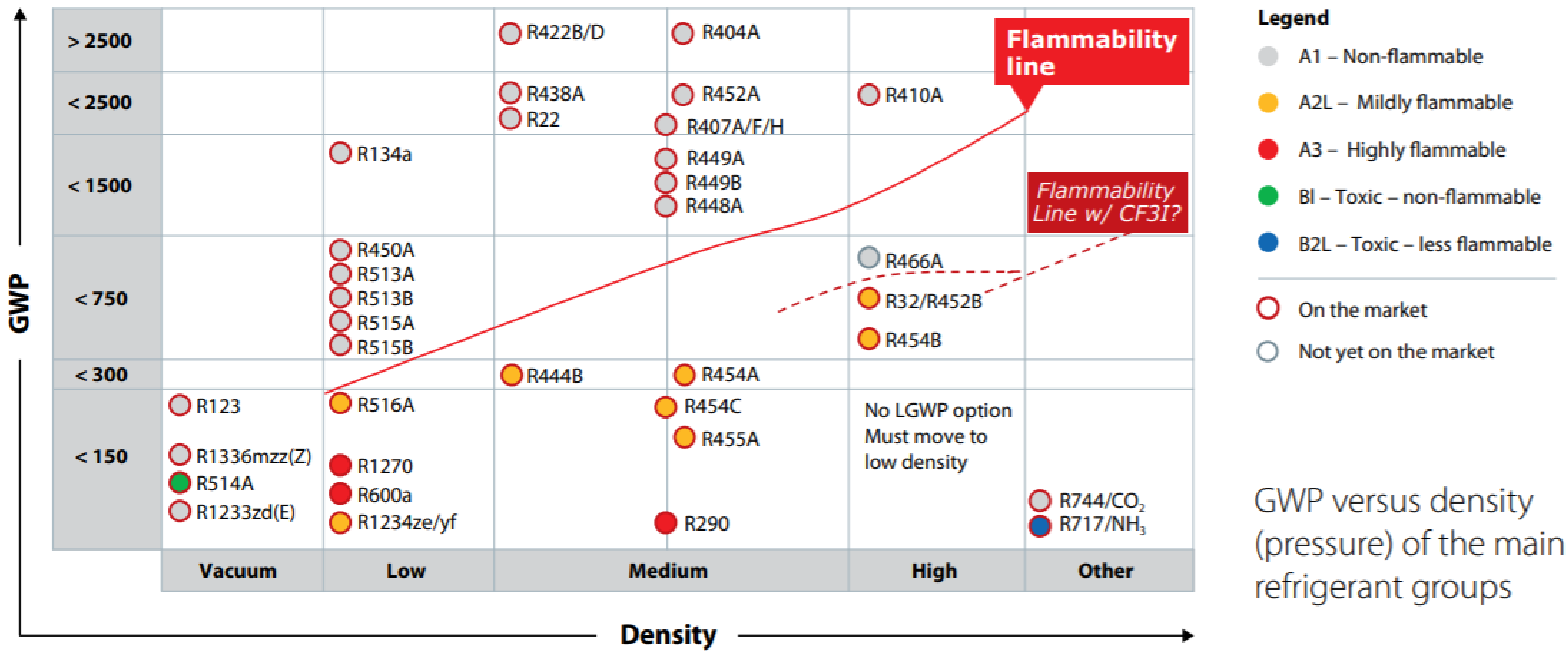
- Variable Speed Drive Compressor tested across a range of inlet and outlet temperatures
- Definite peak in performance at 50Hz-60Hz representing design origins at these frequencies
- Loss in performance becomes more pronounced at lower temperature lifts
- Work was carried out using R410a
- Replacement of R410a by R466A provided 5% greater performance
- R466A GWP > 150 (733) compared to R410A of 2,088



Work Package 3.2 – Vapour Compression Heat Pump for Demand Side Management

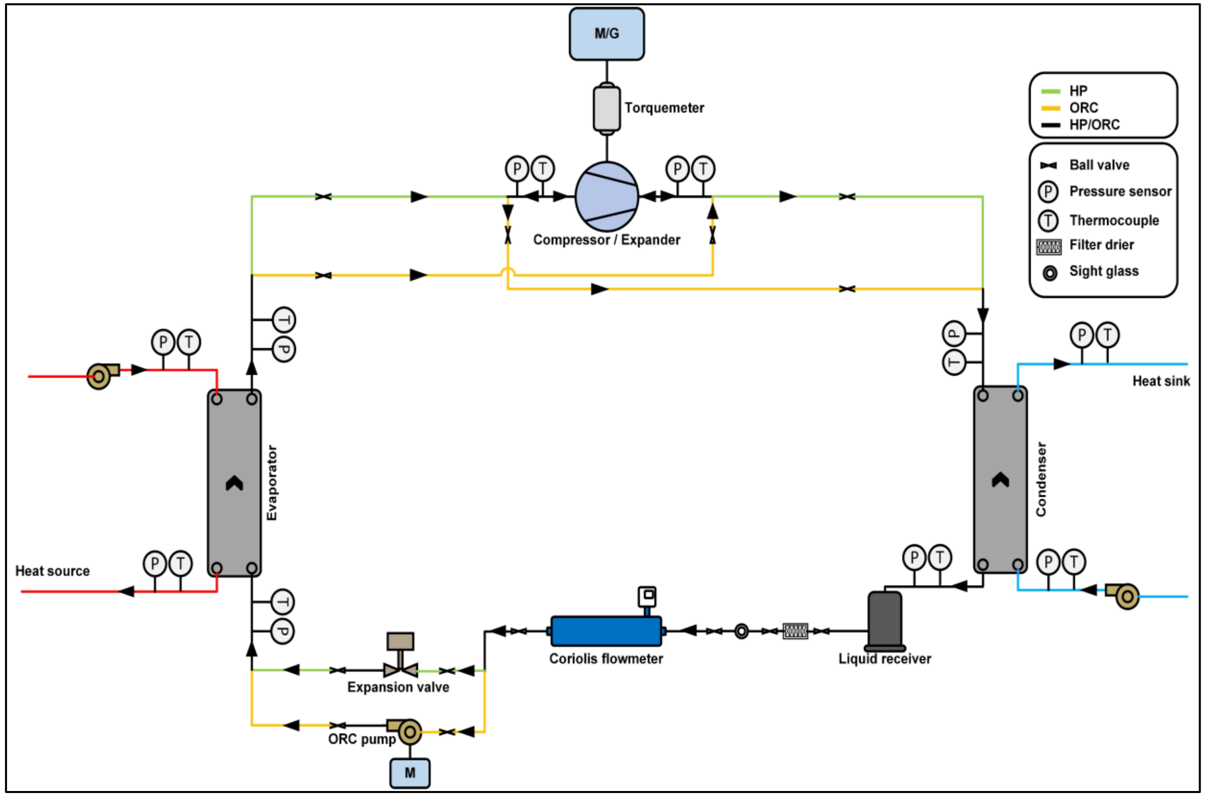
Main refrigerants at play

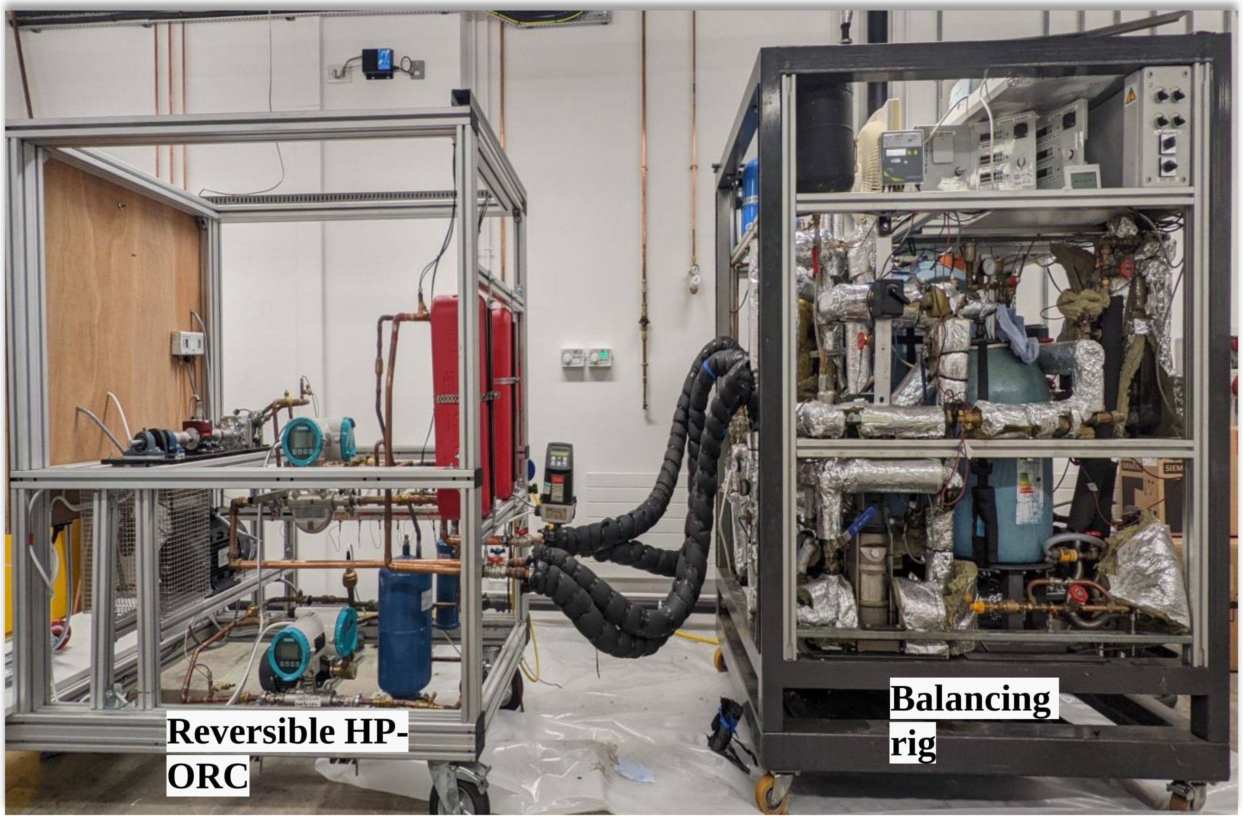
A complex picture in continuous evolution



GWP versus density (pressure) of the main refrigerant groups

Work Package 3.4 – Combined Vapour Compression Heat Pump/Organic Rankine Cycle for Heat or Electricity





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Work Package 3.4 – Combined Vapour Compression Heat Pump/Organic Rankine Cycle (Model Results)

Reversible heat pump – organic Rankine cycle for recovering industrial waste heat lying in lower temperature band (<150°C). R1233zd(E) is selected as the refrigerant for both operating modes (HP and ORC) for its near zero ODP and low GWP.

An automotive scroll compressor (Sanden TRSA09) is chosen as the volumetric machine to be used as compressor and expander in HP and ORC modes respectively.

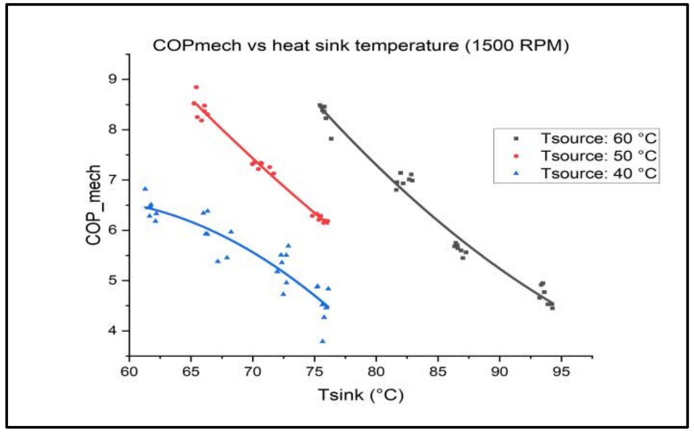
In HP mode, a maximum compressor isentropic efficiency of 75.4% is achieved with a maximum power consumption of 2.39 kW.

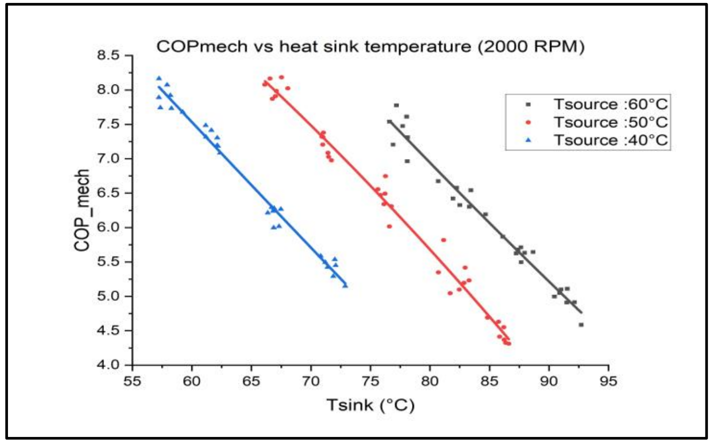
The COP of the HP mode is in 4 – 6.5 range for temperature lifts varying from 35 to 50 K.

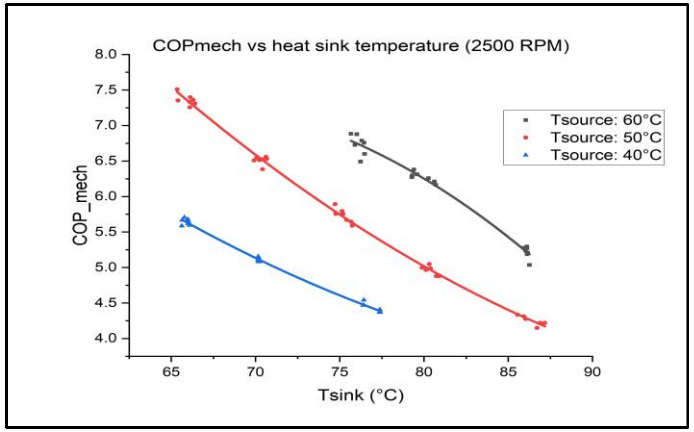
In ORC mode, the cycle thermal efficiency reached a maximum of 5.9%.

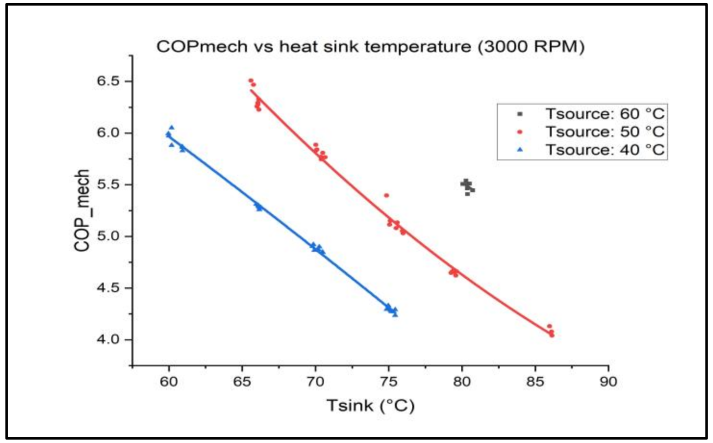
A maximum net power generation of 836W is obtained. Expander isentropic efficiency values up to 62.5% is achieved under mentioned operating conditions.

Work Package 3.4 – Combined Vapour Compression Heat Pump/Organic Rankine Cycle (Heat Pump Mode)









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Heat pump readiness

Assessing the readiness for wide-scale heat pump adoption in the UK domestic market

- **History & Context**
  - A history of policy interventions in the UK domestic heating market with frequent changes and mixed results
  - The Boiler Upgrade Scheme launched in 2022 supporting 90,000 heat pump installations
  - The ambition for 600,000 heat pump installations per year by 2028
  - A heat pump installation may need more work on the house than just the heat pump installation, requiring different skills and greater cost
    - Improved wall and loft insulation, installation of double glazed windows, replacement of inefficient radiators and pipework, increased draught proofing, and increased electricity supply to a home
- **Combining three perspectives**
  - The readiness of the housing stock for heat pumps
  - The readiness for heat pump installers to offer a range of services
  - The readiness of home owners to carry out arrange of activities when choosing to install a heat pump

Heat Pump Ready: Homes

- Aim: to determine the proportion of the English housing stock that meets the eligibility criteria for the current Boiler Upgrade Scheme (BUS) and are also heat pump-ready
- Method
  - Eligibility for BUS requires an Energy Performance Certificate (EPC) and no outstanding recommendations on loft insulation or cavity wall insulation
  - English Housing Survey data provides information on the condition and energy efficiency of housing
  - EHS data covers over 19.5 million houses. EPC data covers over 20 million houses.
  - EPC and EHS data used to propose "Heat pump ready" as EPC A,B and part of C.
- Conclusion
  - There is a significant gap between the proportion of homeowners meeting the eligibility criteria for the Boiler Upgrade Scheme and the proportion of homes in England that could be deemed heat pump-ready.
  - **There are nearly five times more homes eligible for BUS than are heat pump-ready**, creating an eligibility-readiness gap.

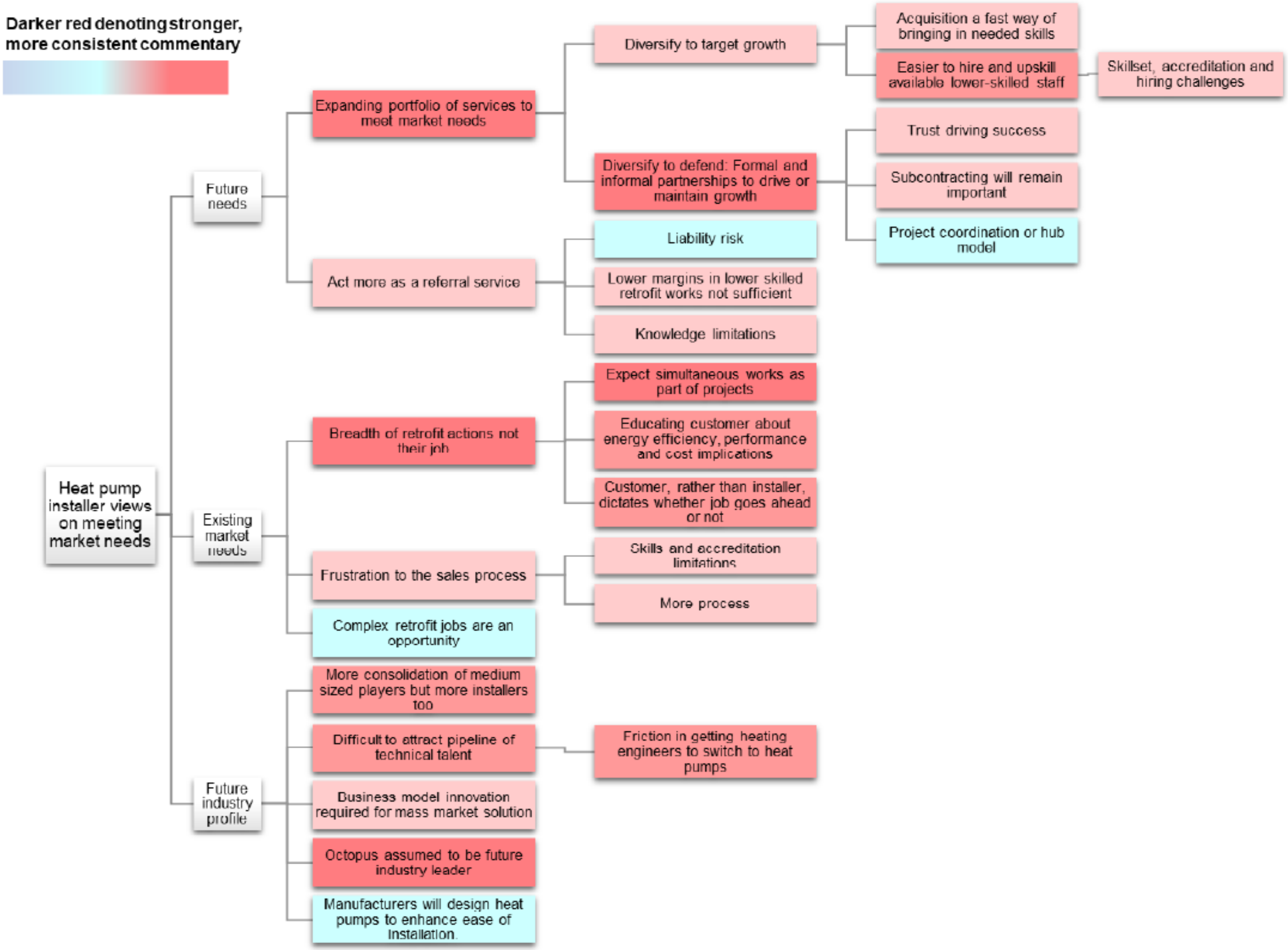
EPC rating	Rating Points	Total houses by EPC rating	% of total houses by EPC rating	Heat pump-ready categorisation
A	92-100 SAP points (Most efficient)	**12,403**	0.1%	3.2% of homes assumed to be **definitely** heat pump-ready
B	81-91 SAP points	**617,266**	3.1%	
C	69-80 SAP points	**6,008,230**	29.9%	
D	55-68 SAP points	**8,626,816**	42.9%	67% of homes assumed to be **definitely not** heat pump-ready
E	39-54 SAP points	**3,611,586**	18.0%	
F	21-38 SAP points	**929,730**	4.6%	
G	1-20 SAP points (Least efficient)	**285,480**	1.4%	
Not Recorded		**35**	0.0%	
	Total	**20,091,546**	100.0%	

	Total
Total number of homes assumed to be definitely heat pump-ready	629,669
Total number of homes assumed to be definitely not heat pump-ready	13,453,647

Heat Pump Ready: Installers

- Aim: to determine how ready the heat pump installation industry is to provide a range of services beyond the heat pump installation when needed.
- Method
  - Semi-structured interviews with senior employees in 12 heat pump installation companies
  - Drawn from directories of the Heat Pump Association, Heat Pump Federation and the MCS. Broad coverage across all of England
- Conclusion
  - **Two thirds of HPIs said no more than 10% of homes were heat pump-ready.**
  - While installers recognise the support from BUS, their ability varies significantly on how to discuss and offer all the actions needed to make a home heat pump-ready for a successful installation.

Thematic analysis of installer views on meeting market needs



Heat Pump Ready: Homeowners

- Aim: To assess home owner views on their willingness and concerns regarding spending money on heat pump installation and associated works in the transition to lower carbon heating.
- Method
  - N=1,021 home owners in England with gas boilers
  - JL Partners' nationally representative survey of 2,000 British adults
- Conclusion
  - Even when homeowners are interested in installing a heat pump they are often unaware of the actions and costs needed for a home to become heat pump-ready.

Table 11: Please select the home improvements you would NOT be willing to consider or implement

	N	%
Installing underfloor heating	434	42%
Replacing heating pipework	290	28%
Floor insulation	263	26%
Replacing radiators	244	24%
CWI or SWI	189	18%
Installing a smart meter	184	18%
Double or triple glazing	129	13%
Loft insulation	119	12%
Air sealing / Draught proofing	118	11%
None of these/I will consider making all improvements	379	37%

Table 13: What is the maximum cost you would be willing to incur to ensure your home is heat pump-ready?

	N	%
I wouldn't - it is not a priority unless it is fully funded by Government.	585	57%
≤£1,000	181	18%
≤£3,000	148	14%
≤£5,000	81	8%
≤£10,000	30	3%
≤£20,000	5	1%

Heat Pump Readiness: Implications

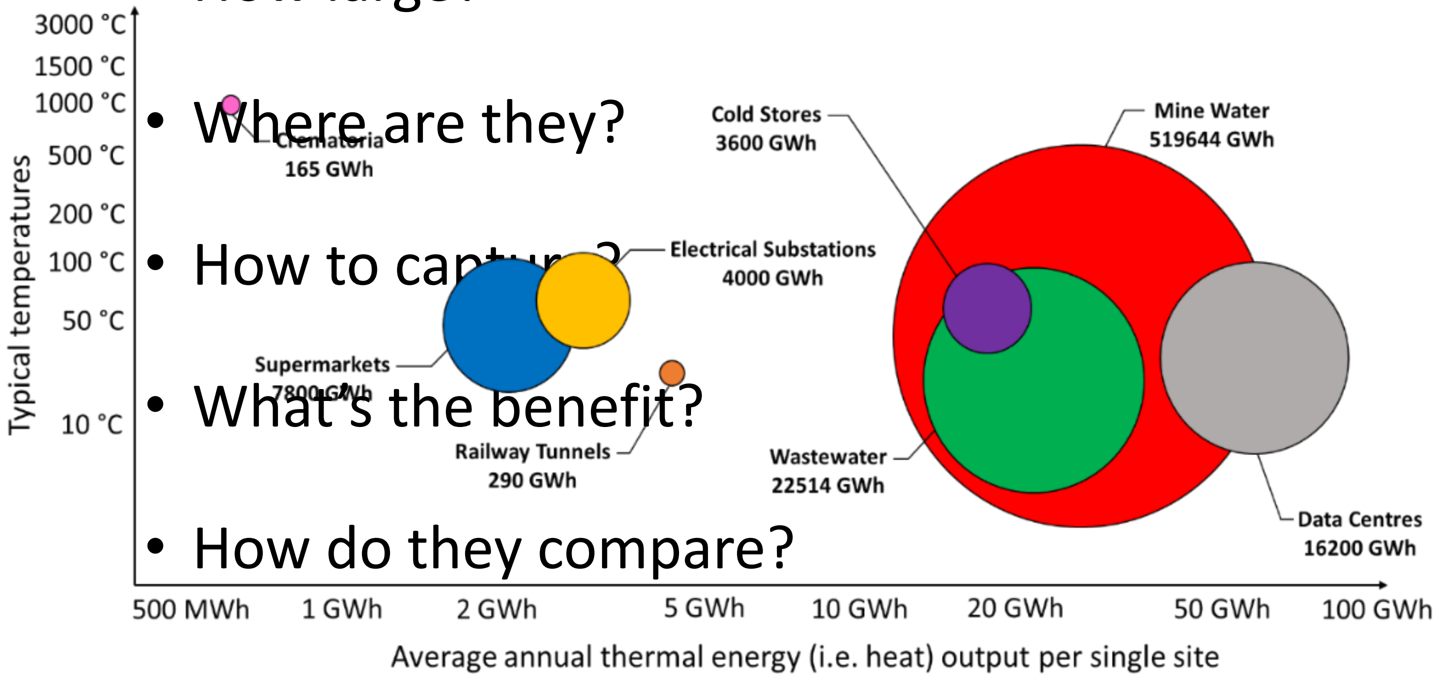
- There is a risk that the joint ambition of Government and Industry to meet ambitious targets for heat pump adoption will stall
- The installation industry is unprepared to coordinate and deliver at scale the services required to make homes heat pump-ready
- Installers see the regulations & incentives as failing to address the necessary home improvements associated with heat pump installations.
- Should schemes such as the Boiler Upgrade Scheme initially be more targeted at homes that are more “heat pump ready” and/or provided through channels more able to provide a package of services?
- Increasing use of electricity for decarbonized heat highlights the need to reconsider the balance of taxes and subsidies between gas and electricity, especially beyond or in the place of subsidies for heat pump costs & installation.

Waste heat recovery

WASTE HEAT SOURCES

Addressing the big questions to identify the opportunity

- How large?
- Where are they?
- How to capture?
- What's the benefit?
- How do they compare?



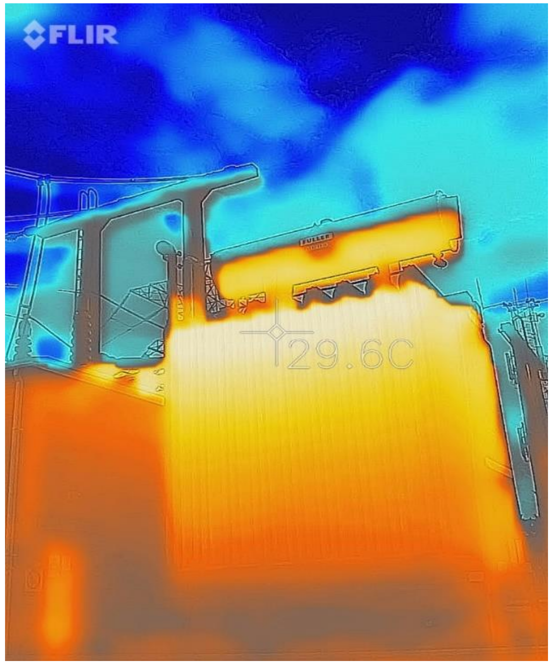
Waste heat source	Number of heat sources > 250kW	Waste heat recovery site/medium	Waste heat temperature(s) (°C)	Total thermal energy (heat) output (GWh.a^{-1})
Data centres	264	IT server exhaust air	30 to 40°C	16200
		Chilled water heat rejection	10 to 20°C	
Electrical substations	1336	Transformer cooling system	40 to 70°C	175
Wastewater	985	Final WWTP effluent	12 to 23°C Average 17.6°C	22514
Mine water	18584	Water	12 to 40°C	519644
Supermarkets	3653	Condenser heat rejection	21 to 27°C	7800
		Desuperheater	53°C	
Cold stores	195	Condenser heat rejection	15 to 30°C	3600
		Desuperheater	60 to 90°C	
Underground railway tunnels	65	Ventilation shaft air	11.5°C to 28°C	290
Cremations	269	Combustion exhaust gases	800 to 1000°C	165

Addressing the big questions to identify the opportunity

	What is they size and location?	How to capture and what is the benefit?	How do they compare?	What are our plans to deliver impact?
Underground Railways	ATE paper + PhD projects	PhD project	Bubble chart + New PhD on low-carbon heat networks	Business case and demo (GreenSCIES)
Data Centres		PhD project + GS case study		Heat zoning and policy advice (new PhD and TICR)
Substations	ATE paper	Modelling + SSE case study		
Supermarkets & Cold stores		GreenSCIES case study		Future PhD and KTP projects (SSE, TfL, Lumen)
Mine water		Helen		
Wastewater		ASHRAE paper: WWTP study		Current PhDs (mine water, data centres)
Crematoria	Separate paper	CIBSE paper on WHR options		

ELECTRICAL TRANSFORMERS

Energy losses in the form of heat are inherent to voltage transformation



From **20** to **70°C**

is the typical range for transformer waste heat, subject to loading and local ambient conditions

$$Q = C \times (0.0065L^2 + 0.0005)$$

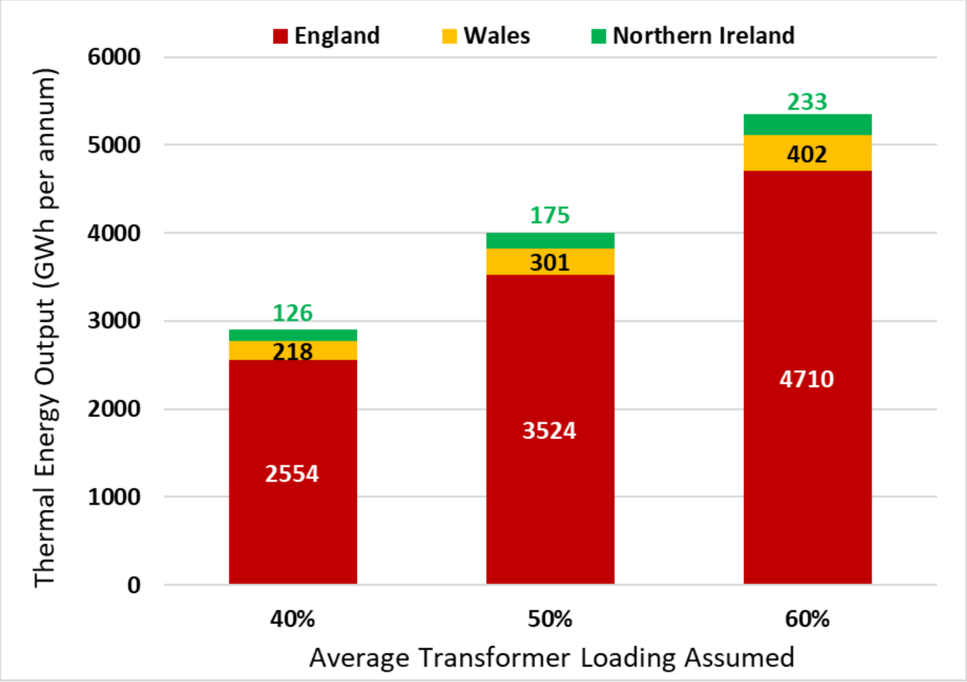
Where **Q** is the total heat loss [kW], **C** is the transformer rating [MVA], and **L** is the loading [%]

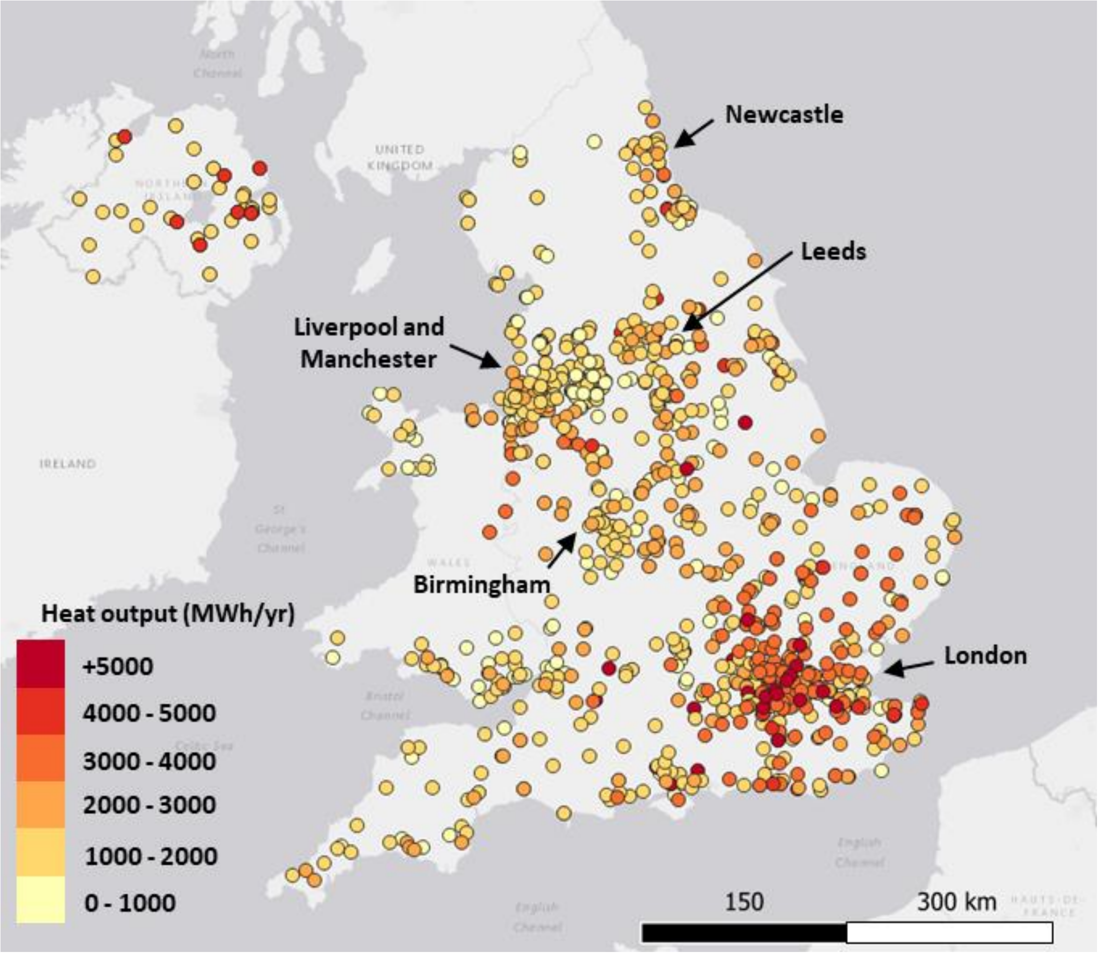
- Energy is lost during the transformation of voltage due to load and no-load losses
- Load losses occur due to the resistance of copper windings, no-load from hysteresis and eddy current losses
- Losses factors can be derived from transformer nameplates provided by manufacturers

NATIONAL POTENTIAL

A significant waste heat potential was estimated for cities across the UK

- UK Government project focused on England, Wales & NI
- Considering GSP, BSP and Primary substations
- 60 MVA threshold: 27% of sites, 66% of heat output





Annual waste heat output for 1,336 sites above 60 MVA, 50% loading

SSE Potential Project

National Grid pilots SSE Energy's heat recovery tech on transformer network

By **Nicholas Nhede** - Aug 27, 2021

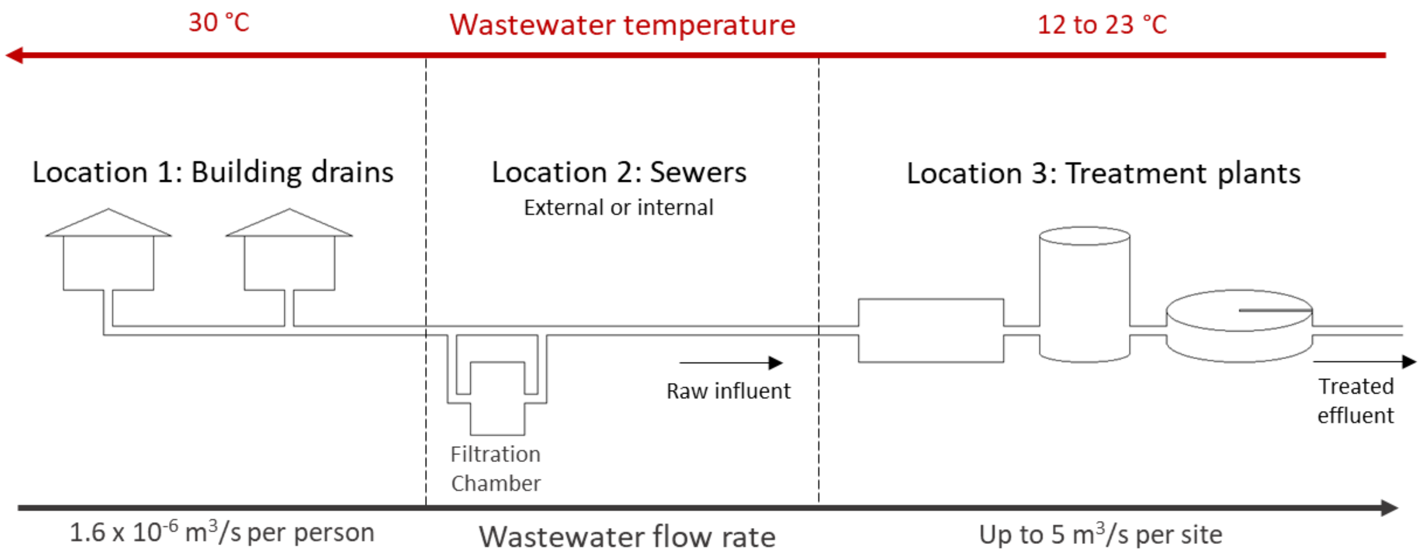
Image credit: National Grid

UK utility National Grid has partnered with SSE Energy Solutions to harvest waste heat from transformers and use it for water and space heating for its residential and business customers.

The heat recovery technology developed by SSE Energy Solutions is being piloted at National Grid's Deeside Center for Innovation, a testbed developed by the utility to test new assets and technologies off-grid.

WASTEWATER TREATMENT PLANTS

Heat comes from mainly from hot water use in buildings



30°C

Is the wastewater temperature exiting the drains of UK homes[1]

350 TWh

Is the amount of waste heat discarded annually through American drains[2]

- There are 3 main locations for heat recovery: building discharge, sewers and treatment plants
- Building discharge is very intermittent, sewers have fouling issues, whereas WWTPs have lower temperatures
- WWTPs offer high flow rates, and heat recovery upstream is undesirable due to biological treatment requirements

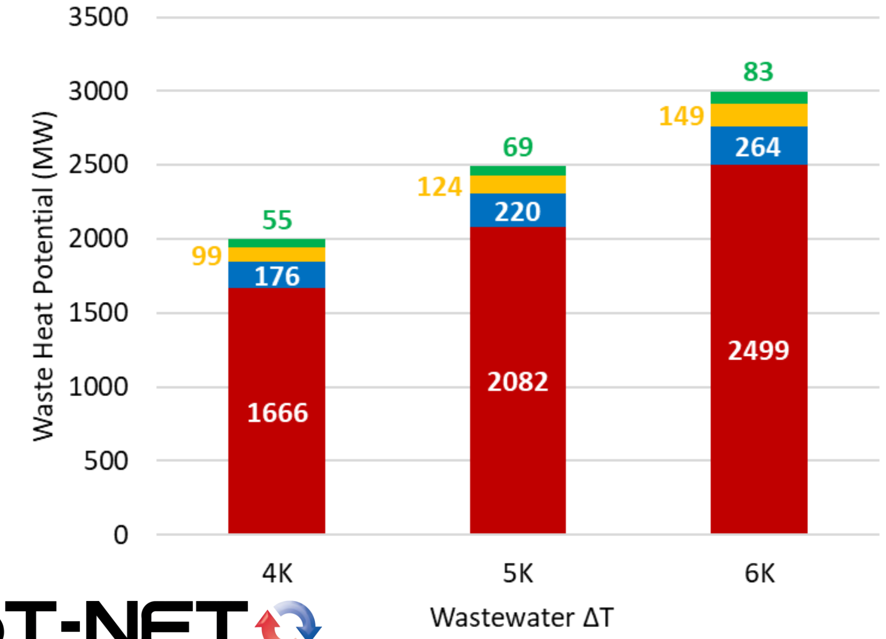
[1]Ali & Gillich (2021) – Opportunities to decarbonize heat in the UK using Urban Wastewater Heat Recovery

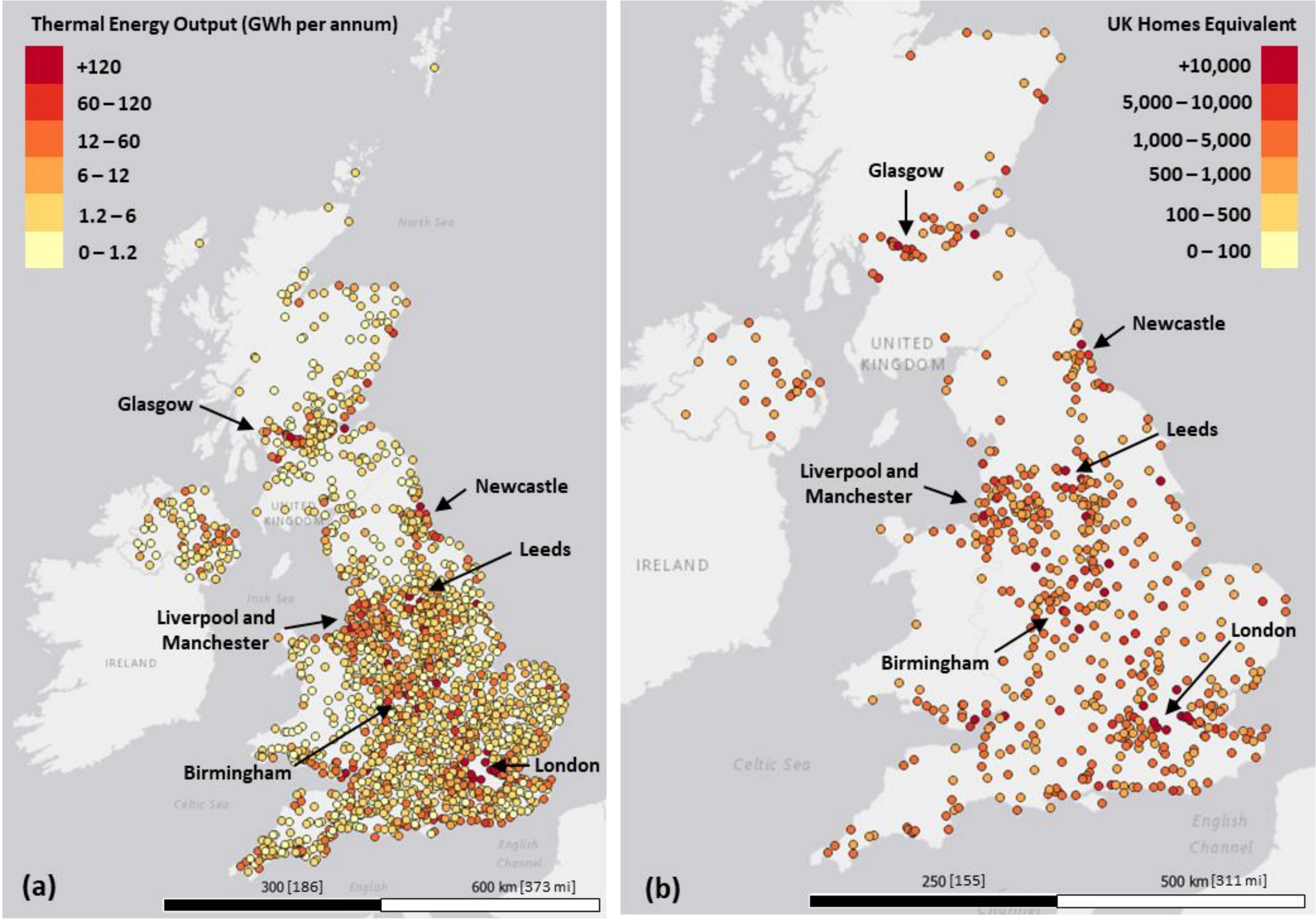
[2]U.S. Department of Energy (2005) – Heat Recovery from Wastewater Using a Gravity-Film Heat Exchanger

National Potential

A significant waste heat potential was estimated for cities across the UK

- 1,876 WWTPs for agglomerations > 2,000 PE
- 22 TWh available per annum across the UK
- 29% of plants account for 88% of total output





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EST 1892 LSBU

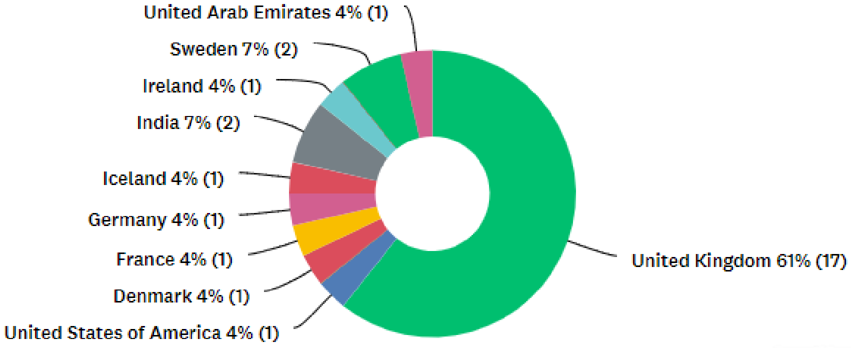
DATA CENTRES

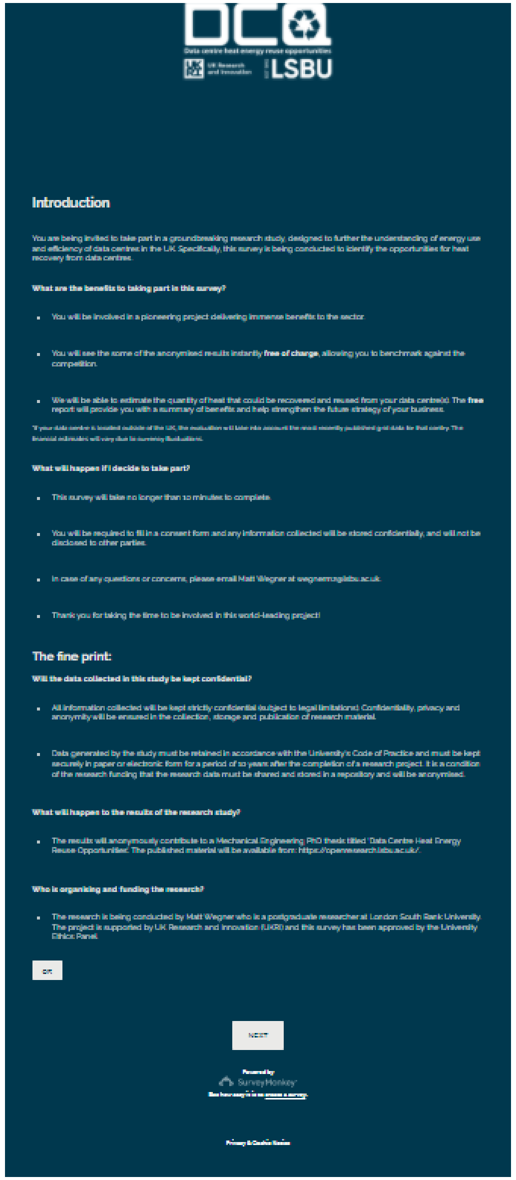
Online survey objectives:

- Overcome the lack of transparency within the sector
- Understand how data centres use energy
- Help establish generic factors between facilities for a more accurate estimate of heat available from the sector
- Invite data centre owners and operators to participate in the project (energy modelling)
- Investigate the industry's attitude towards waste heat recovery

Key highlights:

- Responses now including big names such as META/Facebook, Bulk, RI.SE, Cambridge West DC, Southampton University, and Colt DCS





https://www.surveymonkey.co.uk/r/dc-heat

DATA CENTRES

Recent and upcoming site visits include:

- LUMEN
- Kao Data
- Bulk DK01 (DC) and Høje Taastrup Fjernvarme (DHN) in Denmark
- Colt
- Proximity Datacentres
- Ordnance Survey
- Southampton University DC
- UCL

BEIS project contribution - additional x10 data centre surveys

KTP potential with LUMEN

Social Media & SIRACH

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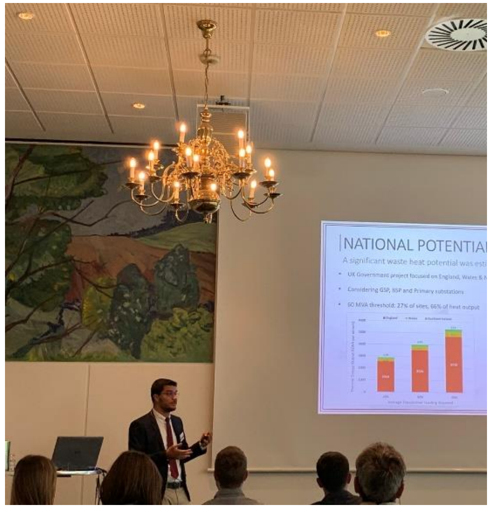


Stats since the account was launched:

Average of **43** impressions per day.

Total of **1938** engagements.

Records of **2,003** impressions and

118 engagements for a single tweet.

Thoughts?

Attitudes to waste heat recovery

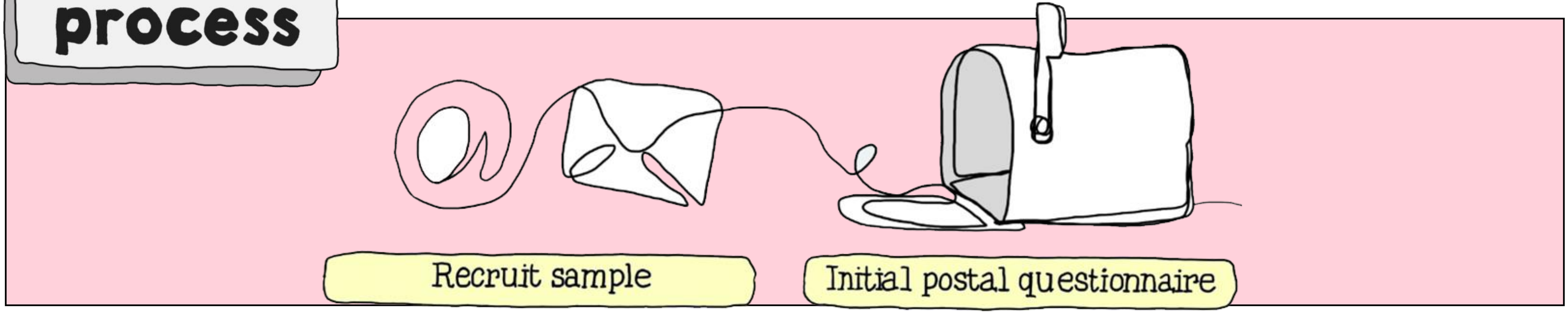
Aims

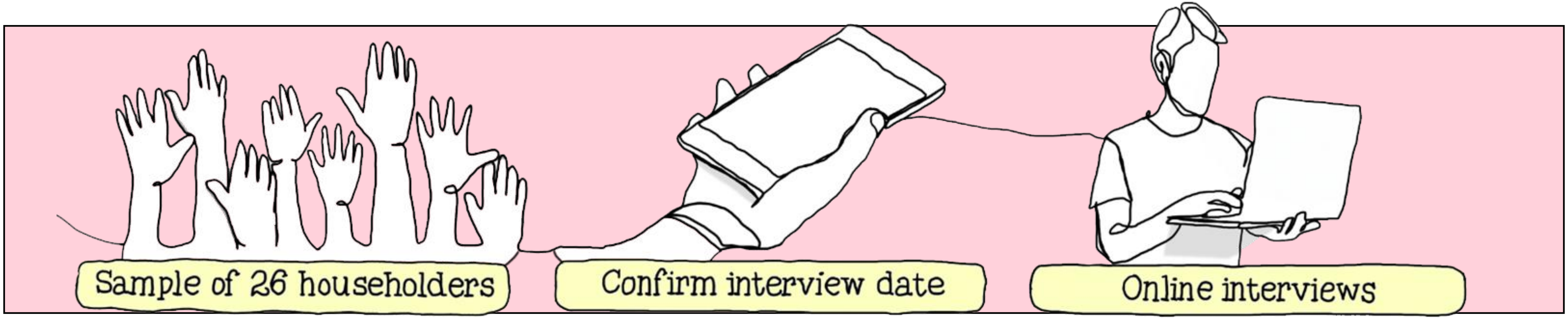
1) Understand UK householders' attitudes towards different waste heat sources

2) Identify UK householders' perceptions of relevant stakeholders and appropriate terminology

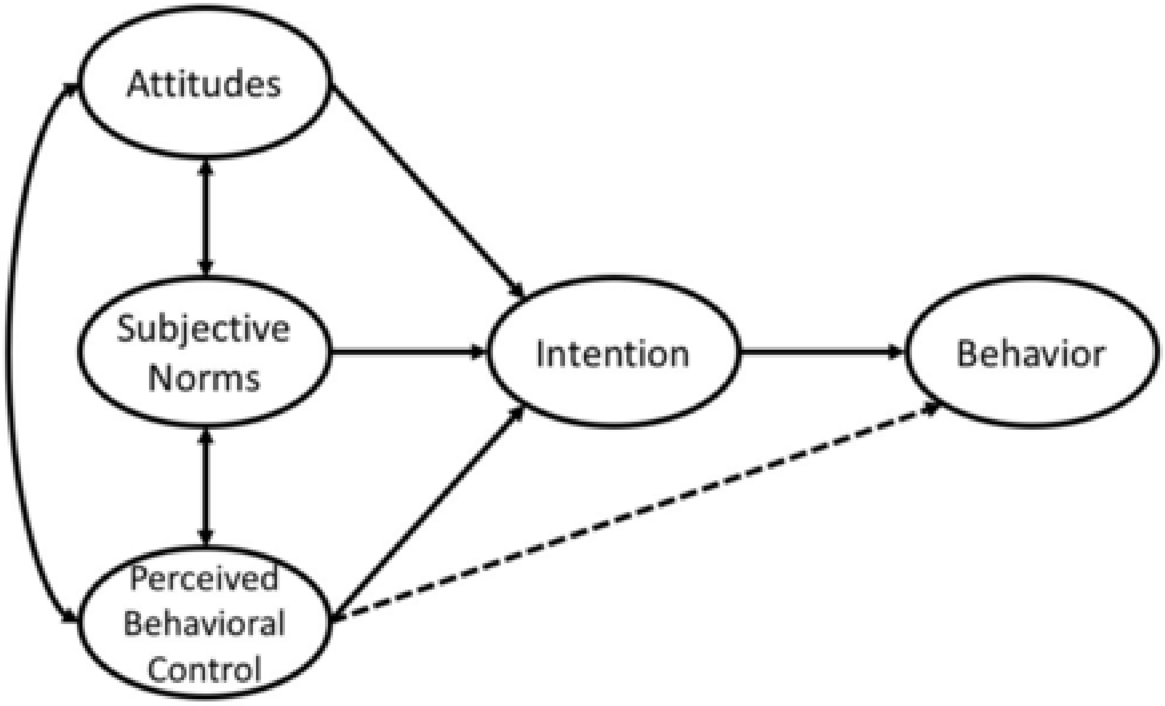
Loughborough University

Research process



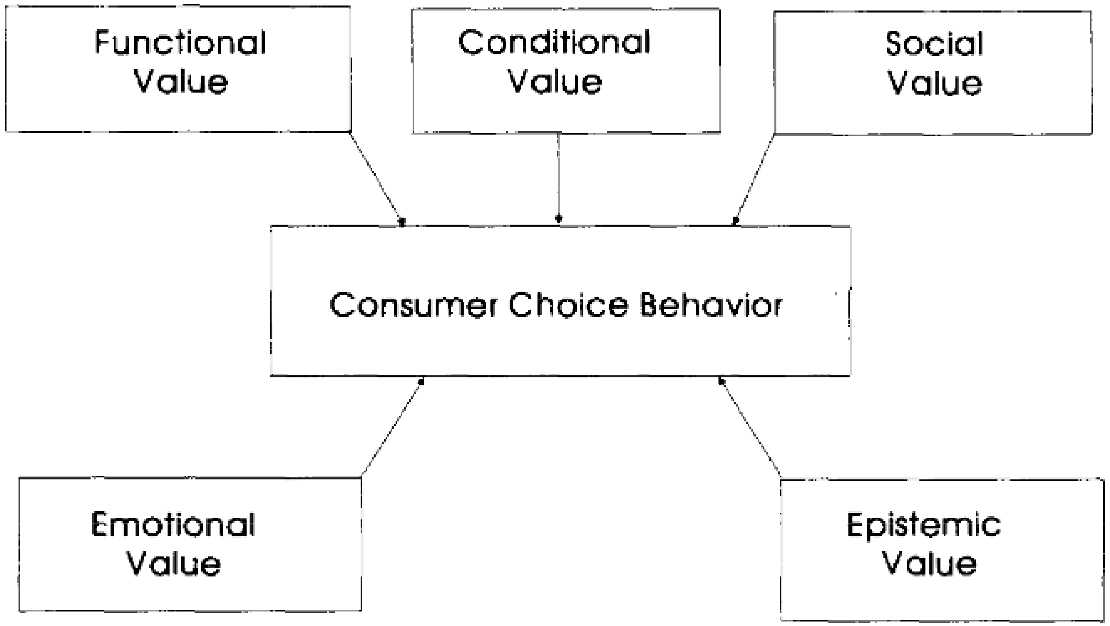


How do we understand householder attitudes?



We use Ajzen's (1991) definition of attitudes from the Theory of Planned Behaviour to understand householders' behavioural beliefs of waste heat adoption, outlining where barriers to adoption may exist

How do we understand why the values motivating householder attitudes?



We draw on the framework produced by Sheth et al. (1991) as a theoretical means to understand householder motivations and decision-making outcomes when reviewing the attractiveness of waste heat as an alternative domestic fuel source

Research Activity 1

Waste heat terminology

1 2 3 4 5 6 7 8 9 10

Least Attractive term

Most Attractive term

1) Waste heat 2) Secondary heat 3) Recovered heat

4) Low-grade heat 5) Recycled heat

Numerical rating scales

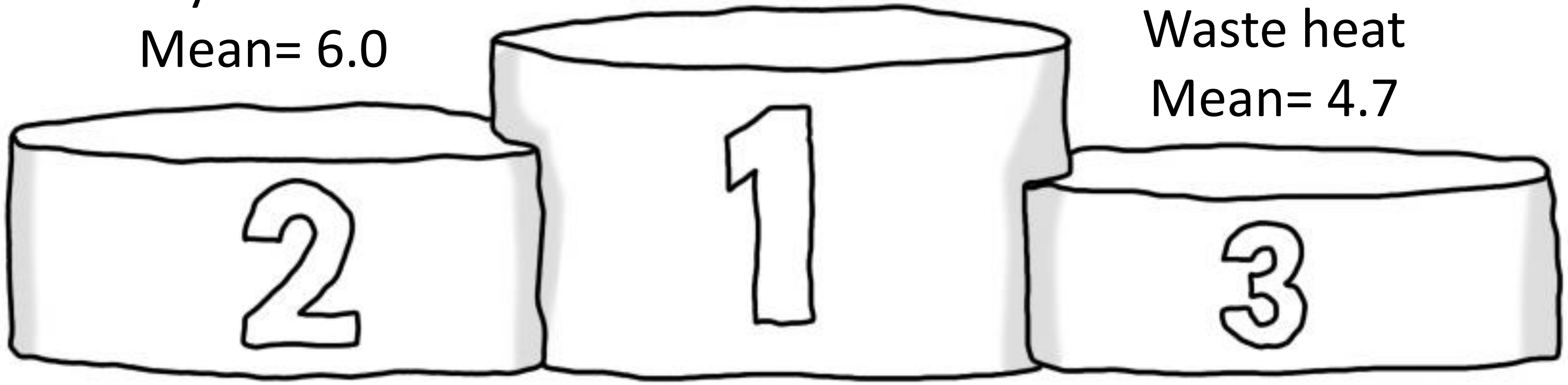
Findings Research Activity 1

Waste heat terminology

Recovered heat
Mean= 9.1

Recycled heat
Mean= 6.0

Waste heat
Mean= 4.7



4th Low-grade heat Mean= 4.5
5th Secondary heat Mean= 3.5

} a poorer type of heat

Findings Research Activity 1

Waste heat terminology

Most familiar term – Recycled heat

Most accurately defined term – Waste heat

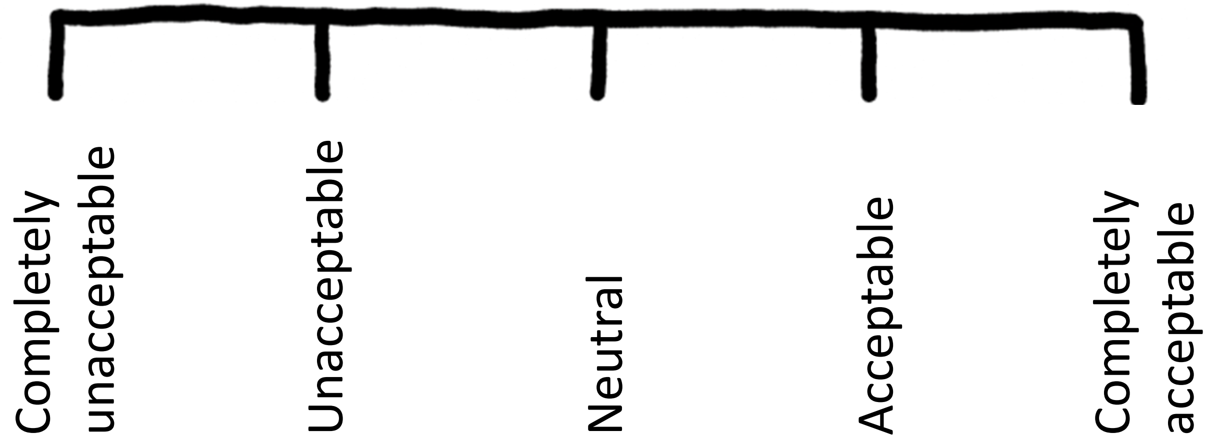
Most ecological term – Recovered heat

Most attractive term – Recovered heat

Most uncomplicated term – Recovered heat

Research Activity 2

Waste heat sources



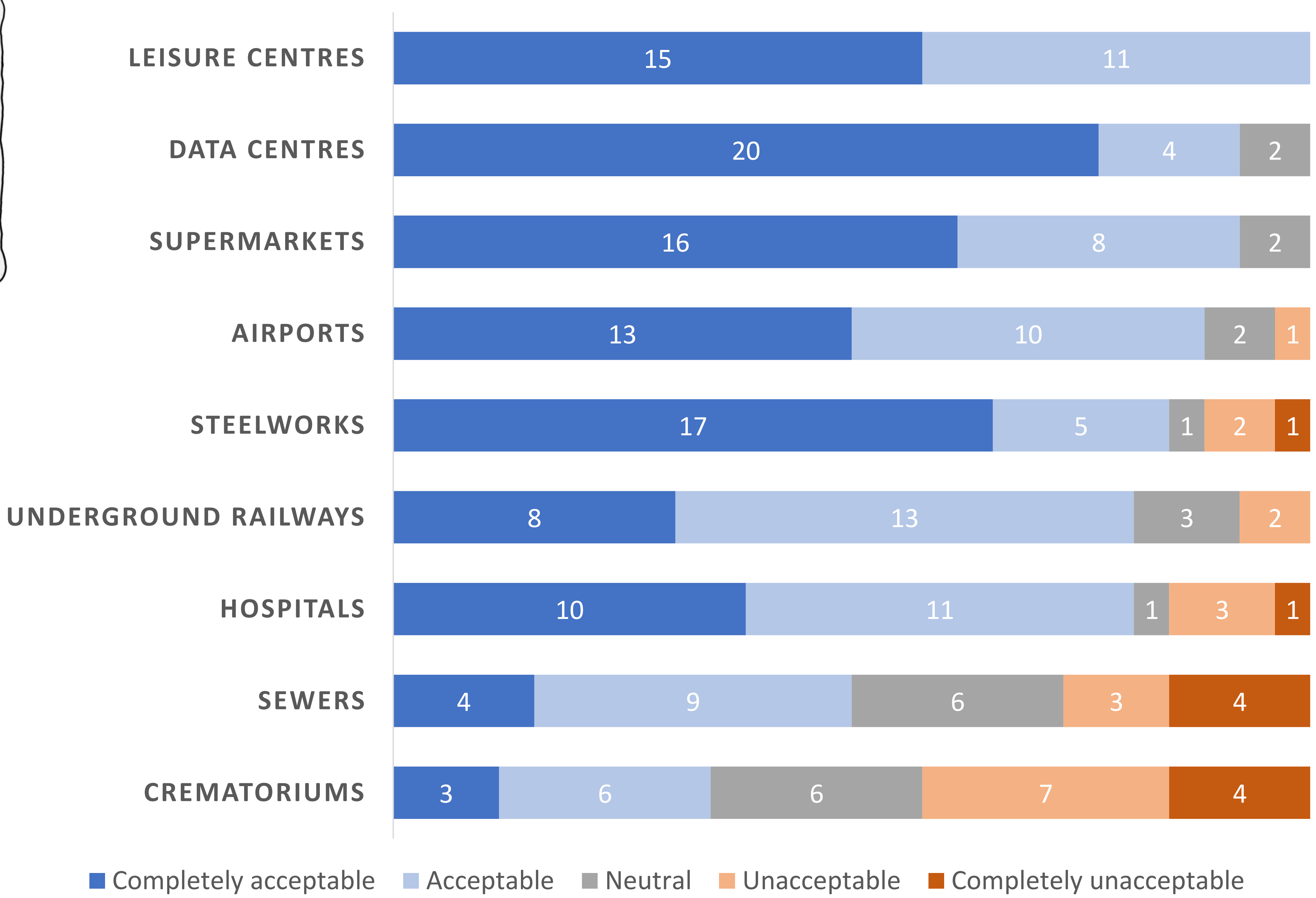
1) Airports 2) Crematoria 3) Data centres

4) Leisure centres 5) Hospitals 6) Sewers 7) Supermarkets

8) Steelworks and 9) Underground railways

Attitude scale

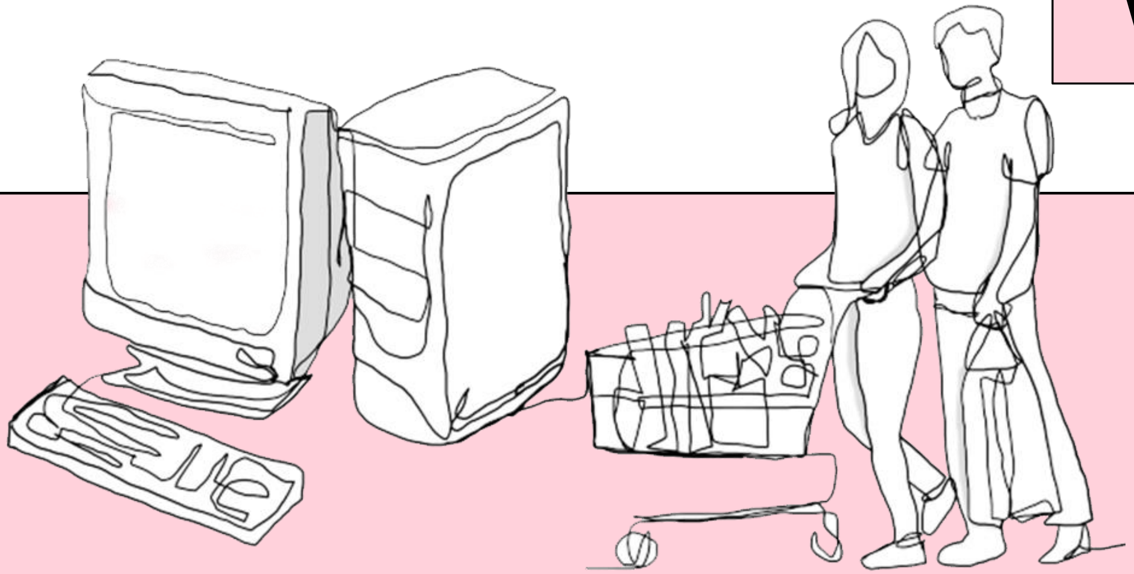
Findings Research Activity2



Most waste heat sources are seen as ‘Acceptable’ or ‘Completely Acceptable’

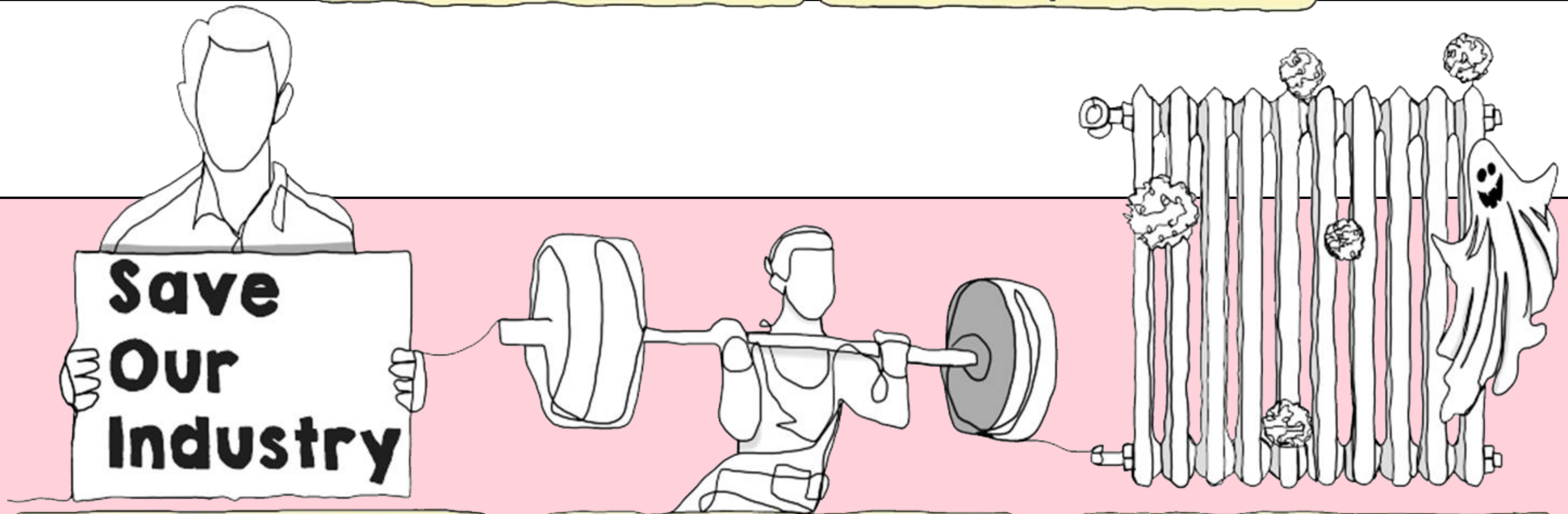
Findings Research Activity2

Waste heat sources



'Clean' heat

'Dirty' heat



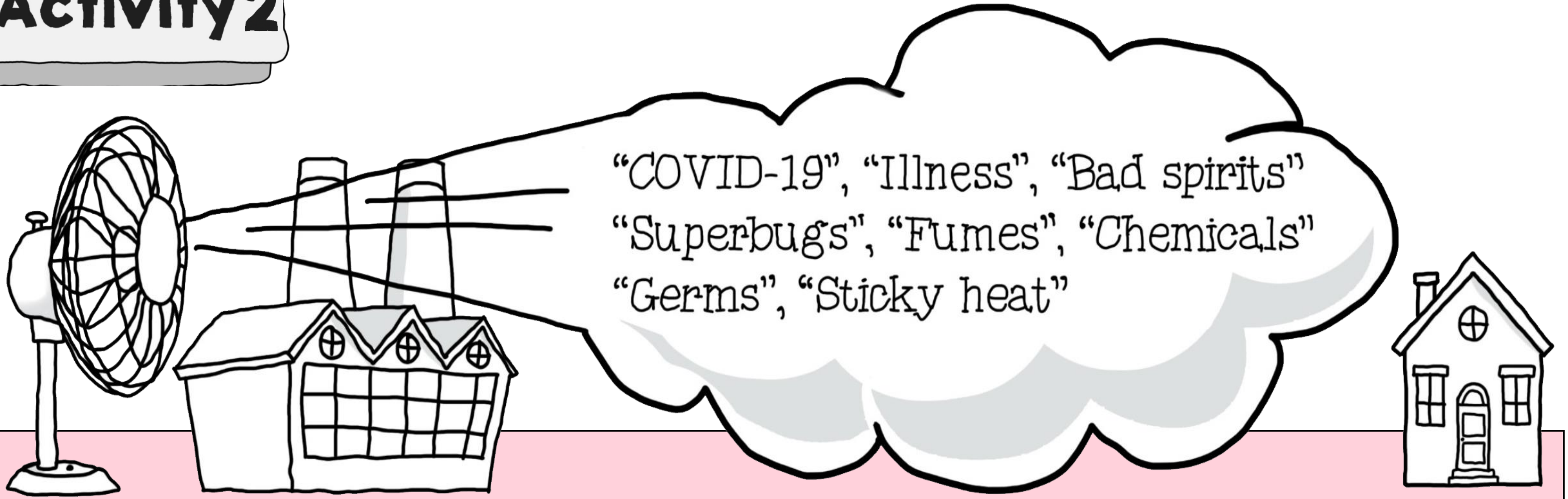
"keeping manufacturing in the UK"

"heat from a by-product of people's wellbeing"

"COVID" & "spirits" in radiator

Findings Research Activity 2

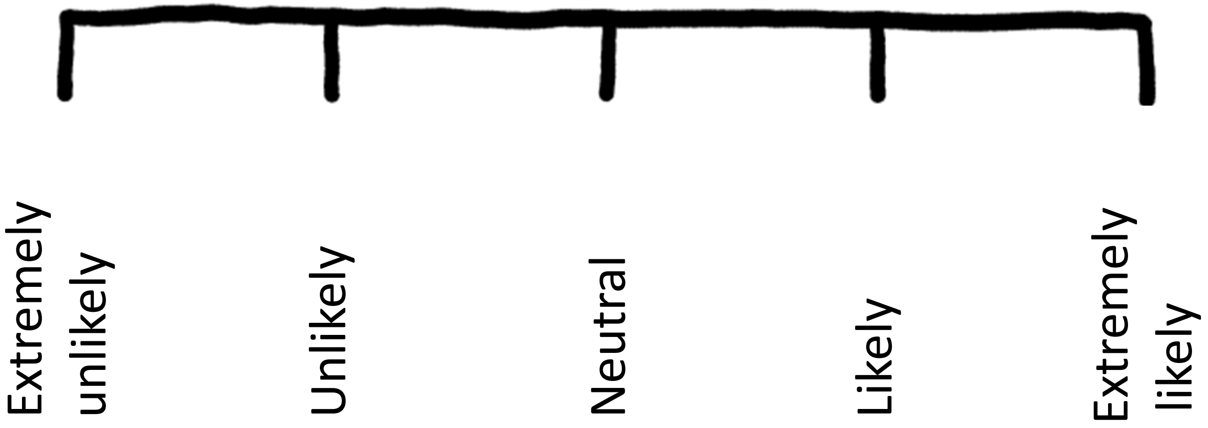
Waste heat sources



Lack of heat transfer knowledge

Stakeholders

Research Activity 3



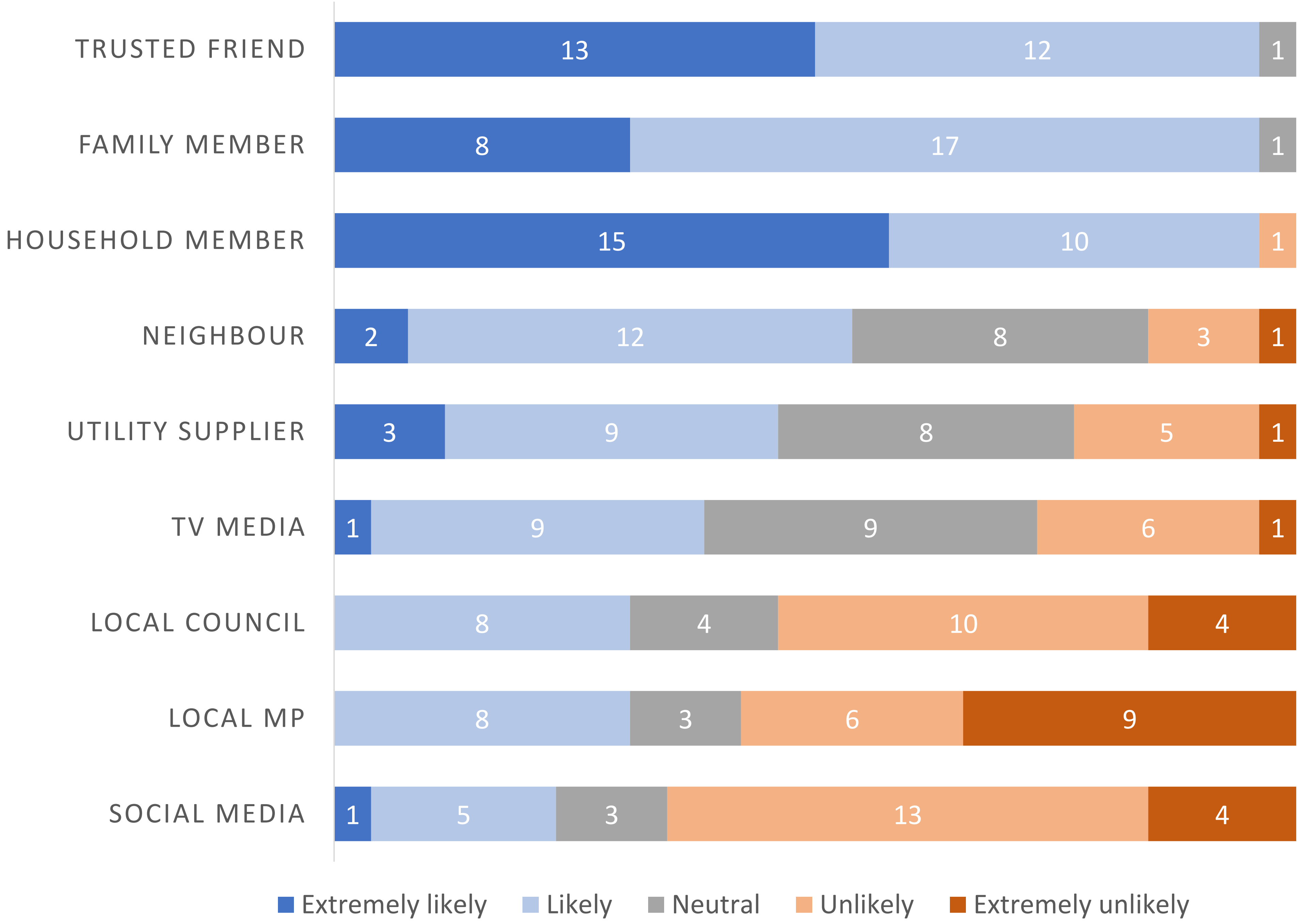
1) Family members 2) Householders 3) Local Council

4) Local MPs 5) Neighbours 6) Social Media

7) Trusted friends 8) TV media 9) Utility suppliers

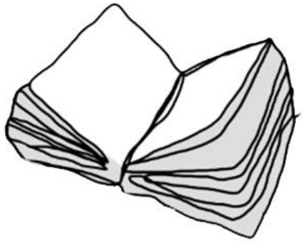
Attitude scale

Findings Research Activity3

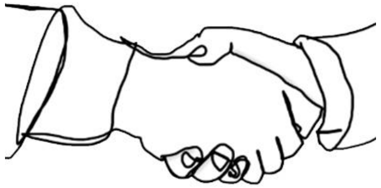


UK householders had clear views when reviewing who would be an influential stakeholder

Meaning

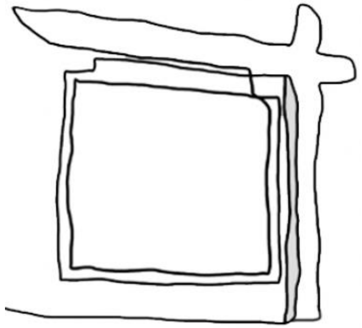


Poor heat transfer knowledge is leading to unhelpful beliefs



Trustworthy stakeholders will be required to encourage UK adoption

Promoting ‘clean’ waste heat sources will be needed to engage UK citizens



Methods of promotion need to align with householder values

Net Zero review

Department for
Business, Energy
& Industrial Strategy

Open consultation

Net Zero Review: Call for evidence

Published 29 September 2022

Contents

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The Net Zero Review

The BEIS Secretary of State has commissioned an independent review of the government's approach to delivering its net zero target, to ensure we are delivering net zero in a way that is pro-business and pro-growth. See the Terms of Reference for further information on the Review.

Suggested scope for LoT-NET response – for feedback

- LoT-NET's research and case studies on heat pumps and low temperature thermal networks helps accelerate the UK's ambition for 20% of heat to come from thermal networks by NNNN (vs 2% today, CCC 2020) and 40% by NNNN (ETI, 2018). This provides evidence for consultation Q29 & 30
- Question 29: How can we ensure that we seize the benefits from future innovation and technologies?
  - Assessing the value of the
  - Both heat pumps and thermal networks as a source of economic growth
- Question 30: Is there a policy idea that will help us reach net zero you think we should consider as part of the review?
  - Accelerate policy guidance on hydrogen in industrial vs domestic markets
  - Add policy support for *services & installation* competition/price reduction as well as heat pump competition/price reduction
  - Include all network reinforcement costs in DNO investment requirements
  - Tighten the EPC requirements for the next phase of Boiler Upgrade Scheme or target channels that know the buildings to prioritise and can support the full package of work

Thank you!

Any question?

LoT-NET