South West Net Zero Hub

5i Heat Network Project – Innovation

South West NET ZERO HUB

Introduction to the 5i Project

Sam Moore

Project Manager
SW Net Zero Hub

Housekeeping

1. Today's 2 hour session will be recorded for sharing
2. There will be three dedicated sessions for questions
3. Q&A is allowed during speaker presentations in the chat function
4. Any unanswered questions please raise your virtual hand in the Q&A session at the end of all of the presentations and I will come to you in turn
5. All presentations will be shared with all attendees as a pack
6. Follow up support is available from the Net Zero hubs

Agenda

1500: Welcome, Introductions, Setting the Scene

- Speaker one: International and regional case studies in recoverable heat
- Speaker two: Training and the Internal Workforce:
- Q&A
- Breakout rooms

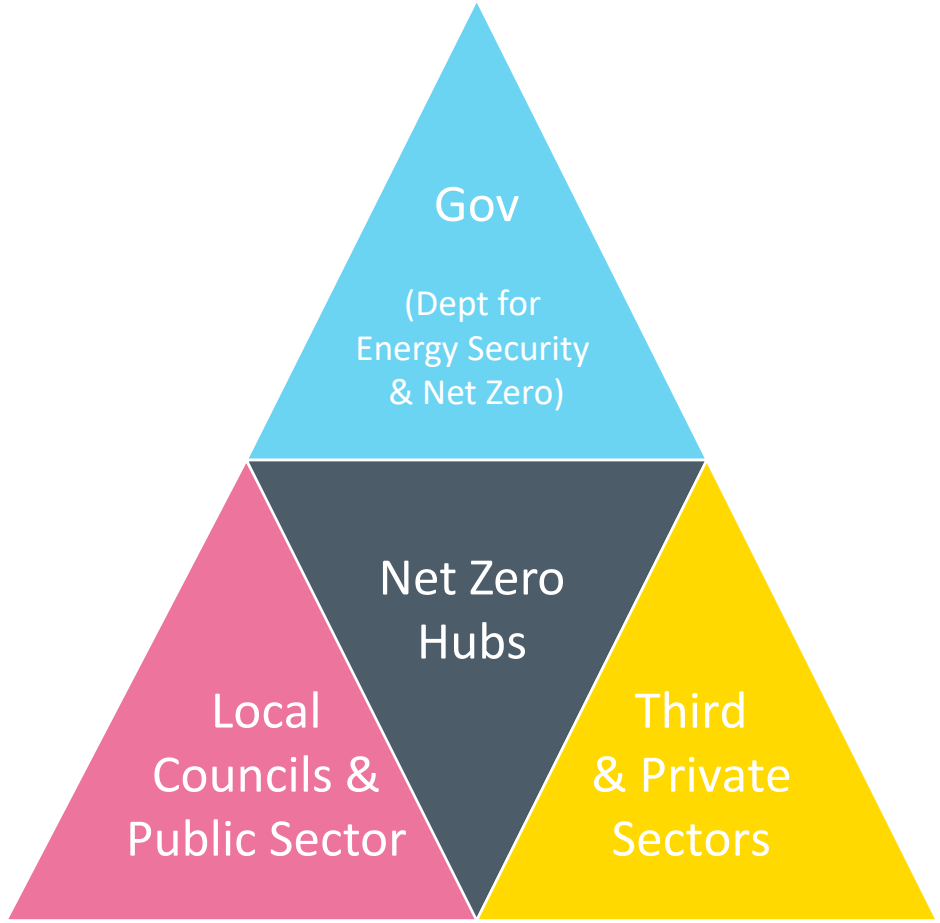
1600: Break

- Speaker three: The National Geothermal Centre - Heat Sources
- Speaker four: Engaging the Community Sector
- Q&A
- Wrap up discussion

1700: Finish

South West Net Zero Hub

The South West Net Zero Hub provides impartial advice, technical support and funding to public and not-for-profit organisations, to develop projects that accelerate emission reductions and enable the transition to a more sustainable future.



South West Net Zero Hub

South West NET ZERO HUB

Government Net Zero Strategy established 5 regional hubs with core objectives:

1. **Attract commercial investment** and help LAs and other local public sector bodies to develop investment models which accelerate progress to net zero
2. Continue to **increase the number, quality, and scale of local Net Zero projects** being delivered across the region in line with national targets and strategies, including supporting the early-stage development and delivery of projects.
3. **Collaborate** with the Department of Energy Security & Net Zero to develop & support Net Zero elements to wider programmes & initiatives including Levelling Up
4. Support a national **knowledge transfer programme** to improve information sharing, training & evaluation
5. **Raise local awareness** of opportunities & benefits of local Net Zero investment

South West NET ZERO HUB

Heat Recovery Opportunities in the South West

Dr Henrique Lagoeiro
Research Fellow, London South Bank University

HEAT RECOVERY OPPORTUNITIES IN THE SOUTH WEST

SOUTH WEST NET ZERO HUB – HEAT NETWORKS

DR HENRIQUE LAGOEIRO | 16 JULY 2024

EST 1892 LSBU

HEAT DECARBONISATION

EST 1892 LSBU

Heat recovery can unlock the potential for district heating in UK cities

Heating represents a challenging area as **85%** of British homes are heated with **natural gas**

Heating represents

1/2

of energy consumption

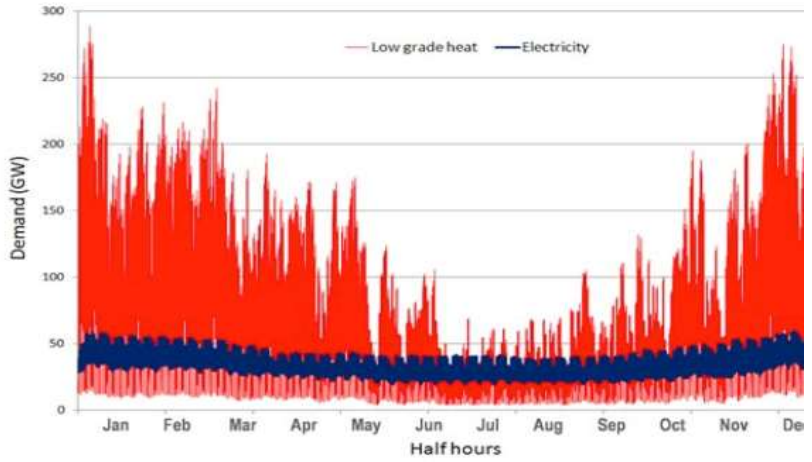
Accounting for

1/3

of carbon emissions in the UK

Electrification Opportunity

Average **grid carbon intensity** decreased by **66%** from **2013** to **2020**



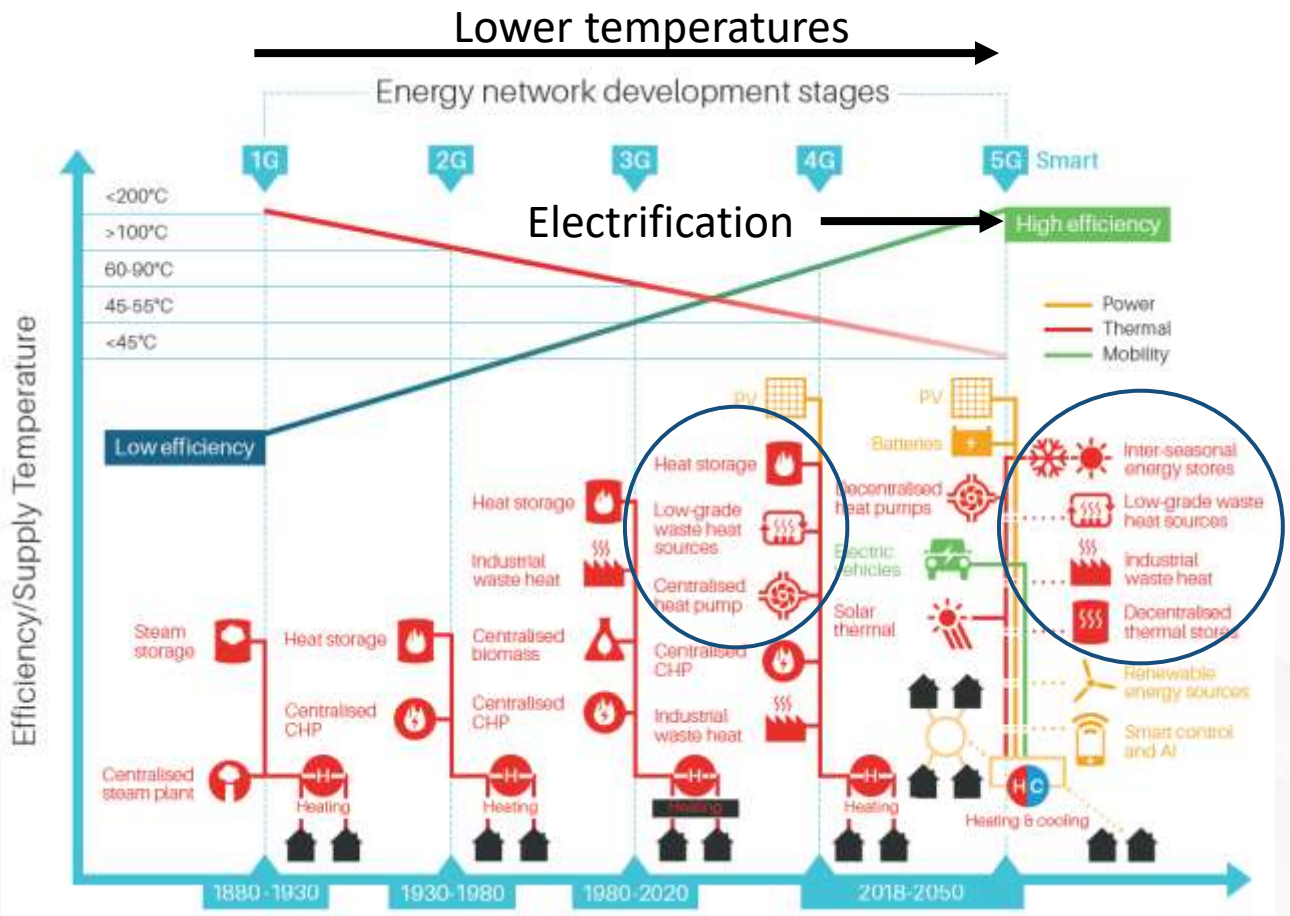
From **2%** to **20%** in 2050

Is the potential for growth in demand met by heat networks according to DESNZ

- District heating: economies of scale = lower costs!
- Recoverable heat: higher efficiencies and locally available
- The UK potential has been estimated at 310 TWh/yr

RECOVERABLE HEAT

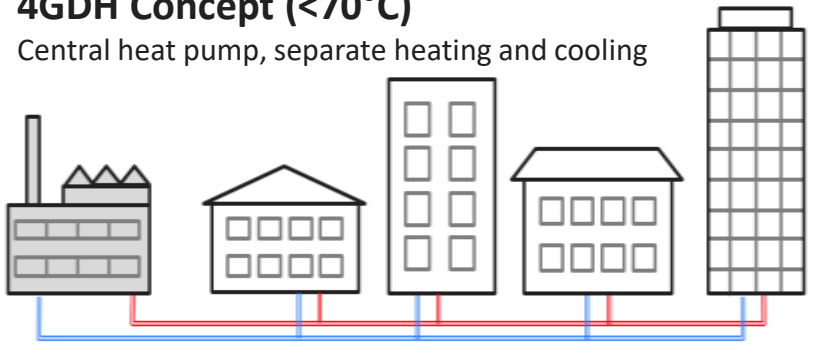
Lower operating temperatures unlocks the potential to recover heat



(Revesz et al., 2020)

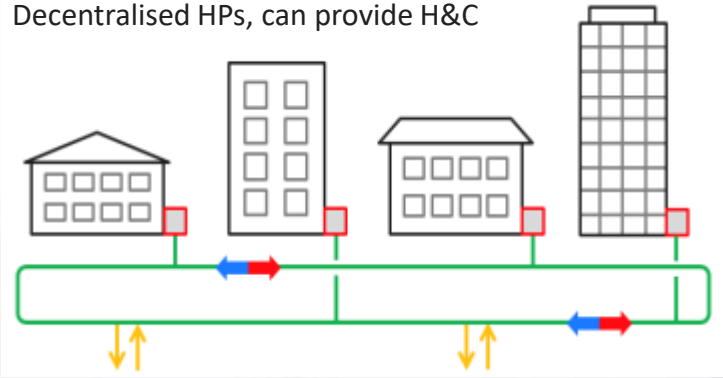
4GDH Concept (<70°C)

Central heat pump, separate heating and cooling



5GDHC Concept or Ambient Loop (15 - 25°C)

Decentralised HPs, can provide H&C



(Jones, 2022)

THERMAL POWER STATIONS

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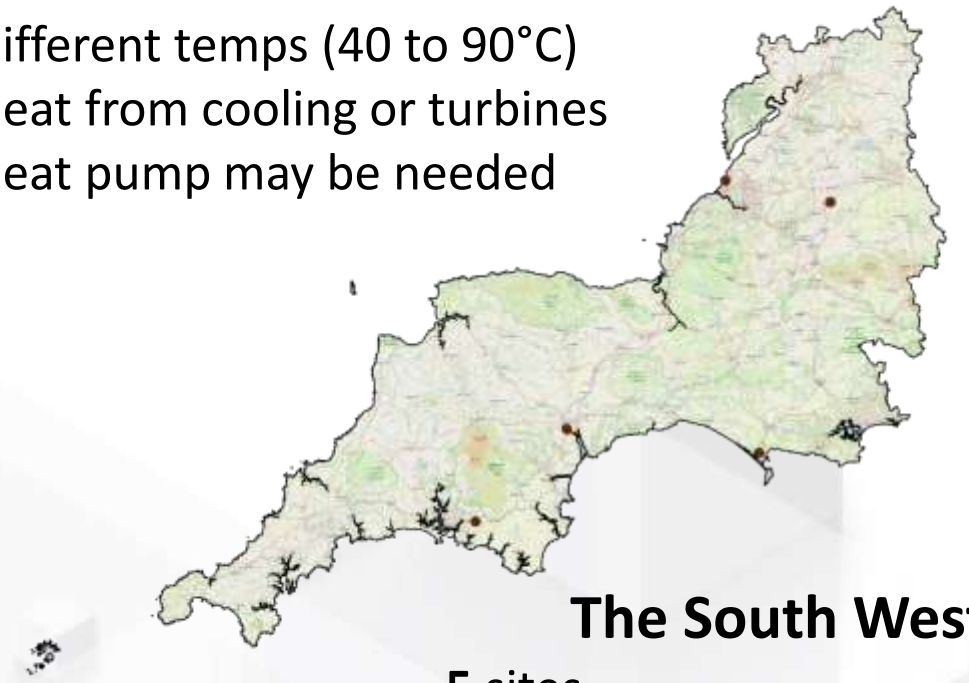
The heat source:

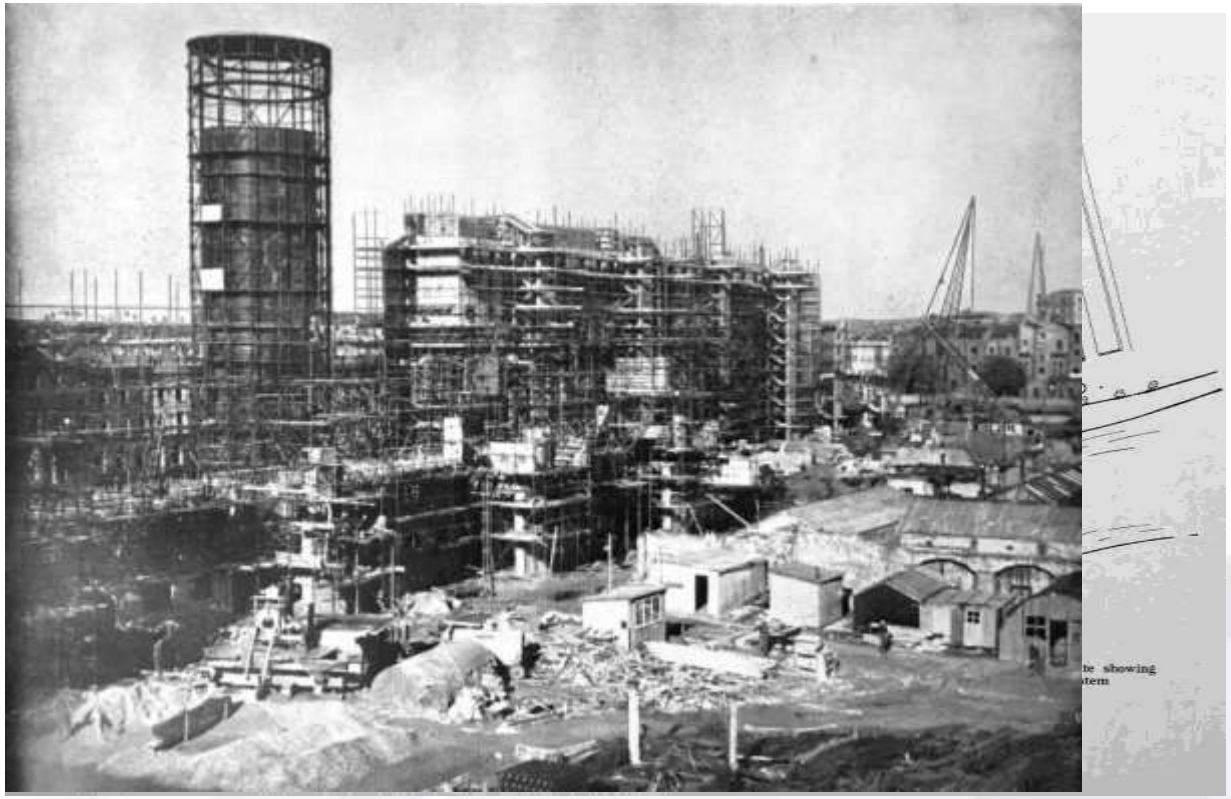
Different temps (40 to 90°C)
Heat from cooling or turbines
Heat pump may be needed



The South West:

5 sites
785 MW_{th} (157 MW_{th} per site)
6.9 TWh per year (cooling)
665k medium-sized homes

Largest site: Seabank Power Station, Bristol
(426 MW_{th}, 3.7 TWh per year)



Pimlico District Heating Network, London

- Recovered heat from Battersea Power Station in the 1950s
- Water delivered at ~90°C, helped displacing coal furnaces

ENERGY FROM WASTE

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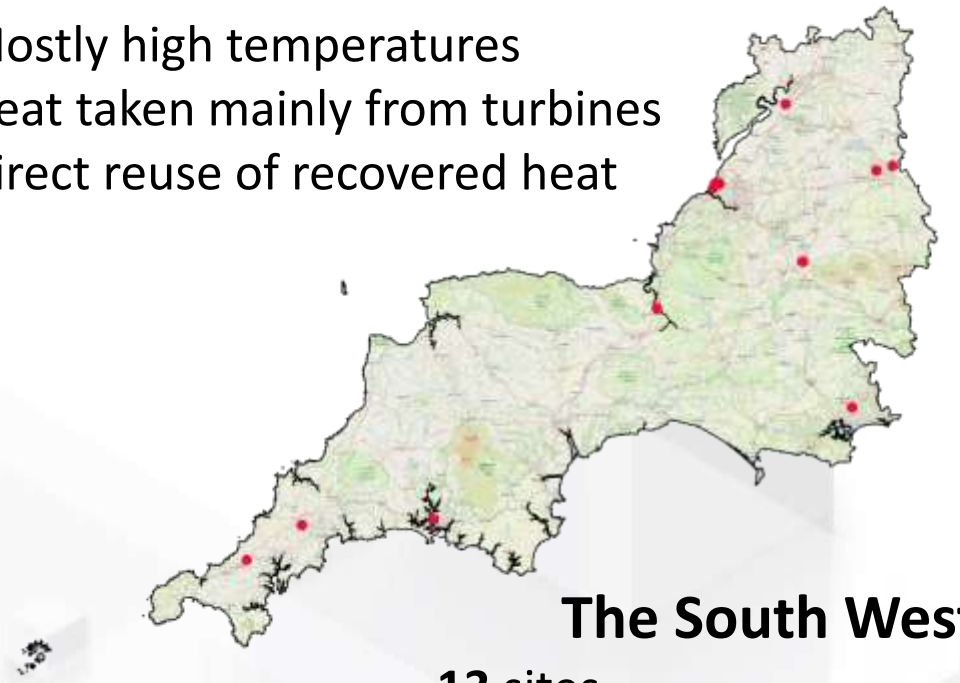
The heat source:

Mostly high temperatures
Heat taken mainly from turbines
Direct reuse of recovered heat



The South West:

13 sites
405 MW_{th} (31 MW_{th} per site)
3.5 TWh per year
343k medium-sized homes

Largest site: Severnside Energy Recovery Centre (65 MW_{th}, 0.6 TWh per year)

South East London CHP – Bermondsey, London

- 460,000 tonnes of solid waste incinerated (since 1994!)
- 30 MW_{th} from steam turbines to supply DH (90°C)
- 7,700 tonnes of CO_2e saved per year by displacing gas

TREATMENT WORKS

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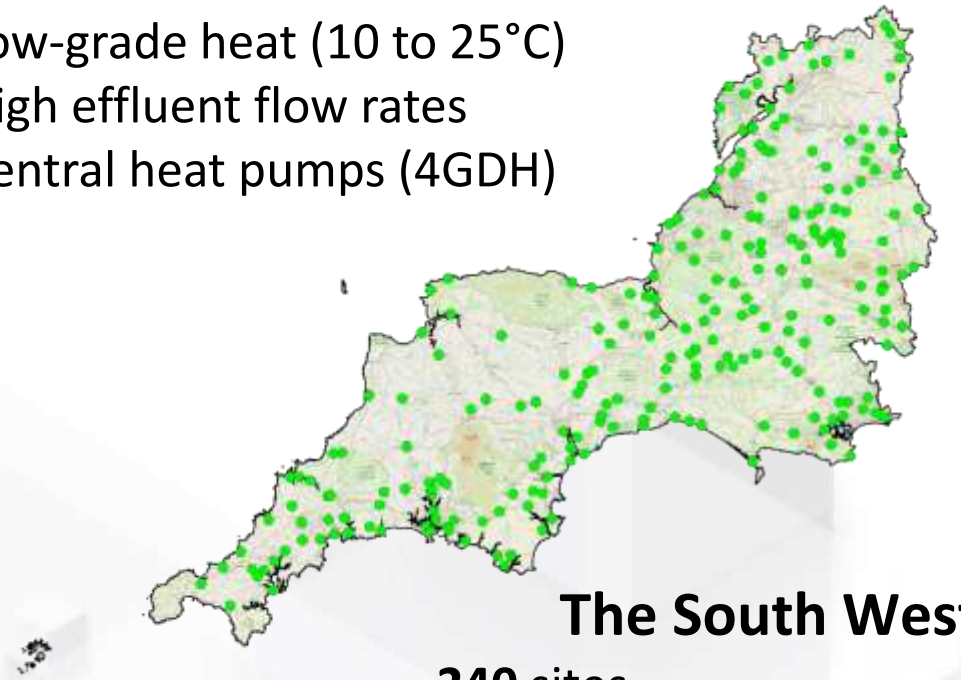
The heat source:

Low-grade heat (10 to 25°C)
High effluent flow rates
Central heat pumps (4GDH)



The South West:

240 sites
237 MW (~1 MW per site)
2.0 TWh per year
190k medium-sized homes

Largest site: Bristol Sewage Treatment Works (35 MW, 0.3 TWh per year)

Katri Vala Heating and Cooling Plant, Finland

- 90 MW: 5 heat pumps (155 MW after expansion to 7 HPs)
- 10 – 20°C wastewater temperatures, SCOP~3.5
- Heat recovered from treated effluent from a WWTP

DATA CENTRES

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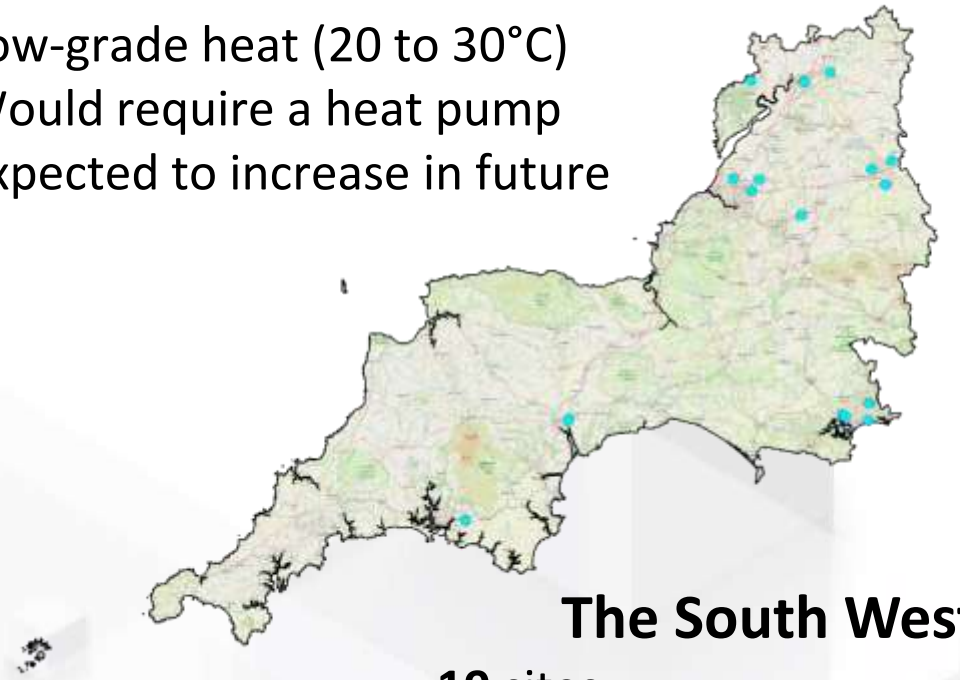
The heat source:

Low-grade heat (20 to 30°C)
Would require a heat pump
Expected to increase in future



The South West:

19 sites
79 MW (4.2 MW per site)
0.7 TWh per year
67k medium-sized homes

Largest site: Ark Data Centre, Corsham
(29 MW, 0.26 TWh per year)

Facebook Data Centre – Odense, Denmark

- 45 MW of heat generated from IT operation
- 175 GWh recovered by a central heat pump (75°C delivery)
- Covers heat demand of 12,000 connected homes

ELECTRICAL SUBSTATIONS

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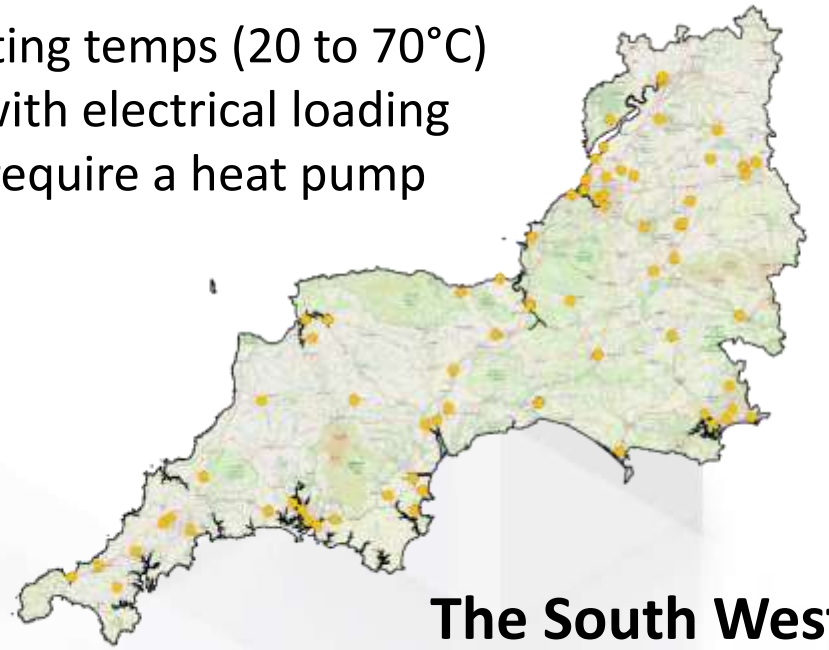
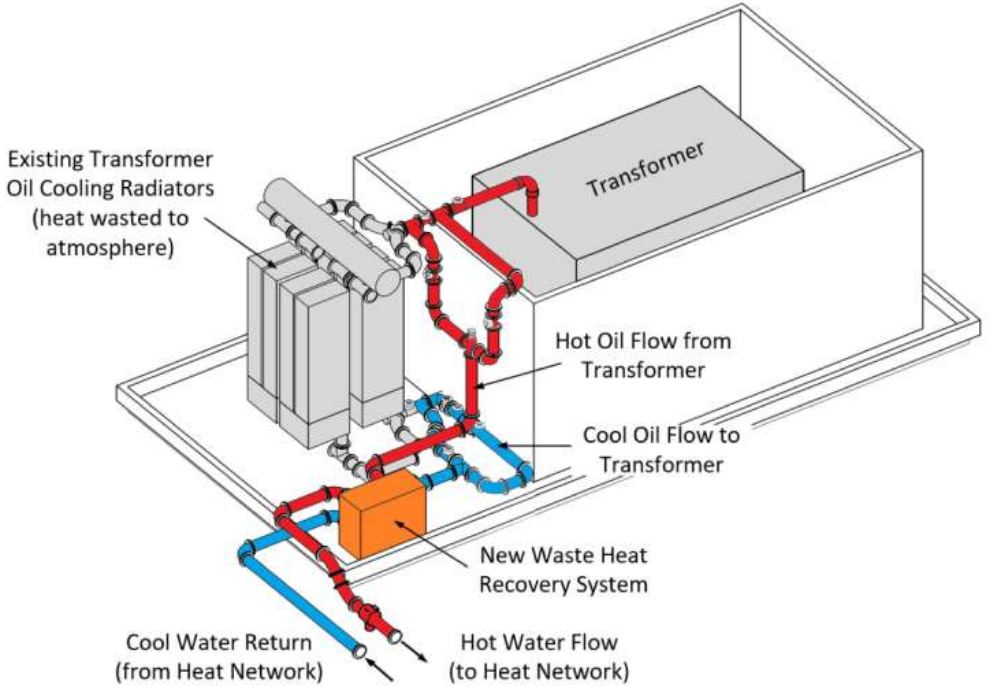
The heat source:

Fluctuating temps (20 to 70°C)
Varies with electrical loading
Would require a heat pump





The South West:

66 sites > 60 MVA
19 MW (283 kW per site)
0.2 TWh per year
16k medium-sized homes

Largest site: Mannington Substation – National Grid
(1.9 MW, 0.02 TWh per year)

Deeside Centre for Innovation – Deeside, Wales

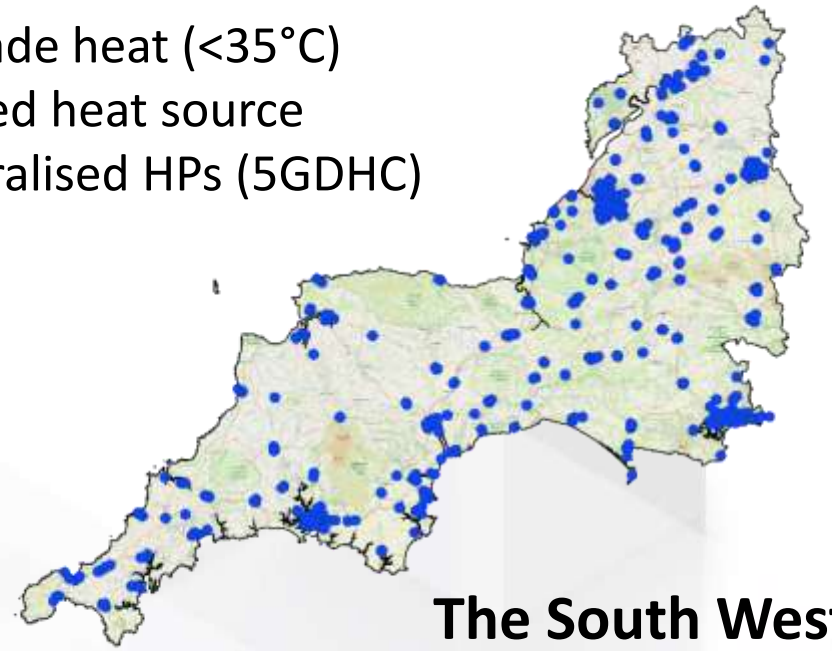
- Off-grid proof-of-concept testing by National Grid
- 60 MVA can provide about 128 kW at 50% loading
- Would require upgrade by heat pump at some point

SUPERMARKETS

EST 1892 LSBU

The heat source:

Low-grade heat (<35°C)
Scattered heat source
Decentralised HPs (5GDHC)



The South West:

527 sites
147 MW (279 kW per site)
0.8 TWh per year
79k medium-sized homes

Largest site: ASDA Swindon Haydon
(1.3 MW, 0.008 TWh per year)

S-market Ritaharju Supermarket, Oulu, Finland

- Heat pump recovers heat from CO_2 refrigeration plant
- 3 GWh produced annually to local district heating system
- Enough to heat 170 homes in the city of Oulu, Finland

INDUSTRIAL

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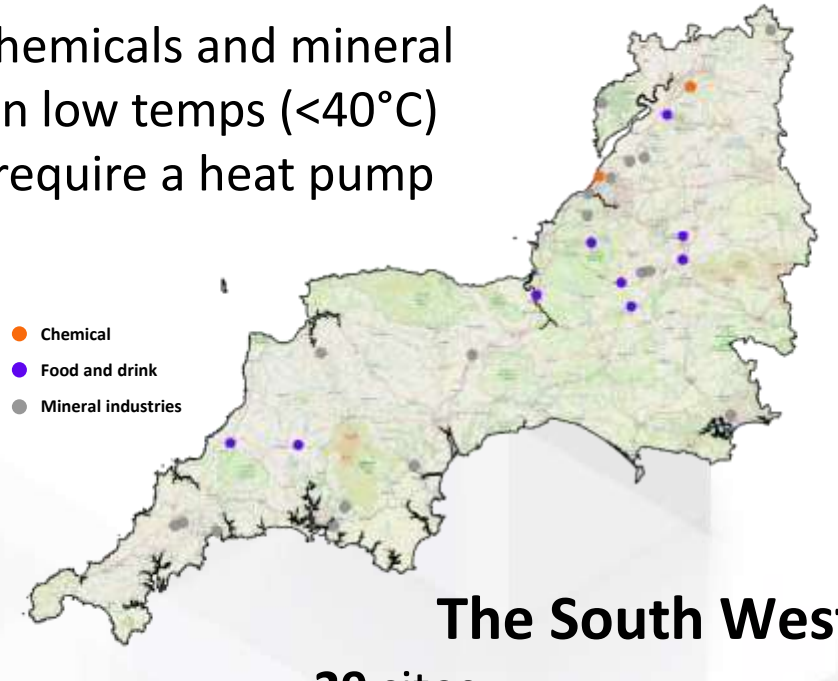
The heat source:

Food, chemicals and mineral
Focus on low temps (<40°C)
Would require a heat pump

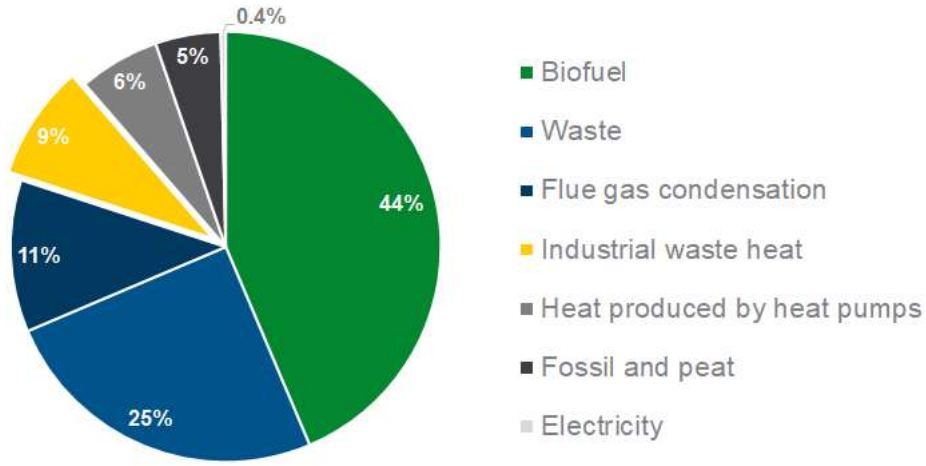


The South West:

29 sites
3.5 MW (120 kW per site)
0.03 TWh per year
2.7k medium-sized homes

Largest site: Etex Building Performance Portbury (0.6 MW, 0.002 TWh per year)

Figure 1: Energy sources for DH generation in Sweden in 2019. Total: 53.0 TWh



Source: Swedenergy (Energiföretagen), Sweco analysis

Sweden's District Heating Generation

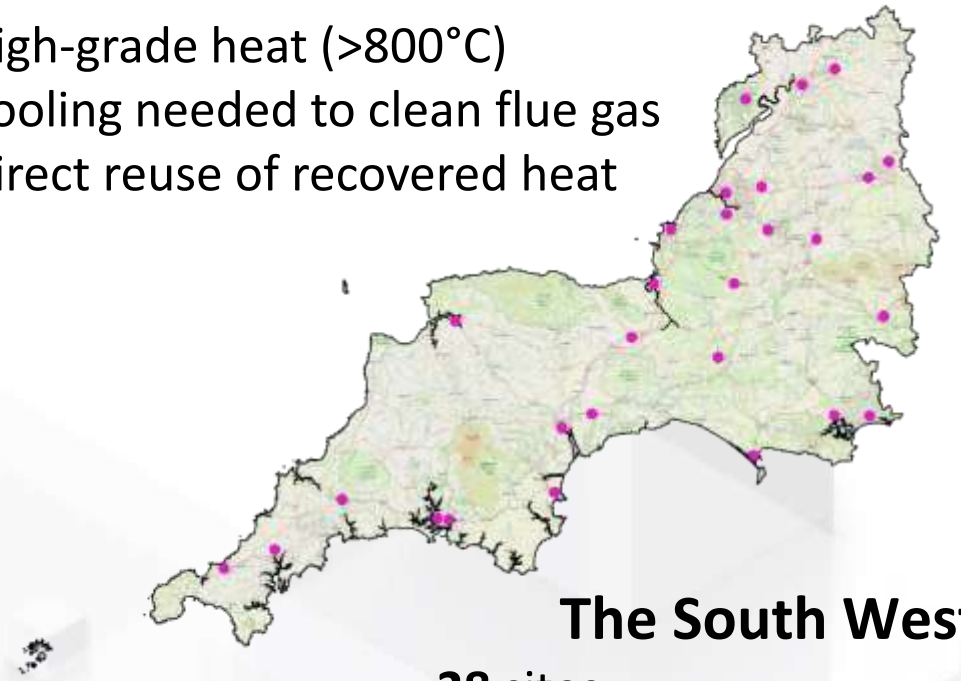
- Industrial sites provide 4.5 TWh per year to Swedish DH
- A ceramic site covers 100% of heat demand for a 13k town
- 30% of Gothenburg's DH demand (1.1 TWh) is industrial

CREMATORIA

EST 1892 LSBU

The heat source:

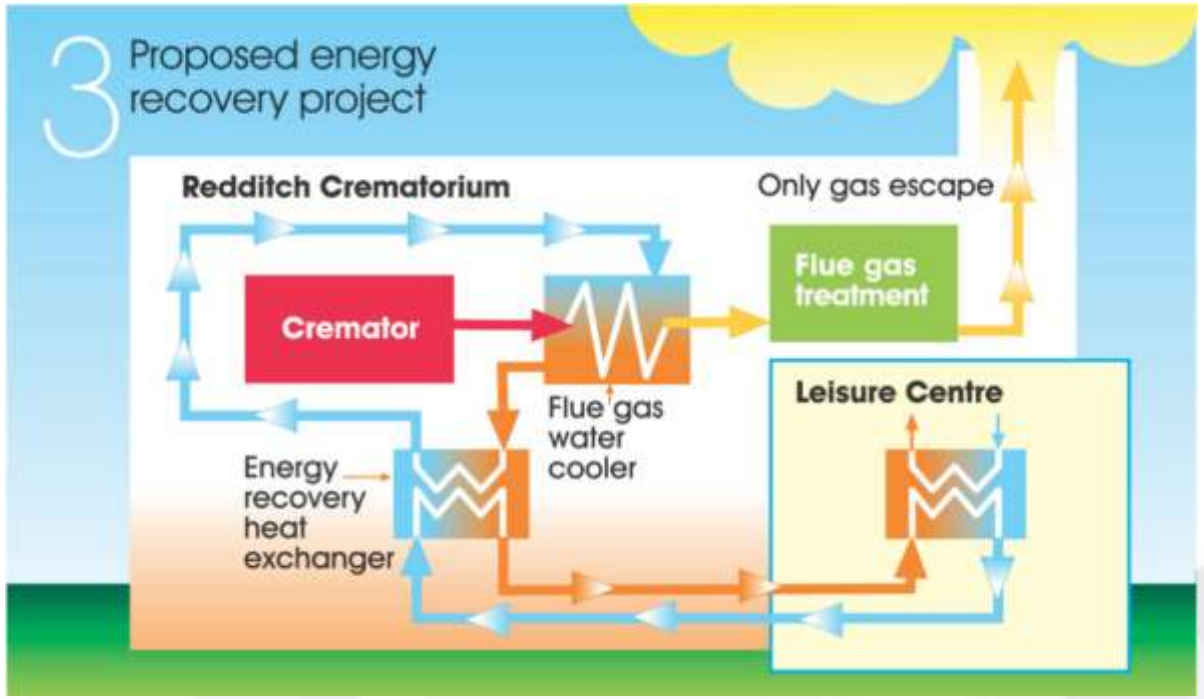
High-grade heat (>800°C)
Cooling needed to clean flue gas
Direct reuse of recovered heat



The South West:

28 sites
9 MW (322 kW per site)
0.02 TWh per year
2k medium-sized homes

Largest site: Bournemouth Crematorium
(0.8 MW, 0.002 TWh per year)



Redditch Crematorium – Redditch, West Midlands

- ~700 MWh of recovered heat reused at local leisure centre
- Average of 280 kW of recoverable heat per cremation
- Water leaves flue gas cooler at 80-90°C (direct reuse)

CONCLUSION

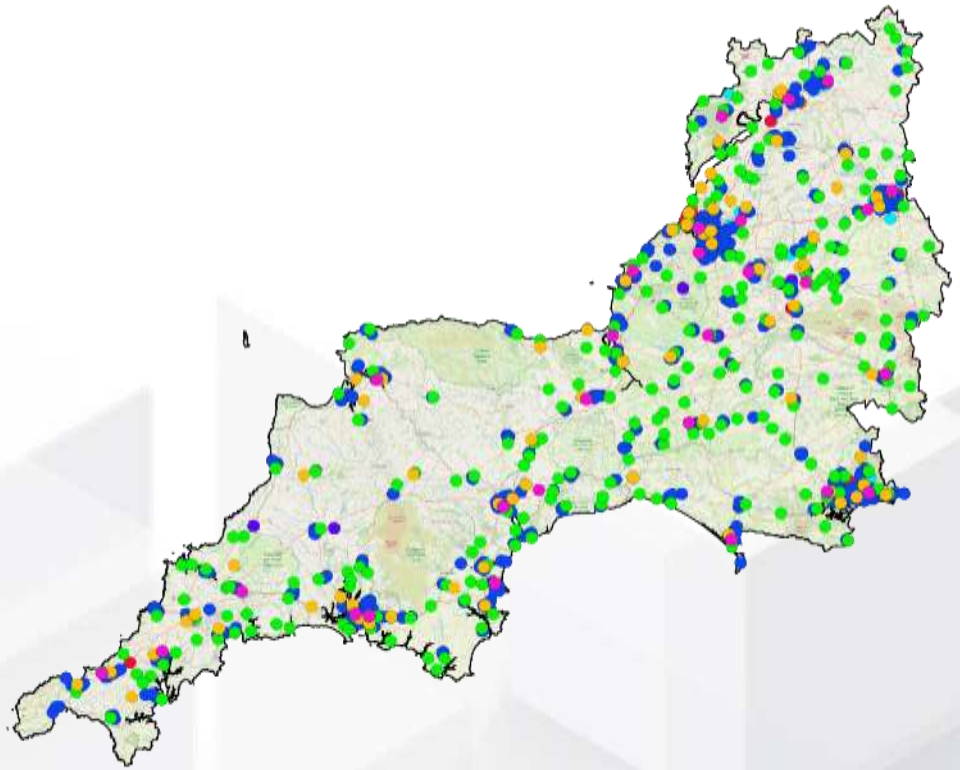
Recoverable heat is a diverse resource with many potential applications

LSBU supported DESNZ in understanding locations and potential from a range of recoverable heat sources

Theoretical potential is massive: 14 TWh in the SW (excluding natural), enough heat for 1.4 million homes

Sources have different characteristics and practical potentials (with many roles within decarbonisation)

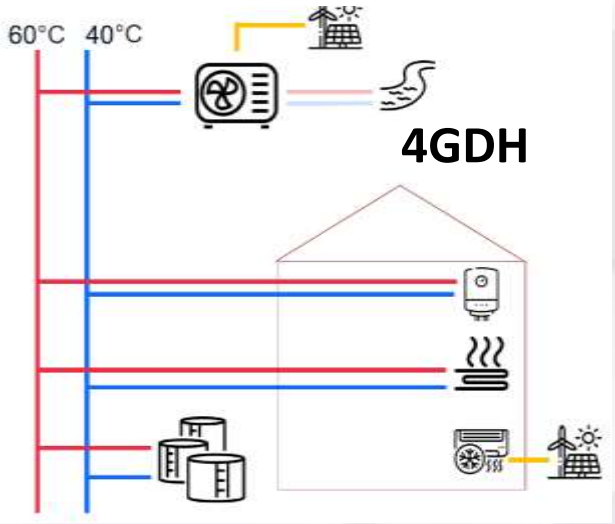
Large-infrastructure projects are capital intensive, but we have plenty of examples showing it is possible!

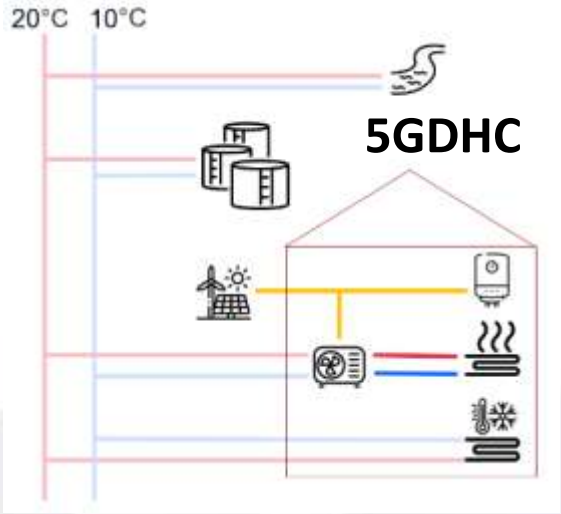


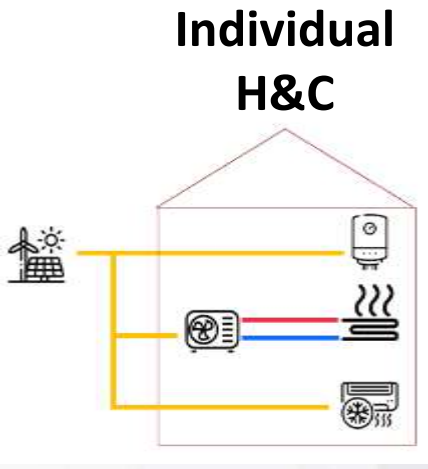
FAST DHC PROJECT

Feasibility Assessment Tool for District Heating and Cooling

A freely available **web-based decision support tool** for the techno-economic performance evaluation of **4GDH** and **5GDHC** networks (including **recoverable heat**!), and their comparison to **individual heating and cooling** (H&C) solutions.







Target Audience:

Municipalities

Consultants/planners

Developers/ESCos

Academics/Researchers

South West NET ZERO HUB

Training and the Internal Workforce

Isabelle Macfarlane
Energy Operations Officer Islington Council

5i Heat Networks Project – Innovation

Bunhill District Heat Network

Isabelle Macfarlane

Energy Operations Officer

isabelle.macfarlane@islington.gov.uk

BunhillHeatAndPower@islington.gov.uk

Bunhill: An Overview

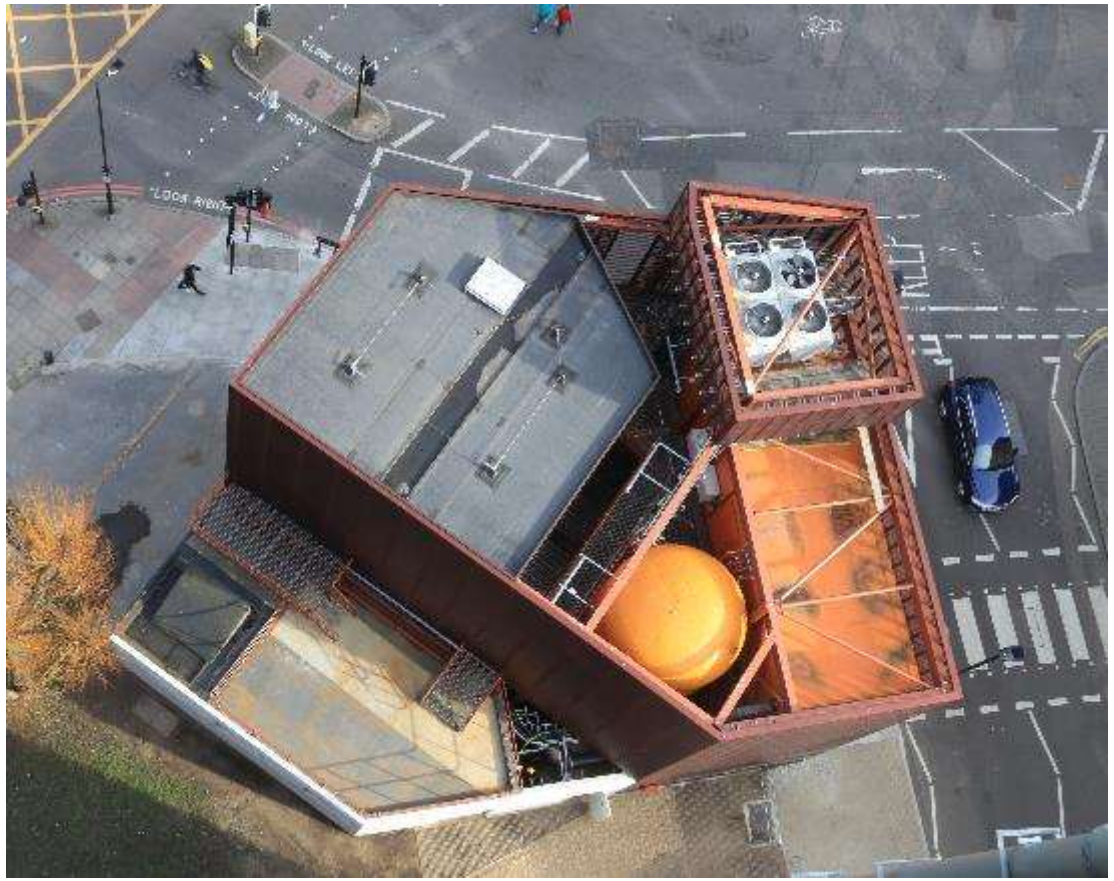
- Owned and operated by Islington Council
- Two energy centres
- 2.4 km pipework
- 15 connections (1,362 properties)
- Phase 1 – 600 council homes, 212 private homes and 2 Leisure Centres
- Phase 2 – 550 council homes and Primary School.

The time before Bunhill 2

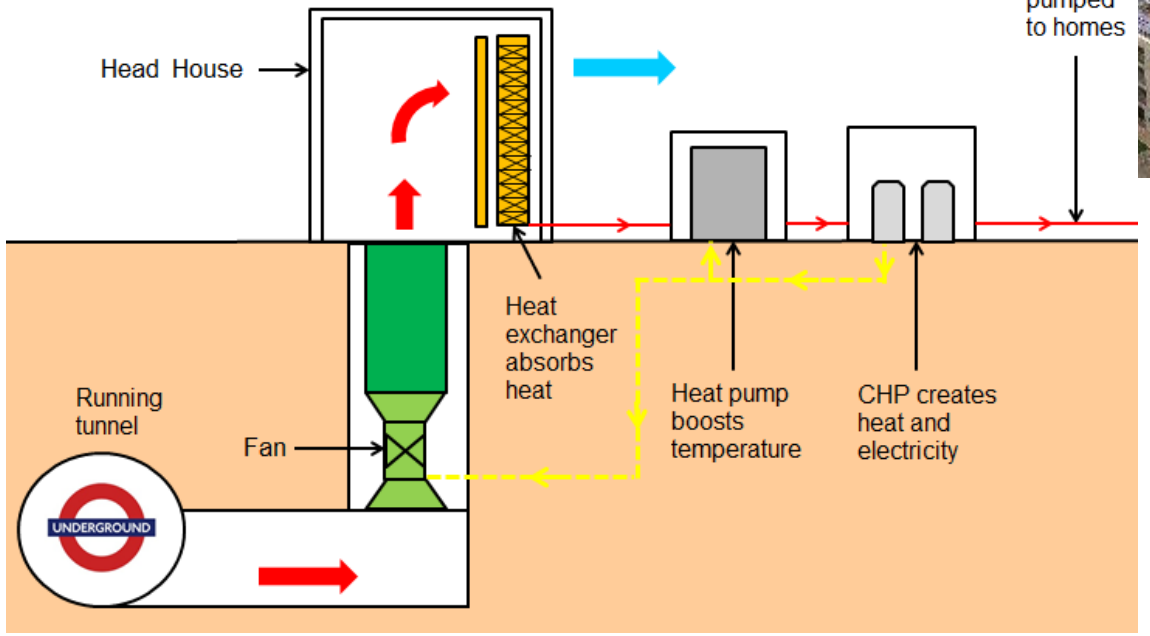
1901-1922


2008

Today



How it works?


Head House
Heat exchanger absorbs heat
Heat pump boosts temperature
CHP creates heat and electricity
Hot water pumped to homes
Running tunnel
Fan
UNDERGROUND

Operational Lessons Learnt – Internal staff engagement

It’s simple, but it has really worked

- **Communication** – regular meeting weekly/monthly meetings, sharing of operational network data with seniors
- **Consulting early and often**
- **Trust** – being transparent about operational issues/risks
- **Bunhill tours: A gateway to understanding**

Future improvements to delivery of operations

- The necessity for a dedicated heat network team – with diversity of officer experience (projects, operations, procurement, legal and finance)
- Consolidating O&M contracts, opposed to having fragmented contracts across primary / secondary sides of the network

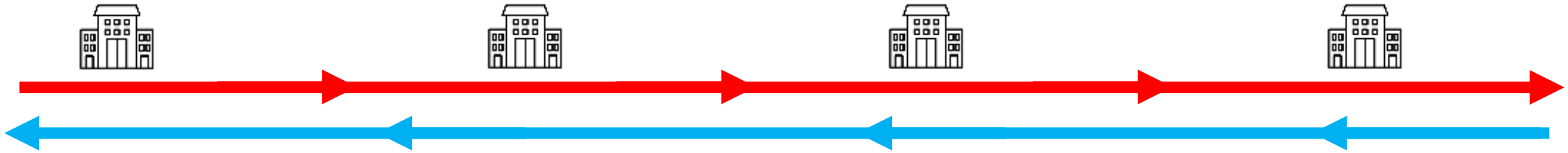
My Journey to the Heat Network Industry

Undergraduate –
BSc Environmental Geography

Postgraduate –
MSc Sustainable Cities

Islington Council –
Internship

Islington Council –
Energy Operations Team



The value of Mentor Programme's

- **District Heating Mentor Programme** (Danish Embassy, DHDH and DEA)
  - 1:1 / Group mentoring
  - Heat Networks Study Trip
- **District Heating Divas** – Connecting women in District Heating
  - National, Public Sector, Young Professional, Northern, Midlands, London

- **Heat Exchanger Mentor Programme (HEMP)**

South West NET ZERO HUB

Q&A

Chair – Sam Moore

Breakout Room

South West NET ZERO HUB

South West NET ZERO HUB

We are in the break – starts again at 1605

Host: Sam Moore, SW Net Zero Hub

5i Heat Network Project Innovation

South West NET ZERO HUB

The National Geothermal Centre- Heat Sources

Dr Charlotte Adams
CEO
National Geothermal Centre

National Geothermal Centre

The National Geothermal Centre

July 2024

Our mission and vision

National Geothermal Centre

Mission:

Unearth geothermal energy to heat and power the UK

Vision:

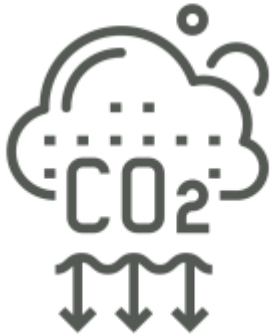
Geothermal energy drives a just transition to net zero

UK Geothermal in 2050

National Geothermal Centre

Supply **10GW**
of the UK's predicted
heating demand

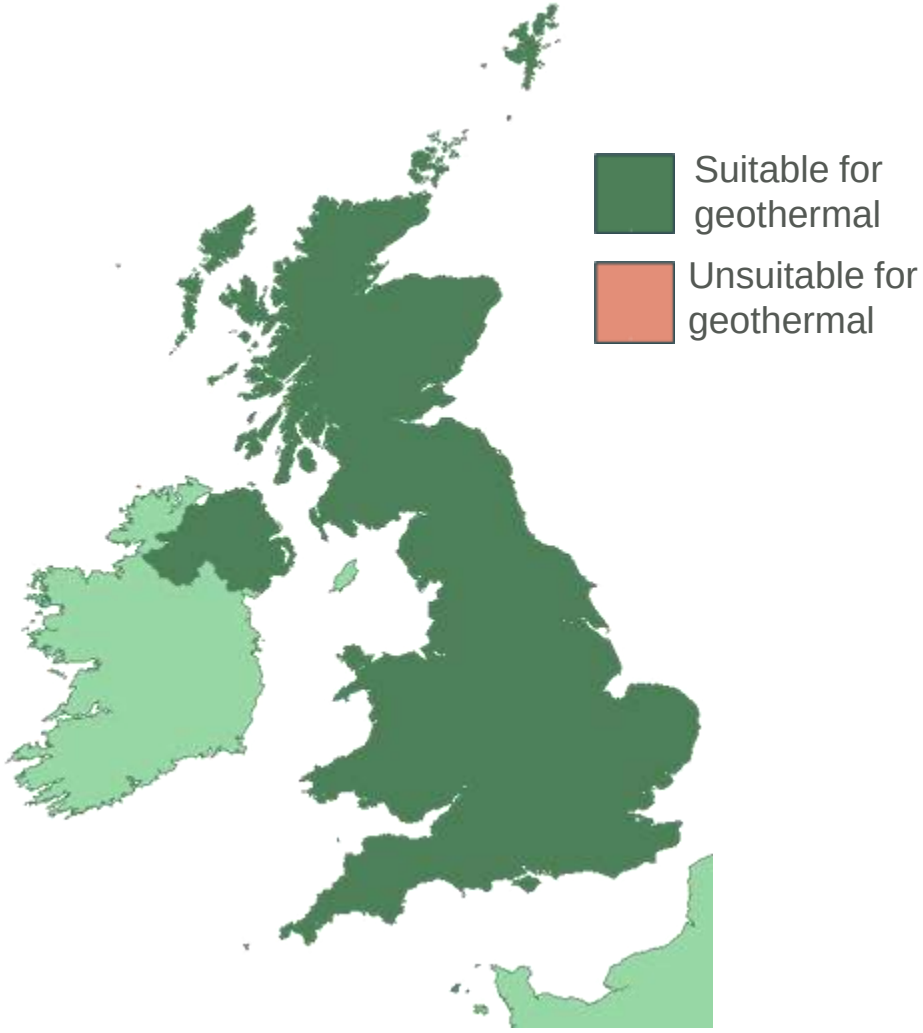
Account for **1.5GW**
of the UK's anticipated
electricity demand



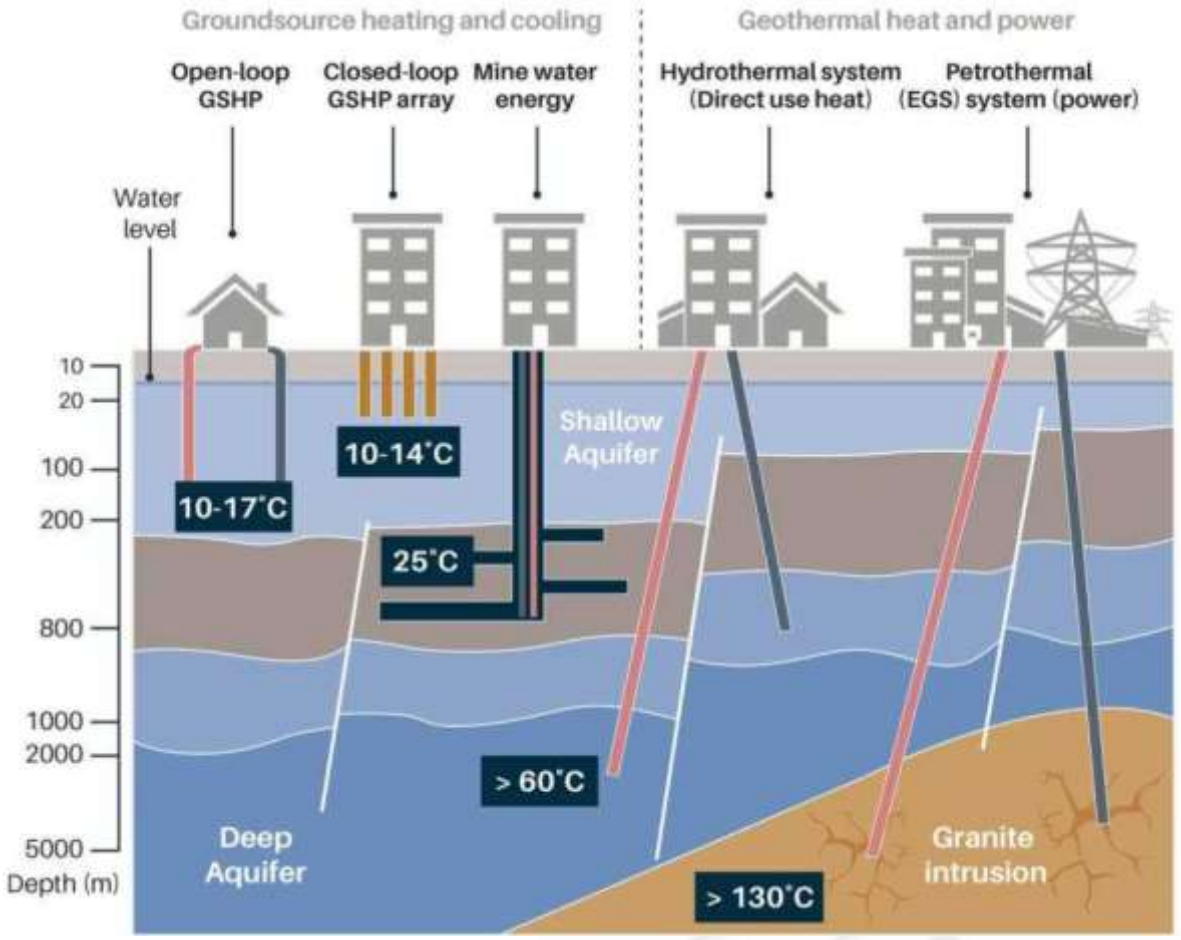
See an annual reduction of
10Mt of CO_2 emissions

50,000 Direct jobs
125,000 Indirect jobs

The UK Resource



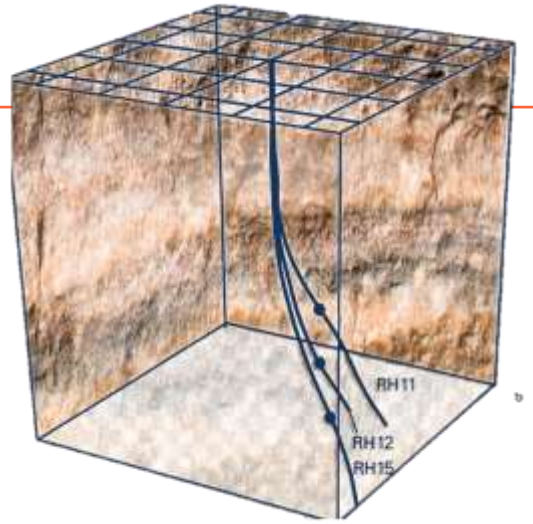
Source: Prof J G Gluyas Durham University

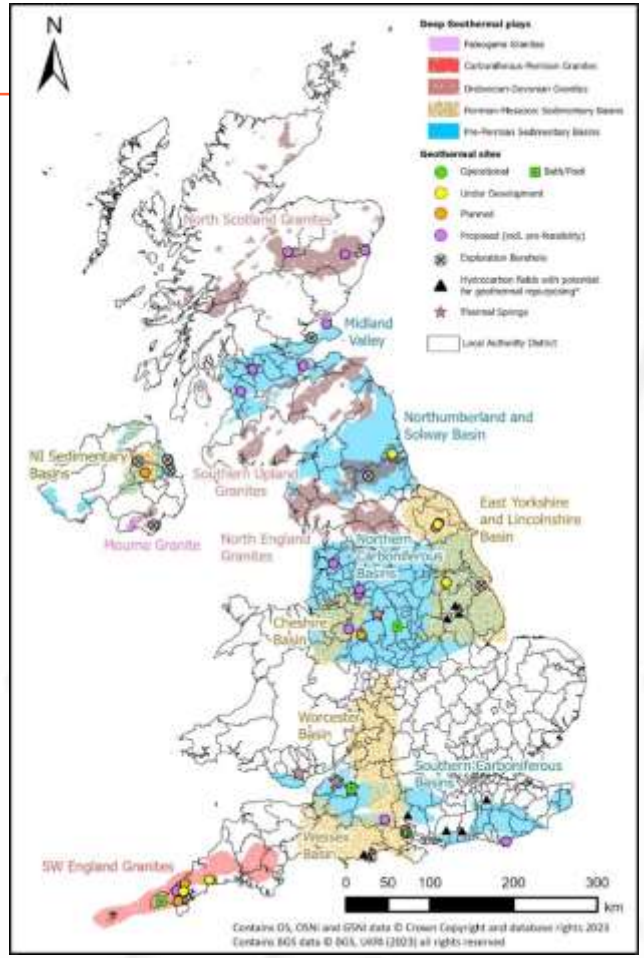


Source: The British Geological Survey

Geothermal in SW UK

National Geothermal Centre





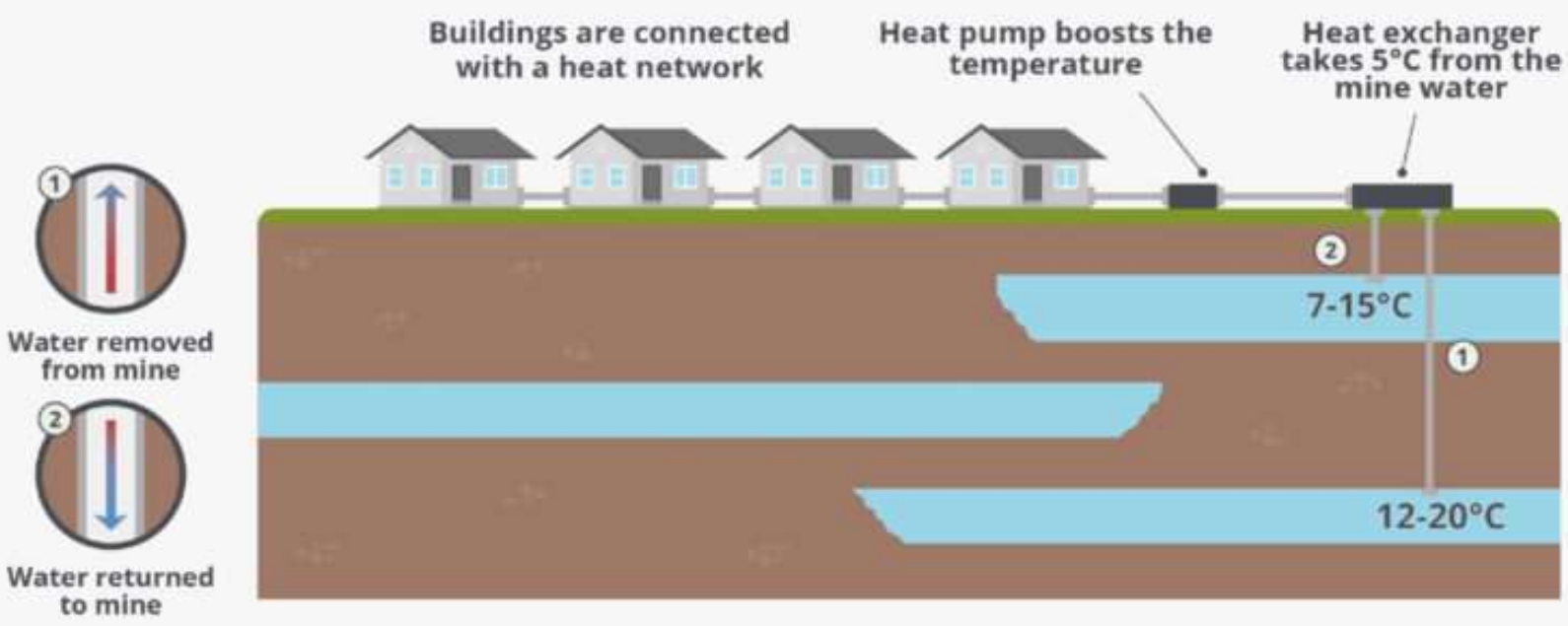
Local Authority Case Study: Gateshead

National Geothermal Centre

How Mine Heat Works

National Geothermal Centre

The Coal Authority



Elsewhere in Europe

National Geothermal Centre

- France, Germany, Belgium and the Netherlands have similar geology
- Geothermal energy is widely used in district heating across Europe with networks ranging in capacity from < 1 to 50 MWth.
- 250GW EU target by 2040
- Direct and indirect support measures have driven success
- Cooling and storage game changer

National Geothermal Centre

Thank you

Net Zero Technology Centre
Technology Driving Transition

Durham University

REECE FOUNDATION

shift GEOTHERMAL

Funded by UK Government

Scottish Government
Riaghaltas na h-Alba
gov.scot

info@ukngc.com | www.ukngc.com | in

South West NET ZERO HUB

Engaging the Community Sector

Louise Marix Evans
Quantum Strategy & Technology Ltd
Rossendale Valley Energy

Heat Network Webinars
Innovation:
Engaging the Community Sector

SW Net Zero Hub
16 July 2024

Louise Marix Evans

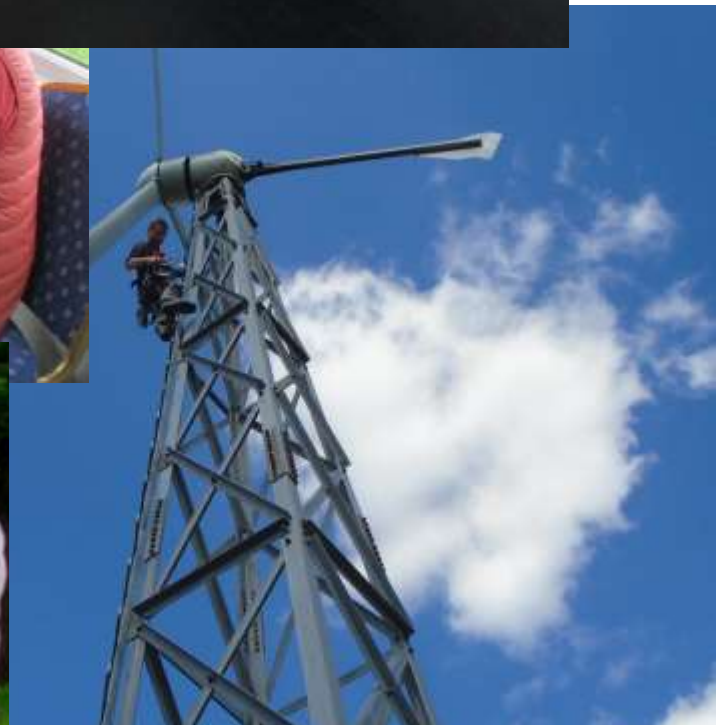
Quantum Strategy & Technology &
Rossendale Valley Energy

louise@quantumst.co.uk

louise@rvenergy.org.uk


RV
ENERGY
A community energy organisation for Rossendale


Ian Russell, Enfield Council
& Sam Bentley-Toon,
Thames21



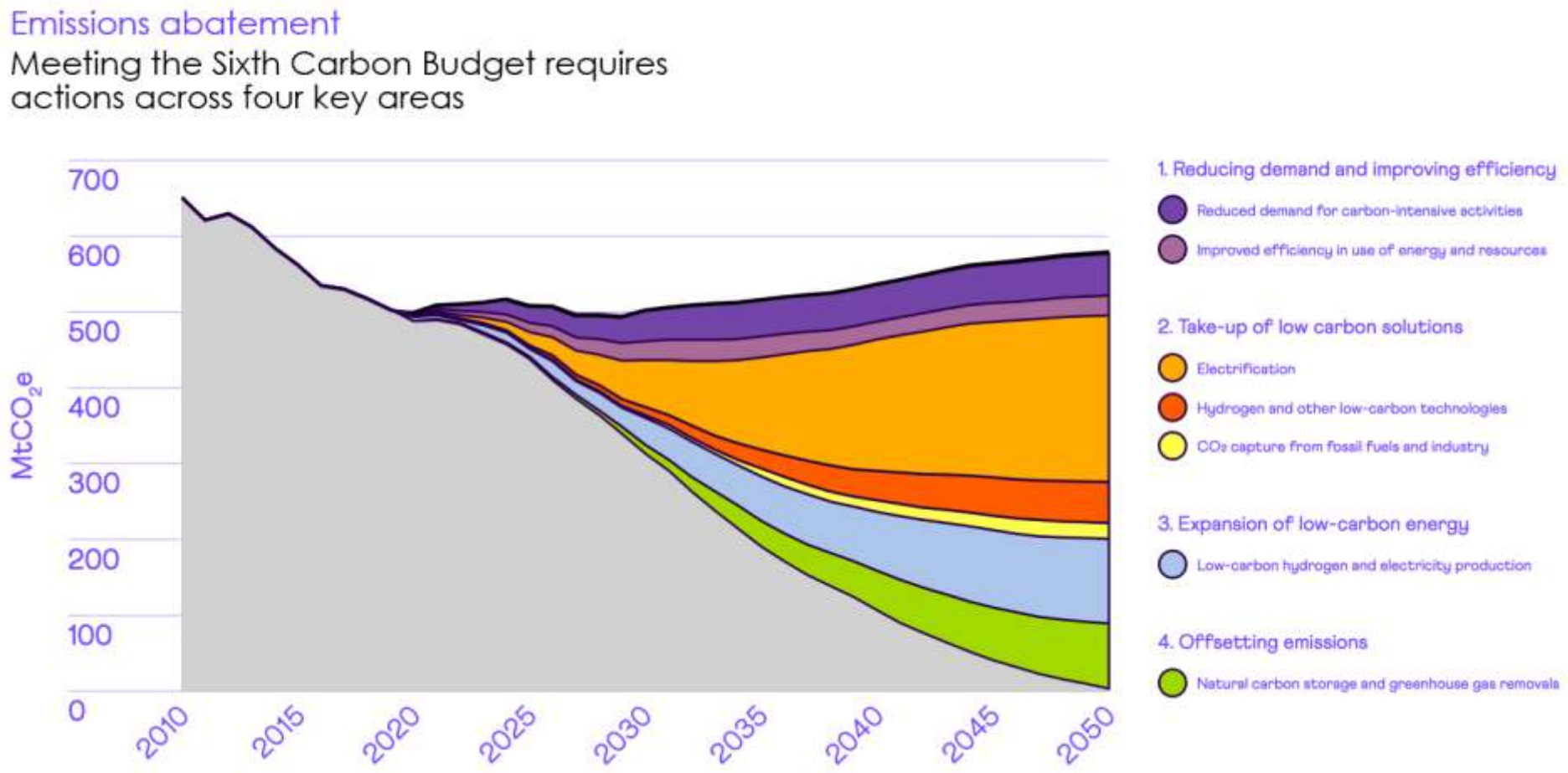
Community Sector & Heat – What I'll cover

- Why tackle heat?
- National picture
- Community Energy, whole systems and heat
- From Local Area Energy Plans to Community Led Energy Plans
- Net Zero Terrace Streets – a community led solution to the UK's 6 million hard to treat homes

Quantum

Meeting the Sixth Carbon Budget

From 2030 every investment and asset must be the low carbon choice to allow 20 years phase out of existing assets



Quantum

Source: CCC Sixth Carbon Budget

Sources of UK emissions

CCC 2023 Progress Report to Government :

"To reach Net Zero, the Government urgently needs to coordinate a shift in how the UK's 28 million homes and two million non-residential buildings use energy."

Figure 2: UK emissions in 2019

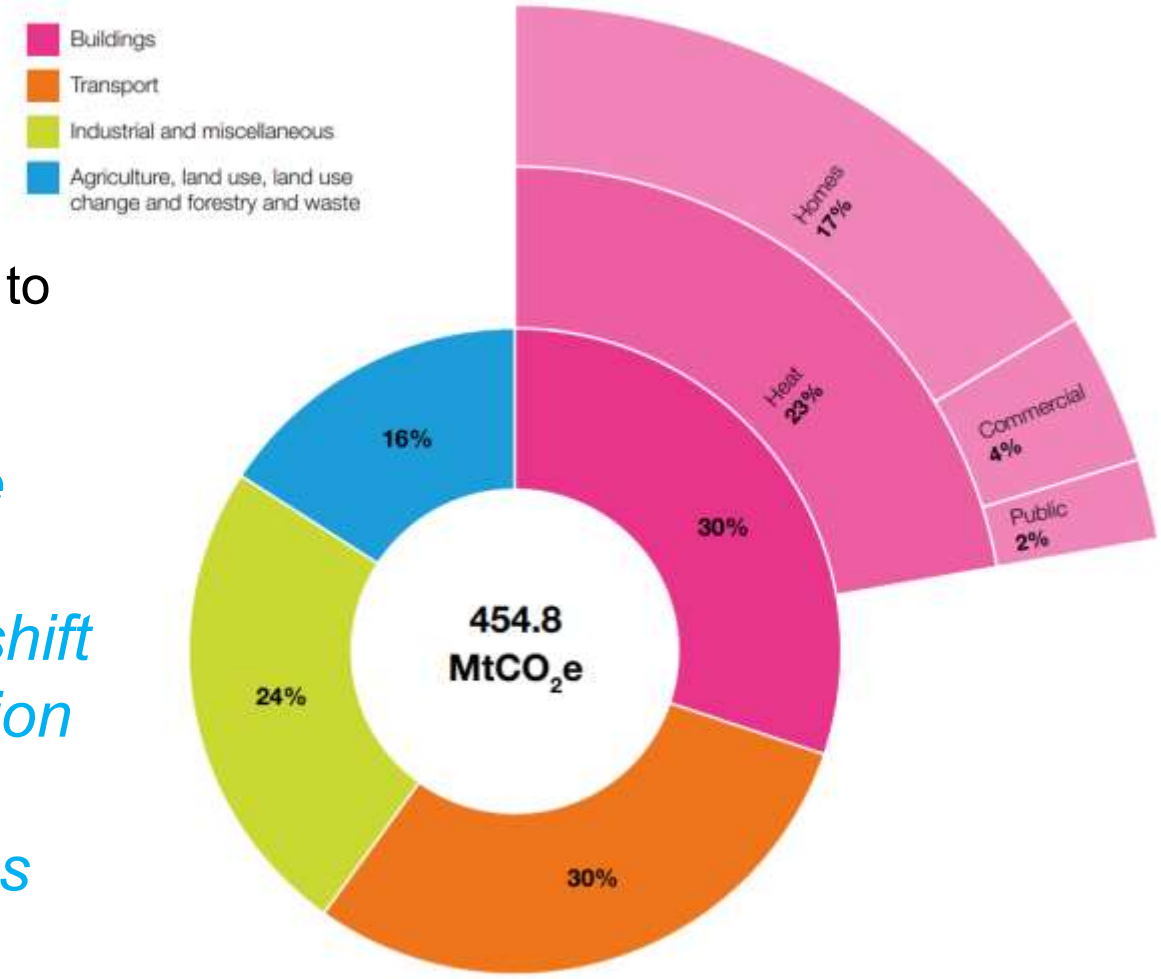


Figure 2 shows the proportion of emissions in 2019 from buildings to the nearest whole number; of the 454.8 mega tonnes of carbon dioxide equivalent ($MtCO_2e$) total emissions, 23% were due to heating buildings, with the largest proportion of this stemming from homes.[35]

Quantum

UK community energy in 2021

68 MW
stalled electricity capacity

331 MW
total renewable electricity capacity

Generating
506 GWh
of electricity

143,000
tCO2e saved annually

7.5 MW
new electricity capacity in 2021

58,000
members

3325
volunteers

644 FTEs
employed

495
organisations identified

183
new FTEs in 2021

217,489
people engaged

90
organisations working in low carbon transport

123
organisations delivering energy efficient services

271
organisations involved in renewable electricity

£3.35m
saved on energy bills

£12.2m
secured for project development

£11.9m
new investment raised

£15m
of community income spent locally

Quantum

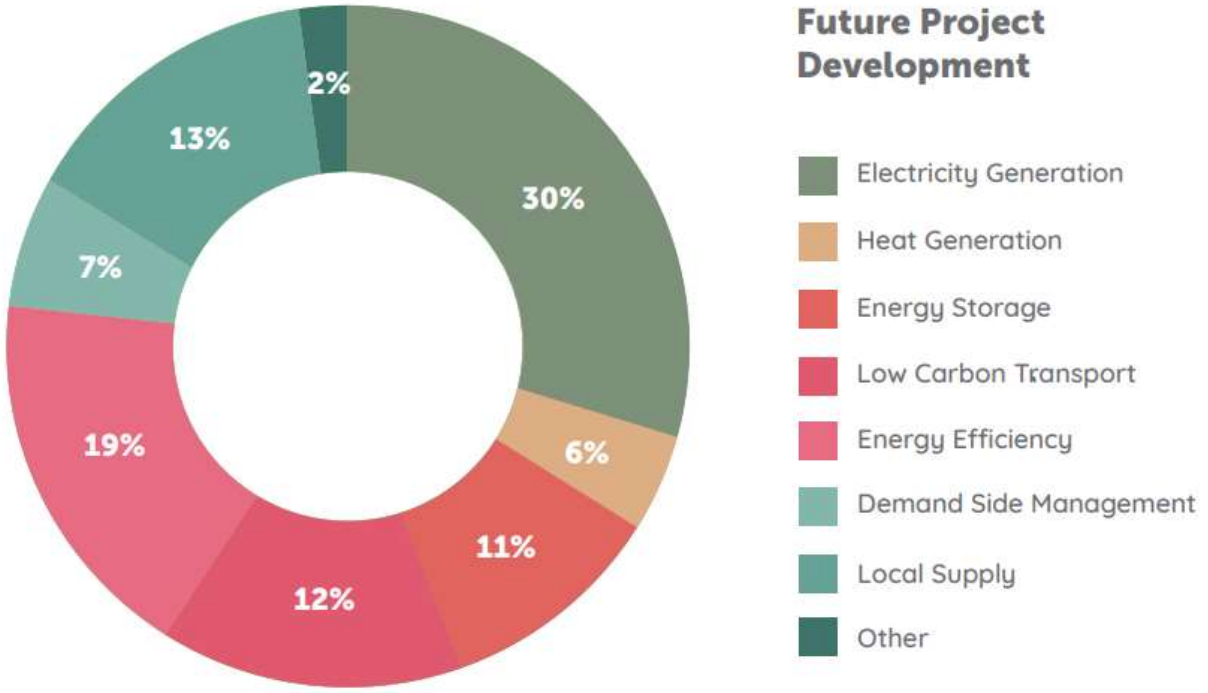
More focus on whole-systems in the sector:

Energy advice
Energy storage
Heat
Demand side management

Capacity building & Partnerships including: CEE Heat Working Group

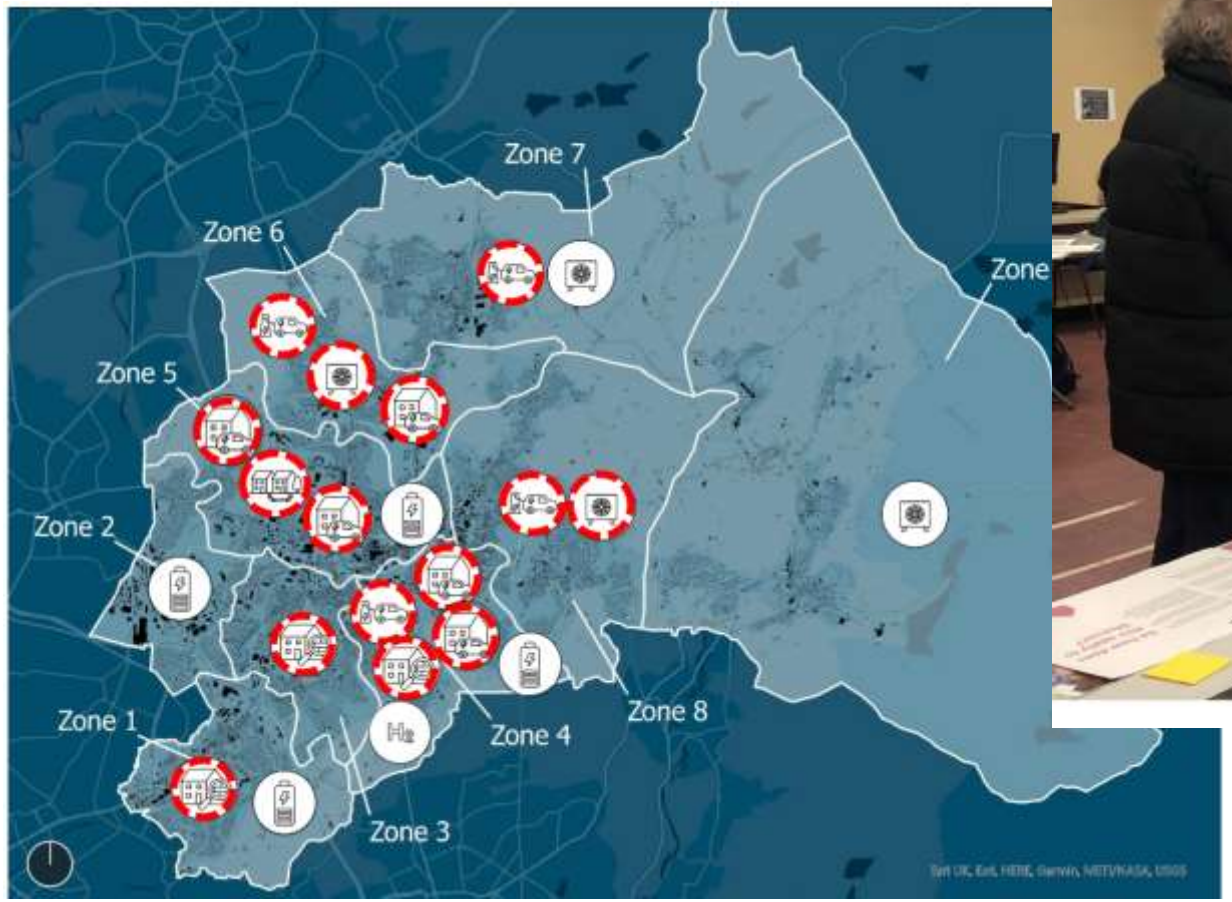
Looking toward the future

160 community organisations have projects in active development. 114 projects are likely to be implemented in the next couple of years and 46 are longer term projects. 92 groups indicated an intention to develop electricity generation projects, with 57 at a later stage of development.



Quantum

Oldham: LAEP and Community Led Energy Plans



Sholver residents feedback on the content and layout of the Community-Led Energy Action Plan

The Net Zero Terrace Street

The problem top level scenarios lack the delivery detail:

- Lack of whole systems community energy plans:
  - Distribution Future Energy scenarios
  - Local Area Energy Plans (in some places) don't do the 'how'?
  - Currently little attention given to decarbonising the Distribution grid
  - Most heat and transport electrification will happen at local level
  - Smart Local/ Community Energy Systems (SLES/SCES) need to be given more support
  - Many smaller resource depleted Local Authorities not got the bandwidth to contemplate the changes required

Nelson, Pendle, E Lancashire

- What needs to happen on the ground?
  - Whole systems approach
  - Planned, Phased approach that can bring speed and scale
  - Collective, community approach (inclusive homogenous)
  - Based sub-station by sub-station – linking with the Grid edge so the grid does not slow down transition
  - Coordinated so no one gets left behind
  - Bringing economies of scale
  - Non- Grant dependent with an investable business model
  - Affordability of solution and energy

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A community energy organisation for Rossendale

The challenge for terraced streets

- **10 million terraced homes** in the UK, ~ 6 million 2/3 bed which have little outdoor space to accommodate an ASHP
- A large proportion are from 19th and early 20th century with **low energy efficiency**
- **Fuel poverty and affordability** may be an issue for many householders (large swathes of terrace homes are in areas of deprivation)
- Default choice for electrification is electric boilers
- **Electric boilers will result in higher bills** for residents than gas
- Electric boilers would have to be delivered with whole house retrofit, an additional challenge
- Electric boilers will put **large additional loads on the grid** triggering very expensive and time consuming upgrades – a significant barrier to Net Zero

Bacup, Rossendale- Many terrace homes have no space for ASHP

Electric boilers are cheap to install, expensive to run

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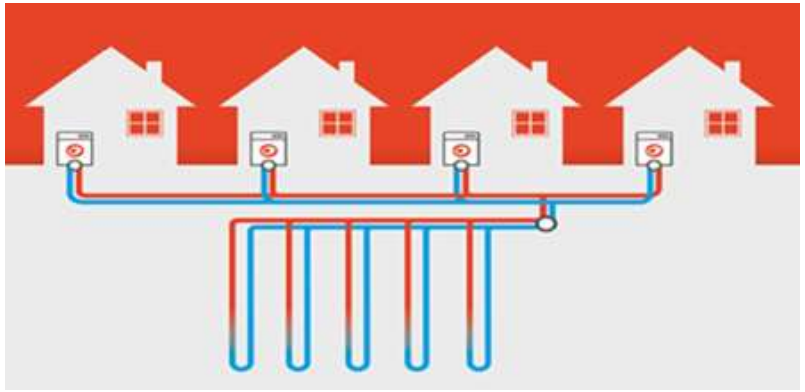
The Solution: Net Zero Terrace Streets

Affordable, low carbon energy, healthy warm homes at no upfront cost to householders.

- Shared ambient loop heat clusters provide efficient community heating
- In street bore holes with individual in-home 5.8 – 6kW heat pump
- Homes connected by a ‘smart’ systems for aggregated savings across an energy club. (Smart, Local Energy, System – SLES – addressing spark gap and protecting future flexibility benefits)
- Infrastructure and retrofit will be debt financed with householders paying a standing charge
- Community engagement (fairer warmth app and energy champions) – creating clusters of interest to move them to critical mass
- A national Community Interest Company supporting networks of local delivery vehicles that are there for the long term to serve and support customers



Kensa – Shared ambient ground loop

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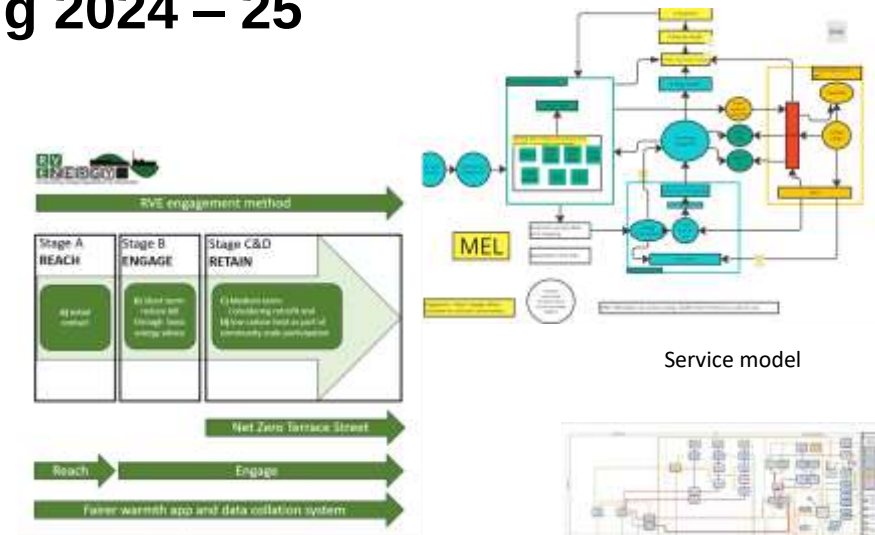
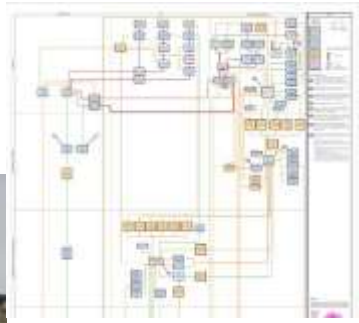
NZTS: Replicable and scalable
We are developing and testing during 2024 – 25

- DNO Planning tool and SLES
- 3 home demonstrator
- Service model & Blueprint
- Building Energy Model
- Techno Economic Model
- Financial Model
- Engagement methodology
- Communications strategy
- Legal templates/ contracts
- Physical & Virtual infrastructure deployment plan
- Supply chain mapping
- Procurement research and strategy
- Working with Fast Followers including Local Authorities



Service model



SLES Architecture

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South West NET ZERO HUB

Q&A:

Dr Charlotte Adams and Louise Marix Evans

South West NET ZERO HUB

Panel discussion and wrap up

Dr Henrique Lagoeiro: LSBU
Isabelle Macfarlane: Islington Council
Dr Charlotte Adams: NGC
Louise Marix Evans: Quantum Strategy
Sam Moore: SWNZH

And finally…

1. Thank you for your time today
2. We will be making the recording of today available on our website and on the website of other Hubs to share learning on this topic
3. Next event 17 Sept : 5i Heat Network Project
4. Please do consider signing up to our newsletter (every two months): South West Net Zero Hub Newsletter
5. Email: sam.moore@WestOfEngland-CA.gov.uk