Welcome!

Heating the Future

Conference
Programme

CIBSE Scotland Conference 2026

University of Strathclyde Technology & Innovation Centre

27 May 2026 Glasgow

CIBSE Scotland

Thank You to our Sponsors

Scotland

Welcome to Conference

Vince Arnold

CIBSE President

2026/2027 Planned Events & 90 years of CIBSE Scotland!

- CIBSE TM70:2025 Drainage in Tall Buildings webinar (18th June)
- Student Poster Competition
- RIAS/CIBSE Scotland Joint Event (September)
- CIBSE Scotland Dinner (23rd October)
- Membership Event (TBC)
- Further STEM Engagement
- Building Services Career Event in partnership with Engineer a Career (TBC)

Scotland

Introduction to Conference

Dr Tanja Groth

Conference Host

Director of Green Heat Network Fund, Triple Point

Keynote Speech

James Hemphill

Unit Head of Heat Networks, Local Government & Public Sector Policy Unit

Scottish Government

Heat Networks:

The Landscape in Scotland

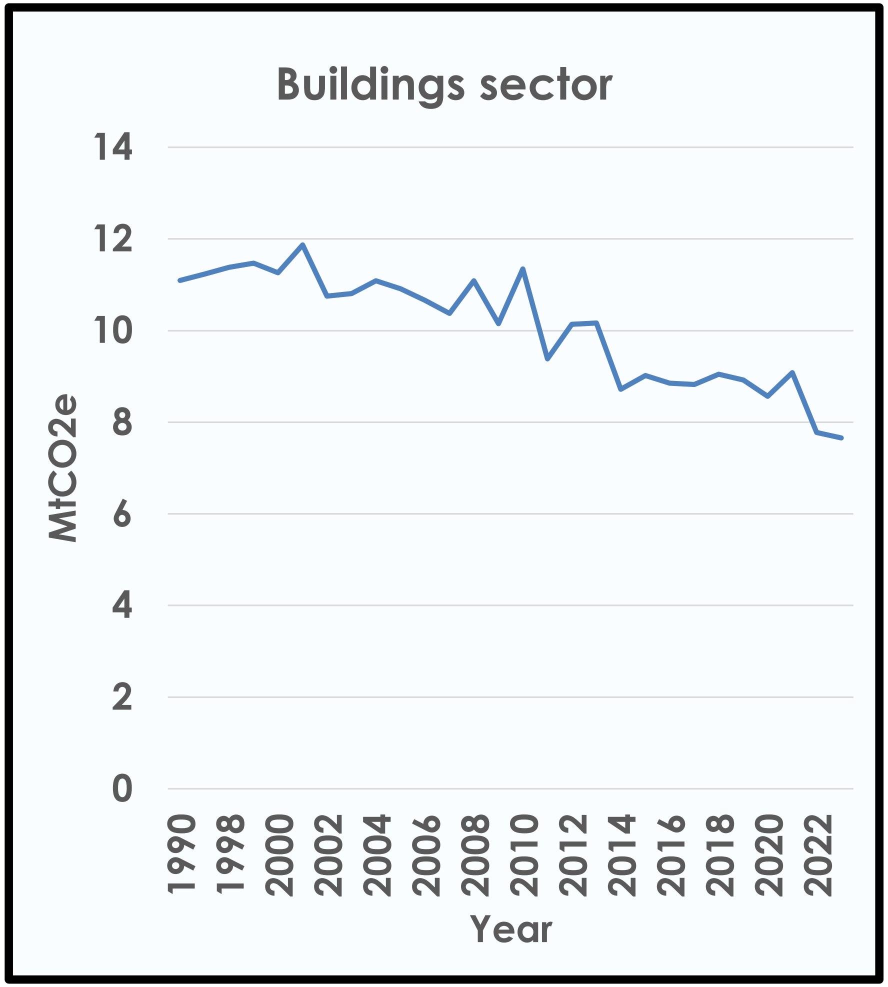
Scottish Government
Riaghaltas na h-Alba
gov.scot

Context

- Buildings need 80 TWh of heat, creating 19% of total emissions (third-largest cause)
- 2,450,000 homes and 220,000 non-domestic buildings
- 40% of homes are flats, and 10% of non-domestic buildings are public buildings
- Energy efficiency –

  56% of homes = EPC C or better
  32% of non-domestic buildings = EPC C or better

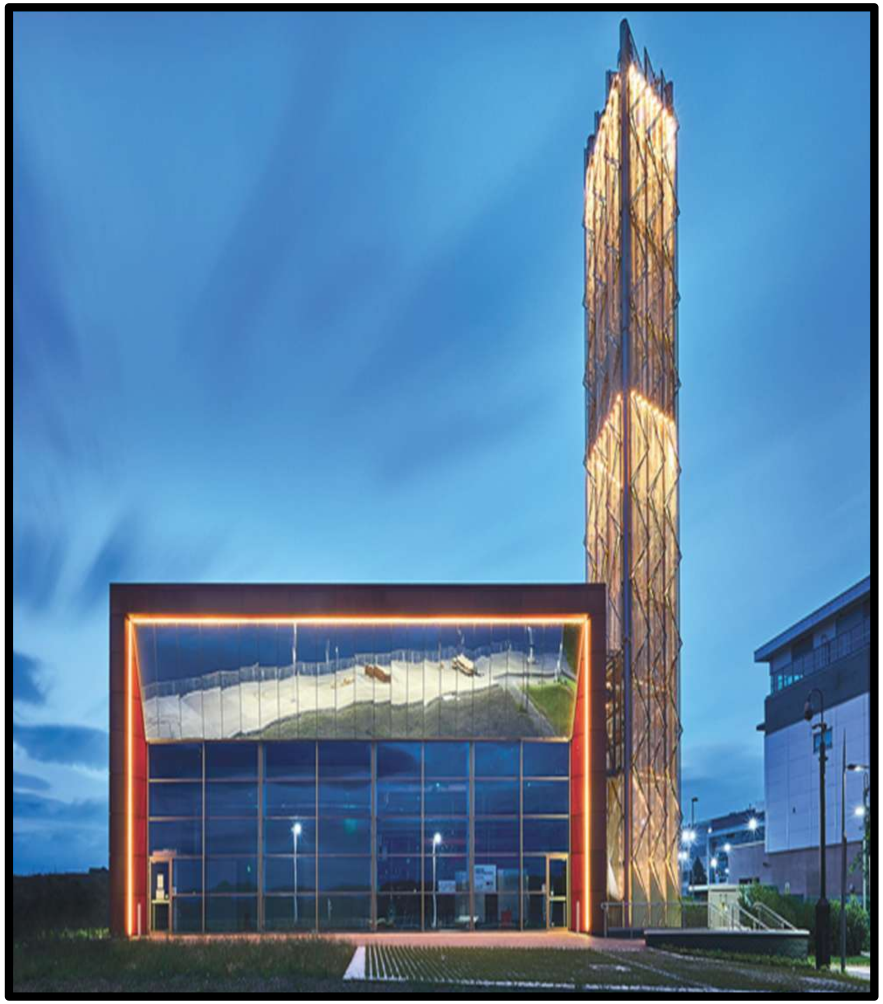
- **34% of homes are in fuel poverty**; by 2040, <5% of homes should be



Heat Networks Today

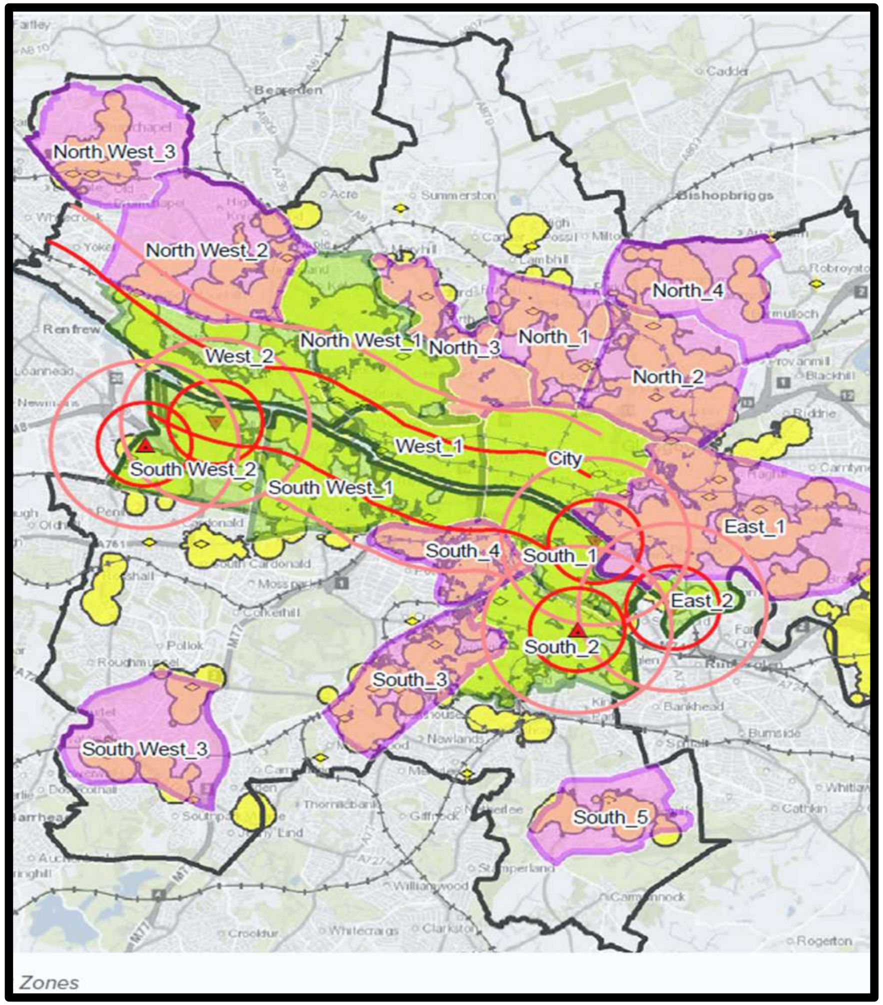
- Over 1,300 heat networks across Scotland
- Supplying over 36,000 homes & 3,000 non-domestic buildings
- **No restrictions** on who may develop / own heat networks in Scotland
- Local authorities often acting as project lead, with support from SFT and ZWS
- Legal targets –

  2.6 TWh by 2027 (3% of total heat demand)
  6 TWh by 2030 (7.5%)
  7 TWh by 2035 (9%)



Potential for Heat Networks

- Potential for up to 15.1 TWh of heat supplied by heat networks, investment of over £18bn.
- Equivalent to 20% of Scotland's heat demand.
- Reaching this potential could lead to –
    - £12bn of investment over 20 years
    - Annual net GVA to 2045 = £350m p.a.
    - Supporting >7,000 jobs (at peak)
    - Ongoing employment of >1,000 net jobs
    - Annual net GVA after 2045 = £125m p.a.
    - Air quality improvements of £35m
    - Removal of 4% of Scotland's total emissions



Heat Networks: Major Policies to Date

LHEES

HNSU

SHNF

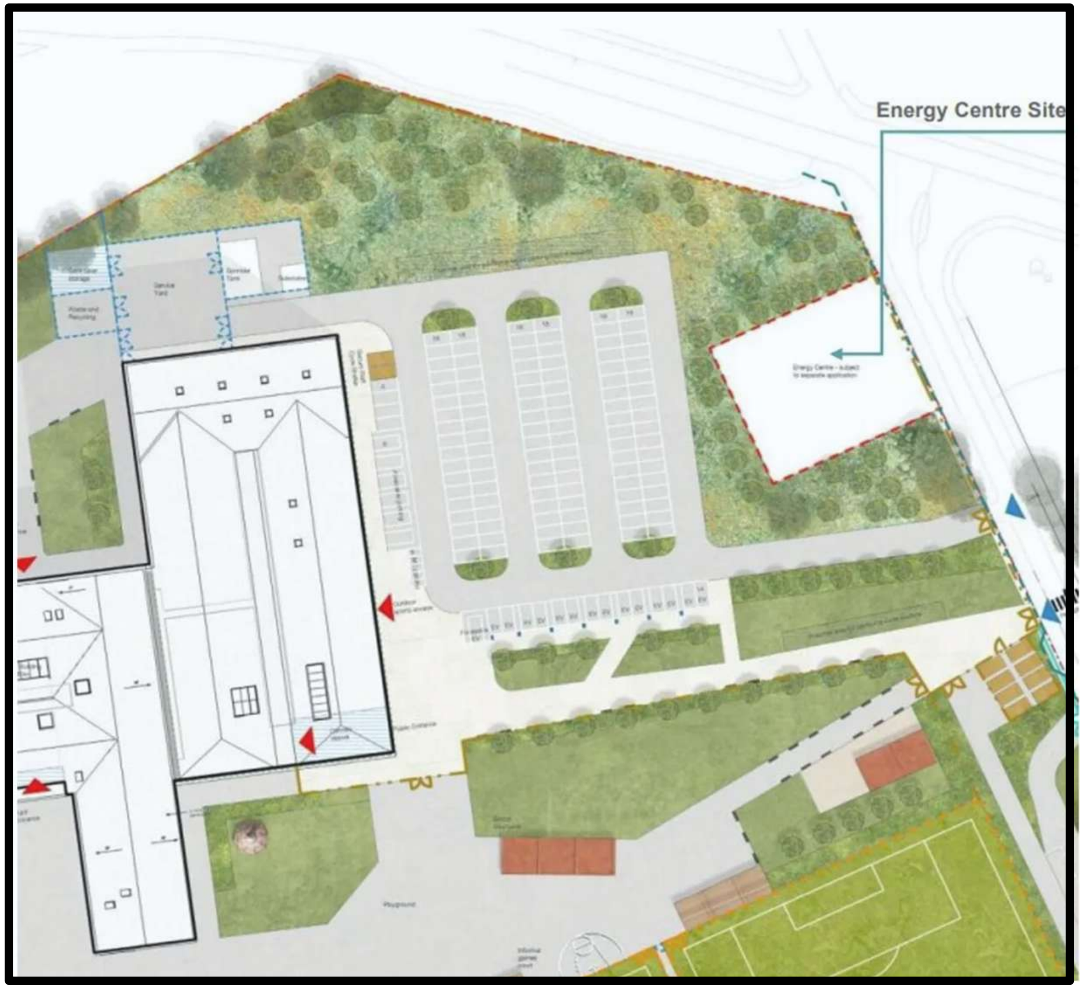
Connection costs

Ofgem Authorisation (including consumer and technical standards)

SHNF Case Study: Hazlehead Heat Network

Lead Organisation: Aberdeen City Council

Grant Awarded: £2,210,166

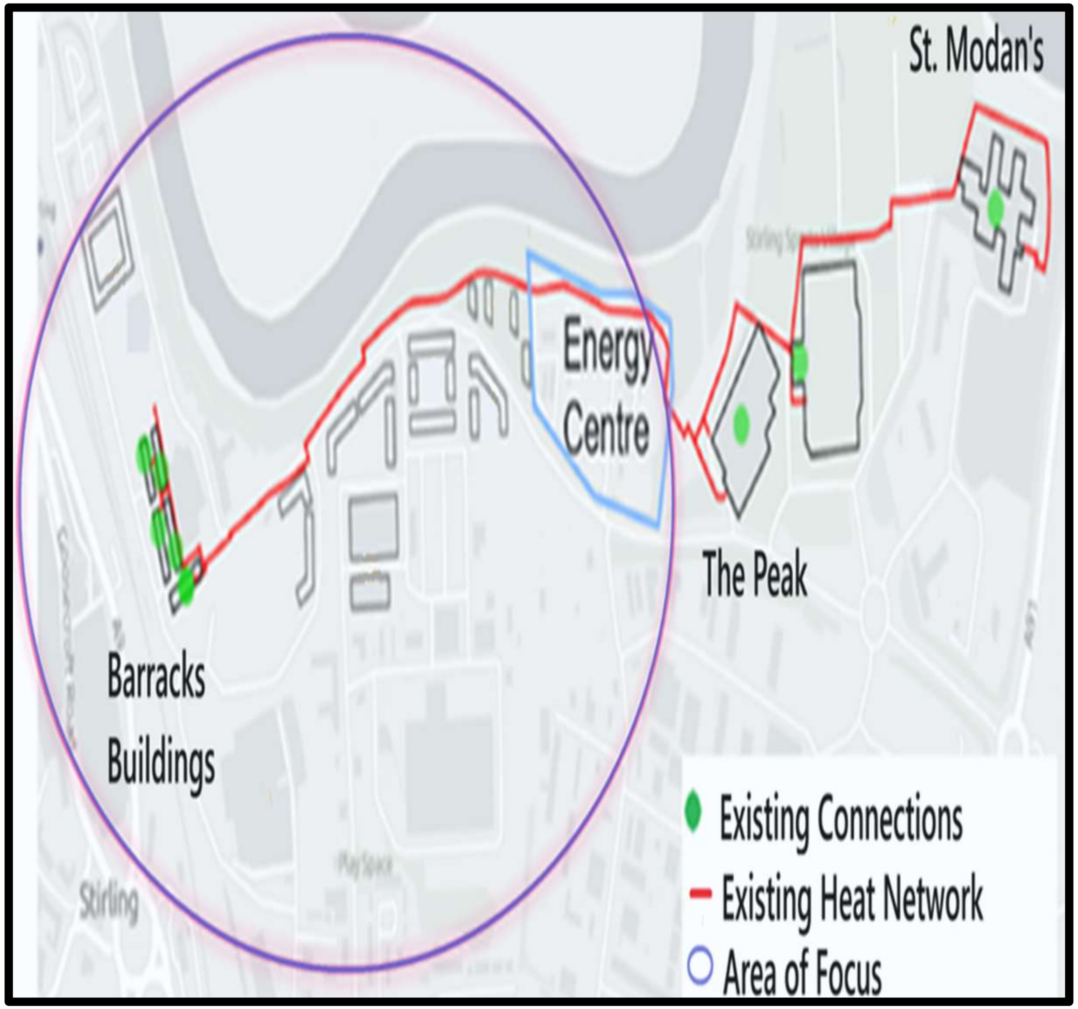


HNSU Case Study: Forthside Heat Network Expansion Feasibility Study

Lead Organisation: Stirling Council

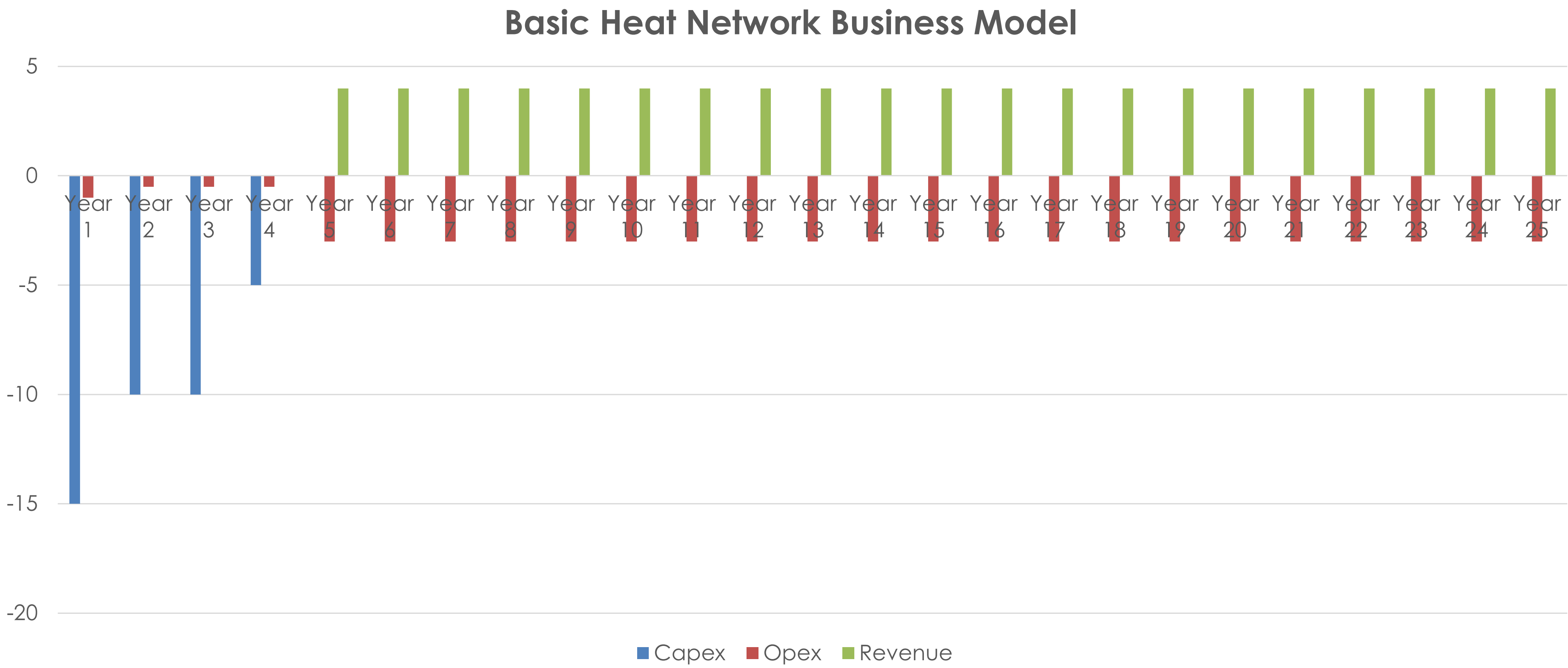
Grant Awarded: £50,000

Project capex: £4m, IRR: 11% (with SHNF funding)



Scottish Government
Riaghaltas na h-Alba
gov.scot

Planned Policies



Capex: SHNF, licensing

Opex: Cost of heat

Revenue: Connection regulations

Scottish Government
Riaghaltas na h-Alba
gov.scot

Conclusion

- Heat networks are a necessity
- Scotland's potential to install them is high
- Underlying commercials inhibit investment
- Scottish Government proposals to de-risk projects (e.g. utility rights and demand assurance)
- Ongoing commitment to capital and pre-capital support

Thank you

james.hemphill@gov.scot

Scottish Government
Riaghaltas na h-Alba
gov.scot

Keynote Speech

Thomas Dam Leth

Large-Scale Heat Pumps and District Heating

Thomas Dam Leth

Senior Specialist, Energy

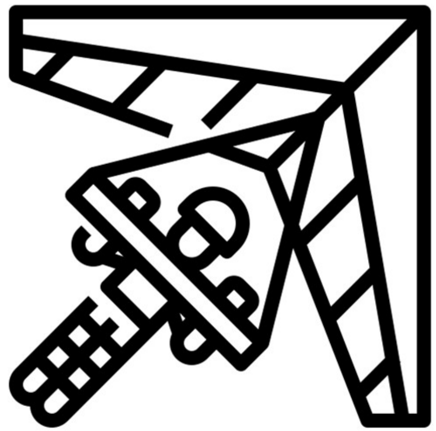
Sweco Denmark

7 years of experience working with:

- Design of Industrial Heat Pumps
- Design of Industrial Refrigeration Plants
- Utilisation of waste heat.

Why Large-Scale Heat Pumps Now?

- Focus on electrifying district heating
- Predicted capacity growth in Denmark 2025 → 2035
  - 700MW → 4,000MW
- Shift from complementary → base load
- Greater heating-sector integration enables grid stabilisation.
- Utilisation of multiple energy sources & large focus on excess heat
- "We used to look for chimneys – now we look for cooling surfaces"

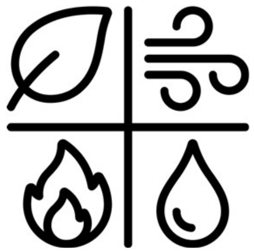


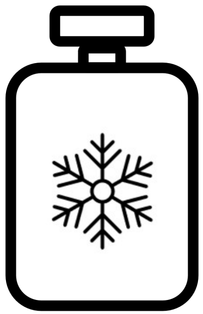
SWECO

Heat Pumps in DH: The Big Picture

Design Drivers

- Energy Source
- Operating profile (hours, part load, flexibility)
- Optimisation of existing hydraulic systems (Return Temperature)
- Refrigerants

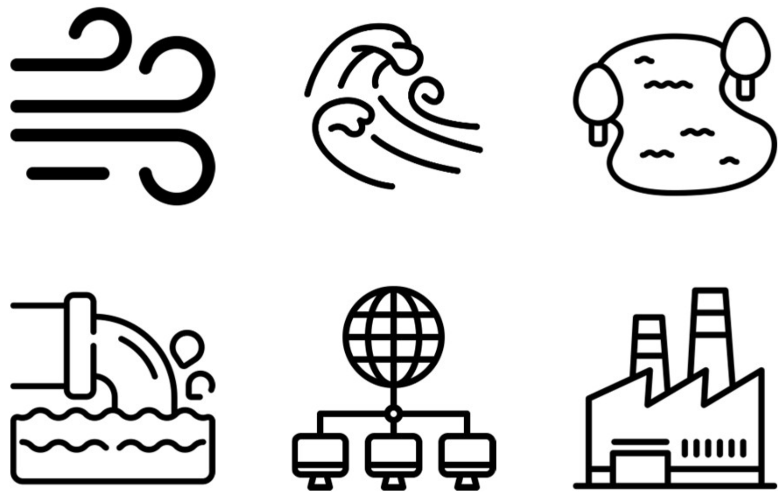




Energy Sources: What Really Matters

Independent vs. Dependent energy sources

- Independent: seawater, air, geothermal
- Dependent: data centres, industry, wastewater



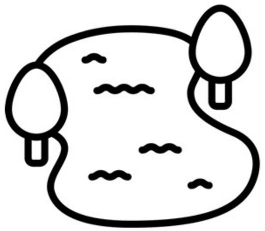
Focus:

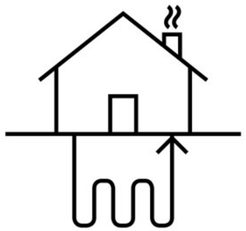
- Availability
- Temperature level
- Annual operating hours

SWECO

Extra Slide for
Web Version

Energy Sources – Independent





Air:
Temperature: -8°C → 30°C
- Availability
- Large Fluctuations
- Direct vs indirect
- Defrosting

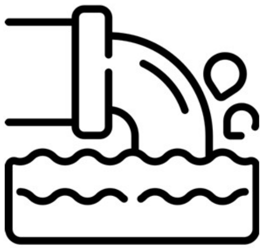
Seawater:
Temperature: 2°C → 20°C
- Availability
- Filtering requirements
- Direct vs indirect

Lakes, Rivers & Mines:
Temperature: 3°C → 22°C
- Availability
- Filtering Requirements
- Direct vs indirect

Geothermal:
Temperature: 60°C → 90°C
- Direct exchange with DH
- Indirect using heat pumps
- High investment

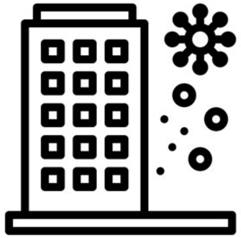
Extra Slide for
Web Version

Energy Sources – Dependent

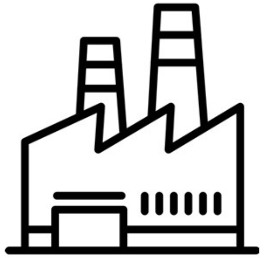


Wastewater:
Temperature: 8°C → 18°C
- Daily variations.
- Filtering requirements.
- Direct vs indirect.

Datacenters:
Temperature: 25°C → 35°C
- In DK: required to utilise if > 1 MW
- Scalable energy source
- In DK: requirements for concept of cooling



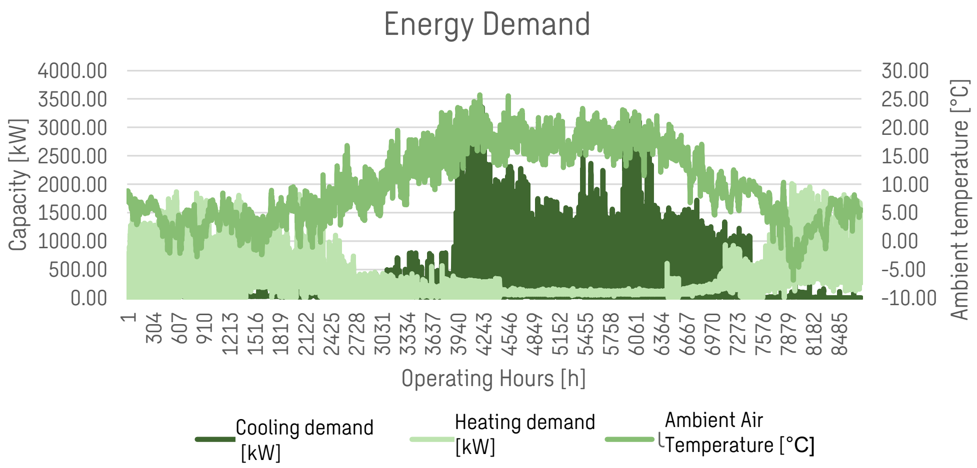
District Cooling:
Temperature: 25°C → 35°C
- Requirement to investigate the potential use of waste heat

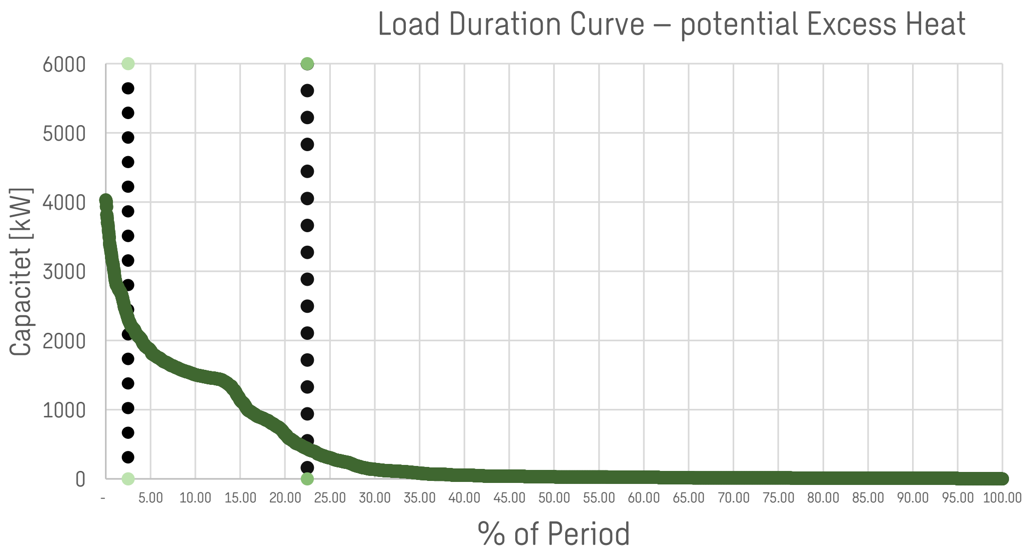


Process Industry
Temperature: 30°C → 60°C
- Production variation
- Careful dimensioning
- Direct vs indirect

Excess Heat: When Does it Make Sense?

- Operating hours > Peak capacity
- Internal vs. external utilisation
- ROI driven by utilisation rate
- Load profile limits HP size

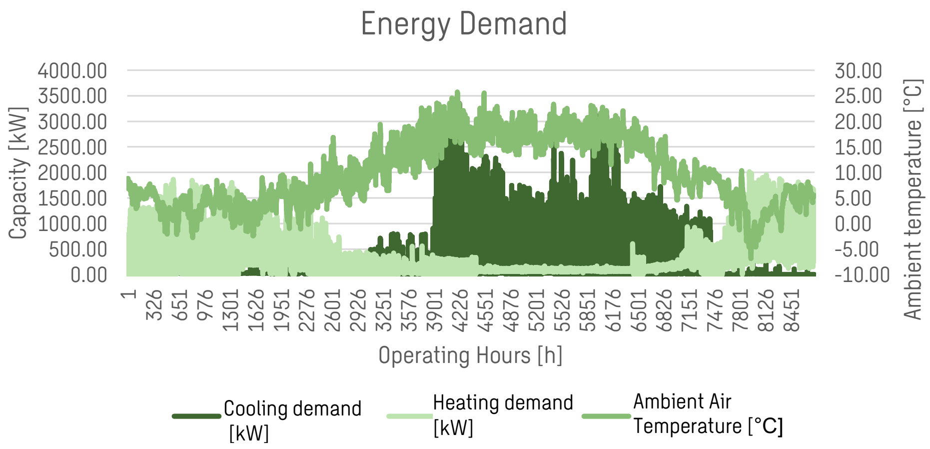


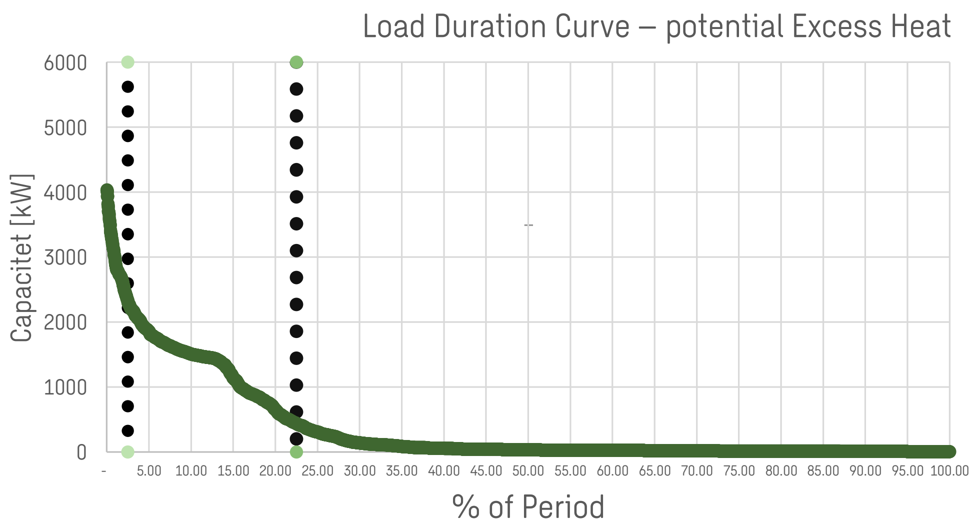


Extra Slide for Web Version

Excess Heat: When does it make sense?

- Profile plot of the yearly cooling and heating demand.
- Nominal distribution of cooling demand on a time basis.
- Often few hours with high peak cooling demand.
  - ➢ Reduces potential for large heat pumps.
- Internal utilisation is often the most optimal solution.
  - ➢ Short ROI thus attractive to private companies.





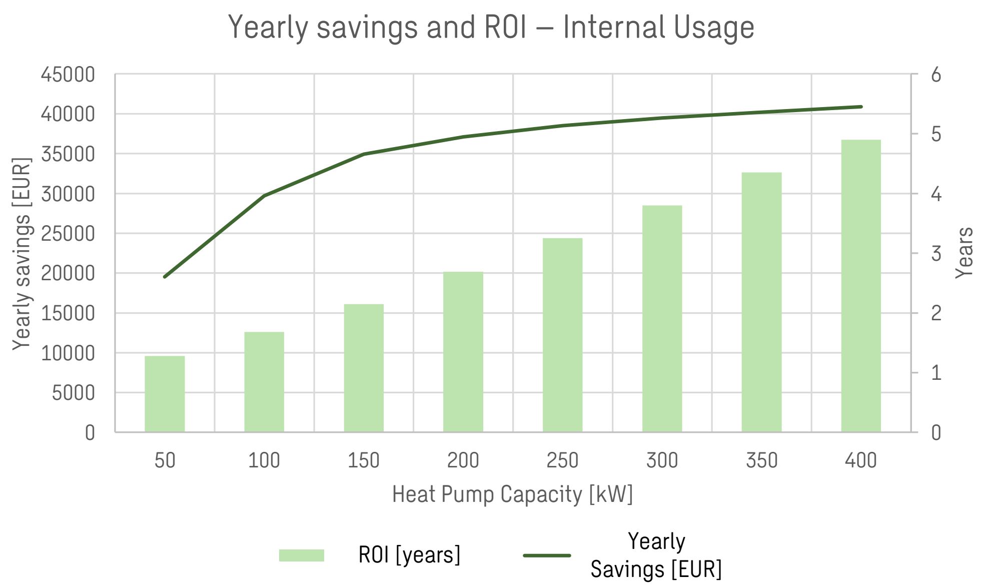
SWECO

Extra Slide for
Web Version

Excess Heat: When does it make sense?

- Different types of heat pumps applicable for the given case.
- Internal usage often relevant
  - ➢ Allows for maximising operating hours

- External usage
  - ➢ Risk of bad utilisation rate
  - ➢ Long ROI



Heat Pump – External utilisation	2,300 kW	500 kW
Potential operating hours [h]	Approx. 2,000	Approx. 3,000
Potential [MWh]	2,792	1,187
ROI [years]	21	11

SWECO

Refrigerants & Configurations

- Natural refrigerants: NH3, CO_2, hydrocarbons
- 1-stage vs 2-stage
- Source temperature often defines complexity and achievable COP

Natural Refrigerants (Large Heat Pumps)	NH3	CO2	Hydrocarbons (R600A, R290 etc.)
Capacity	10→20 MW	10→50 MW	10→50MW
Supply temperature	95°C	+95°C	+95°C
Configuration	1-stage & 2-stage	1-stage	1-stage
Key Advantages	• Excellent Thermal Properties • High Efficiency • Proven industrial Technology	• Non-flammable • High single-stage capacity • No requirements to refrigerant charge	• High efficiency • Low operating pressures • Non-toxic
Key Challenges (BS EN378)	• Toxic – strict requirements • Focus on refrigerant charge	• High operating Pressures • Sensitive to return temperatures	• A3 Refrigerant (flammable) – ATEX requirements • Focus on refrigerant charge

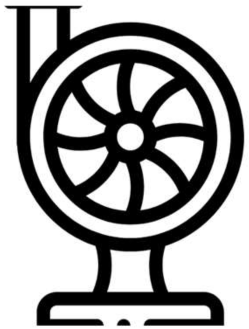
SWECO

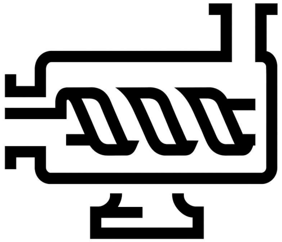
Extra Detail for
Web Version

Compressor Technologies

Piston Compressors: 0.5-4 MW
- High efficiency
- Low capacity
- Low temperature lifts
- Short service intervals

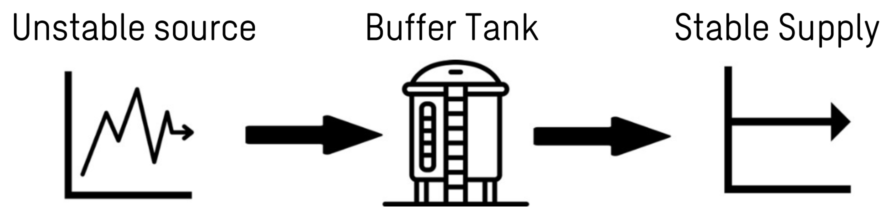
Centrifugal/Turbo Compressors: 5-50 MW
- High capacity
- Large temperature lifts
- Lower efficiency
- Long service intervals





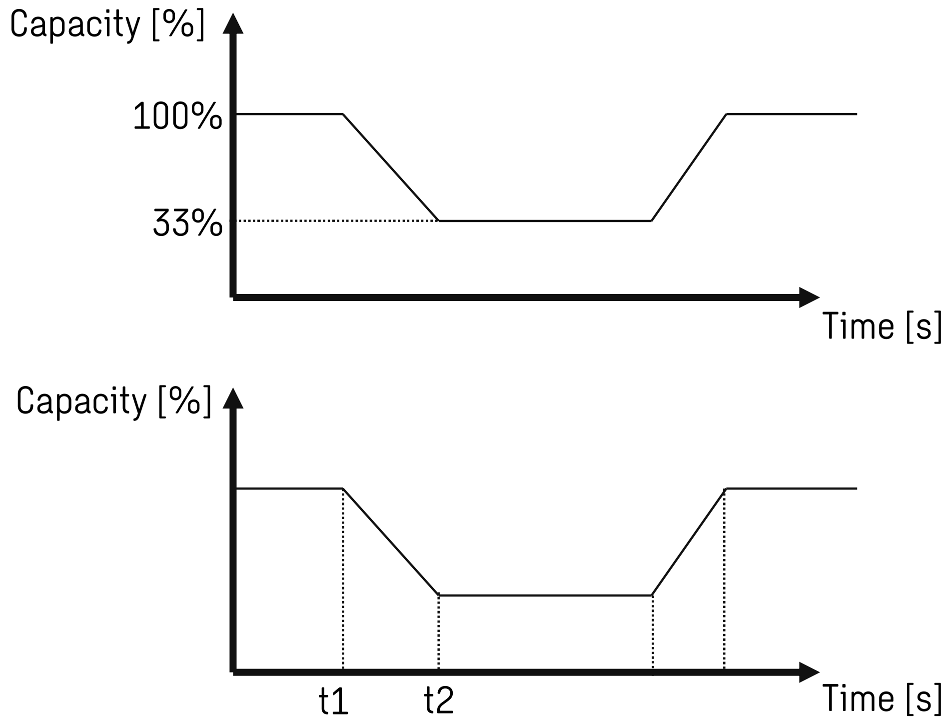
Screw Compressors: 3-20 MW
- High capacity
- High efficiency
- Large temperature lifts – depending on energy source. Requires 2-stage solution for best efficiency
- Long service intervals

Design Pitfalls



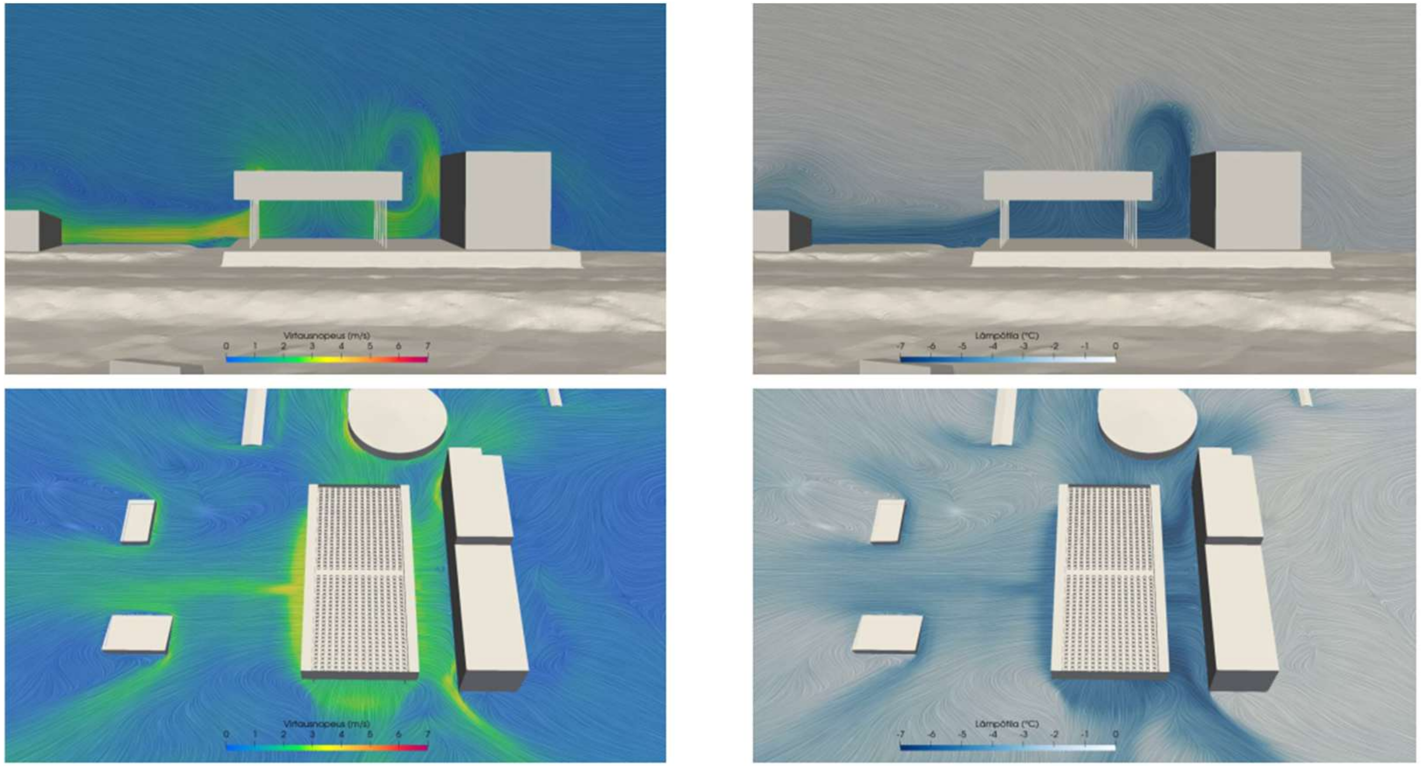
Where things often go wrong

- Temperature & flow fluctuations
  - ➢ Need a buffer tank?
  - ➢ Correct dimensioned hydraulic systems
- External effects
- Start/stop frequency (and response time)
- Part-load operations (and response time)



Example of External Effects: Air Recirculation

- Massive impact on COP and capacity
- CFD early = cheap insurance
- Layout matters more than people think

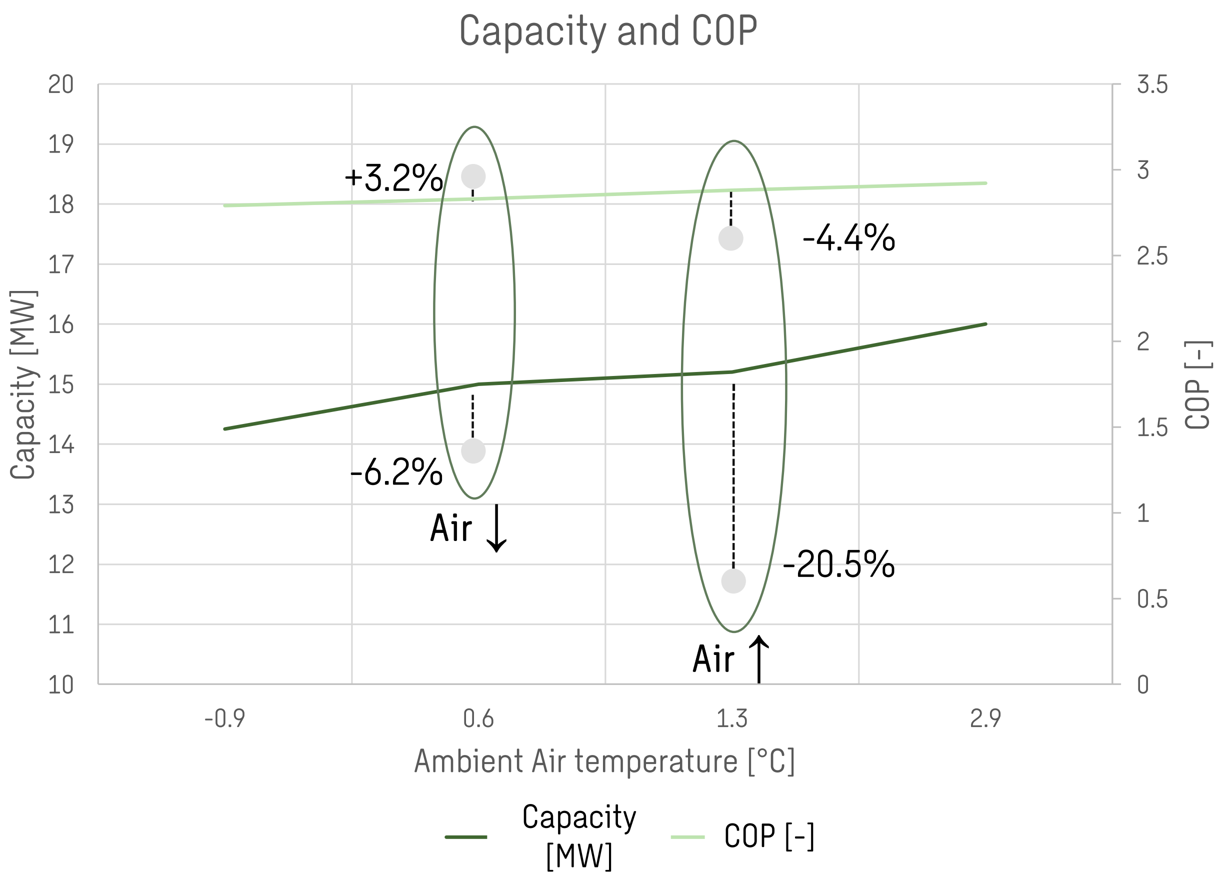


SWECO

Extra Slide for Web Version

Example External Effects: Air Recirculation

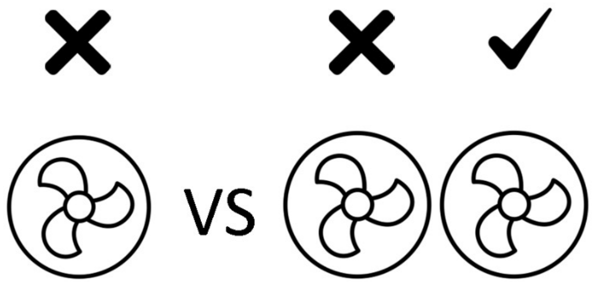
- Optimisation of recirculation at low wind speeds
  - Barriers around energy absorbers
  - Configuration of air directions of the energy absorbers
- COP optimisation
- Capacity optimisation

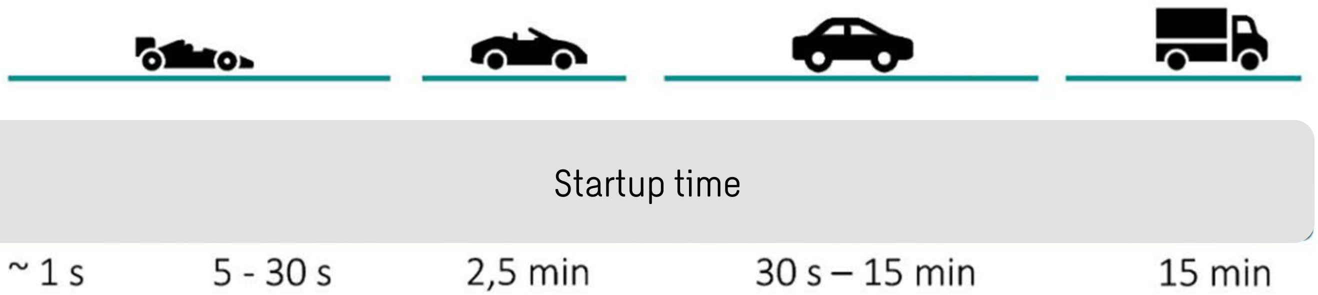


Strategic Perspective

COP vs Uptime

- Base load vs flexible operation
- Redundancy levels
- Integration with electrical boilers and buffer tanks
  - ➢ Stability and Flexibility
- Balancing the electrical grid

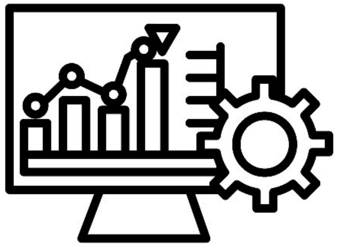


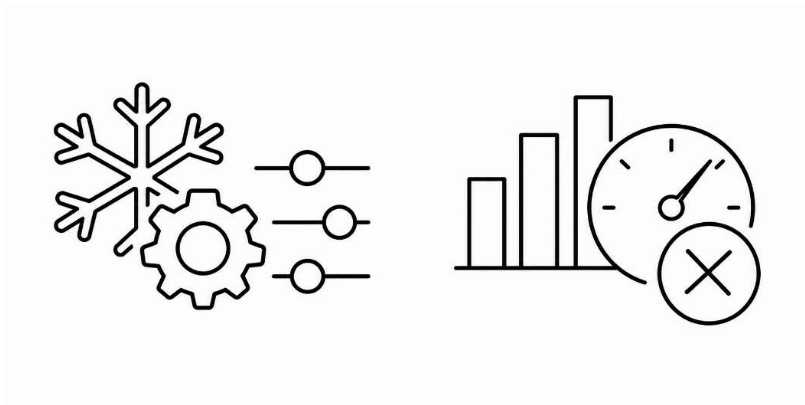


Key Takeaways

Good planning provides good results

- Design for real operation, not nominal data
- Consider refrigerants and configuration early
- Maximise operating hours
- COP is irrelevant without uptime





Extra Slide for
Web Version

Planners Guide – From Idea to Execution

- **Project objectives and framework:** Budget, time schedule, regulatory requirements and success criteria
- **Heat demand:** detailed load profiles
- **Energy Sources:** Seawater, air, waste heat, etc.
- **Design specifications:** Temperatures, flow rates and their variations
- **Physical conditions:** Space requirements, service clearances and access routes
- **Potential refrigerants:** Location, refrigerant charge, safety, etc.
- **Redundancy and operation:** Maximising uptime
- **Paradigms for service:** Scope, response times - comparability
- **Paradigms for performance data:** Methodology, measurement equipment/tolerances, seasonal changes (multiple data points)
- **Tender material:** Consolidation of requirements specification and evaluation criteria's
- **FAT/SAT and uptime testing:** Test and troubleshoot as much prior to on-site installation
- **Commissioning and performance:** Verification of performance guarantees
- **Operation and optimisation:** Continuously monitoring and documentation of performance, uptime and ongoing optimization

SWECO

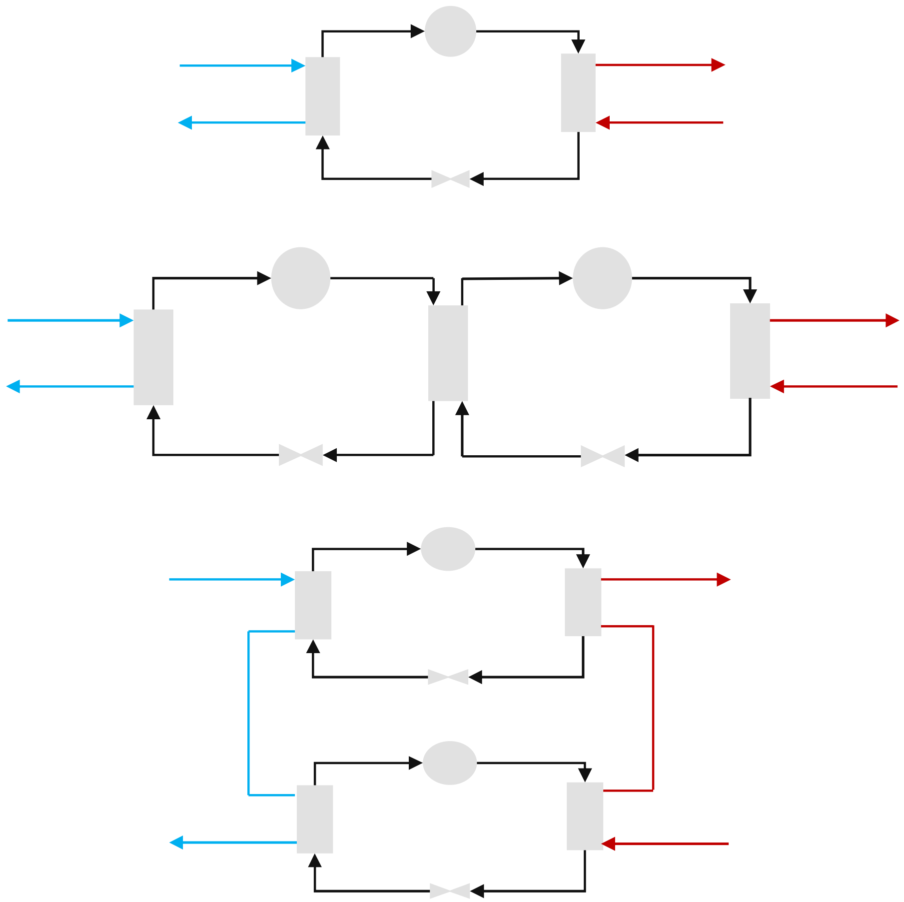
Extra Slide for
Web Version

Heat Pump Configurations - Source Dependent (Extra)

- Source temperature helps define the configuration.
  - High source temperatures provides simple 1-stage systems.
  - Low source temperatures often requires complex 2-stage systems.

- High source temperatures provides higher COP but is often acquired from **dependent** energy sources.
- Low source temperatures is often acquired from **independent** energy sources which varies with the seasons.

- Hydraulic series-coupled heat pumps increases efficiency
  - Applicable if high ΔT on either source or supply side.
  - Complex system controls,

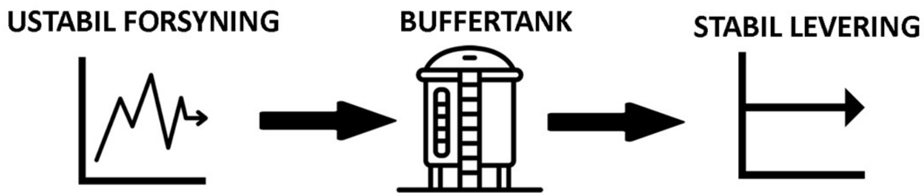


SWECO

Extra Slide for
Web Version

Design pitfalls (Extra)

- Operating conditions– on a yearly basis
  - Temperature variations ✓
  - Flow variations ✓
  - Heating demand ✓
  - Cooling demand ✓



- Process variations/fluctuations during operation
  - Suppliers often list requirements for limits of fluctuations – know these!
  - 0.5 – 3 K/min limit depending on supplier – exceeding these could result in system failures
  - Consider implementing buffer tanks – evens out fluctuations and provides the opportunity of storing thermal energy.

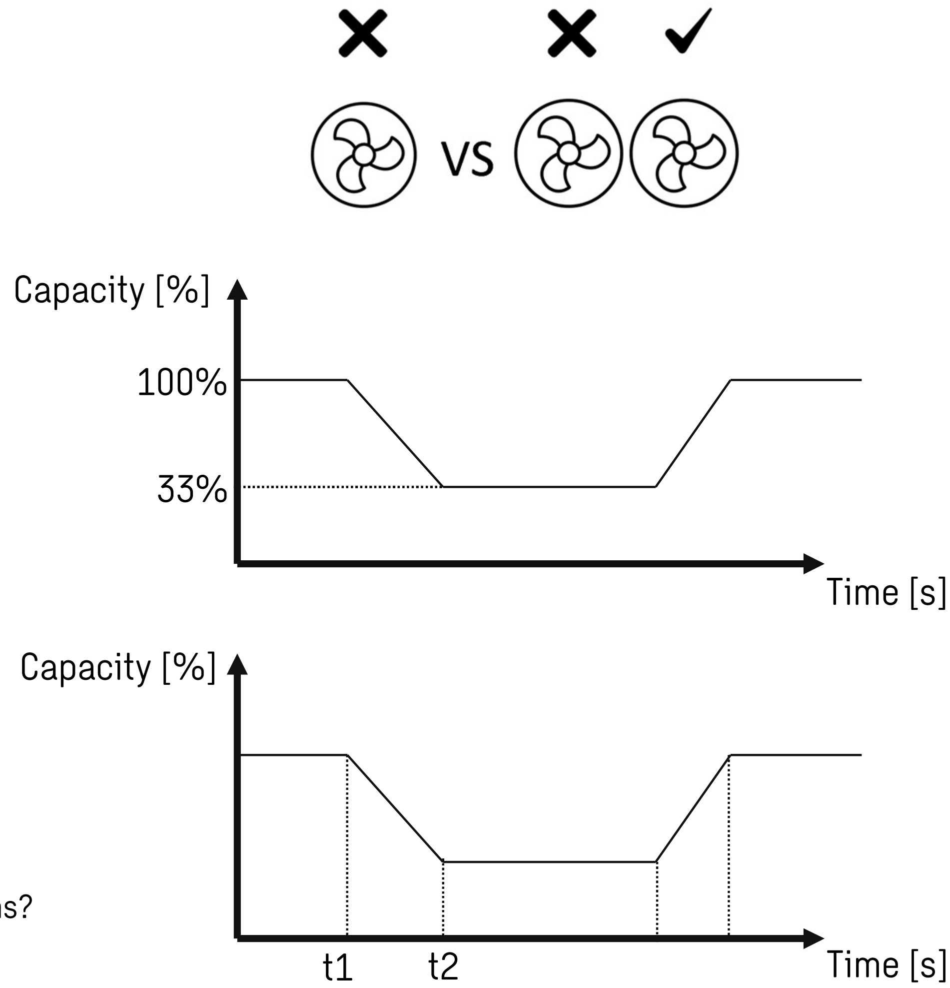
Extra Slide for
Web Version

Design Pitfalls (Extra)

- Requirements regarding up-time and redundancy.
  - Does the heat pump supply base load.
  - Is it possible to supply heat from other production sources if system failure or during service?
  - Fewer components results in less redundancy
  - 25%, 50%, 75% - how much is necessary?

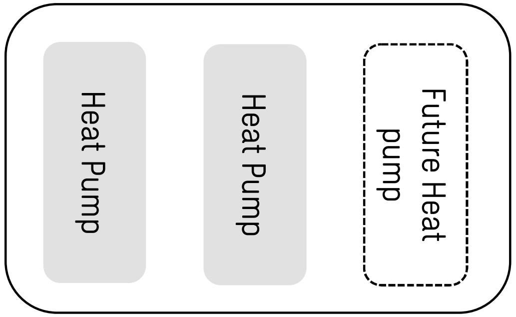
- Part load
  - Part load is usually controlled by variable speed drives: 100% → 20%
  - Can potentially require different system configurations

- Start-up and control response times
  - What is the required start-up time of the heat pump: 5, 10, 15 min?
  - Is the heat pumps system integrated with other electrical based heating systems?

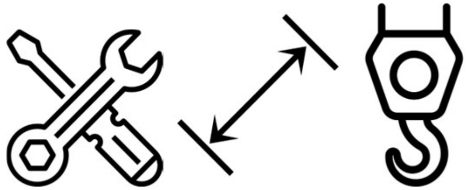


Good Practice (Extra)

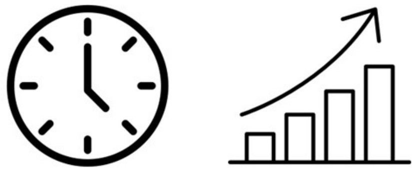
- Requirements for expansion
  - Is the system dimensioned for full capacity from the start,
    or is it expanded in stages?



- Service
  - Service is essential to future-proof operations
  - This must be considered in the design process
  - The larger the heat pumps become, the larger the components become.
    This places demands on structures, cranes, service distances, etc.



- Annual Operating Hours
  - The more operating hours, the greater the importance of COP
  - Provide the optimal conditions for the heat pump



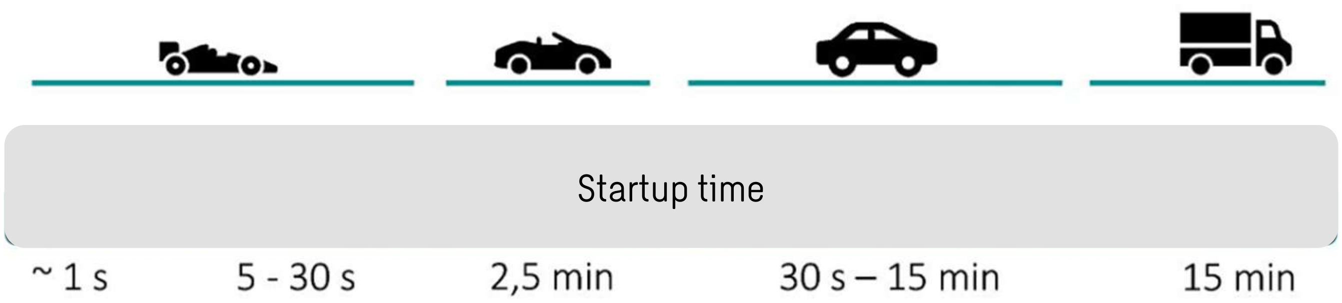
Extra Slide for
Web Version

Strategic Perspective (Extra)

- Heat pump's ability to balance the electrical grid.
  - High demand.
  - Interplay with electrical boilers and buffer tanks.

- Frequent start/stop sequences lead to increased wear on the heat pumps.
  - Requires an increasing level of service.
  - Suppliers requires a minimum pause between each start/stop sequence.

- Different types of systems can achieve different regulation times.



Contact

Thomas Dam Leth

Senior Specialist, Energy

thomasdam.leth@sweco.dk

+45 4282 1688

Presentation

Hilary Dooley

Edinburgh LHEES Project Manager, Edinburgh City Council

Hassan Waheed

Sustainability Lead – Scotland, Turner & Townsend

Edinburgh Update: Heat Networks and LHEES

Hilary Dooley
LHEES Office

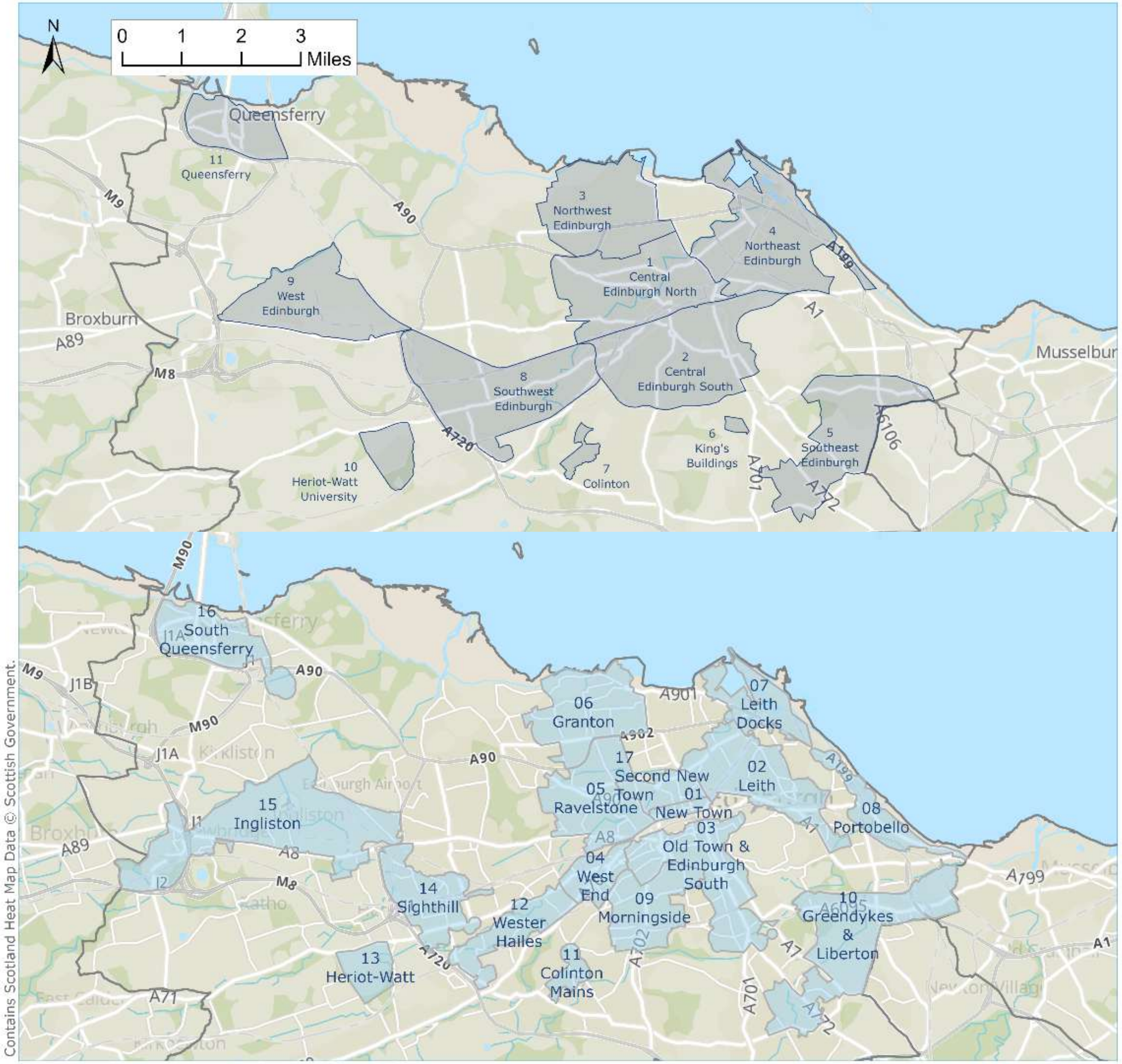
EDINBVRGH
THE CITY OF EDINBURGH COUNCIL

What is an LHEES?

- A **long-term** (20-25 years) **spatial strategy** for decarbonising heat in buildings and improving energy efficiency across Edinburgh that:
  - Sets out how each segment of Edinburgh's building stock needs to change.
  - Identifies "**strategic zones**" for heat decarbonisation within Edinburgh and sets out "pathways" for reducing the emissions of buildings in each zone.
  - Prioritises areas for delivery.
- Published December 2023, followed by public consultation, with **updates after five years**.

Heat network zones

- Original zones based on **LHEES methodology**
- Result of refinement to anchor load heat demands and the shape of zones
  - Avoid major/minor constraints
  - Avoid splitting estates and properties
- 17 zones reduced to **11 zones**
- Refined zonal heat demand of **3.5 TWh**
- Refined zonal anchor load count of 515



Prospective heat network zones

Edinburgh and Lothians boundaries

LHEES prospective heat network zones

Contains National Statistics data © Crown copyright and database right 2024.
Contains Scotland Heat Map Data © Scottish Government.

This map presents a snapshot using the most recent data available. It should be read with the limitations and assumptions provided in the report.

Figure Title:
Prospective heat network zones and LHEES prospective heat network zones

Client:
EDINBVRGH
THE CITY OF EDINBURGH COUNCIL

Project:
Strategic Heat Network Analysis

Project Number: PGB0900002386

Status: Final

Version: 3

Date: 26/02/2025

Prepared by: Calum Mehay, Max Leeson
Checked by: Jess Grant, Hassan Waheed

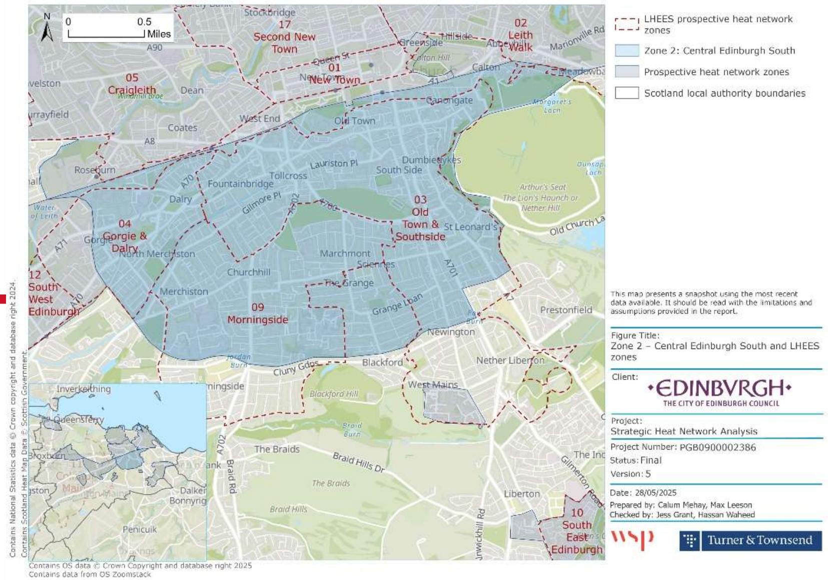
wsp   Turner & Townsend

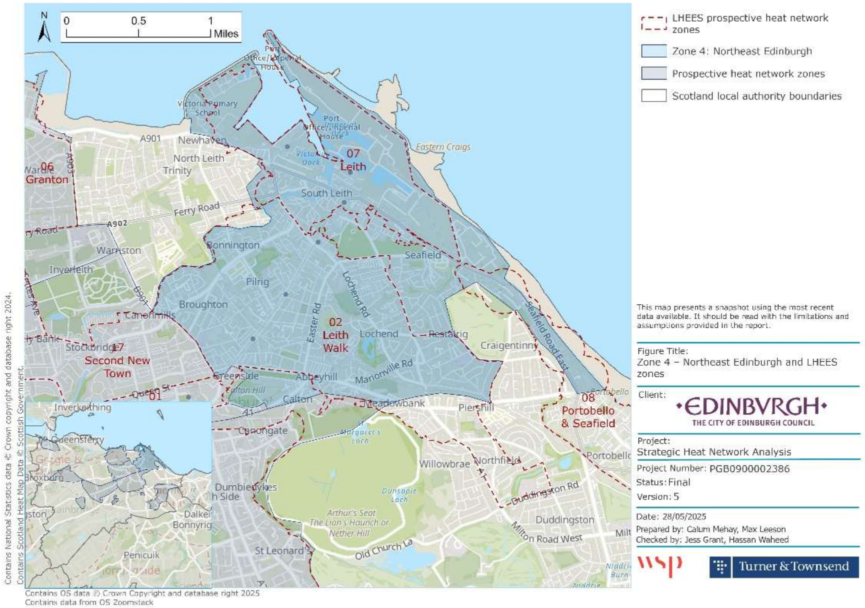
Contains OS data © Crown Copyright and database right 2025
Contains data from OS Zoomstack, Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS

Heat networks

- Formally **designate Heat Network Zones** in line with statutory process (pending government guidance).
- Determine optimal corporate heat network **delivery model** for the Council.
- Register Council's communal heating systems with Ofgem and **ensure regulatory compliance**.
- **Feasibility studies** – range of scale and technologies.


Inch View Care Home
Liberton Primary School
Glenallan Dr


LHEES prospective heat network zones
Zone 2: Central Edinburgh South
Prospective heat network zones
Scotland local authority boundaries
This map presents a snapshot using the most recent data available. It should be read with the limitations and assumptions provided in the report.
Figure Title:
Zone 2 – Central Edinburgh South and LHEES zones
Client:
EDINBVRGH
THE CITY OF EDINBURGH COUNCIL
Project:
Strategic Heat Network Analysis
Project Number: PGB0900002386
Status: Final
Version: 5
Date: 28/05/2025
Prepared by: Calum Mehay, Max Leeson
Checked by: Jess Grant, Hassan Waheed
wsp
Turner & Townsend
Contains OS data © Crown Copyright and database right 2025
Contains data from OS Zoomstack
Contains National Statistics data © Crown copyright and database right 2024.
Contains Scotland Heat Map Data © Scottish Government.


LHEES prospective heat network zones
Zone 4: Northeast Edinburgh
Prospective heat network zones
Scotland local authority boundaries
This map presents a snapshot using the most recent data available. It should be read with the limitations and assumptions provided in the report.
Figure Title:
Zone 4 – Northeast Edinburgh and LHEES zones
Client:
EDINBVRGH
THE CITY OF EDINBURGH COUNCIL
Project:
Strategic Heat Network Analysis
Project Number: PGB0900002386
Status: Final
Version: 5
Date: 28/05/2025
Prepared by: Calum Mehay, Max Leeson
Checked by: Jess Grant, Hassan Waheed
wsp
Turner & Townsend
Contains OS data © Crown Copyright and database right 2025
Contains data from OS Zoomstack
Contains National Statistics data © Crown copyright and database right 2024.
Contains Scotland Heat Map Data © Scottish Government.

Hacking Heat Networks

- Exploring options for **PPAs** with green electricity providers.
- **Partnership** – stakeholder development, relationship building.
- Investigating opportunities to participate in the **flexibility market**.
  - Modelling large thermal store
- **Co-location** conversations with small scale data centres.
- Heat source – **location, scale, assurance**.
- Understanding the options for fossil fuel use for **peaking and back-up**.

The dials

Heat demand

Density
Scale
Certainty

Heat source

Reliability
Scale
Carbon

Proximity

Distance
Geography

Trust

Reputation
Policy
Performance

Land

Availability
Costs
Risks

Routes

Constraints
Space
Optimisation

Temperature

Compatibility
Seasonal
Legal

Electricity

Connection
Costs
Exposure

Supply chain

Design
Construction
Operation

v2

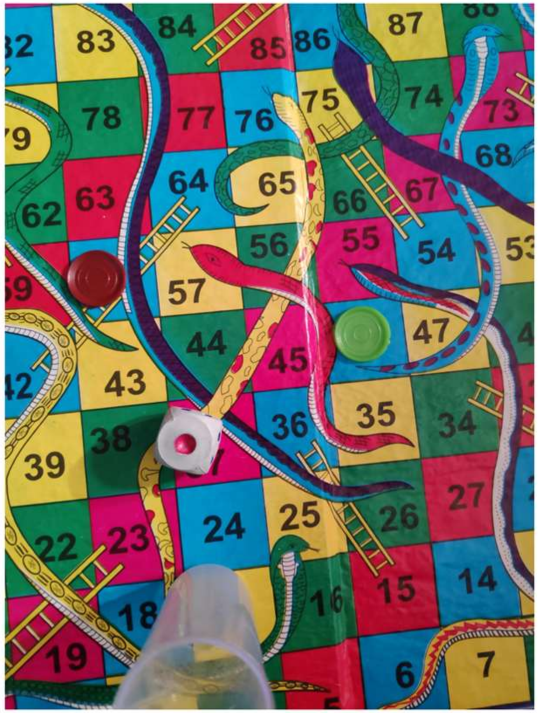
The traps

Most heat network opportunities are not ‘dialled in’, which is often discovered too late.

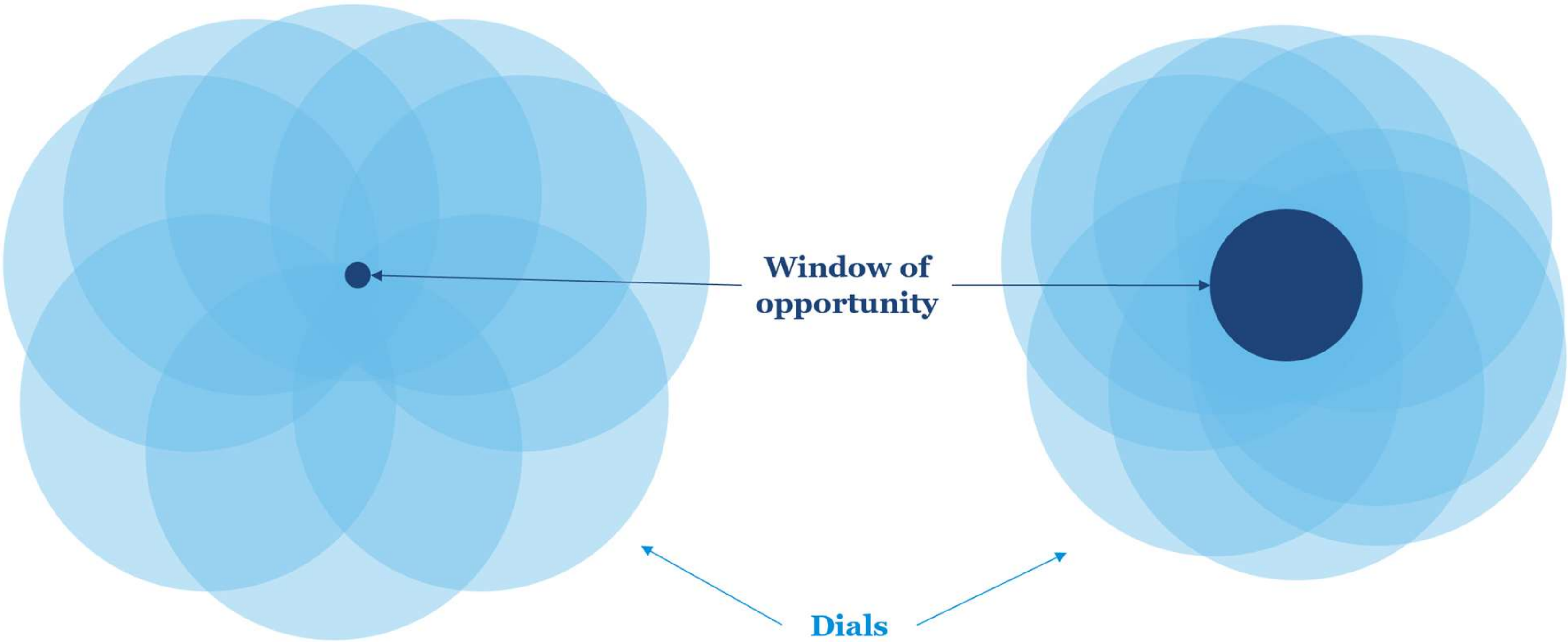
No one answer, location-specific settings

All dials impact the others

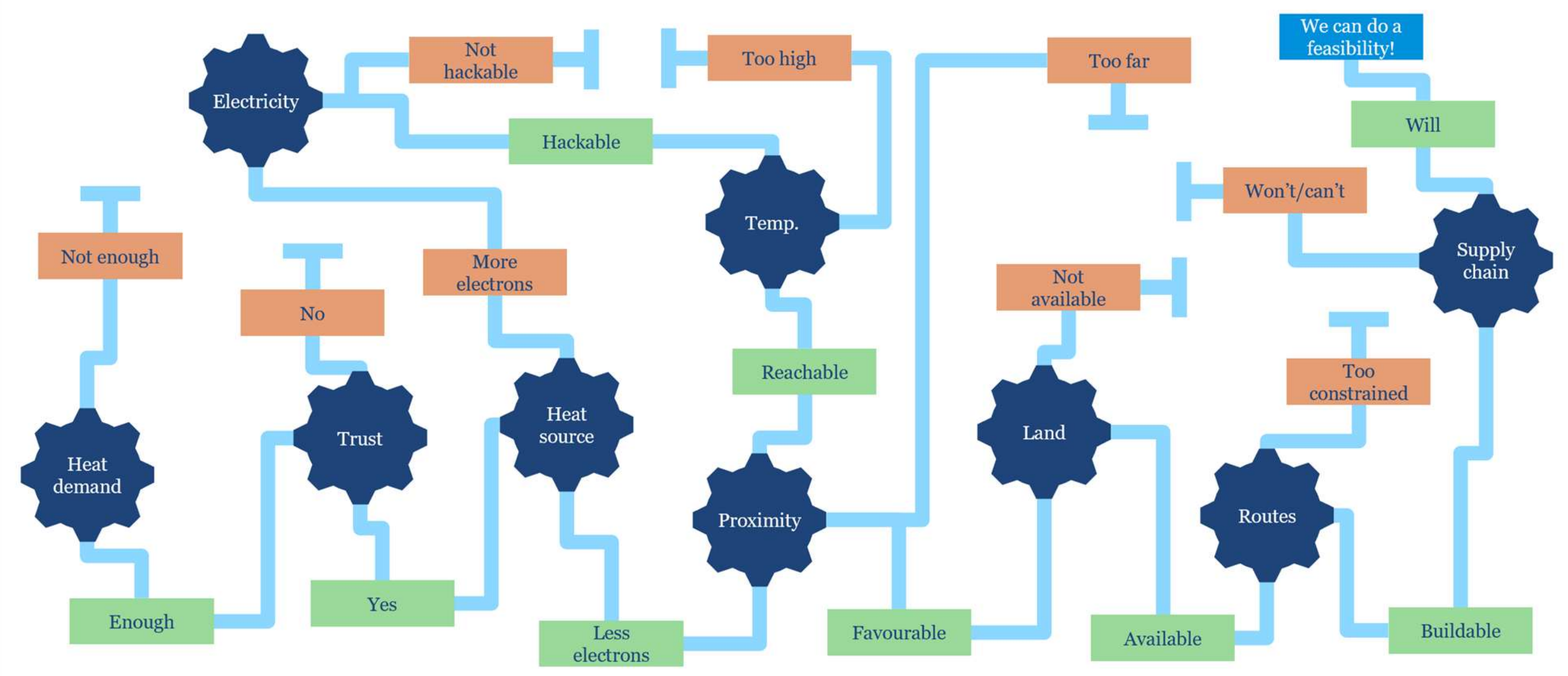
Tweak dials to open a narrow window, if any



Expanding the window



Heat network route



CIBSE Scotland

Keynote Speech

Ken Gordon

DESNZ Technical Standard for Ambient Loops and Shared Ground Loops

and preview of CIBSE TM51

CIBSE
Inspiring people. Transforming places.

Presentation to CIBSE Scotland
Wednesday, 27th May 2026

Ken Gordon

Chief Technology Officer - Ambient Loops and Shared Ground Loops

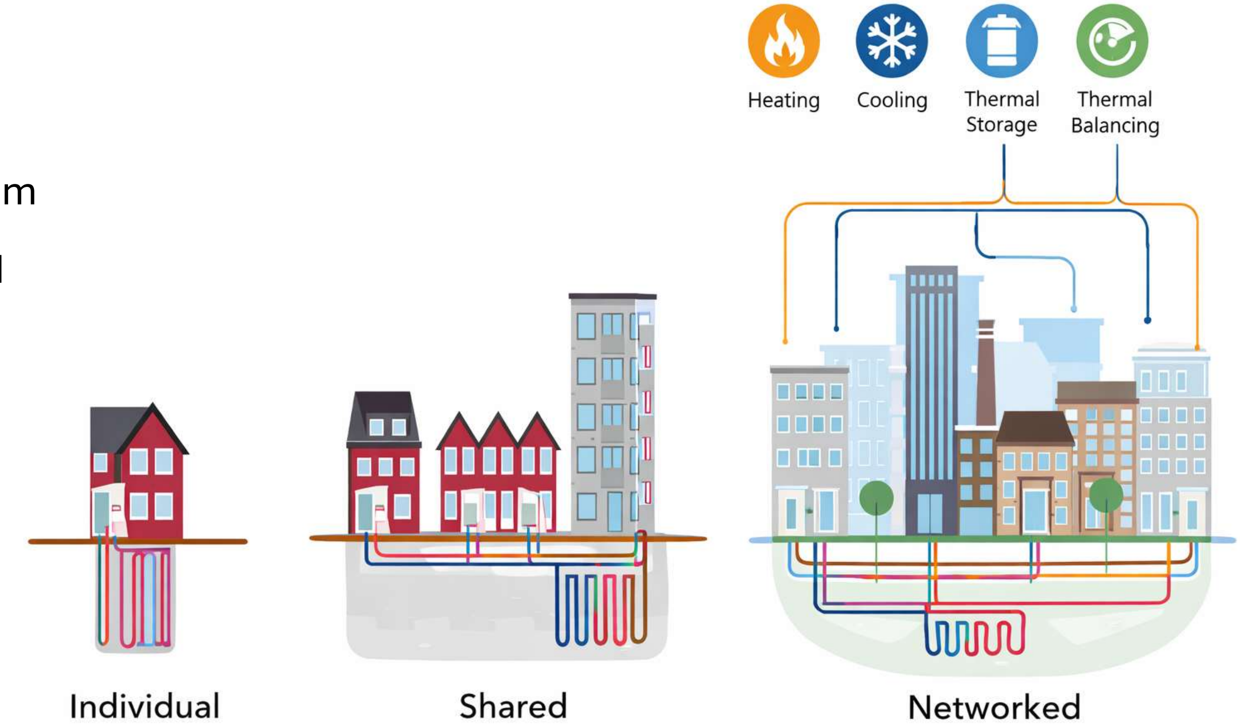
Founder Member – Heat Network Scotland

ade
Heat Networks

The Direction of Travel

From individual heat pumps to scalable thermal infrastructure

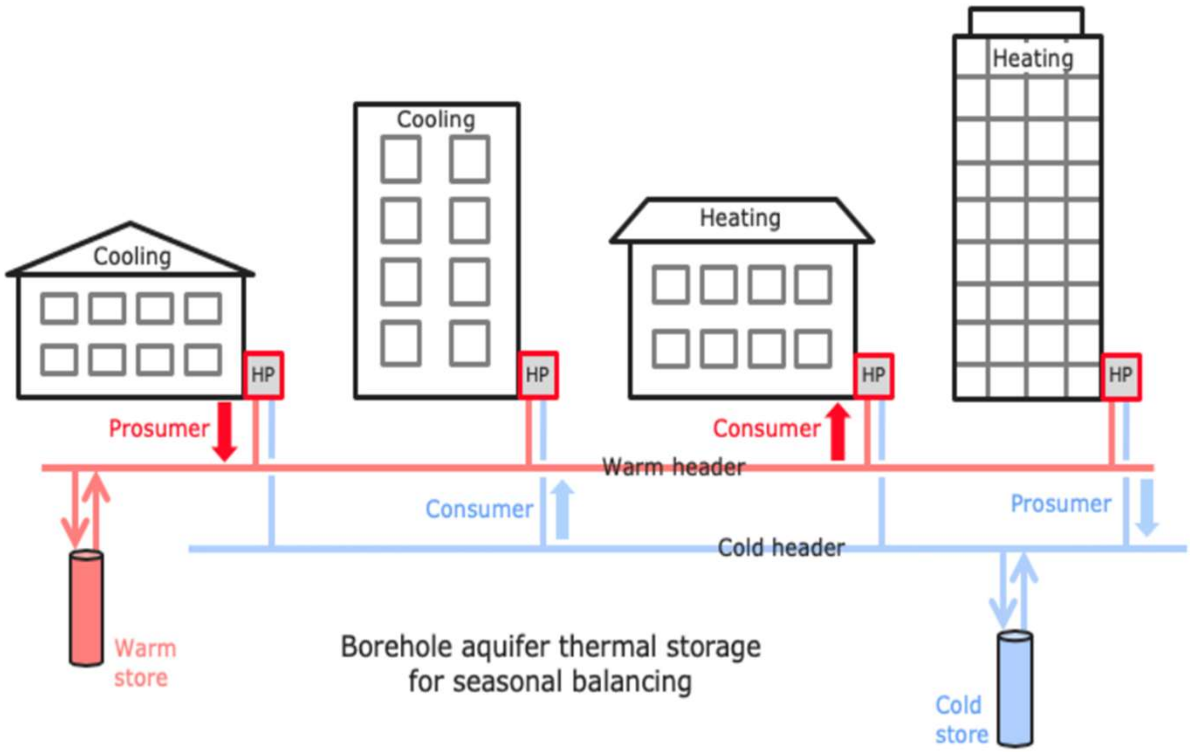
1. Why shared thermal infrastructure changes what the solution can be
2. Why it matters to the wider energy system
3. Why it changes delivery, ownership, and financing
4. What this means for Scotland & the UK



Ambient Networks as Shared Thermal Infrastructure

One loop can connect heating, cooling, storage and multiple building loads

- A shared low-temperature loop serves multiple buildings
- Each building still uses its own local heat pump
- Heating, cooling, and storage can all be integrated on the same network
- This starts to behave like shared infrastructure, not isolated building plant

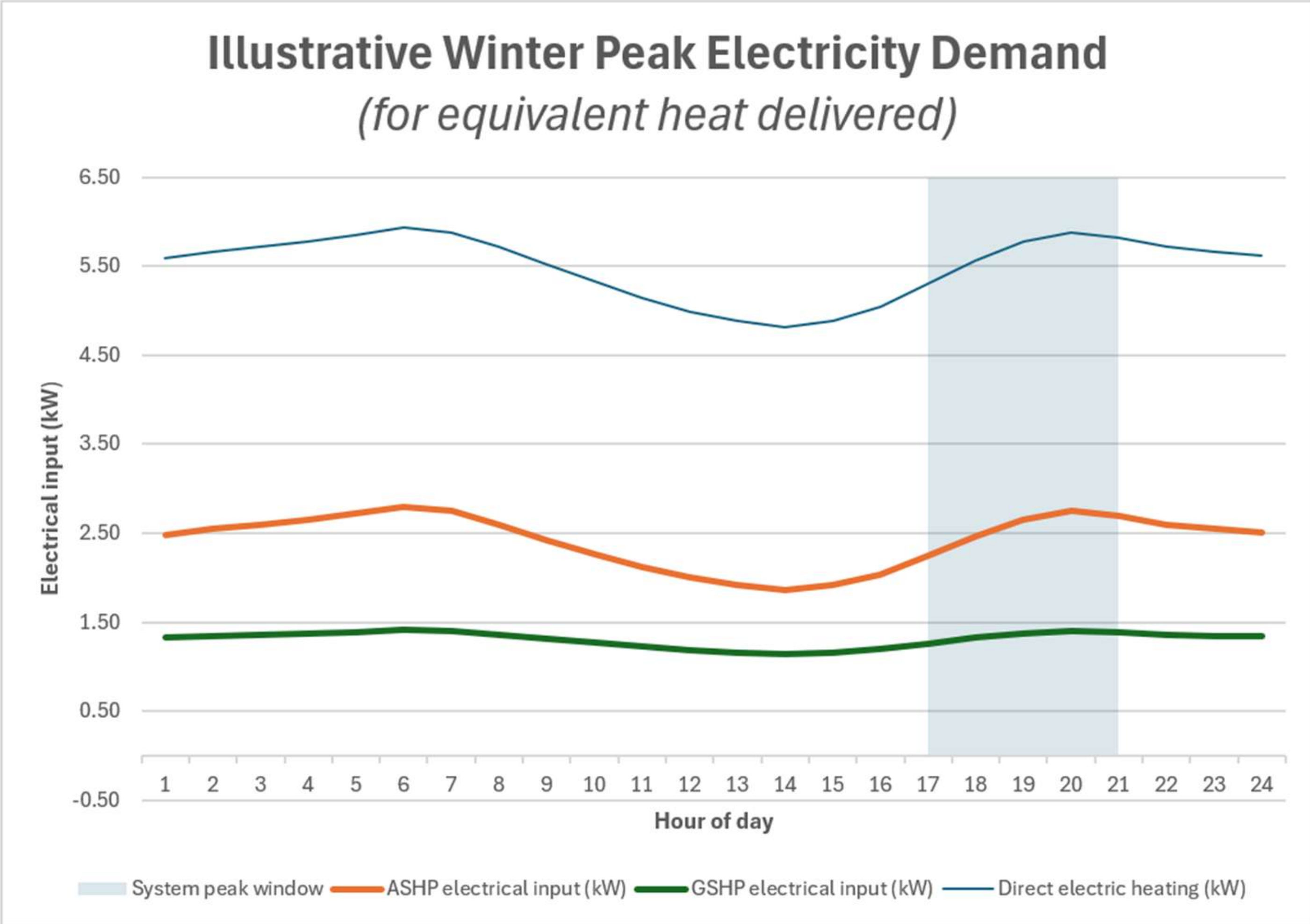


© CIBSE epg - Phil Jones

Grid Stability and Winter Peak Demand

Electric grids are built for peaks, not averages

- Grids are designed around peak load, not yearly energy use
- Cold-weather heating can drive the system at exactly the wrong time
- Ground-coupled systems can reduce peak electrical demand



Illustrative model © Ken Gordon, based on equivalent delivered heat and indicative COP assumptions

Shared Ground Loops as Infrastructure

Once the ground is shared, the model changes

- The energy source is no longer tied to one building
- Loads can be diversified across multiple users
- The shared ground loop becomes a long-life thermal asset

© Kensa UK

From Engineering Solution to Utility Infrastructure

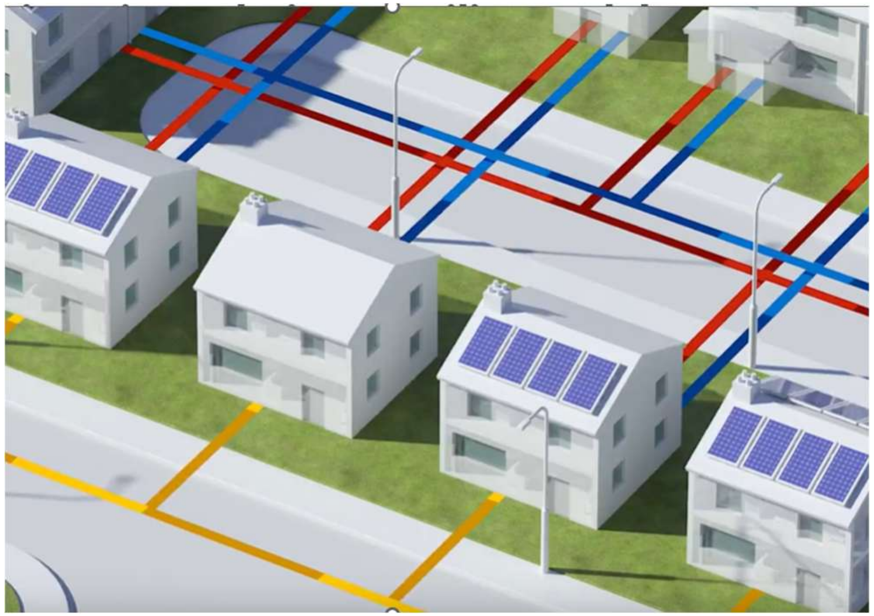
Why regulation becomes critical for scalable thermal infrastructure

Network owners become utility-like organisations:

- Demand assurance for investors
- Standardised technical performance
- Consumer protection

Resulting in:

- Defined long-life asset ownership
- Reduced investor risk
- More predictable revenue
- Lower cost of capital



© Kensa UK

The UK Legislative Framework

How UK policy becomes enforceable market structure

UK Government – Department of Energy Security and Net Zero (DESNZ)
Scottish Government – Housing Portfolio (Heat in Buildings & Heat Networks)
(Policy)

↓

Energy Act 2023
(Law)

↓

Office of Gas and Electricity Markets (Ofgem)
(**Regulator of market framework)**

↓

Heat Network Technical Assurance Scheme (HNTAS)
(Assures technical compliance)

↓

Technical Specifications & Assessment Procedures

(Define what good looks like)

Heat Network Technical Standards

From guidance to regulated technical assurance

“will act as the primary technical reference point for the Heat Network Technical Assurance Scheme”

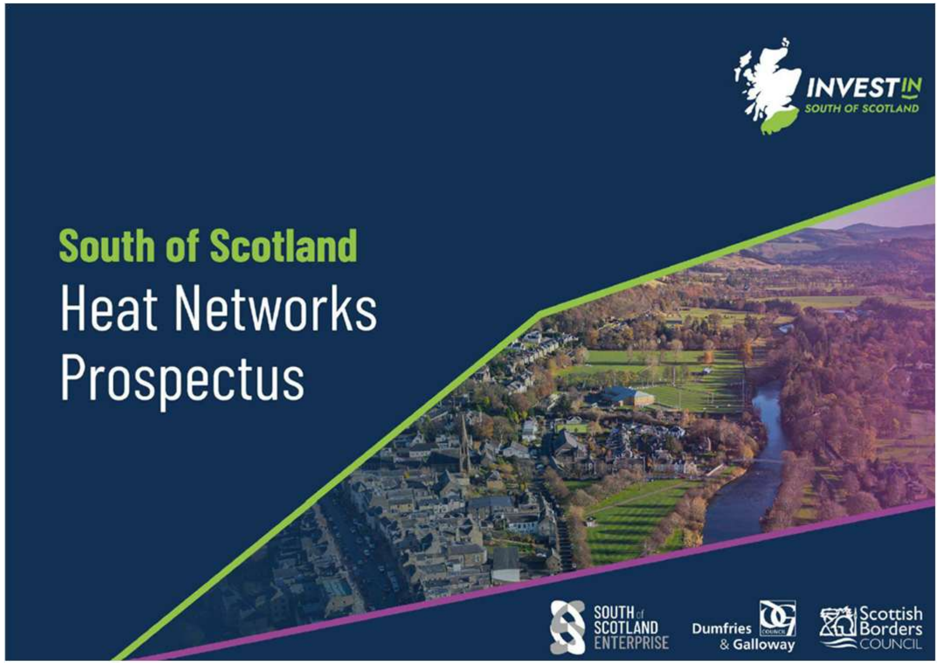
TS1 is the core technical standard underpinning regulated heat network delivery in Great Britain

Current work is extending that framework to include Shared Ground Loops and Ambient Heat Networks

Rural Scotland – Heat Network Opportunity

A route beyond city-centred heat networks

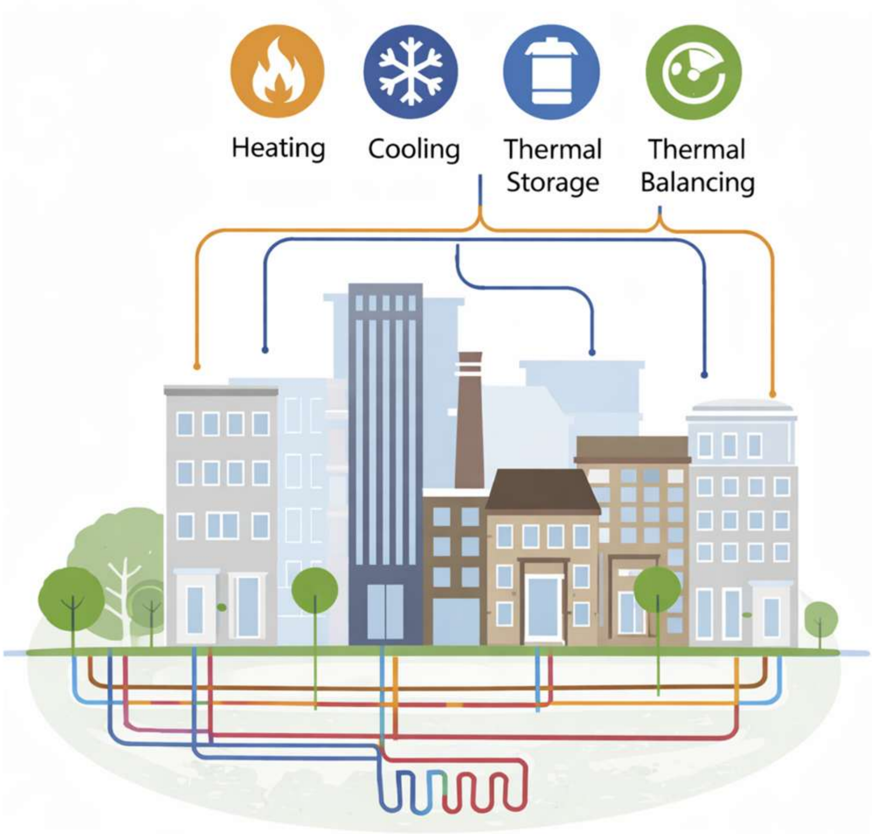
- SOSE has identified heat networks as a strategic regional opportunity
- Rural and small-town Scotland often falls between individual systems and conventional district heating
- Shared ground loops and ambient networks can bridge that gap
- This creates a route to decarbonisation beyond major urban centres



Why This is Becoming Investable Infrastructure

The elements required for scaling are no longer theoretical

1. The engineering model is proven
2. Government policy is increasingly supporting investment confidence
3. The commercial logic is compelling
4. Demand assurance supports the investment case

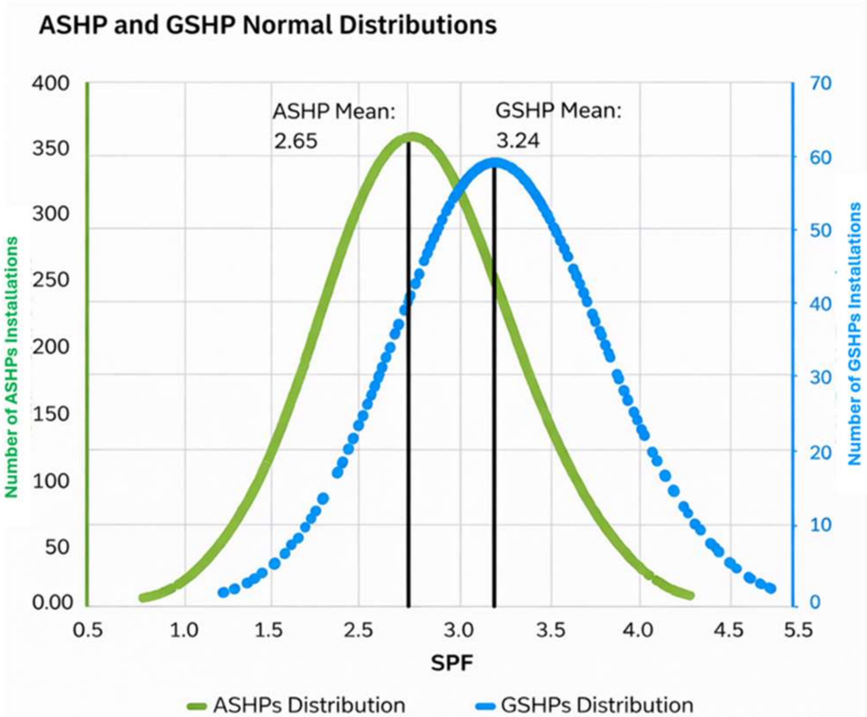


CIBSE TM51

Ground & Water Source Heat Pumps

Executive Author: Ken Gordon

- Full re-write of CIBSE's principal UK guidance for GSHP and WSHP systems
- Establishes engineering framework for Shared Ground Loops and Ambient Heat Networks
- Integrates heating, cooling, thermal storage and seasonal performance methodology
- Supports grid resilience, demand reduction and low-carbon infrastructure delivery
- Aligns with emerging UK heat network regulation and HNTAS direction



In-Situ SPF Distributions for Air Source and Ground Source Heat Pumps
(Meek, 2024)

Scotland and the Future of Thermal Infrastructure

From early heat pump innovation to scalable thermal infrastructure

Foswell Estate, Perthshire, Scotland

Underlying thermodynamic principles were established earlier by William Thomson (Lord Kelvin), University of Glasgow.

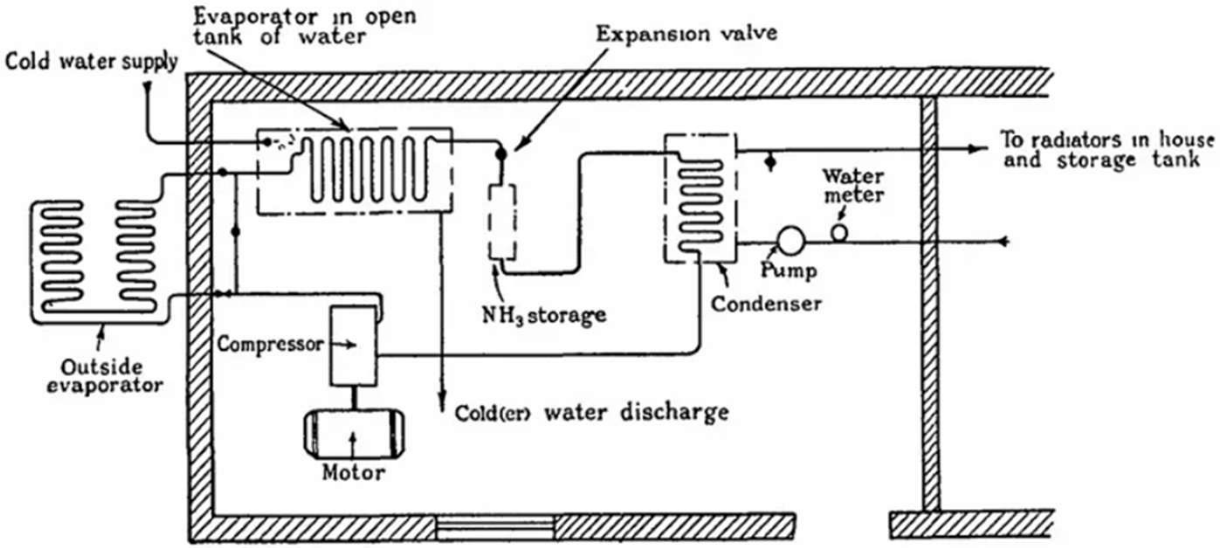


FIG. 6.—Experimental plant installed in author's home.

Haldane, T.G.N. (1930)
"The heat pump – an economical method of producing low-grade heat from electricity"
Journal of the Institution of Electrical Engineers, 68(401), pp. 666–683.

- To learn about CIBSE Special Interest Groups, visit: **cibse.org/sigs**
- To get involved with CIBSE, visit: **cibse.org/get-involved**
- To learn about CIBSE membership, visit: **cibse.org/join-cibse**
- To join the CIBSE Scotland committee, contact: **scotland@cibse.org**
- To become a CIBSE STEM Ambassador, visit: **cibse.org/get-involved/cibse-stem-ambassadors**
- Follow us: **www.linkedin.com/company/cibse-scotland**

Scotland

Scotland

Presentation

Ken Brady

Heat Networks Specialist

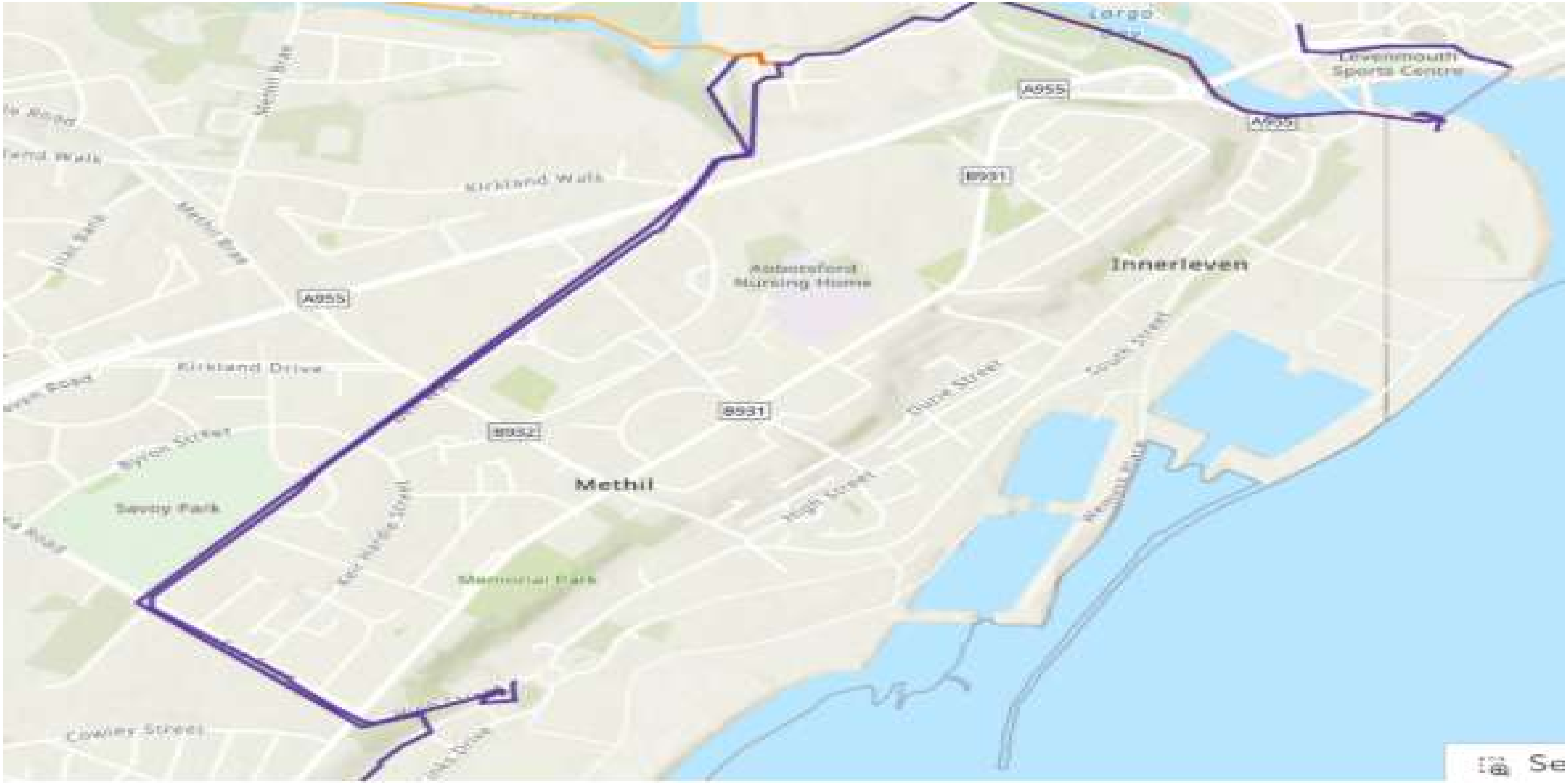
District Heating in Small Communities –
Levenmouth (Fife) Case Study

Ken Brady

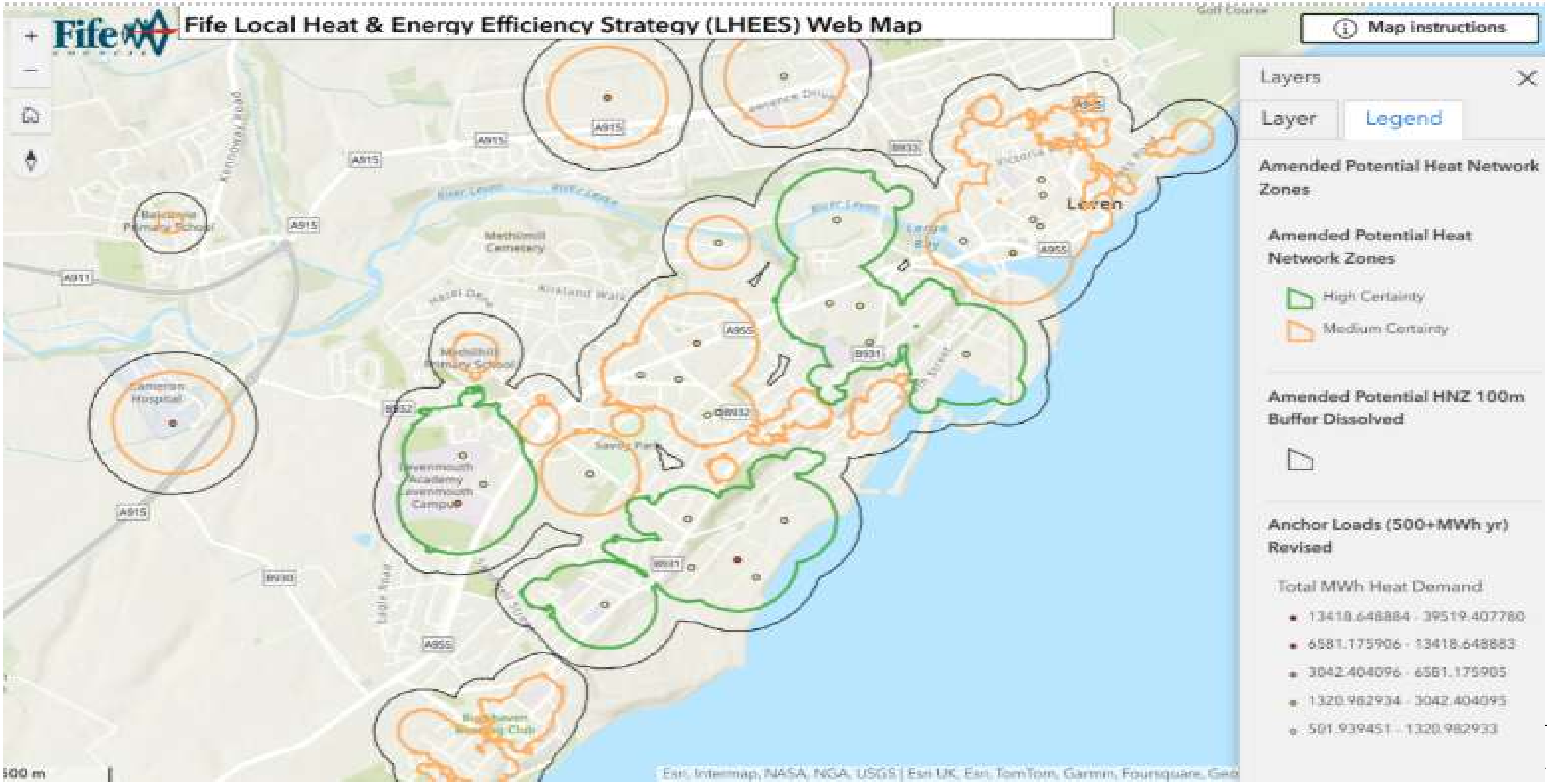
Danish Energy Agency

Levenmouth study area (Leven/Methil/Buckhaven)

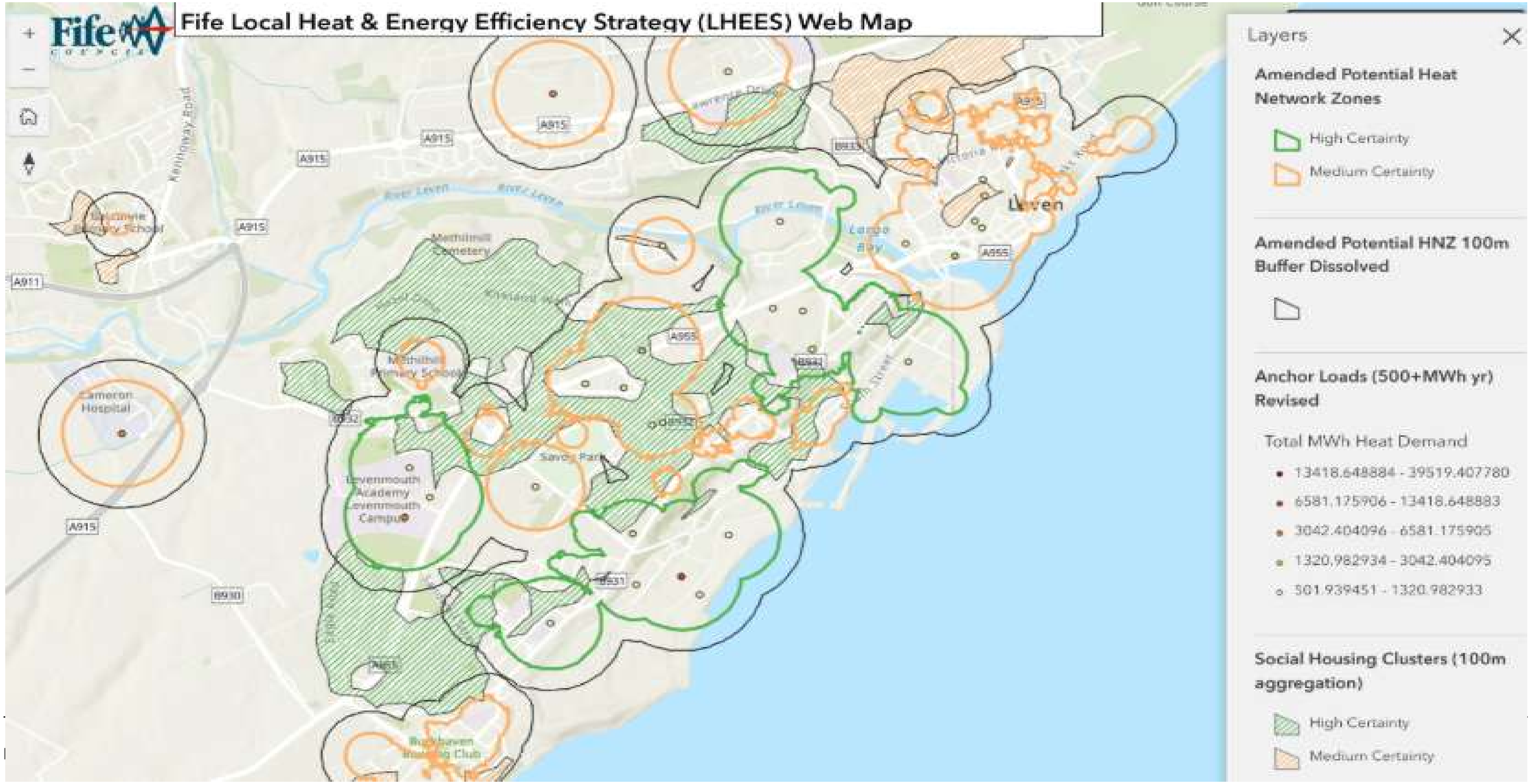
Additional heat source - sewage mains pipe



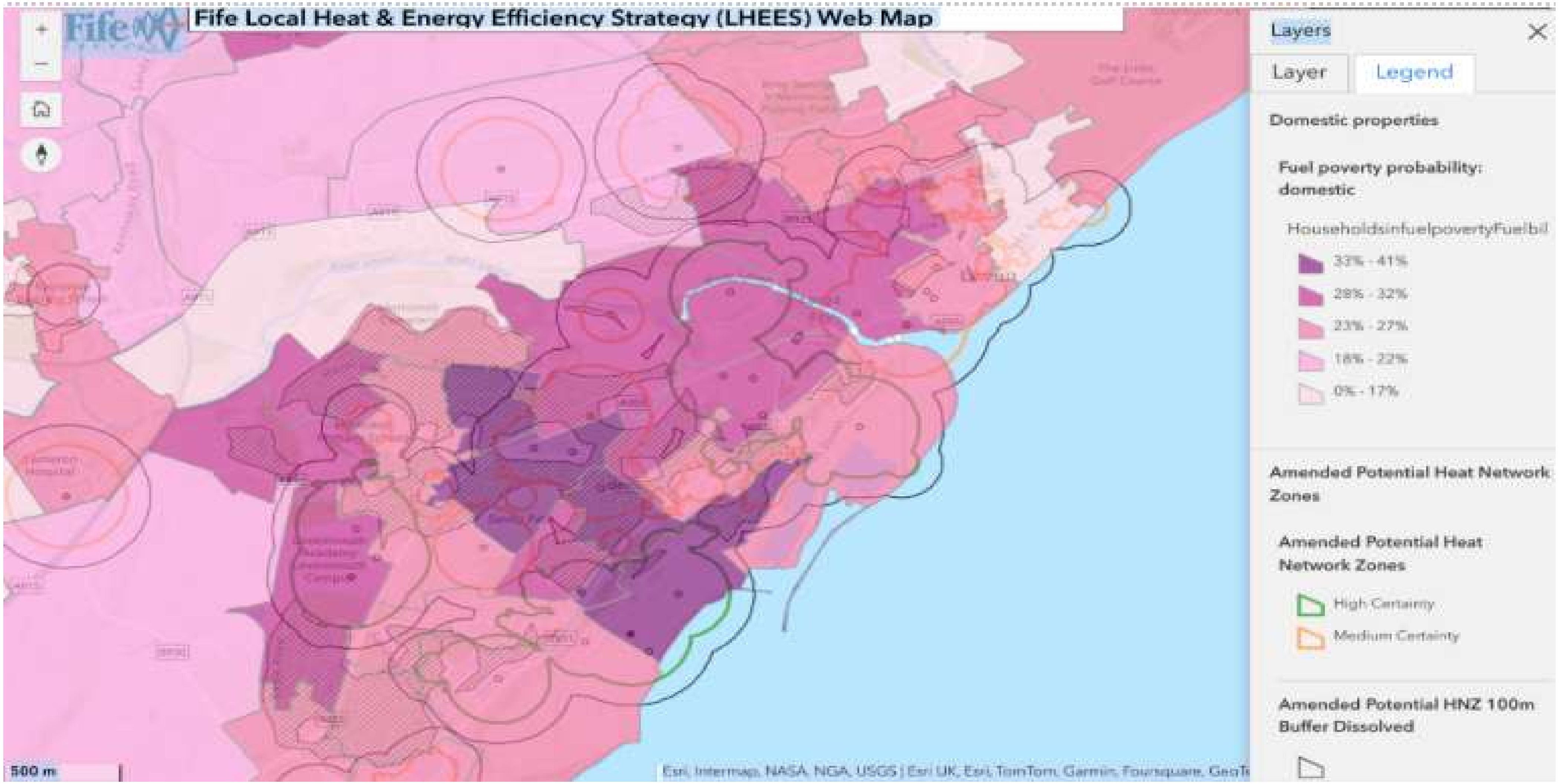
Revised heat network zones



Revised heat network zones – social housing



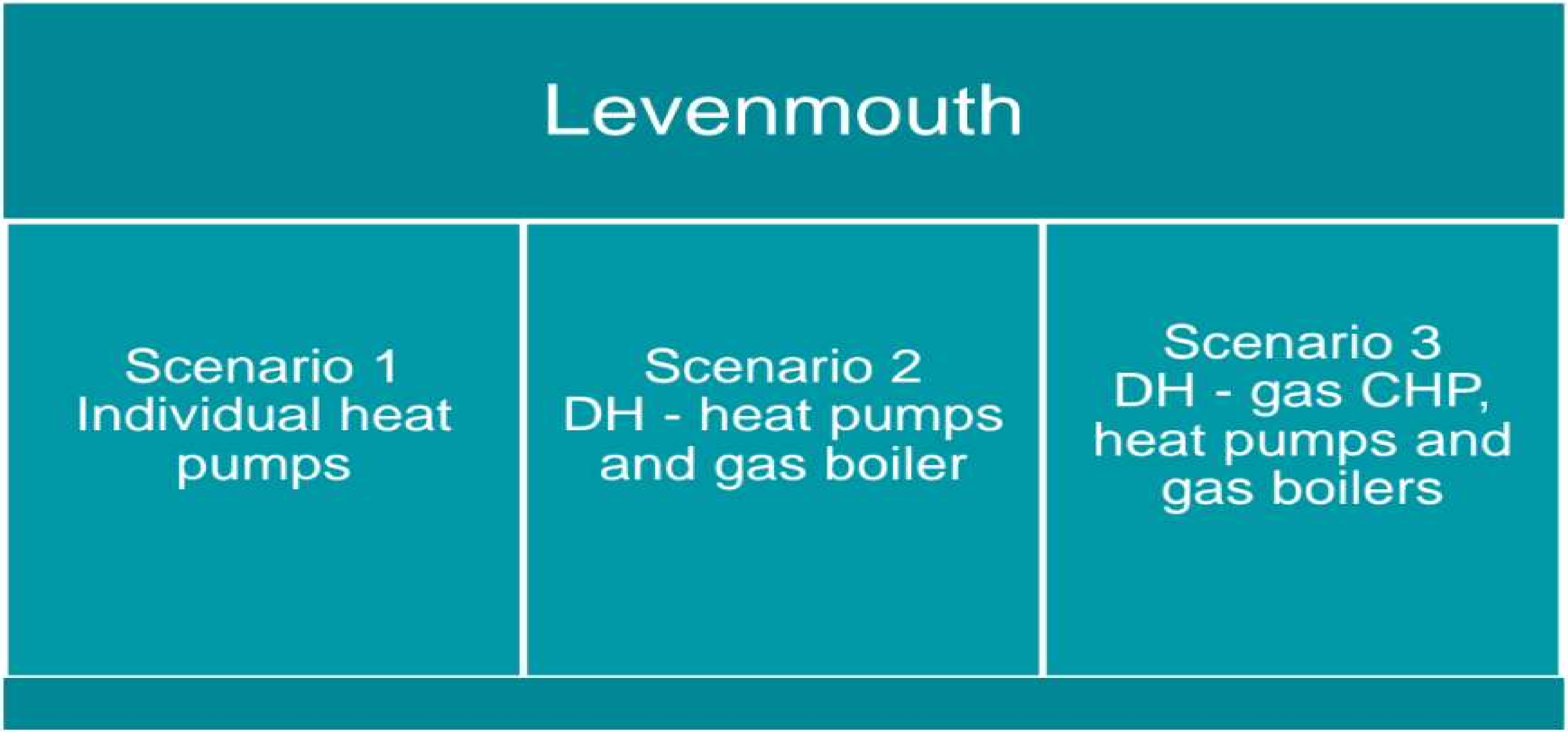
Revised heat network zones – fuel poverty



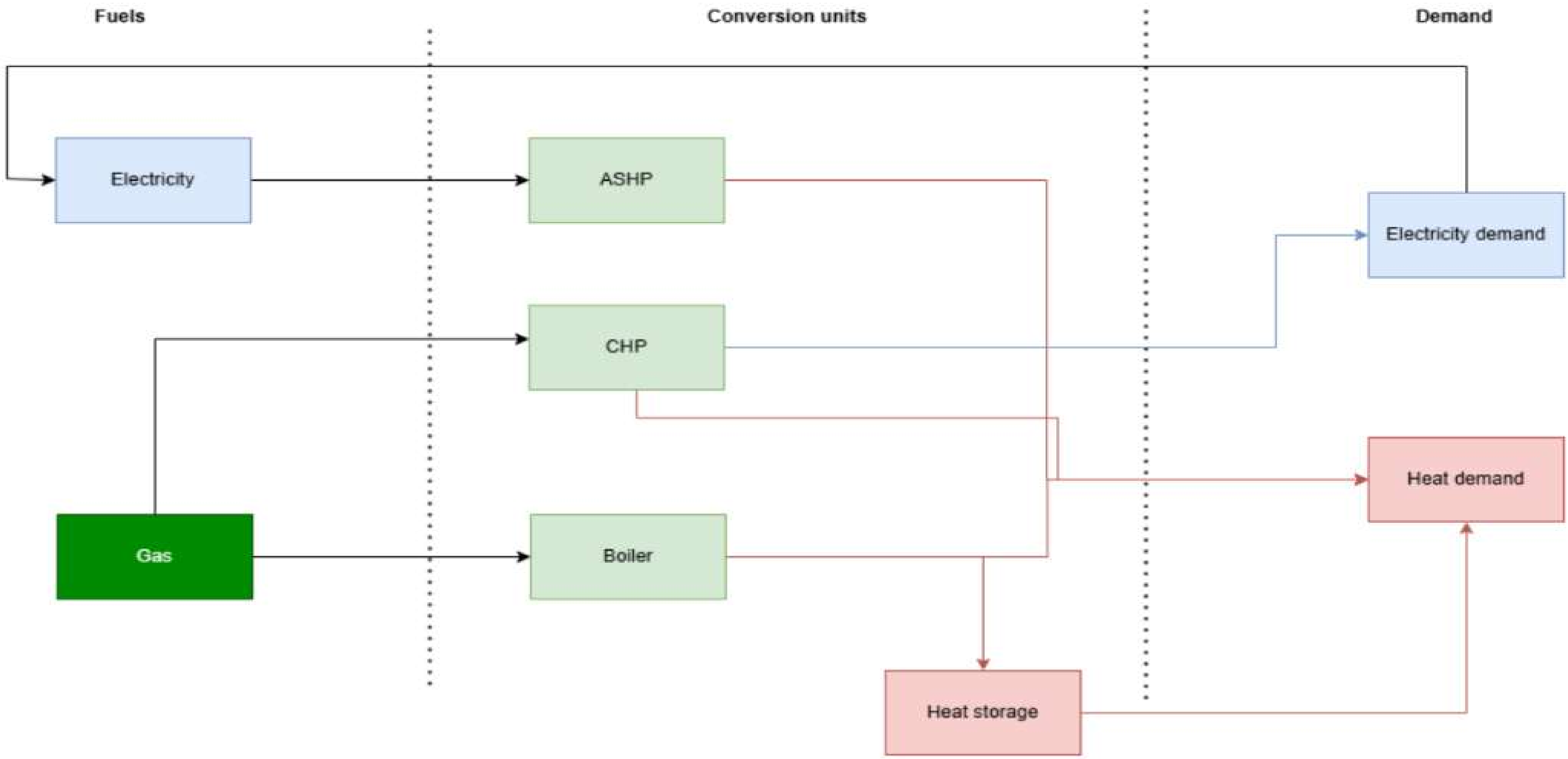
Scenario mapping – the Danish approach

- What is scenario mapping?
  - It is to investigate the different scenarios that could be relevant in a given area.
- Why do scenario mapping?
  - To create an overview of the different possibilities
- What is scenario mapping based on?
  - The scenarios that has been mapped is based upon the local situation – what is relevant in the local context. It will be based upon existing technologies and the lifetime and cost of these.
  - It is further affected by policy goals, technological possibilities, provision of affordable heat, and more.

Modelled scenarios for Levenmouth



Modelled scenarios – scenario 3 (best cost option)



Presentation

Kevin Waters

Challenges & Opportunities in Heat Network Delivery

Kevin Waters
Associate Director
Scottish Futures Trust

SCOTTISH FUTURES TRUST

HEAT NETWORKS SHOULD BE IN THE FIRST CONVERSATION

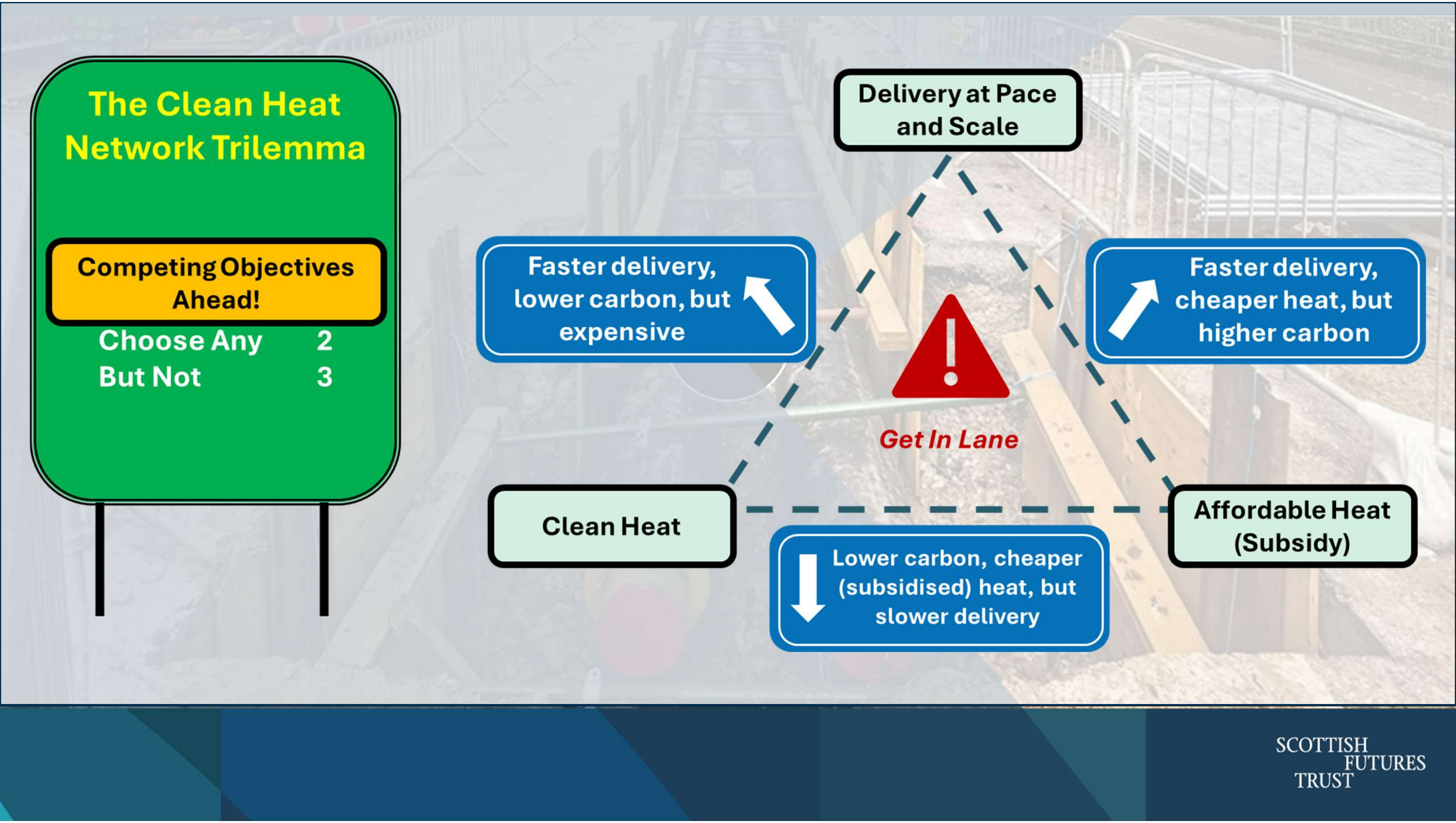
SCOTTISH FUTURES TRUST

HEAT NETWORKS SHOULD BE IN THE FIRST CONVERSATION

- Strategically important technology
- Technology agnostic
- Shares the decarbonisation challenge
- Anchor loads underpin networks

SCOTTISH FUTURES TRUST


DELIVERY IS CHALLENGING
Delivery at Pace and Scale
Faster delivery, lower carbon, but expensive
Faster delivery, cheaper heat, but higher carbon
Get In Lane
Clean Heat
Affordable Heat (Subsidy)
Lower carbon, cheaper (subsidised) heat, but slower delivery
SCOTTISH FUTURES TRUST


The Clean Heat Network Trilemma
Competing Objectives Ahead!
Choose Any 2
But Not 3
Delivery at Pace and Scale
Faster delivery, lower carbon, but expensive
Faster delivery, cheaper heat, but higher carbon
Get In Lane
Clean Heat
Affordable Heat (Subsidy)
Lower carbon, cheaper (subsidised) heat, but slower delivery
SCOTTISH FUTURES TRUST

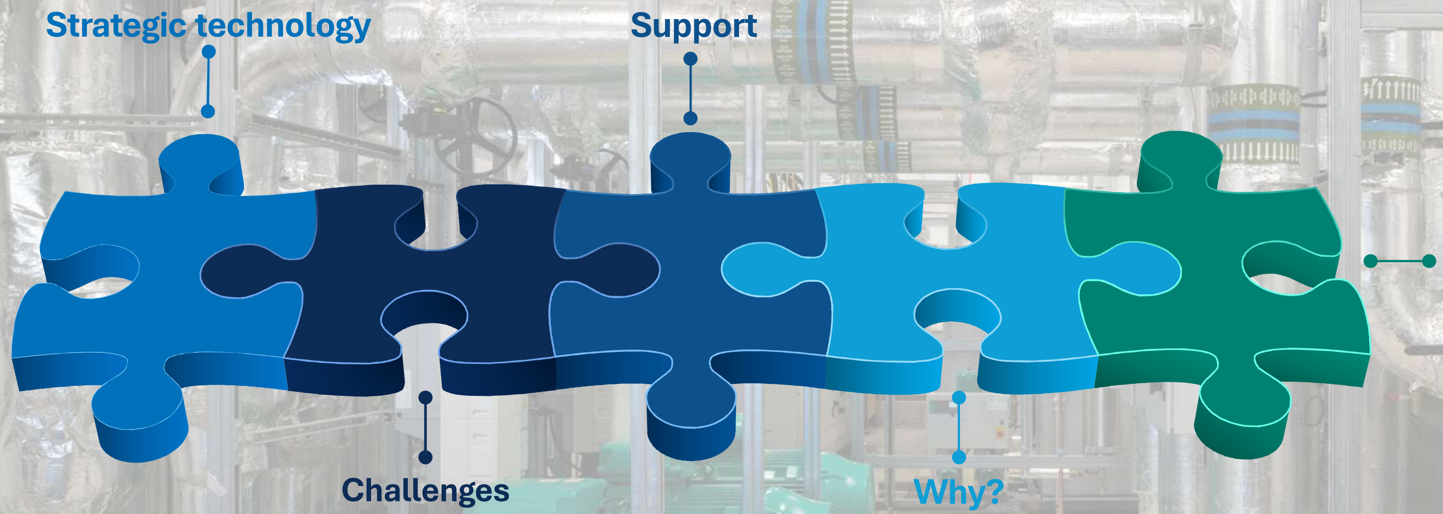
ADDRESSING THE CHALLENGE NATIONALLY

- Scottish Government's strategic review
  - regulation
  - standardised delivery models
  - supply mix assessment
- Scottish Heat Network Fund
- Heat Network Support Unit
  - strategic support
  - support approach in rural areas
  - local generation
  - waste heat

HOW YOU CAN HELP ADDRESS THE CHALLENGE

- Collaborate
- Plan early
- Challenge the default
- Flexibility
- Future proof

Summary



"Heat networks should be the first conversation - not an afterthought!"

kevin.waters@scottishfuturestrust.org.uk

SCOTTISH FUTURES TRUST

Workshops

Web version: See separate slides for facilitators’ workshop presentations

Conference Programme

Heat Network Scotland

A Home & A Voice for the Heat Network Sector in Scotland

Antoine Reguis (MBA, PhD)
Founding Director

CIBSE Scotland Conference, May 2026, Glasgow

Heat Network Scotland
Edinburgh Futures Institute
Office 2.73, 1 Lauriston Place,
Edinburgh, EH3 9EF

What is Heat Network Scotland?

Membership Registration

Heat Network Scotland (HNS)

A membership-based organisation bringing together industry, academia, communities, local and central government to support the development of heat networks and help create a **clean**, **affordable**, and **resilient** Scottish energy system.

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

Heat Network Scotland: 4 pillars

Membership Registration

100% focus on Heat Network sector

The Heat Network sector is broad enough to have its own home

Scottish context

Specific legislative, housing, and energy landscape

Trusted, independent, and strong voice

Robust legal structure, broad membership base, hosted in trusted institution

Sustainable funding model

Based mainly on membership fees

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

Meet the Team

Membership Registration

Directors

Steering group

Prof Jan Webb
Uni of Edinburgh
Chair of Board

Dr Antoine Reguis
Founding Director

Helen Melone
Melone Consulting
Founding Director
Policy

Ken Brady
Independent expert
Founding Director
Funding & Finance

Ben Carter
Vattenfall

Dave Pearson
Star Renewable Energy

Dr Natalie Bain-Reguis
Uni of Edinburgh

Dr Roddy Yarr
Uni of Glasgow

Simon Kerr
SAV Systems

Tom Warren
Innovate UK Business Connect

Heat Network Scotland

Meet the Team

Advisory group

Membership Registration

Prof Daniel Friedrich
University of Edinburgh
Chair of Energy systems

Rachel Fuller
Energy Skills Partnership

Dr Paul J Gilbert
South of Scotland Enterprise

Prof John Innes
CEO Dorsai SEP Ltd
Former Chair Space Scotland

Dr Fadi Kahwash
Edinburgh Napier University

Michael King
Former Dir. Aberdeen Heat & Power

Sarah Peterson
CIBSE Scotland

Jan Reid
Former Scottish Enterprise

Paul Steen
Steen Engine

Martin Whiteford
Anderson Strathern

Heat Network Scotland

Founding Members

Membership Registration

Funding
- Asper

Skills
- ESP
- Powering Futures

Heat network
(Design – Build – Operate)
- Aberdeen Heat & Power – Delivering affordable warmth to Aberdeen through district heat networks
- Colloide
- Energy assets
- Kensa
- Shetland Heat Energy & Power
- Vattenfall

Supply chain
- isoplus
- REHAU Water Technologies
- EnergiRaven
- SAV
- STAR Renewable Energy
- LOGSTOR
- guru systems
- Alfa Laval
- Zero Friction

Public sector
- Dumfries & Galloway Council
- Fife Council
- The Highland Council / Comhairle na Gàidhealtachd
- citizens advice scotland
- advice.scot

Heat supply and demand
- OCS
- APATURA

Expert & Consultant
- Anderson Strathern
- Melone Consulting
- FairHeat
- Ground Source Heat Pumps
- CIBSE
- Evinox – Smarter Heat Networks
- Changeworks
- Sustainable Estate Solutions (SES) Ltd
- Drees & Sommer
- Therma Mech
- Wilson Energy Ltd
- EREBUS
- scarf – support · inspire · develop · impact
- Reheat
- Turner & Townsend
- CMS law·tax·future
- Ener-Vate
- Sustainable Energy

Academic
- CeNZ-HighDB
- Edinburgh Napier University
- University of Aberdeen
- University of Strathclyde Glasgow
- The University of Edinburgh
- Heriot Watt University
- University of Stirling
- Heat and the City

Associate members
- Scottish Government / Riaghaltas na h-Alba / gov.scot
- Consumer Scotland / Luchd-Cleachdaidh Alba
- South of Scotland Enterprise

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

CeNZ-HighDB

Where are we?

Membership Registration

Edinburgh Futures Institute

Founding Members coming from all over Scotland

Heat Network Scotland

What we do

Key topics?

Communication
Just transition
Urban Planning
Interseasonal storage
Opex
Energy prices
Private investment
Price of heat
Pension funds
National Wealth Fund
Pollution
Esco
Design, Construction, and Operation of HN
Procurement chain
Policies
Open water
Building performance
Infrastructure
Profitability
Not for profit
Vision
Low Temperature Radiators
Bypass
ESG criteria
Fabric First
Zoning
Building Performance
Technical standards
Industry Strategy
Skill development
System's resilience
Heat sources
Heat uptake
Sustainability of heat source
Shallow Geothermal
Industrial waste heat
Workforce
Building standards
Urban Planning
Resilience
Sector Coupling
Low return
Occupant's behaviour
Low Temperature Heat
Private wire
Sea water
Public Buildings
Wastewater
Funding
Supply Temperature
Knowledge
Derisk investment
Industry Strategy
ROE
Carbon accounting
Grid Capacity
Fuel Poverty
Environmental footprint
Scottish National Investment Bank
Geothermal
Heat as a service
Fuel Poverty
Education
Capex
Cost of heat
Motivational tariff
Fabric First
Mine Water
LHEES
Industry Strategy
Esco
Interseasonal storage
Cooperative
Infrastructure
Cost of electricity
Heat pumps
Heat network readiness
Funding and Governance
Digitalisation of data
Just transition
ESG criteria
Industrial waste heat
Incineration
Community Engagement
Data Centre
Coefficient of Performance
Business Model
Monopoly
Policies, Regulations, Procurement
Co-benefits
Energy Efficiency
Customer protection
Raise visibility of sector
Communication
Energy system
Heat storage
Delta T
Depletion of gas resources
Private Sector
Digitalization
Deep Geothermal
Industry Strategy
Incineration
Underfloor Heating
Heat as a service
Energy prices
Deep retrofit
Security of data
Street disruption

Heat Network Scotland

What we do

Just transition

Urban Planning

Interseasonal storage

Opex

Energy prices

Private investment

Price of heat

Pension funds

National Wealth Fund

Pollution

Design, Construction, and Operation of HN

curement chain

Policies

Bypass

Esco

Open water

Building performance

Infrastructure

Profitability

Not for profit

Building Performance

Vision

ESG criteria

Fabric First

Zoning

Low Temperature Radiators

Technical standards

Industry Strategy

Skill development

System's resilience

Heat sources

Heat uptake

Sustainability of heat source

Shallow Geothermal

Industrial waste heat

Building standards

Urban Planning

Workforce

Sector Coupling

Resilience

Low return

Occupant's behaviour

Low Temperature Heat

Private wire

Sea water

Public Buildings

Supply Temperature

Wastewater

Funding

Knowledge

Fuel Poverty

ROE

Derisk investment

Industry Strategy

Grid Capacity

Carbon accounting

Environmental footprint

Geothermal

Scottish National Investment Bank

Heat as a service

Education

Fuel Poverty

Motivational tariff

Fabric First

Infrastructure

Capex

Mine Water

Industry Strategy

LHEES

Esco

Interseasonal storage

Cost of electricity

Cooperative

Heat network readiness

Heat storage

Heat pumps

Digitalisation of data

Cost of heat

Funding and Governance

ESG criteria

Just transition

Industrial waste heat

Incineration

Community Engagement

Data Centre

Customer protection

Coefficient of Performance

Business Model

Monopoly

Policies, Regulations, Procurement

Co-benefits

Energy Efficiency

Security of data

Energy system

Communication

Delta T

Incineration

Private Sector

Depletion of gas resources

Heat as a service

Digitalization

Industry Strategy

Deep Geothermal

Deep retrofit

Underfloor Heating

Energy prices

Street disruption

Working Groups

Heat Network Scotland

Urban Planning
- LHEES
- Street disruption
- Urban Planning
- Zoning
- Public Buildings

Digitalisation of data
- Digitalization
- System's optimisation
- Security of data

Industry Strategy
- Depletion of gas resources
- Procurement chain
- Resilience energy system
- Vision

Heat sources
- Coefficient of Performance (COP)
- Data Centre
- Geothermal (Deep / Shallow)
- Heat pumps
- Heat storage
- Incineration
- Industrial waste heat
- Mine Water
- Open water
- Sea water
- Wastewater

Policies, Regulations, Procurement
- Monopoly
- Policies
- Price of heat
- Private wire

Building Performance
- Building standards
- Bypass
- Deep retrofit
- Delta T
- Energy Efficiency
- Fabric First
- Heat network readiness
- Low Temperature Heat
- Motivational tariff
- Occupant's behaviour
- Underfloor Heating

Funding and Governance
- Derisk investment
- Esco
- National Wealth Fund
- Not for profit
- Pension funds
- Private investment
- Private Sector

Energy system
- Cost of electricity
- Energy prices
- Grid Capacity
- Infrastructure
- Sector Coupling
- System's resilience

Just transition
- Co-benefits
- Community Engagement
- Cooperative
- Cost of heat
- Customer protection
- Fuel Poverty
- Heat as a service
- Justice by Design

Knowledge Hub
- Share best practice
- Pooling resources

Environmental footprint
- Carbon accounting
- ESG criteria
- Pollution
- Sustainability of heat source

Design, Construction, and Operation of HN
- Business Model
- Capex
- Heat uptake
- Opex
- Profitability
- ROE
- Technical standards

Communication
- Raise visibility of sector
- Knowledge exchange

Skill development
- Education
- Knowledge
- Workforce

Heat Network Scotland

Working Groups

16 working groups identified as key for heat network development

Engineering	Business, Social and political	Cross-cutting themes
Design - Construction - Operation of HN	Just Transition	Skill Development
Energy System	Funding and Governance	Communication
Heat Sources	Industry Strategy	Policies, Regulations, Procurement
Urban Planning	Voice of consumers	
Building Performance		
Environmental Footprint		
Digitalisation of Data		

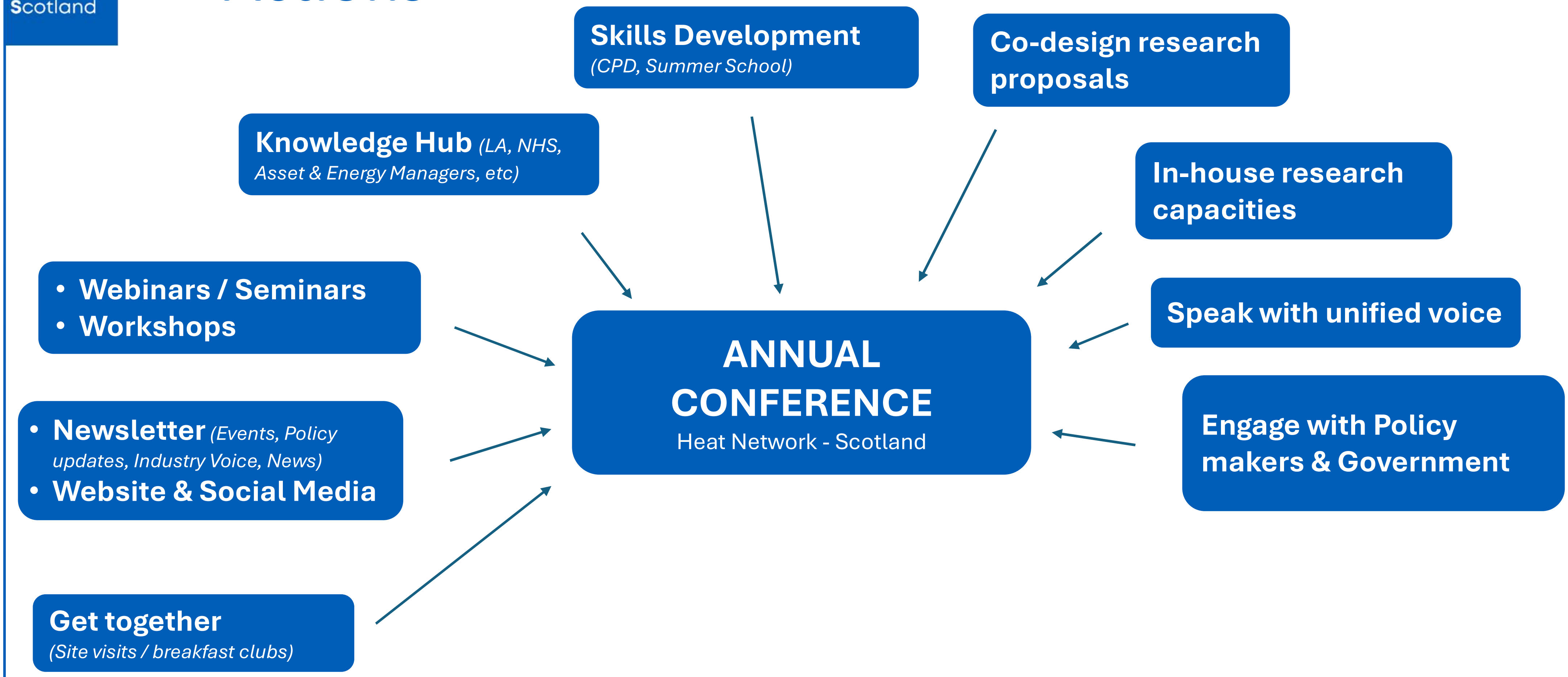
Knowledge Hub:
- Local Authorities
- Heat network owner & managers

Proposed first working groups…to be validated with founding members

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

Actions



A **Home** & A **Voice** for the Heat Network Sector in Scotland

Recent events and engagements

Raising awareness with elected members

A **Home** & A **Voice** for the Heat Network Sector in Scotland

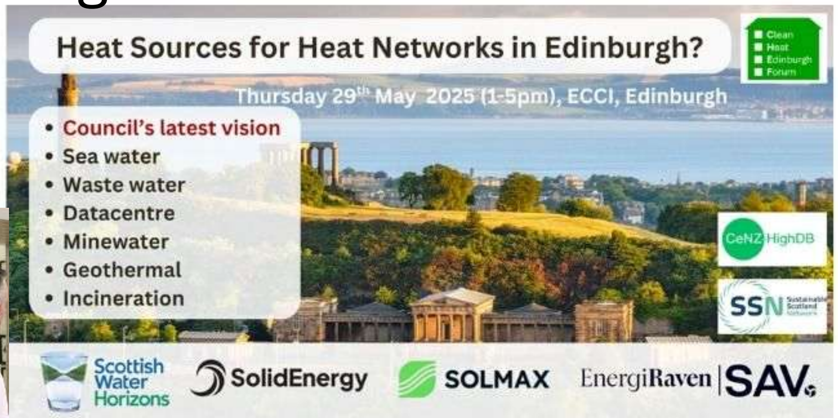
Recent events and engagements

Feedback on Draft Climate Change Plan (CCP)

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Recent events and engagements

Heat Sources for Heat Networks in Edinburgh



A **Home** & A **Voice** for the Heat Network Sector in Scotland

Policy (since March)

1 Letter (with Heat Trust) to the Scottish Government:

Request for a *Scottish Heat Network Efficiency Scheme (HNES)*

HEAT TRUST

2 Heat networks technical standards

Consultation: Introducing a Heat Network Technical Assurance Scheme (HNTAS)

3 

Helen Melone
Head of Policy

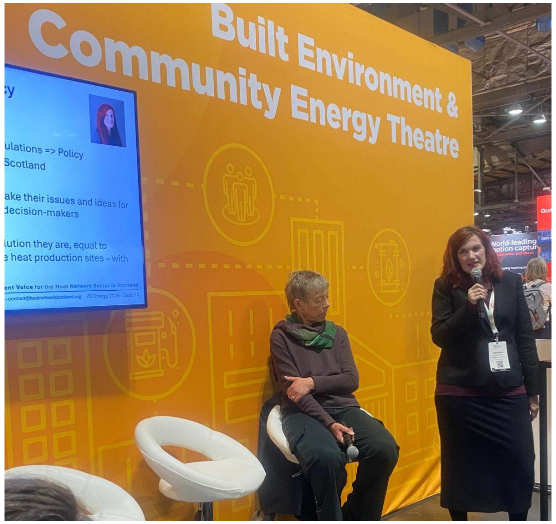
A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

All Energy 2026

3 Standing-room-only sessions

→ Heat Network Zone for 2027



A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

What next

Membership Registration

Pre-launch	January	*(21st) Heat Networks in Scotland (with Danish Embassy)* *(28th) Heat Network Scotland - First public (online) presentation*	
	February		
	March	*(31th) End of the window of opportunity to join as founding member*	
Launch	April	*First in-person workshop with founding members*	• Validation of mission, aims, values, and new visual identity with founding members. • Validation of ToR for WGs • Re-organisation of steering & advisory boards
	May	All-Energy (3 sessions) CIBSE Scotland conference	
	17th of June	Launch event (in-person, Edinburgh)	
	July-August		
Operational & Growth	September	Start of HNS's activities (Working groups, Knowledge hub, Webinars, Newsletter, sites visits, New visual identity, etc)	

A **Home** & A **Voice** for the Heat Network Sector in Scotland

Heat Network Scotland

Membership Registration

Heat Network Scotland

A Home & A Voice for the Heat Network Sector in Scotland

Antoine Reguis (MBA, PhD)

Founding Director

CIBSE Conference, May 2026, Glasgow

Heat Network Scotland
Edinburgh Futures Institute
Office 2.73, 1 Lauriston Place,
Edinburgh, EH3 9EF

Presentation

Simon Kerr

Heat Networks: Creating a Just Transition

Simon Kerr
Head of Heat Networks, Scotland and NI
simon.kerr@sav-systems.com
07768 760515

Working with leading technology partners

- Optimum efficiency, lowest energy cost

SAV

Metering Solutions

kamstrup

Hydronic Solutions

Danfoss

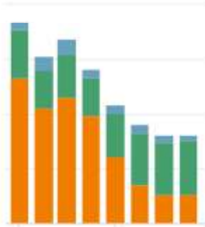
Next Generation
Large dT Heat Pumps

DELTA

THERMONOVA VARMEPUMPER

Mechanical ventilation
and heat recovery

AIRMASTER®



Energy Monitoring &
Management

EnergiRaven

Electric Boilers

DELTA

VÄRMEBARONEN

Hydronic Solutions

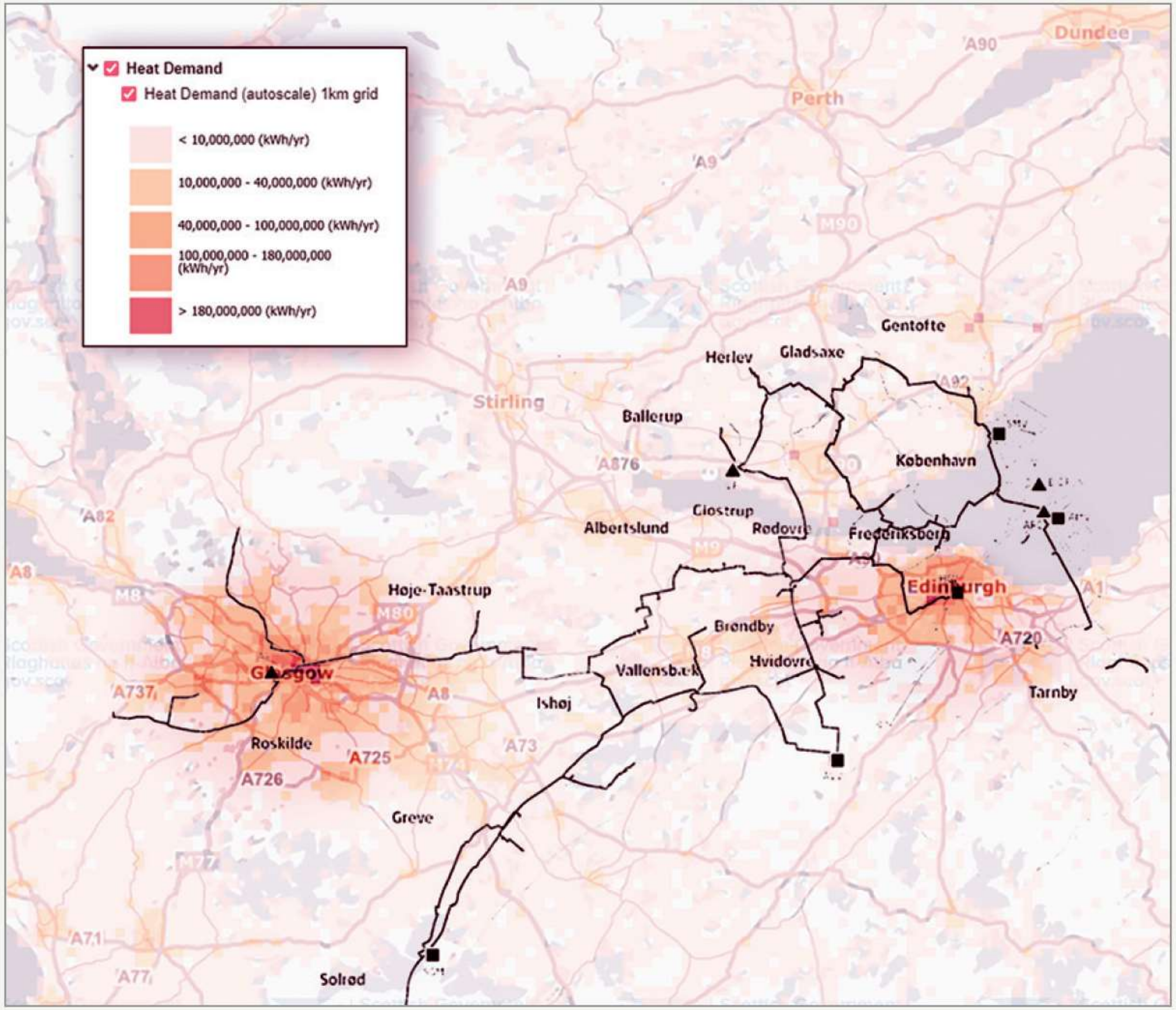
FloCon Watchman

Heat network billing
solutions

KURVE TECHNOLOGIES

CHP, heat pumps &
electric boilers

HYBRID ENERGI



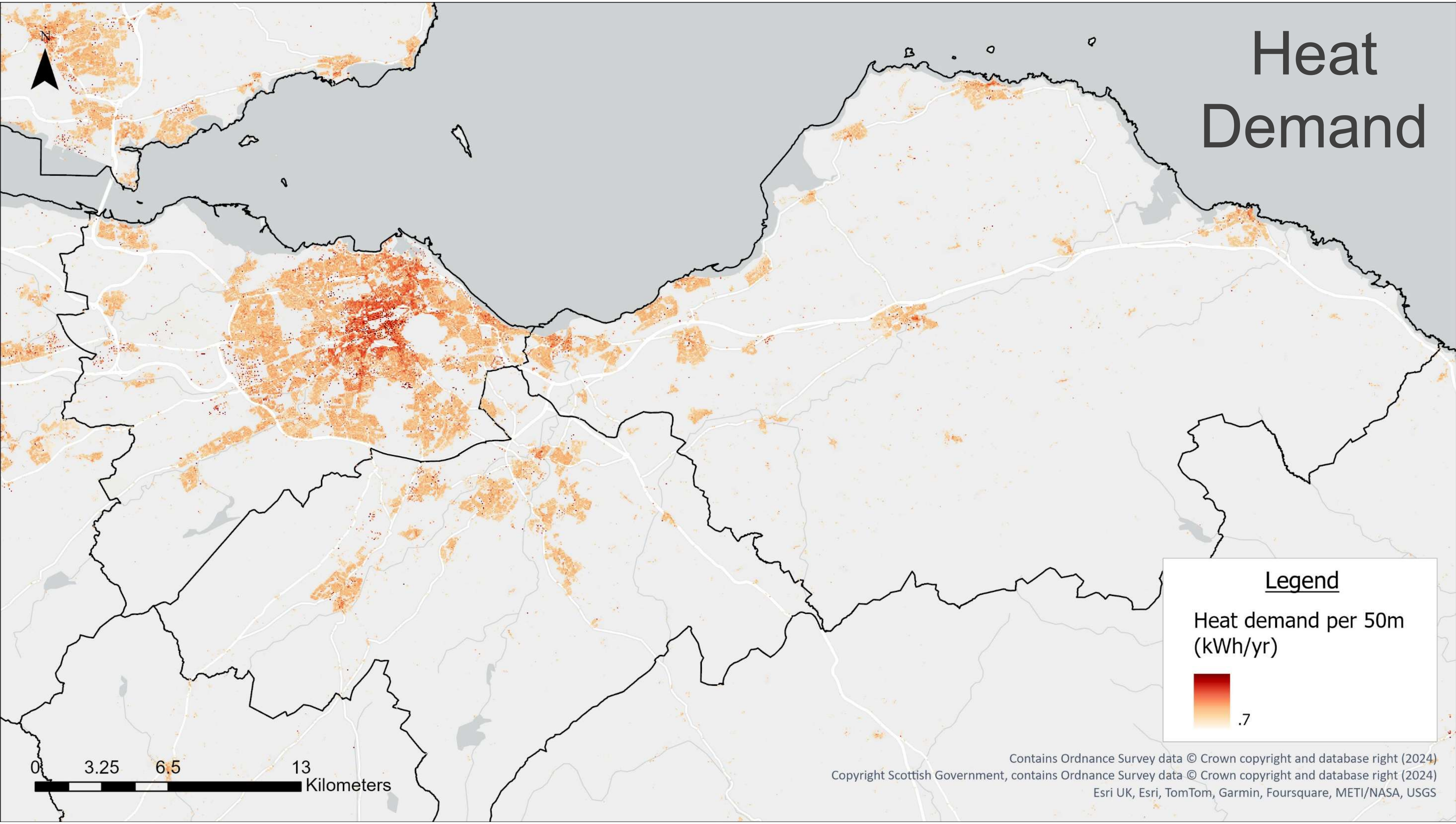
Proposed Heat Highway Example

This image shows an example of a Danish heat highway overlaid onto a heat map of Glasgow and Edinburgh. This illustrates how such a heat highway might connect two cities within the UK.

Heat map image courtesy of the Scottish Government.

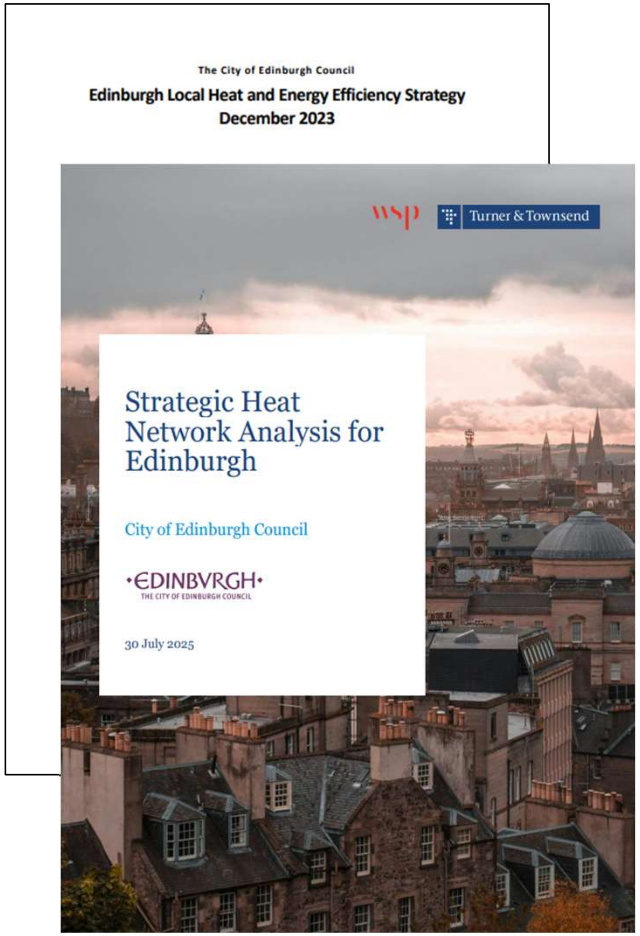
SE Scotland Regional Heat Network Vision

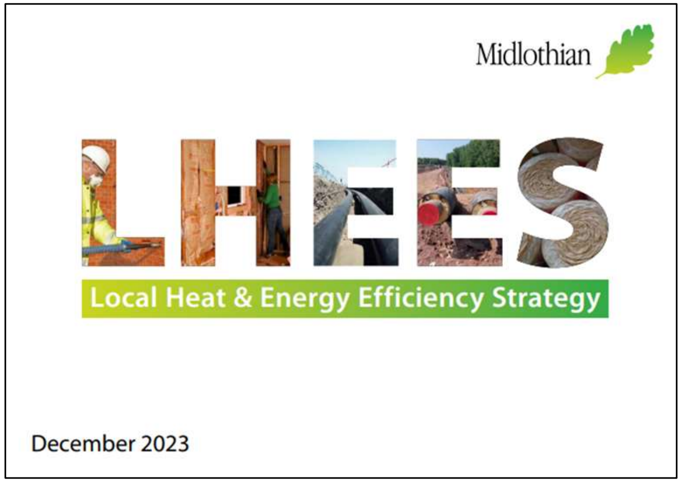
MARTIN HAYMAN



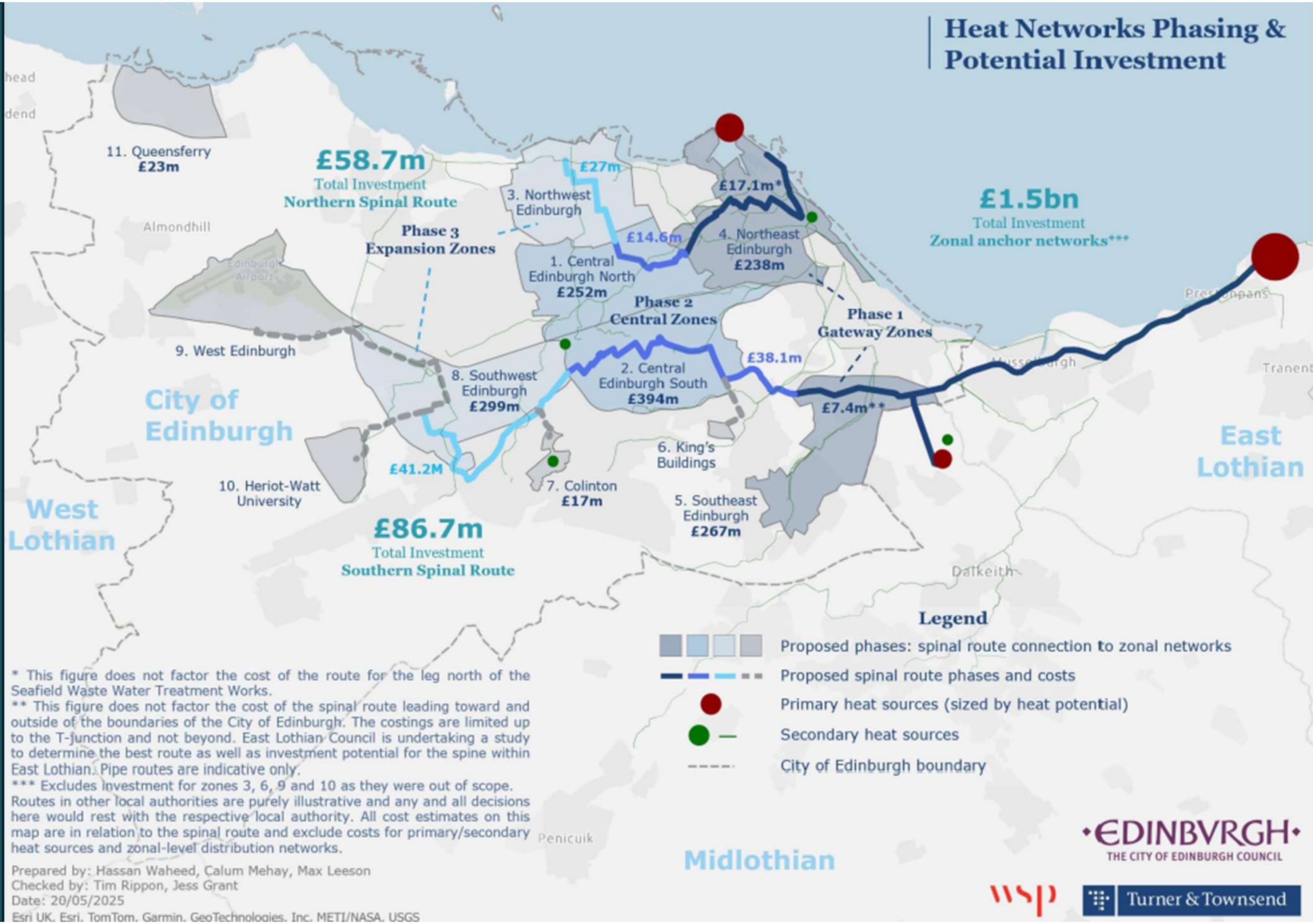
Heat
Demand
N
Legend
Heat demand per 50m
(kWh/yr)
.7
0
3.25
6.5
13
Kilometers
Contains Ordnance Survey data © Crown copyright and database right (2024)
Copyright Scottish Government, contains Ordnance Survey data © Crown copyright and database right (2024)
Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS

Edinburgh, Midlothian and East Lothian LHEES

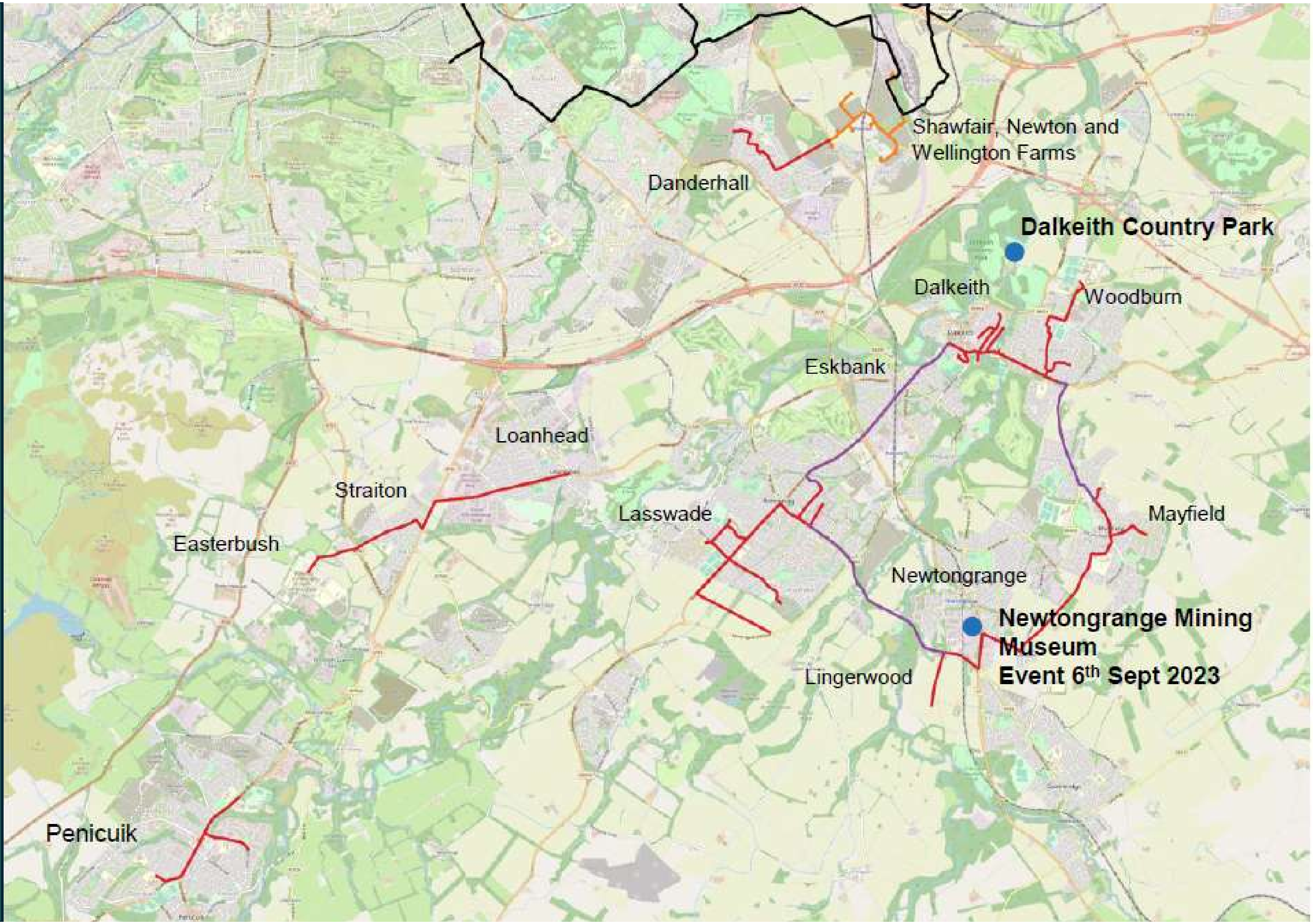




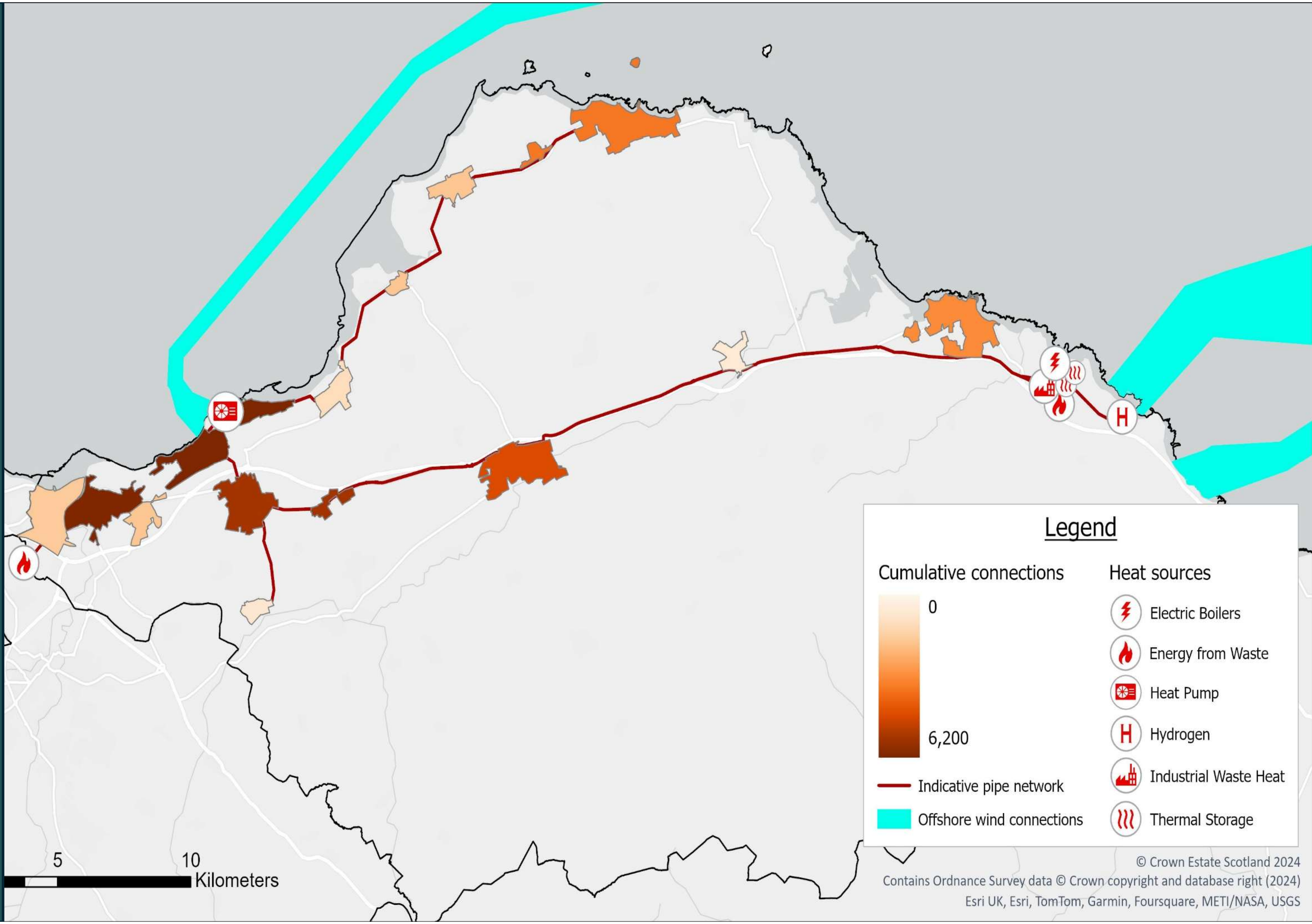
Edinburgh LHEES



Midlothian LHEES



East Lothian LHEES

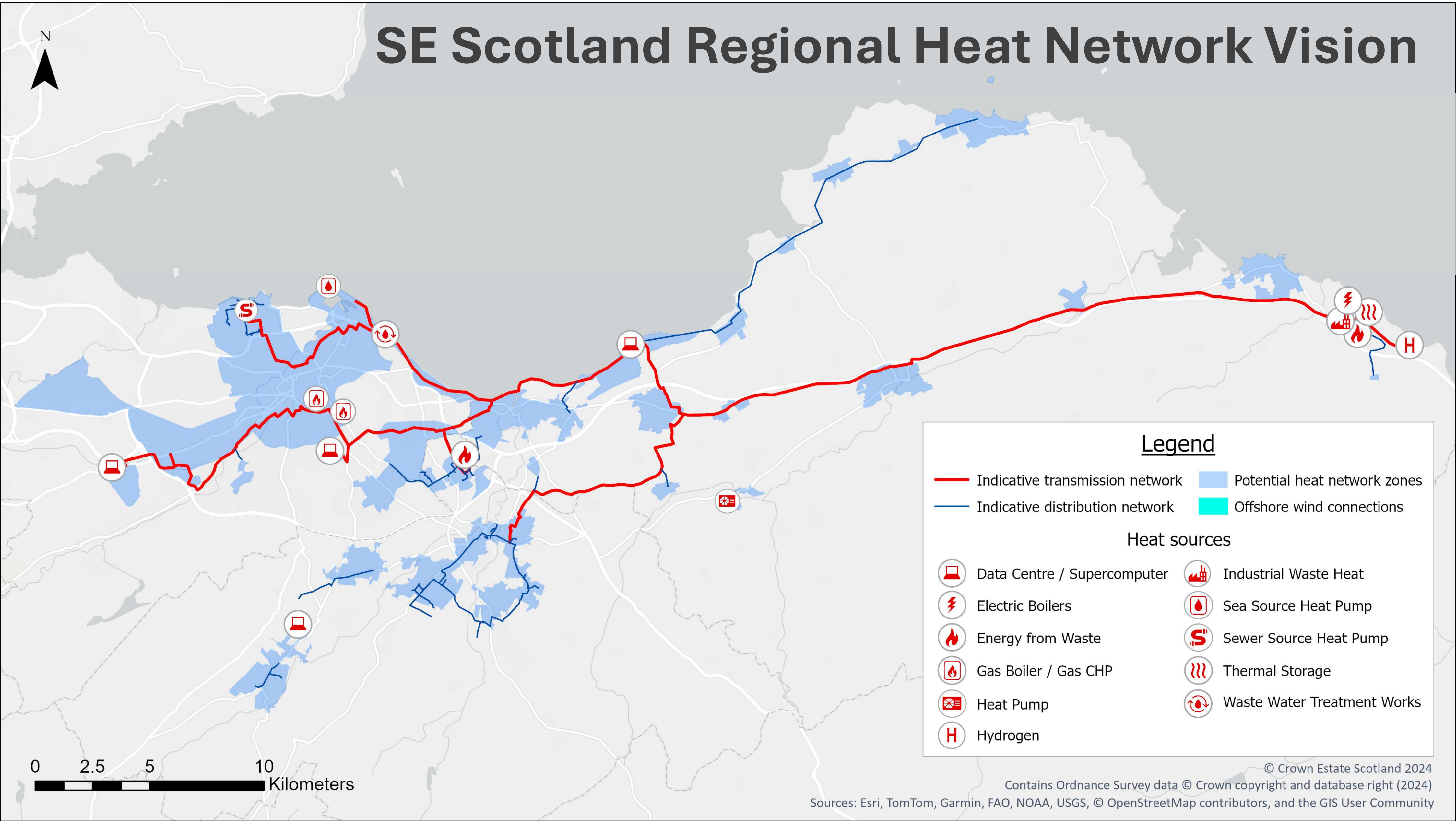


Triangle Region Heat Transmission Company (TVIS)

TVIS is responsible for entering into agreements with local heat suppliers so that the heat demand in their four owner municipalities is covered. They are also responsible for the heat transmission highway in the Triangle Region, which consists of a 123km piping system.

Since its inception in 1983, TVIS has through sector integration and industrial clustering been able to deliver low-cost waste heat to nine independent district heating companies, supplying over 60,000 consumers spread over seven municipalities.

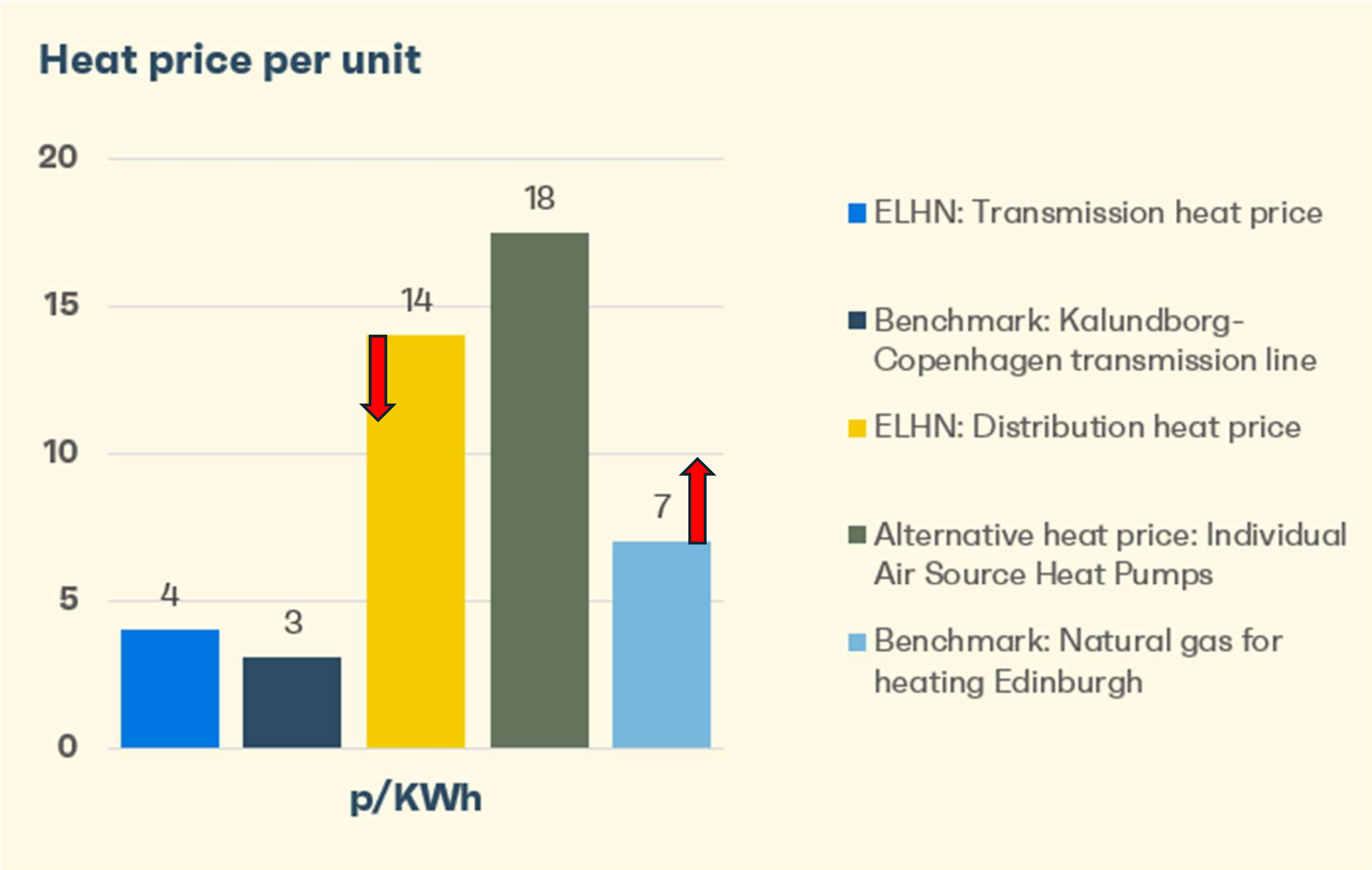
EnergiRaven | SAV



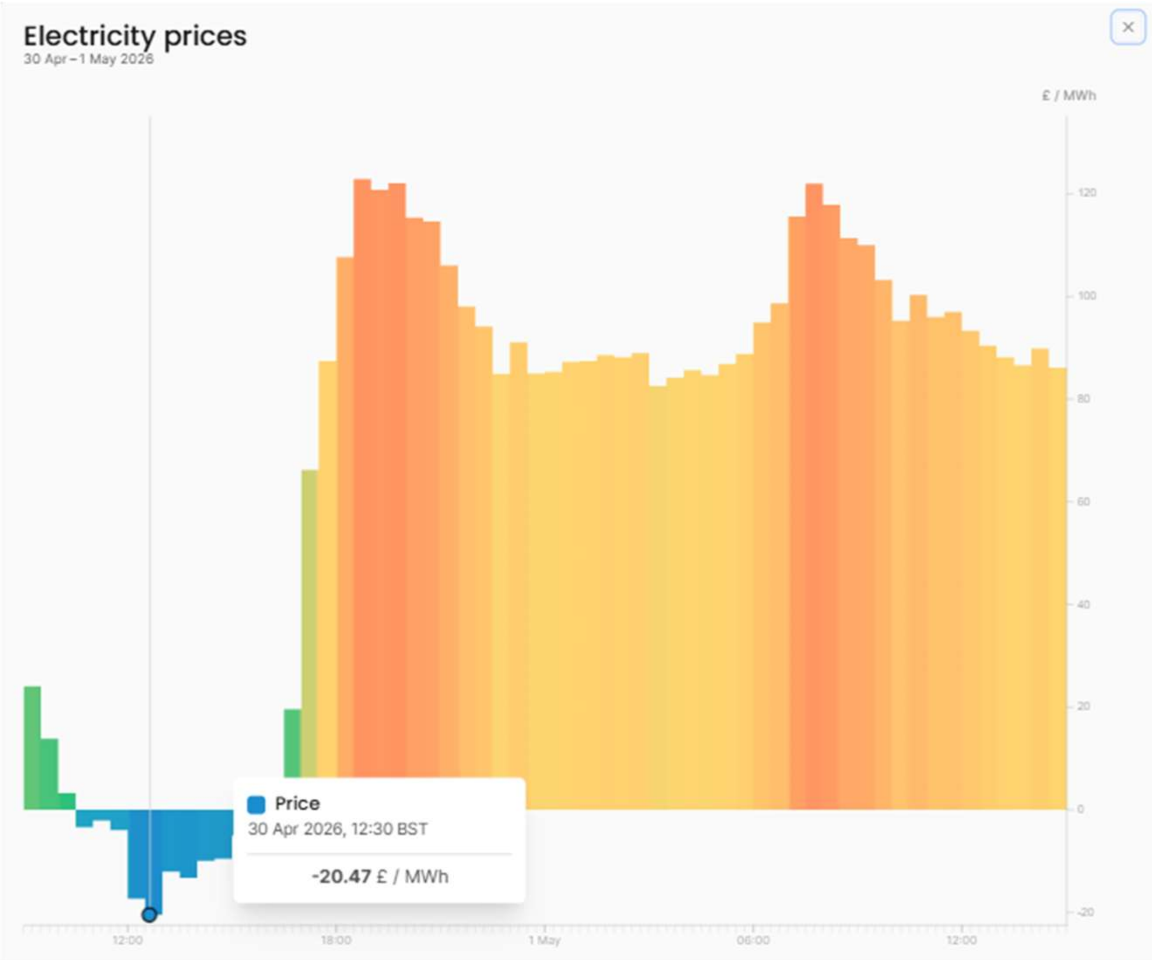
N
SE Scotland Regional Heat Network Vision
Legend
Indicative transmission network
Indicative distribution network
Potential heat network zones
Offshore wind connections
Heat sources
Data Centre / Supercomputer
Electric Boilers
Energy from Waste
Gas Boiler / Gas CHP
Heat Pump
Hydrogen
Industrial Waste Heat
Sea Source Heat Pump
Sewer Source Heat Pump
Thermal Storage
Waste Water Treatment Works
0 2.5 5 10 Kilometers
© Crown Estate Scotland 2024
Contains Ordnance Survey data © Crown copyright and database right (2024)
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

East Lothian
Community Benefits
Solution by 2031
+1,500 GWh/y
Total consumers: ~100,000
Largest heat network in the UK also allowing for exporting heat to:
· Edinburgh 350 GWh
· Midlothian 350 GWh
Further possible heat production to connect
Future hydrogen · Waste to energy · Other?
NORTH SEA
PRESTONPANS, COCKENZIE & PORT SETON
· 79 GWh
· 7,000 Consumers
DATACENTRE HEAT PUMP
· 800 GWh
· 50,000 Consumers
EAST LINTON
· 16 GWh
· 2,000 Consumers
DUNBAR & WEST BARNS
· 62 GWh
· 5,000 Consumers
VIRIDOR
· 420 GWh
· 30,000 Consumers
MUSSELBURGH
· 157 GWh
· 13,000 Consumers
EDINBURGH
· 350 GWh
· 28,000 Consumers
EDINBURGH
MIDLOTHIAN
· 350 GWh
· 28,000 Consumers
MACMERRY & TRANENT
· 79 GWh
· 7,000 Consumers
HADDINGTON
· 90 GWh
· 8,000 Consumers
TARMAC
· 280 GWh
· 20,000 Consumers
PORT SETON
COCKENZIE
PRESTONPANS
MUSSELBURGH
TRANENT
MACMERRY
HADDINGTON
EAST LINTON
WEST BARNS
DUNBAR
VIRIDOR
TARMAC
MIDLOTHIAN
Possible Heat Transmission Highway
Future district heating system
Heat demand
Heat production

Feasibility results



30th April -1st May – wholesale electricity prices



https://app.electricitymaps.com/map/zone/GB-NIR/live/fifteen_minutes

Heat Networks with strategically scaled thermal storage can flex heat production with the electricity grid.

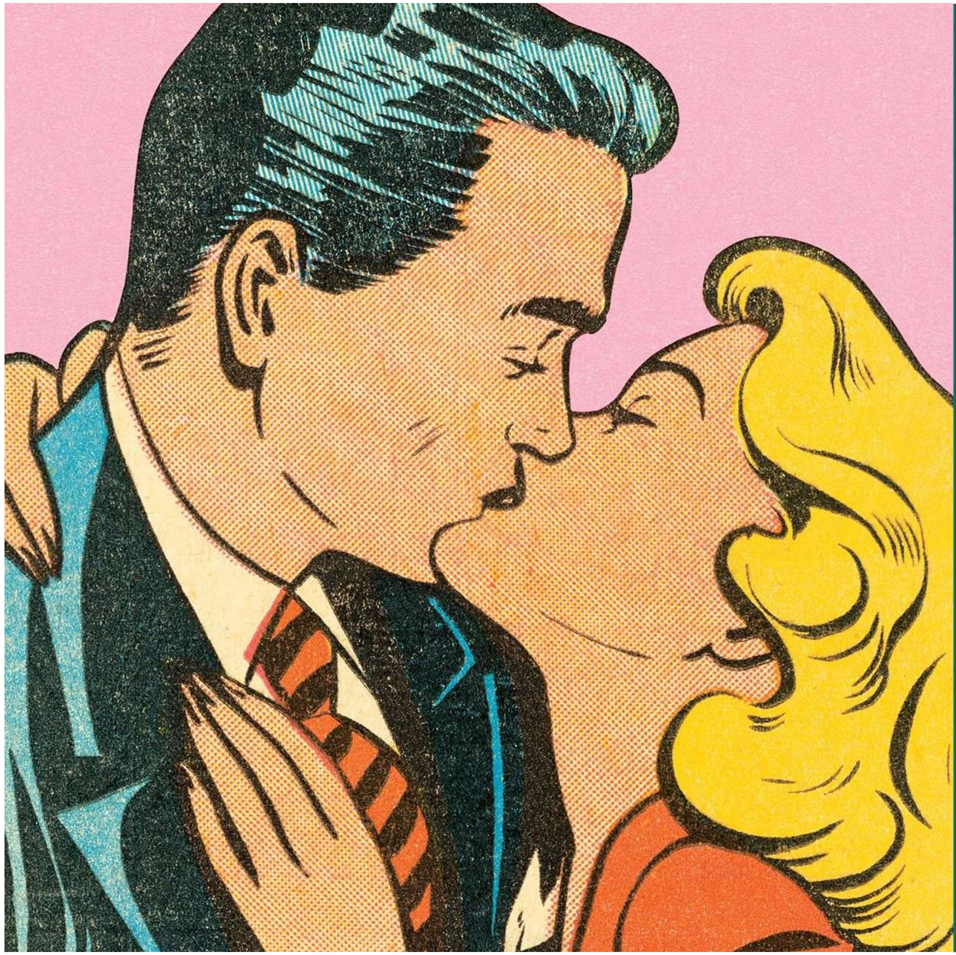
Blue – grid balancing service with electric boilers and solid-state controls for instant reaction.

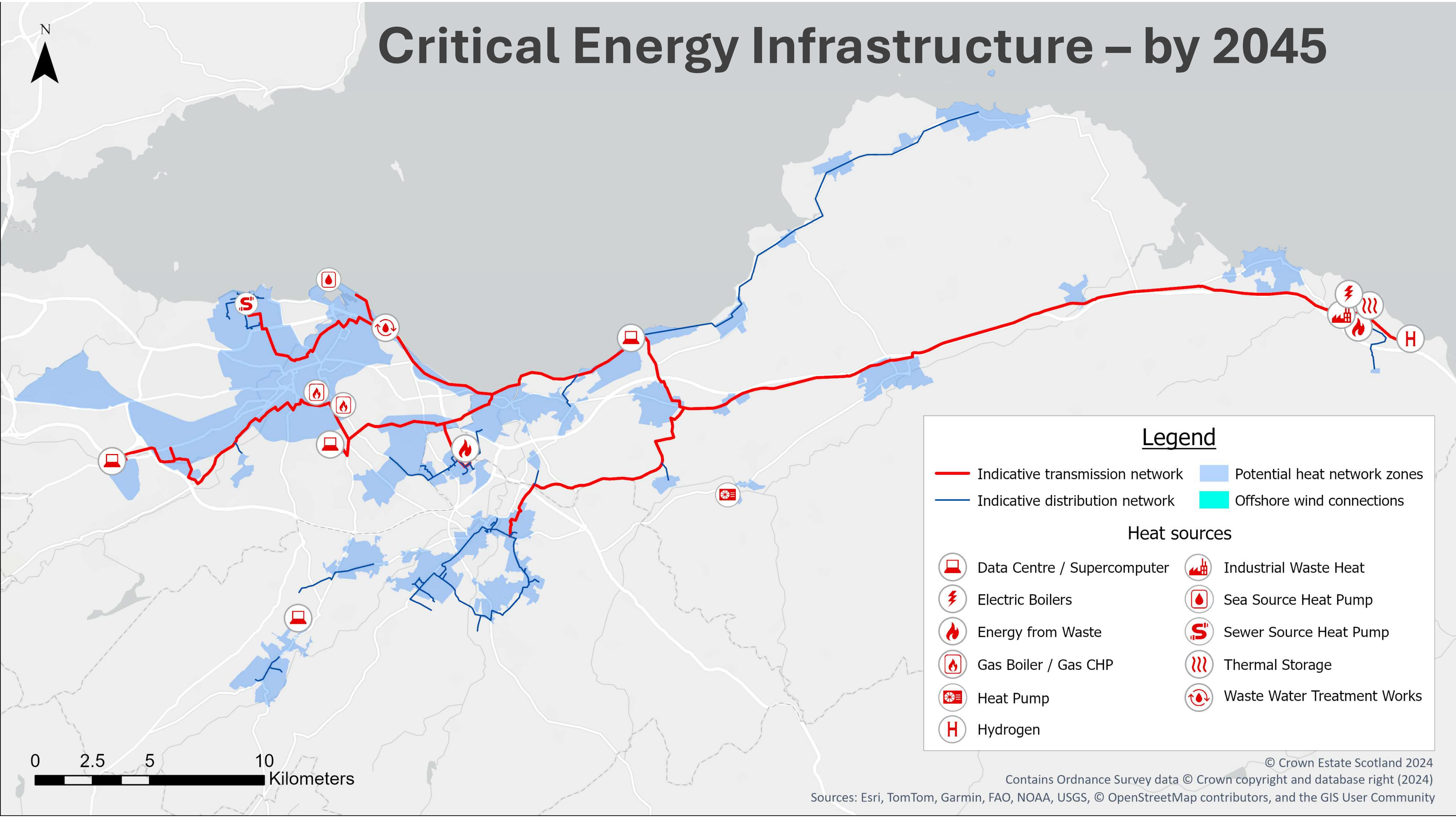
Green/Yellow – general heat production via Heat Pumps.

Red – avoid heat generation and instead discharge thermal storage.

Waste on an Industrial Scale

KISS – Keep It Simple Stupid





Critical Energy Infrastructure – by 2045
N
Legend
Indicative transmission network
Indicative distribution network
Potential heat network zones
Offshore wind connections
Heat sources
Data Centre / Supercomputer
Electric Boilers
Energy from Waste
Gas Boiler / Gas CHP
Heat Pump
Hydrogen
Industrial Waste Heat
Sea Source Heat Pump
Sewer Source Heat Pump
Thermal Storage
Waste Water Treatment Works
0 2.5 5 10
Kilometers
© Crown Estate Scotland 2024
Contains Ordnance Survey data © Crown copyright and database right (2024)
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Delivery Priorities

"No heat is wasted, no home is cold"

- Lothian Heat CIC established in October 2025
- Partnerships agreed with East Lothian Council and City of Edinburgh Council
- Recruiting a Development Team
- Prioritise heat network projects where heat is readily available
- Develop the business case for the regional supply and transmission network
- Work with Transition Finance Scotland to unlock investment
- Develop a Delivery Model that results in the cheapest possible heat for residents

https://lothianheat.org

Let's create a Just Transition

Thank you for listening

Simon Kerr
Head of Heat Networks, Scotland and NI
simon.kerr@sav-systems.com
07768 760515

Scotland

Presentation

Daniel Mill

NHS Lothian

Our NHS
Our People
Our Planet

Daniel Mill

Head of Energy & Sustainability
NHS Lothian

SUSTAINABLE DEVELOPMENT GOALS

NHS Heat & Western General

- Context – NHS Net Zero Pathway
- Western General Hospital (WGH)
- What's next
- Key challenges

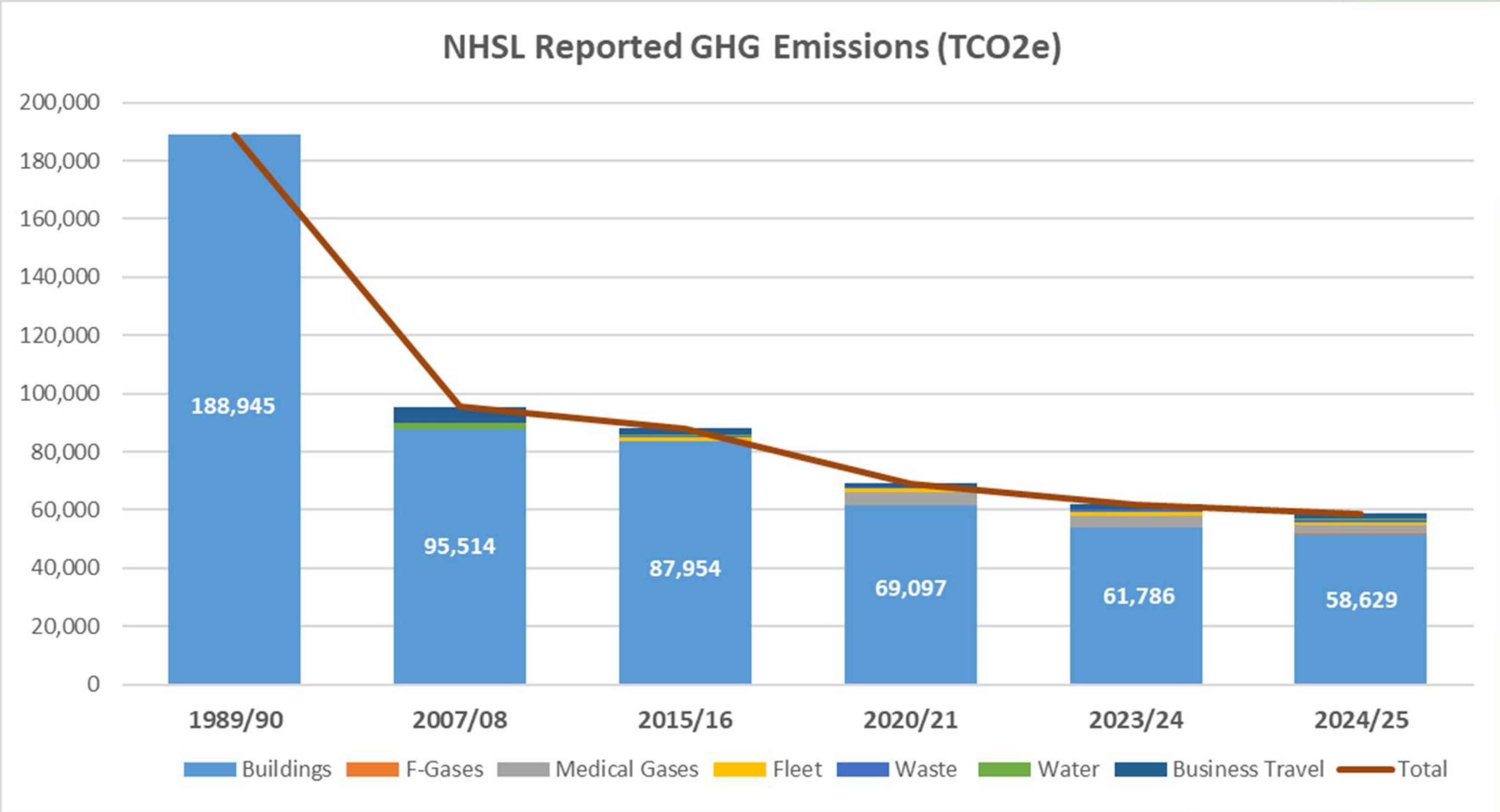
Context

- NHS Lothian Sustainable Development Framework
- NHS Lothian Net Zero Buildings Strategy.
- Climate Change (Scotland) Act 2019:
  - **NHSS Net-zero by 2040**
- Scottish Government – Heat in Buildings Strategy
  - All **publicly-owned buildings** to meet zero emission heating requirements, with a backstop of **2038**.

SUSTAINABLE DEVELOPMENT GOALS

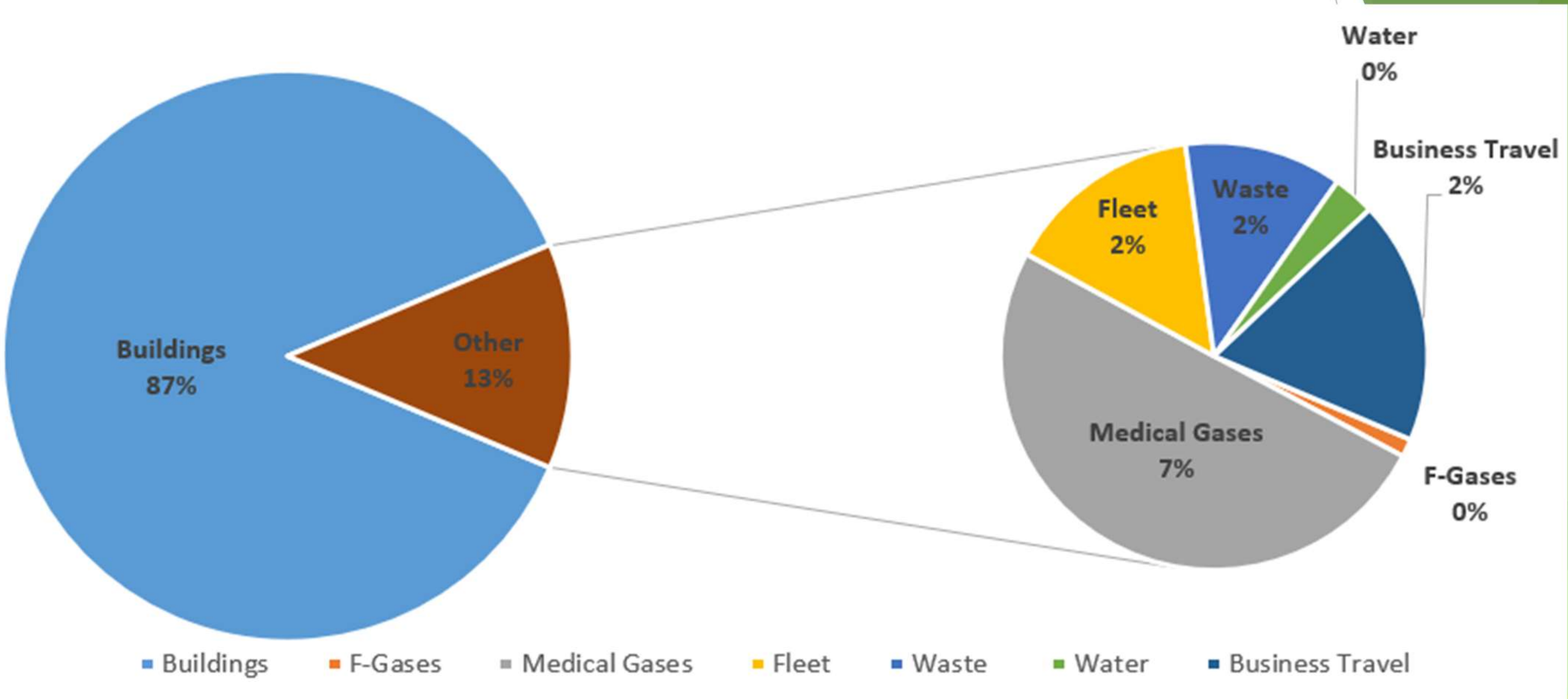
Our NHS Our People Our Planet

2024/2025 Carbon Emissions (TCO_2e)

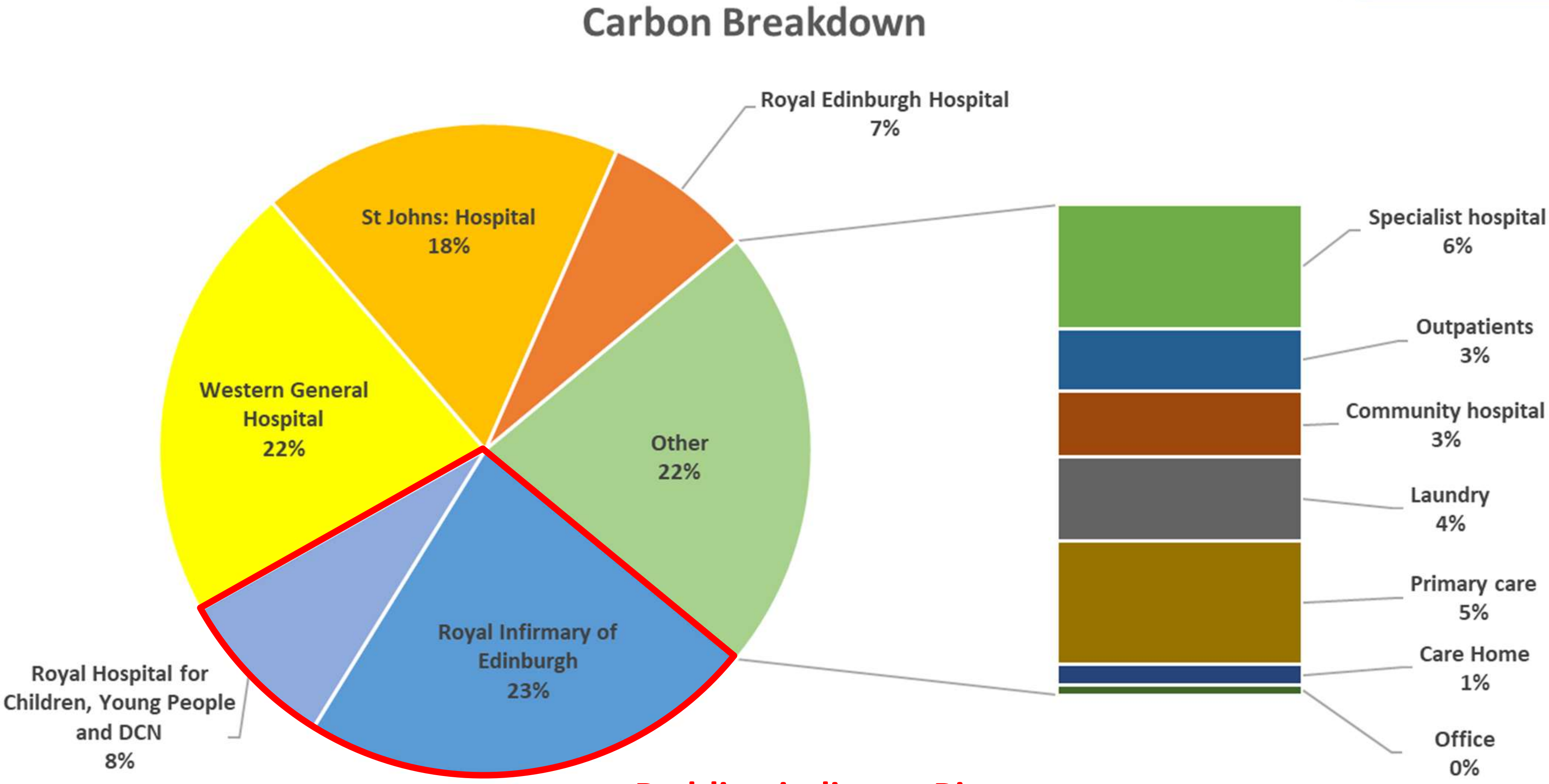


Our NHS
Our People
Our Planet

2024/2025 Carbon Emissions (TCO_2e)



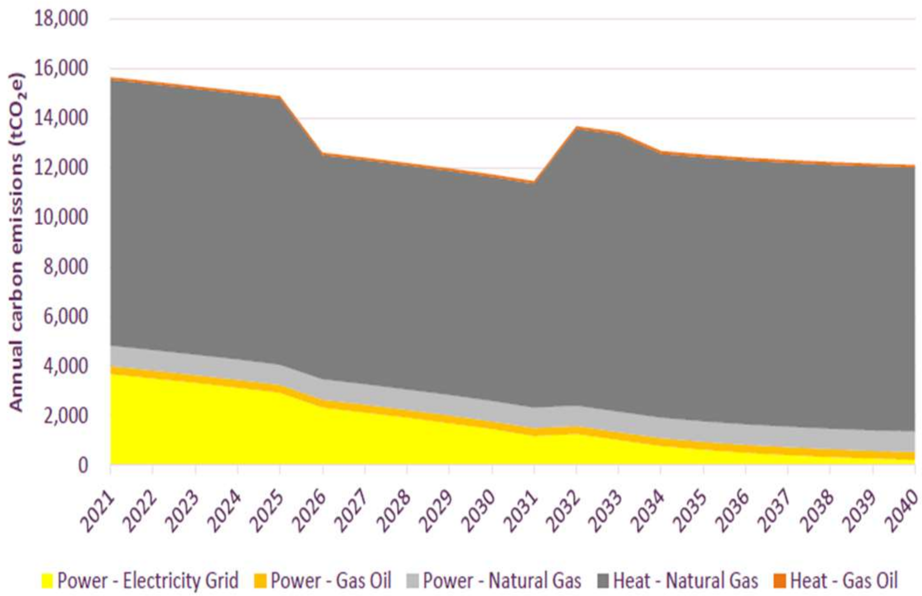
Context - Buildings CO_2



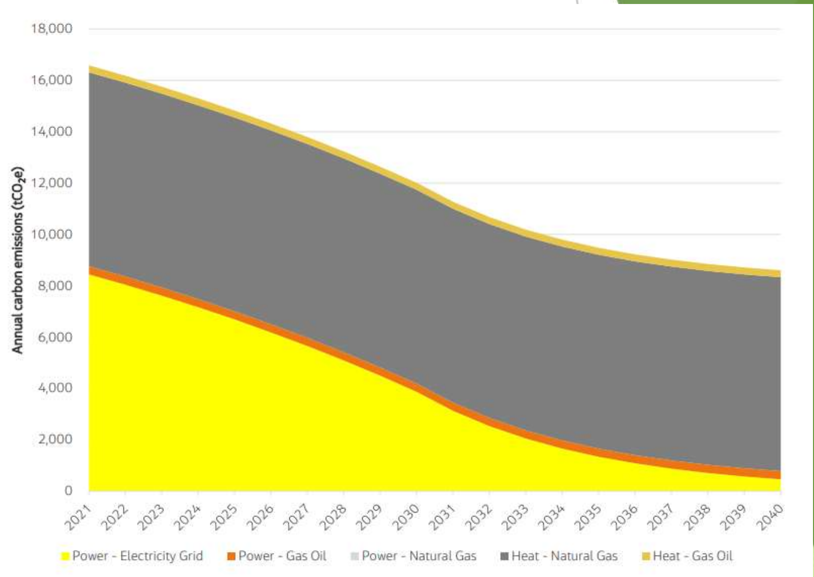
Red-line indicates Bio-quarter

Context - Emissions BAU

Western General Hospital



Royal Infirmary of Edinburgh



	WGH	RIE
Energy - Heat	41.9 GWh	34.7 GWh
Carbon – Heat % of total	14%	12%

Our NHS Our People Our Planet

Western General Hospital (WGH)

SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

Western General Hospital (WGH)

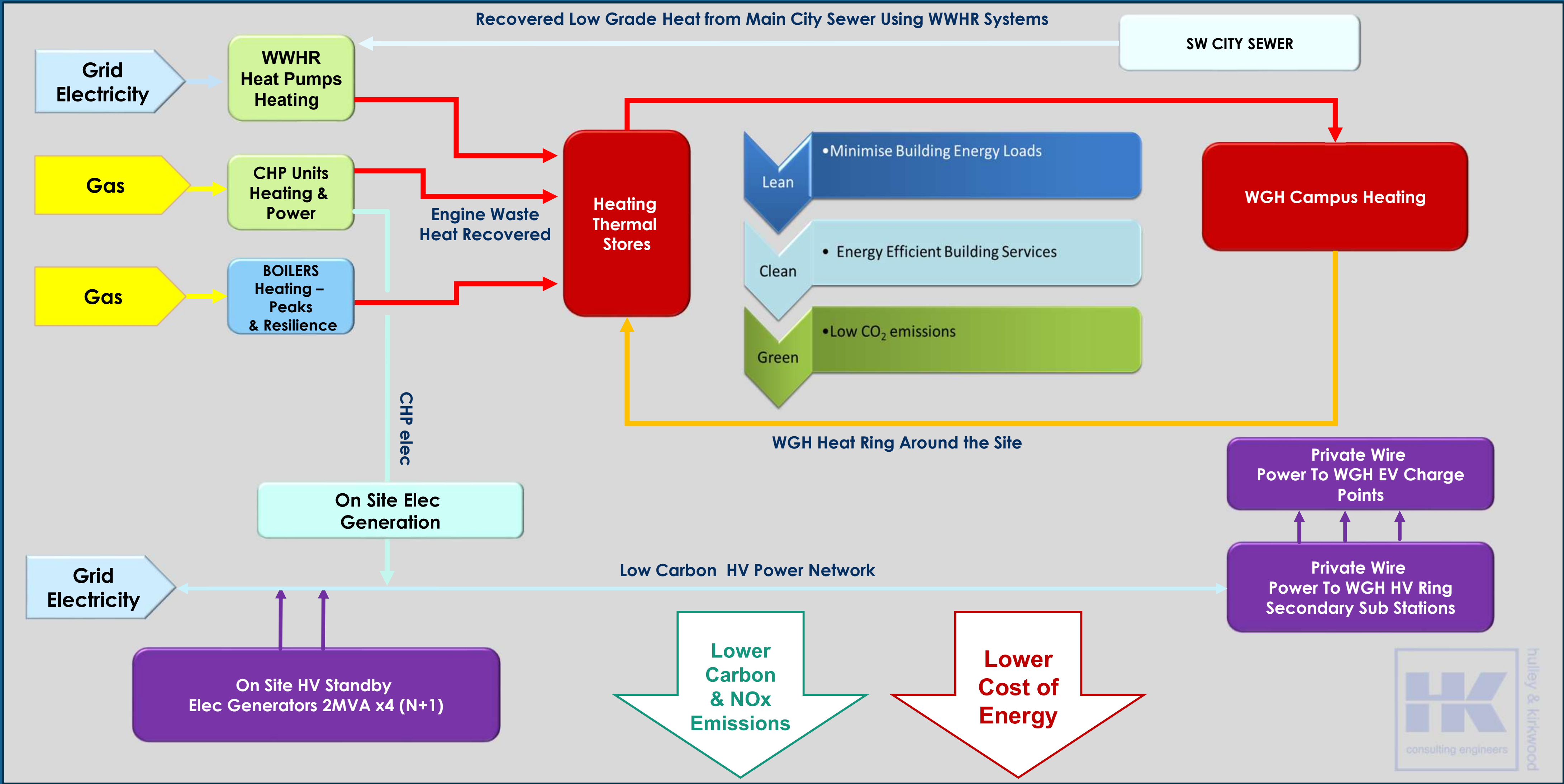
Our NHS Our People Our Planet

WGH Need for change - 2016

What is the cause of the need for change?
Site developments requiring increased **capacity** and **future ready** systems and networks
High Carbon Footprint and need to meet **carbon reduction** targets.
Poor **reliability** and lack of operational **resilience** in systems and networks
Increasing **legislation and policy** requirements in relation to reducing Energy and Carbon emissions.
Direct replacement **does not align** with Low Carbon pathway
High energy infrastructure running costs
Health and Safety risks due to working in excessive high temperatures in limited access environments and potential exposure to asbestos

Our NHS
Our People
Our Planet

WGH PREFERRED FEASIBILITY SOLUTION – WWHR/CHP/BOILERS FOR SITE WIDE LTHW NETWORK: SITE WIDE ENERGY DIAGRAM



WGH Energy Infrastructure Phase 1&2

SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

NHS
Lothian

WGH Energy Infrastructure Phase 1&2

SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

The Works

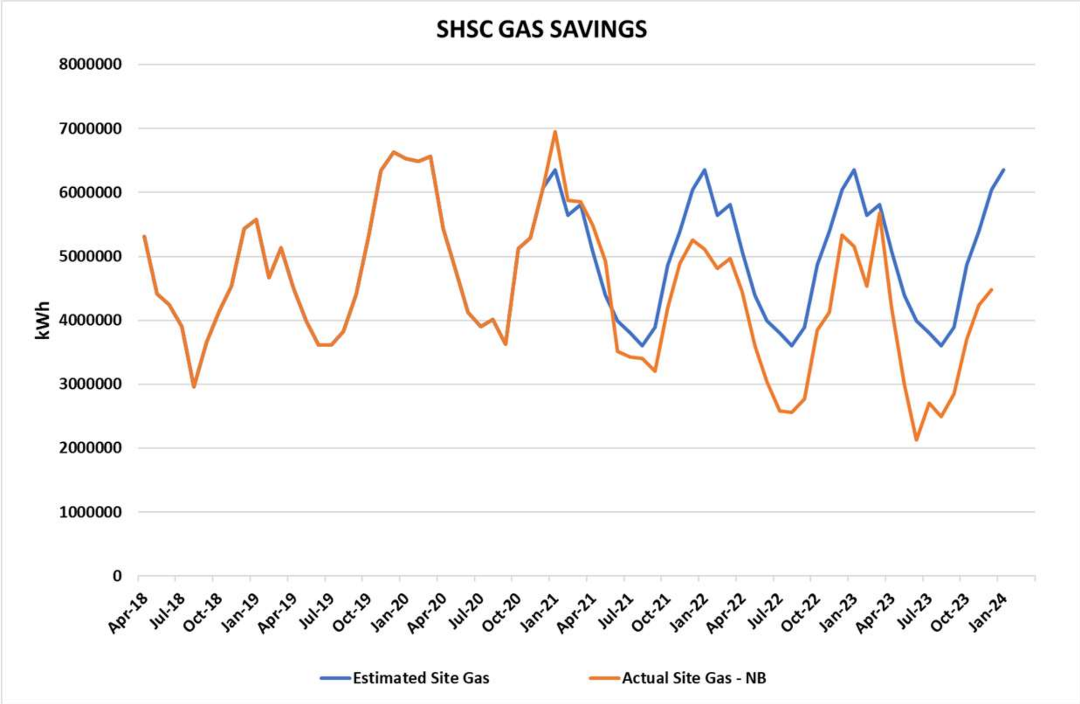
SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

Lessons Learnt - Investment Objectives

Effect of the need for change on the organisation	Was this achieved?
Inability to provide capacity to projects in development (i.e. expanded Linear Accelerator demand and provision).	**YES**. New heating infrastructure was delivered to meet the demands and timescales of the new LINAC and Renal Buildings.
Limited capacity of existing systems and ability to achieve relevant **energy and carbon legislation**.	**YES**. Existing steam had insufficient capacity for new builds. Designing new builds based on low temperature hot water ensures buildings are better suited to future low carbon technologies.
System failures, with increasing frequency, that severely impact on site operationally	**YES**. Transition of existing buildings has reduced steam system failures impacts in this area, and ensured new builds are connected to resilient heat supplies.
Potential future **penalties** and failure to meet national and local policy and legislation.	**YES**. The reduced steam demands, and system losses has reduced site carbon emissions below permitted thresholds.
Current energy **contract beyond original agreed term** and investment in new equipment aligned with low energy distribution network	**NO**. This was further extended due to capacity of Energy Team to manage this project and other service requirements.
Increased running costs due to aging systems and networks from associated maintenance, repair and rising fuel costs	**YES**. Energy demands for the WGH reduced through the de-steaming transition, due to highly inefficient steam distribution.
Health and Safety risks are difficult to manage and there are limited numbers of contractors with the specialist skill set and experience to deal with repair and maintenance	**YES**. Low temperature heating is significantly safer to operate and maintain, due to operational system pressure, temperature, compliance costs and high costs of steam remedial works.

Lessons Learnt - Energy & Carbon



Change	Consumption	Cost	Carbon
Gas	-7,53,254 kWh	-£662,141	-1,356 TCO_2
Electricity	980,707 kWh	£118,118	88 TCO_2
Total	-6,550,547 kWh	-£544,022	-1,179 TCO_2

NHS Lothian

Lessons Learnt

Enabling: Not ready for Low Carbon

Complex: Live Site & many unknows

Partners: Consultants & Contractors

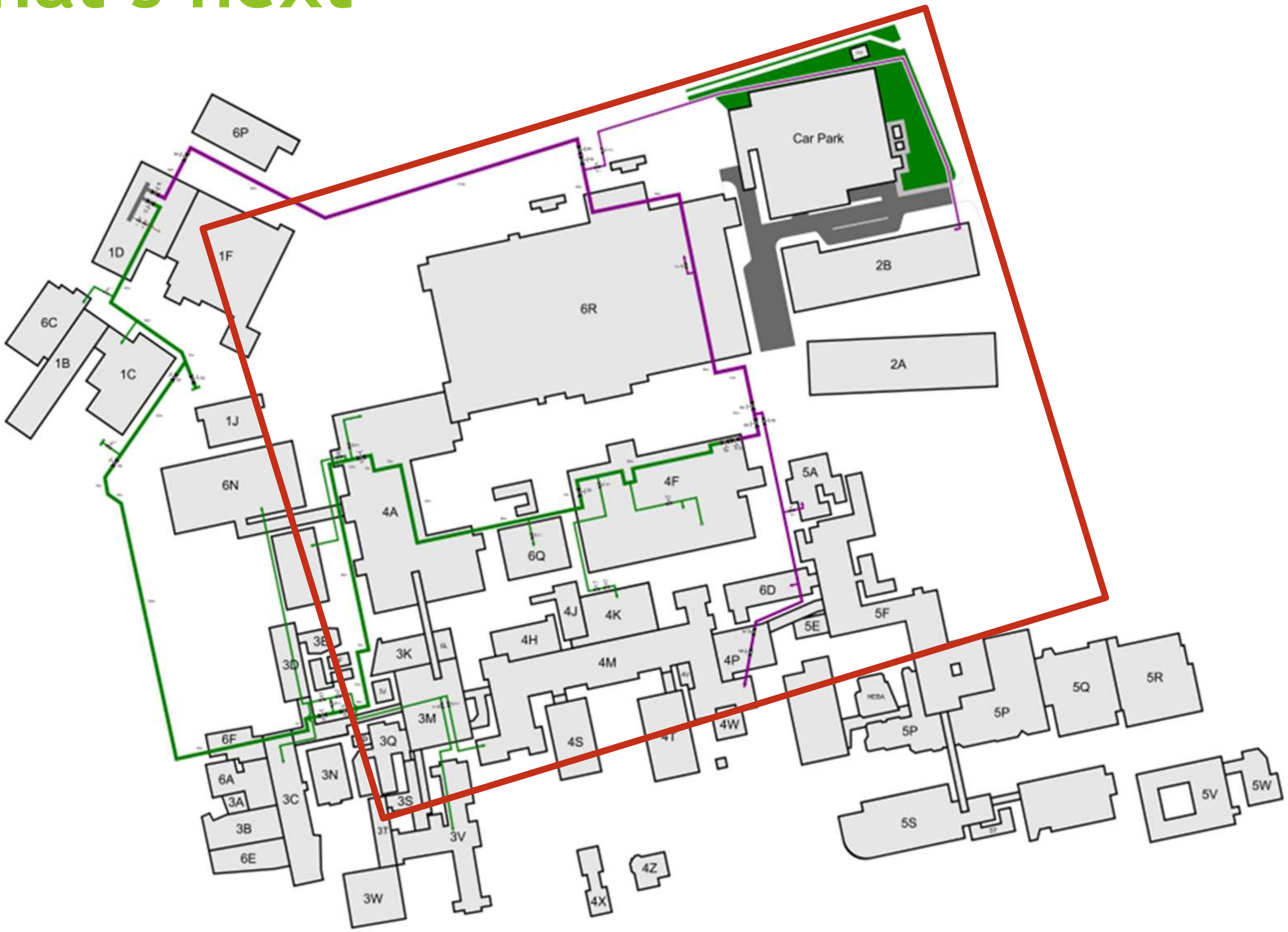
Energy Efficiencies: Large benefits still available

Align objectives: Cost, Carbon, H&S, Resilience and more

SUSTAINABLE DEVELOPMENT GOALS

Our NHS Our People Our Planet

What's next



SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

NHS Lothian

SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

NHS Lothian

Remaining Challenges

Net Zero Solution is Undefined

Approach to Resilience?

What operational models are suitable?

Alignment of actions

SUSTAINABLE DEVELOPMENT GOALS

Our NHS
Our People
Our Planet

Daniel Mill
Head of Energy & Sustainability
Facilities Department
NHS Lothian
daniel.mill@nhs.scot

Scotland

Presentation

Helen Robertson

BURO HAPPOLD

CommuniHeat

Transitioning Communities to Net Zero Carbon

Helen Robertson

Senior Energy Engineer

27th May 2026

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Buro Happold Overview

- Engineering consultancy, founded 1976
- Integrated design, advisory, and consultancy services
- Global presence in 11 countries, 37 locations and c. 3500 employees


Government (US)


Major infrastructure


Science and technology


Commercial


Healthcare


Rail


Aviation


Urban Development


Sport and Entertainment


Education


Cultural

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Buro Happold – Energy Consultancy

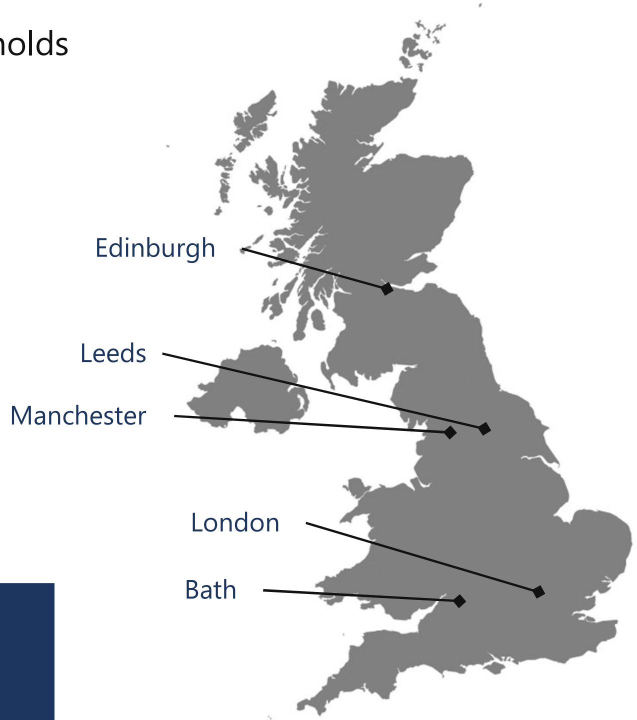
Our values – we believe that distributed energy holds the key to mitigating climate change

Our mission – to implement the distributed energy revolution

We help our clients realise value from distributed energy systems

Our Service Offers:

Energy Planning	Energy System Design + Delivery	Net Zero Campuses
Smart Energy Systems	Utilities Strategy and Commercialisation	Power Systems



Energy Team : 60 engineers
North + Scotland : 26
London + Bath : 34

SELCHP – EfW Southwark District Heat Network Extension

Shawfair Energy Centre, Midlothian Heat Network

Hebburn Minewater District Heating – RIBA 1-7 appointment

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Introduction to CommuniHeat

Develop a **blueprint** for the decarbonisation of our communities.

Enable off gas communities to switch from **expensive and carbon intensive fossil** fuels.

Approximately **four million off gas grid** homes in the UK.

Barcombe Residents

BURO HAPPOLD

OVESCO

UK Power Networks
Delivering your electricity

COMMUNITY ENERGY SOUTH

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Understanding the community

- Barcombe’s household carbon footprint is almost **double the national average**
- **25% of which arises from the burning of oil for heat generation**
- Highly engaged rural off gas grid community
- Early adopters to transition off oil
- Diverse customer base and housing stock

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Data Collection

703 HOMES IN THE COMMUNITY

500 HOMES WITH ENERGY PERFORMANCE CERTIFICATES

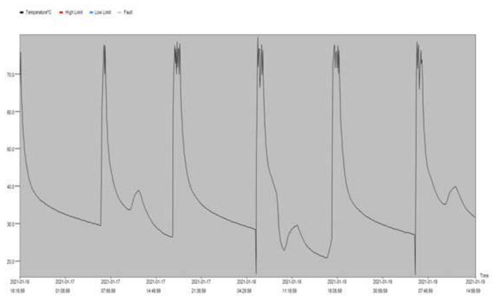
44 HOMES INSTALLED WITH HEAT AND POWER METERING

85 HOMES CARRIED OUT ROOM-BY-ROOM HEAT LOSS SURVEYS

OVESCO WOULD LOVE TO GET **400** HOMES TO COMPLETE THE ONLINE QUESTIONNAIRE

Barcombe weather station data

Energy loggers

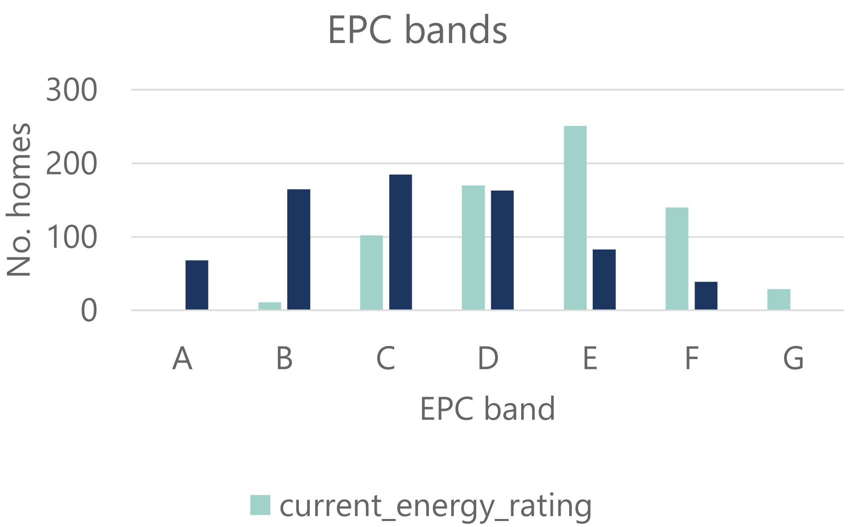


COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Barcombe's current building stock

- Archetypes grouped in broad terms, **age and building type**
- Allows creation of both **heat profiles and retrofit costs**
- Over half of the existing housing stock are deemed poorly insulated

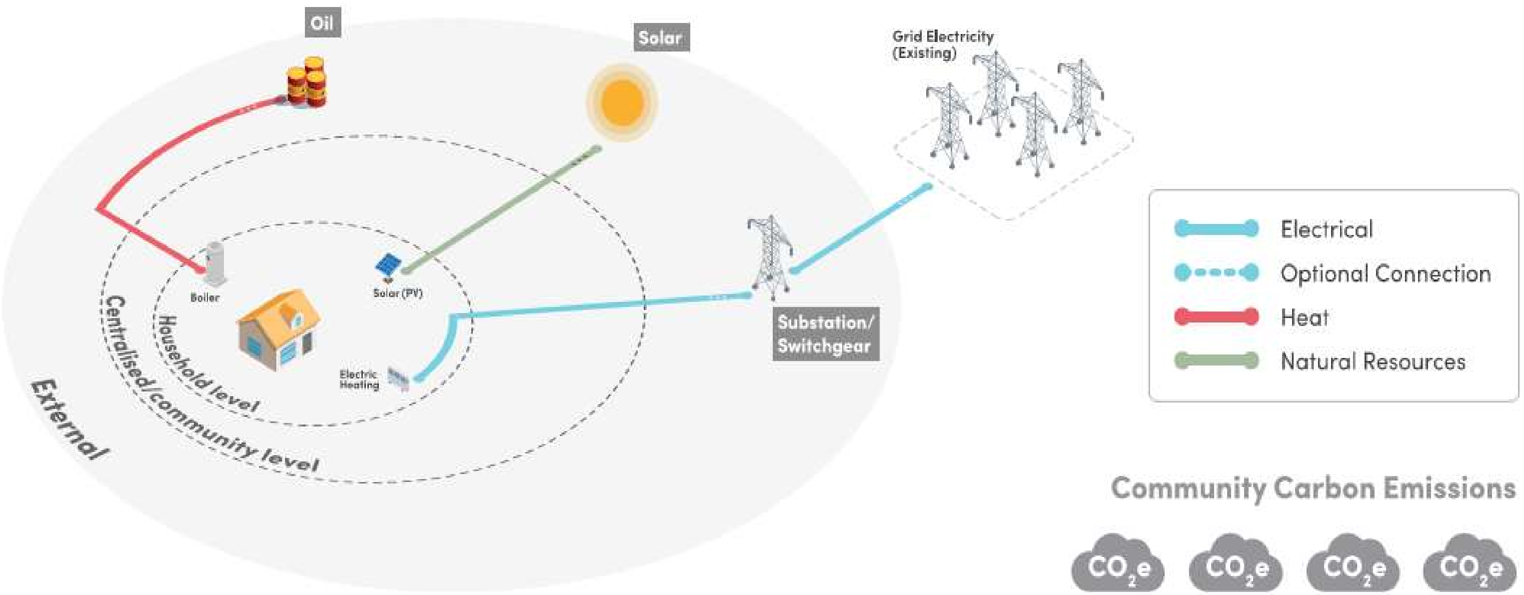
Housing Archetypes



COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

The existing scenario

Fragmented and fossil fuel dependent



COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

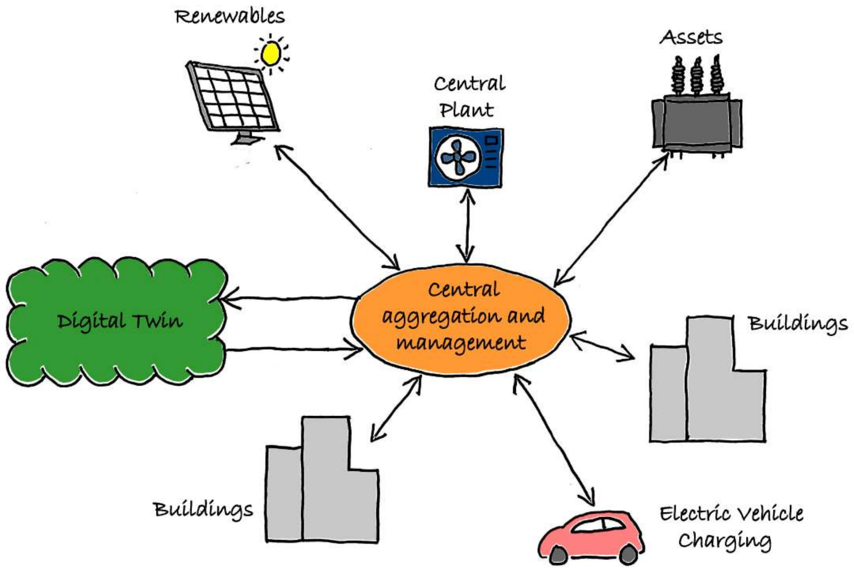
Two pathways to decarbonisation

Not reasonable to compare only to a low uptake scenario

- **Scenario 1: Gradual uptake**
  - Resident led change
  - Irregular growth
  - Market led
- **Scenario 2: Community intervention**
  - Community energy assets
  - Government intervention
  - Shift to digitalised energy systems
  - Subsidy support

Intervention uptake is balanced with ease of adoption

- High uptake scenario
- Medium uptake scenario
- Low uptake scenario



COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

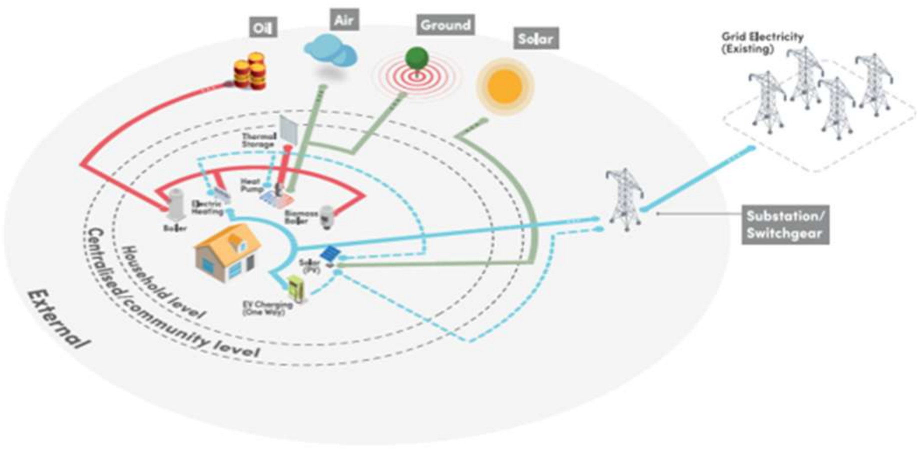
Coordinated vs Uncoordinated Scenarios

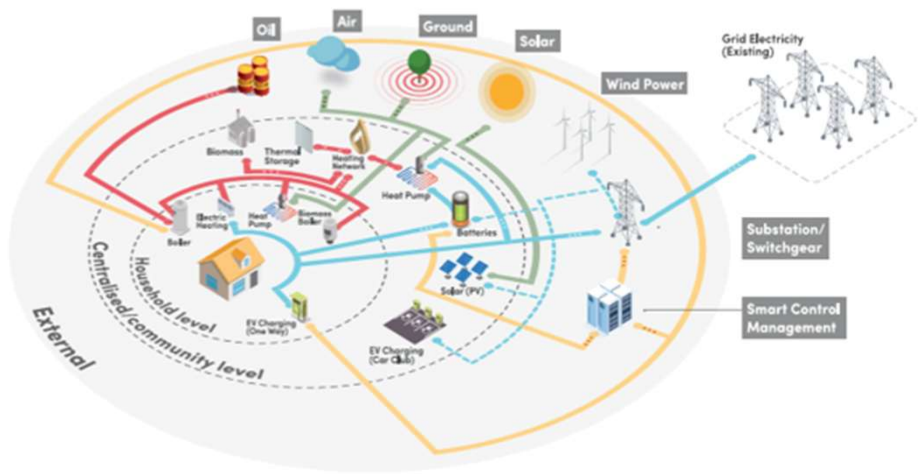
Scenario 1 - Uncoordinated

- Low retrofit uptakes
- Low rooftop PV
- No community energy generation

Scenario 2 - Coordinated

- High retrofit uptake
- High rooftop PV uptake
- Max PV and Wind farm generation
- Community Energy finance

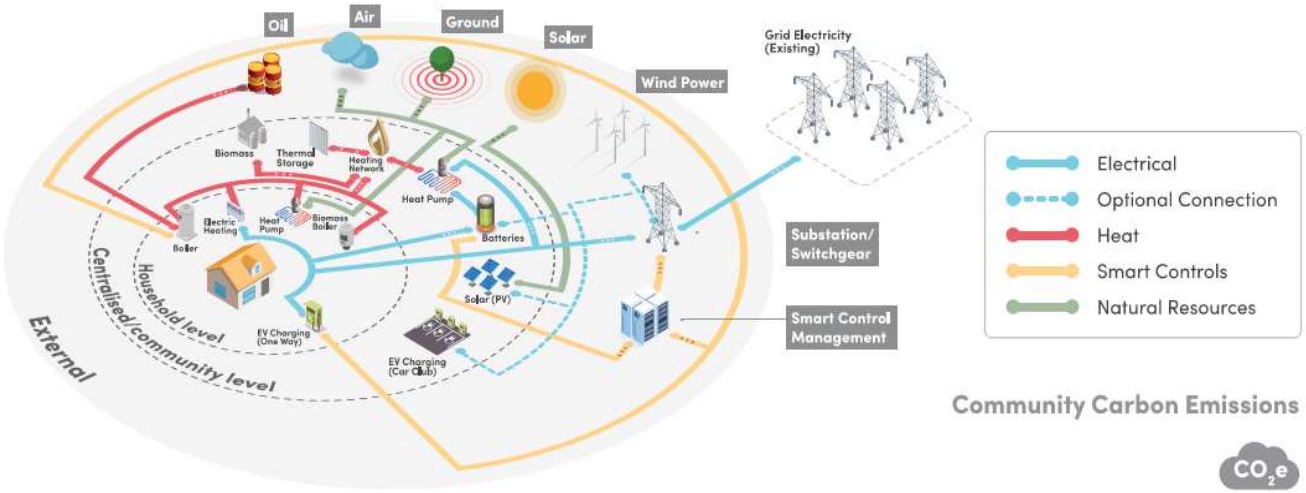




COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Coordinated benefits

- Targeted approach to building fabric retrofits
- Increased number of heat pumps installed
- Savings in network reinforcement cost
- Households could save up to 30% on energy bills vs uncoordinated approach
- Up to 3,000 tonnes of community wide carbon savings per year



COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Digital Twin

- Making sense of vast quantities of data from a variety of sources
- Uses the latest digital engineering technology
- Allows stakeholders to engage with a dynamic model

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Key Insights

Building fabric	Technology selection is sensitive to building archetypes and data quality is important to improving accuracy of the modelling
Strategically targeted transition	Connection strategy can be influenced early on to reduce overheads for all
Partnership and community engagement	Publicly available data must be refined with data from the community
Digital Planning	Allows alignment between roll out of community assets and network assets

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

BURO HAPPOLD

Helen Robertson
Helen.Robertson@burohappold.com

www.burohappold.com

COPYRIGHT © 1976-2026 BURO HAPPOLD. ALL RIGHTS RESERVED

Presentation

Dr Orestis Angelidis

Assessing low temperature waste heat integration in 5th Generation District Heating and Cooling

A case study evaluation in Clyde Gateway, Scotland

Dr. Orestis Angelidis (Buro Happold), Alan Thompson (Ramboll)

This work was conducted during Orestis' PhD at the University of Glasgow, with the support of University of Edinburgh, Energy Technology Partnership and Ramboll.

27 May 2026

Agenda

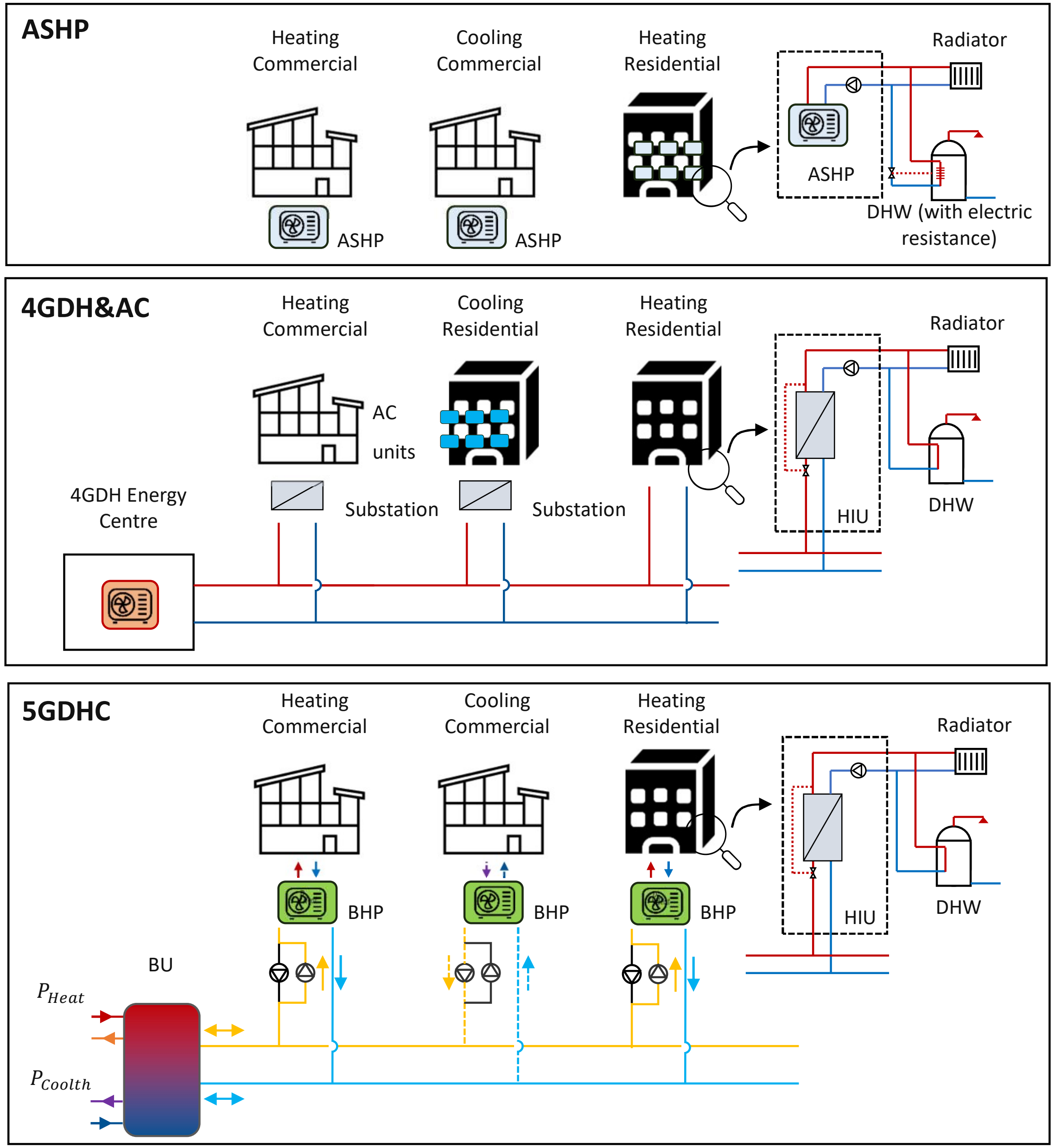
- Why decarbonise heat?
- Heat decarbonisation solutions.
- Demand overlap coefficient and low temperature waste heat.
- Case study.
- Techno-economic results.
- Conclusion

Why decarbonise heat

- About **a third** of UK's overall CO_2 emissions come from **heating** (domestic, industrial and commercial sector) (Revesz et al., 2020).
- Fossil fuels dominate heating and cooling generation, with only 25% from Renewable Energy Systems (Eurostat, 2024), with higher electrification of heat needed.
- Finding pathways to interconnect the **electricity** and **thermal** utilities can prove key in the cost-effective decarbonisation of heat.

Heat decarbonisation solutions; Which?

- Individual building level reversible Air Source Heat Pumps (**ASHPs**).
- 4th Generation District Heating (**4GDH**) with individual Air Condition (**AC**) units for cooling.
- 5th Generation District Heating and Cooling (**5GDHC**) meets heating and cooling demands through the same network, using decentralised booster heat pumps in district, building, or flat level.

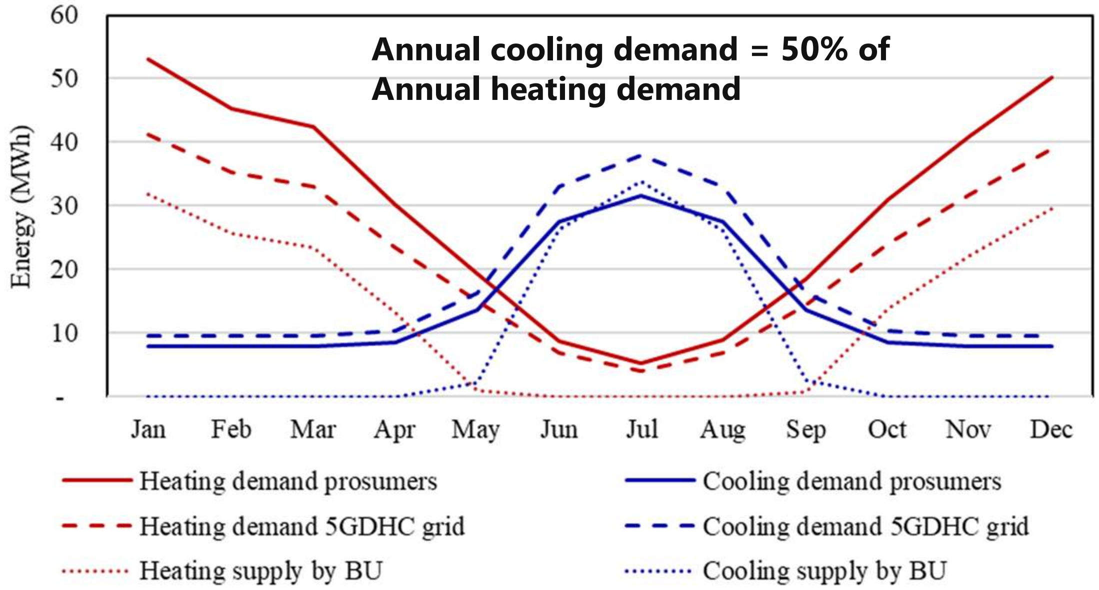


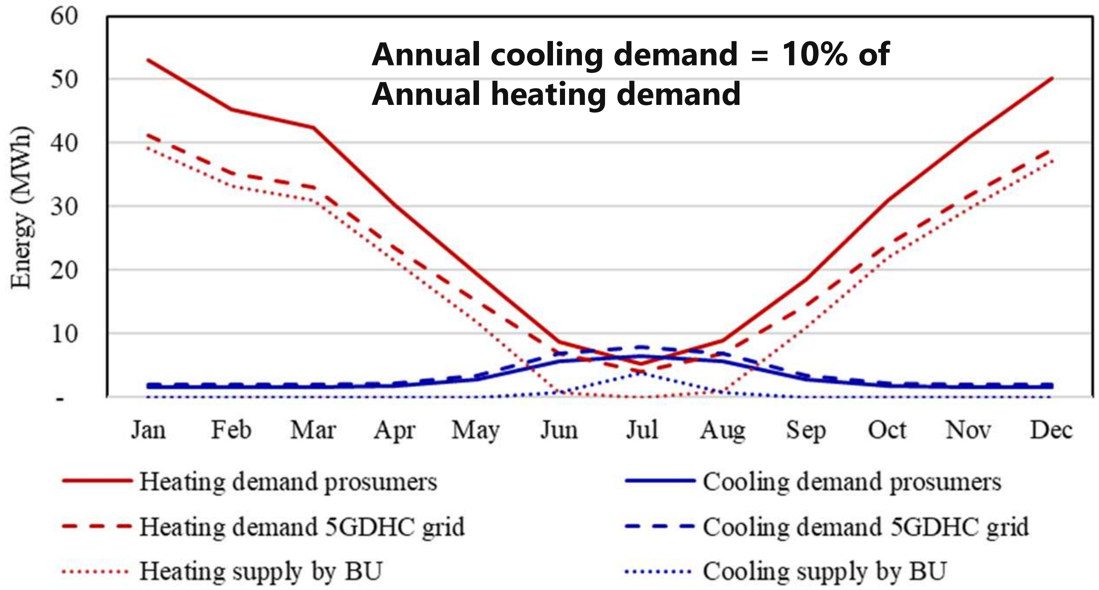
Heat decarbonisation solutions: Which?

- The primary potential advantage of **5GDHC** over these alternatives lies in its ability to facilitate energy reuse by satisfying both heating and cooling demands within the same network
- 5GDHC **economic viability** depends heavily on level of heating and cooling demand co-occurrence (overlapping heating and cooling demands at a point in time).
- But due to demand seasonality is rare to actually get high amounts of demand overlap, therefore the term **Demand Overlap Coefficient** is used.

Demand Overlap Coefficient

- The **Demand Overlap Coefficient (DOC)** depends on the hourly profiles of the demands rather than the annual benchmarks.

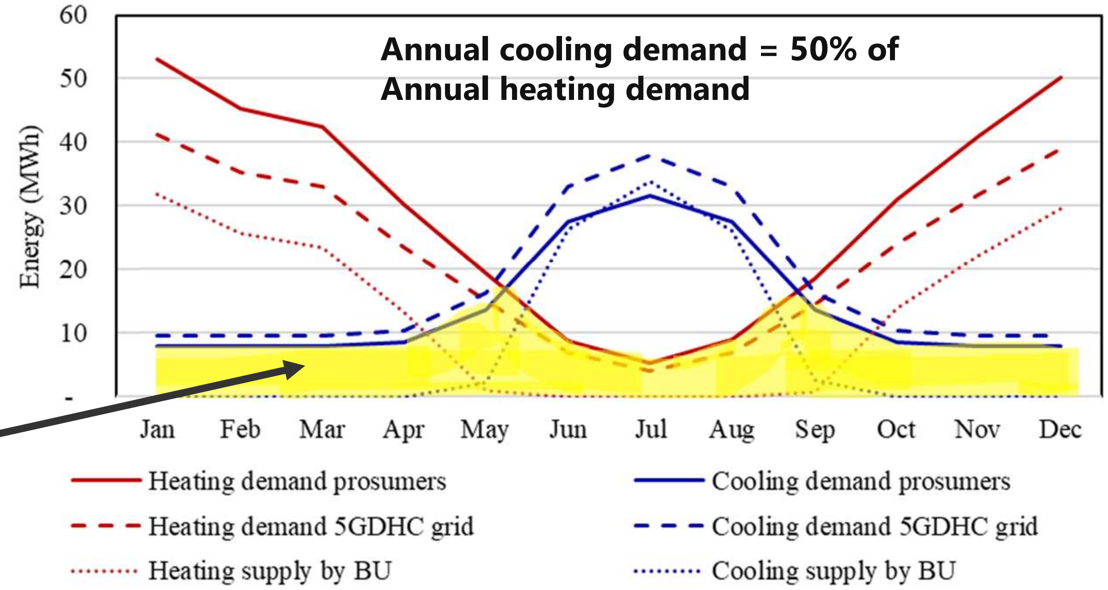




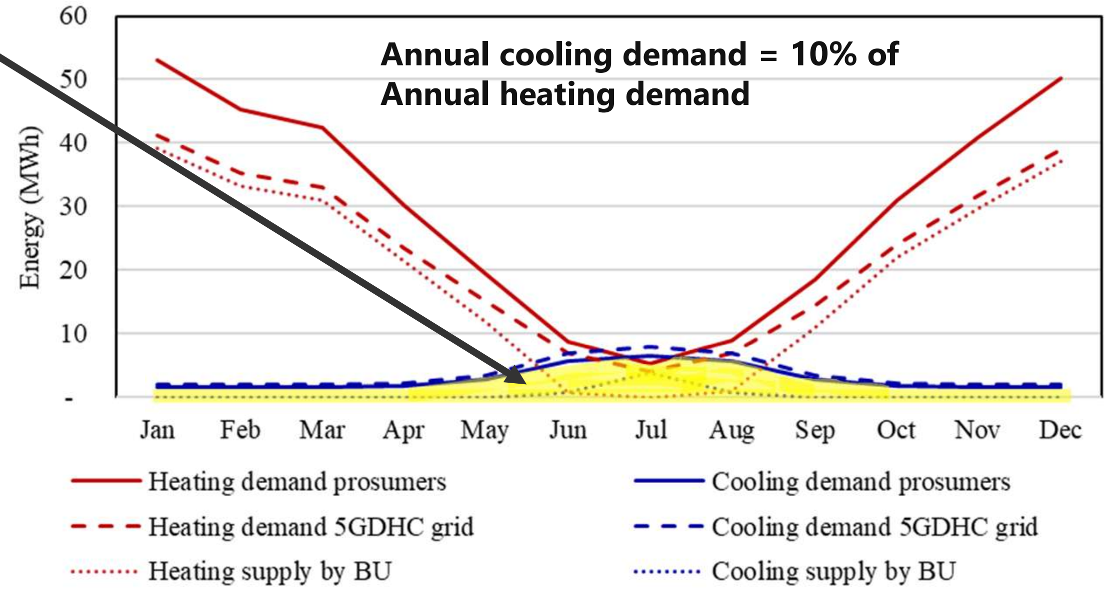
Demand Overlap Coefficient

- The **Demand Overlap Coefficient (DOC)** depends on the hourly profiles of the demands rather than the annual benchmarks.

Demand Overlap Coefficient = 21%



Demand Overlap Coefficient = 9%

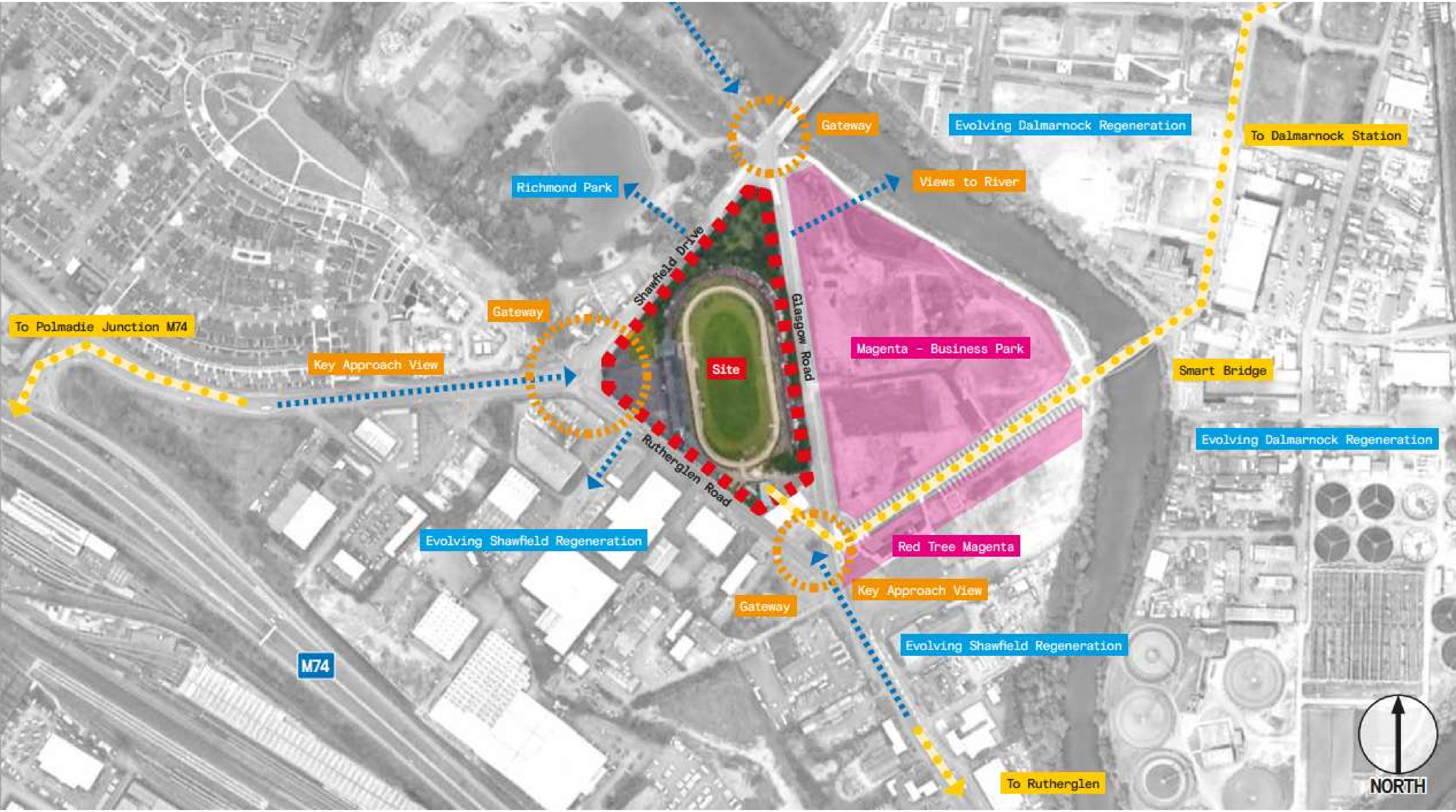


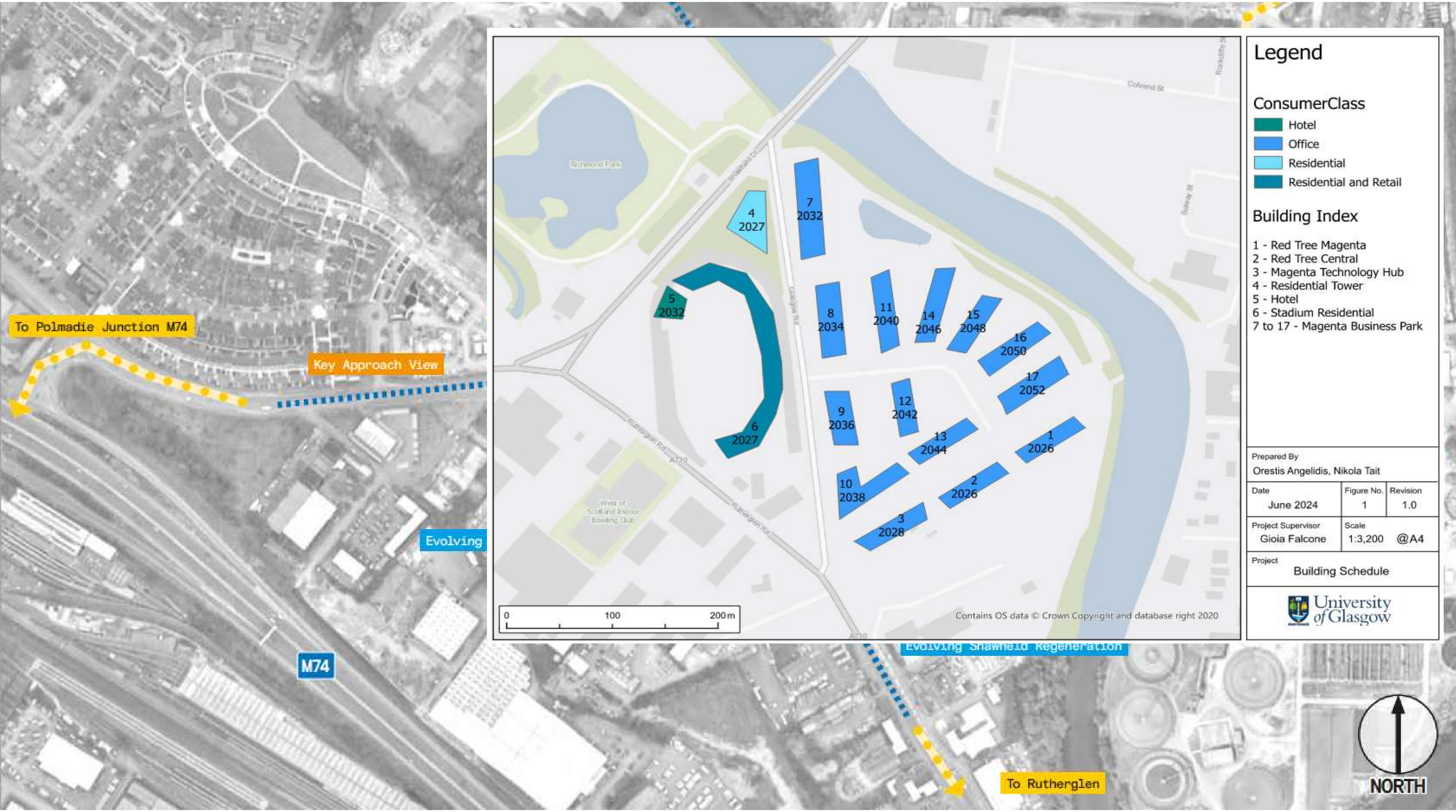
- A DOC of 20%-30% is reported as the minimum requirement for 5GDHC to start becoming economically competitive with other centralised systems.
- Zhang et al. (2023) is reporting that **only 0.1%** of the European building stock achieves a DOC greater than 30%, suggesting a restricted applicability for 5GDHC systems.

Low temperature waste heat

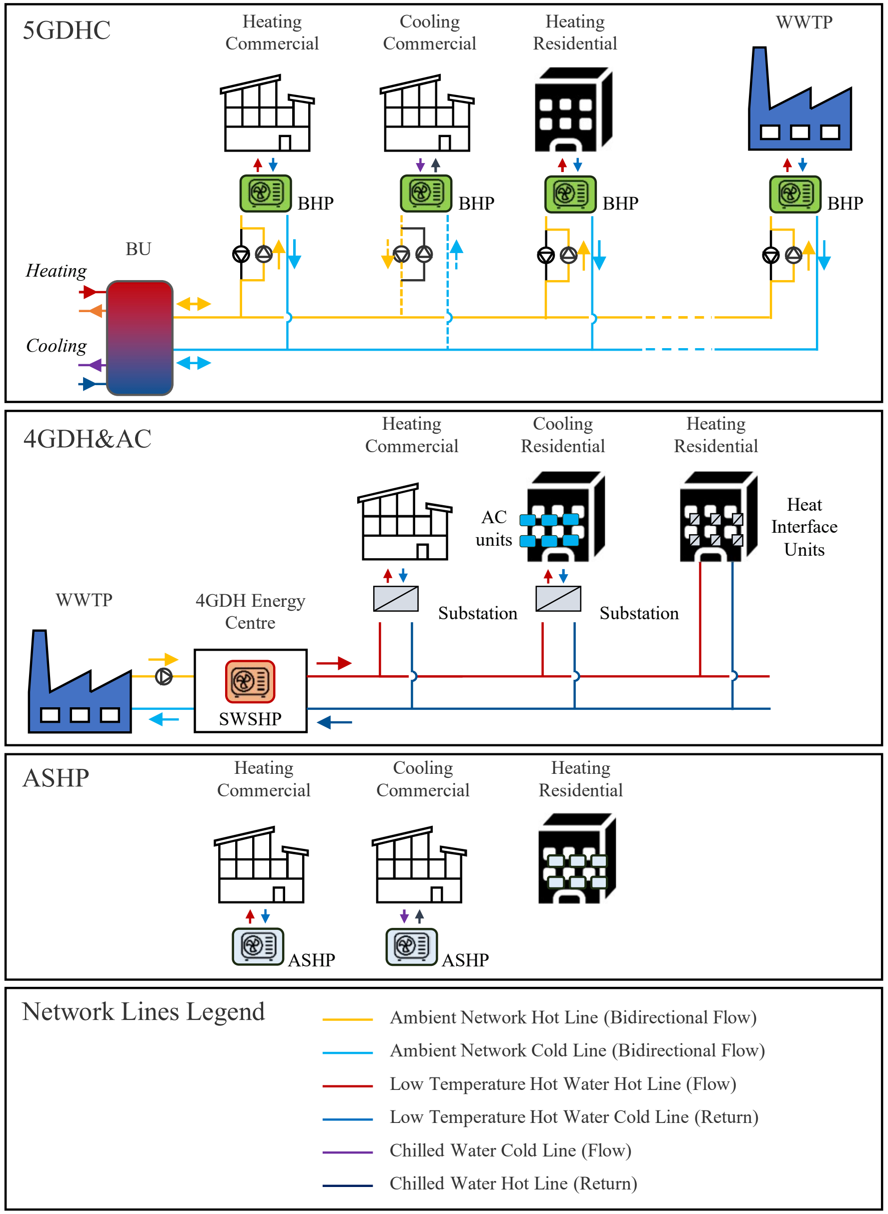
- Leveraging low temperature waste heat such as Waste-Water Treatment Plants (WWTP) as **a heat source/sink**, could help increase the amount of DOC in a system.
- What **system configurations** and **operational strategies** are most effective for integrating a low-temperature heat source/sink into a 5GDHC system?
- How does the techno-economic-environmental performance of 5GDHC systems utilising WWTPs as a dual source/sink compare to that of 4GDH and individual ASHP systems?
- What is the impact of these different 5GDHC designs (integrating WWTPs) on the local and wider electricity grid, particularly concerning grid capacity, when compared to 4GDH and individual ASHP systems?

Clyde Gateway Case Study


Gateway
Evolving Dalmarnock Regeneration
To Dalmarnock Station
Richmond Park
Views to River
Shawfield Drive
Glasgow Road
Gateway
To Polmadie Junction M74
Key Approach View
Site
Magenta - Business Park
Smart Bridge
Evolving Dalmarnock Regeneration
Rutherglen Road
Evolving Shawfield Regeneration
Red Tree Magenta
Key Approach View
Gateway
Evolving Shawfield Regeneration
M74
To Rutherglen
NORTH

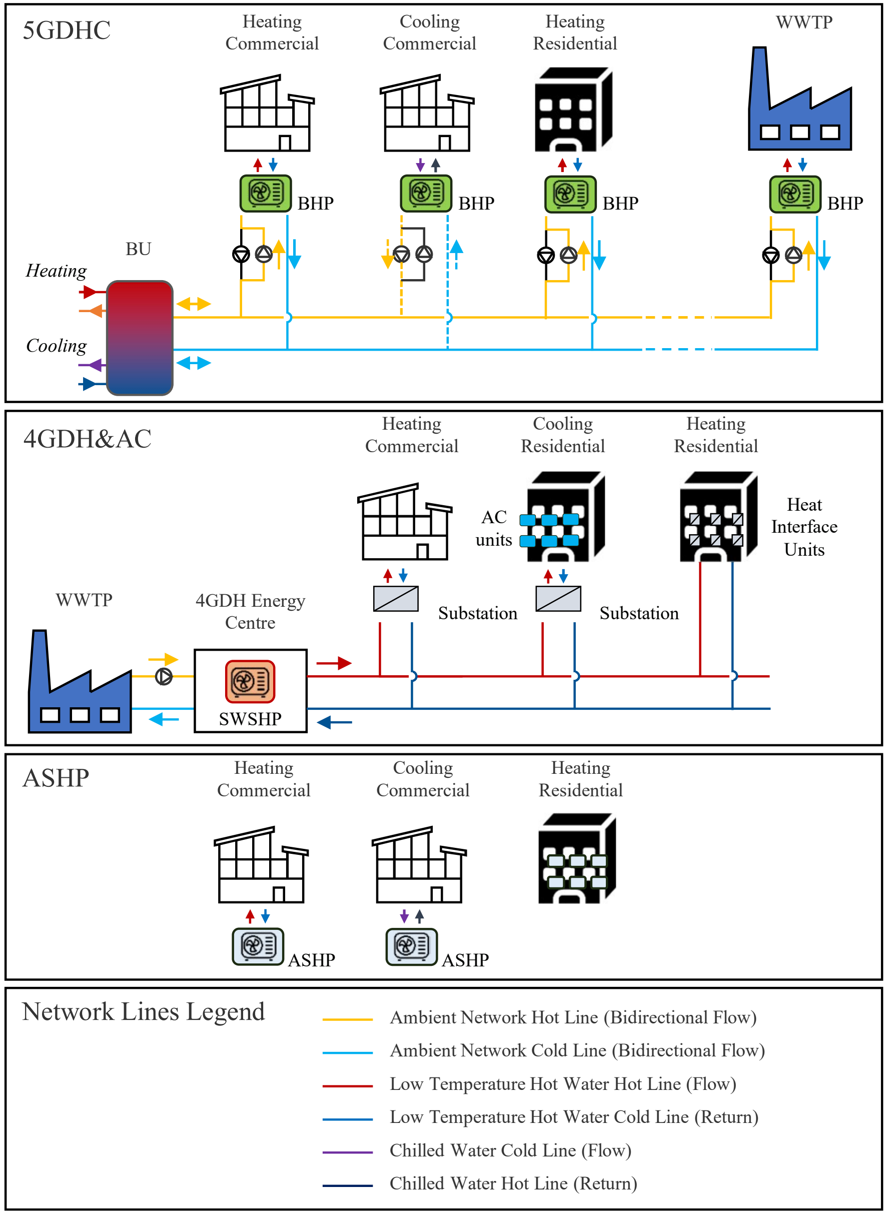


To Polmadie Junction M74
Key Approach View
Evolving
M74
Evolving Shawfield Regeneration
To Rutherglen
NORTH
Legend
ConsumerClass
Hotel
Office
Residential
Residential and Retail
Building Index
1 - Red Tree Magenta
2 - Red Tree Central
3 - Magenta Technology Hub
4 - Residential Tower
5 - Hotel
6 - Stadium Residential
7 to 17 - Magenta Business Park
1 2026
2 2026
3 2028
4 2027
5 2032
6 2027
7 2032
8 2034
9 2036
10 2038
11 2040
12 2042
13 2044
14 2046
15 2048
16 2050
17 2052
0 100 200 m
Contains OS data © Crown Copyright and database right 2020
Prepared By
Orestis Angelidis, Nikola Tait
Date
June 2024
Figure No.
1
Revision
1.0
Project Supervisor
Gioia Falcone
Scale
1:3,200 @A4
Project
Building Schedule
University of Glasgow



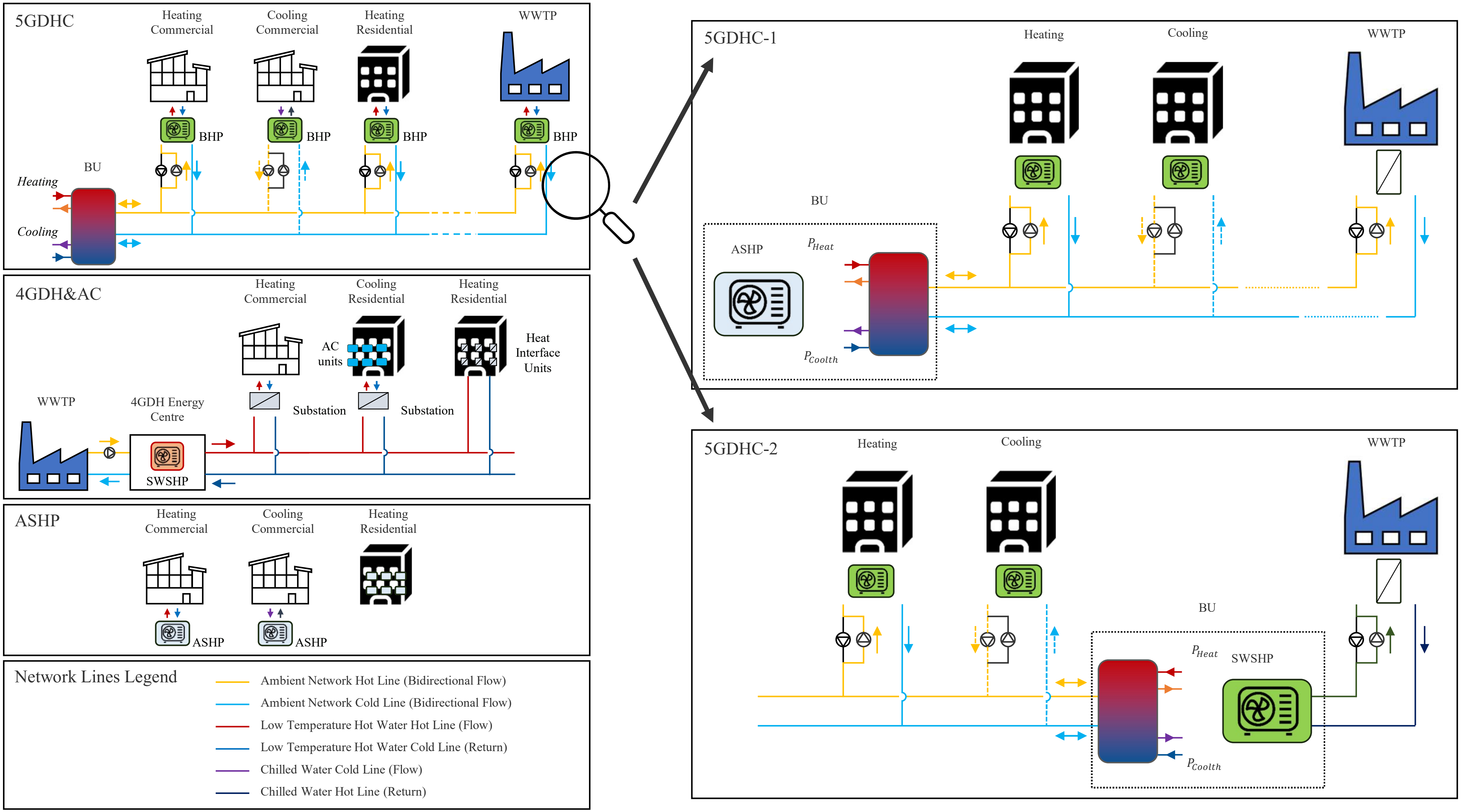
Heat decarbonisation solutions; Which?

- 5th Generation District Heating and Cooling (5GDHC) meets heating and cooling demands through the same network, using decentralised booster heat pumps in district, building, or flat level.
- 4th Generation District Heating (4GDH) with individual Air Condition (AC) units for cooling.
- Individual building level reversible Air Source Heat Pumps (ASHPs).

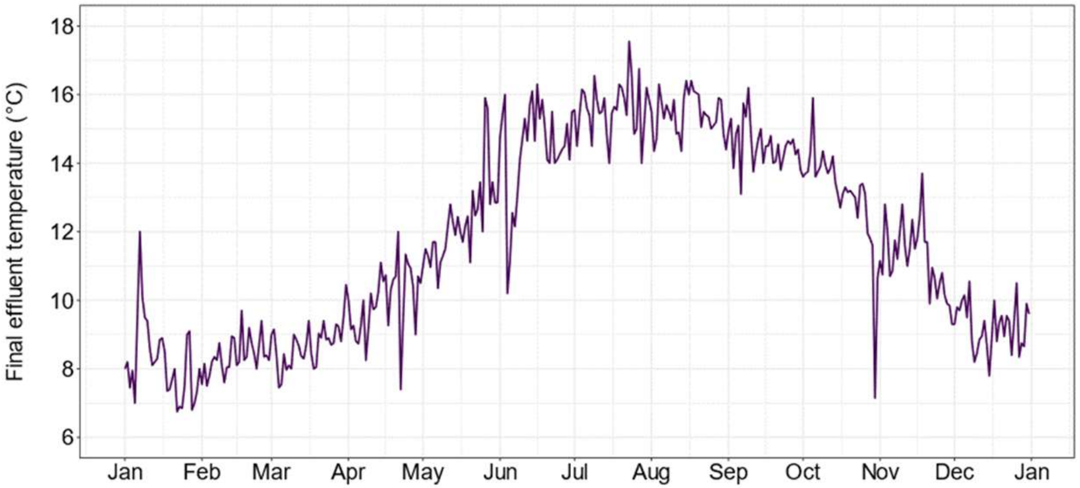


Heat decarbonisation solutions; Which?

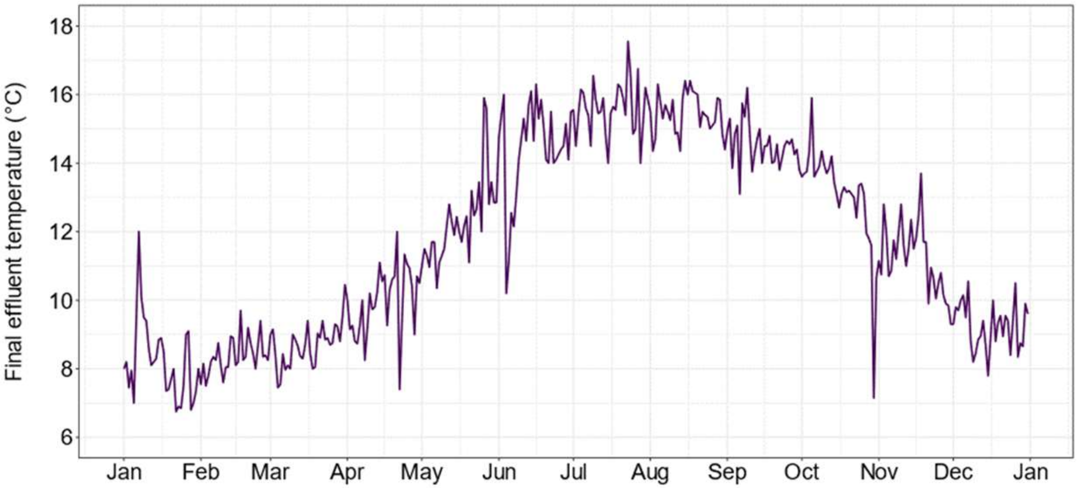
- **For 5GDHC two possible scenarios**
- **Scenario 1 (referred to as 5GDHC-1):** use of existing HEX at the WWTP plant. Appropriate network temperatures are needed to use the WWTP as a heat source during winter and as a heat sink during summer.
- **Scenario 2 (referred to as 5GDHC-2):** WWTP acts as a heat source/sink for a reversible SWSHP in the BU. The SWSHP acts as the main charging unit for the BU's TES.

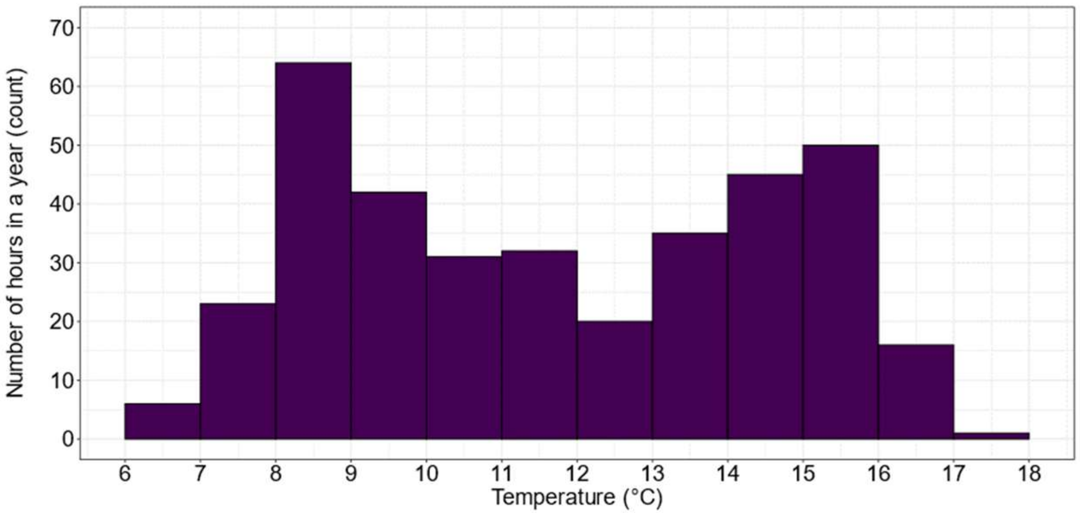

5GDHC
Heating Commercial
Cooling Commercial
Heating Residential
WWTP
BHP
BU
Heating
Cooling
4GDH&AC
Heating Commercial
Cooling Residential
Heating Residential
AC units
Heat Interface Units
WWTP
4GDH Energy Centre
Substation
SWSHP
ASHP
Heating Commercial
Cooling Commercial
Heating Residential
ASHP
Network Lines Legend
Ambient Network Hot Line (Bidirectional Flow)
Ambient Network Cold Line (Bidirectional Flow)
Low Temperature Hot Water Hot Line (Flow)
Low Temperature Hot Water Cold Line (Return)
Chilled Water Cold Line (Flow)
Chilled Water Hot Line (Return)
5GDHC-1
Heating
Cooling
WWTP
BU
ASHP
P_{Heat}
P_{Coolth}
5GDHC-2
Heating
Cooling
WWTP
BU
P_{Heat}
SWSHP
P_{Coolth}

Waste heat utilisation

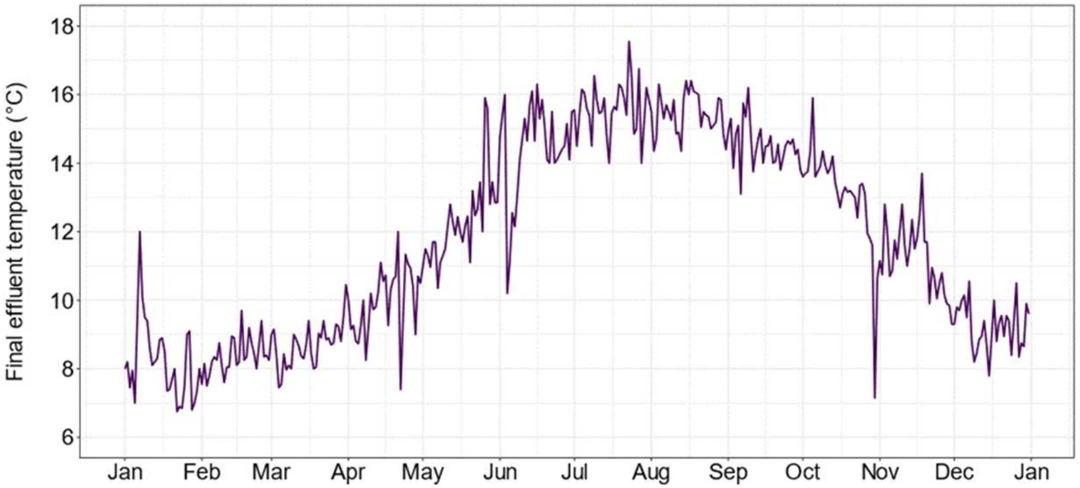


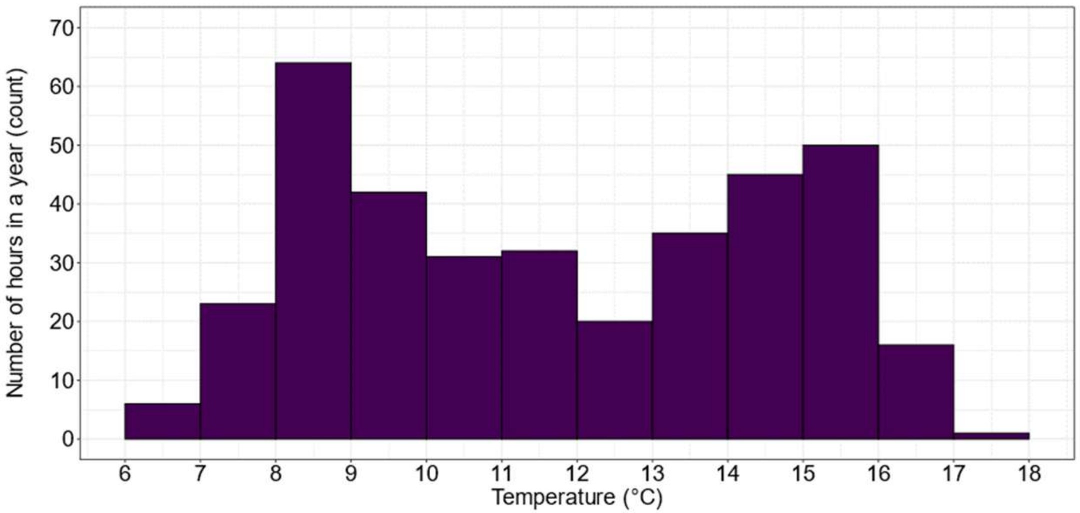
Waste heat utilisation

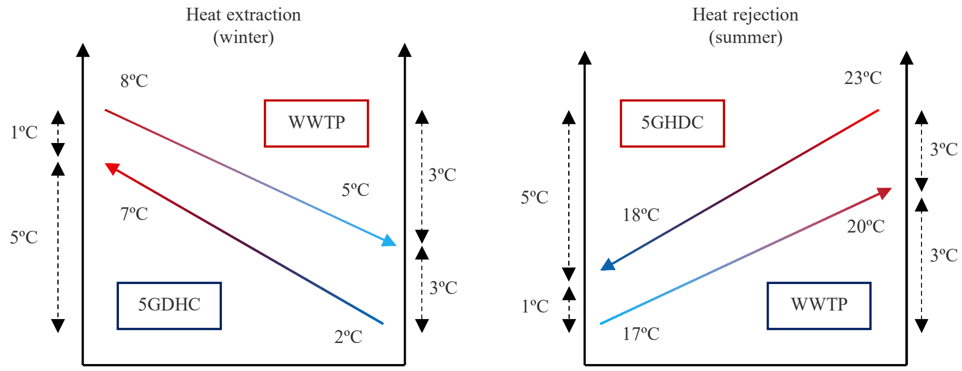




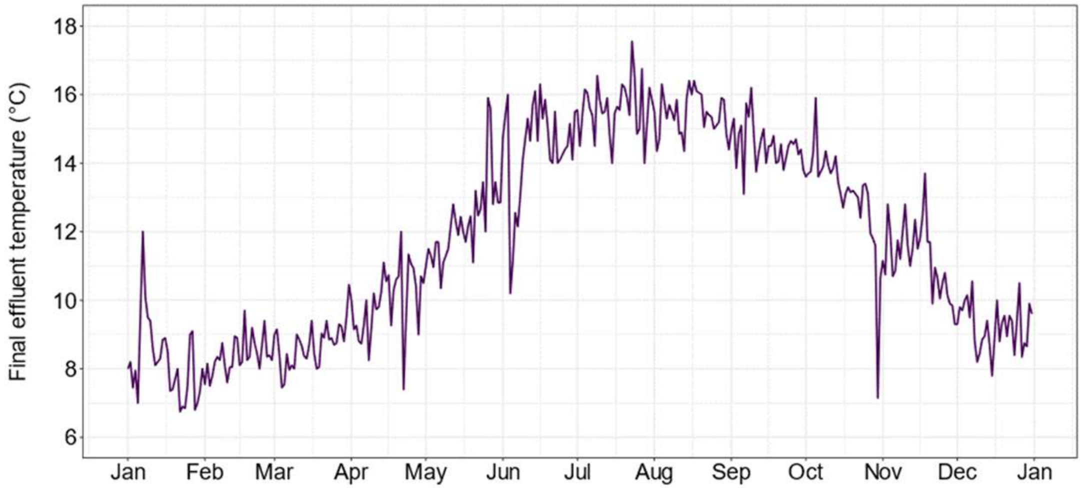
Waste heat utilisation

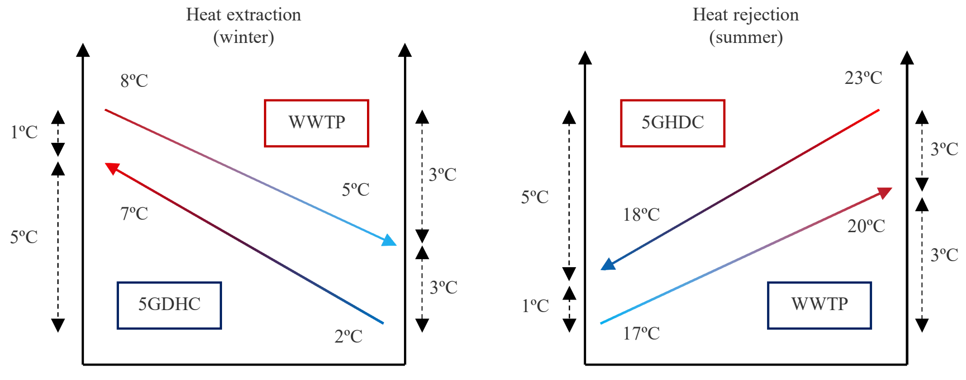


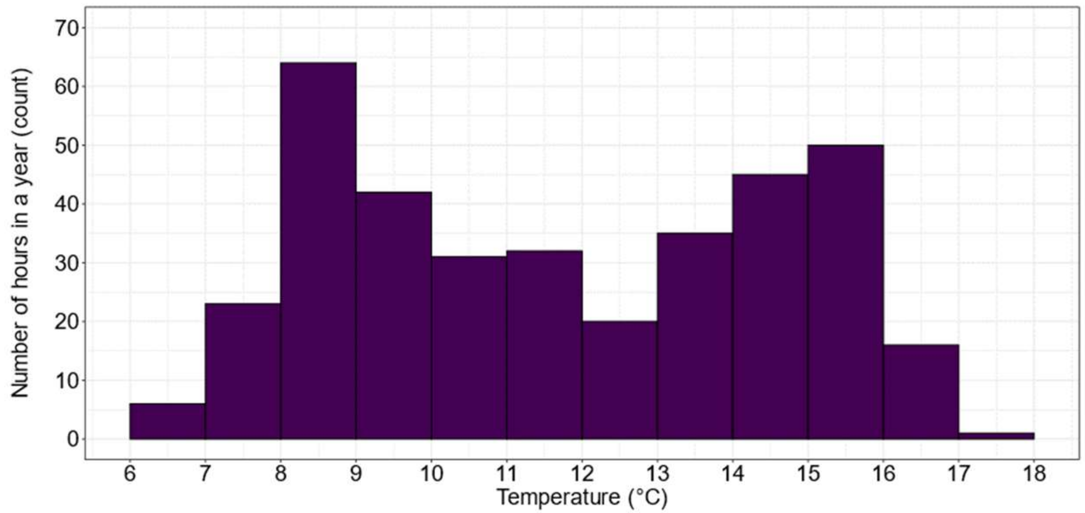


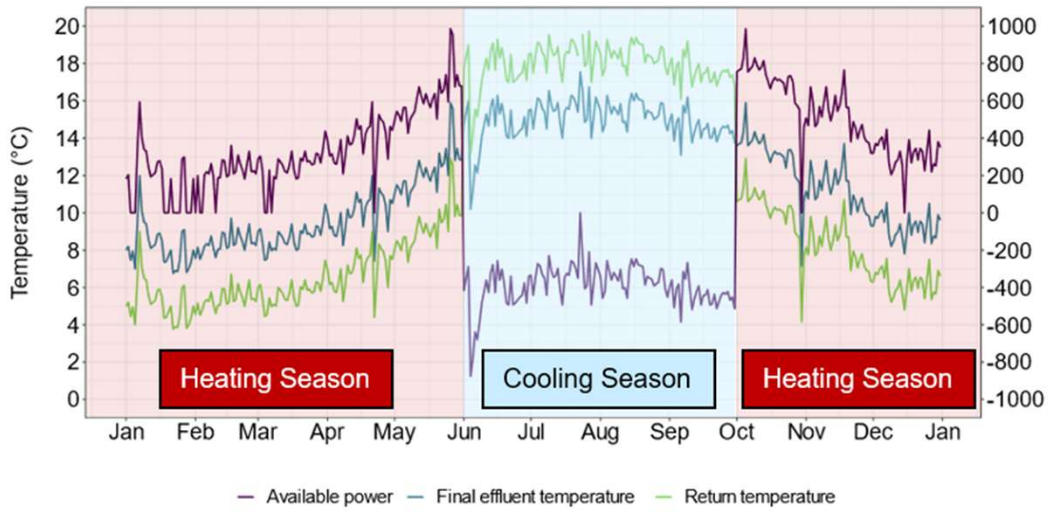


Waste heat utilisation









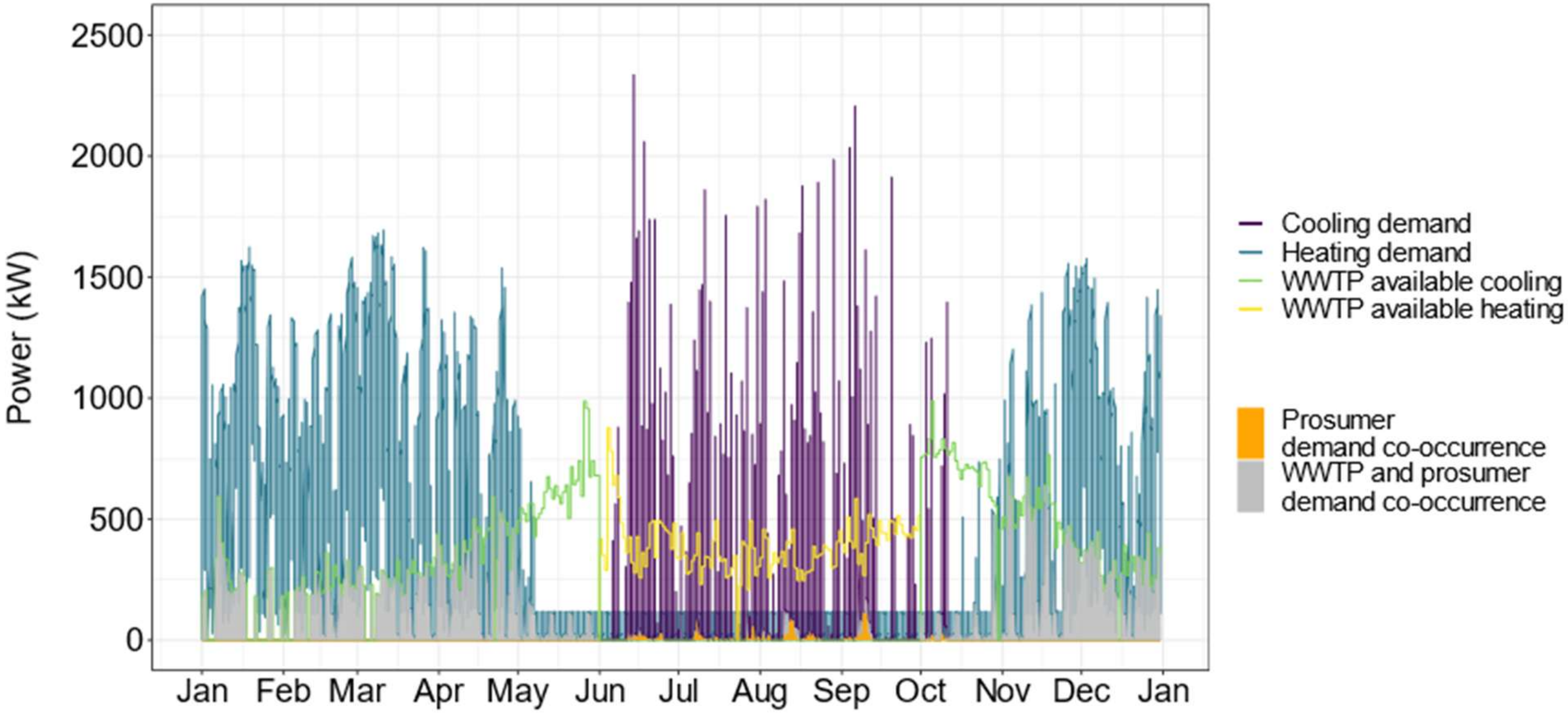
Analysis methodology

Stage	Action	Model / Software	Output
1. Demand Modelling	Demand assessment for individual buildings	Modelica ProHMo building models	Individual prosumer hourly power supply profile
2. Supply Analysis	Design for waste heat utilisation and other supply energy assets	Excel	5GDHC and 4GDH network characteristics
3. Network Simulation	Integrate prosumer profiles and fixed network controls	Modelica ProHMo prosumer/BU models	Hourly power flow profile for ambient network
4. Hydraulic Analysis	Network topology in GIS and hydraulic assessment	GIS and CATHeaPS	Pipe schedule and network characteristics for 5GDHC and 4GDH networks
5. Techno-Economic-Environmental Analysis	Calculate total system yearly electricity use	CATHeaPS	Complete Techno-Economic-Environmental Analysis

- A lot more details on each of these can be found on the paper which **is open access. → QR code**

https://www.sciencedirect.com/science/article/pii/S0378778826003166?via%3Dihub

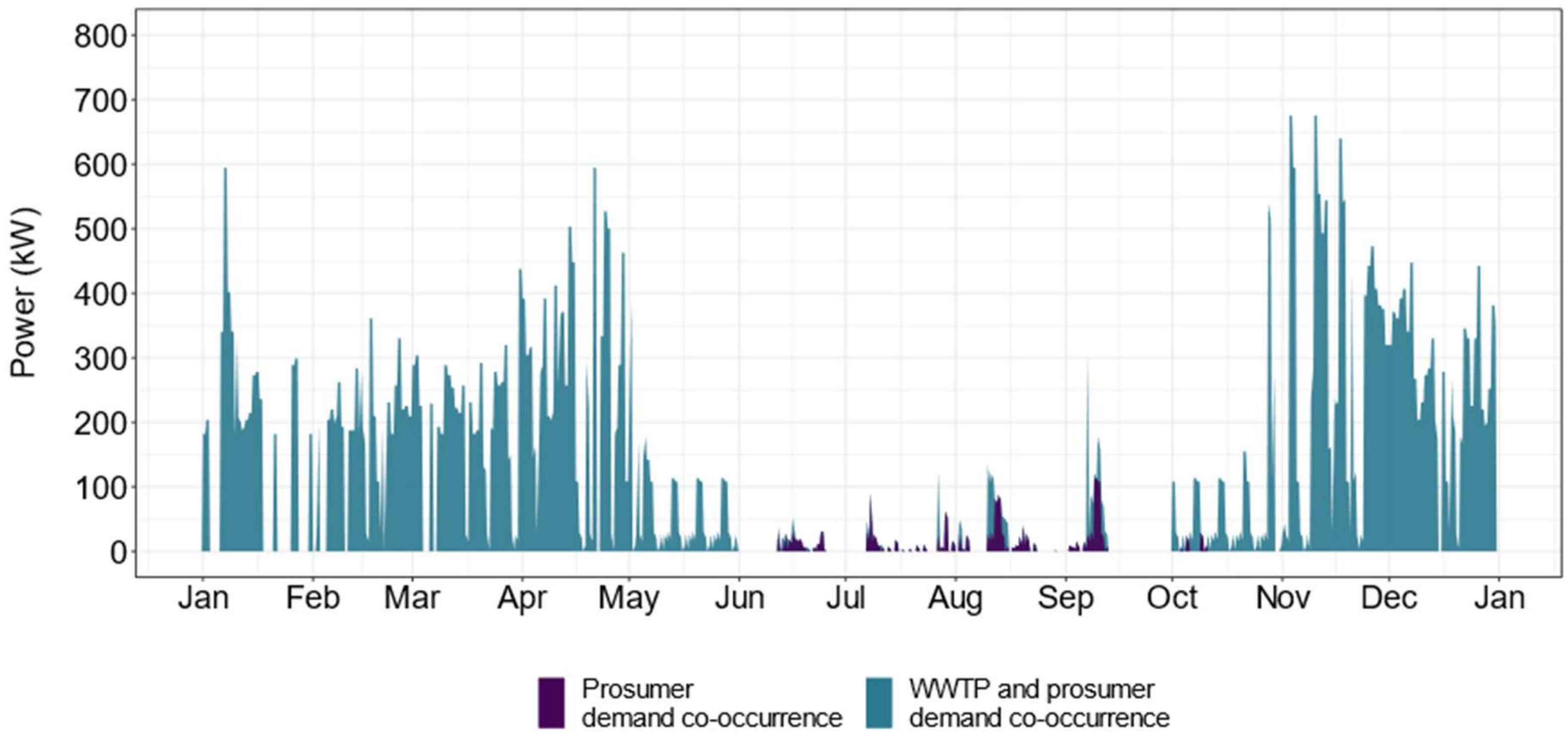
Results: The effect of low temperature waste heat



- Seasonal demand profile. Heating and cooling demand co-occurrence of **114MWh for full built out**, which represents **3.4%** of the total energy demand.

- The potential **energy share from the WWTP reaches 38.4%** with the additional 3.4% coming from demand overlap from buildings.

Results: The effect of low temperature waste heat

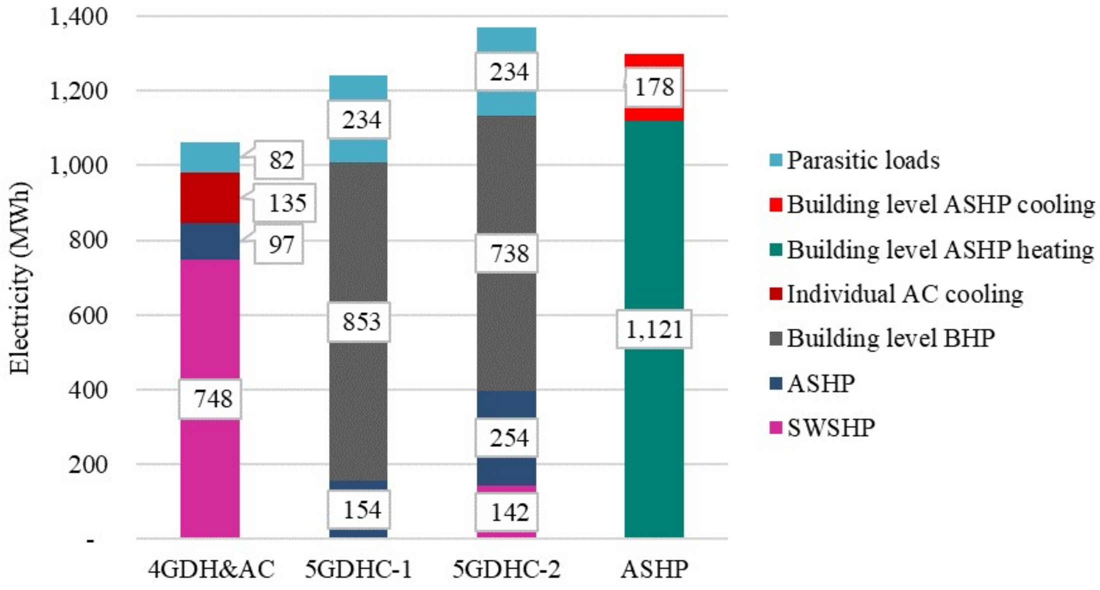


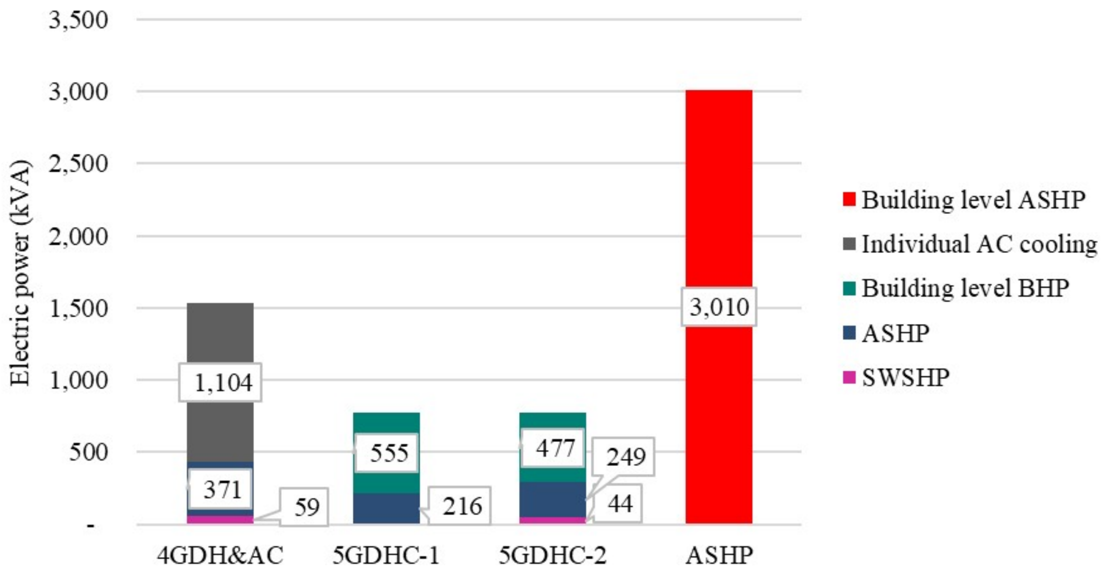
- Seasonal demand profile. Heating and cooling demand co-occurrence of **114MWh for full built out**, which represents **3.4%** of the total energy demand.

- The potential **energy share from the WWTP reaches 38.4%** with the additional 3.4% coming from demand overlap from buildings.

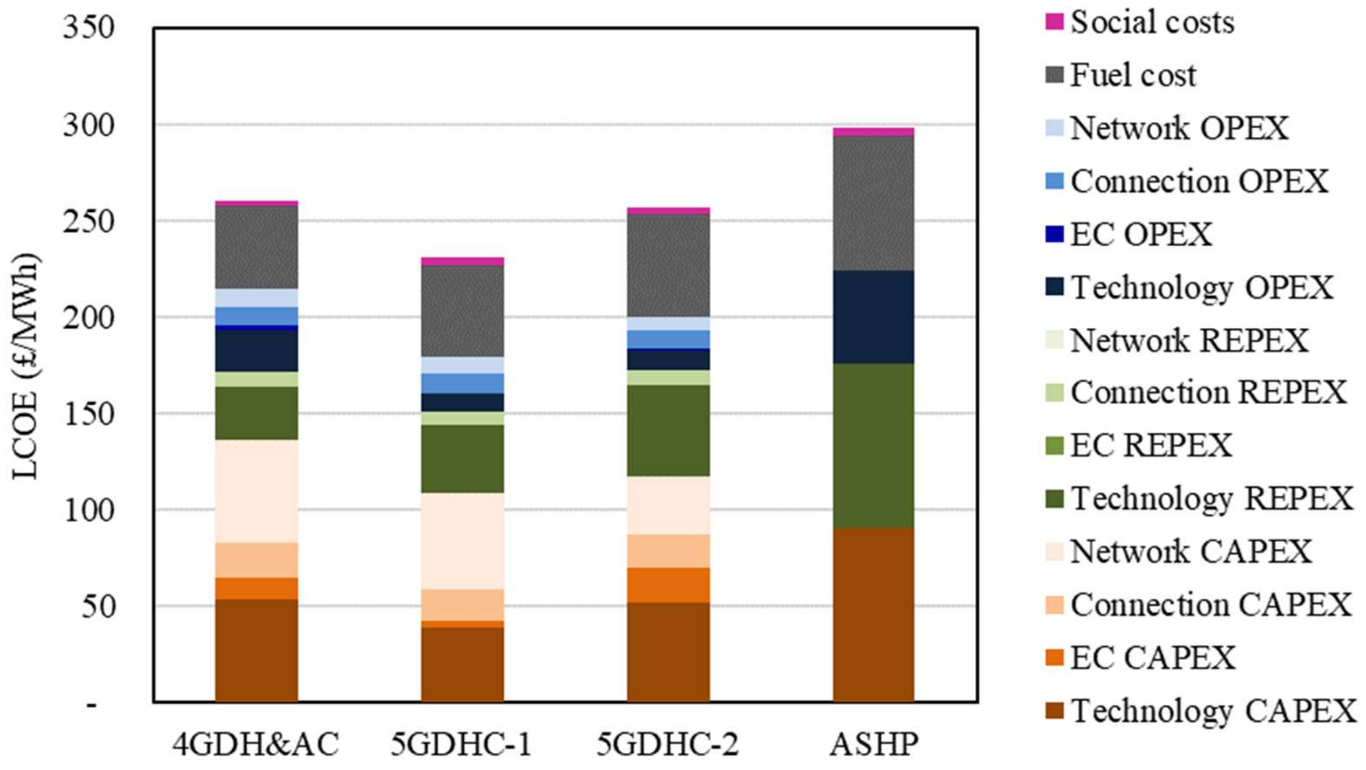
Results: Electricity use

- 5GDHC requires more electricity overall than DH&AC units.
- There are variations on the total electric power capacity requirements, ranging from 1.5MVA for 4GDH&AC and 3.0MVA for ASHP to 0.8MVA for 5GDHC-1 and 5GDHC-2.
- Overall, the solutions with decentralised, individual units have a large electrical capacity requirement, even though their individual impact is small.



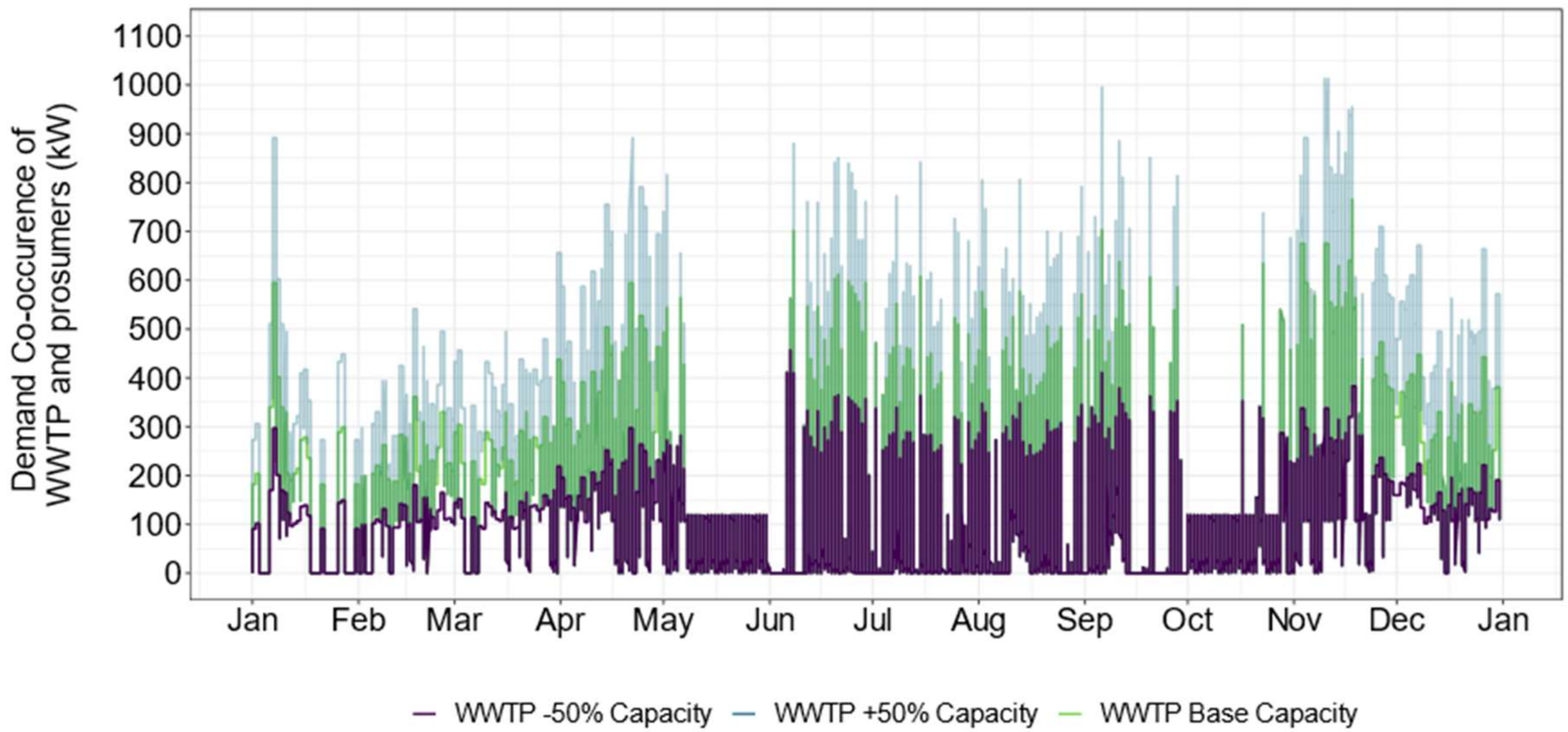


Results: The effect of low temperature waste heat



- The best performing scenario is 5GDHC-1 with a LCOE of 227£/MWh. 5GDHC-2 has the second lowest LCOE with 253£/MWh. The 4GDH&AC scheme is the next best performing option with an LCOE of 257£/MWh and lastly the ASHP option has a LCOE of 294£/MWh.

Results: Sensitivity analysis of WWTP capacity



- For 5GDHC-2, the only difference will be the SWSHP's share of supply but for 5GDHC-1, the effect on the BU demand needs to be studied.

- When the WWTP available capacity increases by 50% and the DOC reaches 41.8%, the electricity use drops by 76%. Adversely, when there is 50% less available WWTP capacity and the DOC is at 28.1%, the electricity use increases by 40%.

Discussions

- High LCOE in new buildings due to low demands.
- Seasonality of heating and cooling demands.
- 5GDHC could provide flexibility in phasing the CAPEX by utilising reversible units.
- Low demand co-occurrence can be tackled by utilising low temperature waste heat sources.
- Several limitations include:
  - Hydraulic component behaviour.
  - Impact of more complex control regimes for the prosumer BHPs.
  - Incorporation of an equipment free BU.
  - Investigation of a wider technology mix.

Conclusions

- Proposal of a detailed 5GDHC feasibility study including design and operation for a real case study with waste heat utilisation.
- More electricity use for 5GDHC due to lower SPF than DH&AC but lower capacity requirement due to reversible units.
- Best economic performance for 5GDHC.
- More complicated controls for the 5GDHC network.
- Quantified benefits and shortfalls of 5GDHC against counterfactuals. Proposed 5GDHC as best option for 5GDHC when waste heat is available.

Thank you for your time

A lot more details on each of these can be found on the paper which **is open access.** → **QR code**

https://www.sciencedirect.com/science/article/pii/S0378778826003166?via%3Dihub

Scotland

Conference Panel Session

Chaired by Tanja Groth

Scotland

Closing Address

Sarah Peterson

CIBSE Scotland Vice Chair