

Key stages in mine energy project development

Bobo Ng PhD, CEng, MCIBSE
Programme Manager, North East LEP
Geothermal Task Force

Geothermal Task Force Mine Energy White Paper and project development process

The Case for Mine Energy – unlocking deployment at scale in the UK

A mine energy white paper

Both papers can be downloaded in our website:
<https://www.northeastlep.co.uk/key-sectors/energy/energy-for-growth/geothermal-task-force/>

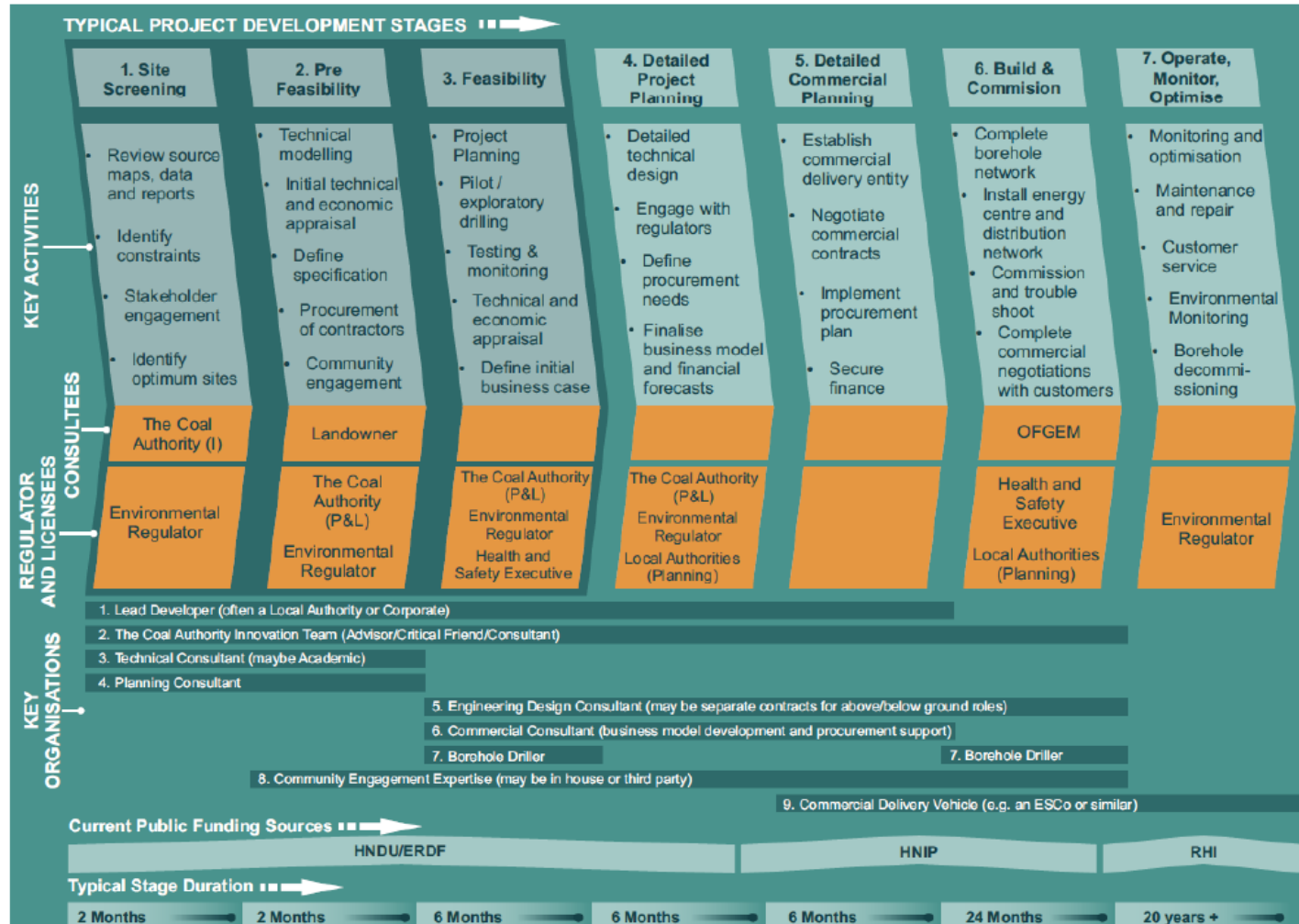


Characteristics of a typical mine energy project and the development process

APPENDIX TO NELEP MINE ENERGY WHITE PAPER

Key stages in Mine Energy Project Development

Figure 2: Key Stages in the Development of a Mine Energy Project



Characteristics of a typical mine energy project and the development process

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Note: There are two relevant teams at The Coal Authority with distinct and separate roles; the Innovation Team (I) and the Permissions and Licensing Team (P&L).

Characteristics of a typical mine energy project and the development process

APPENDIX TO NELEP MINE ENERGY WHITE PAPER

3.1 Stage 1 - Site Screening

Stage Summary: A high level review to identify potential projects within a given area. Often this is used to inform the development of a Master Plan (as required by HNDU funding) which may identify multiple potential projects and highlight the most viable.

3.2 Stage 2 - Pre-Feasibility Assessment

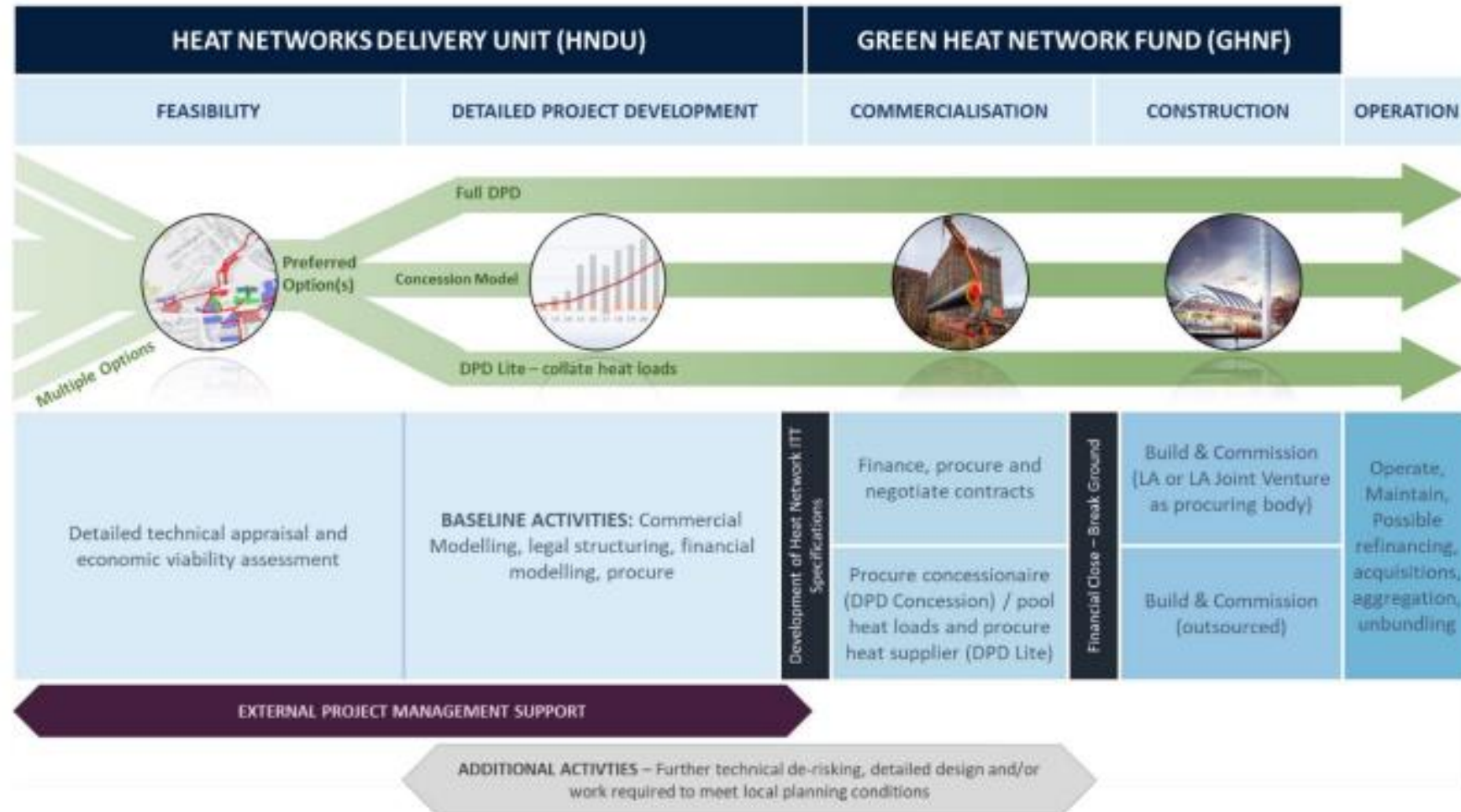
Stage Summary: Once a preferred location has been identified, the pre-feasibility study undertakes further, more detailed site-specific analysis to confirm its initial technical and economic potential, to plan for the detailed Feasibility Study and to identify the most appropriate drilling or abstraction location(s).

3.3 Stage 3 - Feasibility Study

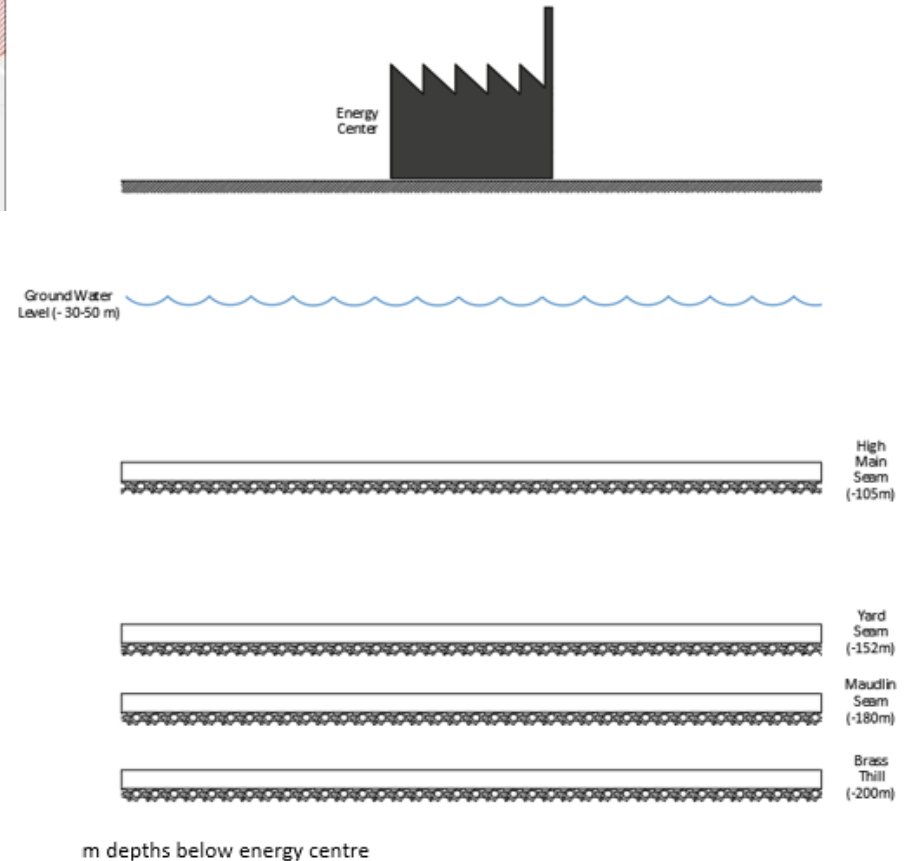
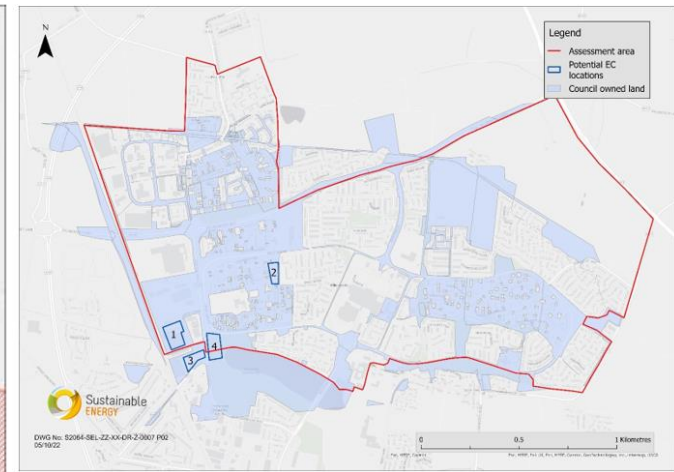
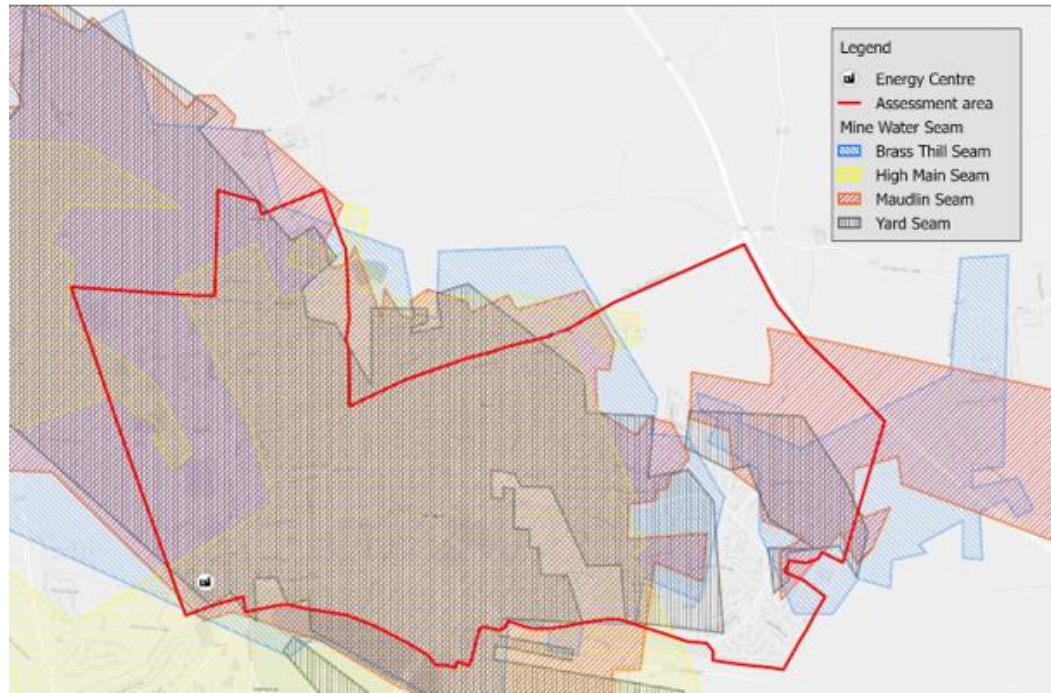
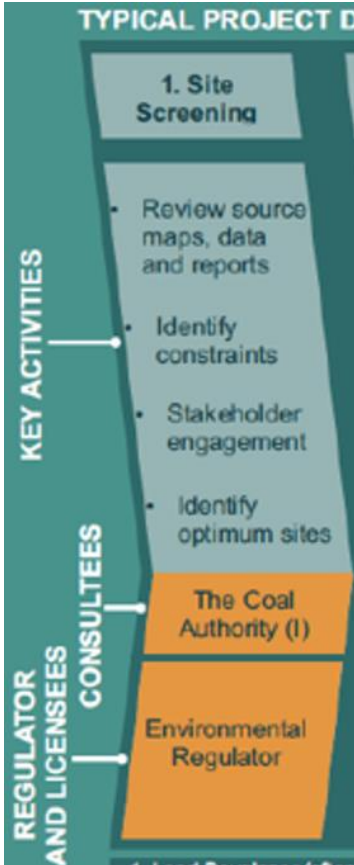
Stage Summary: To accurately determine the technical and economic viability of a proposed mine energy scheme via exploratory field investigations and develop a commercial business case.

Key stages of Heat Network development

Figure 1: Heat Network Development Stages



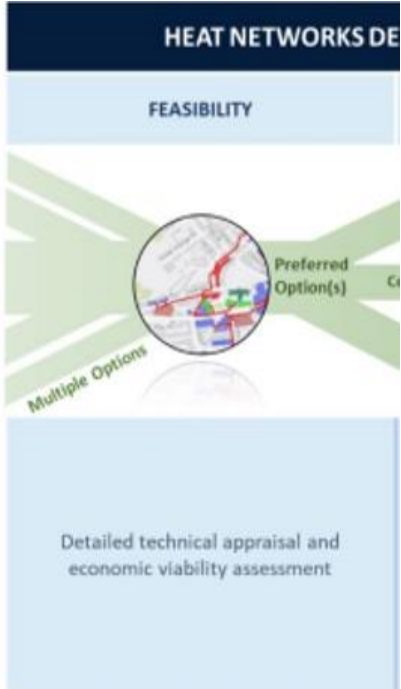
Stage 1 - Mine Heat Feasibility



Stage 1

- Mined areas and outcrops;
- Depths of potential target workings;
- Mine water monitoring sites where available;
- Position of known surface discharges if any in the locality;
- Anticipated mine water temperatures and heat yields.
- Gaps in knowledge
- Recommendations

Heat Network Feasibility – HNDU Master Planning



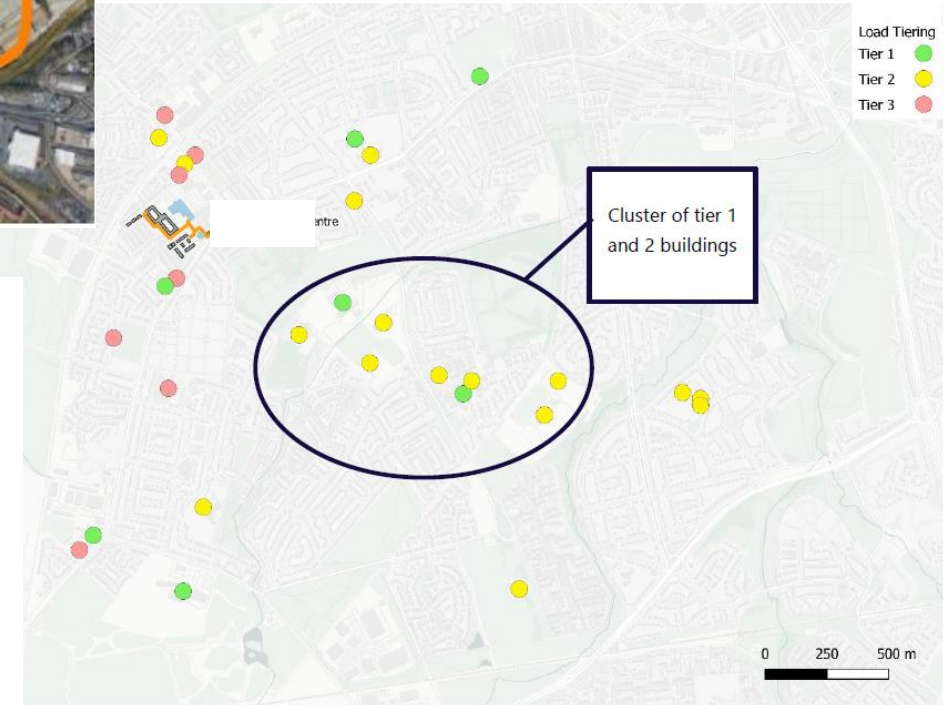
Potential heat source: Industrial waste heat, River source, mine water source



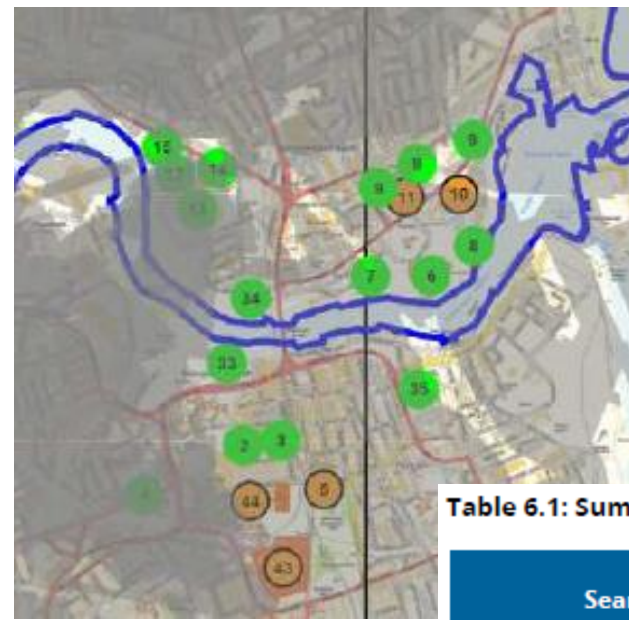
Heat demand analysis:

A tiering system based on annual heat demand, building ownership and typology was used to refine the initial list of possible building connections

- | Tier | Building Type |
|---------------|---|
| Tier 1 | <ul style="list-style-type: none"> Building with annual heat demand >1000 MWh/a, excluding multi-address buildings Local government or other public building with annual heat demand >500MWh/a Any planned building with annual heat demand > 500 MWh/a Planned local government or other public building with annual heat demand >100MWh/a Publicly owned planned sites with unknown annual heat demand |
| Tier 2 | <ul style="list-style-type: none"> Local government or other public building with annual heat demand >100MWh/a & <500 MWh/a Private building with annual heat demand >500MWh/a & <1000 MWh/a Planned private buildings with annual heat demand >100MWh/a & <500MWh/a Buildings in planning phase: privately owned with annual heat demand >100MWh/a & <500MWh/a Unknown heat demand either planned private developments or existing public buildings |
| Tier 3 | <ul style="list-style-type: none"> Any building with annual heat demand <100MWh/a Any Private building with annual heat demand >100MWh/a & <500MWh/a Existing private buildings with unknown heat demand |



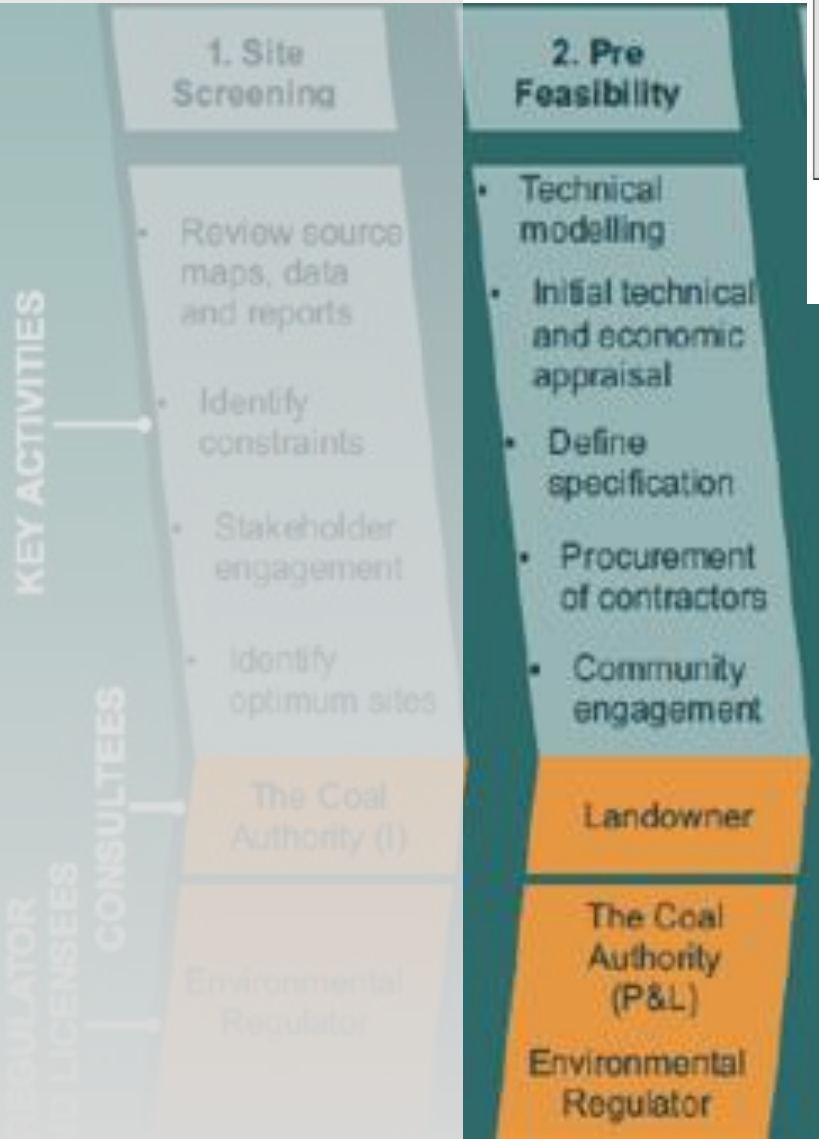
Mine Heat Feasibility – Stage 2



Review of site area for borehole options

Table 6.1: Summary of mine workings in study site areas

Seam	(1)	(24)	(36)	(43)
Ryhope	No	No	No	No
Yard/Bottom Yard	No	No	No	No
Maudlin	Recorded	Recorded	Recorded	Recorded
Brass Thill	No	No	No	No
Hutton	Recorded	Recorded	Recorded	No
Harvey	Recorded	Recorded	No	Recorded



Stage 2 Scope

- Detailed review of deposited abandonment plans
- Identification of potential target workings for abstraction and reinjection boreholes;
- Risks associated with identified borehole site areas;
- Estimated costs for drilling abstraction and reinjection boreholes;

**Discuss with Coal Authority/ design consultant to confirm the details of scope*

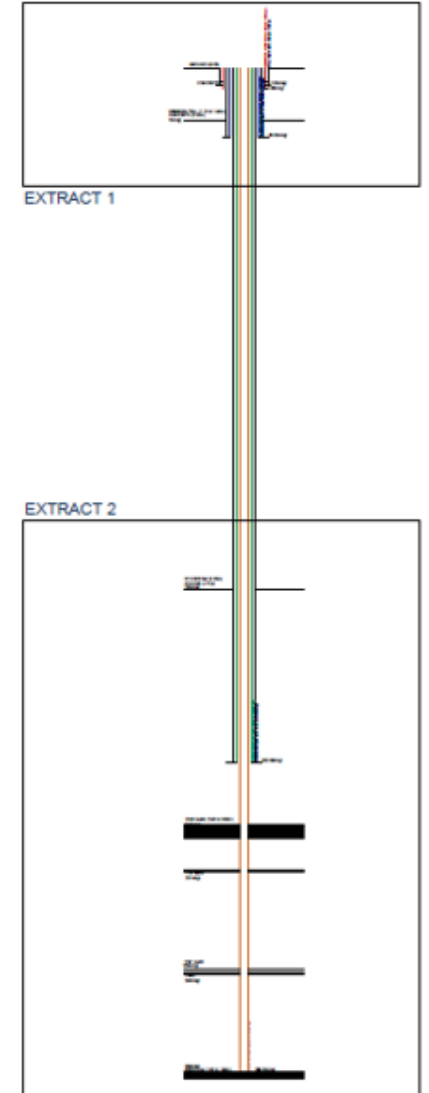


Mine Heat Feasibility – Stage 2

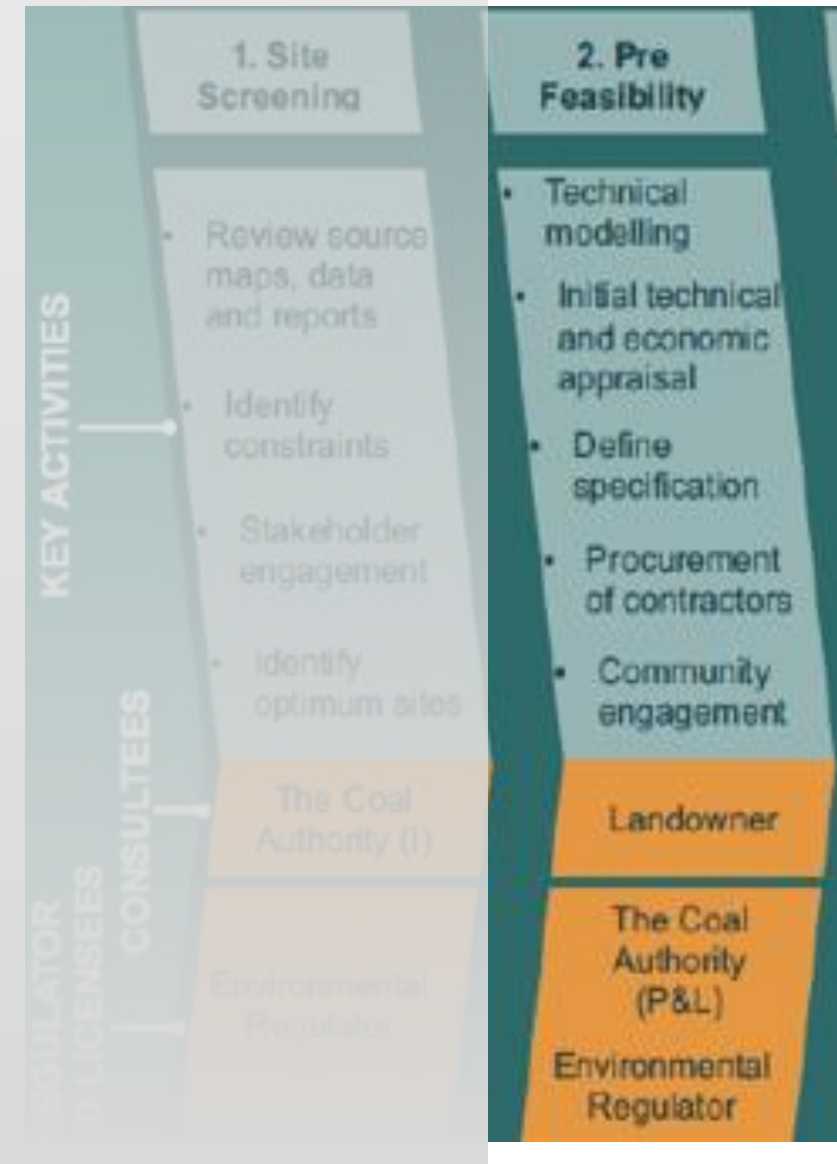
This stage includes the development of a detailed project plan for the subsequent Feasibility Study, the development of a drilling specification for the pilot or exploratory boreholes, and a protocol for subsequently testing of the mine water (e.g. temperature, quality, flow rates and levels).

- 5 Borehole Design Review
- 5.1 Basis of Design (Drilling Method Statement)
- 5.1.1 Casing design
- 5.2 Quality Assurance and Quality Management Plan
- 5.3 Pollution Prevention Plan
- 5.4 Mine Gas Drilling Management Plan.....
- 5.5 Site Waste Management and Disposal Plan.....
- 5.6 Operational Program
- 5.7 Construction Phase Health and Safety Plan

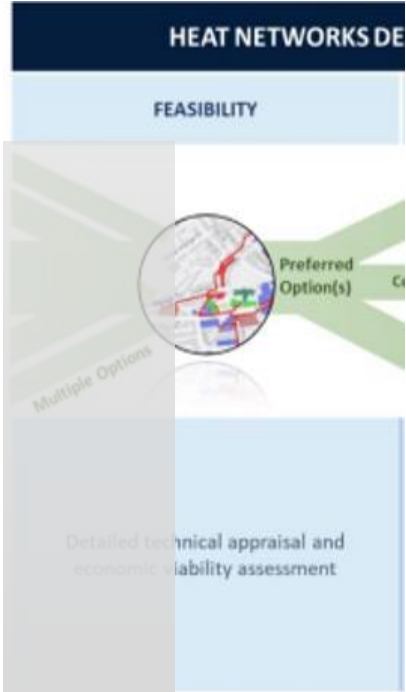
how to size; optimum velocities for extraction/injection; extraction pump specification; water level measurement devices; types of casing; grouting; flushing requirements;



**Discuss with Coal Author, confirm the details of scop.*



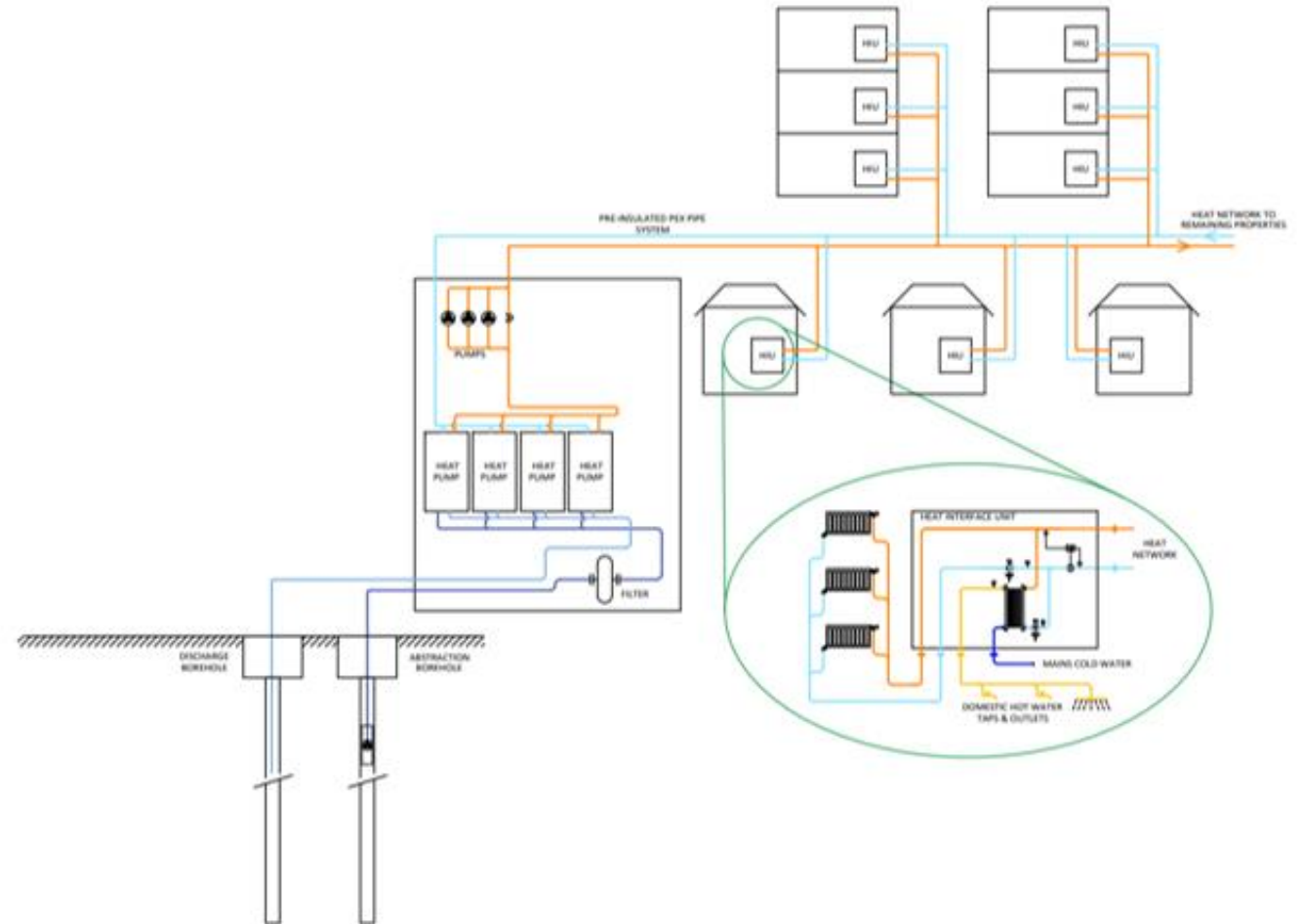
Heat Network Feasibility – Techno-feasibility study



Typical Long list options of potential heat sources

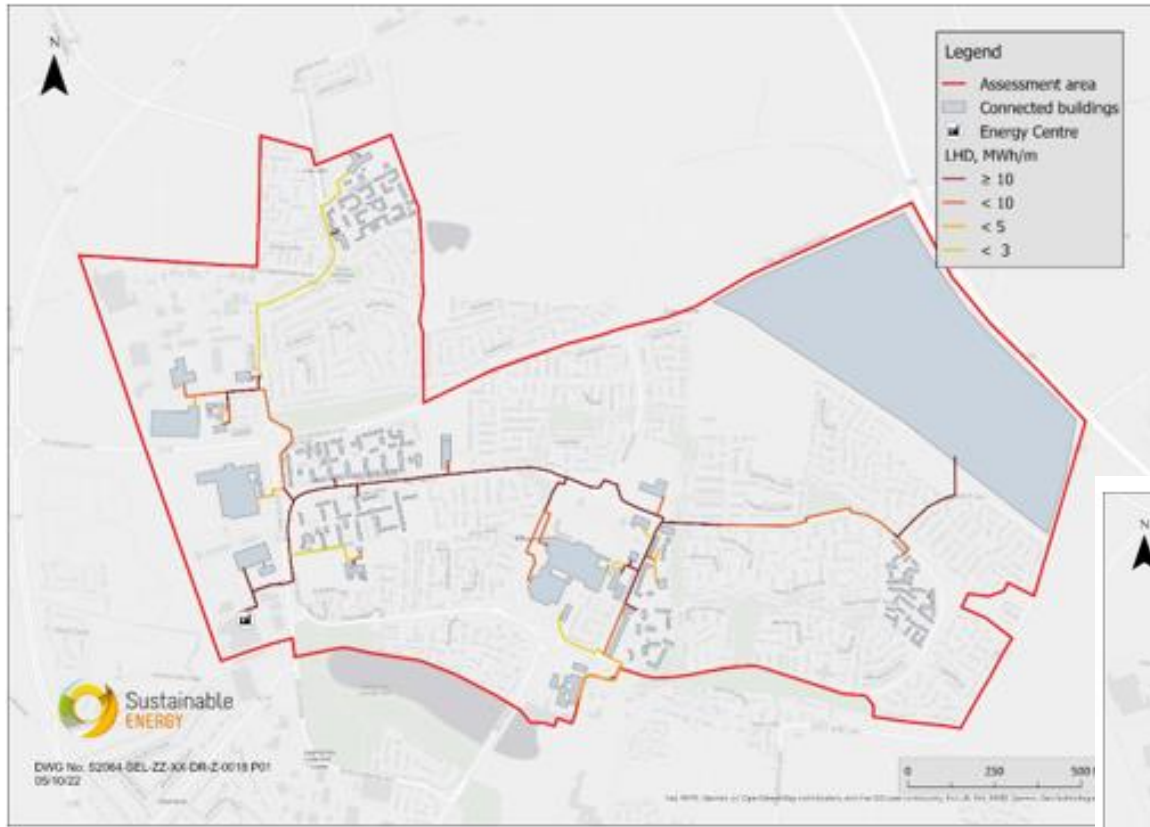
Technology		High level technical viability considerations
Open loop heat pump	Boreholes utilising aquifer	<ul style="list-style-type: none"> Geo-environmental reports do not state pumping rates or water resting levels, which may indicate limited amounts of water Test well required
	Deep geothermal	<ul style="list-style-type: none"> Killingworth (approximate) Ground temperature Significant storage counterfactual Higher temperature High CAPEX
	Mine WSHP	<ul style="list-style-type: none"> Abstraction CAPEX Lower operational Potentially high pump option Third party risk Further assessment of the heat resource Potentially complex
Closed loop bore field	WSHP Killingworth lake	<ul style="list-style-type: none"> About 1m depth Low income Space requirements EA requirements
		<ul style="list-style-type: none"> Requires a large Significant CAPEX May have a high correctly

Typical arrangement of mine water source heat network



Heat Network Feasibility – Techno-feasibility study

Typical Network route analysis



- Linear Heat Density
- Site constraints
- Connection %
- Housing cluster network costing

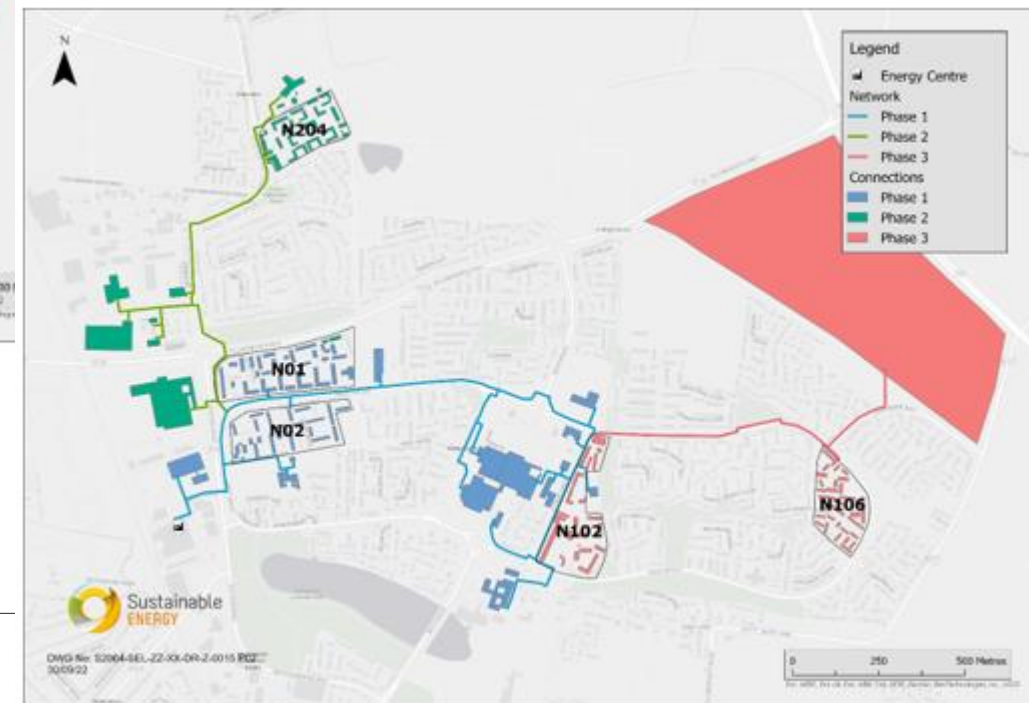
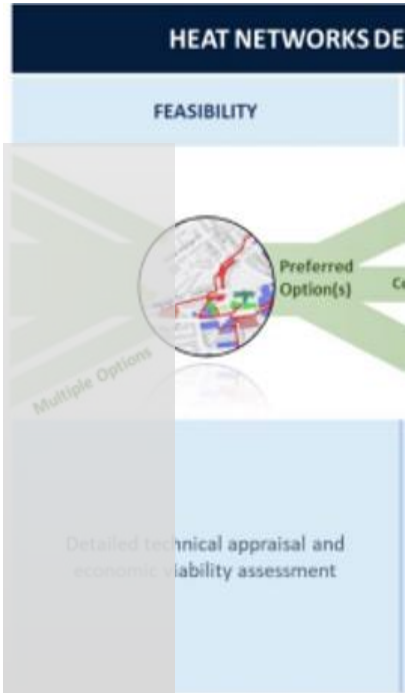
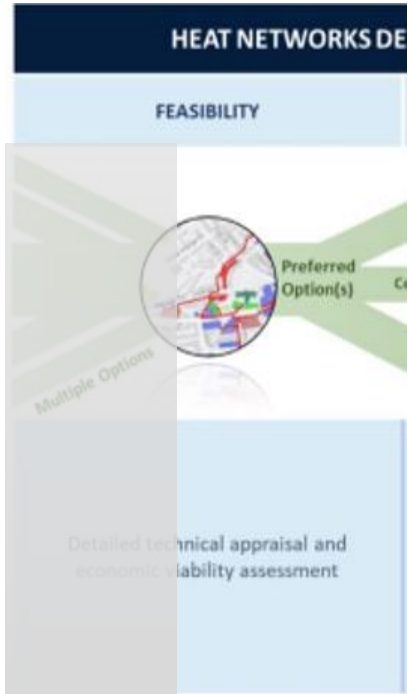


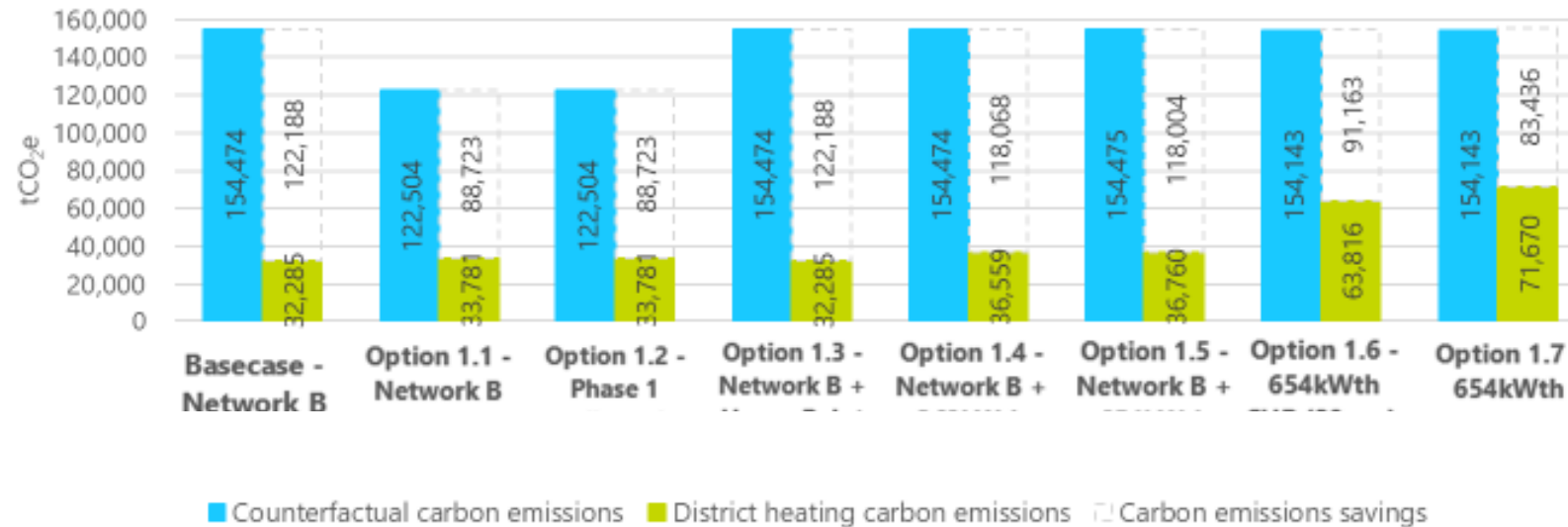
Figure 24: Phased network route

Heat Network Feasibility – Techno-feasibility study



Typical Techno – Economic Modelling (TEM) output

Key KPI include NPV, IRR, payback, CAX, OPEX, REPEX and CO2 saving across a number of mine water heat pump plant options



Mine Heat Pilot drilling

The primary activity during this stage of development is the drilling of pilot/exploratory boreholes and testing and monitoring of the well to determine the water quality characteristics and potential yield (flow rate and temperature).

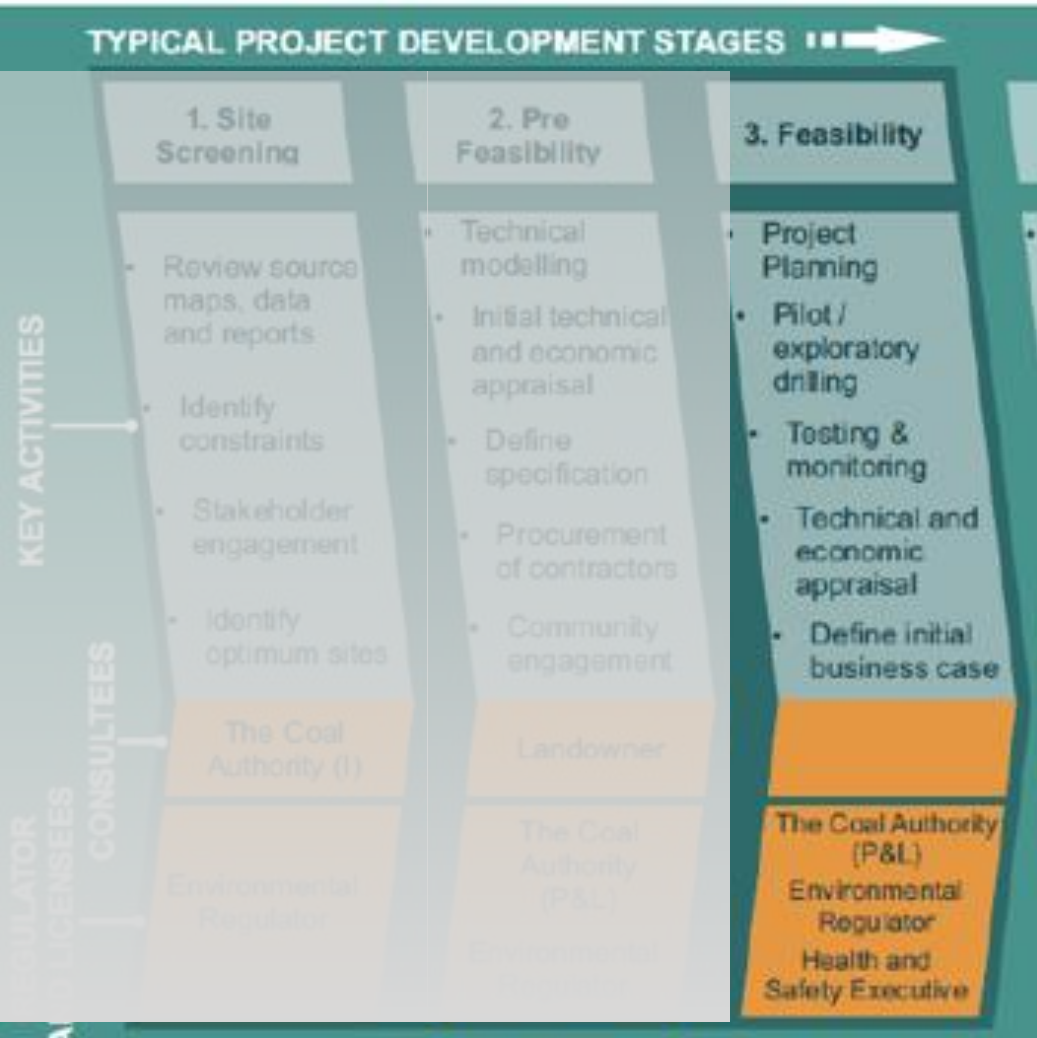


Permit to Enter or Disturb Coal Authority Interests

CONSENT TO INVESTIGATE A GROUNDWATER SOURCE
Section 32(3) Water Resources Act 1991



NOTICE OF GRANT OF PLANNING PERMISSION
Town and Country Planning Act 1990
Town and Country Planning General Regulations 1992
Town and Country Planning (Development Management Procedure) (England) Order 2015



Mine Heat Pilot drilling

Environment Impact Assessment (EIA) screening
 Conservation area? Heritage asset? Flood risk? Tree preservation order? Contamination of soil or ground water

Potential effects from: noise, vibration, dust, loss of open space, contamination, highways and access

Noise and vibration assessment

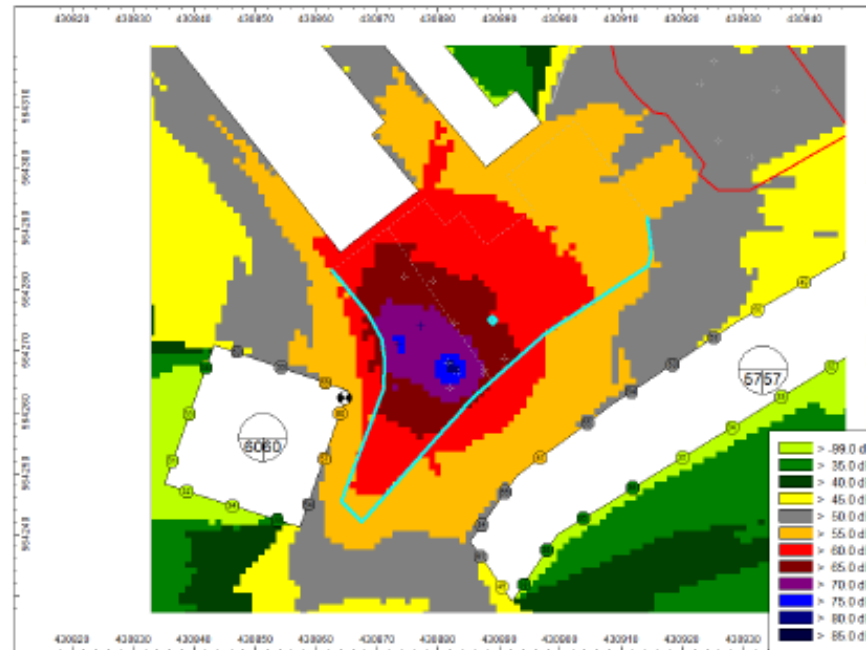
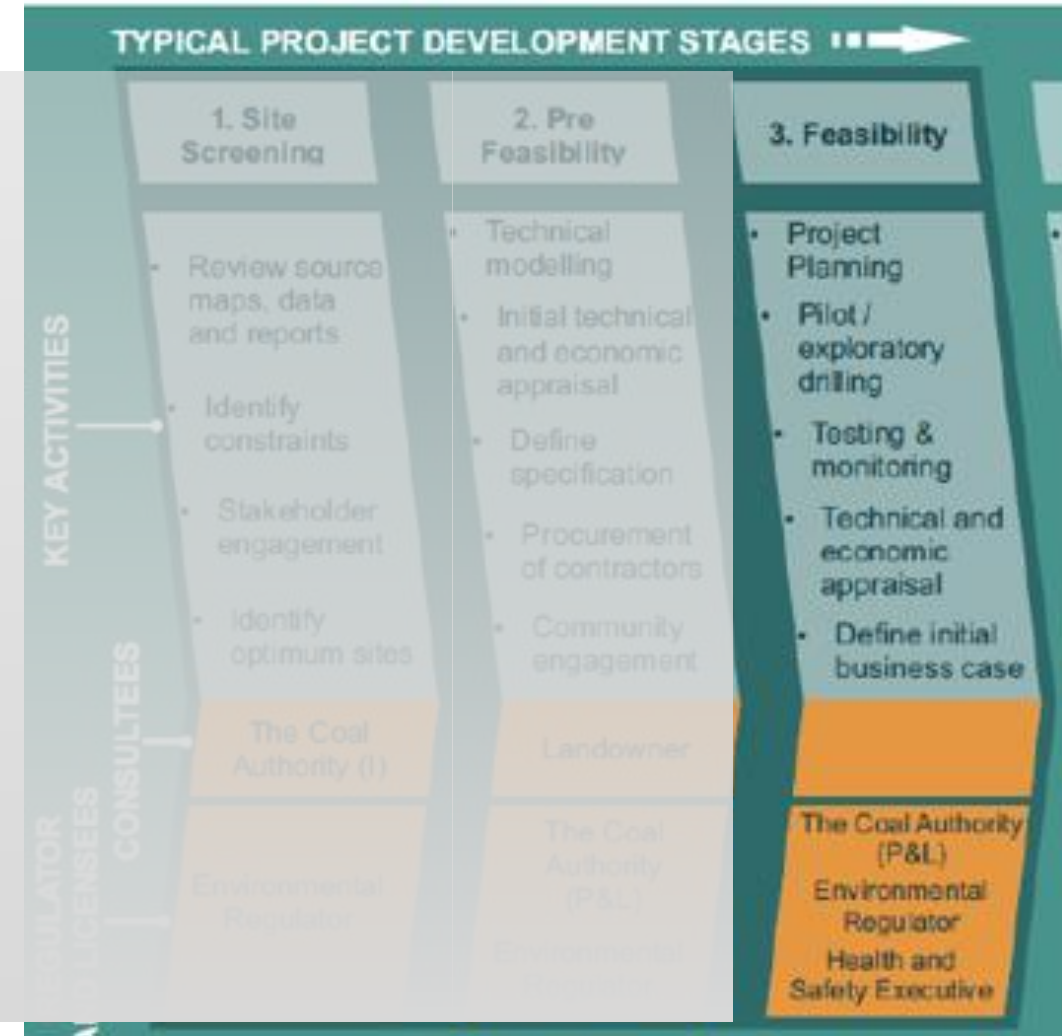


Figure 15: Noise level contour at 4 m – drilling pilot hole

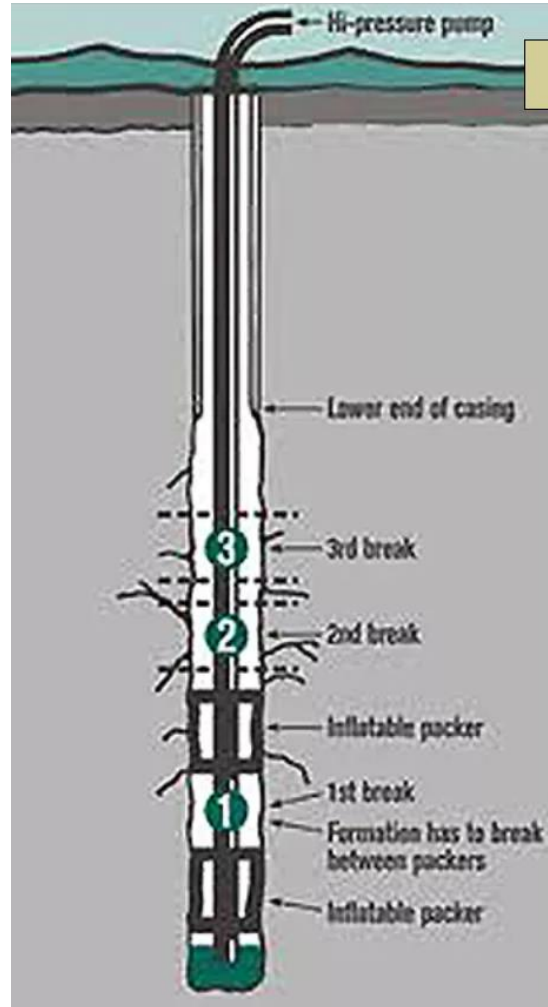


Figure 1: Site location, measurement position and identified noise sensitive

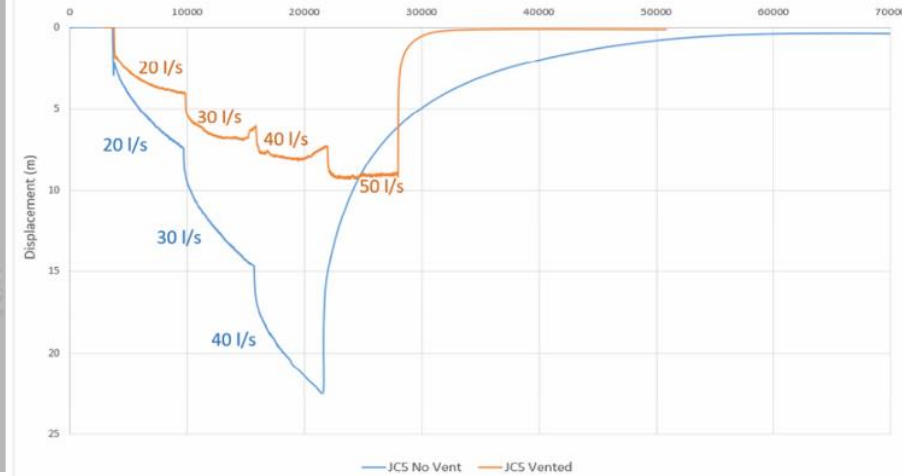


Mine Heat Pilot drilling

Packer test

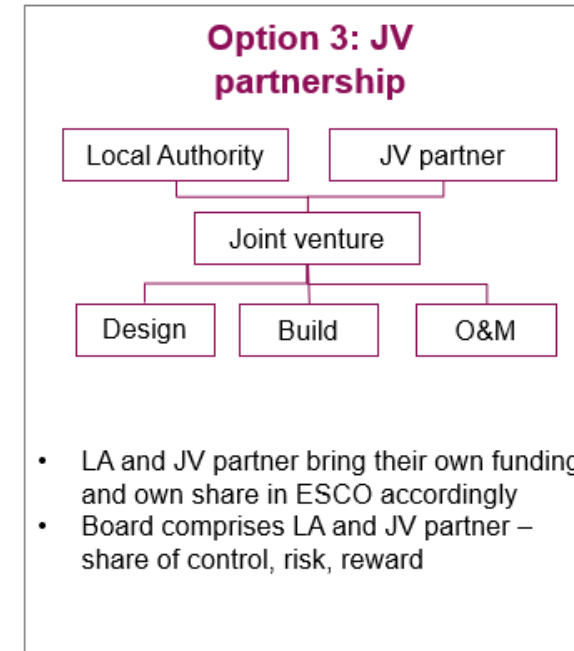
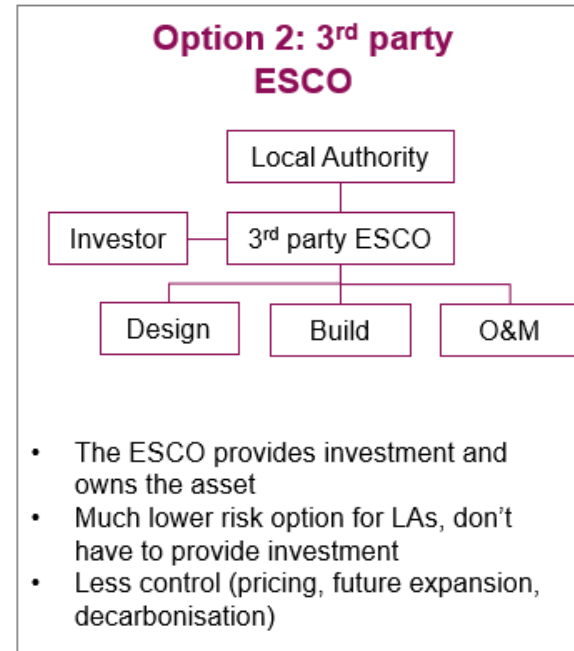
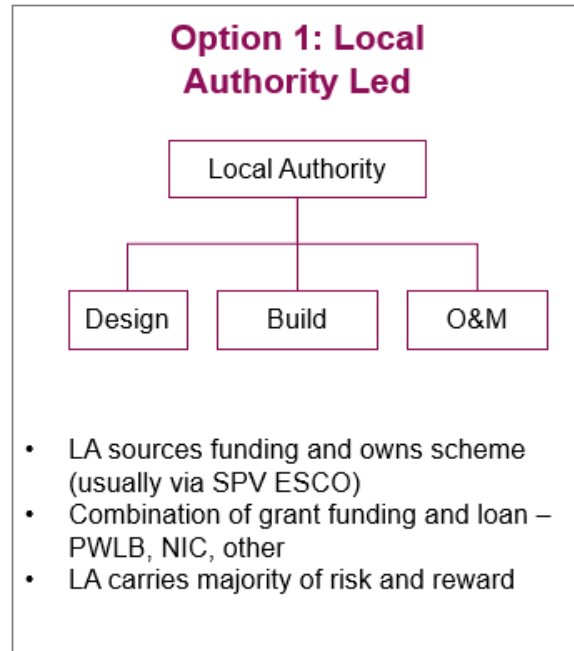
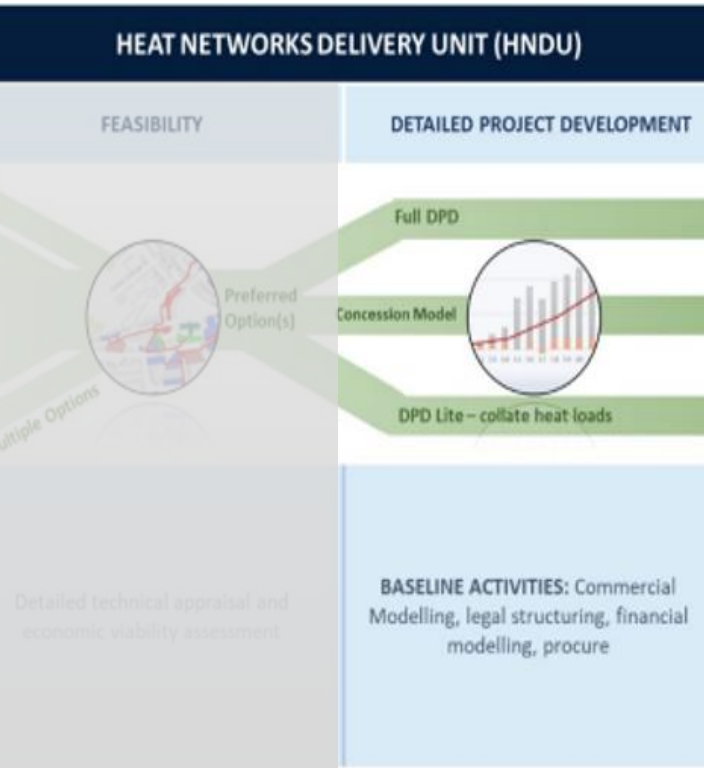


Step pumping test

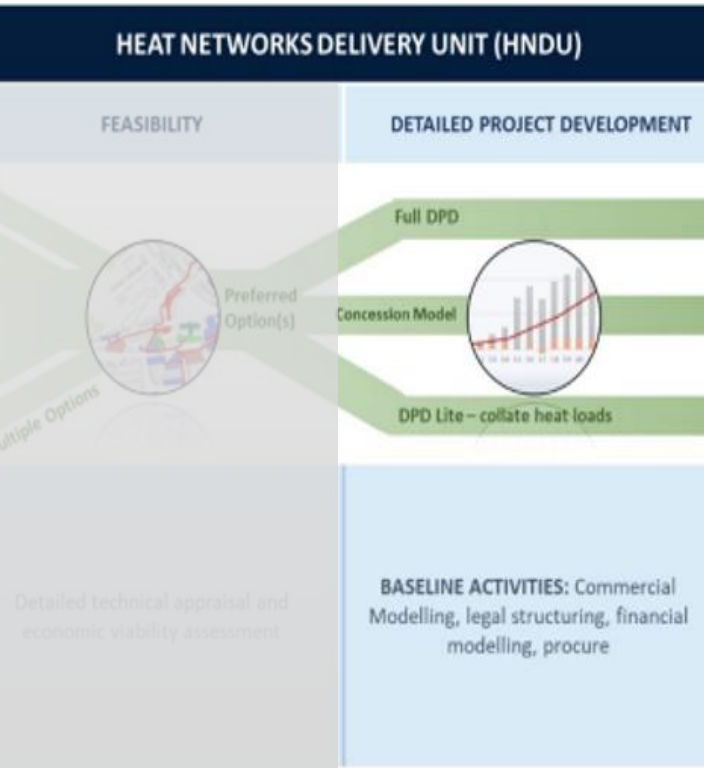


Heat Network Feasibility – Detail Project Development

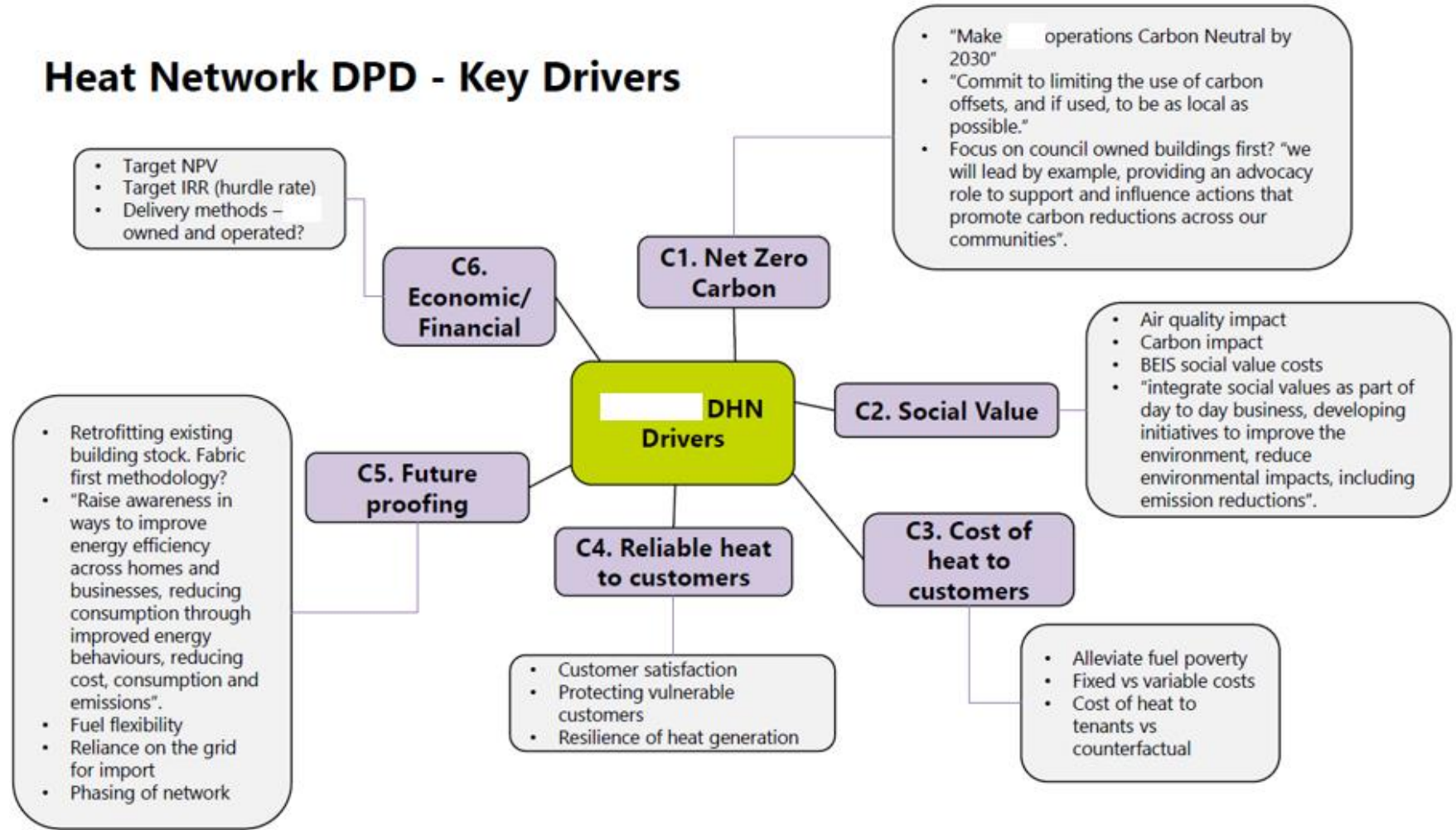
Commercial structures for delivering heat networks



Heat Network Feasibility – Detail Project Development



Heat Network DPD - Key Drivers

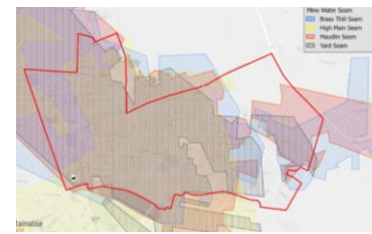


[The Green Book \(2022\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/111749/green-book-2022.pdf)

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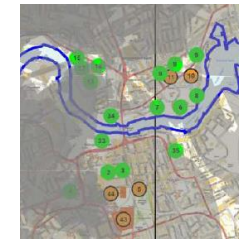
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Q&A

Email: bobo.ng@nelep.co.uk