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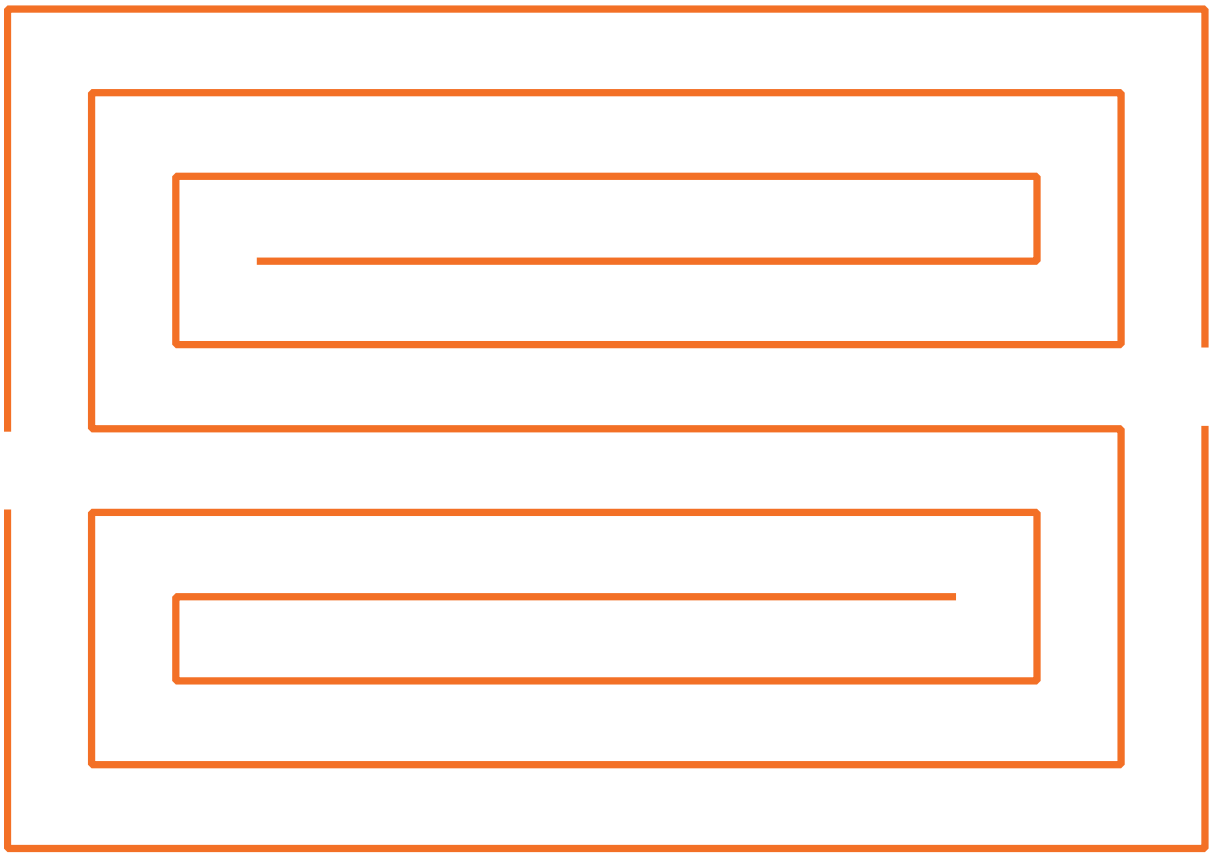

Department for Energy Security & Net Zero

Heat Network Optimisation Guide
Template Scope of Works

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Authors

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Disclaimer

1. Definitions

The following terms are used throughout this scoping document:

- **Client** – the organisation (typically the network owner or operator) procuring or mobilising external resource to deliver the Optimisation Study.
- **Consultant** – the procured or mobilised external resource (typically a contractor or Consultant) delivering the Optimisation Study scope of works.
- **Project** – the district heating network or communal heating network for which the Optimisation Study is being carried out.
- **Optimisation Guide** – the Heat Network Optimisation Guide published by the Department for Energy Security and Net Zero.

2. Use of document

This scoping document will typically sit within a broader tender pack. The Client will need to provide further information on the site within the tender back to support Consultant pricing and responses:

- Client Objectives
- The need for works including issues identified with the building and sub-optimal outcomes experienced by users
- If there are immediate urgent issues with the site to be addressed through stabilisation measures
- Long term objectives for the study and the site. This may include a targeting specific funding, or an organisational next zero target
- Number of blocks and number of dwellings
- Information regarding any commercial connections
- Age of building & key network components (highlighting if any are reaching end of life)
- Network topology: two pipe or four pipe, direct or indirect, communal or individual heating systems
- Dwelling systems: HIUs, cylinders or alternative; radiators or underfloor heating
- Heat sources: boilers, CHP, heat pumps etc.
- Current operating temperatures (if known)
- Key sub-optimal outcomes experienced and any initial root cause analysis
- Available information: If known, the Client should summarise the information listed in Section 4.2 of the Optimisation Guide which can be made available to the Consultant
- Project timelines

The text assumes the Client wishes to pursue all three phases of a heat network optimisation study. If this is not the case, any redundant sections can be omitted or adjusted appropriately.

3. Introduction to required scope of services

This scope has been developed to align with the Heat Network Optimisation Optimisation Guide. Where clarification is required, Consultants should first review this document, highlight clarification points to the Client, and (if possible) propose a way forward aligning with best practice.

The structure of this scope of works comprises three phases of work:

- Phase 1: Initial Investigation consisting of data collection, site audit and high level technical report
- Phase 2: Techno-economic options appraisal, consisting of determining interventions and initial business case development
- Phase 3: Implementation plan, including scope development, contractor costing of interventions, delivery plan and final business case

The key activities and outputs of each stage are outlined in Table 1.

Key stakeholder involvement throughout the optimisation study is shown in Figure 1 and an outline process flow diagram is presented in Figure 2 showing the main activities and responsibilities throughout the optimisation study process.

The Consultant shall cost each phase individually to allow for the event that project termination is required at the end of a given phase.

The findings and proposed next steps shall be presented to the Client in a workshop at the end of each phase. This workshop shall be a decision point within the study for the Client to decide whether to proceed with the next steps of the project.

Pre-project		Phase 1: Initial investigation				Phase 2: Techno-economic options appraisal			Phase 3: Implementation plan	
	0. Define project	1. Information & data collection	2. Pre-audit analysis	3. Site audit	4. Technical review	5. Detailed technical analysis	6. Determine potential interventions	7. Cost benefit analysis	8. Costing of interventions	9. Final business case
Stage outcome	Understand Client aims & agree project scope	All relevant information on heat network identified	Initial understanding of system issues and potential causes	Sufficient understanding of system to complete optimisation assessment	Gain qualitative understanding of system issues	Quantitative assessment of performance against KPIs completed	Optimisation opportunities developed and modelled	Initial business case for optimisation opportunities completed	Detailed costing of interventions to inform final business case	Final business case for optimisation opportunities completed
Core tasks	Initial engagement Understand heat network typology and issues	Issue & return RFI Collect M&B and O&M data	Analyse all information returned from RFI Interview Client to understand issues from Client perspective Data gap analysis	Organise site visit and dwelling access Undertake site audit Measurements of key parameters (e.g. temperatures) Meeting and discussing performance with end users	Review of information site audit and pre-audit analysis Develop hypotheses regarding probably causes of performance issues Presentation of findings Discuss queries with manufacturers	Undertake root cause analysis Heat loss modelling Pump energy modelling Analysis of reliability and financial KPIs	Selection and design assessment of interventions Heat loss modelling Pump energy modelling Analysis of reliability and financial KPIs	Financial modelling of work packages Produce business case	Develop high level scope of works Engage with contractor and equipment suppliers to cost for works Undertake pilot of works if appropriate to assist with costing & confirming impact of interventions	Financial modelling of work packages Produce delivery plan Update business case
Information exchanges	High level summary of issues Scope and quote	Heat network documentation Heat meter data BMS data O&M logs	Queries raised during analysis	Requirements to ensure successful site audit RAMS	Findings of site audit		Client feedback on intervention options	Client inputs into financial model	Information for costing Data collected during and following pilot (if conducted)	Client inputs into financial model
Key outputs	Defined project scope Engagement to undertake optimisation study	RFI register & gap analysis	Draft system issue list Data gap analysis results	Completed site audit checklists	Initial investigation report Presentation of findings Decision on next steps	Heat loss model KPI analysis	Work package selection Heat loss model KPI analysis	Techno-economic options appraisal report Presentation of findings Decision on next steps	High level scope of works Detailed interventions cost planPost-pilot report	Implementation plan Presentation of findings Decision on next steps

Table 1: Summary of key optimisation study stages

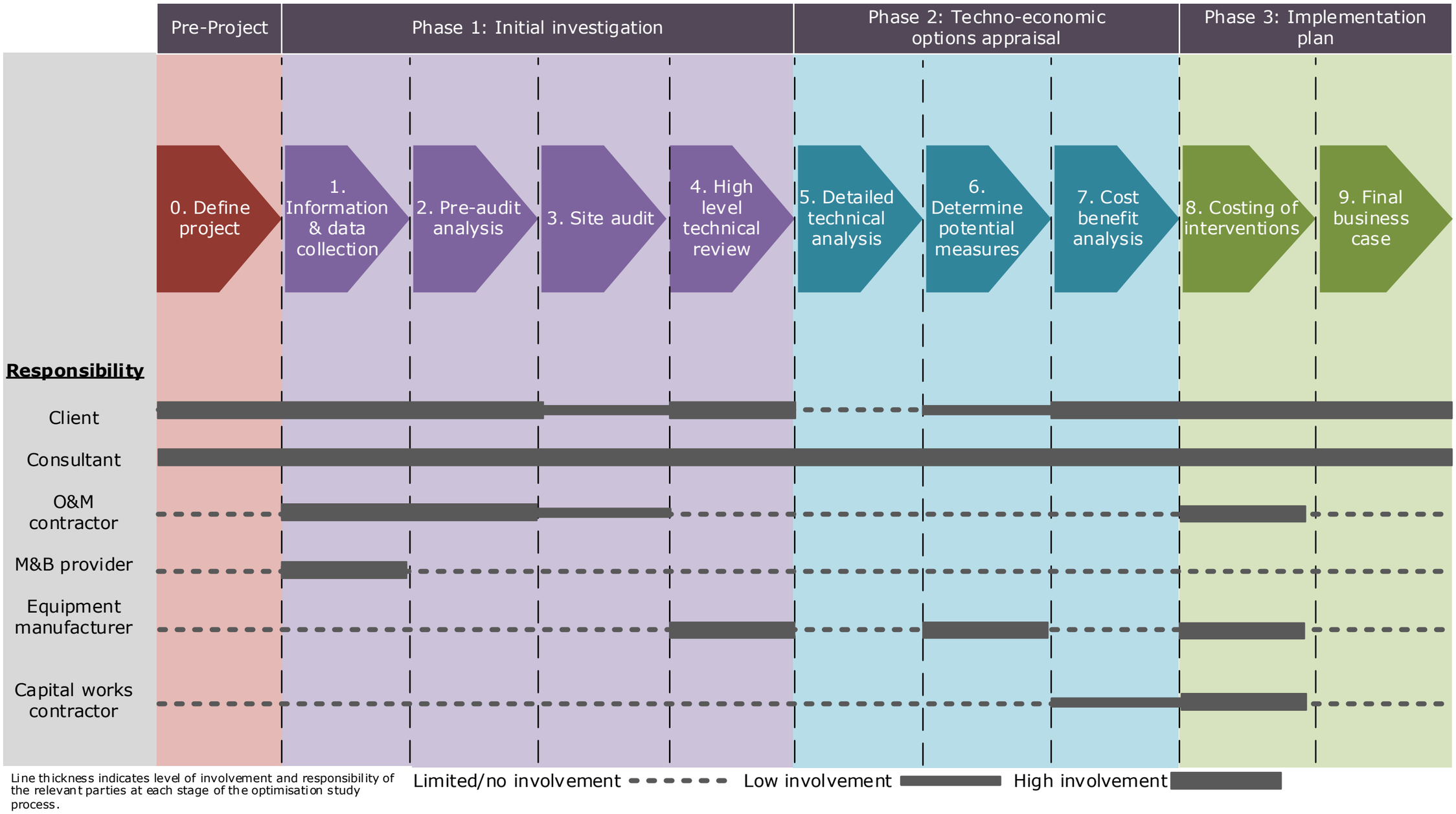

Figure 1: Key stakeholder responsibilities throughout optimisation study

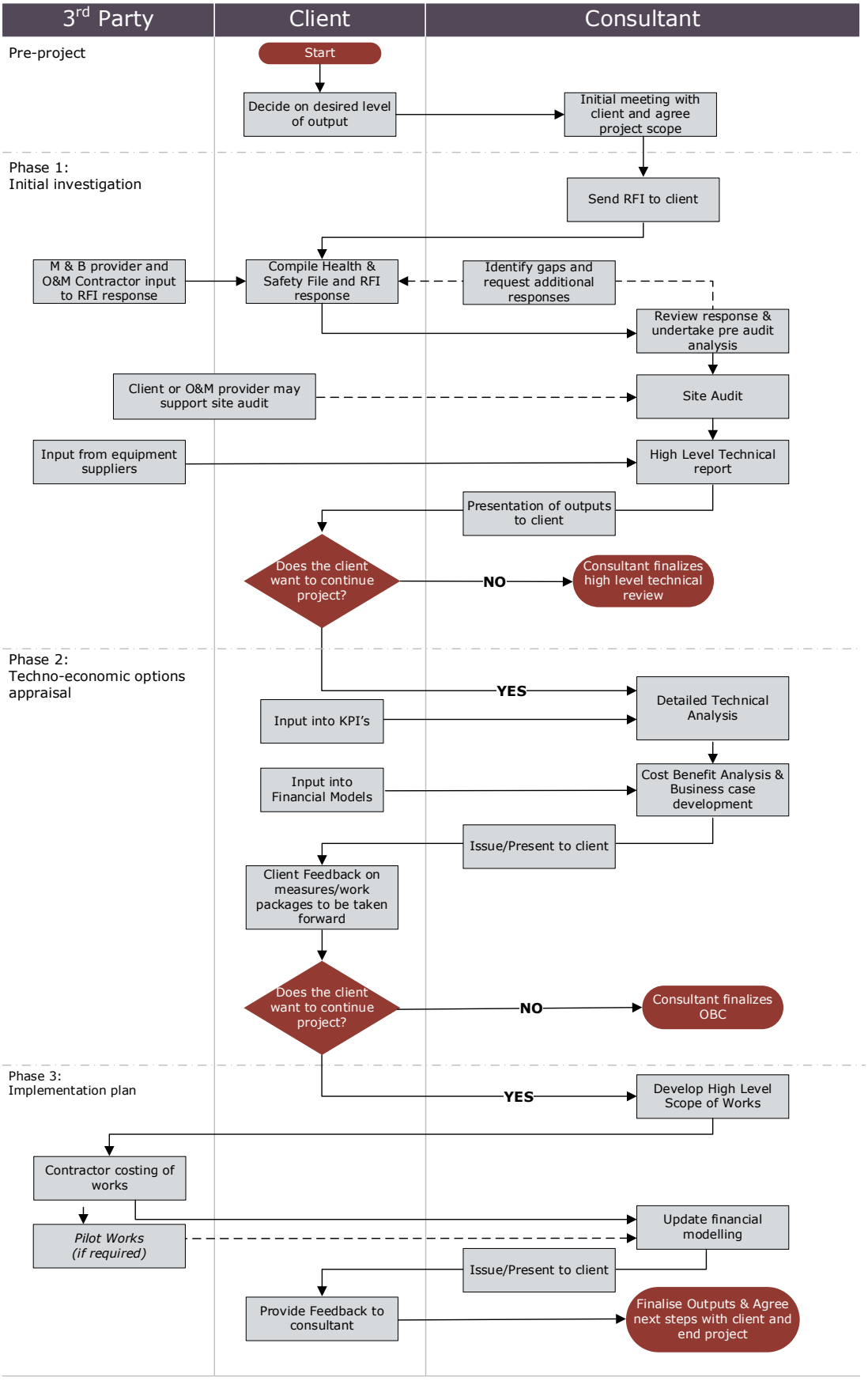

Figure 2: Process flow diagram for Optimisation Studies

4. Knowledge and experience required

In order to ensure that the technical and financial analysis carried out during the Optimisation Study is undertaken to the required quality, a prerequisite level of knowledge and experience is required.

The engineers undertaking the work must have the minimum knowledge and experience as outlined in this section.

4.1.1. Required knowledge

Heat network Optimisation Studies require a combination of technical and analytical skills. Some of the essential skills required for this field include:

- Knowledge of thermodynamics: A strong understanding of thermodynamics is essential to understand the principles of heat transfer, heat loss, and heat recovery. This knowledge is necessary to carry out root cause analysis and to optimize their performance.
- Data analysis skills: Heat network optimisation studies require the analysis of large datasets, including heat meter and BMS data. The ability to analyse and interpret data using statistical and mathematical tools is essential for effective optimisation.
- Project management: Heat network optimisation studies involve multiple stakeholders and require effective project management skills to ensure timely completion and successful implementation of the optimization recommendations.
- Communication skills: Effective communication skills are essential for presenting findings and recommendations to stakeholders. The ability to communicate technical information in an accessible manner is necessary.

4.1.2. Required experience

Some of the essential experiences required to carry out Optimisation Studies include:

- Engineering background: A degree in engineering, such as mechanical or chemical engineering and/or substantial work experience in engineering as recognised by a Professional Institution (e.g. EngTech, IEng or CEng).
- Project experience: Practical experience in project management, such as leading or participating in energy projects, is valuable for understanding the challenges and opportunities associated with heat network optimisation.
- Industry-specific experience: Experience in the heat network sector provides a valuable understanding of the unique challenges and opportunities associated with heat network optimisation.
- Analytical skills: Experience in data analysis and mathematical modelling is essential for effective heat network optimisation studies. This includes experience in statistical and root cause analysis.
- Communication skills: Experience in presenting technical information in an accessible manner is essential for successful heat network optimization studies. This includes experience in developing reports, presentations, and other forms of communication for different audiences.

- Knowledge of regulations and policies: Knowledge of energy policies, regulations, and incentives is valuable for understanding the legal and regulatory framework surrounding heat network optimisation.

4.1.3. Roles and minimum requirements

Project Role	Project Activities	Minimum Experience	Minimum Qualifications
Study Engineer	Leads on site audit and responsible for managing the technical and financial analysis of the optimisation study	2+ years operational experience in heat network sector	Either Level 6 qualification (England, Wales and Northern Ireland) in engineering related discipline or Level 10 (Scottish Credit and Qualifications Framework) in engineering related discipline or Professionally registered as an Engineering Technician (EngTech) with the Engineering Council
Study Lead	Accountable for the technical quality of report, conclusions and recommendations	5+ years operational experience in heat network sector	Either Level 7 qualification (England, Wales and Northern Ireland) in engineering related discipline or Level 11 (Scottish Credit and Qualifications Framework) in engineering related discipline or Professionally registered as a Chartered Engineer (CEng) with the Engineering Council

Table 2: Minimum experience and qualifications for key specialist optimisation study role holders

5. Phase 1: Initial Investigation

The aim of a Phase 1 assessment is to gain a full qualitative understanding of system performance and issues. This can involve high level heat meter data analysis if available but does not need to extend to a full KPI assessment of current performance.

5.1. Data collection and pre-audit analysis

The Consultant shall review any initial data provided by the Client and issue a Request For Information (RFI) for any items which are missing. The Client shall respond to this RFI within 2 weeks of issue.

During the data review the Consultant shall arrange a meeting with the Client, during which main issues with scheme and optimisation study priorities shall be discussed.

The Consultant shall request all relevant H&S information and documentation from the Client, and promptly inform the Client where gaps in the information provided are likely to impact operative safety and/or site audit outcomes.

Prior to the site audit, all available information, data and Client feedback shall be reviewed to determine potential causes of issues with the heat network. This review can then be used to tailor the site audit and ensure all required equipment is available as required. This ensures that all key aspects of the system are reviewed, which is especially key on larger systems where it is not practical to audit 100% of the heat network.

When handling personal data (such as end user heat meter data), Consultants shall comply with their obligations under the UK's implementation of the General Data Protection Regulation (UK GDPR). All individuals handling this data shall undertake appropriate training to ensure they are aware of their responsibilities.

5.2. Site audit

The Consultant shall work with the Client (or nominated representative) to co-ordinate a suitable date for a site audit.

The Consultant shall undertake a suitable risk assessment and issue a Risk Assessment and Method Statement (RAMS) to the Client for review prior to attending site.

The Consultant shall audit a sufficient portion of the site to enable the optimisation study to be completed in line with this scope of works. As a minimum, the following areas of the system shall be audited in line with Section 4.5 of the Optimisation Guide:

- All primary plantrooms/energy centres with heat generation plant.
- All substations associated the heating or hot water system.
- In exceptionally large networks this may not be possible. If the specialist deems this to be the case, an alternative approach should be agreed with the Client prior to the site audit.
- In these circumstances at least 3 substations or 50% of the system (whichever is larger) should be inspected.
- If a substation is not physically audited, as a minimum operational data should be used to review performance of all substations. This should be conducted prior to the audit to identify key substations causing detrimental network performance which require further review on site.
- In domestic developments with more than one block, the secondary distribution network of 3 blocks or 50% of the blocks (whichever is larger) should be inspected.
- A minimum of 3 dwellings of each type should be inspected to give good understanding of dwelling heat demand. A type of dwelling is defined by the number of bedrooms/bathrooms or, type of HIU.

These requirements are a minimum, and it is imperative that Consultants conduct a thorough survey of the plantroom, ensuring that all meaningful data is collected.

In larger or more complex heat networks more than one site audit may be required in order to fully understand and investigate the system. Additional audits may also be required to confirm the viability of works recommended within the initial technical review.

5.3. Technical report

The Consultant shall use the information gathered in the site audit and pre-audit analysis to provide a technical overview of the site. This shall consist of three primary components:

- Key Performance Indicator (KPI) gap analysis
    - The Consultant shall identify where the Client may not be able to monitor network KPIs (as defined in Optimisation Guide Section 3.1) due a lack of system monitoring or available data
- Root Cause Analysis
    - The Consultant shall review issues with the current operation of the site and utilise a root cause analysis (RCA) assessment to identify the underlying causes. Issues should be evaluated against their likely impact on:
        - Operational cost (e.g. maintenance costs / electricity usage)
        - Thermal efficiency (e.g. impact to heat losses or heat generation efficiency)
        - Resident comfort (e.g. overheating, reliability of heat network, heating and hot water delivery times and temperatures)
        - Risk of system failure or regulatory risk
        - Other factors as agreed between Client and Consultant
    - Undertake heat meter (and other) data analysis where required to assist in root cause analysis of issues
- Initial work package identification
    - Following the root cause analysis the Consultant shall develop an initial set of potential measure/work packages to address the underlying issues with network performance. This shall categorise proposed interventions/work packages as:
        - Stabilisation measures that should be implemented as soon as possible to stabilise the system and/or to address high risk issues.
        - KPI monitoring interventions which will support system monitoring and validation of performance improvements.
        - Easy wins whereby significant performance gains can likely be made with limited investment from the Client.
        - Continuous improvement measures, these measure will require more extensive system upgrades but may deliver further significant improvements in performance.
    - The Consultant shall provide an order of magnitude cost associated with the proposed work packages.

5.4. Outputs

The output of Phase 1 shall be an initial investigation report which includes the following information:

i. Major gaps in site information impeding further analysis

ii. Outcomes of data review and gap analysis

iii. Detail of plant room, network and dwelling level issues

iv. Rating of issue severity

v. Root cause analysis of issues

vi. Potential interventions to address issues

Where relevant, this reporting will include reference to external standards, data or guidance.

The Consultant shall await confirmation from the Client before moving to detailed technical analysis.

6. Phase 2: Techno-economic options appraisal

The aim of the Phase 2 assessment is to develop and analyse optimisation opportunities (individual measures and packages of measures) aimed at targeting causes of sub-optimal operational performance.

The Consultant shall make recommendations to the Client as to which measures or packages of measures should be taken forward, with accompanying justification/rationale.

6.1. Detailed technical analysis

Detailed quantitative technical analysis shall be undertaken to establish baseline performance.

This information can be used to model the impact of potential interventions during the techno-economic options appraisal.

The KPIs to be analysed by the Consultant are detailed in Section 3 of the Optimisation Guide.

The Consultant shall identify where limitations in the available data and site information mean that the above metrics cannot be calculated and provide justification for this.

To support calculation of these metrics the Consultant shall undertake the following assessments in line with Section 5 of the Optimisation Guide:

- Undertake a detailed assessment of all available heat meter (and other available) data including analysis of the following at all relevant sections of the heat network as a minimum:
  - Average flow temperature
  - Average return temperature
  - Average flow rate
  - VWAFT
  - VWART
  - Bypass flow rate
- Develop a detailed network heat loss model calculating heat losses for all sections of the heat network:

- Energy centre
- Primary distribution pipework (above ground and underground)
- Secondary distribution pipework
  - Risers
  - Laterals
  - Terminal runs
- Heat losses from HIUs or other capital equipment considered relevant

- Calculate an estimate of pump energy consumption based upon the installed equipment

All key assumptions within the technical analysis shall be highlighted within the deliverables.

This analysis shall support root cause analysis of sub-optimal outcomes experienced by network users and operators to confirm conclusions of the Phase 1 assessment.

6.2. Development of optimisation measures and packages of measures

The Consultant shall carry out analysis on a potential system interventions or packages of interventions intended to improve performance. This analysis shall quantify the operational impact of any measure against project baseline metrics and KPIs.

The dependency of potential interventions shall be assessed, as several of these interventions interact with each other and multiple interventions are commonly required for the benefits to be realised. To account for this complexity, groups of interventions shall be presented together and modelled as distinct 'work packages'.

These measures shall focus on eliminating of sub-optimal outcomes being experiences on site. As a minimum the analysis should quantify:

- Improvements to the technical performance and operation (e.g. plant efficiency, losses, flow/return temperatures) of the network across all elements of the Project architecture.
- Improvements to the customer experience of the Project energy provision (e.g. cost to the operator of delivering heat to end customers, customer tariff, outages/service interruptions, overheating).

As a minimum, it is expected measures are categorised and packaged as stabilisation measures/Risk Items, "easy wins" or "longer term improvement" as per Section 1.4 of the Optimisation Guide. Packages may be broken down further at the discretion of the Consultant.

- The deliverables shall also qualitatively evaluate the impact of proposed interventions on short and long term system decarbonisation as per Section 6.4 of the Optimisation Guide.
- Risk Items should be presented as a separate work package, as per Heat Network Optimisation Guidance.

6.3. Cost benefit analysis

The proposed measures/packages shall be costed in order to analyse the business case for undertaking the works. Costs should be derived based on supplier quotes wherever possible or based on previous similar works delivered by the Consultant (note formal contractor quotations are not required until Phase 3).

The cost benefit analysis will include as a minimum:

- Capital costs of measures
- Operational costs of measures
- Replacement costs of measures
- Indirect/social costs (such as carbon) as requested by the Client
- Funding support mechanisms (e.g. HNES/GHNF/PSDS) as requested by the Client
- As a minimum the Consultant shall calculate simple payback, Net Present Value (NPV) and Internal Rate of Return (IRR) for each of the proposed work packages.
- Additional financial KPIs/metrics shall be agreed between the Client and Consultant.

6.4. Outputs

The aim of a Phase 2 assessment is to gain a full quantitative understanding of system performance and issues, and the impact of addressing issues on system performance. This impact is compared against initial costing to indicate the business case of potential interventions.

The output of Phase 2 shall be a techno-economic options appraisal which includes the following information:

i. Root cause analysis of issues and determining potential performance improvement interventions

ii. KPI assessment of current performance and potential interventions

iii. Modelling of operational impact of potential interventions

iv. Initial costing and business case

The techno-economic assessment shall derive and outline a recommended set of optimisation measures to the Client – these shall be a targeted and project-specific set of actions for delivering performance improvements.

7. Phase 3: Implementation plan

The aim of a Phase 3 assessment is to gain a full understanding of costs of potential interventions to finalise the business case. Where relevant, pilot works may be required to confirm project benefits.

The costs associated with procuring and delivering pilot works are outside of this scope of works and shall be agreed separately between the Client and Consultant.

7.1. Outline Scope of works

The Consultant shall develop an outline scope of works for the proposed work packages. This scope of works shall sufficiently detailed to allow contractors to provide accurate costs for delivering the works.

7.2. Equipment supplier & contractor engagement

The produced scope(s) shall be used to engaged with the Client's preferred contractor to secure a cost estimate. If the Client does not have a preferred contractor, the Consultant shall be responsible for securing quotes from a suitable source.

The Consultant shall also secure quotes from equipment suppliers for key plant items (e.g. HIUs).

The Consultant shall allow for sufficient time (including site attendance if required) to engage with contractor and receive their input on the proposed measures.

7.3. Techno-economic assessment update

The Consultant shall use the costs received from contractors and equipment suppliers to update the techno-economic assessment.

7.4. Delivery plan

The Consultant shall produce a delivery plan with input from the Client, contractors and equipment suppliers where required. As a minimum, all factors outlined in Section 7.5 of the Optimisation Guide shall be considered within the plan.

7.5. Outputs

The aim of a Phase 3 assessment is to gain a full understanding of costs, bus of potential interventions to finalise the business case.

The output of Phase 3 shall be an implementation plan which includes the following information:

i. An outline scope of works

ii. Detailed costing of works

iii. Revised business case

iv. Revised KPIs and modelling of interventions following pilot (if applicable)

v. Project delivery plan

8. Required response

The Consultant shall provide the following documents in response to this scope of works:

- Outline of proposed optimisation study methodology, demonstrating understanding of the project and all information outlined in the Optimisation Guide
- A project programme covering all main activities
- Brief CVs of key staff involved in the project, including the Study Engineer and Study Lead
- Short case studies/details of relevant experience
- Price schedule