# District Heating Feasibility Study Standardised Template

## A standardised template for District Heating Project Feasibility Studies

# District Heating Feasibility Study Template

## A template to develop Feasibility Analysis of District Heating Systems in Ireland

June 2024



**Sustainable Energy Authority of Ireland**

SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.


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# Contents

# 1 Introduction

## 1.1 Purpose of this document

The purpose of this template is to present in a concise document, a layout for presentation of district heat feasibility studies, that includes sample tables, and key considerations for each section of the template.

This District Heating Feasibility Study Template, paired with the accompanying District Heating Feasibility Study How-to Guide, will support and enable technical analysts to develop their own District Heating Feasibility studies.

Further Supplementary Guidance is also provided as an accompanying text and is intended to offer additional information on preparation post completion of the feasibility study template for future following stages of the District Heating development process.

## 1.2 How to use this document

This District Heating Feasibility Study Template should be read in conjunction with the accompanying District Heating Feasibility Study How-to Guide.

To help make this template easier to use, the following approach has been taken:

- For quick reference, summary bullet points highlighting core elements of analysis and information expected in each section of a district heating feasibility study are included in each section of this template.
- Detailed information on how to complete the analysis for each section of this template can be found in the accompanying How-to Guide.
- The primary section numbering is consistent between the How-to Guide and the Template for ease of reference, i.e., for explanation of what analysis and information is expected in Section 3 of this template, it can be found in Section 3 of the accompanying How-to guide.

## 1.3 Audience for this document

The primary end-users of this District Heating Feasibility Study Template are professional technical staff, with experience in techno-economic analysis.

It is the responsibility of the document user to evaluate information presented, and apply their knowledge, decision making, and technical judgement with reference to the specifics of each separate district heat feasibility study project.

## 1.4 Contents of this document

This section provides an overview of the contents of the District Heating Feasibility Study Template. It outlines a structured approach for conducting future district heating feasibility studies. An outline of each chapter is detailed below, providing a brief description to guide users through the sequential elements involved in a comprehensive study. The subsequent sections of this report describe each chapter for future feasibility studies (Table 1, Table 2). Note that further detailed information for each chapter can be found in the accompanying How-to Guide for this template.

**Table 1: Contents of the Feasibility Study Template and How-to-Guide**

| Chapter No | Chapter Title (Template) | Description of Chapter contents |
|---|---|---|
| **2** | Executive Summary | Summarises the key findings, conclusions, and recommendations derived from the feasibility study. |
| **3** | Introduction | Sets out broader context for district heating in Ireland. |
| **4** | Background | Discusses regulatory contexts, pre-feasibility studies, and detailed project development phases including technological and economic assessments. |
| **5** | Feasibility Process Overview | Describes the step-by-step process for conducting the techno-economic feasibility analysis, including stakeholder engagement. |
| **6** | Demand Assessment | Analyses the thermal energy demand within the district heating network, discussing key factors like operating temperatures and building connections. |
| **7** | Initial Assessment of Energy Supply Options | Identifies and evaluates potential energy supply options, forming a long list and then a shortlist based on specific criteria. |
| **8** | Heat Distribution Systems & Plant Assessment | Focuses on the design and assessment of the pipe network and plant sizing to support the chosen heat supply options. |
| **9** | Summary of Energy Supply Scenarios | Outlines the various energy supply scenarios considered, including the preferred options and counterfactual analyses. |
| **10** | Techno-Economic Feasibility Analysis | Undertakes a multicriteria evaluation of identified heat supply options, culminating in the selection of the most suitable solution. |
| **11** | Detailed Financial Analysis of the Preferred DH Option | Provides an in-depth financial analysis of the preferred DH heat supply option, integrating various assessments to determine viability. |
| **12** | Risk Assessment | Considers key risks to the project, severity rating and potential mitigation measures. |
| **13** | Recommendations & Summary | Offers concise recommendations based on the analyses conducted, summarizing the viability and benefits of the district heating project. |

**Table 2: Supporting Material Relating to post-Feasibility Steps**

| **Supplementary Guidance** | | |
|---|---|---|
| Chapter No. | Chapter Title | Description of Chapter contents |
| **3** | Initial Public Procurement and Guidance Alignment Review | Ensures the project aligns with public procurement guidelines and reviews compliance with infrastructure development standards. |
| **4** | Establishing the Case for Change | Provides a clear justification for the DH project' necessity and secures stakeholder and public support by articulating benefits and addressing concerns. |
| **5** | Initial Business Model Appraisal | Discusses potential business models and evaluates their suitability based on project specifics and stakeholder preferences. |
| **6** | Initial Procurement Options Appraisal | Examines different procurement strategies and their alignment with the project's needs and regulatory requirements. |
| **Appendices** | | |
| **A-I** | Appendices | Contains detailed background analyses and supporting information |

## 2 Executive Summary

This section of the report outlines the purpose of this report and summarises the key findings and conclusions based on the results of the feasibility study analysis. This executive summary also highlights the recommendations and next steps from this report.

**AN EXECUTIVE SUMMARY SHOULD INCLUDE THE FOLLOWING:**

- Restate the purpose of the report.
- Summarise the key points of the report.
- Describe any results and explain conclusions.
- Highlight any limitations of the analysis.
- Highlight recommendations and next steps identified.

## 3 Introduction

The development of District Heating (DH) projects involves multiple stages, forming an iterative process where each stage builds upon and refines the previous one. This report specifically addresses the **Feasibility stage**, which is the second step in the development process, as illustrated in Figure 1 below.

This introduction section of the feasibility study could include:

- A brief description of what DH is.
- How DH aligns with Ireland’s climate objectives and associated targets at a national/local level.
- Where this feasibility study sits within the broader project development phases (See Figure 1).


| Pre-Feasibility | Feasibility | Post Feasibility Preparatory Steps | Detailed Project Development | Procurement & Contracting | Construction | Operation |
|---|---|---|---|---|---|---|
| Heat mapping | Background | Initial Business Model Appraisal | Detailed business model development | Implement procurement strategy | Construction & commissioning | Operation & maintenance |
| Energy masterplanning | Regulatory context | Establishing the Case for Change | Detailed financial analysis and plan | Finalise contracts | Handover | Expansion planning |
| Demand assessment | Pre-feasibility work validation | Initial Procurement Options Appraisal | Detailed procurement strategy and plan | Depending on method chosen the detailed design may take place in this development stage or the previous stage | | Metering & billing |
| Identification of key anchor loads | Stakeholder & community identification &engagement (Including data acquisition) | | Contract development (with key stakeholders) | | | Customer service |
| Identification of heat supply options | Operating temperature analysis | | Define the design requirements for procurement process& legal assurance | | | |
| Identification of key Stakeholders (supply, demand, anchor loads, developer) | Heat demand analysis | Alignment Feasability Study with Infrastructure Guidelines/ Public Spending Code | Public spending compliance code | | | |
| Begin data acquisition from key stakeholders | Assessment of network and supply options | | Local planning considerations | | | |
| | Financial & sensitivity analysis | | Update business case | | | |
| | Risk assessment & recommendations | | Depending on procurement method chose, detailed design may take place at this development stage or next stage. | | | |

**Figure 1: District Heat Project Development Diagram.**

In the above Figure 1 five stages are identified, and the content of this feasibility study template are outlined in the second stage: **"Feasibility"**. This is useful for identifying, the preceding and following stages to this stage in the DH lifecycle. The accompanying **Supplementary Guidance** to this Template provides additional insights into potential steps that could be undertaken post- feasibility stage in order to transition successfully to Detailed Project Development Stage. The contents of the guidance are contained in ("**Post feasibility Preparatory Steps"** in the above figure).

# 4 Background

This section of the report outlines the current situation in terms of heat provision in the study area and outlines the boundary of the study area being considered as part of the feasibility study. It also clearly states the objective of conducting this feasibility study. Where applicable, this section also outlines any previous relevant energy or heat analysis conducted in the area.

**Core Elements useful in the Background Section**

- **Current Situation in the Area:** (describe the existing heat supply scenario in the study area, the building types, planned developments and construction phases where relevant, may include broader context of the town, city, or county).
- **State the objective** of conducting the feasibility and investigating the development of DH in this area.
- **Clarify the position of the feasibility study** within the overall project development phases.
- **Study Area Boundary:** Define the boundary of the study area, outlining whether it aligns with local area plans, decarbonisation zones, predefined opportunity areas from pre-feasibility or heat masterplans, areas with high heat density, or other logical boundaries.
- **Reference to any previous relevant energy or heat analyses** conducted in the area of the feasibility study.

## 4.1 Regulatory and legislative context

This section of the report provides an overview of relevant policy at national, regional and local levels, to provide background context for DH in Ireland.

**Considerations for regulatory and legislative section**:

- Provide an overview of the regulatory and legislative context for the proposed project.
- Consideration of National policy and regulations
- Consideration of Regional or Local policy and regulations
- Ensure to include any new policies, regulations, or legislation relevant to the project.

## 4.2 Pre-feasibility Study

This section of the report outlines any previous pre-feasibility work that has been conducted for the study area.

**Focus of the Section – Note and Summarise Key Findings From Pre-Feasibility Analyses**

- Heat mapping
- Energy master-planning
- High-level demand assessment

- Identification of potential 'anchor loads'
- Early investigation of heat source options
- Stakeholder evaluation (demand, supply, scheme developer)
- Commencement of data acquisition for key anchor loads to minimize delays in the next stage.

Use of maps and GIS mapping software is a best practice way to present information such as heat demand, heat supply, geographical constraints, and local energy infrastructure.

# 5 Feasibility Process Overview

## 5.1 Step-by-Step Techno-Economic Feasibility Process

This section details the steps for conducting the core techno-economic feasibility analysis. This analysis serves as the foundational evidence for the conclusions and recommendations within this report.

**Focus of the section:**

- To outline the steps of the techno-economic feasibility analysis, improving the reader's comprehension of the entire process.
- To emphasize that this analysis is the main evidence base for the feasibility study.
- Stakeholder engagement is a continuous process that both informs and is informed by the techno-economic analysis, particularly regarding business models and procurement options.

**Overview of the Feasibility Stages:**

Each stage of the feasibility study is described in detail below, complemented by Figure 2 and Table 3, which visually represent these stages for a comprehensive overview of the process.

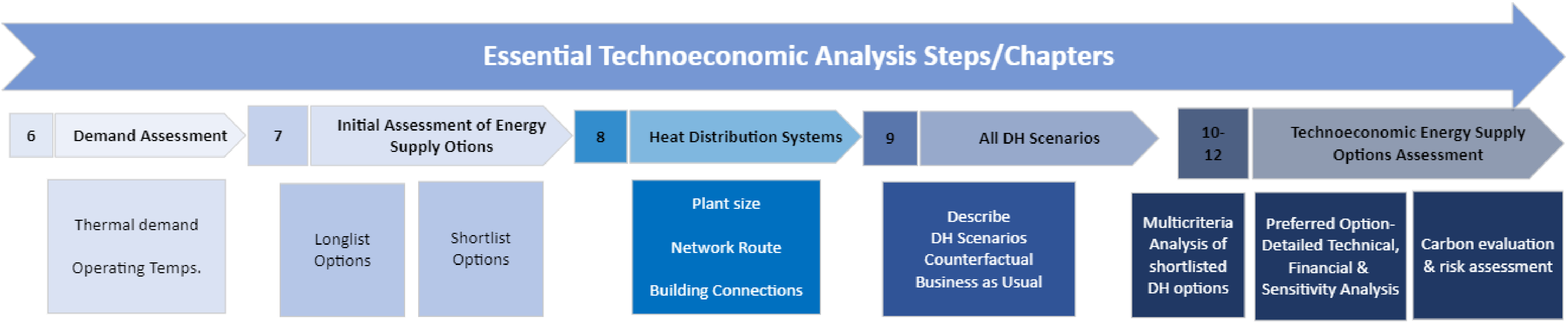


**Figure 2: Key Steps and Outputs in Feasibility Study Process, highlighting the corresponding chapters of the template.**

**Table 3: Main stages and substages of the feasibility analysis explained in the following sections of this template.**

| Main Stage | Sub-Stages |
|---|---|
| **6. Demand Assessment** | **6.1 Evaluation of thermal demand** |
| | - Building demand |
| | **6.1 Evaluation of operating temperatures** |
| | - Operating temperatures Analysis |
| **7. Initial Assessment of Energy Supply Options** | **7.1 Longlist of options** |
| | Brainstorming potential options, typically 6 to 10. |
| | **7.2 Shortlist identification** |
| | Qualitative evaluation to narrow down to 3 to 5 best options. |
| **8. Heat Distribution Systems** | **8.1/8.2/8.3 Network Route, Plant sizing & Building connections** |
| | Evaluation of feasible network routes and building connection types and constraints. |
| **9. Summary of Energy Supply Options** | **Description of 1) DH scenarios, 2) business as usual and 3) counterfactual scenarios to be analysed** |
| | Documenting all scenarios explored, including variations in network design and energy supply options. |
| | Identify the existing or typical solutions (business-as-usual) and alternative (counterfactual) scenarios to understand potential impacts and benefits. |
| **10. Multicriteria Analysis of Shortlisted Options** | **10.1/10.2 Multicriteria analysis** |
| | Applying a weighted multicriteria analysis to the shortlisted DH options and conducting a high-level techno-economic analysis for each option. |
| **11. Detailed Technical and Financial Analysis** | **Detailed Technical and Financial Analysis** |
| | Detailed financial assessment (40 years typically) Includes technical sizing, hydraulic modelling, pipe sizing, and energy system modelling. Includes sensitivity analysis. |
| | **11.5 Carbon performance evaluation** |
| | Assessment of CO2 emissions and savings |
| **12. Risk Assessment** | **Risk assessment** |
| | Evaluation of environmental and technical risks |
| **13. Conclusions and Recommendations** | Synthesis of key findings and analysis from the Feasibility Study. |

## 5.2 DH network Stakeholder Identification & Engagement

This section of the report summarises the stakeholder engagement process used as part of this feasibility study and provides an overview of the information captured as part of this process. This stakeholder engagement process supports all sections of the feasibility study.

**Focus of the section** - **Adopting a process for effective stakeholder engagement, and learnings and information gathered:**

**Four-step process:**
- Identifying relevant stakeholders.
- Understanding stakeholder drivers and barriers.
- Prioritising stakeholders based on impact and interest.
- Implementing effective engagement tailored to each stakeholder.

**Types of Information Obtained Through Engagement:**
- Heat loads
- Stakeholders' key drivers (environmental, legal, economic, etc.)
- Opportunities for collaboration (e.g., trench sharing)
- Electrical grid connection capacity
- Customer heating systems details (temperature regimes, age, location of plant rooms, etc.)
- Levels of interest/commitment to the project
- Estimated time for customer connection to the network

# 6 Demand Assessment

**Understanding Energy Demand within the District Heating Network**
This chapter provides a comprehensive assessment of thermal energy demand for the proposed district heating network. It covers the selection of buildings, analysis of energy data, and evaluation of specific building demands.
Additionally, it discusses the operating temperatures assumed for the network, highlighting their impact on design and efficiency. The goal is to ensure the network is designed to effectively meet both current and future energy needs, promoting sustainability and efficiency.

## 6.1 Heat Demand

**Heat demand outputs:**

- Annual heat demand for each connection (both existing and future demands in MWh)
- Phasing of demands - what year will heat demand connect to the network.
- Peak heat demand (MW) for each connection (including for diversity of demand where relevant) – Important for network and plant sizing (heat production and substations particularly).
- Location of demands (to be mapped) – To facilitate the development of potential pipe network routes.
- Customer building use types and ownership – informing the likelihood of connecting to the network.
- Customer heating system & operating temperatures – Informing network temperature requirements and likelihood of connection (operating temperatures discussed in greater detail in section 6.2)

Accurate assessment of heat demand is crucial for any district heating feasibility analysis, as it shapes the network design and scalability. This section outlines key aspects such as annual and peak demands, connection phasing, and the characteristics of potential customer buildings, which are essential for strategic planning. The following Table 4 provides a concise overview of these critical elements, detailing their impact on the network's development. Following Table 4, the likelihood of connection is further outlined in Table 5, providing insights into the potential engagement of various building types with the district heating network.

| Concept | | Reference |
|---|---|---|
| **Detailed Load Profiles** | Importance of analysing detailed load profiles for accurate network design and operation. | Methodologies and tools in How-to Guide |
| **Sector-Specific Energy Considerations** | Importance of analysing energy use variations across sectors such as residential, commercial, and industrial for accurate demand projections. | Case studies and examples in How-to Guide |
| **Future Energy Scenarios** | Importance of incorporating future energy scenarios to predict changes in demand due to factors like urban development, policy changes, increased retrofitting, or technology advances. | Development methods in How-to Guide |
| **Renewable Energy Integration** | Evaluating the potential of renewable energy sources to reduce peak loads and overall demand. | Detailed analysis in How-to Guide |
| **Sensitivity Analysis** | The role of sensitivity analysis in validating demand forecasts and ensuring robust network design. | Detailed methods in How-to Guide |
| **Annual and Future Heat Demand** | Total annual heat required per connection, reflecting both current and projected future needs. | Methodology in How-to Guide |
| **Phasing of Demands** | Expected timeline for connections to the DH network, essential for planning | Mention in Template; |

| Concept | | Reference |
|---|---|---|
| | expansions and capacity. | detailed strategies in How-to Guide |
| **Peak Heat Demand** | The maximum heat load expected from each connection, essential for sizing network capacity and the heating plant. Includes considerations for diversity of demand where multiple buildings or units are involved. | Details referring to the diversity of the Peak demand in the How to guide |
| **Geographic Demand Location** | The physical location of heat demands which is crucial for mapping potential pipe network routes and identifying optimal paths for infrastructure development. | Geographic mapping in How-to Guide |
| **Building Usage and Ownership** | Information about how a building is used (residential, commercial, industrial, etc.) and who owns it, influencing the likelihood of the building connecting to the network. | See Table 3 for likelihood assessment |
| **Existing Heating Systems** | Review of the current heating solutions in place within potential connected buildings, including operating temperatures, affecting network temperature requirements and connection feasibility. | Operating temperatures detailed in Section 5.2 |
| **Operating Temperatures** | The temperature levels assumed for the network, crucial for designing the pipe network, thermal store volume, and overall network efficiency. Optimization can lead to energy savings. | Further discussed in Section 6.2 |

**Table 4: Critical elements involved in a detailed heat demand assessment accompanied by a brief explanation and a reference for further information (See Section 6.1/6.2 in How to Guide).**

Table 5 and Table 6 provide a sample method for presentation of heat demands and connection likelihood respectively. Each project and context are different, and it is the responsibility of a feasibility study author to evaluate the most appropriate and relevant means of analysis and presentation with respect to each individual project. Further information can be found in the corresponding section of the accompanying District Heating Feasibility Study How-to Guide.

| Connection Likelihood | Description (e.g. Ownership, Supporting Regulations/Policy, Existing/Planned, etc.) | Buildings |
|---|---|---|
| **High** | Publicly owned buildings, high certainty of connection | • University Building |
| **Medium** | Buildings with energy efficiency obligations and new developments that must meet new building energy regulations, increased likelihood of connection | • Office 1 |
| **Low** | Private buildings/rentals, limited ability to influence connection. Buildings with heating systems that are less compatible with DH i.e., systems that are not water based and/or are not centralised. | • Existing Residential Apartment Block |

**Table 5: Sample Connection Likelihood Assessment Table**

## 6.2 Operating Temperature Analysis

This section outlines the assumed operating temperatures for the district heating network and their implications. These temperatures are crucial for determining the sizing of the pipe network, thermal storage, and overall network efficiency. A brief overview of the reasons behind these temperature choices is provided, focusing on their necessity for achieving efficient heat distribution and system connectivity.

Note: Detailed calculations, methodological justifications, and potential optimizations for these temperatures can be found in the accompanying District Heating Feasibility Study How-to Guide, which provides in-depth technical guidance and examples.

This section of the report sets out the assumed operating temperatures in the network and the rationale for these assumptions.

**Operating temperature outputs:**

- Assumed operating temperatures for proposed DH network – which will inform the pipe network. sizing, thermal store volume and the network efficiency assumptions.
- Description of reasoning for this – temperature requirement of heating systems connecting, impact of temperatures on DH system efficiency, etc.
- OPTIONAL - Commentary on potential savings from optimising operating temperatures.

Table 6 below provides a sample method for presentation and comparison of design temperatures for secondary heating systems. Each project and context are different, and it is the responsibility of a feasibility study author to evaluate the most appropriate and relevant means of analysis and presentation with respect to each individual project. Further information can be found in the corresponding section of the accompanying District Heating Feasibility Study How-to Guide.

| Phase | Heat On Date | Buildings | Heat Demand (MWh) | Peak Heat Demand @ Connection (MW) | Peak Heat Demand @ EC (MW) | Assumed Allowable Temperature Regime (°C) | Likelihood of Connecting | Comments |
|---|---|---|---|---|---|---|---|---|
| 1 | 2025 | Office | | | | 80/60 | Medium | |
| | | Existing Residential Apartment Block | | | | 80/60 | Low | Uses electric storage heaters |
| 2 | 2028 | University Building | | | | 80/60 | High | |
| | | Hotel | | | | 80/60 | High | |
| **Total** | | | | | | | | |

**Table 6: Sample Heat Demand Information Table**

# 7 Initial Assessment of Energy Supply options.

This chapter identifies and assesses potential energy sources for a district heating network, starting with a broad list (longlist) and narrowing it down to the most feasible options (shortlist).

## 7.1 Identification of a Long list of Supply Options

**Long List of Energy Supply Options outputs:**

- Longlist completed in Table 7 of template.

**Objective**: Begin by generating a comprehensive long list of potential district heating (DH) supply options based on proximity, source characteristics, and capacity. This helps in identifying the most feasible solutions for further analysis (Table 7).

**Methodology**: Utilise heat source mapping tools to identify 5-10 potential DH supply options within a 2-5 km radius of the proposed network. Evaluate these options against a set of criteria to establish a shortlist of the best candidates for further detailed assessment.

**Table 7: Supply Option Longlist Comparison Table. This table will help to systematically identify potential energy sources based on a range of important criteria without deep evaluation.**

| Criteria | Description | DH Option 1 | DH Option 2 | DH Option 3 | … | DH Option n |
|---|---|---|---|---|---|---|
| **General Description** | Brief overview of the energy source type. | | | | | |
| **Proximity to Network** | Distance from the energy source to the nearest network point. | | | | | |
| **Heat Capacity (MW)** | Available energy capacity to meet DH needs. | | | | | |
| **Heat Source Temperature (°C)** | Typical operating temperature of the heat source. | | | | | |
| **Regulatory Compliance** | Compliance with local and national environmental regulations. | | | | | |
| **Infrastructure Retrofitting Feasibility** | Potential for integrating with or retrofitting existing infrastructure. | | | | | |
| **Scalability** | Ability to scale up the solution to meet future demands. | | | | | |
| **Climatic Suitability** | Efficiency of the heat source under local climatic conditions. | | | | | |
| **Space Required for** | Assesses feasibility within the | | | | | |

| Criteria | Description | DH Option 1 | DH Option 2 | DH Option 3 | ... | DH Option n |
|---|---|---|---|---|---|---|
| **Installation** | available space. | | | | | |
| **Socio-economic Impact** | Impact on local job creation, energy costs, and public perception. | | | | | |

**Key factors for the identification of the Longlist of DH Supply Options (from the above Table 7)**:
- Proximity to the network
- Source temperature
- Capacity (in MW) suitable for DH needs

## 7.2 Supply Option Shortlist

**Shortlist of Energy Supply Options outputs:**
- Shortlist of potential options identified from Table 8.

**Purpose:** This following stage narrows down the options from the long list (up to 10 options) to the top 3 to 5 potential DH supply options for more detailed techno-economic analysis. This selection is based on a well-defined set of criteria that ensure the chosen options are viable, cost-effective, and suitable for the specific conditions of the network.

**Methodology:** Review each option from the longlist against a set of predefined criteria to identify, through a qualitative assessment, those that could offer the best balance of feasibility, cost, and strategic fit. The criteria are designed to assess each option comprehensively, considering both technical and socio-economic factors.

### 7.2.1 Heat Source Options Shortlist Qualitative Evaluation (Template)

This section guides the shortlisting of potential heat sources by providing a detailed comparison of each option based on various technical, economic, and environmental criteria. This helps in selecting the most suitable options that align with the project's requirements and strategic objectives.

**Table 8 Supply Options Shortlist Comparison Table. Criteria to be applied to long list of options 1 to n.**

| Criteria | Description | Method of Assessment |
|---|---|---|
| **General Description** | Brief overview of each option | Qualitative description |
| **Proximity to Network (m)** | Distance from the energy source to the network | Closer proximity scores higher, evaluated based on measured distances |
| **Heat Capacity Available (MW)** | Capacity to meet DH needs | Must meet/exceed minimum required capacity, evaluated for both peak and regular demand |
| **Installation Cost (€/MW)** | Initial setup cost | Evaluated on Low, Medium, High scales; includes potential for financial incentives |
| **Proportion of Heat Covered** | Percentage of annual demand fulfilled | Higher percentages preferred, quantitative assessment |
| **Availability & Access** | Ease of accessing the heat source | Easily accessible sources preferred, considers existing infrastructure compatibility |
| **Security of Supply** | Reliability of heat source supply | Considers transport of fuel and other socio-economic factors that might interrupt supply |
| **Price Stability/Reliability** | Economic stability of heat supply | Assessed through historical data and future projections |
| **Expected Lifespan** | Operational lifespan of the heat source | Longer lifespan preferred; local environmental factors considered |
| **Renewable/Waste Heat Source** | Compliance with sustainability criteria | Must align with Efficient DH criteria |
| **Space Required for Installation** | Space needed for setup | Less space-intensive options preferred, critical in dense areas |
| **Heat Owner Engagement** | Willingness of heat source owner to cooperate | High engagement levels preferred |
| **Adaptability to Local Conditions** | Suitability to local geographic and climatic conditions | Must be highly adaptable |
| **Flexibility for Future Expansion** | Potential to scale the solution | Scalable solutions preferred |
| **Environmental Considerations** | Impact on $CO_2$ emissions, air quality, etc. | Includes pros and cons for each source |
| **Planning Considerations** | Land availability, permissions, grid connection requirements | Includes pros and cons for each source |
| **Technology Readiness** | Maturity of the technology | Fully proven & operational preferred |

| Criteria | Description | Method of Assessment |
|---|---|---|
| **Level** | used | |

Section 7 of the How to Guide accompanying this template shows a shortlisting example from a set of long list options.

# 8 Heat Distribution Systems & Plant Assessment

## 8.1 Pipe Network Route & Construction Assessment

Once the preferred short-listed options are identified, this section analyses the various pipe network routes to determine the preferred pipe network route for the DH network related to each of these options.

**Pipe network assessment outputs:**

- GIS maps of proposed routes analysed showing phasing where applicable.
- Table of loads connected to the network under each phase – please consider future expansion of network when sizing network where applicable.
- Assumptions around diversity applied to pipe network branches (serving multiple connections)
- Total trench length for each phase of network
- Required size of each length of network pipe to inform network costs – based on peak heat demand and network temperatures (max flow temp determined by highest temp requirement of building connecting unless being boosted locally – see operating temperature analysis in Section 6.2 for further details)
- Preferred pipe network route for each supply option – considering least cost and other practical considerations like recent road reinstatement, land ownership, possibility to maximise heat source available expansion of network beyond initial phases, etc.
- Preferred pipe construction based on lowest life cycle costs (Capex, heat losses)
- Associated pumping requirement (pump head and flowrate required) and cost of pump set for preferred network route option.

A sample method for presenting and comparing route options for a single heat supply option or for several shortlisted options is provided in Table 9. Each project and context are different, and it is the responsibility of a feasibility study author to evaluate the most appropriate and relevant means of analysis and presentation with respect to each individual project. Further information can be found in the corresponding section of the accompanying District Heating Feasibility Study How-to Guide.

**Table 9: Route Option Comparison Table**

| Route | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Network Trench Length (km)** | | | |
| **Life Cycle Costs (€)** | | | |
| **Pipework Capital Cost (€)** | | | |
| **Combined Cost (€)** | | | |
| **Comments (Major obstacles/no-go areas avoided etc.)** | | | |

## 8.2 District Heating Plant(s) Sizing Assessment

This section of the report analyses different plant sizing options to arrive at the optimal size of primary and backup heating plant as well as thermal storage for the heat source options.

**Plant sizing assessment outputs:**

- Sizing scenario comparison table – showing contribution of primary and backup heating plant.
- Optimal size of primary and backup plant the thermal storage
- Comment on potential phased installation of equipment

## 8.3 Building connections to DH networks

Building connections are crucial for district heating systems, impacting feasibility and efficiency. This section focuses on establishing strong links between the heat distribution network and buildings or heat consumers.

**Building Connections Outputs:**

- **Detailed Connection Plans**: Provide detailed diagrams and specifications for necessary hardware and configurations.
- **Project Timeline**: Present a detailed timeline for the connection process, emphasizing key milestones and dependencies.
- **Cost evaluation**: Cost evaluation to feed the technical and economical assessments in following sections.

### 8.3.1 Key Considerations:

The following Table 10 serves as a guide to understand the essential components and strategic approaches in connecting buildings to district heating systems, ensuring efficient and effective integration. Refer to the How to Guide for a more detailed description of these categories.

**Table 10 Considerations for Building Connections to District Heating Networks**

| Consideration Category | Details |
|---|---|
| **Connection Types** | Equipment needed for various building types. |
| **Integration Challenges** | Challenges in integrating network pipes. |
| **Technical Requirements** | Specs for connection equipment. |
| **System Compatibility** | Checks for compatibility with heating systems. |
| **Cost Implications** | Financial aspects of connections. |
| **Stakeholder Benefits** | Benefits to building owners and occupants. |
| **Installation Process** | Steps from surveys to commissioning. |
| **Implementation Strategy (8.3.2)** | Phased rollout and engagement plans. |

### 8.3.2 Implementation Strategy

For evaluating and implementing a strategy for building connections within district heating systems, consider the developing the following approach:

- Phased Connection Rollout
- Stakeholder Engagement Plan
- Monitoring and Optimization.

# 9 Detailed Energy Supply Options Assessment

Once the shortlisting of DH energy supply options is carried out, this section aims to outline all the scenarios possible to be included in the techno-economic assessment, including:

a) The DH Network scenarios
b) The business-as-usual (BaU) or "do-nothing" scenario which represents the current situation in terms of heat supply.
c) The counterfactual low-carbon heat option.

**Section Outputs**

**DH development scenarios.**

- The use of different primary and backup heat sources and the size and contribution of each
- Variations around loads which will connect and when.
- Network route options
- Energy Centre location options
- Electricity grid or other fuel carbon intensity projections

**The Counterfactual Scenario**
This section describes what is being assumed as the counterfactual heat supply scenario. This is the scenario against which the DH scenario(s) will be compared in the techno-economic analysis.

**The Business-As-Usual Or 'Do Nothing' Scenario**
This section of the feasibility study outlines the heat supply options that would be used were the DH network not to be developed.

## 9.1 The District Heating Network Development Scenarios

This section sets out the details of the DH scenarios investigated as part of the TEA. This will include the different heat supply shortlisted options in previous section but also scenarios can be added to these options with different network routes, energy centre locations, as examples.

## 9.2 The Business as Usual (BAU) or 'Do Nothing' Scenario

This section of the feasibility study outlines the heat supply options that would be used were the DH network not to be developed or other low-carbon heat supply was not to be adopted. This sets out the current situation in terms of heat supply and the impact of this "Do Nothing" situation on heat customers over the lifespan of the proposed DH project.

## 9.3 The Counterfactual Scenario

This section describes what is being assumed as the counterfactual heat supply scenario. This is the scenario against which the DH scenario will be compared in the detailed technical economic (financial) analysis. This includes details of the technology being assumed under this scenario and key factors such as lifespan, costs, etc. For the majority of cases this is likely to be a scenario which adopts individual heat pumps for buildings

# 10 Techno-Economic Feasibility Analysis. Weighted Multicriteria analysis.

This section evaluates the DH scenarios identified in previous section through a multi-criteria weighted analysis, considering financial viability, operational efficiency, environmental impact, and strategic alignment. It further analyses the DH options against counterfactual scenarios It identifies a preferred DH option for detailed financial examination.

**Outputs: Techno-Economic Feasibility Analysis, Multi-criteria analysis**

- **Evaluation Matrix:** An evaluation matrix is filled in to assess each sub-criterion parameter defined in previous sections, such as NPV of each shortlisted option., individual heat pumps can serve as an alternative scenario to collective district heating.
- **Weighting Criteria Matrix:** The evaluation team establishes a weighting criteria matrix and assigns weights to each sub-criterion based on their relative importance.
- **Evaluation and Scoring.**
  Preferred solution for detail analysis in the following section.

## 10.1 Heat Supply Analysis Criteria

The assessment focuses on four key areas presented in detail in Table 11:

- **Financial Considerations**: Analyses Life Cyle Costs (LCC eg IRR or NPV), initial investment, maintenance and operation costs, energy expenses, and dependability.
- **Implementation & Operability**: Considers influence on the energy hub, activation time, and spatial requirements.
- **Strategic/Market Vision**: Evaluates scalability potential and impact on consumer costs.
- **Environmental Impact**: Reviews carbon emissions mitigation and overall environmental footprint.

**Table 11 Heat Supply Analysis criteria and their sub-criteria.**

| Criteria Categories | Sub-Criteria |
|---|---|
| **Financial Considerations** | Life Cycle Cost (Net Present Value)* |
| | Initial Investment** |
| | Maintenance & Operations Expenditure** |
| | Fuel Cost Expenditure and Variability |
| | Dependability & Flexibility |
| **Implementation & Operability** | Influence on Energy Centre Operation |
| | Time to Activation |
| | Space/Footprint Requirements |
| **Strategic/Market Vision** | Scalability Potential |
| | Consumer Cost Impact |
| **Environmental** | Carbon Emissions Mitigation |
| | Environmental Impact |

**note criteria with two asterix may substitute LCC* evaluation.

Section 10.1 of the How-to Guide provides an in-depth explanation of each sub-criteria presented in the above table and to be used in the multi criteria analysis in the following section.

## 10.2 Weighted Multi-Criteria Analysis

A weighted multi-criteria analysis is conducted to compare the different DH options by assessing multiple criteria, including with different weights to reflect their relative importance to a project. This should be done through three steps:

1. **Evaluation Matrix:** An evaluation matrix is filled in to assess each sub-criterion parameter defined in previous sections, such as NPV of each shortlisted option. This includes a counterfactual solution, like individual air source heat pumps. Note that typical counterfactual solutions (individual heat pumps) may not have collective NPV or CAPEX values. In such cases, the evaluation team may need to assess equivalent parameters (equivalent collective costs) for the collective counterfactual scenario where for example, individual heat pumps can serve as an alternative scenario to collective district heating.
2. **Weighting Criteria Matrix**: The evaluation team establishes a weighting criteria matrix and assigns weights to each sub-criterion based on their relative importance.
3. **Evaluation and Scoring:** The evaluation matrix is scored, with each sub-criterion parameter receiving a score. These scores are then aggregated to rank the options.

This structured process ensures that all relevant factors are systematically considered, resulting in a comprehensive evaluation.

### 10.2.1 Evaluation Matrix

This matrix (Table 12) needs to be filled in by the evaluation team. It provides a detailed assessment of each heat supply option across key criteria, with explanations for each sub-criteria. For example, NPV or CAPEX needs to be assessed for each option.

**Table 12: Evaluation multicriteria matrix**

| Criteria Categories | Sub-Criteria | Option 1 Evaluation | ... | Option n Evaluation | Counterfactual |
|---|---|---|---|---|---|
| **Financial Considerations** | Life Cycle Cost (NPV of Costs) * | | | | |
| | Initial Investment (CAPEX)** | | | | |
| | Maintenance & Operations Expenditure** | | | | |
| | Energy/Fuel Cost Expenditure** | | | | |
| | Dependability & Flexibility | | | | |
| **Implementation & Operability** | Influence on Energy Centre Operations | | | | |
| | Time to Activation | | | | |

| Criteria Categories | Sub-Criteria | Option 1 Evaluation | ... | Option n Evaluation | Counterfactual |
|---|---|---|---|---|---|
| | Space/Footprint Requirements | | | | |
| **Strategic/Market Vision** | Scalability Potential | | | | |
| | Consumer Cost Impact | | | | |
| **Environmental** | Carbon Emissions Mitigation | | | | |
| | Environmental Impact | | | | |

** note criteria with double asterix may substitute LCC (NPV)* evaluation.

### 10.2.2 Weighting Criteria Matrix. Proposed Criteria for Sub-Criteria Weight Evaluation

The following Table 13 provides detailed descriptions of the criteria used in the multi-criteria analysis of heat source options. It elaborates on the considerations and factors influencing each criterion, aiding stakeholders in understanding the basis for scoring in the main weighted analysis.

**Table 13: Weighted Multi-Criteria and Sub criteria Assessment Description**

| Criteria Categories | Sub-Criteria | Weight (%) (2) | Scoring criteria |
|---|---|---|---|
| **Economic** | LCC (1) | 25% | Ranges from very low to very high, reflecting the initial investment cost. |
| | (Capital Expenditure) | (15%) | Ranges from very low to very high, reflecting the initial investment cost. |
| | (Operational and Maintenance Costs) | (10%) | Varies from very low to very high, indicating ongoing system upkeep expenses. |
| | (Fuel Cost Expenditure) | (5%) | Escalates from no or very low increase to a very high increase, reflecting fuel price fluctuations. |
| | Energy Supply Security | 10% | Spans from very high to very low levels, including the capacity to meet all or minimal heat demands. |
| **Implementation & Operability** | Influence on Energy Hub Disruption During Installation | 10% | Describes the level of disruption during installation, from very low to very high impact. |
| | Heat Network Disruption | 5% | Indicates the impact on heat network operation during installation and commissioning, from very low to very high. |
| | Future Expansion Potential | 15% | Covers the potential and ease of future expansion, from very high potential and ease |

| Criteria Categories | Sub-Criteria | Weight (%) (2) | Scoring criteria |
|---|---|---|---|
| | | | to very low or difficult expansion. |
| **Strategic/Market Vision** | End User Cost Impact | 10% | Reflects the potential change in end user costs, ranging from negligible to very high increases. |
| | Emissions Savings | 10% | Describes the potential for emissions reduction, from very high to very low, compared to other options. |
| **Environmental** | Local Environmental Impact | 5% | Ranges from very low to very high, indicating the degree of ecological disturbance. |
| | Spatial Footprint | 5% | Varies from very little or no impact to a very high spatial footprint, considering effects on local sites and biodiversity. |
| Total Score | | 100% | |

(1) criteria under parenthesis may substitute NPV/IRR evaluation.
(2) sub criteria weights in this table are examples, each feasibility study team may agree different weights for each case.

### 10.2.3 Weighted Multi-Criteria Analysis. Evaluation and Scoring

Following the establishment of weights and scoring criteria for each sub-criterion in the previous section, this phase utilises a structured weighted multi-criteria analysis. This method systematically evaluates all pertinent factors, facilitating a thorough assessment of each heat supply option.

The table below presents the weighted scores for each option, providing stakeholders with clear insights into the relative importance and impact of each criterion on the overall decision-making process.

**Table 14: Weighted Multi-Criteria Analysis. Score Matrix and preferred option**

| Criteria Categories | Sub-Criteria | Weight (%) | Option 1 score | ... | Option n Score | Counterfactual |
|---|---|---|---|---|---|---|
| **Financial Considerations** | LCC (NPV) (1) | 25 | Score | ... | Score | Score |
| | (Initial Investment) | 15 | Score | ... | Score | Score |
| | (Maintenance & Operations Expenditure) | 5 | Score | ... | Score | Score |
| | (Energy Expenditure) | 10 | Score | ... | Score | Score |
| | Dependability & Flexibility | 10 | Score | ... | Score | Score |
| **Implementation & Operability** | Influence on Energy Hub | 5 | Score | ... | Score | Score |

| Criteria Categories | Sub-Criteria | Weight (%) | Option 1 score | ... | Option n Score | Counterfactual |
|---|---|---|---|---|---|---|
| | Time to Activation | 5 | Score | ... | Score | Score |
| | Space/Footprint Requirements | 10 | Score | ... | Score | Score |
| **Strategic/Market Vision** | Scalability Potential | 5 | Score | ... | Score | Score |
| | Consumer Cost Impact | 15 | Score | ... | Score | Score |
| **Environmental** | Carbon Emissions Mitigation | 15 | Score | ... | Score | Score |
| | Environmental Impact | 5 | Score | ... | Score | Score |
| **Total Score** | | 100 | Total Score | ... | Total Score | Total Score |
| **Ranking** | | | Rank | ... | Rank | Rank |

The rankings identified in the table above should identify the preferred options to be analysed in detail in the following detailed techno-economic feasibility section.

# 11 Detailed Techno-Economic Feasibility Analysis: Financial & Sensitivity Analysis of the preferred option.

This chapter provides a comprehensive analysis of the preferred heat supply option for the district heating (DH) system. It includes a thorough financial analysis, sensitivity analysis, and a carbon evaluation to assess the feasibility and sustainability of the proposed solution.

**Outputs of this section:**

- **Financial Analysis**: Summarize key metrics like Net Present Value (NPV), Internal Rate of Return (IRR), and cash flow, to show the project's profitability.
- **Sensitivity Analysis**: Identify critical variables impacting financial outcomes, such as fuel prices and demand variability, along with potential financial risks. Outline strategies for managing risks and key success factors based on the risk assessment. Strategies to be defined in the following risk assessment section.
- **Carbon Evaluation**: Highlight the carbon emissions for the preferred district heating (DH) option versus the Business-As-Usual (BAU) scenario, emphasizing environmental benefits.
- **Risk Management:** Outline strategies for managing risks and key success factors based on the risk assessment.
- **Preferred Option:** Clearly state the preferred heat supply option, providing a brief justification based on its alignment with objectives and performance across financial and environmental criteria.

## 11.1 Objective and Scope of a Financial Assessment

The objective of this section is to perform a financial analysis of the different DH technical options being considered, including a counterfactual or base case scenario. The focus here is on affordability and financial impact, distinguishing it from an economic analysis, which considers broader societal impacts.
The financial analysis typically includes the following stages:

1. Definition and assessment of key variables and inputs.
2. Definition of key outputs.
3. Construction of a financial model based on key inputs and outputs.
4. Sensitivity analysis.
5. Carbon Evaluation.

The financial analysis should cover parameters such as Net Present Value (NPV), Internal Rate of Return (IRR), and payback period. Sensitivity analysis should also be performed to evaluate the effects of key variables on the financial outcomes, accounting for bias, uncertainty, and risk.

## 11.2 Model Inputs

This section focuses on the key inputs required for a comprehensive financial analysis, including technical and financial elements.

### 11.2.1 Technical Inputs

The technical inputs should outline the recommended development option and cover aspects like energy demands, heat sources and storage, phasing, and network length. These details guide the accurate evaluation of financial viability. It's advisable to review technical inputs and possibly update plant sizes or capacities for more accurate cost evaluation.

### 11.2.2 Costing and Financial Inputs

Cost estimates should derive from similar projects and account for inflation and risk, with accuracy improved by peer reviews, benchmarking, and forecasting.

### 11.2.3 Context of Financial Analysis - Project Development and Financing

Funding and financing details are crucial for a successful DH system. The financial model should remain independent of the business model during the feasibility study stage. Common funding sources include equity, loans, grants, and developer contributions.

### 11.2.4 Capital Costs & Operation Costs

Refer to the multi-variable section for detailed descriptions of all capital, replacement, and operational costs. This section should evaluate costs in greater detail and accuracy than previous sections. Note that the technical inputs at this stage suggest possible resizing of network or plant sizes after a detailed review.

### 11.2.5 Revenues

Customer payments constitute the primary revenue source for DH systems. Revenue types, including connection, fixed, and variable charges, should be evaluated based on legislative, regulatory, and customer contexts. At this stage, it is advisable to identify revenues based on expenses from the counterfactual scenario.

## 11.3 Key Model Outputs

This section presents key financial metrics such as cash flow, NPV, IRR, and payback period. The financial model should also evaluate total CAPEX, OPEX, revenues, and other relevant parameters.

## 11.4 Sensitivity Analysis, Uncertainty, Bias, and Risk

This section assesses potential risks associated with a DH system, including financial and operational performance. The focus is on sensitivity analysis, bias, uncertainty.

## 11.5 Carbon Emissions Abatement

This section evaluates carbon emissions for the preferred DH options compared to a Business-As-Usual (BAU) scenario, leveraging data from the techno-economic feasibility study. The evaluation should align with industry standards and account for both direct and indirect emissions.

## 12 Risk Assessment

Following the completion of the technical, economical multivariable analysis and the detailed technical economical (financial) analysis, the risk assessment focuses on the preferred option.
This involves creating a risk register to categorize and assess risks related to technical, environmental, financial, and other aspects. Risks are evaluated by their likelihood and impact, with corresponding mitigation strategies develop.

**Outputs:**

**Risk Register**: Initial risk register which considers initial key risks to the project (technical, environmental, financial/economic, reputational, commercial, planning, health &safety) – will include the risk identified, the risk severity rating and mitigation measures.
Provides a structured overview of potential risks and their management, supporting informed decision-making and project planning.

**Risk Assessment Table**

| Risk Category | Description | Likelihood (1-5) | Impact (1-5) | Severity | Mitigation Strategy |
| --- | --- | --- | --- | --- | --- |
| Example | Description | Rating | Rating | Calculated Lx I | Proposed actions |

# 13 Conclusions and Recommendations

This section provides a concise summary and outlines the recommendations based on the comprehensive analysis conducted in the previous chapters. It establishes the viability of the district heating (DH) project and highlights the potential benefits, aligning them with broader infrastructure and policy objectives.

**Outputs:**

**Conclusions:**
This section summarises the conclusions from the techno-economic analysis undertaken. This includes:

**Summary of the key findings; technical viability and financial analysis.**

**Assessment of Benefits and Challenges:**
Feasibility Conclusion

**Recommendations:**
Preferred Technical Solution,
Project Viability
Carbon Savings
Strategic actions
Policy, Panning, Regulatory advice.
Stakeholder engagement

**Next Steps:**
Immediate actions
Timeline
Responsible parties/resources

## 13.1 Conclusions

- **Summary of key findings**
- **Assessment of benefits and challenges**
- **Feasibility Conclusion**

## 13.2 Recommendations

- **Preferred Technical Solution:** Identify the optimal heat source, network route, pipe construction, and energy centre location derived from the technical analysis. Include specifications such as insulation level, pipe construction material, backup supply, and thermal storage size.
- **Project Viability**: State whether the project is viable based on the financial analysis, including IRR, NPV, and cash flow assessments. Discuss the economic feasibility and how the project aligns with funding and investment requirements.
- **Carbon Savings**: Provide a comparison of carbon emissions against the business-as-usual scenario, quantifying the environmental benefits of the DH project.
- **Strategic actions**: specific actions or strategies to address identified issues.
- **Policy, Planning and Regulatory Advice**: Suggestions for navigating regulatory landscapes and securing necessary approvals.

- **Stakeholder Engagement**: Guidance on how to engage and communicate with stakeholders effectively.

## 13.3 Next steps:

For transparency and stakeholder engagement, include a final section that invites feedback on the feasibility study and outlines the next steps for project development and community involvement. For example, it should also include:

- **Immediate Actions:** Specific tasks that need to be initiated promptly, such as detailed project planning, securing funding, or conducting further technical assessments or financial/ economic analyses.
- **Timeline:** A clear timeline for these actions, often with short-term milestones.
- **Responsible Parties:** Identification of who will be responsible for each action, ensuring accountability and clarity.

## 13.4 Using the Supplementary Guidance

The Supplementary Guidance accompanying this template offers further guidance in transitioning from the feasibility stage to detailed business case development stage in the DH Project cycle (Figure 1). The intention of including this guidance is to offer further support to aid decision making.

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