



Department for  
Energy Security  
& Net Zero

# Evaluation of the Heat Networks Investment Project

Final report

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# Summary

## Introduction

Heat networks meet demand for space and water heating, and space cooling. They typically convey hot water from a shared heat source (or sources), which is distributed across a number of buildings or different premises within the same building. Heat networks can provide greater energy efficiency, lower prices for consumers and carbon savings compared with conventional gas or electric heating<sup>1</sup>. They can deliver heat from a range of sources, such as waste heat recovery, combined heat and power (CHP) plants, and large heat pumps. The Climate Change Committee (CCC) have identified low carbon heat and heat networks as a policy priority to meet UK climate change commitments.<sup>2</sup> The high upfront capital investment and long payback periods however can deter investment in heat networks compared with other heat sources<sup>3</sup>.

## The Heat Networks Investment Project

The aim of HNIP<sup>4</sup> was to create the conditions for a self-sustaining heat network market that would contribute to the decarbonisation of the UK energy system at the lowest cost to the economy by 2050 by:

- Increasing the volume of strategic, optimised and low-carbon heat networks built through provision of central Government funding which will draw in significant additional investment.
- Improving the quality of heat networks that meet local infrastructure and consumer needs.
- Building the capability of project sponsors and the supply chain to develop heat networks of the right type and quality.

It would do this by providing funding support for the commercialisation and construction phases of a heat network's development. Funding rounds took place on a quarterly basis, and there were 12 rounds in total, between January 2019 and January 2022. Funding could be either grant or low-cost loan, and could be used to fund commercialisation and

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<sup>1</sup> Heat Networks: Ensuring Sustained Investment and Protecting Consumers, December 2018, BEIS.

<sup>2</sup> See for example: <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>

<sup>3</sup> Heat Networks Investment Project Consultation, Capital Funding for Building Heat Networks, June 2016, BEIS.

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/532483/HNIP\\_consultation\\_vF1\\_NAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532483/HNIP_consultation_vF1_NAL.pdf); DECC (2013). Research into barriers to deployment of district heating networks, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/191542/Barriers\\_to\\_deployment\\_of\\_district\\_heating\\_networks\\_2204.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191542/Barriers_to_deployment_of_district_heating_networks_2204.pdf).

<sup>4</sup> The latest version of the HNIP application guidance, available at: [https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-digital\\_dec2020.pdf](https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-digital_dec2020.pdf)

construction subject to certain conditions. Full details can be found in the application guidance.<sup>4</sup>

The Department for Business, Energy and Industrial Strategy (BEIS)<sup>5</sup> ran a pilot of the HNIP scheme from October 2016 to March 2017. The pilot scheme was evaluated<sup>6</sup>, and lessons learned from the pilot were incorporated into the main scheme design and delivery.

HNIP is part of the government's Heat Networks Transformation Programme (HNTP), which includes other heat network related policies.

## The evaluation

BEIS commissioned Risk Solutions, with the Tavistock Institute of Human Relations, to carry out an independent evaluation of the HNIP scheme to evaluate the process and the impact of HNIP.

The aim was to provide a process and impact evaluation of the main HNIP scheme, with the objective of offering lessons learned to inform any further development of the scheme and any future similar schemes. The evaluation is realist informed, following the principles of realist evaluation, especially the impact evaluation elements.<sup>7</sup> This report is the final evaluation report for the main HNIP scheme.

### Evaluation approach

The process evaluation examined HNIP implementation and the way it was delivered and provides information to inform the development of theories for testing and development in the impact evaluation. The impact evaluation incorporated the realist approach<sup>8</sup> by asking what works, for whom, how, and exploring the influence of context.

Both the process and impact evaluations were underpinned by an evolving theory of change that shows how HNIP is expected to lead to the desired impacts and outcomes.

Both the process and impact evaluations were largely qualitative in nature, involving interviews, and some document review and analysis of project data. The fieldwork was carried out in two waves of process then impact evaluation between June 2019 to February 2023. Evaluation design, delivery and sense-making was delivered working collaboratively with BEIS. More details of the approach, the methods used and its limitations are provided in 'The evaluation approach' in the main body of this report and in [Appendix 1](#).

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<sup>5</sup> We refer to BEIS throughout this report

<sup>6</sup> <https://www.gov.uk/government/publications/evaluation-of-the-heat-networks-investment-project-hnip-pilot-scheme>

<sup>7</sup> See for an example of realist evaluation Pawson and Tilley, Realistic Evaluation, June 1997, SAGE Publications Ltd

<sup>8</sup> Pawson and Tilley, 1997; a theory-based approach to evaluation. For more information see: [http://www.betterevaluation.org/en/approach/realist\\_evaluation](http://www.betterevaluation.org/en/approach/realist_evaluation)



## Findings and conclusions

The findings and conclusions are given in [Chapters 2](#) and [3](#) and summarised here.

We find that HNIP has contributed to the aim of creating a self-sustaining heat network market, albeit not in the way originally envisaged, i.e. through the investment HNIP represents directly stimulating the market. The project was too small to achieve this, especially in the absence of a strong, supportive policy framework and with much market uncertainty.

Project funding has attracted investment from ESCOs (Energy Service Companies), and the funded projects have started to build local capacity and capability and deliver a range of wider benefits in their locations. However, more is needed to leverage the value of the project and in particular the significant body of potential ‘learning by doing’ the project has enabled. Among other things this learning has allowed:

- BEIS to identify and begin to develop, with partners, the broader planning and regulatory frameworks needed to support market growth – for example, zoning (see Glossary for the definition).
- BEIS and TPHN (Triple Point Heat Networks Investment Management) to identify and develop products to reduce costs and improve access to investment, for example through standardisation and provision of BHIVE (the BEIS Heat Network Investment Vehicle) Dynamic Procurement System (DPS).
- TPHN to foster and engage with a network of stakeholders (actual and potential sponsors, investors, customers etc., interested in heat networks).

As HNIP funded projects mature towards full operation, they are expected to provide an additional rich source of exemplars, demonstrating the viability and investability of heat networks to sponsors, customers, and third-party investors.

We suggest the following priorities for DESNZ looking forward:

- Crafting a coherent and practical system of [knowledge management](#) both to synthesise knowledge strands from HNIP, GHNF (and other HNTIP projects) to inform market development, and to ensure the body of knowledge can be developed, managed and deployed beyond GHNF.
- Shifting policy focus with respect to heat decarbonisation to provide a greater emphasis on system strengthening, picking up the [strategic lessons from HNIP](#), including incorporating lessons for market development and integration of heat networks within broader net zero objectives, and
- Considering how lessons from HNIP can inform policy and practice for other national capital support projects delivering in a place-based<sup>9</sup> way.

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<sup>9</sup> A place-based approach is about understanding the issues, interconnections and relationships in a place and coordinating action and investment to improve the quality of life for that community.

# Glossary

Term or acronym	Definition
Alternative theories	<p>Alternative theories describe:</p> <ul style="list-style-type: none"> <li>• Alternative explanations for observed outcomes that do not involve HNIP, OR</li> <li>• Explanations for how HNIP could be failing to deliver an outcome (sometimes called a ‘theory of no change’).</li> </ul> <p>Alternative theories may not be mutually exclusive, several theories may be at work to trigger or inhibit outcomes.</p>
Anchor load	<p>A long-term, stable and predictable demand source. It provides heat network developers with security that the heat produced will have a buyer and helps to optimise technical efficiency by reducing variability in the level of demand.</p>
Association for Decentralised Energy (ADE)	<p>A trade association representing organisations with an interest in decentralised energy. Their full role is described here: <a href="https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-_digital_dec2020.pdf">https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-_digital_dec2020.pdf</a></p>
BDM	<p>Business Development Managers are experienced individuals employed by TPHN to provide guidance prior to and throughout the HNIP application process.</p>
BEIS	<p>The former Department for Business, Energy and Industrial Strategy. BEIS replaced the Department for Business, Innovation and Skills (BIS) and the Department of Energy and Climate Change (DECC) in July 2016. It was responsible for Government policy relating to business, industrial strategy, science research and innovation, energy and clean growth, and climate change. Since a departmental reorganisation in early 2023, responsibility for heat networks now rests with the Department for Energy Security and Net Zero (DESNZ)</p>
BHIVE	<p>The BEIS Heat Investment Vehicle – the framework process for third-party investment. This is a dynamic purchasing system (DPS) for heat networks. It is designed to allow public sector heat network</p>

Term or acronym	Definition
	owners and developers to procure funding and funding-related services for their heat network projects from a range of potential funding providers.
CAPEX	Capital Expenditure
CHP	Combined heat and power – sometimes called co-generation. Combines electricity and heat because the waste heat from thermal electricity generation is captured and used.
Cluster Analysis	Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense) to each other than to those in other groups (clusters). Statistical analytical methods are used across multiple dimensions of both numerical and categorical variables to identify these clusters.
Commercialisation	The stage in the development of a heat network project during which finance is arranged, contracts are procured and negotiated, concessions are negotiated and heat supply is procured.
Condition precedent	A requirement(s) or event that must happen before the contract - or certain parts of it - can come into effect.
Condition subsequent	A condition that affects the validity of an existing valid contract ie. the contract exists but will terminate if the condition subsequent isn't met.
Context, mechanism, outcome configurations (CMOCs)	<p>A concept used in realist evaluation – these are theorised, short cause-and-effect chains that can be tested through evaluation; one way of representing these is shown in the figure below (taken from Jagosh, J. (2019) 'Realist Synthesis for Public Health: Building an Ontologically Deep Understanding of How Programs Work, For Whom, and In Which Contexts', Annual Review of Public Health, 40(1), pp. 361–372. doi: 10.1146/annurev-publhealth-031816-044451.)</p> <p>Please see figure 4 on page 60.</p>

Term or acronym	Definition
Counterfactual	A counterfactual is what would have happened without the intervention being considered. For example, for a local authority installing a heat network serving several blocks of flats, the counterfactual might be installing individual gas boilers in those flats, or electric storage heating.
DECC	Former Department of Energy and Climate Change.
Decentralised energy	Energy (for example electricity, or heat) that is produced close to where it will be used.
Delivery partner	In this report the ‘delivery body’ is the organisation commissioned by BEIS to carry out a range of functions associated with administering the Heat Networks Investment Project, including acting as the key point of contact for applicants and processing applications.
Demi-regularity	A concept used in realist analysis – these are semi-predictable patterns, called demi-regularities because they are not identical but close enough to be recognised as tendencies through qualitative coding.
Developer	May refer to a property developer or heat network developer. The former may be a heat network sponsor, or potential customer for heat from the network.
DESNZ	The Department for Energy Security and Net Zero is focused on the energy portfolio from the former Department for Business, Energy and Industrial Strategy (BEIS).
District heat network	A heat network that provides heat generated at a central location to (more than one) nearby buildings. District heat networks are different than communal heat networks, which deliver heat to one building only.
Due diligence	Due diligence refers to reviewing a potential investment or other transaction in detail to make sure that the buyer understands the investment and its associated risks.

Term or acronym	Definition
ESCO	Energy Service Company
EfW	Energy from waste
Funding gap	The gap between the amount of money available to a project from existing sources and the amount needed to fund development and construction of the project so that it can proceed to operation.
Future-proofed	Designed and developed in a manner that considers and takes account of a range of potential future events and changes in relevant drivers (for example commodity prices, technological developments) to reduce the risk that significant changes will be required in the future to accommodate such changes.
Gap funding	HNIP supplied gap funding, to cover a funding gap. Applicants were required to show that the heat network would have positive project returns without any HNIP support, but the financial returns would be too low to attract the full amount of funding required to deliver the project. The amount of HNIP funding for which each project was eligible to apply was called the project’s “funding gap” and was individual to each project. The method for calculating the funding gap was provided in the application guidance. (See <a href="https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-_digital_dec2020.pdf">https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-_digital_dec2020.pdf</a> )
Green Heat Network Fund (GHNF)	The Green Heat Network Fund (GHNF) is a 3-year £288 million capital grant fund that supports the commercialisation and construction of new low and zero carbon heat networks, and the retrofitting and expansion of existing heat networks. It aims to develop and grow the heat network market and to address some of the challenges of decarbonising the UK’s heat sector. GHNF has followed HNIP.
Gross grant equivalent (GGE)	Gross Grant Equivalent is the amount of state aid subsidy that is provided via a HNIP award as either grant or loan. If the award is in the form of a grant (either for commercialisation or construction) this counts 100% in terms of Gross Grant Equivalent. For loans the GGE is the Net Present Value of the cost of the state subsidy provided in relation to the loan. This is calculated based on determining a commercial rate for the loan less the actual interest rate charged on

Term or acronym	Definition
	<p>the loan (the difference being the subsidy), discounted at the commercial interest rate over the term of the loan. The GGE was used to inform the application scoring. . For HNIP, the GGE of loan funding is about 20% of that for an equivalently-sized grant.</p>
Heat interface unit	<p>Heat interface units act as a bridge between the central source of hot water (or sometimes steam) in distribution pipes, and the heating and hot water systems of individual buildings, or individual apartments.</p>
HMT	<p>His/Her Majesty's Treasury</p>
Heat network (HN)	<p>A heat network is the system of insulated pipes which transports heat from a source (or multiple sources) to more than one end user. There are two types<sup>10</sup>:</p> <ul style="list-style-type: none"> <li>• A communal heat network supplies heat and hot water to a number of customers within one building only.</li> <li>• A district heat network (district heating) supplies heat and hot water to customers in more than one building. District heating networks can range in size from a few hundred metres supplying just a few homes to several kilometres of pipe supplying heat and hot water to multiple buildings in a development.</li> </ul> <p>HNIP is concerned with district heat networks.</p>
HNTP	<p>Heat Network Transformation Programme. Through this programme, the government is working with industry and local authorities, and investing over half a billion pounds in funds and programmes, to develop new heat networks and improve existing ones. HNIP is part of that programme.</p>
Heat network zone / zoning	<p>A heat network zone is an area that will be identified and designated by central and local government working together with industry and local stakeholders, within which heat networks are the lowest cost solution for decarbonising heating. In a heat network zone all new buildings, large public-sector and large nondomestic buildings – as</p>

<sup>10</sup> From: <https://www.heattrust.org/resources/2-general/112-what-is-a-heat-network> downloaded 29/03/23

Term or acronym	Definition
	well as larger domestic premises which are currently communally heated – would be required to connect to a heat network within a prescribed timeframe. See e.g. Proposals for heat network zoning: <a href="https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning">https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning</a>
HNDU	Heat Network Delivery Unit – this BEIS team provides support and guidance to local authorities in England and Wales who wish to explore heat network opportunities.
HNIP	Heat Networks Investment Project
HP	Heat Pump
IRR	Internal Rate of Return - a measure that is sometimes used in capital budgeting and project appraisal as a measure of attractiveness. It is calculated as the discount rate that gives a net present value of zero and the higher it is, the more desirable the investment will be.
kW	Kilowatt – a measure of the heat supply capacity of a system or appliance, or the rate of supply of heat.
kWh	Kilowatt hour – a measure of quantity of heat (equivalent to the quantity of heat supplied at a rate of 1 kW, for an hour).
Market Transformation Commitment	All applicants to GHNF must provide a signed Market Transformation Commitment statement. The Market Transformation Commitment sees the applicant commit their project to enabling actions that will help the Green Heat Network Fund transform the heat network sector. For example, the applicant will commit to an open procurement process that has fair contractual terms, so as to not present an obstacle to new market entrants.
Mid-range theory (MRT)	A concept used in realist analysis - these are theories that are specific enough to generate particular propositions to test and general enough to apply across different situations. See for example <a href="#">Better Evaluation</a> .

Term or acronym	Definition
MW	Megawatt – a measure of quantity of heat, equivalent to 1,000 kW
LA	Local authority
LEP	Local Enterprise Partnership - non-statutory bodies responsible for local economic development in England.
NPV	Net Present Value – a measure used in project appraisal and capital budgeting to assess the financial return from a project (also see social NPV).
OPEX	Operating Expenditure
Place-based approach	A place-based approach is about understanding the issues, interconnections and relationships in a place and coordinating action and investment to improve the quality of life for that community. (From: <a href="https://www.ourplace.scot/">https://www.ourplace.scot/</a> )
Project sponsor	Entities initiating development of a heat network and/ or providing a source of funding. Includes property developers, local authorities, universities, business park owners, leisure centres, schools, commercial/social landlords, community organisations, charities etc.
Realist interviews	Theory-driven interviews, that investigate propositions about how, where, when and why programmes are and are not effective. Theories are placed before the interviewee for them to comment on with a view to providing refinement. The subject matter of the interview is the researcher’s theory and interviewees confirm, falsify, and refine this theory. This relationship – described as a teacher–learner cycle – is integral to realist evaluations.
REPEX	Replacement expenditure e.g. of components over time.
SDDS	Standard Due Diligence Set - an explanation of the technical, legal and financial due diligence requirements of project finance lenders and investors that enables the standardisation of due diligence across the project portfolio.



Term or acronym	Definition
SOMS	Sales, Operating and Maintenance Set - template contracts for Sales, Operation and Maintenance of heat networks available from: <a href="https://tp-heatnetworks.org/heat-contract-templates/">https://tp-heatnetworks.org/heat-contract-templates/</a> .
Supplier	A member of the supply chain, for example: lead or prime contractor civil engineer (e.g. for trenching works); mechanical or electrical systems (e.g. for the design, configuration and installation of heat network systems); pipework specialists (e.g. pipe manufacturers, pipe laying or welding); heat network specific mechanical and electrical equipment (e.g. Heat Interface Units or specialist controls); and consultants and specialist advisors.
Realist evaluation	Multi-method evaluation approach that emphasises the importance of understanding not only whether a policy contributes to outcomes (which may be intended or unintended) but how, for whom and in what circumstances it contributes to these outcomes.
Ripple effect	A term we have used in the evaluation to describe outcomes or effects that reach, or have the potential to reach, beyond HNIP's immediate impact on funded schemes to have a wider impact. For example, establishing a further education course in heat network engineering in response to local heat network development. Ripple effects are key to ensuring that HNIP achieves its wider objectives of contributing to a self-sustaining market.
Social NPV	Social Net Present Value – a measure of the value of a project to society as a whole used in project appraisal. It takes costs and benefits into account (also see NPV).
System leadership	System leadership makes the knowledge and understanding gained at one point in a system relevant and useful in another. It is about making connections and system building and supports sustainable change.
Triple Point Heat Networks (TPHN)	Triple Point Heat Networks Investment Management – the HNIP main scheme delivery partner.
Transaction costs	Transaction costs are costs associated with making an economic transaction. For heat networks investments, these will include legal

<b>Term or acronym</b>	<b>Definition</b>
	fees for example. Many of these costs – such as the cost of due diligence exercises – will be similar for both small and large investments.

# Chapter 1 Introduction

*The Heat Networks Investment Project (HNIP) provides capital support for the latter stages of commercialisation and construction of new heat networks in England or Wales. The scheme also provides funding for the expansion and connection of existing networks. This report presents the results of the process and impact evaluations of HNIP.*

This chapter outlines the scheme and evaluation aims and methods, but first we introduce the structure of the report.

## Introduction to this report

### Aim of the report

This report details the process and impact evaluation of the HNIP main scheme, with the objective of offering ‘lessons learned’ to inform future similar schemes.

### How to read this report

This report is structured so that readers with different interests can engage with it at different levels:

- Readers interested in a high-level overview of the evaluation and its findings can read just the summary.
- The main report provides greater detail, and presents the findings in the form of a narrative describing the impact HNIP has had and lessons regarding its delivery. It is aimed at people interested in understanding more about how the scheme has performed at the systems level and provides signposting to more detailed information provided in the appendices. It is structured as follows:
  - This chapter outlines the background to the development of HNIP, and introduces the evaluation aims and methods.
  - [‘Chapter 2 Overview of findings’](#) – summarises our findings in the form of a narrative setting out the theory of change, what HNIP has achieved, what has worked well, what less well, and the reasons for this.
  - [‘Chapter 3 Conclusions and looking forward’](#) – draws conclusions based on findings presented earlier in this report and suggests ways these can inform future projects and policy.
- The appendices are more technical in nature. They set out the methodology and findings in much more detail, as follows:
  - [‘Appendix 1 Evaluation approach’](#) describes the methods we used.

- [‘Appendix 2 Evolution of the impact theories’](#) shows how the impact theories evolved during the evaluation.
- [‘Appendix 3 Findings – Impact’](#), summarises our findings with respect to outcomes. The findings explore the evidence for whether and how HNIP is delivering early outcomes on the pathways to impact.
- [‘Appendix 4 Findings – Process’](#), looks at evidence around high-level themes 1 (scheme technical design) and 2 (administrative design and delivery), structured around the applicant journey, from becoming aware of HNIP through applying, to post-funding decision activities.
- [‘Appendix 5 An exploration of project diversity’](#) – Cluster Analysis presents an exploration of the diversity of the funded project portfolio using cluster analysis, and
- [‘Appendix 6 Learning and knowledge strands’](#), presents suggested learning strands that can be derived from the portfolio.

We have illustrated findings with quotes from interviewees. Due to the small number of projects and players central to HNIP and its evaluation, we have not identified which organisation each interviewee belongs to, but have indicated whether they are speaking predominantly from a project or other perspective. Other perspectives include BEIS, the delivery partner, suppliers or third-party investors.

## Background

### Heat Networks

Heat networks typically convey hot water from a shared heat source (or sources) to meet demand for space and water heating, and space cooling distributed to more than one end user. Heat networks are important because, compared with conventional gas or direct electric heating, they can provide an opportunity for greater energy efficiency, lower prices for consumers and carbon savings<sup>11</sup>. They can deliver heat from a range of sources, such as waste heat recovery, combined heat and power (CHP) plants, and large heat pumps. However, the economic case for heat networks is challenging compared with other heat sources, such as individual gas boilers. This can deter traditional investors from investing in heat networks<sup>12</sup> because initial capital costs are high. Investors seek guaranteed demand underpinned by long-term contracts, and heat networks offer relatively low returns over long payback periods.

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<sup>11</sup> Heat Networks: Ensuring Sustained Investment and Protecting Consumers, December 2018, BEIS.

<sup>12</sup> Heat Networks Investment Project Consultation, Capital Funding for Building Heat Networks, June 2016, BEIS.

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/532483/HNIP\\_consultation\\_vF1\\_NAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532483/HNIP_consultation_vF1_NAL.pdf); DECC (2013). Research into barriers to deployment of district heating networks, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/191542/Barriers\\_to\\_deployement\\_of\\_district\\_heating\\_networks\\_2204.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191542/Barriers_to_deployement_of_district_heating_networks_2204.pdf).

Experimental statistics published in 2018<sup>13</sup> state that as of 2017 there were 2,000 district heating networks and 12,000 communal heating networks in the UK, together providing 14TWh of heat per year (around 3% of UK buildings' heat demand). Heat networks are most frequently found in locations with a high heat demand density, such as urban areas, university campuses and hospitals. Examination of the system-wide implications of decarbonisation highlighted the long lead times for heat network infrastructure and the need for clear plans at a local level for the potential use of heat networks<sup>14</sup>.

## Policy

The Climate Change act, passed in 2008, committed the UK to an 80% reduction of greenhouse gas emissions by 2050, compared with 1990 levels. The UK's carbon emissions derive mostly from fossil fuel combustion, with heating accounting for a significant share of total energy use. For this reason, the Committee on Climate Change (CCC) makes low-carbon heat (and heat networks as part of this) a policy priority.<sup>15</sup> In the 2021 Heat and Building strategy, the government cites a Climate Change Committee recommendation for around 18% of UK heat to come from heat networks by 2050 as part of a least cost pathway to meeting net-zero<sup>16</sup>. The high upfront capital investment and long payback periods compared with other heat sources can, however, deter investment in heat networks<sup>17</sup>.

The Heat Network Delivery Unit (HNDU) was launched in 2013. HNDU provides support (grant funding and guidance) to local authorities in England and Wales to progress the development stages of district heat network projects (from heat mapping through to detailed project development). HNDU support does not provide funding for commercialisation costs and costs associated with the construction, operation and maintenance of a heat network.<sup>18</sup>

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<sup>13</sup> Energy Trends: March 2018, special feature article - Experimental statistics on heat networks <https://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks>

<sup>14</sup> Imperial College (2015) Energy system crossroads - time for decisions: UK 2030 low carbon scenarios and pathways - key decision points for a decarbonised energy system, <https://workspace.imperial.ac.uk/icept/public/energy%20system%20crossroads.pdf>; UKERC (2016) Heat Networks and Governance. Report of event held on 11 & 12 April 2016, <http://www.ukerc.ac.uk/publications/meeting-report-heat-networks-and-governance.html>.

<sup>15</sup> See for example: <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>

<sup>16</sup> Heat and Building Strategy, BEIS, October, 2021

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1044598/6.7408\\_BEIS\\_Clean\\_Heat\\_Heat\\_Buildings\\_Strategy\\_Stage\\_2\\_v5\\_WEB.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1044598/6.7408_BEIS_Clean_Heat_Heat_Buildings_Strategy_Stage_2_v5_WEB.pdf)

<sup>17</sup> Heat Networks Investment Project Consultation, Capital Funding for Building Heat Networks, June 2016, BEIS.

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/532483/HNIP\\_consultation\\_vF1\\_NAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532483/HNIP_consultation_vF1_NAL.pdf); DECC (2013). Research into barriers to deployment of district heating networks, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/191542/Barriers\\_to\\_deployment\\_of\\_district\\_heating\\_networks\\_2204.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191542/Barriers_to_deployment_of_district_heating_networks_2204.pdf).

<sup>18</sup> [Heat Networks Delivery Unit](#)

In 2016 BEIS (now the Department for Energy Security and Net Zero)<sup>19</sup> launched HNIP. The department ran a pilot of HNIP from October 2016 to March 2017; the pilot scheme was evaluated<sup>20</sup>, and lessons learned from the pilot were built into the main scheme design and delivery. The main scheme closed for applications in 2022.

## The Heat Networks Investment Project

### Aims and objectives

The aim of HNIP<sup>4</sup> was to create the conditions for a self-sustaining heat network market that would contribute to the decarbonisation of the UK energy system at the lowest cost to the economy by 2050 by:

- Increasing the volume of strategic, optimised and low-carbon heat networks built, through provision of central Government funding, which will draw in significant additional investment.
- Improving the quality of heat networks that meet local infrastructure and consumer needs.
- Building the capability of project sponsors and the supply chain to develop heat networks of the right types and quality.

HNIP was concerned with district heat networks. Where we refer to heat networks in this report, we mean district heat networks.

### Project delivery

As Table 1 shows, BEIS appointed a delivery partner in September 2018. Triple Point Heat Networks Investment Management (TPHN) was appointed following a competitive tendering exercise, and BEIS then adopted a collaborative working approach to finalise the design of HNIP.

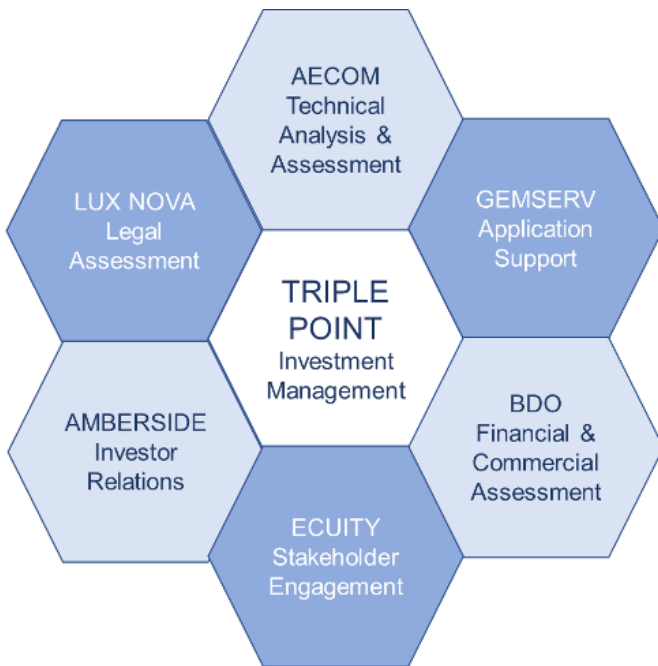
TPHN is a consortium formed to deliver HNIP, led by Triple Point Investment Management and comprising seven organisations in total at the time of the HNIP main scheme start-up, as shown in Figure 1.

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<sup>19</sup> We refer to BEIS throughout this report

<sup>20</sup> <https://www.gov.uk/government/publications/evaluation-of-the-heat-networks-investment-project-hnip-pilot-scheme>

**Figure 1: Triple Point Heat Networks Consortium<sup>21</sup>**



At the time of writing (March 2023) TPHN comprised: Triple Point Investment Management LLP (Investment Management), AECOM (Technical Analysis and Assessment), Amberside Advisors Ltd (Investor Relations), Asteros Advisers (Financial and Commercial Assessment), Gemserv (Application and Data Support and Stakeholder Engagement) and Lux Nova Partners Ltd (Legal Assessment). Following another competitive tendering exercise, the consortium was also appointed delivery partner for the GHNF in March of 2022, the target successor scheme to HNIP.

Project sponsors could submit applications to HNIP at any time, however the process was divided into funding rounds, with the Investment Committee meeting on fixed dates to make final decisions on which projects to fund. Project sponsors submitted a pre-application to confirm eligibility. They could request an estimate of their scheme’s social net present value at that point, and TPHN provided feedback on the pre-application. Applicants then submitted a full application in the same or a future funding round. Table 1 shows the dates for the first funding rounds and shows – using rounds 4 and 5 as an illustration – that the application window was continuous, with the submission date determining when the application would be assessed, and a funding decision made.

The final round of funding (round 12) was opened in October 2021 and closed in January 2022.

<sup>21</sup> Triple Point Heat Networks group as constituted at the time of scheme launch, August 2018.

**Table 1: HNIP selected timeline events**

Activity or event	Date or time period
Delivery Partner appointed	September 2018
HNIP main scheme launched	October 2018
Guidance materials published	November 2018
Round 1 opened	5 February 2019
...	
Round 4 pre-application window closed	4 December 2019
Round 4 full application window closed	3 January 2020
Round 5 application window opened	4 January 2020
Round 4 funding decisions made	February 2020

## Funding mechanisms

HNIP had three separate funding mechanisms that applicants could request:

- Grants – payments that do not need to be repaid.
- Corporate loans – loans at below market interest rates for the length of the project concession less two years, with a maximum term of 25 years.
- Project loans – in addition to the features of a corporate loan, project loans are non-recourse<sup>22</sup> secured lending direct to a project SPV<sup>23</sup> (special purpose vehicle) and have a connection guarantee feature. This connection guarantee means that if, for reasons beyond the SPV's control, anchor load connections are delayed, then an interest and principal grace period of up to three years can be agreed.

<sup>22</sup> Non-recourse loans are secured only on the assets of the project company, so there is no recourse to the assets of the parent organisation.

<sup>23</sup> An SPV is a separate company created for the project, with its own finances, separate from the parent company or organisation.



Commercialisation funding was normally made by way of grant. Public-sector applicants could apply for a grant and/or a loan for construction funding. Private and third sector applicants were expected to apply for construction funding by way of a loan rather than grant, unless they could show that loan funding was insufficient, on its own, to resolve the funding gap. Full details could be found in the application guidance.<sup>24</sup>

## The evaluation

BEIS commissioned Risk Solutions, with the Tavistock Institute of Human Relations, to carry out an independent process and impact evaluation of the HNIP scheme. The evaluation was delivered through a series of process and impact evaluation cycles between December 2016 and June 2023.

### Evaluation questions

The evaluation questions were:

#### *Process evaluation*

- How are the HNIP application and project initiation stages working?
- What improvements can be made, both between the pilot and main schemes and as the scheme progresses?

#### *Impact evaluation*

- What impact has HNIP had, how has it achieved these impacts, and
- To what extent can the policy be said to have contributed to the observed outcomes?

Our overall evaluation aimed to address these questions, and to explore five high level themes:

1. Scheme technical design
2. Administrative design and delivery
3. Delivery of projects
4. Market sustainability
5. Scheme outcomes.

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<sup>24</sup> The latest version of the HNIP application guidance is available at: [https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-\\_digital\\_dec2020.pdf](https://tp-heatnetworks.org/wp-content/uploads/2020/12/heat-networks-investment-project-application-guidance-_digital_dec2020.pdf)

The process evaluation focused mainly on Themes 1 and 2. The impact evaluation explored early evidence of impact relevant to Themes 3, 4 and 5; some of the findings have implications for Themes 1 and 2.

## The evaluation approach

The evaluation was founded on a theory of change showing how HNIP was expected to lead to the desired impacts and outcomes. This theory of change has evolved over the course of the evaluation in response to findings.

The evaluation, especially the impact evaluation element, was realist informed, that is, it followed the principles of realist evaluation.<sup>25</sup> This approach is called 'realist' because it investigates how the project, or intervention, is experienced in reality by the people affected by it. To achieve this it explores how project context, the resources offered by HNIP, and people's motivation for taking part in the project, combine to produce outcomes. The emerging evidence is used to form theories that explain how and why the project is working, for whom, and in what context.

**The process evaluation** examined activities involved in HNIP's implementation and the pathways by which the project was delivered. It was carried out in two waves from June 2019 to April 2022, covering application rounds one to ten of the main scheme.

**The impact evaluation** incorporated the realist approach by exploring how HNIP activities and outputs, combined with contextual factors, triggered responses and resulted in outcomes. Fieldwork was completed between August 2020 and January 2023, covering applications up to round 12 (the final round) of the main scheme. This was a system-level evaluation. That is, we used the data collected to go beyond the impact on individuals and groups to chart and explain the wider systemic impact of HNIP.

The principal data collection method used was interview. We carried out semi-structured and realist interviews<sup>26</sup> with BEIS, the delivery partner Triple Point Heat Networks Investment Management (TPHN), applicants, funded and unfunded projects, a trade association, suppliers and stakeholders having an investor perspective. Other methods included: a short e-survey of funded applicants, analysis of projects' application data, some limited document and website review, attending a sample of TPHN webinars, and reviewing data on website views and seminar sign-ups.

The approach was iterative and collaborative. Theory development, topic and sample selection, data gathering and analysis were carried out iteratively with frequent sharing of

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<sup>25</sup> For examples of realist evaluation approaches and methodologies see: Pawson and Tilley, *Realistic Evaluation*, June 1997, SAGE Publications Ltd; and Jagosh, *Realist Synthesis for Public Health: Building an Ontologically Deep Understanding of How Programs Work, For Whom, and In Which Contexts*, *Annual Review of Public Health*, Volume 40, 2019, pp 361-372

<sup>26</sup> For a full description of realist interviewing techniques see: Manzano, A., 2016. The craft of interviewing in realist evaluation. *Evaluation*, 22(3), pp.342-360.

emerging findings with BEIS through internal project reports, and presentations and sense-making with BEIS and TPHN through presentations and workshops.

An economic evaluation was also originally planned. However, as delays to the scheme and to funded projects have become apparent, it was decided we would no longer be delivering this.<sup>27</sup> Given that the full range of HNIP benefits will not be realised until several years after project closure, BEIS decided to conduct a separate cost benefit analysis once the complete range of benefits can be robustly assessed.

### **Quality of the evidence**

Recruitment throughout the process and impact evaluations has proved difficult. While responses were lower than ideal (see Table 3 and Table 4 in Appendix 1 Evaluation approach), we achieved a good spread of different types of respondent and project in our samples. Interviewees were able to evidence their assertions with examples, providing a coherent and persuasive narrative.

Project sponsor knowledge and perspectives were supplemented by interviews with BEIS and TPHN, investors, suppliers and other relevant people. Alternative (non-HNIP) impact theories have been identified and tested to ensure we examine other ways that outcomes may be being delivered. Workshops involving relevant stakeholders from BEIS and TPHN provided opportunities for additional triangulation and sense checking, ensuring we grounded our findings in ways that would be useful for future work.

Overall, we found the data to be very rich and we are confident that it was sufficient to support theory development and testing.

Due to the nature of the projects funded by HNIP, there were a high proportion of grant-funded, public-sector led schemes in our sample frame. Also, because the delivery of a heat network is a major project, which takes several years to complete, few of the projects in the main scheme are fully operational at the time this work was completed. Findings here are subject to these limitations. Due to the complexity of the different project contexts and relatively small number of projects, it would not be possible to identify representative samples or reliably identify causal associations in the data and we have not attempted to do this.

We have tried our best to ensure that the findings presented in this report were accurate at the time the analysis was carried out. Some may have been superseded by subsequent events.

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<sup>27</sup> Our partners London Economics however completed a review of the HNIP monitoring templates and commented on their suitability for collecting information that would be necessary to conduct a cost-benefit analysis in the future.

# Chapter 2 Overview of findings

## Introducing the theory of change

HNIP was founded on the assumption that the initial £320m investment would be a one hit intervention aimed at stimulating a growing, self-sustaining heat network market. It would do this by attracting additional investment, and building system capability, especially of sponsors and the supply chain, bringing new providers and investment to an expanding and thriving heat network market.

Six years on much has changed. The heat network environment has developed and although some of it has been influenced by HNIP, it has also been subject to major external influences such as greater climate change emergency awareness, and developments in the energy market, to name just two.

It was quickly realised that the level of investment provided by HNIP would be too low to 'kick-start' the market in the way anticipated. The theory of change (TOC), developed early in the evaluation, recognised that market development would be a slower process than initially anticipated, in which HNIP would build the capability and capacity of the market principally by:

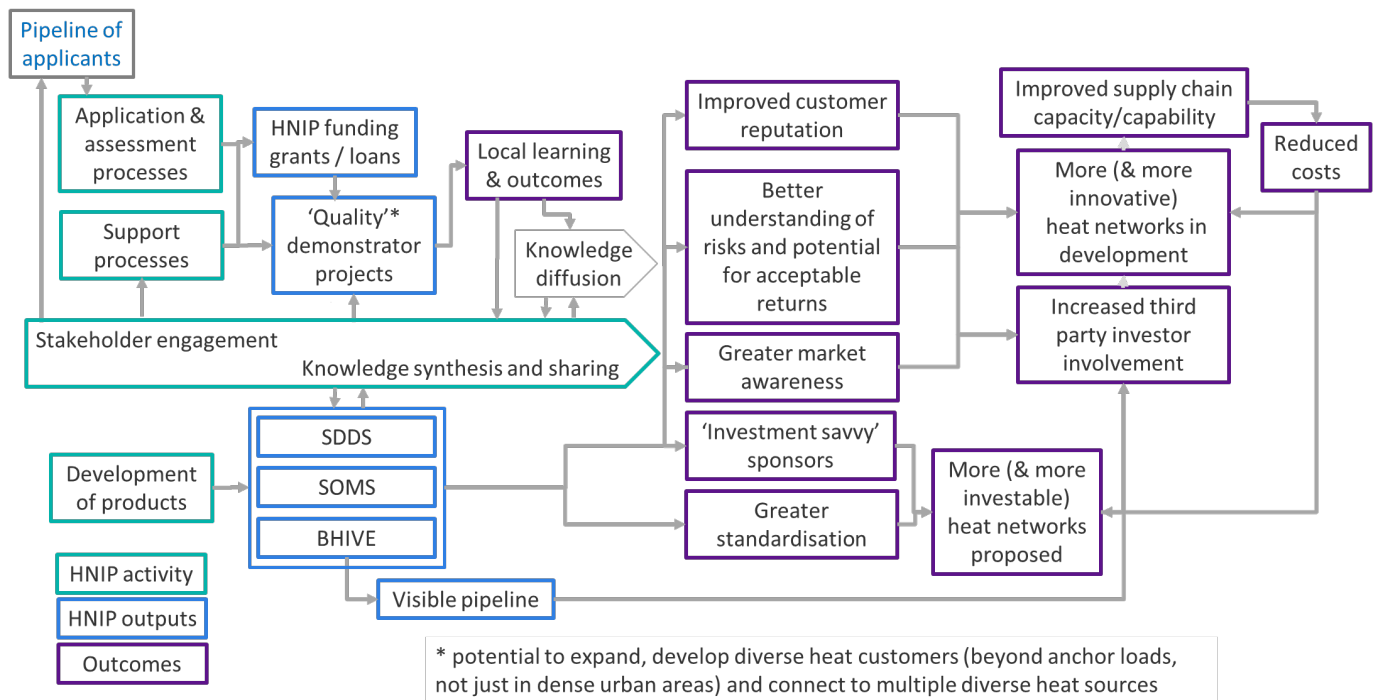
- Providing a body of projects that would demonstrate the viability and investability of heat networks, showing for example: the feasibility of innovative solutions (e.g. new heat sources or situations), heat networks' potential to expand, increase the diversity of heat customers (beyond anchor loads, and not just in dense urban areas), and connect to multiple diverse heat sources.
- Promoting private sector programme development and investment, award practices and behaviours in the public sector, hence among other things generating more 'investment savvy' sponsors and more investable projects.
- Generating better understanding (particularly in the investment community) of risks and the potential for acceptable returns over longer timescales, and hence greater third-party investor involvement.
- Delivering/catalysing greater standardisation of commercial documents and reducing costs, leading to more investable heat networks (through for example

the standardised due diligence sets (SDDS)<sup>28</sup>, the Sales, Operating and Maintenance Set (SOMS)<sup>29</sup>, and the BEIS Heat Investment Vehicle (BHIVE)<sup>30</sup>.

- Providing better visibility of a growing pipeline (e.g. through BHIVE), and greater awareness in the market.
- Improving the reputation of heat networks with customers and end users, making heat customers easier to secure.
- Developing the supply chain in response to demand, including building capacity and capability (skills, etc.).
- Driving down costs by increasing volume and innovation.

We have visually represented our current understanding of the main elements of the TOC in Figure 2. The following sections expand on how HNIP was intended to deliver the expected outcomes and to what extent the evidence suggests it has done this.

**Figure 2: The theory of change map**



<sup>28</sup> The Standard Due Diligence Set is an explanation of the technical, legal and financial due diligence requirements of project finance lenders and investors that enables the standardisation of due diligence across the project portfolio.

<sup>29</sup> The Sales, Operations and Maintenance Set is a suite of template heat contracts for use by anyone involved in a district heating scheme intended to reduce costs and increase standardisation.

<sup>30</sup> The BEIS Heat Investment Vehicle is a Dynamic Purchasing System (DPS) that allows public-sector heat network owners/developers in England and Wales to procure funding and funding-related services for their heat network projects from a range of potential funders.

## Delivery against the theory of change

This narrative sets out an overview of the evaluation’s findings with respect to HNIP’s progress towards its goals, what has worked well, what less well, and the reasons for this. Full details of the evaluation’s process and impact findings can be found in Appendix 3 and 4 respectively.

### Delivering impact

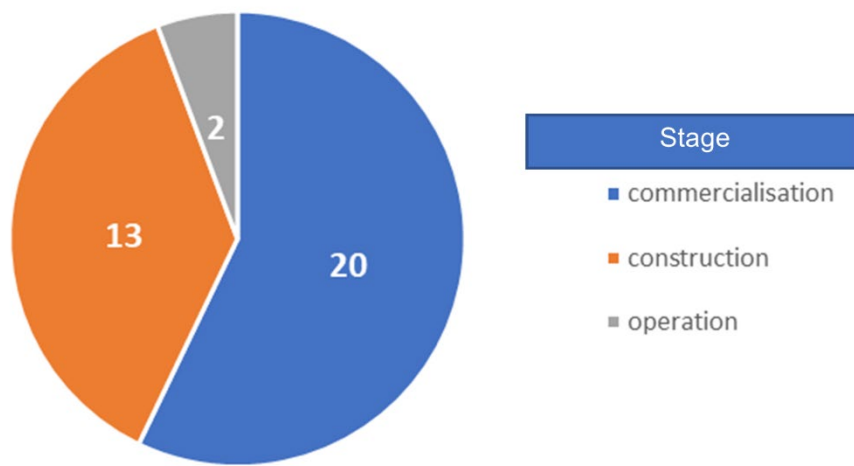
A picture has emerged of a project that has contributed to raising awareness of heat networks as a viable solution to low carbon heating where the right conditions exist. Funded projects are helping to build local capacity and support delivery of local benefits. However, the project is some way from having the impact on the wider market envisaged at the outset.

### Initial impact – local projects delivering local benefits

#### The funded projects

The HNIP main scheme, at the time of our analysis<sup>31</sup>, had funded 35 projects. This compares with an initial aspiration of 200 funded projects. The projects are now proceeding through commercialisation and construction to operation as shown in Figure 1211. A very small number are fully operational.

**Figure 3: Proportion of funded scheme at each stage (source: TPHN)**



#### Getting projects off the ground

The initial, but short lived, expectation that the level of investment provided would stimulate market development and bring new suppliers and investment to an expanding and thriving heat network market, was not realised.

<sup>31</sup> Data from most recently received download of information from BEIS Master data tool 02/11/2022. This reflects the position with respect to projects which were awarded, and expected to deploy, funding at that time.

Instead, the initial impact of HNIP has been LA and ESCO sponsors' recognition of the [opportunities](#) it provided them, in combination or individually, to seek and obtain support for the development of heat networks that fitted with their current, or emerging, strategies. These included not only decarbonisation aspirations, but also wider ambitions, such as regeneration and local employment. While HNIP may not be a primary driving force for change, it has helped some projects bring forward or increase their scale of ambition more rapidly than would otherwise have been the case.

*I think that the potential projects have been there before. I think it's the element of government support which has developed the projects a bit quicker from inception. (Project)*

In other cases, HNIP has played a key role in getting individual projects off the ground. In particular, it has provided [gap funding](#) to enable projects to proceed, while government funding has signalled the [legitimacy of heat networks](#) and helped build confidence among local stakeholders.

*for us it's the ability to bridge the affordability gap [...] there are other methods and instruments we can use but without that initial intervention, this heat network would probably not have been possible. (Project)*

*It gives you a lot of legitimacy to show that this is real, that you've got actual money behind you and you can deliver this. (Project)*

The [funding of the commercialisation](#) phase of projects has been particularly valued. Commercialisation is a key phase, providing a proving ground in which the commercial viability of a project is put to further test post award, with both sponsors and BEIS having some expectation of failure.

*... when we got the funding, [we used it] to de-risk it [the design] because we didn't want to run the procurement with any obvious risks in there where someone prices that in and it becomes an unaffordable bid, so we wanted to take as much risk out of it as we possibly could. (Project)*

HNIP is not the only factor affecting confidence in heat networks, other key factors that can help build, or erode, confidence include previous experience with heat networks, policy and economic uncertainty, and the presence or absence of strong local leadership and effective champions. Which factors are more important depends on the local context – but HNIP has had a critical role to play for the funded networks, and this can be more significant in some areas than others.

### **The role of champions**

In most, if not all, of the projects we have interviewed, [champions](#) have played a key role in marshalling resources, stakeholders, and agendas in support of heat network development. HNIP has provided champions with a catalyst they can use to draw together people with different motivations.



Champions may be local authority employees, local councillors, consultants, ESCO employers or academics. Among them are the 'District Heating Divas', a forum for women across the Heat Network industry. In LAs they often work in roles associated with addressing climate change and achieving net zero. Within an LA sponsored scheme they might have a project management role.

*We've had a local champion for 10 years or so [...]. He's been with us on quite a lot of [the] journey and he's been fundamental, to allow us to take risks and keep politicians on-side and informed but in such a way that the project team is given a lot of confidence to go ahead and potentially do things which could go wrong, but [as unless] you take that sort of approach, you're going to struggle with district heating networks to make them happen. (Project)*

Strong local leadership is also important, both in keeping stakeholders on board over the long development lead time of schemes and helping to position the schemes within the broader local context such as climate emergency and decarbonisation strategies.

*There's plenty of authorities I know of that just haven't got somebody who's willing to support them so HNDU feasibility studies, [...] they just get left on the shelf, they do a feasibility study, and it may come up with a really good project but there's just no appetite. That because there's risks felt about delivering that kind of project. (Project)*

### **Local impact**

Locally, we can see funded projects delivering a range of benefits. Very few projects were operational at the time of our analysis (see above), but benefits delivered or anticipated, in addition to their contribution towards decarbonisation of heat, have included:

- Expansion of the [skills and knowledge of the sponsors](#), particularly local authority sponsors, in multi-party infrastructure development.

*Without doubt I think the county council officers are learning a lot of new skills ... lessons we are learning can then have a beneficial effect for other projects ... [e.g.] a project this year on governance around understanding the most appropriate mechanism to procure somebody or something. It's wider project stuff to be honest. (Project)*

- The creation of [local training and employment opportunities](#), and  
*...we've seen examples of utilities and ESCOs running local apprenticeship schemes, we've seen local adult educational colleges running courses to re-train Corgi engineers from fitting gas boilers and servicing gas boilers, through to installing and servicing heat pumps or in a heat network context, installing and maintaining heat interface units. (Other)*



- [Locality enrichment](#) – for example HNIP has provided support to delivery of local regeneration plans, regeneration is a feature of 16 of the 35 funded schemes.

*A heat network ultimately is a place-based investment so whilst a certain proportion of the civils will potentially be delivered by wider UK and possibly international, it's still very much an investment that is local and has very local impact, bringing about local benefits. (Other)*

### **Impact on the wider market**

While HNIP has contributed to local market capability relevant to low carbon heat networks, its reach into the general market, in engaging more key players, has been limited. Much still needs to be done to build the supply chain, attract new sponsors and third-party private-sector investment into the market and build confidence with customers.

### **The supply chain**

A sense emerges from interviews that the [supply chain](#) remains narrow, and that HNIP has had little impact on it:

*Yes, the supply chain is woefully narrow. But I think that only gets broken when you've got that greater clarity of a long-term pipeline and government behind it. (Other)*

Suppliers have largely consisted of the 'usual suspects' or in-house development for ESCOs. Two factors [dampened supply chain development](#) prospects. Firstly, COVID and secondly, the timescale and structure of awards, which shortened the time and reduced the opportunity for new players to come to the market. Time pressures arose from the need to align heat network development programmes with heat customers' plans and priorities, and from HNIP processes. For example, HNIP timescales for application and drawdown often fitted poorly with internal LA accountability processes and the time needed to respond to emerging issues (see also 'Applicants' experiences' below).

### **Investors and investability**

Since 2017 there has been a growing interest and increasing commitment to 'green investment' among third-party investors. However, the funded heat networks, as currently configured, are not sufficiently developed or uniform in structure to [attract investment](#) at this stage. High risks and uncertainty around heat demand and scalability, coupled with the long timescales to generate returns and the low level of return, make heat networks generally less attractive than other similar infrastructure investments.

*But the main things in my opinion are the demand risk and the lack of clarity on deal flow. [...] If you want to get pension funds involved you need to have much bigger scale. (Other)*

A stronger [policy framework](#) is also required (see 'Conclusions' below). Nevertheless, HNIP has drawn considerable investment from [ESCOs](#) and Local Authorities, through the

provision of capital ‘start up’ funding and the skills and services valuable in getting projects underway.

*We’ll be investing into the scheme which realistically we probably wouldn’t have otherwise done if it wasn’t for the HNIP. I think that’s definitely some proof in that and we’re looking again and [another HNIP project] is bringing in different [ESCO] funders, to help with the scheme and obviously having the HNIP behind it certainly helps. (Project)*

HNIP sought to improve the investability of projects through:

- Building the maturity of sponsors, particularly developing private sector programme development and investment practices and behaviours in public-sector sponsors
- Providing resources such as the SOMS and SDDS to improve standardisation
- Improving accessibility to the investment market while providing a more visible pipeline of investment opportunities through BHIVE, and
- Communicating project exemplars to demonstrate the viability and investability of heat networks, illustrating risks and returns, pathways to scale etc.

### **Building the maturity of sponsors**

The HNIP application process, and the consideration, application for and subsequent management of HNIP loans,<sup>32</sup> have enabled development among public-sector sponsors of some [private-sector commercial practices and behaviours](#). As have the collaborations and wider conversations HNIP has promoted.

*Almost all of the early public-sector projects, they provided finance to the project but raised from PWLB [Public Works Loan Board], raised from the public sector purse. I think the fact that a lot of projects, including public-sector projects now have more commercially based loans in them, is helping to shift that mindset. (Other)*

The benefits of this learning, however, has been largely limited to the funded projects. The application process also highlighted skills gaps within local projects, and gaps in the guidance relevant to the ownership, partnership and governance models critical to enabling early investment and procurement.

### **The impact of SOMS and BHIVE**

The impact of [SOMS and BHIVE](#) has been limited by the late stage in the project at which they were introduced. [BHIVE](#) was designed, among other things, to support early investor engagement. Sponsors and green investment practitioners feel that earlier informal contact between them would have been beneficial for considering the future potential for

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<sup>32</sup> Consideration of loans may be driving a more positive mindset with respect to loans in general within public-sector sponsors.

investment in any aspect of heat networks. Absence of this has contributed to little consideration of the possibilities of primary investment (outside ESCOs). Concerns were raised with us, that a competitive framework such as BHIVE would not fully address the need for early engagement. This and the immaturity of the market and policy framework has limited the ability of BHIVE to work in a game-changing way.

### **Diverse project exemplars**

Despite attracting a smaller than anticipated number of applications, TPHN has succeeded in getting projects into the scheme and successfully through commercialisation. This has resulted in a knowledge-rich portfolio of funded projects that provides a [diverse set of exemplars](#) ranging from small, public sector led schemes retrofitting existing premises in rural areas, to very large city networks, often with private-sector sponsors, delivering heat to both existing and new premises.

The [source of the diversity](#) comes largely from the different challenges each location and heat network project faces, and changes in the heat network market. Changes to the HNIP design also increased diversity. Midway through the project, BEIS and TPHN recognised that they faced a challenge in ensuring that the funds allocated to the programme for loan finance would be spent. The loan offer was restructured, with the interest rate for loans changed to make loans more attractive. This resulted in larger scale applications with an increasing number from ESCOs. ESCOs have brought knowledge and experience to the UK market, and can facilitate access to well-developed supply chains in the UK and abroad.

The diversity of the HNIP funded projects affects the development of market maturity in two ways. On the one hand it reduces the prospect of the market standardisation that would facilitate progression to scale and thereby attract investment. On the other hand, and from a 'start-up' perspective, diversity broadens opportunities for learning. Within the portfolio are markers for: network development and expansion in different settings, technology solutions, policy responses such as zoning<sup>33</sup> and regulation, customer and consumer engagement, and possible investment pathways.

We have not, however, seen much evidence of projects [acting as demonstrators](#) beyond the local area. This lack of direct evidence may not be surprising given the current stage of project development.

*We need to give it a little bit more time. Because for me, that ... needs to come from when these projects are operational and delivering heat at a steady state of kind of normal. (Other)*

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<sup>33</sup> See e.g. Proposals for heat network zoning: <https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning>

Also, we did not interview sponsors of heat network projects being pursued outside HNIP. Nevertheless, we would have expected to see more projects reporting contacts from outside their locality or region.

This knowledge is invaluable and should be fully exploited and maintained by successor projects and policies for the future development of the Heat Network market.

*... [the portfolio] can start to influence things like zoning, technology selection, what kind of buildings need to be connected. (Other)*

## Overall impact

Overall, the scale of impact on the market observed to date reflects the relatively small size of BEIS's initial investment against the likely potential worth of the future heat network market should it achieve the target of 18% of the market by 2050.

The learning provided by the diversity of the project portfolio, and its place-based<sup>34</sup> dynamic, points to the variety of interests open to engagement in heat network development. It consequently offers valuable learning for future heat networks and the introduction of zoning. It identifies a growing constituency of actors, especially sponsors, with the experience and knowledge that will enable their continuing, and useful, engagement in heat network development while providing practical knowledge to others drawn to reduced carbon heat network development.

In assessing the impact of HNIP, however, we need to distinguish between the portfolio as a set of individually locally impactful projects and the extent to which HNIP as a whole has had a distinct impact on the wider heat network market in England and Wales. The simplest answer at this stage is that, while local impact is already apparent, the impact on the wider market is emerging, but limited. More is needed before the goal of a self-sustaining, growing heat network market is achieved.

It is clear that the initial intended impact of founding a self-sustaining heat network market has not been realised and it became apparent fairly early on that this was not going to happen in the lifetime of the project. Nevertheless, it has been impactful in several ways which provide knowledge that can be fed back into successor policies and projects. Further details are in [Appendix 6](#), examples include:

- Delivering national projects in a place-based way
- Gaining and maintaining stakeholder engagement
- Combining network development and carbon abatement
- Demonstrations of diverse, and sometimes innovative, HNIP heat generation and decarbonisation solutions.

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<sup>34</sup> A place-based approach is about understanding the issues, interconnections and relationships in a place and coordinating action and investment to improve the quality of life for that community.

Perhaps the key barrier limiting HNIP's impact has been the absence of a policy and planning framework that supports a strategic, whole energy system approach. This is needed to manage demand risk, support development at scale, and place heat networks on a level playing field with other energy sources and utilities. This is now being addressed, through interventions such as the future homes and buildings standards, changes to business rates<sup>35</sup>, as well as development of technical standards for distributed heat

However, these are not a panacea. There remains much uncertainty about what regulation will contain, and whether zoning can deliver, given: constraints in the supply chain, the technical and administrative challenges of managing large infrastructure projects, preparing existing and new developments to be zone ready, and working across LA boundaries. Zoning needs to work hand-in-hand with strong regulation that enforces property standards.

In complexity theory terms, we could theorise that HNIP, acting in a context where there is increasing emphasis on carbon reduction, environmental, social, and governance goals and place-based investing, has helped to bring the system close to a tipping point. The delivery of critical system-enabling policies such as zoning, alongside initiatives such as GHNF, may push the system into a new equilibrium, with heat networks playing a much greater role in delivery of heat, alongside other low carbon solutions. However, we are not there yet.

## Delivering the project

### Challenges and risks encountered

A fundamental challenge for HNIP was that its [addressable market](#) was small; the number of heat network proposals that met HNIP eligibility rules was limited. This meant the number of eligible applications received was smaller than anticipated.

*It's almost a single topic what defines HNIP really, and the biggest thing we've wrestled with, our addressable market is really pretty small, [...] We've got four very precise, variations on what constitutes the strategically important heat network. [...] So when you figure all those things out, trying to find an adequate number of projects to ensure a competitive process every quarter over the last three years has been the biggest single part of the job. (Other)*

This narrowed the number of applicants to the scheme, reduced competition, and created a risk that HNIP funds could not be completely allocated. However, it allowed more time for TPHN to [work with applicant projects](#) from the time they expressed interest through to post award.

The [support and advice](#) that TPHN were able to provide to projects during commercialisation was of significant value to them (see below). Several projects reported

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<sup>35</sup> <https://www.gov.uk/government/publications/business-rates-heat-network-relief-local-authority-guidance/business-rates-heat-network-relief-local-authority-guidance>.

flexible, proactive, and agile support from the BEIS/TPHN partnership in enabling funded projects to deal with commercialisation difficulties such as [funding draw down timetables](#) and identifying and calculating projected carbon savings.

### **Applicants' experiences**

Applicants continued to find the [application and assessment processes](#) onerous and opaque, but the support TPHN have provided, and the Business Development Managers (BDM) role, has been highly valued, with few criticisms offered once the team had 'bedded in' (see below).

*However, the team have been really, really friendly and accommodating when we've wanted meetings with them to clarify questions. They are also very willing to not just work with us but also our advisers who as we advise are working with us to help us understand how to better respond to questions.  
(Project)*

The simplification of the application process for GHNF has been commented on and appreciated.

During commercialisation, [challenges](#) have included supply chain constraints, peripheral investor engagement, COVID, EU-exit, the war in Ukraine and high market volatility, which have added to the uncertainties and risks.

A fundamental challenge has been achieving alignment between the many stakeholders involved, and in particular, securing the necessary contracts for the supply of heat within the changing and highly uncertain market conditions and within the timescales required by HNIP. Many potential [customers still perceive heat networks as high risk](#).

*... property developers look at heat networks with great scepticism and are reluctant to engage and that's largely because you've created a project on project risk for them, they're working to their timetable, they want to build. There are some exceptions ..., but ... the vast majority see heat networks as a risk to their project. (Other)*

Many of the application, assessment and subsequent drawdown challenges projects encountered, arose because those administering HNIP, and the projects funded by it, are caught between government funding rules (and the due diligence processes required when spending public money) and the exigencies of a multi-year complex infrastructure project.

Projects understand this, but a concern expressed was that HNIP processes are often poorly aligned with 'real world' processes and constraints. In particular, the timescales allowed for response to HNIP processes, and the deadlines set for drawdown on funding, were too short.

*I think there is incredible naivety on how local authorities actually can operate given that we don't have specialist officers, you're having to procure*



*everything in, and then you're having to go through decision making processes within the authority. (Project)*

The impact of deadlines has been widespread, influencing decisions on whether to apply for commercialisation funding, causing pre-application and commercialisation activities to be completed at greater pace than ideal, constraining the choice of suppliers to those already in the market, and constraining the flexibility with which projects and HNIP can respond to change and uncertainty.

BEIS acknowledges the difficulty this causes, but sees little chance that this will change, as it arises from the need to manage government cash flow.

*Needlessly accelerating programmes at breakneck speeds, putting at risk quality of delivery, this is not a good way to manage things. We have projects which understandably will of course straddle multiple fiscal years. There's no way a strategic heat network can be delivered in a fiscal year, it will of course take three to five years to deliver, and within that there will be milestones that will move. That's just the nature of it. At the moment, the way that budgets work is there's almost no flexibility. (Other)*

However, TPHN, BEIS (and projects), found a number of ways of mitigating the impact of these.

### **TPHN and BEIS responses**

TPHN and BEIS have been flexible and responsive to the challenges projects and the scheme have faced, adopting a collaborative learning approach that enabled them to respond to experience, feedback, and changes in the market.

TPHN stepped up their business development role in collaboration with BEIS. They developed a [broader, supportive role](#) focusing, to a greater extent, on ensuring that awarded projects were well informed on the information they needed to provide, and the risks they managed.

[Post award](#), BDMs worked with the monitoring and reporting function within TPHN, and through personal contacts in projects, to support projects dealing with the high-levels of risk and uncertainty encountered later in HNIP.

*Excellent. Very supportive. ... I think once they were comfortable the project was still alive and actually quite healthy apart from not signing up the developer, they then did everything they could to help us ... (Project)*

A process to enable funded projects to apply for additional funding during commercialisation was introduced, allowing otherwise viable projects to 'weather the storm'.

Another key measure adopted was to switch between conditions precedent and subsequent in contracts<sup>36</sup>:

*It [switching conditions precedent to conditions subsequent] seems quite a minor change, but that enables a project to draw down funding in order for us to meet our budgets, for a project to meet their needs on the ground, whilst maintaining important controls. (Other)*

The breadth and depth of expertise in the consortium, and its ability to bring this to bear to the benefit of applicants and the project, has meant TPHN operated an intelligent delivery partner function. This has enabled the consortium to make the most of the projects that have come forward for funding and achieve a better set of demonstrator projects, more closely matched to HNIP's aims than might otherwise have been possible. At the same time, however, this raises questions about the extent to which the portfolio has been managed [strategically](#). Is the helpful diversity apparent in the portfolio serendipitous? Would a portfolio approach to management of the application gateway have resulted in more optimal portfolio makeup?

While TPHN has been active in [raising awareness](#) of heat networks, publicising funded projects, and sharing learning at events, challenges remain around extraction and dissemination of knowledge.

## **Ways of working**

It is worth emphasising here that HNIP's flexible response to the challenges encountered has been enabled by the [agile, learning approach](#) adopted by BEIS and TPHN. The transition to working with a delivery partner took longer than anticipated as BEIS and the members of the TPHN consortium learned to work together and with the complexity and variety of the applicant projects. However, over time, TPHN and BEIS established a good collaboration characterised by high levels of trust. Data sharing between TPHN and BEIS has been a weakness. While this improved towards the end of the project, greater attention to this from the outset would have facilitated better learning from projects.

The key challenge for preparing the pathway towards expandable, investable low carbon networks has been the small size of the project: the number of schemes HNIP can support is too small to make a significant impact on the market on their own. The task now is around transferring and exploiting the learning generated through individual projects, a task which is made more difficult by the time it takes for projects to reach a stage where they can be effective demonstrators of heat network viability and investability. To do this, networks need to be built and operating, and as yet only a very small number of the funded projects are delivering heat.

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<sup>36</sup> A condition precedent is a requirement that must be met before the contract - or certain parts of it - can come into effect. A condition subsequent is a condition that affects the validity of an existing valid contract i.e. the contract exists but will terminate if the condition subsequent isn't met.



# Chapter 3 Conclusions and Looking Forward

## Conclusions

We conclude that HNIP has made a valuable contribution to the aim of creating a self-sustaining heat network market. It has not done this, as originally envisaged, through the investment HNIP represents directly stimulating the market. The project was always too small to achieve this, especially in the absence of a strong, supportive policy framework and much market uncertainty. While project funding has attracted investment from ESCOs and the funded projects have started to build local capacity and capability and deliver a range of wider benefits in their locations, more is needed to leverage the value of the project and in particular the significant body of potential 'learning by doing' the project has enabled. Among other things this learning has allowed:

- BEIS to identify and begin to develop, with partners, the broader planning and regulatory frameworks required to support market growth – e.g. zoning.
- BEIS and TPHN to identify and develop products to reduce costs and improve access to investment (e.g. through standardisation, provision of the BHIVE DPS).
- TPHN to:
  - foster a network of stakeholders (actual and potential sponsors, investors, customers etc interested in heat networks)
  - share through events, website, LinkedIn page etc, news about funded projects and other relevant information with this network
  - broker introductions between interested parties, and through these
  - encourage active engagement in the market.

As HNIP funded projects mature towards full operation, they are expected to provide an additional rich source of exemplars, demonstrating the viability and investability of heat networks to sponsors, customers, and third-party investors. HNIP can also offer wider learning that can be fed back into successor policies and projects and more widely, for example, on how national programmes can work effectively with local strategies and plans, enhancing local value.

## Looking forward

We suggest the following priorities looking forward:

- Crafting a coherent and practical system of [knowledge management](#) to maximise the value from investment in HNIP. This means:

- Synthesising knowledge strands from HNIP (and also GHNF and other HNTTP projects – see next) that can inform market development and the place of expanding heat networks in contributing to decarbonisation.
- Developing a knowledge system to ensure the body of knowledge can be retained, developed, managed and deployed beyond GHNF. This includes developing a more nuanced market segmentation e.g. of the different types of investor for different stages and aspects of heat network development.
- Shifting policy focus to provide a greater emphasis on system strengthening, picking up on the [strategic lessons from HNIP](#), including incorporating lessons for market development and integration of heat networks within broader net zero objectives. Individual interventions should be more about where heat networks fit into decarbonisation and investment rather than being a stand-alone manifestation of policy. To enable this BEIS should:
  - Periodically step back and review the learning from HNIP alongside learning from other projects under the Heat Networks Transformation Programme (HNTTP), integrating the evaluation of individual schemes within an overall HNTTP evaluation framework within which evaluation activities can continue after a scheme comes to an end.
  - Adopt a systems-based approach to future heat network project and programme design, including:
    - Using and maintaining the ‘green heat network system map’ to identify policy needs and locate new policy proposals in the broader heat network landscape.
    - Developing a system-based TOC as a key step early in policy design.
    - Including formal risk assessment of the TOC to inform current scheme delivery and design of future programmes.
- Considering how HNIP learning can inform policy and practice for other national capital support projects delivering in a place-based way. This would include considering:
  - How national policy and practice can be designed to work effectively with local strategies and plans.
  - Whether and how the make-up of project portfolios can be managed to optimise opportunities for learning.
  - How space can be built into funding and drawdown processes of future schemes to enable projects and delivery partners to respond to the exigencies of a multi-year complex infrastructure projects and for supply chain development to occur.

# Appendix 1 Evaluation approach

## The overall approach

BEIS commissioned Risk Solutions, with the Tavistock Institute of Human Relations, to carry out an independent evaluation of the process and impact of HNIP.

The evaluation was carried out between Dec 2016 and June 2023 in a series of process and impact evaluation cycles as shown in the table below.

**Table 2: Evaluation cycles**

Dates	Evaluative activity	Status
Dec 2016 - 2018	Process and impact evaluation of the pilot scheme	Published, available at the <a href="#">evaluation webpage</a>
2019 - 2021	Process and impact evaluation of the early stages of the main scheme	Findings reported to BEIS
2021 - 2022	Process and impact evaluations update	Findings reported to BEIS
2022 - 2023	Final synthesis	Contained in this report

The evaluation was theory-based. This means that evidence is collected to build, test and refine candidate theories about how HNIP works.

The process evaluation examines HNIP implementation and the way it was delivered. The impact evaluation incorporates the realist approach<sup>37</sup> by asking what works, for whom, how, and in what context. The process evaluation provided data on context used to inform candidate theories for the impact evaluation.

Realist evaluation is a method-neutral approach rather than a specific methodology. It is called ‘realist’ because it investigates how the project, or intervention, is experienced in reality by the people affected by it. To achieve this it explores how project context, the resources offered by HNIP, and people’s motivation for taking part in the project, combine

<sup>37</sup> Pawson, R., 2013. The science of evaluation: a realist manifesto. Sage.

to produce outcomes. The emerging evidence is used to form mid-range theories (MRTs) that explain how and why the project is working, for whom, and in what context.

Consequently, the process evaluation's purpose was to capture data on the project's core processes so that in the impact evaluation we could use detailed knowledge of those processes to understand actors' responses to them.

Both the process and impact evaluations were underpinned by an evolving theory of change that shows how HNIP is expected to lead to the desired impacts and outcomes.

## Evaluation aims and questions

The evaluation questions were:

### *Process evaluation:*

- How are the HNIP application and project initiation stages working and
- What improvements can be made, both between the pilot and main schemes and as the scheme progresses?

### *Impact evaluation:*

- What impact has HNIP had, how has it achieved these impacts, and
- To what extent can the policy be said to have contributed to the observed outcomes?

Our overall evaluation aimed to address these questions through exploring five high level themes:

1. Scheme technical design
2. Administrative design and delivery
3. Delivery of projects
4. Market sustainability
5. Delivery of scheme outcomes.

An economic evaluation was also originally planned. However, as delays to the scheme and to funded projects have become apparent, we will no longer be delivering the economic evaluation<sup>38</sup>. Given that the full range of HNIP benefits will not be realised until several years after project closure, BEIS decided to conduct a separate cost benefit analysis once the complete range of benefits can be robustly assessed.

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<sup>38</sup> Our partners London Economics have however completed a review of the HNIP monitoring templates and commented on their suitability for collecting information that would be necessary to conduct a cost-benefit analysis in the future.

## COVID-19

Our evaluation timescale overlapped with the global COVID-19 pandemic. The first confirmed cases in the UK were identified in late January 2020, and on 23 March 2020 people were instructed to work from home if they could. Some employers placed people on furlough as a result of the economic impact of COVID-19. While we were able to continue interviews by telephone, the impact of COVID-19 affected timescales in several ways. Notably, it affected the availability of interviewees, delaying some interviews, and preventing others from taking place, where potential interviewees had been furloughed, or diverted to priority COVID-19 related work. We discuss the quality of the evidence and limitations of findings under each of the process and impact evaluation sections below.

## The process evaluation

The key aim of the process evaluation of the early stages of the HNIP main scheme, was to offer 'lessons learned' to inform any further development of the main scheme and any future similar schemes. It focused on themes 1 and 2.

### Process evaluation questions

**Scheme technical design explored:** What works and what does not, why, and for whom (e.g. BEIS, delivery partner, the different types of applicant and project (incl. technology type)), in terms of the scheme technical design, including:

- Eligibility and scoring criteria, and
- Funding mechanisms provided by the scheme.

**Administrative design and delivery explored:** What aspects of the scheme administrative design and delivery work, what does not, why, and for whom, for the different stages in the applicant journey. Perspectives considered included BEIS, the delivery body, the different types of applicant and project (incl. technology type).

In addition, we sought to gain contextual knowledge for the overall realist informed approach, and evidence of outcomes to inform early impact evaluation of the main scheme.

### Process evaluation approach

We used a range of well-established evaluation methods for the process evaluation including:

- Semi-structured interviews
- Some limited documentary review, and review of TPN's website
- Attendance at communication events, and
- Review of some event attendance data and satisfaction reporting.

The work was carried out in two waves:

1. The first wave was carried out from June 2019 to May 2020, covering application rounds one to three of the main scheme. At the end of round three, 11 projects had been funded, eight had public-sector sponsors and three private-sector sponsors<sup>39</sup>.
2. The second wave was carried out from July 2021 to April 2022, covering applications up to round ten of the main scheme. At the end of round ten, 29 projects had been funded, 21 had public-sector sponsors and eight private-sector sponsors.

## Wave 1

This work had two phases. From June 2019 to September 2019, we focused on the perspectives of BEIS and the HNIP Delivery Partner, Triple Point Heat Networks. We used semi structured interviews with officials from BEIS, key individuals at the TPHN, people who had submitted a pre-application, full applicants and heat network sponsors who had not applied to HNIP. The interviews were designed to explore the breadth of participants' experience of the scheme and its administration. The interview data was coded to identify core and minority themes. This approach allowed us to explore a wide range of issues. We also attended a webinar run by TPHN to observe the structure and content of the event, and briefly reviewed the TPHN website, the application guidance and the application form. We conducted an initial analysis and provided interim feedback to BEIS on the results.

From February 2020 to May 2020, we carried out wider evaluation activities, including interviewing some people who had submitted pre-applications but had not submitted a full application for their project (an area of particular interest to BEIS). We again carried out interviews and reviewed the HNIP website and carried out some limited review of documentation. We reviewed the event attendance data and satisfaction reporting and drafted an internal project note focused on the process evaluation, which was issued in June 2020.

A final report, which combined this wave of the process evaluation, with Wave 1 of the impact evaluation (see below), was issued to BEIS in March 2022.

## Wave 2

For this wave, we adopted a hybrid approach, which blended an exploration of process implementation and experiences, but recognised the relationship between process and impact, in that:

- Topic prioritisation with BEIS was in part informed by the theories developed through the last impact evaluation phase, and
- Additional prompts during interview and our analysis have been informed by theorising on people's responses to the intervention and the context.

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<sup>39</sup> At November 2021 nine were still being funded, two were private sector funded.

We explored the following topics:

- HNIP Award processes – supporting and assessing applications and funding awards.
- How TPHN and BEIS were working with projects to respond to risks, change and uncertainty.
- Experience of SOMS<sup>40</sup> and BHIVE<sup>41</sup> – key HNIP deliverables designed to reduce costs and increase investor engagement.
- Communication and engagement.

We used a combination of interview and some limited document, data and website review to inform the process evaluation. We interviewed project representatives, a trade association, BEIS and TPHN staff members and stakeholders having an investor perspective. The focus on commercialisation and the priority topics listed above, were selected in consultation with BEIS.

Data gathering and analysis was again carried out iteratively with frequent sharing of emerging findings with BEIS. An internal project note was issued to the evaluation team in BEIS in March 2022.

## Sampling

### Sampling strategies

Given the timescales within which the evaluation was conducted, and the small samples available to us, we used a limited number of sampling strategies described below.

A census approach to sampling implies attempting to interview all of the individuals within a particular group or population. We employed a census approach in the context of the relatively small numbers of applicants to the pre-applicants to rounds 1 to 4 who had not submitted full applications because there were very few of these, and we could therefore approach all of them.

Purposive sampling involves selecting specific potential interviewees whose objectives, characteristics, knowledge, expertise, and experiences are germane to the research questions. We used this approach in all the phases of qualitative research during the evaluation to cover the variety of the domains of interest to BEIS among stakeholders. We also used this approach for interviewees with BEIS and the Delivery Partner to ensure that we captured the scope and details of the engagement and application processes. When selecting interviewees, we took into account the need to avoid over-burdening participants. Purposive sampling works well with realist interviewing in seeking to understand how the

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<sup>40</sup> Template contracts for Sales, Operation and Maintenance of heat networks

<sup>41</sup> The BEIS Heat Investment Vehicle (BHIVE) is designed to allow public-sector heat network owners/developers in England and Wales to procure funding and funding-related services for their heat network projects from a range of potential funders.

lived experiences of key actors informed their participation in HNIP and the outcomes achieved.

Snowballing describes an approach within which interviewees are asked to recommend further interviewees with particular characteristics. Consequently where interviewees suggested people who could provide further information on particular aspects of our evaluation, we added them to our sample. For example, having spoken to some ESCO key players we asked for more contacts to expand our knowledge of ESCO engagement in, and commitment to, district heating development and investment. This helped us to get multiple perspectives on the salient aspects of HNIP. While there is potential for this type of sampling approach to focus interviews on people with similar views, we minimised this risk by targeting those who could tell us more about a topic or provide a different perspective.

### Saturation and flexibility in sampling

We concurrently analysed interview transcripts while we were also still recruiting and interviewing interviewees. This responsive interviewing approach had the advantage of allowing us to be flexible in our recruitment strategy based on the extent to which we felt we were achieving saturation with particular groups of interviewees. A commonly-used principle in qualitative studies, saturation is the name given to the stage in the analysis at which no new information is being obtained from the data by the evaluator. By the end of the analysis, we were reasonably confident that we had reached saturation for most groups based on our experience of the lack of new themes in the data.

Table 3: Semi-structured interviews completed Table 3 shows the numbers of interviews we completed for the process evaluation reported here. These interviews typically lasted about an hour.

**Table 3: Semi-structured interviews completed for the process evaluation**

	Total	Wave 1	Wave 2
BEIS	12	8	4
TPHN	20	11 (Note 1)	9
Pre-applicants	7	7	
Applicants awarded funding	7	7	
Applicants not awarded funding	3	3	



	Total	Wave 1	Wave 2
Heat networks who have not applied to HNIP	2	2	
Total interviews	51	38	13

Note 1 – One of these was a group interview with three people.

## Recruitment

An email was sent to the prospective interviewee, inviting them to interview. This email was accompanied by a letter signed by BEIS (on a BEIS letterhead), the participant information sheet and consent form.

When we received a positive response, we established a convenient date and time for the interview. If we received no response after one week (or sometimes sooner, due to the urgency of the task), we sent a reminder email, or a follow-up telephone call. In the event of no further response, a third email was sent, and further telephone calls were made. If we received no response after this process, the individual was removed from the list of potential participants.

## Topic guides

We constructed bespoke topic guides for each of the evaluation audiences or categories (pre-applicants, applicants, non-applicants, BEIS, and TPHN). The topic guides were informed by the overall aims of the evaluation and the evaluation themes. Topic guides were reviewed within the evaluation team and by BEIS, and revised accordingly.

## Interviews

We used semi-structured interviews because they are a well-established qualitative evaluation method for the elucidation of in-depth understanding of a particular social context or phenomena<sup>42</sup>. Although both semi-structured interviews and large-scale surveys each have their relative advantages and disadvantages in terms of understanding attitudes and experiences, semi-structured interviews were particularly appropriate in this case because the evaluation populations were too small to conduct large-scale surveys. Semi-structured interviews were also appropriate because they allow the evaluators to investigate pre-determined themes while also allowing the interviewee to introduce themes that may not have been in the evaluators' minds in advance. The interviews were undertaken by two different evaluators from the evaluation team. This was useful because – through discussion of the interviews and the data – it contributed to maximising quality and minimising subjectivities in the interviews and the analysis.

<sup>42</sup> Bryman, A (2012) Social Research Methods (4<sup>th</sup> edition), OUP Oxford.

## Analysis of interviews

Within thematic analysis and qualitative evaluation in general, the analytical objective is not to quantify, count or measure. Instead, the aim is to reflect range and diversity, and – as far as possible – to explore and explain these. Indeed, while outliers might be omitted from quantitative analyses, in qualitative approaches these cases often provide considerable insight and elucidate key themes within the data<sup>43</sup>.

Our approach to ‘thematic analysis’ was shaped by the need to be rigorous within the context of the time that was available for data collection, analysis and report writing. We used NVivo to analyse interview transcripts. In NVivo, coding proceeds by gathering related material into a container called a theme node. Theme nodes are codes that represent the themes or topics in the data. Our coding approach was to establish initial nodes relating to the evaluation themes and questions. We then identified additional new themes, and added corresponding nodes, through close reading of the data. This is an important element of qualitative analysis because it allows the voice of the interviewees to be heard independently of the preconceived ideas of the evaluators about what is important. These themes were validated through discussion within the interview team. Interviews with applicants, HNIP and BEIS were analysed within the same coding frame and captured in the same NVivo project file, allowing us to triangulate findings. From the perspective of grounded theory, our approach ensured that the analysis was ‘grounded’ in the data<sup>44</sup>.

To ensure consistency across the analysis, coding was undertaken by two evaluators working closely. The evaluators regularly discussed and interrogated the emerging themes – derived from both the evaluation questions and the data. In this way, themes were further developed, refined and (re)structured as conclusions in the note.

## Documentary review, communications events

We reviewed the HNIP applicant guidance documentation and the TPHN website. We subscribed to emails advertising HNIP and telling potential applicants about events. These provided us with a road map in preparation for the process evaluation and a means of checking claims about e.g. the accessibility of the guidance. We also attended a number of TPHN webinars, which allowed us both to observe how they were conducted and to learn from the content. For example, a webinar on commercialisation was valuable in enabling us to gain a deeper understanding of the role of procurement frameworks.

## Quality of the evidence and limitations

As in most evaluative work of this nature, there was some potential for sampling bias, non-response bias and inadequate coverage in some elements of the semi-structured interview

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<sup>43</sup> Ritchie, J. et al (2014) *Qualitative Research Practice - A Guide for Social Science Students & Researchers*, 2nd Edition, NatCen (National Centre for Social Research)/SAGE

<sup>44</sup> Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 509–535). Thousand Oaks, CA: Sage.

programme. These are discussed separately below. However, concerns about the likelihood and potential impact of these are largely mitigated by the fact that the narratives that we heard both within and between interview groups were broadly consistent, the overall populations for interview are small, and we are reasonably confident that we reached saturation<sup>45</sup> within each of the interview groups, except potentially for applicants not awarded funding, because of the very small number interviewed. Within this context, we regard the findings and conclusions derived from semi-structured interviews to be sufficiently robust to be fit for use.

### **Sampling bias**

Sampling bias occurs when an interviewee cohort is selected in such a way that some members of the intended population are less likely to be included than others. Obviously, within the context of purposive sampling, this can sometimes be a specific objective. We do not feel that sampling bias was an issue among the HNIP applicants.

However, the sampling frame for the non-applicants, were largely based upon lists provided by BEIS, and we were unable – in the context of timescales and the impacts of COVID-19 – to recruit any non-applicants via other routes.

### **Non-response bias**

Non-response bias occurs when individuals who are selected for interview are unwilling or unable to participate. This can be a problem because we might conjecture that the non-response is related to a lack of engagement with the topic or perhaps a negative view of the topic, such that the views of respondents may differ in meaningful ways from those of non-respondents. We do not consider that non-response bias occurred in our samples; any bias was a result of the small sample sizes and non-availability as a result of the impact of COVID-19.

### **Coverage**

Coverage describes the extent to which the material collected covers the target audiences for the evaluation. Clearly, a lack of coverage can be the result of both sampling bias and non-response bias, as well as of larger populations. Coverage over the course of the project we considered to be sufficient with respect to relevant BEIS staff, TPHN staff, and applicants awarded funding. However, coverage of applicants not awarded funding was not high.

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<sup>45</sup> Morse, J. (1995) The significance of saturation, *Qualitative Health Research*, 5(2): 147-149.

## The impact evaluation

### Overall approach

#### **Realist informed approach**

For the impact evaluation we have adopted an approach informed by the principles of realist evaluation.

Realist evaluation is a theory-based approach<sup>46</sup> that emphasises the importance of understanding not only whether a policy contributes to outcomes (which may be intended or unintended), but how, for whom and in what circumstances<sup>47</sup>. The explanatory strength of realist evaluation in complex situations makes it an attractive choice for the HNIP impact evaluation. The full realist evaluation question is:

*What works, for whom, in what respects, to what extent, in what contexts, and how?*

Realist evaluation focuses on building depth of understanding. Evidence gathering is purposive – designed to explore how the programme is working across a breadth of contexts rather than collating views from a representative sample.

It starts by using a theory of change to describe how the programme or intervention will work. The theory is built from a synthesis of knowledge of how programmes have worked in similar settings combined with the assumptions, experiences, knowledge and perspectives of programme designers and actors.

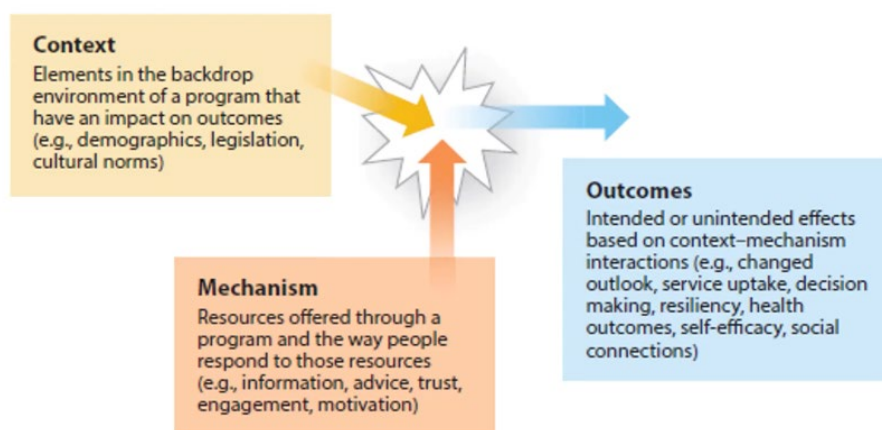
The units of analysis in realist evaluation are testable theories about how specific mechanisms lead to outcomes and how these are affected by context. They explain how context shapes people's responses to an intervention to deliver the observed outcomes. Realist evaluation seeks to discover the reason why people have responded in the way that they have, and the reason for their response is described as a 'mechanism'. People will respond in varying ways to interventions depending on context and their views and experiences of the world. Within realist evaluation these theories are usually described as Context-Mechanism-Outcome (CMO) configurations. Context can include data provided by a process evaluation.

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<sup>46</sup> That is, it uses an explicit theory of change to draw conclusions about whether and how an intervention contributed to observed results. It is an approach - a way of structuring and undertaking analysis - not a specific method or technique.

<sup>47</sup> Pawson, R. & Tilley, N. Realistic Evaluation. London: Sage (1997).

**Figure 4: Context, mechanism and outcomes**<sup>48</sup>



Understanding how mechanisms are triggered to produce outcomes provides explanations of how the programme is working.

CMOCs are tested, refined, confirmed or rejected through an iterative and purposive process of evidence collection (tailored to the CMOCs under consideration).

Key to delivering this approach is realist interviewing<sup>49</sup>, which is used to elicit data from programme actors on the mechanisms that deliver the outcomes mainly by asking why they responded to the intervention in the way that they did. In realist interviewing, the interviewer does not need to adopt a neutral or ignorant stance but can share the programme theories, theories suggested by others, the experiences related by others (anonymously) etc in order to prompt deliberative responses. Interviewees become partners in sense making, not just sources of information that will be analysed by the evaluation team.

The explanatory strength of realist approaches in complex situations and the potential for transferability of learning to other similar schemes has made this an attractive choice for the HNIP impact evaluation. However, we quickly discovered a number of challenges in applying this approach to the HNIP evaluation, we therefore developed the approach, in discussion with the evaluation team at BEIS, as described in the next section.

## Applying the realist informed approach to the impact evaluation

### Theory development

As described above, the concept of theories, often articulated as CMOCs, is central to realist evaluation. In this evaluation however, context is highly variable and evolving and the context of an individual heat network project depends on the interaction of many different factors. The design of projects responds to this, resulting in very different designs

<sup>48</sup> Jagosh, J. (2019) 'Realist Synthesis for Public Health: Building an Ontologically Deep Understanding of How Programs Work, For Whom, and In Which Contexts', *Annual Review of Public Health*, 40(1), pp. 361–372. doi: 10.1146/annurev-publhealth-031816-044451.

<sup>49</sup> Manzano, A., 2016. The craft of interviewing in realist evaluation. *Evaluation*, 22(3), pp.342-360.

– there are no ‘plain vanilla’ projects. This multiplicity of different, interacting and evolving contextual factors, and the small number of projects, meant it is often not possible for us to isolate and examine the effects of individual contextual factors. We therefore adapted our approach, in discussion with the BEIS evaluation manager, drawing on the principles of critical realism<sup>50,51</sup> which underpin realist evaluation.

Both CMOCs and MRTs are approaches to abstracting from data produced in realist informed evaluation. Abstraction is the process of making sense of the data in terms of a general class of events. MRTs are specific enough to generate particular propositions to test and general enough to apply across different situations. As the project moved into its later phases, we decided to apply MRTs, rather than CMOCs, for abstraction, although we continued to make some use of CMOCs in starting the process. The MRTs express the underpinning mechanisms that are stimulating responses and outcomes at the HNIP project level (e.g. seizing the HNIP opportunity). We then explored how these, in broad terms, are being influenced by context. For example, our recognition of opportunity as a driver for HNIP application was applied generally across the application process among context that varied in detail but carried sufficient similarity for us to be confident that an MRT could be applied.

The examination of context, mechanism and outcome remains relevant. HNIP’s outcomes are observed and their pathways are traced from the effect of the intervention on context and the responses it generates, which in turn lead to outcomes. These findings then go to inform the mid-range theories that are tested and developed through evidence gathering. In addition to the mechanisms generating responses in programme actors, the mid-range theories developed for HNIP incorporate the broader societal generative mechanisms, such as concerns about climate change, that shape the context and responses.

By testing the theories, we sought to identify the demi-regularities in mechanisms that can provide lessons for other schemes. Demi-regularities are findings emerging from the data, that are not identical, but can be recognised as tendencies through qualitative coding. For example, we found that HNIP is working by strengthening and aligning factors already present in the heat network’s operational context - enabling ambitions already apparent in the locality, rather than stimulating new ambitions. This is a demi-regularity that reoccurs across multiple projects, in a wide range of contexts, a defining feature of demi-regularities.

The use of demi-regularities enables us to generalise, up to a point, across the HNIP projects. This is because, although the projects vary, they do not vary to the point of complete dissimilarity. For example, they all emerge in varying ways as a response to climate change. The HNIP intervention is offered in environments with similar complexities. The outcomes are generated by a similar range of motivations and interests responding to

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<sup>50</sup> Critical realism distinguishes between the 'real' world and the 'observable' world. The 'real' cannot be observed and exists independent from human perceptions, theories, and constructions. Thus, unobservable structures cause observable events and the social world can be understood only if people understand the structures that generate events.

<sup>51</sup> Edwards, Maohoney & Vincent, *Studying Organizations Using Critical Realism*, Published to Oxford Scholarship Online: April 2014, Print ISBN-13: 9780199665525



HNIP. In other words, we see the same sorts of things happening in different ways across a set of diverse projects. They differ, however, in nature and outcome because of the influence of the individual operational contexts.

## Impact evaluation delivery

The impact evaluation was carried out in two waves:

1. Fieldwork for the first wave was completed between August 2020 and March 2021, covering application rounds one to six of the main scheme. By round six, 22 projects had been funded, of which 14 were public sector led and eight private sector led<sup>52</sup>.
2. Fieldwork for the second wave was carried out from July 2022 to January 2023, covering applications up to round 12 (the final round) of the main scheme. By round 12, 35 projects had been awarded funding, of which 25 were public sector led and 10 private sector led. Not all the funded projects had taken up their funding award at the time of writing.

We used a small team of experienced evaluators from Risk Solutions and the Tavistock Institute of Human Relations (TIHR), with support from TIHR's survey team, and guidance and direction from the BEIS evaluation team and board.

### Wave 1

Wave 1 was conducted in two phases, with interim findings shared with the BEIS evaluation team, prior to beginning the second phase. Both phases involved realist interviews with applicants and suppliers (advisors or consultants working closely with sponsors to develop their projects) drawn from rounds one to six.

Phase 1 began in August 2020 with a review of information emerging from the process evaluation and the impact evaluation of the pilot, against the theory of change. From this we identified a number of draft theories around whether and how HNIP was delivering observed outcomes. These were developments of existing theories, and also new theories emerging from the process evaluation work and from a review of the theory of change. New theories were sought because the mix and status of projects being funded by HNIP was changing and, with time, new outcomes were becoming apparent.

The theories were developed and prioritised through discussion with the steering board. We carried out a series of gleaning interviews with funded applicants and suppliers in September and October 2020. These explored the draft theories and sought evidence of additional theories. We analysed the information collected and prepared a project note describing our findings. We discussed this with the BEIS evaluation team, developing a set of refined theories and alternative theories. Alternative theories describe how factors other

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<sup>52</sup> At November 2021 16 were still being funded, three were private sector funded.

than HNIP could be delivering or contributing to the observed outcomes, or how HNIP is failing to deliver a desired outcome.

We carried out the second phase of fieldwork between November 2020 and March 2021. We interviewed funded projects, a supplier, one heat network sponsor who had a failed application and one that had withdrawn their application. Phase 2 also involved a short e-survey of funded applicants. The sample frame included applicants to rounds 1 - 6 and one from round 7.

The information gathered was analysed to determine whether the theories were categorised as supported, supported in part or unsupported<sup>53</sup>, to further explore the influence of context, and to identify new emerging theories. We updated the impact evaluation note with the draft findings and these were discussed with the BEIS evaluation team. The impact and process evaluation notes were then combined in this final report which was presented in draft to the project board in June 2021, prior to issue of the final report.

## **Wave 2**

Wave 2 was carried out in a similar way to Wave 1, beginning in May 2021 and continuing into January 2023. Interviewees included BEIS and TPHN staff, sponsors of funded projects, their partners and senior stakeholders (e.g. council members), investors, a trade association and suppliers. Instead of distinct phases of evaluation activity however, the work proceeded in a more agile way, with participant selection, recruitment and emerging findings regularly reviewed with our evaluation managers in BEIS. Emerging findings were also shared and discussed more regularly with wider BEIS and TPHN stakeholders. A workshop was held with BEIS and TPHN stakeholders in HNIP and also the new Green Heat Network Fund (GHNF) to review the theory of change and prioritise theories for exploration in this final wave of evaluation.

Draft findings were shared at a final sense-making workshop on 12 January, 2023, which again involved BEIS and TPHN stakeholders in HNIP and GHNF, and also the GHNF evaluators. Analysis and reporting were completed during February and March 2023, with the results captured in this, the final report.

## **Interviewees and data sources**

Data was collected through:

- Interviews (see Table 4)
- Workshops
- Review of extracts from the Green Heat Network Fund business case (unpublished document)

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<sup>53</sup> Note that by supported here, we mean the body of evidence is good enough to support the theory as being true given the use intended for evaluation findings; the burden of proof here is closer to 'on the balance of probabilities', than 'beyond reasonable doubt'.



- Analysis of application data – including a cluster analysis to look for natural groupings in the funded projects, based on 15 data items available for all of the funded projects (see Appendix 3).

**Table 4: Semi-structured interviews completed and e-survey returns for the impact evaluation**

	Total	Wave 1	Wave 2
BEIS / TPHN / Other	6		6
Funded project interviews	32	21 (note 1)	11 (note 2)
Total interviews	38	21	17

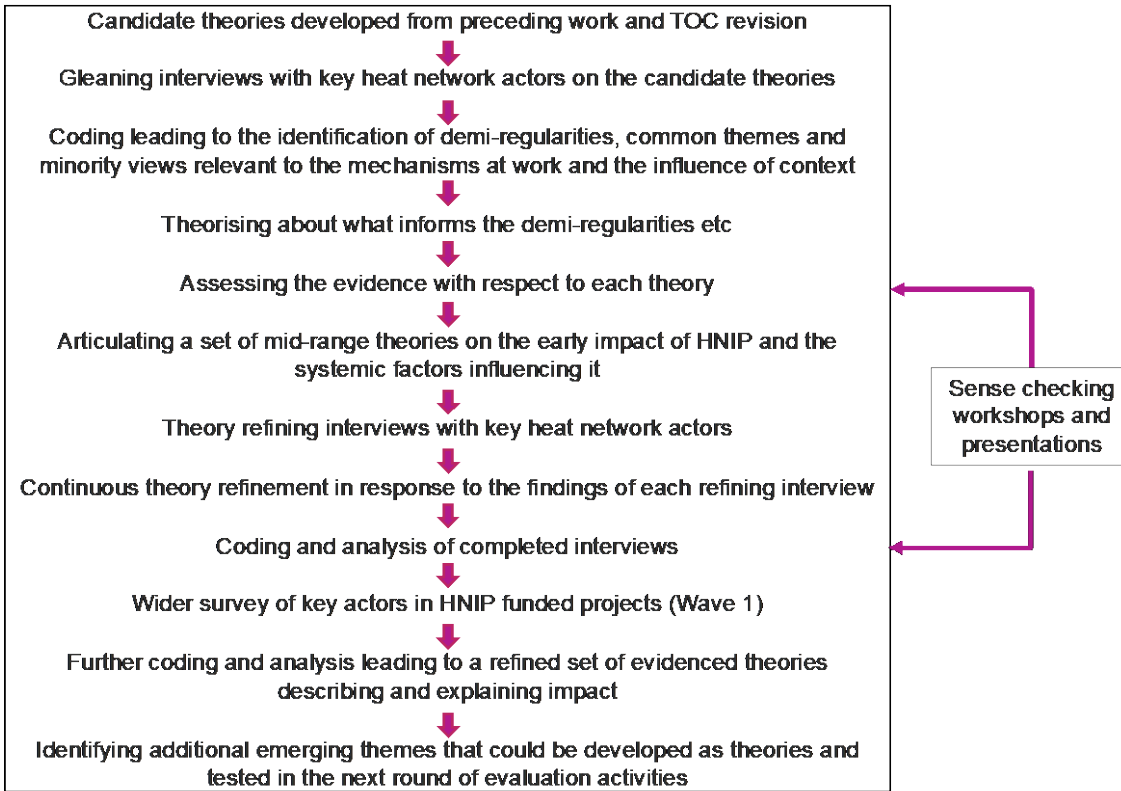
Note 1 - Includes 13 interviews, and 8 e-survey returns, involving in total 17 different individuals and 13 different projects (including one failed and one withdrawn). The interviews of funded projects were drawn from a sample frame of 22 projects that applied to rounds 1 to 6. The e-survey was sent to 23 funded projects as we were able to include one round 7 project. Participants were a mix of local authority, private-sector partners, and suppliers.

Note 2 – All interviews of funded projects, sampled across all rounds of the main scheme (35 funded projects at the time the sample was completed) and including LAs, ESCOs and a housing association.

## Tasks carried out

The tasks we carried out are shown in Figure 5 and described below using Wave 1 as an example.

**Figure 5: Steps we took in Impact Evaluation Wave 1**



## Description of the impact evaluation methodology

In the following sections we describe how we applied the approach, using Wave 1 as an example.

### Constructing and testing initial theories

We began by assembling the candidate theories that we wanted to test, develop, and refine during the impact evaluation. The sources for these were: previous Pilot evaluation, the main programme Process Evaluation and the revised theories of change following the Process Evaluation.

These theories were discussed, developed, and prioritised with the steering group. The evolution of the theories is shown in Appendix 3. For the initial Wave 1 theories, we constructed short chains of cause and effect around each theory, drawing out elements of Context, Mechanism and Outcome (CMO). An example of a mid-range theory (MRT) developed for Initial Theory 1 and presented using the CMO construct is shown overleaf.

**Figure 6: Example of a Mid-Range Theory structured using the CMO construct**

<p><b>Theory 1: HNIP has encouraged more ambitious projects, better aligned with HNIP’s objectives, with respect to decarbonisation, by helping manage risk and uncertainty.</b></p>
<p><b>Overview</b></p> <p>This theory searches for evidence that, by helping to manage risk and uncertainty, the investment facilitates heat network development technically, structurally, and at scale, that will inform the pathway to a growing level of de-carbonised district heating.</p>
<p><b>Context</b></p> <p>Potential applicants, from local authorities and/or ESCOs, who are already actively considering, or planning, heat network development, become aware of HNIP via BEIS and/or TPHN publicity and of the gap funding opportunity. Encouraging signals from TPHN to submit ideas on a range of technologies. Innovation is visibly encouraged. Pre-application submitted.</p>
<p><b>Mechanisms</b></p> <p>Response to pre-application tests of eligibility and gap funding viability.</p> <p>Applicants recognise HNIP as an opportunity for managing financial risks, via gap funding, and other uncertainties associated with heat network development.</p> <p>Applicants respond to the positive innovation/ technological diversity cues with pre applications and applications that they might not otherwise have submitted.</p>
<p><b>Outcomes</b></p> <p>(1) Full applications covering a diverse range of technologies beyond CHP or demonstrating bridging between CHP and zero carbon approaches are submitted.</p> <p>(2) HNIP enables potential heat networks to explore more ambitious heat networks than would otherwise have been considered.</p> <p>(3) Projects install green heat sources earlier than they might have done.</p>

We used gleaning interviews to explore the validity and relevance of the initial theories, and in addition, to draw out material to enable the construction of refined and new theories.

Six projects were selected to cover a range of different:

- Types of project (new build or existing)
- Delivery models (in-house or ESCO)
- Private and public sector involvement
- Energy types (CHP, EfW, geothermal etc)
- Customer base (domestic, non-domestic, mixed), and
- Funding (loan or grant or mixed)
- Interviewees included LA sponsors, suppliers, and a private investor.

The projects demonstrated significant differences from the pilot scheme projects. For example, in size, composition, integration within broader decarbonisation strategies (e.g. climate change emergency declarations), stronger presence of decarbonisation ambitions, quantity of HNIP funding available and provided. Less changed though was the low level of engagement and interest from third-party investors.

We carried out the gleaning interviews using realist interviewing techniques<sup>26</sup>. We used the theories and CMOCs to structure the topic guide with some broader questions, to seek for other emerging themes. The topic guide was reviewed by the BEIS evaluation team and updated to address comments.

We made minor revisions to the theories (and hence the topic guides) as the gleaning interviews progressed in line with realist evaluation good practice. Mainly these were to clarify the intent of the theory. Figure 7 shows the full evolution of the theories, an example of the evolution of Theory 1 during gleaning is shown below:

**Figure 7: Evolution of Theory 1 during the gleaning interviews**

<b>Initial theory before gleaning interviews</b>
HNIP funding has helped to manage cost and technology risks to enable the project to proceed and achieves a good mix of heat network developments.
<b>Evolution of theory during gleaning</b>
<b>First evolution</b>
HNIP has encouraged more ambitious projects better aligned with HNIP’s objectives by helping manage risk and uncertainty
<b>Second evolution</b>
HNIP has encouraged more ambitious projects better aligned with HNIP’s objectives with respect to decarbonisation by helping manage risk and uncertainty

## **Developing refined theories**

We coded the interview data using NVivo and then collated the evidence for and against each theory in an evidence matrix. We identified demi-regularities, actors' perspectives, and emerging themes from the gleaning interviews to shape theory development. This process of theory refining led to one initial theory and the articulation of a new theory (see Appendix 2 for details). Where relevant we also identified alternative theories.

The refined theories were discussed and finalised with the BEIS evaluation team. An example of theory development during the analysis is shown below. The example shows how Theory 1 (introduced above) and Theory 2, which at the end of the gleaning interviews was stated as "HNIP government funding adds legitimacy to heat network schemes and stimulates carbon saving ambitions", continued to develop. In this case elements of these two theories were combined to arrive at two new theories.

The development of all the theories is shown in full in Annex 3.

**Figure 8: Evolution of Theories 1 and 2 during analysis and discussion at the end of the gleaning stage**

<b>Theory 1 and 2 at end of the gleaning interviews</b>
<p><b>Theory 1:</b> HNIP has encouraged more ambitious projects, better aligned with HNIP’s objectives with respect to decarbonisation, by helping manage risk and uncertainty.</p> <p><b>Theory 2:</b> HNIP government funding adds legitimacy to heat network schemes and stimulates carbon saving ambitions.</p>
<b>Evolution of Theory 1 following analysis and review with BEIS</b>
<p><b>New Theory 1:</b> HNIP ‘cues’ in the application process are driving decarbonisation ambitions OR enabling ambitions to be brought forward or increased.</p> <p><b>New Alternative Theory 1:</b> HNIP is an opportunity programme, enabling ambitions already present and stimulated by other drivers, rather than a change programme. It produces change because of its impact on the system.</p>
<b>Summary of change</b>
<p>Separated out the specific references to decarbonisation ambitions from Theories 1 and 2 – into a single theory and alternative theory.</p>
<b>Evolution of Theory 2 following analysis and review with BEIS</b>
<p><b>New Theory 2:</b> HNIP is building confidence and hence enabling heat network development (through providing legitimacy, managing risk, reducing uncertainty)</p> <p><b>New Alternative Theory 2:</b> Other factors, in addition to government funding, are at work to build legitimacy (confidence) in specific schemes (e.g. the additional due diligence provided by any external funder, the change of attitudes achieved by promoting heat as a service).</p>
<b>Summary of change</b>
<p>Combined aspects of Theories 1 and 2 that relate to building confidence in a heat network scheme – principally: managing risk and uncertainty, and the role of government funding in communicating the legitimacy of heat networks.</p>

### Testing the refined theories – data collection

Following the gleaning interviews, we expressed the theories as a series of statements, which were tested through interview with a second sample of seven interviewees, selected from funded projects, one withdrawn project, one failed project and one large supplier. The topic guide was structured around these statements. An example set of statements is shown in Figure 9. The purpose of the statements was to elicit well focused responses relevant to the theory. The interviewer then explored contextual factors relevant to the response and also probed other themes emerging from the interview.

**Figure 9: Example of a set of statements**

Theory being tested
Theory 1: HNIP ‘cues’ in the application process are driving decarbonisation ambitions OR enabling ambitions to be brought forward or increased in scale.
Statements
Statement 1.1: The existence of HNIP sparked your (organisation/local authority) decarbonisation ambitions.
Statement 1.2: Applying for HNIP funding enabled your existing decarbonisation ambition to become more ambitious or greater in scale or delivered sooner.
Statement 1.3: The application process prompted new ambitions or increases in ambition or scale (e.g. eligibility and scoring criteria, conversations with TPHN).
If interviewee agrees, ask supplementary question: What was it in the application process that did this?

Interviewees included LA sponsors, a private-sector investor and consultants and suppliers. In line with realist evaluation good practice, we adapted the topic guide as the interviews progressed to reflect experience in the early interviews.

Throughout the Wave 1 impact evaluation, response rates to requests to participate have been lower than we anticipated. This may be due to a combination of the impact of COVID-19 and a number of other calls on projects’ time from other project monitoring and review activities. A decision was therefore taken to supplement the interviews with a short e-survey. An interim analysis of interviews was carried out to inform the design of the survey.

With the BEIS evaluation team we decided to focus the e-survey on those theories where the evidence was weakest. The survey questions were developed iteratively with the BEIS

evaluation team and TIHR survey team. The survey was implemented in the Qualtrics on-line survey package and sent to all first and second contacts on TPHNs contact data base for funded projects.

To encourage as good a response as possible:

- We designed the survey so it could be completed in around 10 minutes
- We sent it with a personalised link
- TPHN sent an email encouraging participation
- We sent follow-up reminders.

We sent 37 invitations to 23 projects funded through rounds 1 to 6 (and one project from round 7) and received 8 responses, again COVID-19 and other demands on people's time probably affected responses. However, overall between the interviews and survey we reached 17 different individuals, involved in 13 different projects (11 different funded projects) and thus an acceptable sample size. Details of participant characteristics are given in Annex 4.

### **Testing the refined theories - analysis**

We analysed the data from the interviews and survey data to:

- Assess the evidence with respect to each theory and alternative theory
- Identify demi-regularities, common themes and minority views relevant to the mechanisms at work and the influence of context, and
- Identify additional emerging themes that could be developed as theories and tested in the next round of evaluation activities.

As for gleaning, this was a highly iterative process involving NVivo coding of interviews, extraction of coded evidence into an evidence matrix, review of the collated evidence to draw out initial conclusions and discussion of these internally to refine the theories further, where necessary, and identify themes for further investigation. The figure shows how Theory 3 was refined through this process.



**Figure 10: Development of Theory 3 through the refining interviews**

Theory at start of refining interview	Theory at end of analysis
<p>Theory 3: HNIP funded projects demonstrate a range of benefits to both potential customers and sponsors, leading to more widespread adoption of heat networks (a key ripple effect).</p>	<p>Theory 3: HNIP funded projects demonstrate the viability of heat networks and their potential to deliver a range of benefits to both potential customers and sponsors, leading to more widespread adoption of heat networks (a key ripple effect).</p>
<p>Alternative Theory 3.1: Non HNIP funded heat networks already operating in the UK, or elsewhere, provide a better demonstration of benefits to potential customers and sponsors than HNIP funded projects.</p>	<p>Alternative Theory 3.1: Non HNIP funded heat networks already operating in the UK, or elsewhere, are likely to provide a better demonstration of viability and benefits to potential customers and sponsors than HNIP funded projects.</p>
<p>Alternative Theory 3.2: While demonstration of economic, and other, of benefits can have impact in local conversations - it is not sparking interest more widely in potential stakeholders because the benefits are not:</p> <ul style="list-style-type: none"> <li>• seen as relevant or sufficient to balance perceived barriers and uncertainties, or</li> <li>• communicated effectively or widely enough.</li> </ul>	<p>Alternative Theory 3.2: While demonstration of viability and benefits can have impact in local conversations - it is not sparking interest more widely in potential stakeholders because the benefits are not:</p> <ul style="list-style-type: none"> <li>• seen as relevant or sufficient to balance perceived barriers and uncertainties, or</li> <li>• communicated effectively or widely enough.</li> </ul>

We prepared a project note presenting the results of our detailed analysis as a basis for discussion with the BEIS evaluation team prior to preparing this report.

We presented and discussed the draft report with the HNIP steering group in June 2021.

### Quality of the evidence and limitations

Sampling was purposive and managed in the same way as described for the process evaluation. While recruitment throughout the impact evaluation proved difficult, we achieved a good spread of different types of project in our sample, with examples from each of the identified clusters (see Appendix 5).

Interviewees were able to evidence their assertions with examples, providing a coherent and persuasive narrative. On analysis we found the data to be very rich and are confident that it is sufficient to support theory development and testing.

Due to the nature of the HNIP funnel, there are a high proportion of grant funded, public sector led schemes – so findings here are subject to that limitation.

We have included in our analysis evidence collected in the pilot scheme impact evaluation and the main scheme process evaluation, building on these earlier phases of evaluation.

Alternative theories have been identified and tested to ensure we examine other ways that outcomes may be being delivered.

Project sponsor knowledge and perspectives were supplemented by interviews with BEIS and TPHN, investors, suppliers and other relevant people. Workshops involving relevant stakeholders from BEIS and TPHN provided sense checking.

Due to the complexity of the different project contexts and overall relatively small number of projects, it would not be possible to identify a representative sample in this case or reliably identify causal associations in the data and we have not attempted to do this.

# Appendix 2 Evolution of the impact theories

## Wave 1 Impact evaluation theories

Initial theory (gleaning)	Evidence strength	New Refined theory (theory refinement)	Derived from
<p>Theory 1: HNIP funding has helped to manage cost and technology risks, to enable the project to proceed and achieves a good mix of HN developments.</p> <p>[Developed during gleaning to read: HNIP has encouraged more ambitious projects, better aligned with HNIP’s objectives [with respect to decarbonisation], by helping manage risk and uncertainty.]</p>	<p>Strong evidence that HNIP builds confidence by helping manage risk and uncertainty (Theory 1) and adding legitimacy to heat network schemes (Theory 2).</p> <p>Little evidence that HNIP is stimulating greater decarbonisation ambitions.</p> <p>We suggest Theory 1 and 2 are restructured to enable clearer focus on the role of HNIP in supporting more ambitious plans.</p>	<p>Theory 1: HNIP ‘cues’ in the application process are driving decarbonisation ambitions OR enabling ambitions to be brought forward or increased in scale.</p> <p>Alternative Theory 1: HNIP is an opportunity programme, enabling ambitions already present and stimulated by other drivers, rather than a change programme. It produces change because of its impact on the system.</p>	<p>Initial Theories 1 and 2</p> <p>Separated out the specific references to decarbonisation ambitions in Theories 1 and 2 – into a single theory and alternative theory</p>
<p>Theory 2: HNIP [government] funding adds legitimacy to heat</p>		<p>Theory 2: HNIP is building confidence and hence enabling heat network development (through providing</p>	<p>Initial Theories 1 and 2</p>

Initial theory (gleaning)	Evidence strength	New Refined theory (theory refinement)	Derived from
<p>network schemes and stimulates carbon saving ambitions</p>		<p>legitimacy, managing risk, reducing uncertainty ...)</p> <p>Alternative Theory 2: Other factors, in addition to government funding, are at work to build legitimacy (confidence) in specific schemes (e.g. the additional due diligence provided by any external funder, the change of attitudes achieved by promoting heat as a service).</p>	<p>Combined aspects of Theory 1 and 2 that relate to building confidence in a heat network scheme – principally: managing risk and uncertainty, and the role of government funding in communicating the legitimacy of heat networks</p>
<p>Theory 3: HNIP has a role demonstrating economic benefits to engage potential customers with heat networks. Funded schemes demonstrate the benefits of heat networks, leading to more widespread adoption (a key ripple effect) and heat provided to end</p>	<p>There is evidence of heat networks potential to generate a wide range of economic benefits, outside those captured in the business case. But it is too early, or the scale is too small for benefits to be clear.</p> <p>There is little evidence that potential benefits are sparking interest in stakeholders outside the local area.</p>	<p>Theory 3: HNIP funded projects demonstrate [the viability of heat networks and their potential to deliver] a range of benefits to both potential customers and sponsors, leading to more widespread adoption of heat networks (a key ripple effect)</p> <p>Alternative Theory 3.1: Non HNIP funded heat networks already operating in the UK, or elsewhere, [are likely to] provide a better demonstration of [viability and]</p>	<p>Initial Theory 3</p> <p>Broadens Theory 3 to consider a wider range of benefits beyond economic ones</p> <p>More specific ripple effects are also explored under relevant theories</p>

Initial theory (gleaning)	Evidence strength	New Refined theory (theory refinement)	Derived from
<p>users at no customer detriment on average.</p> <p>[Developed during gleaning to read: HNIP funded projects demonstrate economic benefits to both potential customers and sponsors, leading to more widespread adoption of heat networks (a key ripple effect)]</p>		<p>benefits to potential customers and sponsors than HNIP funded projects</p> <p>Alternative Theory 3.2: While demonstration of economic, and other, of [viability and] benefits can have impact in local conversations - it is not sparking interest more widely in potential stakeholders because the benefits are not:</p> <ul style="list-style-type: none"> <li>• seen as relevant or sufficient to balance perceived barriers and uncertainties, or</li> <li>• communicated effectively or widely enough.</li> </ul>	
<p>Theory 4: By applying private-sector standards (regarding information requirements in funding applications) to HNIP the public sector, other applicants, plus supply chain partners, will learn the programme</p>	<p>There is no strong evidence of additional learning in the sample of projects.</p> <p>There is some evidence that HNIP can prompt close collaborative working with external experts in addition to TPHN or HNDU - thus</p>	<p>Theory 4: HNIP is building market and applicant maturity – helping promote private sector programme development and investment award practices and behaviours gained from applying for HNIP investment.</p> <p>Alternative Theory 4: Applicants already have reasonable skills and knowledge due to work leading up to</p>	<p>Initial Theory 4</p> <p>Specific reference to going through the HNIP application process added, reference to the self-sustaining market removed</p> <p>New alternative theories developed</p>

Initial theory (gleaning)	Evidence strength	New Refined theory (theory refinement)	Derived from
<p>development and investment awards practices and behaviours of the private sector. This will contribute to a self-sustaining market.</p>	<p>increasing and potentially spreading learning. We suggest that we continue to investigate this theory and also:</p>	<p>HNIP application, or would learn them, or access them, anyway from necessary interactions with the supply chain during feasibility and design phases.</p>	
<p>Developed during gleaning to read: HNIP is building market and applicant maturity – helping promote private sector programme development and investment award practices and behaviours, contributing to a self-sustaining market]</p> <p>Note: it is not possible to test the third-party investment award aspects of this theory due to limited loans awarded and recent changes</p>	<p>whether this learning is spreading beyond the funded projects to contribute to a self-sustaining market (a ripple effect) and the sustainability of Theory 2 (legitimacy/confidence) and Theory 4 (maturity) outcomes – but also more broadly (a new theory).</p>	<p>New sustainability theory Theory 5: HNIP is promoting sustainable change by building organisational capacity and capability, not just individual capacity and capability in the private sector – consultancies and other suppliers, in local authorities – councillors and staff Alternative Theory 5: to achieve a sustainable green heat network market there needs to be a more strategic approach with longer term capital or low-cost loan support reinforced by other messages and local and national policy drivers (e.g. planning rules).</p>	<p>Initial Theories 2 and 4 Separates out sustainability aspects of 2 and 3 into a new theory regarding the sustainability of the impacts of the scheme, and the likelihood of it achieving its longer term goals The longevity of specific effects such as confidence and maturity are also explored under the relevant theories</p>

Initial theory (gleaning)	Evidence strength	New Refined theory (theory refinement)	Derived from
<p>Theory 5: Many of the projects funded so far are at the commercialisation stage. Success and timeliness at this stage is dependent on the availability of a suitable procurement framework.</p>	<p>We found little evidence in the sample of projects that lack of procurement frameworks is a barrier to heat network commercialisation.</p>	<p>Theory unsupported</p> <p>We agreed to drop this theory. There may be something useful to consider around procurement more generally</p> <p>It was agreed that the process evaluation could explore the usefulness of the model documentation produced by TPHN.</p>	

## Wave 2 Impact evaluation theories

These theories were developed through gleaning and theory refining. The final theories were then used to derive findings through the final workshop and analysis for this final report.

### A. HNIP delivered local action and impact

Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Theory A1: Building confidence locally:</b> HNIP has helped build <b>confidence</b> that a heat network can be a viable solution to heat, and decarbonisation of heat, in a locality. The fact that the government is prepared to commit resources to heat networks is key to demonstrating their <b>legitimacy</b> to both public and private-sector stakeholders. HNIP funding of <b>commercialisation</b>, and scrutiny of the application, has also been helpful in de-risking projects and building confidence in the business case.</p> <p>However, <b>HNIP is not the only factor</b> here. Other local factors can also be important. Strong local leadership and due diligence processes applied by other funders, also builds confidence, while high inflation is increasing the perceived risks of committing to funding. Which factors are more important depends on the local context - but HNIP has a critical role to play, and this can be more significant in some areas than others.</p>	<p><b>SUPPORTED</b></p> <p>The initial <b>Wave 1 Theories 1 and 2</b> and related ALT theories were developed from the <b>Pilot Evaluation</b> findings and <b>Wave 1</b> gleaning interviews. They explored themes around whether and how HNIP encouraged decarbonisation ambitions and built the confidence of key stakeholders in heat networks. These initial theories were tested and from these a new theory was proposed that focused specifically on HNIP’s role in building confidence. Evidence collected through <b>Wave 2</b> continued to support this theory.</p> <p>It is presented as <b>Finding A2: Building confidence</b></p>



Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Theory A2: Aligning motivations:</b> HNIP acted as a catalyst to <b>align motivations</b> – drawing key stakeholders in a location with different motivations together. These include revenue generation, tackling fuel poverty and regeneration, as well as recognising the need to decarbonise heat as part of tackling climate change. The way HNIP has been implemented, has enabled the project to work in support of local strategies and plans (see also <b>Theory A3</b>)</p> <p>The role of <b>local champions</b> and other influencers, is also very important in sparking interest in, and marshalling commitment to, HNIP and heat networks and bringing key stakeholders together.</p>	<p><b>SUPPORTED</b></p> <p>This theory was derived from the <b>pilot process evaluation</b> and gleaning interviews carried out at the start of the <b>pilot impact evaluation</b>.</p> <p>Evidence collected in later rounds continues to support this theory, highlighting, particularly the role of local champions.</p> <p>It is merged with A3 to become <b>Finding A4: Working with, and within, local strategies</b></p>
<p><b>Theory A3: HNIP provides opportunity to support local strategies:</b> HNIP impact locally is achieved through funded projects’ incorporation of, and response to, <b>place-based strategies, priorities, and plans</b>. They deliver a range of specifically local benefits to both potential customers and sponsors in addition to any financial investability they offer, including building place-based resilience and locality enrichment. In this, HNIP has worked as an <b>opportunity programme</b>, enabling fulfilment of ambitions already present in the location, rather than a change programme.</p> <p>While ‘cues’ in the HNIP application process have helped shape or focus decarbonisation ambitions, they are not driving them. HNIP principally works by <b>strengthening and aligning factors already present in the heat network’s operational and wider context</b> (such as the increasing recognition of the need to decarbonise heat, the policies and plans that support this, regeneration etc).</p>	<p><b>SUPPORTED</b></p> <p>The initial <b>Wave 1 Theories 1 and 2</b> and related ALT theories were developed from the <b>pilot impact evaluation</b> findings and <b>Wave 1 impact evaluation</b> gleaning interviews. They explored themes around whether and how HNIP encouraged decarbonisation ambitions and built the confidence of key stakeholders in heat networks. These initial theories were tested and from these a new theory was proposed that focused specifically on HNIP’s role in promoting decarbonisation ambitions.</p> <p>Evidence collected through <b>Wave 2</b> continued to support this theory, emphasising the role played by increasing</p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>The diversity in projects allowed by HNIP’s design and implementation, has allowed stakeholders to grasp the opportunities the programme offered, and generate value against a range of objectives (see also <b>Theory B3</b>).</p>	<p>recognition of the need to decarbonise heat, and the diversity of projects, allowed by HNIP.</p> <p>It is merged with A2 to become <b>Finding A4: Working with, and within, local strategies</b></p>
<p><b>Theory A4: Covering a funding gap:</b> HNIP helped cover a <b>funding gap</b>, to enable the project to proceed. HNDU funding alone would not have been sufficient to deliver the benefits described.</p> <p>While scalable solutions, in a growing market, should increasingly be able to attract funding from sources other than central government, a funding gap will persist in less investable networks (e.g. rural off gas), or as a means of eventually securing an investable network. In these situations, government support would be required for the foreseeable future.</p>	<p><b>SUPPORTED</b></p> <p>This theory was derived from <b>the pilot process evaluation</b> and gleaning interviews carried out at the start of <b>the pilot Impact evaluation</b>. Evidence collected in later rounds continues to support this theory.</p> <p>It is reported as <b>Finding A1: Bridging a funding gap</b></p>
<p><b>Theory A5: Building public-sector applicant maturity, skills and knowledge:</b> HNIP has built applicant <b>maturity</b>, helping <b>promote private-sector programme development and investment award practices and behaviours in public-sector applicants</b>. HNIP funded projects are also contributing more generally to the maturing of skills and knowledge relevant to complex, multi partnership, hybrid infrastructure projects.</p> <p>HNIP does this through:</p> <ul style="list-style-type: none"> <li>• The <b>application process</b> (coaching by the delivery partner has been material here, resulting in a pipeline of good quality projects being submitted for funding)</li> </ul>	<p><b>SUPPORTED</b></p> <p>The initial version of this theory (<b>Wave 1 Theory 4</b>) and the related ALT theory were developed from <b>the pilot impact evaluation</b> and <b>Wave 1</b> gleaning interviews. It was modified during refining and testing to add reference to the HNIP application process and remove reference to the self-sustaining market. New ALT theories were added.</p> <p>Evidence collected during <b>Wave 2</b> continued to support this theory, emphasising the role of:</p>

Final Impact theories	STATUS, derivation and relation to report findings
<ul style="list-style-type: none"> <li>• The loan offers</li> <li>• Funding commercialisation, which has broadened heat network relevant engagement, among Local Authorities, <b>with private-sector partners</b>, consultants and suppliers.</li> <li>• Sparking <b>wider conversations</b> around e.g. regeneration, expanding decarbonisation etc,</li> </ul> <p>Applicants also gain <b>relevant skills and knowledge</b> from pre-application work or from other large infrastructure projects. The maturity development value of HNIP to individual projects depends on context e.g. networks with ESCO partners might already have the skills available therefore requiring less direct help from TPHN ‘coaching’.</p>	<ul style="list-style-type: none"> <li>• the delivery partner (TPHN) as they developed their role as one of coaching and supporting applicants, and</li> <li>• partners such as ESCOs</li> </ul> <p>It is combined with A6 and reported as <b>Finding A3: Building local maturity, skills, and knowledge</b></p>
<p><b>Theory A6: Building capacity and capability:</b> While HNIP projects are building both individual and organisational capacity and capability in:</p> <ul style="list-style-type: none"> <li>• the private sector – consultancies and other suppliers, and</li> <li>• local authorities – councillors and staff.</li> <li>• the scale and scope of HNIP funding of projects is insufficient to achieve wider sustainable change in the market.</li> </ul> <p>Ways of leveraging the value of HNIP funding into the wider market within the broader HNTP are required. The next section addresses this.</p>	<p><b>SUPPORTED</b></p> <p>The initial version of this theory (<b>Wave 1 Theory 5</b>) and the related ALT theory were developed during <b>Wave 1</b> theory refining, separating elements relating to sustainable market change and the likelihood of HNIP achieving its longer term goals.</p> <p>Evidence collected during <b>Wave 2</b> continued to support this theory.</p> <p>It is combined with A5 and reported as <b>Finding A3: Building local maturity, skills, and knowledge</b></p>

B: The impacts of HNIP projects and products on the wider market

Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Theory B1: Projects demonstrating viability and investability:</b> HNIP funded projects are demonstrating and building awareness of, and confidence in, the viability and investability of heat networks and their potential to deliver a range of benefits, both in the local area and more broadly.</p> <p>In one locality, for example, it has stimulated the creation of a Green Skills academy as part of a larger drive on local sustainability linked to job creation. Further afield, potential sponsors have shown interest in funded projects’ experience. This is especially the case where the approach is seen to be innovative and to have specific applicability in the area (a key ripple effect).</p> <p>While interest in projects is becoming more apparent, the impact of this on the market is limited to local and regional levels.</p> <p>The early stage of many of the schemes, which are not yet delivering heat, limits the value of the projects as demonstrators. Evidence of actual costs and performance is important to investors and sponsors, and this is sparse. Many <b>customers</b> still need to see pipes in the ground to provide confidence supply will be available.</p> <p>Other exemplars and sources of information are available to stakeholders. These include other operating heat networks (in the UK and abroad) and knowledge of partners, especially ESCOs and consultants (see also <b>Theory A4</b>). Which sources of information are more important depend on context.</p>	<p><b>SUPPORTED at this stage</b> – we recommend the GHNF evaluation continues to monitor this.</p> <p>The Initial version of this theory (<b>Wave 1 Theory 3</b>) and related ALT theories were developed from <b>the pilot impact</b> evaluation and <b>Wave 1</b> gleaning interviews. Theory refining interviews resulted in a broadening of this initial theory to consider a wider range of benefits beyond economic ones.</p> <p>Evidence collected during <b>Wave 2</b> continued to support this theory, with wider ripple effects becoming more apparent than in earlier rounds of the evaluation.</p> <p>This is reported as <b>Finding B2: Projects demonstrating viability and investability</b></p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>Communication of the projects, and lessons emerging from them, may also be an issue (see <b>Theory B5</b> below). <b>Section C</b> below explores engagement further.</p>	
<p><b>Theory B2: Diversity of projects supporting learning:</b> The diversity of the HNIP project portfolio has been beneficial in providing a wide range of <b>knowledge from heat network projects, and applied expertise. It is contributing to the development of the UK heat network market. This contribution is more than the sum of the contributions of the individual funded projects.</b> Localities will benefit from the construction of a heat network but the portfolio of funded projects will achieve impact beyond that.</p> <p>The portfolio offers clear potential for proof of concept and learning around a wide range of different technologies and settings, ownership, management, commercial and governance arrangements, policy design, developing networks strategically and at scale, wider benefits, such as contribution to grid balancing, and the barriers and risks associated with low carbon heat projects.</p> <p><b>Portfolio diversity delivers ‘learning by doing’:</b></p> <ul style="list-style-type: none"> <li>• For projects, the diversity ranges from off gas community projects through to multi site, and expandable, urban networks, and is <b>providing valuable exemplars of viable heat network solutions</b></li> <li>• For TPHN, the diversity <b>allows deeper learning to be derived and shared by looking across different settings</b></li> <li>• For <b>BEIS, the diversity has helped understand issues on the ground and develop policy to address these</b> – for example around</li> </ul>	<p><b>SUPPORTED IN PART</b> in that to fully realise the potential of the portfolio its learning needs to be captured and communicated effectively</p> <p>In <b>Wave 2 of the process evaluation</b> we found that HNIP received fewer applications than anticipated. TPHN developed a supportive role in response to this, that focussed on ensuring that projects submitted for awards were of good quality. The result was shaped by the nature of the projects submitted for funding.</p> <p>The final portfolio of projects awarded funding was very diverse providing a range of examples of how carbon reduced heating, via heat networks, can be enabled, produced, and delivered in different settings.</p> <p>An initial theory on the value of project diversity, and related ALT theory, was developed through the gleaning interviews carried out for <b>Wave 2 of the impact evaluation</b> and subsequent refining and testing interviews.</p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>zoning and regulation. In addition, it can inform policy on which aspects of heat network development should continue to be government funded.</p> <p>While the diversity of the portfolio is seen as providing rich knowledge, it could be too varied and too small to point to any particular approach being more applicable to a particular context. However, the variation in project contexts, would make this extremely difficult if not impossible.</p> <p><b>To fully realise the potential of the portfolio its learning needs to be captured and communicated effectively</b> (this is explored under <b>Theory B5</b>).</p>	<p>This theory was reported as <b>B1: Diversity of funded projects enabling learning</b></p>
<p><b>Theory B3: Portfolio diversity responds effectively to complexity:</b> The make-up of the portfolio has not been planned, but emerges as a result of individual funding decisions. Core aspects of strategy delivery become apparent in the portfolio, and have changed as the market has changed. For example, in early rounds network build was privileged over decarbonisation, in later rounds, and in GHNF (by design), this has reversed. From this perspective HNIP makes the best of what emerges, rather than steering the project along specific strategic pathways.</p> <p>While a higher degree of strategic intention in shaping the portfolio with a view to optimising learning, could have been desirable, the approach has delivered a number of benefits, producing more opportunities for learning than a narrow focus on a fixed strategic delivery path could have done:</p>	<p><b>SUPPORTED</b></p> <p>In the absence of a mechanism to manage the overall make-up of the portfolio, <b>Wave 2</b> of the <b>process evaluation</b> identified a concern that the portfolio could be sub-optimal in terms of delivery of policy aims i.e. stimulating the green heat network market and contributing towards the decarbonisation of heat. An initial theory, and related ALT theory, were developed through the <b>Wave 2</b> gleaning interviews and was refined during the subsequent refining and testing interviews.</p> <p>This theory was developed through the final sense-making workshop and subsequent analysis and reported as <b>B5: Understanding HNIP’s strategic impact</b></p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>It has allowed BEIS and TPHN to respond effectively to the <b>complexity</b>, and hence <b>change and uncertainty</b> inherent in the green heat networks market</p> <p>The schemes presented to HNIP, and subsequently funded, are influenced by developments in the market – and this has steered learning in useful directions – including exploring the challenges of bringing EfW to heat networks and implementing 5th generation solutions.</p> <p>It has allowed BEIS and TPHN to work more effectively with local strategies and plans, enhancing local value and shining a light on how public funding for infrastructure development can usefully work with local strategies delivering locally negotiated solutions for a national infrastructure strategy (see also <b>Theory A3</b>).</p>	<p>Evidence collated under this theory also informed discussion of sources of diversity reported under <b>B1: Diversity of funded projects enabling learning</b></p>
<p><b>Theory B4: HNIP products tackle market barriers:</b> HNIP products SOMS, SDDS, BHIVE have the potential to tackle barriers to heat network development and third-party investor involvement in the market, by:</p> <ul style="list-style-type: none"> <li>• standardising how information is presented to the market – and improving their investability,</li> <li>• improving projects’ access to investors and vice versa, and</li> <li>• reducing costs.</li> </ul> <p>While their potential value is recognised (particularly the SOMS), their late development limited their impact during the HNIP project lifetime.</p>	<p><b>SUPPORTED</b></p> <p>Building on findings emerging through <b>Wave 1</b> and <b>process evaluation Wave 2</b>, we continued to explore through <b>Wave 2</b> of the impact evaluation the impact of SOMS, SDDS and BHIVE on market development.</p> <p>This theory is reported as <b>Finding B3: HNIP products are helping tackle barriers to market entry.</b></p>

Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Theory B5: Synthesis of lessons and communication supports wider awareness and engagement:</b> HNIP funded projects are generating a rich knowledge base, demonstrating the viability and investability of heat network solutions. HNIP products can improve investability of heat networks. However, to fully realise value from HNIP, TPHN and BEIS need to do more to ensure the knowledge and lessons are identified and communicated effectively.</p> <p>TPHN communications and engagement activities are welcomed, and events are well attended, but not all funded projects are aware of them. More needs to be done here to ensure learning is received and understood. Both targeted knowledge capture and dissemination (via HNIP events, the TPHN website, coaching of GHNF applicants etc), and network building and maintenance (to support knowledge diffusion<sup>54</sup>) are important.</p>	<p><b>SUPPORTED</b></p> <p><b>Wave 1</b> suggested that a more strategic approach to communication and sharing learning may be needed to fully realise the benefits of HNIP projects as demonstrators. An initial theory, and related ALT theory, were developed and tested through <b>Wave 1</b> refining and testing interviews.</p> <p>This theory was reported as <b>Finding B4: Synthesis and sharing of lessons and communication supports wider awareness and engagement</b></p>

<sup>54</sup> By knowledge diffusion, we mean the gradual building and spreading out of knowledge via people involved in funded projects.



C: The impact of HNIP on key market segments

Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Investors and sponsors</b></p>	
<p><b>Theory C1: HNIP is raising some awareness among investors and sponsors: HNIP projects and communications are beginning to attract interest from other potential sponsors</b>, especially where the approach is seen to be innovative and to have specific local applicability (<b>Theory B1</b> above). But, <b>market engagement sparked by HNIP</b> is still limited.</p> <p><b>Climate Emergency declarations, recognition of the challenges of heat decarbonisation and local plans to address this, work in synergy with central government policies such as HNIP, GHNF and plans for zoning and regulation. The impact of this on heat network attractiveness</b> is becoming more apparent.</p> <p>As more heat networks are built, feedback effects will accelerate further development. For example, where an LA demonstrates commitment to heat networks, ESCOs and utility companies will be more likely to locate a heat network in that area. This may lead to private-sector sponsored networks emerging in LAs where there are already HNIP funded LA sponsored heat network, accelerating the route to scale.</p>	<p><b>SUPPORTED IN PART</b> there was too little evidence to support reporting of elements relating to feedback.</p> <p>Wider sponsor engagement has been a core objective of HNIP from its inception. Theories addressing this were developed and tested in <b>Wave 1</b> (Theory 3 and related ALT Theories).</p> <p>These were further developed in <b>Wave 2</b>.</p> <p>This theory is combined with C2 and C4 and reported as <b>Finding C1: HNIP attracting some interest among potential investors and sponsors</b></p>
<p><b>Theory C2: Investor impact limited: HNIP has attracted the interest, and engagement, of investors</b> in a way that would not otherwise have been possible, but it remains early days, with much still to do to attract third-party investment into the market. Active interest in HNIP has been limited to public-sector investors, ESCOs and investors who were already engaged in</p>	<p><b>SUPPORTED IN PART.</b></p> <p>Early HNIP experience showed that uniform readily investable networks were not going to be realised in the lifetime of HNIP. This did not diminish the need for active</p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>the market, rather than wider third-party investors. This is largely a product of the current state of the market but investment by local authorities and ESCOs is not insignificant. In many cases it exceeds the HNIP funding and represents the impact of HNIP in enabling joint funding and sparking additional investment.</p>	<p>investor engagement, but it engendered a more nuanced approach. BHIVE is a product of this. However, private-sector investment in HNIP heat networks, except ESCOs, remains at a low level.</p> <p>Building on findings emerging through <b>Wave 1</b> and <b>Wave 2 of the process evaluation</b>, theories relating to investor engagement and ESCO involvement in the market were developed and tested during <b>Wave 2 of the impact evaluation</b>.</p> <p>These included two theories that were not supported:</p> <ul style="list-style-type: none"> <li>• That investment was being inhibited because sponsors and investors consider heat networks a marginal technology on the path to net zero, which would be obsolete in a relatively short time</li> <li>• That increasing interest in ethical and place-based social, green, low carbon etc investments means there is more money willing to accept lower returns from green infrastructure such as heat networks.</li> </ul> <p>This theory is combined with C1 and C4 and reported as <b>Finding C1: HNIP attracting some interest among potential investors and sponsors</b></p>

Final Impact theories	STATUS, derivation and relation to report findings
<p><b>Theory C3: Greater ESCO involvement, but limited by supply chain constraints:</b> HNIP has facilitated greater ESCO involvement in heat network development in the UK. Recognition of long-term UK government support for heat network development, manifested by HNIP and GHNF, combined with developments that anticipate zoning (e.g. London plan and other LA frameworks) give ESCOs the confidence to invest. Other factors likely to attract ESCOs include expandable larger scale networks, for example regeneration and large housing developments, that guarantee demand. A further appeal is a readily available large scale reduced carbon heat generation opportunity such as EfW. Although HNIP funding might represent a smaller share of the heat network capital cost its contribution to, for example, energy centre development, and sometimes commercialisation, provides essential and critical gap funding. Currently the pace of supply chain development is insufficient to support very extensive ESCO involvement in the UK market (see also <b>Theory C5</b> below).</p>	<p><b>SUPPORTED IN PART</b> as other factors are important, and they can bring in their own supply chains.</p> <p>This theory was developed during <b>Wave 2</b> based on findings emerging during <b>Wave 2</b>.</p> <p>This finding is reported as <b>Finding C2: Greater ESCO (Energy Service Companies) involvement, but limited by supply chain constraints</b></p>
<p><b>Theory C4: The risk return ratio is too low: For many sponsors and investors, the return from heat networks is too low given the level of risk, including volume (demand) and price risk.</b> The halting of the South West Exeter project has highlighted the issue of demand risk. So, while HNIP (and now GHNF) are laying the foundations for investability, raising awareness and engaging audiences, <b>the benefits of this will not be seen until the policy framework is in place to help manage risks including, critically, zoning and regulation.</b></p>	<p><b>SUPPORTED IN PART</b> in that zoning, regulation etc are not a panacea.</p> <p>There remains much uncertainty about what regulation will contain, and whether zoning can deliver, given constraints in the supply chain and the technical and administrative challenges of managing large infrastructure projects, preparing existing and new developments to be zone ready, and working across LA boundaries. Zoning needs to be hand in hand with strong regulation that enforces property standards.</p>

Final Impact theories	STATUS, derivation and relation to report findings
	<p>As HNIP progressed it became apparent that a more strategic policy framework was required that would involve continued funding support alongside measures such as zoning and regulation. Building on this, and findings emerging through <b>Wave 1</b> and <b>Wave 2 of the process evaluation</b>, theories relating to investor engagement in the market were developed and tested during <b>Wave 2 of the impact evaluation</b>.</p> <p>This theory is combined with C2 and C4 and reported as <b>Finding C1: HNIP attracting some interest among potential investors and sponsors</b></p>
<p><b>Suppliers</b></p>	
<p><b>Theory C5: The supply chain remains constrained:</b> HNIP has had both positive and negative impacts on supply chain development; overall, its impact has been very limited and the supply chain remains constrained.</p> <p>On the positive side, HNIP has resulted in capability and capacity development associated with funded projects, it has stimulated the establishment of a Green Skills academy, and encouraged ESCOs to consider investing more in the UK supply chain. However, the <b>HNIP timetable has reduced the opportunity for new and emerging suppliers to engage</b> with funded projects, thus leaving it to a narrower band of established suppliers. Where larger ESCOs (Energy Service Companies)</p>	<p><b>SUPPORTED</b> Previous research by BEIS has pointed to supply chain weakness. We explored this through <b>Wave 2</b>.</p> <p>This theory is combined with C2 and C4 and reported as <b>Finding C3: The supply chain remains constrained</b></p>

Final Impact theories	STATUS, derivation and relation to report findings
<p>are a sponsor, or partner, they use their own established supply chains mainly based elsewhere (e.g. Nordic countries).</p>	
<p><b>Customers and consumers</b></p>	
<p><b>Theory C6: Many customers continue to see heat networks as high risk:</b> HNIP communications around projects have helped raise public awareness, but customer awareness and engagement is still limited. While larger organisations such as large commercial users and housing associations, may now be more aware of heat networks, many customers still need to see pipes in the ground to provide confidence supply will be available.</p> <p>Developers perceive heat networks as high risk (to timescales). Once a heat network is seen to be operating, potential customers do come forward as the risk of the heat network not being operational within required timescales is eliminated. Cost is also an issue for housing developers and for retrofit. Zoning is seen as very important in enabling retrofit, which would otherwise be priced out in most situations. With individual consumers the impact of HNIP is very limited.</p>	<p><b>SUPPORTED</b></p> <p>Demand risk has been highlighted as an issue from the first pilot impact evaluation, and this continued to be highlighted in subsequent waves.</p>

# Appendix 3 Findings – Impact

In this section, we describe the impacts of HNIP across three aspects:

A: The local impacts of HNIP projects due to their place-based nature

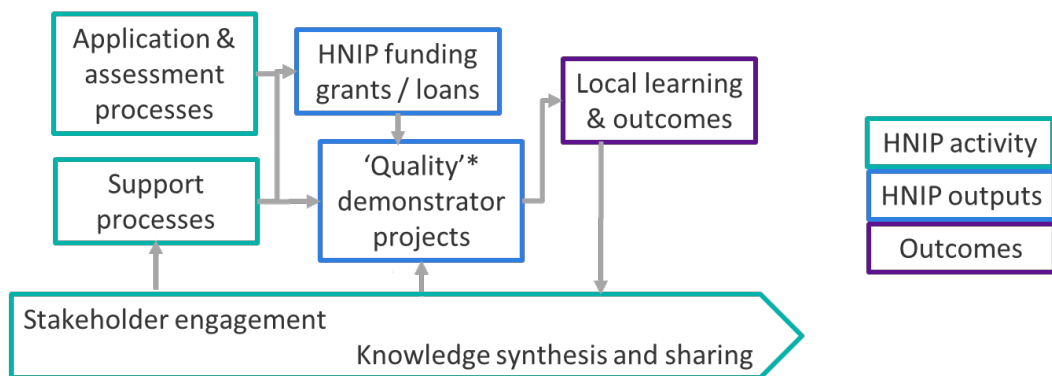
B: The impacts of the HNIP funded project portfolio, HNIP products and HNIP on the wider market

C: The impact of HNIP on key market segments

Each of these aspects is considered in turn below. For each set of findings, here and in Appendix 4, we first present an extract of the theory of change (TOC) map showing where the findings are principally focused, and then a short summary of our findings highlighting the main mechanisms we believe are supporting delivery of impacts and good or poorer performance.

## A. HNIP delivered local action and impact

**Figure 11: Focus of this section of the findings with respect to the theory of change map**

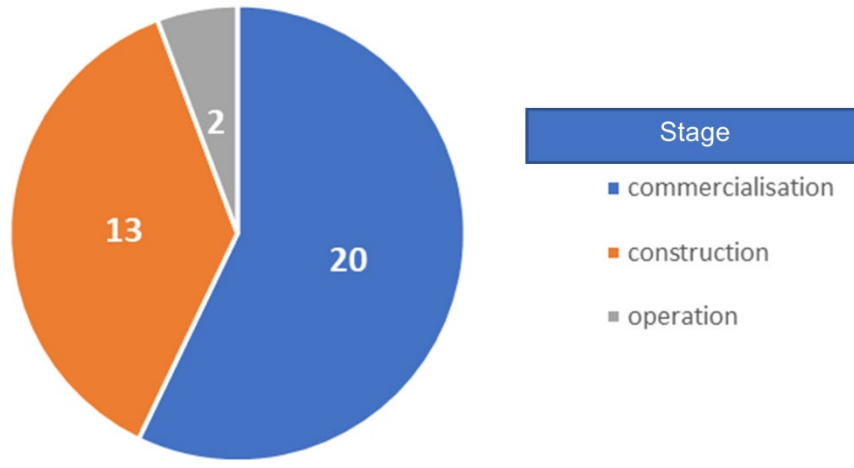


\* potential to expand, develop diverse heat customers (beyond anchor loads, not just in dense urban areas) and connect to multiple diverse heat sources

**The TOC narrative:** We conclude that the HNIP funded heat networks are essentially place-based projects delivering a range of local benefits. HNIP does this by helping remove barriers to heat network adoption in funded locations, generating a pipeline of good quality projects that work with local strategies and plans to deliver local benefits. The supportive role adopted by TPHN, and HNIP’s flexibility to work in support of local strategies, has been material in enabling schemes to proceed towards delivery of a range of benefits.

The HNIP main scheme, at the time of our analysis<sup>55</sup>, had funded 35 projects that are now proceeding through commercialisation and construction to operation as shown in Figure 1211.

**Figure 12: Proportion of funded scheme at each stage (source: TPHN)**



Our results suggest that HNIP has enabled local action and outcomes through:

- A1: Bridging a funding gap
- A2: Building confidence among local stakeholders
- A3: Building local maturity, skills and uncertainty
- A4: Working with, and within, local strategies
- A5: Delivering local benefits.

### A1: Bridging a funding gap

#### Overview

We reported in our evaluation of the pilot scheme<sup>56</sup>, that HNIP funding has been critical for projects, enabling schemes to proceed, which other funding sources (including HNDU funding) could not have delivered. Further work confirmed this. Among other things, HNIP funding has:

- provided 'start up' funding for critical network components (e.g. energy centre development) and commercialisation that would be hard, or impossible, to provide in other ways.

<sup>55</sup> Data from most recently received download of information from BEIS Master data tool 02/11/2022. This reflects the position with respect to projects which were awarded, and expected to deploy, funding at that time.

<sup>56</sup> BEIS research paper: 2020/040:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/913520/hnip-pilot-evaluation-report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/913520/hnip-pilot-evaluation-report.pdf)

- enabled funding to be secured other than from central government (e.g. from an ESCO partner) and facilitated collaboration.

The funding has enabled projects to carry out well-defined activities with valuable outcomes, for example funding feasibility studies of a novel technology. This suggests that the funding provided was set at a useful level.

*Definitely, I think it's that point that was said earlier, for us it's the ability to bridge the affordability gap that would never have probably been, there are other methods and instruments we can use but without that initial intervention, this heat network would probably not have been possible. (Project)*

### **Unlocking potential and enabling progression to scale**

HNIP funding has been used to fund feasibility studies, integral parts of a larger planned network, where this component was not otherwise viewed as investable, and to enable a path to scale:

*it's now a very small amount of the pie, in terms of there is no way if I can be honest, there is no way we would have looked to have set up a company, an SPV, without it and I would have been probably sitting here saying let's have an HR or a housing revenue account owned network, like for like and we would have sorted out our housing but that wouldn't have benefited [the non-housing customers] (Project)*

*... it meant they were able to start something, that every subsequent investment was going to be more and more additional, more and more lucrative in times and ultimately, contributed to them getting their [major investment] procurement. (Other)*

*BEIS investing in these projects to make them a reality is really important, because that catalyst will generate more projects to be delivered. But more importantly, it will get customers connected which means that networks will grow, or can grow, because they've got investment. (Project)*

*I don't think those kind of more strategic low carbon networks would have been built in the absence of HNIP. (Other)*

HNIP has also provided the funding that gave confidence to other parties to add further investment, for example, attracting or enabling ESCO investment in a locality:

*HNIP has brought in a scale of funding that has given the council confidence to let us [ESCO] bring our business plan forward by about 20 years so that our city scale system will be city scale within 10 years rather than within 30 years. (Project)*



## Challenges encountered

There have been challenges for applicants, associated with both the application process, and managing the deadlines for drawdown of funding and emerging cost risks, post award. These are discussed in 'Appendix 4 Findings – Process'. The supportive role adopted by TPHN, and HNIP's flexibility to work in support of local strategies, has been material in enabling schemes to overcome these challenges.

We also saw some evidence that the design of the programme may have limited the extent to which some smaller, or more innovative projects, could take advantage of the opportunities offered. This was a consequence of HNIP privileging BEIS requirements and conditions over local de-carbonisation strategic objectives. For example, take up of the HNIP opportunity could create tension between meeting carbon targets and delivering fully on local requirements and expectations. This resulted sometimes in failure to accommodate the strategic nature of some schemes or the absence of a phased approach. These limitations were products of HNIP constraints rather than a failure to recognise the legitimacy of local strategies.

## Looking forward

While scalable solutions in a growing market should increasingly be able to attract funding from sources other than central government, funding gaps will remain and even widen (due to inflation), for the foreseeable future. For example, in projects less able to attract other investment (e.g. off-gas rural community) or to 'kick-start' initial build. This highlights the need for government to consider continuing longer term targeted funding support to certain types of heat network, or in certain situations, where start-up funding will still be needed to enable a heat network to proceed.

*I think there is still this feeling though that we are still not past the need for capital funding, which is always going to be a thing until we're in a more sustainable place. It can only go so far, I think. (Project)*

## A2: Building confidence locally

### Overview

HNIP has helped build confidence that a heat network can be a viable solution to heat, and decarbonisation of heat:

- The fact that the government is prepared to commit resources to heat networks, is key to demonstrating their legitimacy to both public and private-sector stakeholders.
- The support provided by TPHN through the application process has also helped to build confidence.

- HNIP funding of commercialisation, and scrutiny of the application, has helped build confidence by de-risking schemes (e.g. geothermal and mine water projects).
- Continued TPHN and BEIS support to projects through commercialisation has been critical, helping projects deal with emerging risk and uncertainty.
- HNIP has enabled BEIS and TPHN to identify and capture knowledge that emerges from the local experience of delivering commercialisation and the ensuing de-risking. The role of this knowledge base in building confidence is addressed further under B4.

However, HNIP is not the only factor here, other key factors that can help build, or erode, confidence in heat networks include:

- Perceptions and attitudes to risk: Risk and uncertainty cannot be entirely eliminated. Lack of familiarity with heat networks, previous experience of poorly performing heat networks, inflation and economic uncertainty, policy uncertainty etc all create an environment where the risks associated with heat networks can be seen as too high
- Local leadership: Strong local leadership and effective champions build confidence, can help allay fears and generate commitment across key stakeholders

Which factors are more important depends on the local context – but HNIP has had a critical role to play for the funded networks, and this can be more significant in some areas than others. In most cases HNIP funding has enabled a specific and significant step in accelerating, or expanding, the development of a Heat Network already planned or under construction. For some of the smaller networks, however, HNIP support has been the most significant factor in enabling the network to be established.

### **Demonstrating legitimacy**

Government funding is vital. This is because it shows the government is prepared to commit resources to heat networks and also because of the due diligence the funding application process provides. Both of these build confidence. The following quotes are typical:

*I would say yes, again. One of the most useful things is that it's got a stamp of approval to say that it's already been approved by HNIP and then it does provide that, like I said earlier, it provides that bit of confidence which can then lead to those conversations, lead to more. (Other)*

*It gives you a lot of legitimacy to show that this is real, that you've got actual money behind you and you can deliver this. (Project)*

## **De-risking schemes and managing perception of risk**

The risks managed via HNIP are context specific, depending on the circumstances of the particular project. They may include cost, commercial, technological or financial risks, but the response of stakeholders to HNIP, as a mechanism to manage risk and build confidence, is a clear theme apparent in many of the projects in our sample. HNIP has provided an opportunity to confidently pursue the climate change agenda, in respect of decarbonised heat, by diminishing some of the risks.

The due diligence provided by HNIP, and crucially for some heat networks the funding of commercialisation, provides confidence that uncertainty has been reduced and that risks have been investigated and will be manageable.

*... when we got the funding, [we used it] to de-risk it [the design] because we didn't want to run the procurement with any obvious risks in there where someone prices that in and it becomes an unaffordable bid, so we wanted to take as much risk out of it as we possibly could. (Project)*

Continued TPHN and BEIS support to projects through commercialisation has been critical, helping projects deal with emerging risk and uncertainty. TPHN and BEIS have responded to the challenge presented by emerging risks well, including project specific risks (e.g. assessing borehole viability) and more general risks (arising from e.g. COVID, EU-exit and the war in Ukraine), providing additional financial support and advice through the commercialisation phase where necessary. We look at this in more detail in '[Appendix 4 Findings – Process](#)' TPHN/BEIS response.

## **Local champions and strong local leadership**

Local champions and strong local leadership play an important role. Local champions may be local authority employees, local councillors, consultants, ESCO employers or academics. We find champions working in climate change management, energy services, waste, sustainability, housing and finance areas.

Champions and leaders act to 'push forward' a specific heat network development, working to engage key stakeholders for example, enthusing local councillors and garnering political support, or identifying and connecting with the local community. They help in overcoming negative perceptions of heat networks, keeping stakeholders on board over the long development lead time of schemes, and helping to position the schemes within the wider local context such as climate emergency and decarbonisation strategies, which can facilitate adoption.

*We've had a local champion for 10 years or so [...]. He's been with us on quite a lot of [the] journey and he's been fundamental, to allow us to take risks and keep politicians on-side and informed but in such a way that the project team is given a lot of confidence to go ahead and potentially do things which could go wrong, but [as unless] you take that sort of approach, you're*

*going to struggle with district heating networks to make them happen.  
(Project)*

*There's plenty of authorities I know of that just haven't got somebody who's willing to support them so HNDU feasibility studies, [...] they just get left on the shelf, they do a feasibility study, and it may come up with a really good project but there's just no appetite. That because there's risks felt about delivering that kind of project. (Project)*

In Wave 1 of the impact evaluation, we carried out a short survey of applicants. Survey returns were consistent with the interviews: Participants 'strongly' or 'somewhat' agreed that strong championship of heat networks by individuals was an enabler of the decision to implement their heat network. However, relying on individuals carries risk, as people can move on. We have seen some evidence that learning is becoming embedded more deeply in organisations and that HNIP is not simply upskilling these individuals (see A3 below).

### **Looking forward**

The legitimacy HNIP funding provides and TPHN and HNDU support, have helped build the confidence of sponsors and active investors. Commercialisation, often funded by HNIP, has helped reduce risk and uncertainty, and further consolidates confidence in the scheme with a wider constituency of stakeholders. However, this requires an active programme of engagement, particularly with anchor load customers, and in some circumstances with end users (consumers of heat) to bring and keep them on board. Local champions are key to enabling this.

Champions have played a fundamental role in most, if not all, of the projects we have interviewed. This suggests a number of challenges:

- How can the knowledge and skills held by champions be captured, disseminated, and applied to future projects, and
- In this, and other policy areas, how can ways of working with local champions, be recognised by national policy that relies on local action to maximise value both in terms of delivery of national and local objectives.

Capturing learning from HNIP is discussed further under Appendix 3, 'B: The impacts of HNIP projects and products on the wider market'.

## A3: Building local maturity, skills, and knowledge.

### Overview

HNIP has helped develop local skills and knowledge and transferred to public-sector participants some of the private sector programme development and investment award practices and behaviours required to successfully implement heat networks. It has done this via:

- Supporting commercialisation, which has broadened heat network relevant engagement, among Local Authorities with private-sector partners, consultants and suppliers. Support from the delivery partner has been important where projects encountered challenges.
- Bringing together project collaborations and hence enabling learning from project partners and advisors.
- Sparking wider conversations around e.g., regeneration and expanding decarbonisation.
- The application process and loan offers, and the support provided by TPHN have been material here.

The learning is not just vested in individuals, but is becoming embedded in organisations, and in HNIP products such as the SOMS, and BHIVE.

HNIP is not the only source of learning. Applicants also gain relevant skills and knowledge from pre-application work or from other large infrastructure projects. The development value of HNIP to individual projects and locals depends on context e.g. networks with ESCO partners might already have the skills available, some LAs have been more willing to consider loans, and have learnt from the process of application.

### Source and nature of learning from HNIP

Learning has taken place throughout HNIP, both through the process of application and drawdown and through the support provided by HNDU, TPHN and BEIS (see 'Appendix 4 Findings – Process', for more on support received).

Both the nature and extent of learning is shaped by local factors. Consequently, the learning varies across projects, but some common learning themes have emerged, for example learning relevant to financial modelling and commercialisation:

*We probably do model our finances better now ... we relied on internal resource, but actually the HNIP process has almost been an independent check on that and we've actually probably improved and simplified some of the things we do, which was good. (Project)*

*I would say that for us, we've gone through the Heat Network Delivery Unit's process of high-level feasibility, master planning, detailed project*

*development, that's given us a whole set of skills but I would say for us, the opportunity to access the commercialisation grant has actually allowed us to build skills sets that are beyond technical ... (Project)*

Other examples of learning cited included:

- Business case development skills
- The capacity to apply more innovative solutions than would have been the case without the learning
- How to develop heat decarbonisation strategies for rural communities
- New skills associated with different heat technologies that can be deployed in other projects across the authority
- Retail function development and how to obtain the necessary legal advice
- Establishing an SPV for a pipe company
- Governance and procurement
- Rules relevant to state aid, and
- Partnership working to reduce OPEX costs (e.g. ESCO, LA, infrastructure companies).

While some of the learning is quite specific, such as the rules around state aid, much is more general with relevance to a wide range of projects, such as handling procurements. HNIP projects have helped mature the skills and knowledge relevant to complex, multi partnership, hybrid infrastructure projects. The learning gained strengthens local authority skills sets for this type of project.

*Without doubt I think the county council officers are learning a lot of new skills ... lessons we are learning can then have a beneficial effect for other projects ... [e.g.] a project this year on governance around understanding the most appropriate mechanism to procure somebody or something. It's wider project stuff to be honest. (Project)*

### **Building private sector skills in the public sector (maturity)**

The application process and loan offers, and the support provided by the TPHN, has been helpful in building maturity in the public sector. BEIS believes that the process of considering and applying for HNIP loans may have been shifting public-sector mindsets towards consideration of loans:

*Almost all of the early public-sector projects, they provided finance to the project but raised from PWLB [Public Works Loan Board], raised from the public sector purse. I think the fact that a lot of projects, including public-sector projects now have more commercially based loans in them, is helping to shift that mindset. (Other)*

When we explored this through the e-survey, returns were mixed. We asked participants to “indicate the extent to which you agree or disagree that the private-sector standards for programme development and investment award practices required by HNIP have left your local authority, or your local authority partner, better equipped to engage with the private sector in any future heat network developments”. The responses were widely spread – ranging from ‘strongly agree’ to ‘disagree’ and ‘don’t know’.

### **Learning from working with partners**

It is difficult to differentiate learning from the HNIP application process from learning generated from the opportunity HNIP provides to work with private-sector organisations in developing and delivering the heat network. The value of knowledge acquired in response to HNIP through collaborating with others has been a common theme in interviews e.g.:

*because I had already procured, we had a lawyer, an accountant, and an engineer in [...] working on the project ..., so helping put that application together was across all of them, we all fed in and wrote parts of that application. I don't think there's many local authorities that could put that application together on their own. (Project)*

*... support provided [from private-sector partner] really made a difference to this project because, as you noted, I don't have a training or background in this, I'm just a planning officer, so we did need that. (Project)*

### **Knowledge resilience – individual versus organisational**

Our interviews showed that in many cases learning was becoming embedded in organisations – HNIP isn't just upskilling champions:

*... we spent a lot of time just getting together as a project team and building a really deep understanding of the different aspects of this project, ... to the point where it wasn't just me who understood the various pieces, but actually five or six people in the project team would step in and chair a weekly meeting and knew what was going on in all of the different workstreams. (Project)*

In some cases, LAs have recruited to fill knowledge gaps and this also builds institutional knowledge:

*I suppose there's been a ripple effect into our planning department, they certainly know district heating better and because they've had to do some more kind of evaluation of proposals which are coming forward, they've invested in a specific sustainability low carbon planning officer to help with that kind of understanding. (Project)*



## Looking forward

While HNIP has done much to build skills and experience in funded areas, BEIS and TPHN believe that there is still more to be done, particularly developing public sector skills in the area of commercial structures and procurement. We return to how HNIP has contributed to the wider development of skills under B and C below.

### A4: Working with and within local strategies and plans

#### Overview

As well as working within local decarbonisation strategies and plans, HNIP has worked with other local strategies to deliver benefits:

- Rather than stimulating new ambitions, HNIP is experienced locally as an opportunity programme, drawing people with different motivations (decarbonisation, regeneration, local employment, revenue generation etc) together, and enabling existing local decarbonisation and other wider strategic ambitions to be realised more rapidly and, in some cases, more ambitiously. It works by enabling, strengthening and aligning these existing contextual and strategic factors rather than driving change.
- Additional value is delivered locally via funded projects working with place-based strategies, policies and plans. HNIP's design and implementation has allowed stakeholders to grasp the opportunities the programme offered, and generated value against a range of objectives (see A5 below).
- At the same time, local, regional and national plans, such as the levelling-up agenda, may have helped bolster support for HNIP funded schemes, and may be the key to unlocking the full potential of heat networks to tackle a range of local issues through e.g. retrofit.

#### HNIP working as an opportunity programme

There is good evidence that HNIP is working as an opportunity programme<sup>57</sup>, rather than a change programme. That is, it works by enabling decarbonisation ambitions already apparent among key actors in the locality, rather than stimulating new ambitions.

It works by strengthening and aligning factors already present in the heat network's operational context. For example, with the declaration of Climate Emergency across many LAs in 2019 the focus for HNIP applications changed – HNIP did not drive the changes, but enabled them to be realised.

While HNIP may not be a primary driving force for change, it has helped some projects bring forward or increase their scale of ambition more rapidly than would otherwise have

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<sup>57</sup> An "opportunity" programme is a programme that is viewed by an actor, or body, as an opportunity that aligns well with their ambitions or strategy.



been the case and has been essential for some projects to ‘get off the ground’. This is a common theme apparent in many of the projects in our sample, for example:

*I think that the potential projects have been there before. I think it's the element of government support which has developed the projects a bit quicker from inception. (Project)*

### **HNIP working within local decarbonisation strategies and plans**

There is strong evidence that HNIP impact locally is achieved through funded projects’ incorporation of, and response to, place-based decarbonisation strategies, priorities and plans. It’s not something that descends from BEIS, it’s something that primarily comes from what people want to do in their own localities around decarbonisation and climate emergency, and taking the opportunity provided by BEIS to pitch that in with their own local schemes, for example:

*So there was a Climate Action Plan [...] to go zero carbon by 2030, and we're part of that delivery. We're a very important part of that delivery for council owned buildings and infrastructure. Then by 2040 they want the whole borough to be zero carbon, or carbon neutral I should say, and of course we're a large part of that delivery because of our wider connections to private developments and hopefully existing homes and businesses through the zoning government act that you were mentioning earlier. (Project)*

The external context has changed rapidly throughout the HNIP funding rounds, with the UK commitment to Net Zero and LA declarations of climate emergency encouraging projects towards greater decarbonisation ambition. Local plans such as the London Plan (and the related energy master plans) have provided a strong framework supporting new heat network development and expansion, which HNIP funding has facilitated.

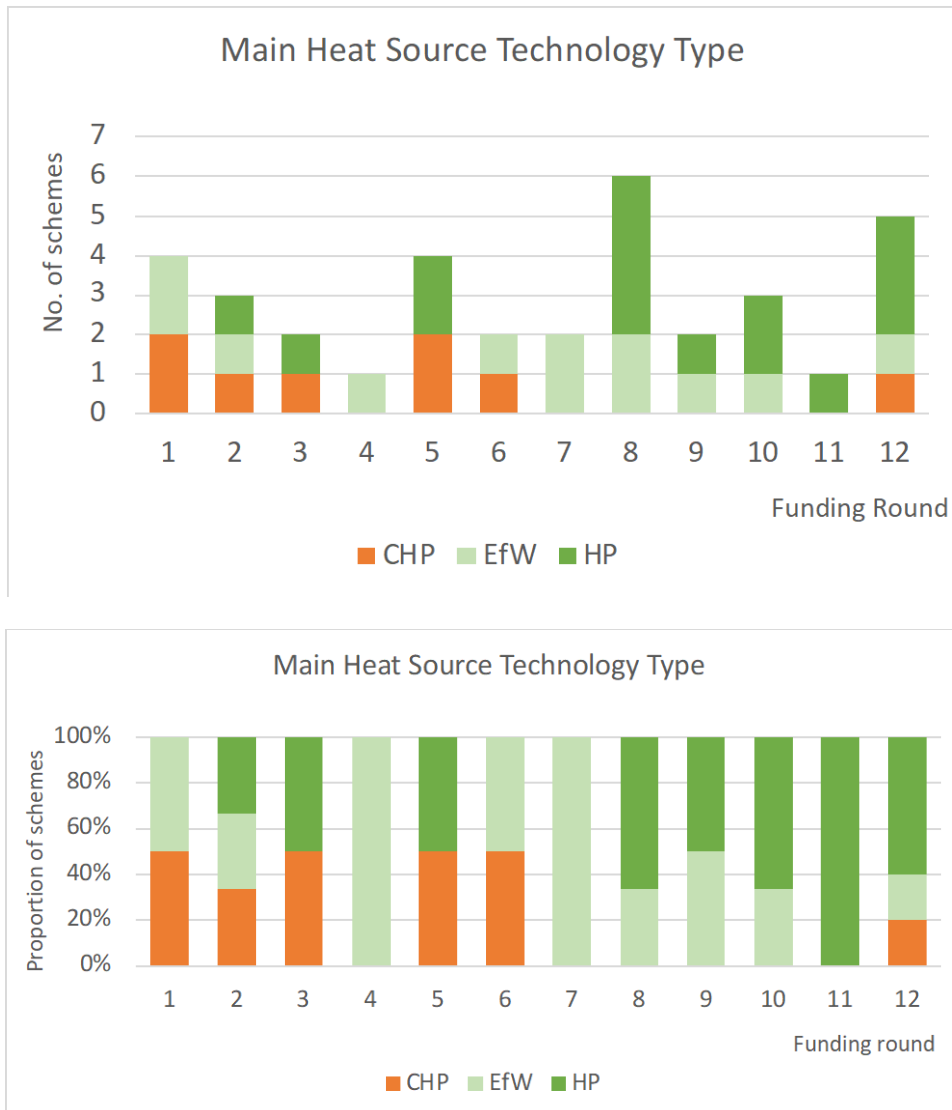
*We have seen the declaration of local climate emergencies happened in a really very substantial number at the beginning of HNIP. Everyone's eyes are on the opportunities here, not necessarily on heat networks but on the solution that heat networks were intended to deliver, i.e. reducing carbon emissions. (Other)*

*HNIP from that perspective is pump priming those wider connections. (Project)*

Figure 13 shows that low carbon heat sources have become more prevalent in later rounds of applications to HNIP. It is notable however that CHP did not dominate over lower carbon heat sources even in the early rounds of the main scheme.

**Figure 13: Heat Source Technology Distribution Across Schemes as HNIP Funding Rounds Progressed<sup>58</sup>**

Note: CHP means Combined Heat and Power, EfW means Energy from Waste, and HP means Heat Pumps.



### HNIP working with broader local strategies and plans

While HNIP is concerned with decarbonisation of heat, it has also been seen by sponsors as an opportunity to support other strategic objectives for example around place-based resilience, inequalities, or, in particular, regeneration:

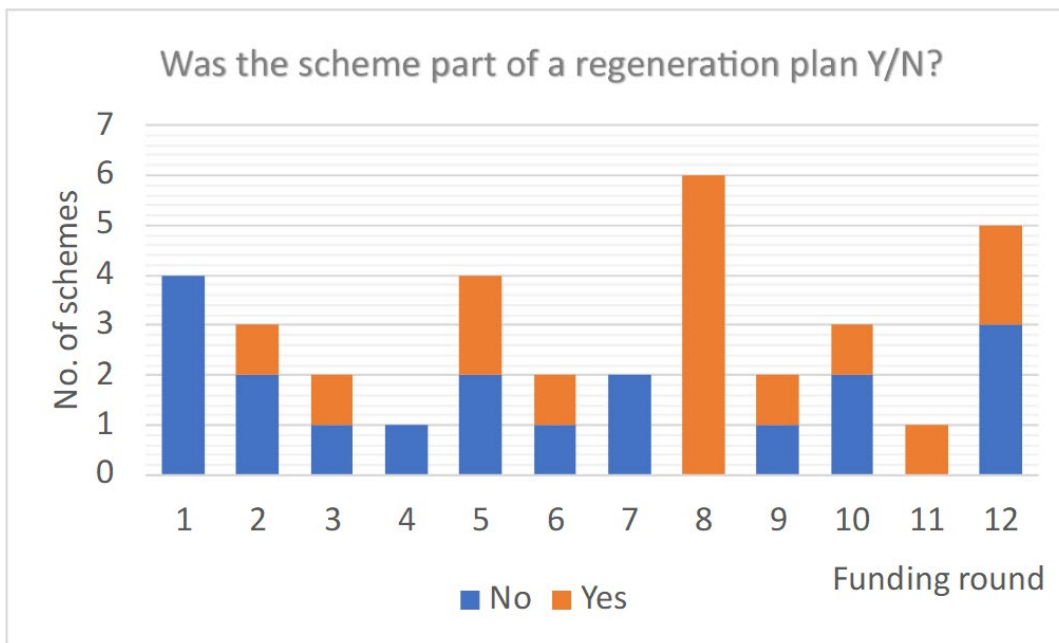
*Definitely jobs, I think definitely in terms of promoting a wider dialogue on sustainability, in our case that was happening concurrently but we're setting up a green skills academy (Project)*

<sup>58</sup> This shows the position following the round 12 awards and does not reflect any subsequent non take-up of funding by projects

In this way, HNIP has helped enable delivery of broader benefits such as building place-based resilience and locality enrichment. This has been enabled by the way HNIP has been delivered. Rather than the local perspective being brushed aside in order to make way for the national perspective, we see, particularly through the agency of TPHN, the construction of a fit between local priorities and perspective and what BEIS overall is trying to achieve.

A good example of this is regeneration. This has been a feature of 16 of 35 funded schemes, throughout the lifetime of HNIP.

**Figure 14: Number of HNIP funded schemes which are part of a wider regeneration plan in their area (data from scheme websites and TPHN)**



HNIP has been seen as an opportunity to support delivery of local regeneration plans, with the heat network one component within an overall strategy:

*... I think HNIP in enabling the projects and then characteristics of heat networks that mean they are much more additional to local communities than conventional utilities are, you don't just have a load of white vans pouring into the city, putting pipes in the ground and driving away again, heat networks will contribute to growing local economies, creating new businesses. (Other)*

### Case Study 1: HNIP as a Key Component of Regeneration of a Local Area

A local authority seeking to regenerate their town centre has received a small HNIP grant to support construction and commercialisation of a heat network. The HNIP grant represents less than 2% of the total regeneration budget, but has nonetheless been described as a critical component in unlocking some of the wider regeneration benefits envisaged by the authority:

*...it was key, it was one of the gamechangers because carbon neutrality etc is high on certainly our councillors' agendas at the moment so whilst they wanted a complete regeneration in the town centre, what they didn't want was the traditional build etc that we would have had in the past, they wanted something that was going to shine around the green credentials. (Project)*

*We have quite a few independent members who are very vocal around the development and this was one of the ones that really sold it to them as well. (Project)*

The low carbon heat network solution supported by HNIP also met the council's wider aspirations:

*From our perspective, it's giving our customers more dependable cost of energy that's not open, it's not as volatile as it would be to fossil fuel type of typical energy infrastructure and also being able to benefit from those green credentials as an investor or operator. (Project)*

HNIP funding is helping the council realise its redevelopment ambitions while reducing their environmental impact.

### HNIP working 'in concert' with a broad range of national policies

As well as HNIP and local plans acting in synergy, other national policies (e.g. tackling place-based inequalities) also support and facilitate HNIP participation creating a more compelling case for local action:

*we've been able to support schemes in towns and cities where there's a lot of regional placed based inequalities, the likes of the Rotherhams of this world, [...] ... and lots of those schemes have kicked off because of the different focus on those communities as a consequence of levelling up initiatives and the Towns Fund and other [...] There is a bow wave of these mutual supportive policies and funding programmes that mean a heat network is right, it might not be doing all of that heavy lifting on its own but it's been a*

*solution that has been easier to deliver because all eyes have been on those kind of communities and the particular requirements that they have. (Other)*

## Looking forward

HNIP provides lessons for future capital support schemes, how through their design, communication and the active support provided by the delivery partner, they can work flexibly to:

- Bring people with different motivations together
- Work effectively in support of local decarbonisation plans – to enable change within the local context – this may mean e.g. being flexible in supporting different pathways to decarbonisation (see Section B1: ‘Looking forward’, below)
- Reflect connections to other relevant local strategies and plans (e.g. regeneration, local-resilience) and work with them, both to enable heat network development and delivery of other local objectives
- Encourage planning to enable simultaneous delivery of works to address other objectives such as upgrading utilities (e.g. laying fibre).

## A5: Place-based schemes delivering local benefits

### Overview

HNIP has been successful in funding over 30 local heat networks, many of which are now in construction. These are delivering a wide range of local benefits, and have potential to deliver more as heat networks come online:

- HNIP is building relevant individual and organisational private and public sector capacity and capability in the locations it has supported (see A3 above),
- It has clear potential to deliver significant additional local benefits in support of local strategies such as regeneration (see A4 above), and
- TPHN and BEIS have had a material role in facilitating benefits delivery through their positive, proactive and responsive approach.

However, the timing, scale and scope of HNIP funding has been insufficient to achieve sustainable change to the heat network market.

### Local benefits beyond delivering heat

The perception of heat networks as essentially place-based projects delivering a range of local benefits is well supported. While most of the HNIP funded heat networks are not yet delivering heat, they are already delivering benefits. There is good evidence that the impact of HNIP locally has already spread beyond simply the introduction of pipes in the ground,

with skills development, local employment and the unlocking of regeneration schemes that would otherwise have taken longer to happen (see also A4 above):

*...we've seen examples of utilities and ESCOs running local apprenticeship schemes, we've seen local adult educational colleges running courses to re-train Corgi engineers from fitting gas boilers and servicing gas boilers, through to installing and servicing heat pumps or in a heat network context, installing and maintaining heat interface units. (Other)*

*I think the local benefits, the place-based benefits have been really fantastic. We don't talk really enough about the role heat networks will play as a driver of green jobs, when you start thinking about place and communities, that snaps into focus, crystal clear. (Other)*

In the longer-term benefits anticipated include low-cost heat, better energy security, social funding, better quality, more resilient homes.

*A heat network ultimately is a place-based investment so whilst a certain proportion of the civils will potentially be delivered by wider UK and possibly international, it's still very much an investment that is local and has very local impact, bringing about local benefits. (Other)*

## **Maximising the potential of place-based impacts**

Participants identified a number of ways delivery of place-based benefits could be facilitated, including:

- Aligning heat network delivery with other priorities and plans
- Working with communities
- Private-sector projects working closely with LA hosts, and
- Use of social impact requirements in procurement processes.

### **Aligning heat network delivery with other priorities**

In 'A4: Working with and within local strategies and plans', above, we saw that heat networks can support delivery of local strategies addressing a range of local priorities. This is enabled by a benefits led approach and careful planning to join up strategies and align works. This is facilitated in unitary authorities, and where there are strong influential local enterprise partnerships (LEPs).

*Any new heat network has the power to deliver improvements in a place for communities, I think it only does it in a way that is truly impactful and measurable, if you set about it with impact intentionality there, we're not just building a heat network in the hope that it does all these things, we're going to start benefits first, what projects locally will yield X jobs on this timeline, save this amount of carbon, take this number of people out of fuel poverty, I think if*

*you start with what you're trying to achieve, then you can do all those things.  
(Other)*

*... when there are transport works involved quite often you get those restrictions of saying you're going to dig the roads up now so you can't dig it up until 2030. ... So that instantly brings together this idea of not only are you doing the heat network project but you're doing that within the context of other works that are going on. (Project)*

### **Working with communities**

In some locations, it has been important to work very closely with the local community, going beyond getting necessary agreements in place, to understanding the community and recognising and responding to local sensitivities and different information needs.

### **Use of social impact requirements**

Social impact requirements included in procurement processes can 'lock-in' social benefits for residents:

*But what we've also said, and now our members have agreed, is that half of that [...] return goes straight back into a social fund for those residents of those homes served by district heating such that it can help fund [...] things that would directly benefit those residents going forward. So it's very much about that kind of social dividend as well from our perspective. (Project)*

### **Private-sector projects working closely with LA hosts**

The emphasis on working with local plans and priorities and recognising local restrictions and sensitivities, emphasises the need for private-sector sponsors to work with LA hosts to maximise benefit:

*... for those private-sector projects there needs to be that engagement with the local authority to say actually is this suitable, and how do we work together? So I think naturally that forms that conversation to say we're working with you on this, but how does it fit in within your wider works? And I suppose a lot of those private-sector project sponsors offer services that are not necessarily heat network related but can also help with those wider regeneration works. (Other)*

### **The role of TPHN and BEIS**

There is strong support for the proposition that TPHN and BEIS's responsive and supportive approach has been successful in melding the Government's national priorities and objectives from HNIP with local priorities [see 'A4: Working with and within local strategies and plans', above].



## Looking forward

### Approaching a tipping point – but more is needed

In complexity theory terms, there is some evidence that HNIP, acting in a context where there is increasing emphasis on carbon reduction, environmental, social, and governance goals and place-based investing, has helped to bring the system close to a tipping point.

*[...] I think things are going to switch quite quickly actually in terms of gas now, maybe people are starting to question, “gas isn’t as cheap as it used to be”, which is the usual argument and the short termism might be not as much of a challenge. (Project)*

National initiatives are providing additional support and motivation through the Future Homes and Buildings Standards, the development of enabling regulation and zoning (see next), and development of the CP1 technical standards.

We have seen more evidence from projects that attitudes are changing and that the green credentials of schemes are becoming more important:

*We find now as developers, when we’re attracting investors, sustainability is hugely important, they want green credentials and that’s a new thing, I’ve only started seeing that in the last two years but if an investor’s got two options and one is an incredibly green scheme, they will now always take the green scheme. (Project)*

While HNIP is delivering local benefit from funded projects, the scale of HNIP is insufficient to make a difference in terms of generating a growing, sustainable market:

*...it needs that grant to get things established, show everyone it’s not as scary as we think it is, and then I think the public sector will invest, but I don’t think we’re going to get from HNIP ending to this self-sustaining heat network model, I can’t see it. (Project)*

*... [the lack of] other essential building blocks [such as zoning, means that] HNIP has perhaps created heat networks that may not have an enormous potential to expand. May not be laying the framework for the really big expanding projects that we need to see, for example. (Project)*

There is clear recognition in BEIS that HNIP has not achieved some of its original objectives. The GHNF business case says:

*The objective of HNIP was to create a self-sustaining heat network market that does not require direct Government subsidy [...] A key lesson learned is that HNIP aimed to realise too many benefits, which were challenging to deliver in a nascent market.*



The department recognises that more is needed, including:

- Strengthening of the enabling policy and planning frameworks, and
- Leveraging the value of HNIP outputs and outcomes into the wider market within the broader HNTF – Sections B and C address this.

*One of the original aims of HNIP, for example, was a sustainable market for heat networks. Well, I think experience has shown us that HNIP couldn't do that by itself. It has provided the kick, but you also needed the suite of other things like the market frameworks, zoning, regulation, and also something to push. [...] It's more than one thing, so I think HNIP has done an amount, but other interventions and also greater market involvement is needed. (Other)*

### **Strengthening the enabling policy and planning framework**

The delivery of critical system-enabling policies, alongside initiatives such as GHNF, may push the system into a new equilibrium, with heat networks playing a much greater role in delivery of heat, alongside other low carbon solutions. Changes to the business rates have already been announced; zoning and a suitable regulatory framework that places heat networks on a level playing field with other energy sources and rebalances energy prices, are under active development. These are seen as very positive developments. Zoning is particularly welcomed as a way of reducing demand risk and enabling expansion. Other measures suggested have included: Government loan guarantees, and creation of a national heat delivery body. Once a stronger policy framework is realised, then the risk profile and economics become much more attractive and investors more likely to consider heat networks.

Zoning is particularly welcomed as a way of reducing demand risk and enabling expansion. Investor judgements on where and how to invest in heat delivery, as infrastructure investment, could be influenced by zoning:

*... if you applied zoning across the country, you would be able to ... say perhaps the best band savings, the most efficient, the cheapest energy costs, are not from a heat network, and it gets the answer. Once there's an answer there's clarity, and if there's clarity there's going to be a heat network or a heat pump zone, the relevant private-sector companies can prepare, they can build up supply chains in that area, they can train people in that area. Because right now it's difficult. (Other)*

More standardisation is required to enable moves to scale by connecting networks, and this may require planning rules to change to enable e.g. siting of energy centres, pipework and planning regulations:

*It needs to be a bit more standardisation across the board with this, because at the moment there's lots and lots of private companies jumping on with new technologies, new control systems, there's hundreds available out there,*

*some are good, some are bad. But I think there needs to be some approach to making it a fairly standard system that anybody can plug and play into.*

*Also with pipework, if it's not viable to run pipes in streets, because London's obviously very complicated for that, you may have to see them running on the surface. It's not a pretty thing, but other cities have done it, they've put pipework down a road. They have to incorporate it into something so it's architectural, but you may have to see some of these district networks running above ground to alleviate the problem of digging holes in London. So rather than say we can't do it because we can't dig down your street, we can do it, but you're going to have to accept it's going to be bolted to the front of a building somewhere. (Other)*

### **Leveraging the impact of capital support schemes**

HNIP has been able to work well with local strategies and plans to deliver both decarbonisation and broader place-based benefits. Future schemes could learn from this, encouraging a benefits-based, place-based approach:

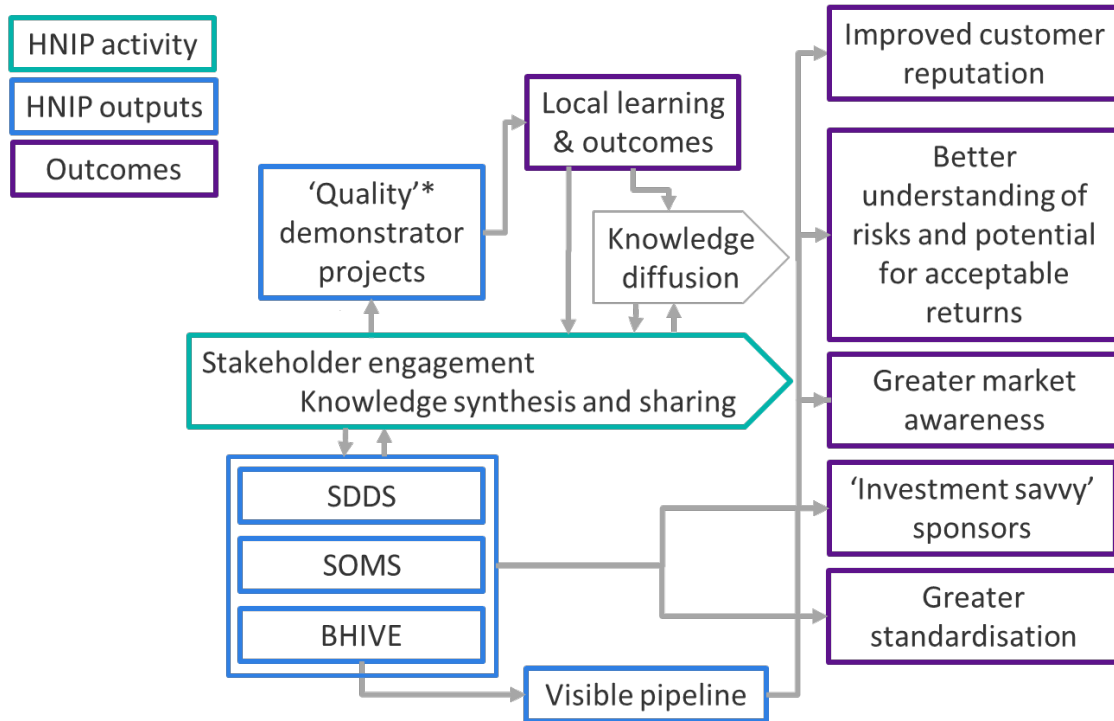
*I think if you think of DLUHC as leading the charge on this kind of approach and BEIS being among the frontline departments responding to that, then I think you've got something really powerful. (Other)*

*There was a really interesting Friends of the Earth study recently looking at, I think they called them heat or energy hotspots, they were trying to identify areas where there was lots of power usage, leaky buildings and areas that were more likely to be affected by localised poverty and things. They picked these off and you say, "This is golden, this is our addressable market", not just for heat networks but for other kind of solutions in time. Everything in the context of a place seems to be sensible. (Other)*

*I think so [a bigger place for place based factors in future application assessments]. The "what else are you doing"? Where does this fit into your local area or energy plan? We ask people to provide chapter and verse on the heat network in isolation and we don't really look beyond the red line boundaries of the scheme they're building out. (Other)*

## B: The impacts of HNIP projects and products on the wider market

**Figure 15: Focus of this section of the findings**



**The TOC narrative:** HNIP builds the capability and capacity of the market by:

- Providing a diverse body of projects that demonstrate the viability and investability of heat networks, showing for example: the feasibility of innovative solutions (e.g. new heat sources or situations), heat networks potential to expand, develop diverse heat customers (beyond anchor loads, and not just in dense urban areas), and connect to multiple diverse heat sources.
- Delivering/catalysing greater standardisation of commercial documents and reducing costs, leading to more investable heat networks (through for example the standardised due diligence sets (SDDS), the Sales, Operating and Maintenance Set (SOMS), and the BEIS Heat Network Investment Vehicle (BHIVE),
- Providing better visibility of a growing pipeline (e.g. through BHIVE), and greater awareness in the market.

HNIP has funded a diverse portfolio of projects. In this section, we describe five ways in which this portfolio and HNIP products are influencing the market. We consider this under the following headings:

- B1: A diverse project portfolio enable learning

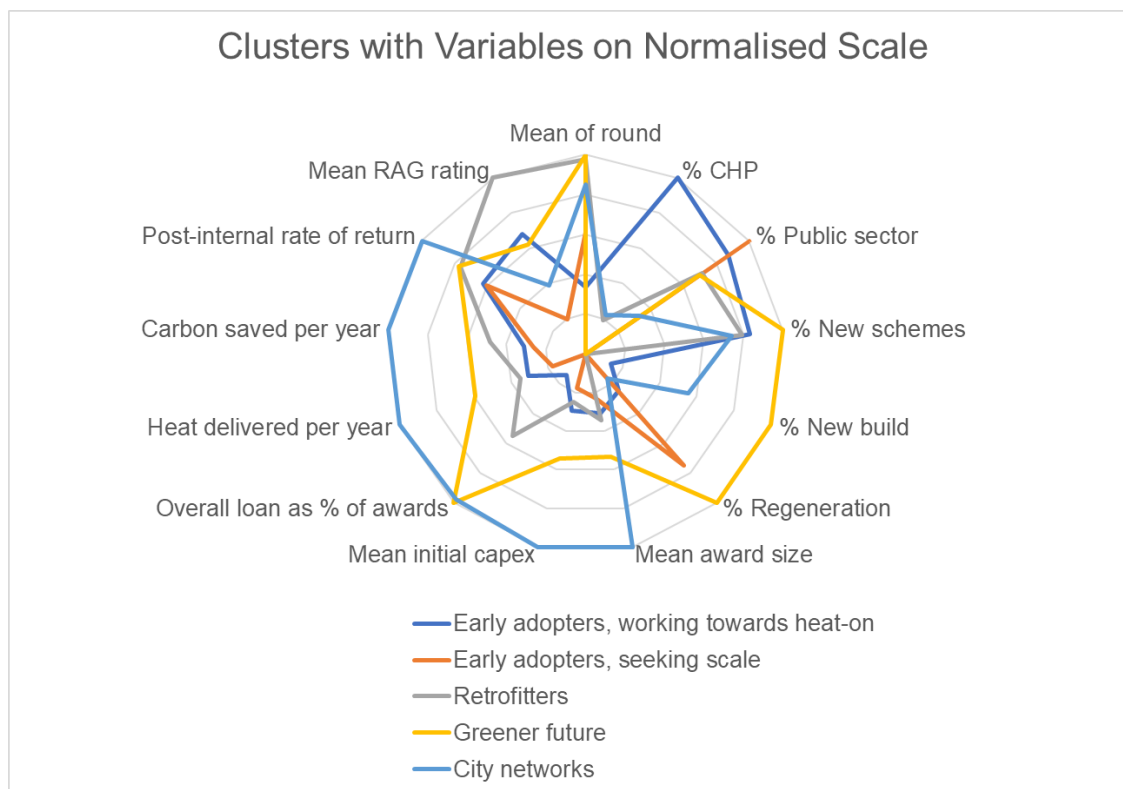
- B2: Projects demonstrate viability and investability
- B3: HNIP products can help tackle market barriers
- B4: Synthesis of lessons and communication supports wider awareness and engagement.
- B5: Understanding HNIP’s strategic impact

Before presenting the findings, the following section describes project diversity in the HNIP context.

### Portfolio diversity explored through cluster analysis

As part of the exploration of what is meant by project diversity within the HNIP context we have carried out a cluster analysis of the funded projects. This is described in ‘Appendix 5 An exploration of project diversity – Cluster Analysis’. Cluster analysis is a well-established statistical method used to identify different groupings in a data set. Items within a group (or cluster) have a higher measure of similarity to each other, than to other items in other clusters. We used this method to group similar HNIP funded projects. We began by looking for ‘ideal’ types, i.e. well defined groupings, whose members were clearly distinct from the members of other groups and represented identifiable project typologies. The extent of project diversity however made this impossible. Instead, we identified five reasonably distinct clusters, but within the clusters much diversity remains:

**Figure 16: The Five-Cluster Model of HNIP-Funded Project**



The absence of ideal types tells us something about the extent of variability and diversity in the project portfolio, but does not allow us to provide easy predictions about the types of future projects that may arise. The clusters do provide us with a way of illustrating some of the diversity within the HNIP portfolio. We were also able to check that our interview sample included examples from across the five clusters.

The clusters, described in detail in the appendix, are summarised here:

- **Cluster 1: Early adopters, working towards heat-on (8 projects)** - predominantly public sector led projects from the earliest round of HNIP, with heat derived primarily from CHP sources. The heat networks are generally new schemes. Despite being some of the earliest projects to be funded, progress of these projects has been relatively slow.
- **Cluster 2: Early adopters, seeking scale (4 projects)** – projects in this cluster are characterised by public-sector organisations seeking to extend existing heat networks, serving both existing buildings and new properties with a focus on regeneration. Heat is from lower carbon energy sources (EfW and heat pumps) and all funding is grant-based.
- **Cluster 3: Retrofitters, working in communities (7 projects)** – projects in this cluster were predominantly based on heat pump technology and dominated by new schemes sponsored by the public sector, but to supply existing buildings rather than regeneration/ new developments. Local communities are very important to these schemes.
- **Cluster 4: Greener Future (10 projects)** – the projects in the cluster are mostly projects from later rounds, with EfW and heat pumps as the only heat source, primarily public-sector sponsors with new developments and regeneration as the focus for the end users of the schemes.
- **Cluster 5: City Networks (6 projects)** – projects in this cluster are dominated by very large schemes, often with private-sector sponsors, with heat supplied by EfW, taking large amounts of heat to both existing and new premises. Funding provided by HNIP to projects in this cluster often takes the form of loans rather than purely grant funding.

Case study exemplars of these clusters are given in the Appendix 5.

## B1: Diversity of funded projects enabling learning

### Overview

The portfolio of funded projects is very diverse, as illustrated by the cluster analysis results. This diversity has been beneficial, providing a wide range of knowledge and applied expertise. The portfolio offers clear potential for proof of concept and learning around a wide range of different technologies and settings, ownership, management, commercial and governance arrangements, policy design, developing networks strategically and at scale, wider benefits, such as contribution to grid balancing, and the barriers and risks associated with low carbon heat projects.

While the diversity of the portfolio is seen as providing rich knowledge, it could be too varied and too small to point to any particular approach being more applicable to a particular context. However, the variation in project contexts, would make this extremely difficult if not impossible.

To fully realise the potential of the portfolio its learning needs to be captured and communicated effectively (this is explored under Section 'B4: Synthesis and sharing of lessons and communication to support wider awareness and engagement', below). The opportunities for learning offered by projects that were not funded should also be explored, for example did they receive funding from elsewhere.

### Learning by doing

Portfolio diversity delivers 'learning by doing': An understanding of the type of learning available and how the data produced by projects can be used was provided by this respondent:

*... it can start to influence things like zoning, technology selection, what kind of buildings need to be connected. (Other)*

- **For projects**, the diversity ranges from off gas community projects through to multi-site, and expandable, urban networks, and is providing valuable exemplars of viable heat network solutions.
- **For BEIS and TPHN**, the diversity allows deeper learning to be derived and shared by looking across different funded project settings.
- **For BEIS**, the diversity has helped understand issues on the ground and develop policy to address these – for example around zoning and regulation. In addition, it can inform policy on which aspects of heat network development should continue to be government funded.

The learning potential from the portfolio diversity is greater than the sum of its parts, the individual projects. While there are many differences, we can see that projects share many common components, but for contextual and temporal reasons, the configuration of these components varies.

*[Across the projects] ... I guess the Lego blocks were very similar, (but) ... the way they were working through their challenges was always very different because those challenges were different from project to project. (Other)*

The project diversity provides an opportunity to extract and learn from these different strands. Learning and knowledge strands we suggest are evident in the portfolio are introduced in Appendix 6.

### **Five contributors to portfolio diversity**

The origins of the diversity of funded projects can be explained in five ways – each of which generates opportunities for learning:

1. **Place-based and multi stakeholder:** Projects coming to the market have been prompted by the locality focused opportunities offered by HNIP leading to diversity derived from varieties of contexts and configurations underpinning the funded projects. Local ambitions are being realised via networked decarbonised heat for significant local projects and developments.

*The climate emergencies have all been announced ..., but (all of) these towns, cities and regions, (have) very different agendas, challenges and barriers that they have to work towards. (Other)*

2. **The nascent UK heat network market:** The market is developing through diverse strands and approaches. Some projects have a distinct ‘start up’ feel to them where heat relevant decarbonisation technology is being developed and used by a Local Authority for the first time. This brings with it novel infrastructure development, partnership, and procurement experiences.

*I think the pre-existing market was less representative of the future market than the market that HNIP has stimulated ... there’s definitely many more projects and a much wider range with different risks and issues. (Other)*

3. **Delivery Partner (TPHN) agency:** The practice, versatility, and adaptability of TPHN in enabling diverse projects to be realised via a thorough, competitive, detailed and consistent framework for assessing applicant projects and steering them through commercialisation.

*It’s designing schemes like this with the flexibility to acknowledge and value learning, that were different to those that were originally sought going into it (and avoiding) what good looks like, to be locked on Day 1 (Other)*

4. **BEIS adaptability:** BEIS altered the scheme in response to emerging experience. For example, in round 7 the loan requirements were changed by BEIS and TPHN to increase their commercial attractiveness. Later rounds saw a greater take up of loan offers and projects with a higher median level of capital budget than in earlier rounds.



*Most of the early public-sector projects, they provided finance to the project but raised from PWLB [Public Works Loan Board], raised from the public sector purse. I think the fact that a lot of projects, including public-sector projects now have more commercially based loans in them, is helping to shift that mindset. (Other)*

5. **Greening of the energy market:** Factors such as: declarations of Climate Change emergencies by sponsoring local authorities; improvements in non-fossil fuel technologies; a broader commercial, stakeholder and investor commitment to a greening of the energy market have influenced the shape of the portfolio

## Looking forward

The portfolio offers significant opportunities for learning. We have identified some examples of learning strands that could be taken from the portfolio. These are presented in 'Appendix 6 Learning and knowledge strands'. Examples include:

- **The dual goals of decarbonisation and network expansion:** The portfolio provides valuable worked-through examples of how, and in what contexts, the dual goals decarbonisation and network expansion can be achieved. We note that HNIP examples of combined place-based strategies of multi-stakeholder decarbonisation and heat network development usefully anticipate zoning.
- **Moving to scale:** The HNIP portfolio provides exemplars for heat networks at very different scales and with very different aspirations, including: small off-gas communities without ambitions for going to scale, heat networks developing at scale, and heat networks working towards scale.
- **Getting and maintaining stakeholder engagement:** The portfolio provides valuable examples of engagement within the LAs, with council members, with partners (including ESCOs), with customers (particularly anchor load customers), with the supply chain, and in some circumstances with end users (consumers of heat).
- **Different procurement, commercial and investment models:** A recognised gap in skills, knowledge and guidance is the lack of public sector knowledge, experience and expertise in relevant procurement, commercial and investment models. The HNIP portfolio potentially provides a rich knowledge base to inform this.

To fully realise the potential of the portfolio, learning needs to be captured and shared effectively. This requires:

- **Continuous tracking of the performance of funded projects over time:** This would provide answers to the question of which emergent benefits are strengthening in relevance and value for future heat network development. Data sharing between TPHN and BEIS has been poor, and although we can now see



signs of improved collaboration, more efficient and effective ways of collecting and sharing data are needed.

- **Continuous synthesis and sharing of project performance lessons with the wider heat network market:** Embedding the learning within the heat network development system by creating a pathway and framework for the continuing deployment and development of knowledge.

We return to this under B4 below.

## B2: Projects demonstrating viability and investability

### Overview

HNIP projects provide knowledge of what viability and investability means in the context of heat network development, and, particularly in the local area.

As exemplars, their potential to help build awareness of, and confidence in, heat networks and their potential to deliver a range of benefits is recognised. This is especially the case where there are innovative aspects relevant to the local context. However, this still does not appear to be widespread. While we have found some evidence of learning and capacity building spreading beyond the immediate project, and of HNIP projects sparking interest outside the immediate area, we did not find evidence of concrete impact.

While our interview sample was too narrow to properly test this, we would have expected to see more projects reporting wider contacts.

A key limitation is that most of the funded schemes are not yet fully operational, so concrete evidence of their value is limited. Because of this, this section considers mainly potential viability and investability.

### What is meant by viability and investability

#### Viability

We can see three types of **viability** demonstrated by HNIP projects:

- **Technical viability** – Covering a range of different contexts and heat sources while meeting heat delivery and carbon reduction targets.
- **Local acceptability** – Strong acceptability among stakeholders and potential beneficiaries.
- **Business case viability** – Covering delivery to budget, income projections, identifying and meeting demand, IRR targets, sustainable partnerships, commercialisation and procurement. This is closely linked to investability.

Viability changes over time. For example, the early period of HNIP saw CHP as a viable transitional vehicle for carbon reducing heat networks. The later period saw an increase in

heat pump and EfW solutions with a diminishing focus on CHP as ideas about viability developed in the context of net zero ambitions.

### **Investability**

In the heat network context **investability** is governed mostly by factors driving the emergent market rather than by HNIP. HNIP and policy developments influencing investability of HNIP supported projects include:

1. Market development and support products (e.g. SOMS, BHIVE, SDDS) enabling access and promoting standardisation.
2. Expansion of ESCO and stakeholder engagement and investment across the funded portfolio
3. Projects acting as demonstrators
4. Policy developments such as zoning and regulation that e.g. manage demand risk
5. Funding of the commercialisation phase.

Potential types of investment in HNIP projects include:

- Central government investment via HNIP, GHNF and the Public Works Loan Board
- Local Authority and ESCO investment and stakeholder investment for example via housing development and regeneration projects.
- Supply chain investment, other than by ESCOs - this is less apparent within the HNIP funded projects
- Third-party investor investment including green investors.

Different types of investor have different requirements from investment. We were told that local authorities can accept long term, 40 year plus, timescales to generate returns. For private investors, the picture is different, the investability of a heat network will depend on a number of closely related and interlinked factors affecting scalability, risk and rates of return.

The long timescales to generate returns and the low level of returns, coupled with high risks and uncertainty, e.g. around heat demand and scale, generally make heat networks less attractive to private-sector investors than other similar infrastructure investments.

*But the main things in my opinion are the demand risk and the lack of clarity on deal flow. What we often see in Europe is secondary capital markets, we see pension funds setting in, buying £100m worth of various portfolios of heat networks. Pension funds as you know seek an annual cash yield of 5/6%, depending on who you're talking to. That's why the clarity of demand is crucial. The clarity of deal flow is more important in the UK because at the*

*minute it's, what, 2-3% of the market. If you want to get pension funds involved you need to have much bigger scale. (Other)*

The costs of commercialisation, during which many uncertainties can be resolved, can also inhibit investment, making HNIP funding for this stage of the project particularly valuable.

Another factor often cited was the lack of consistency and standardisation in terms of financial structures, standards, contracting and due diligence is important across investment opportunities. The diversity of funded projects may have partially masked investment attractiveness. The SOMS, the SDDS and BHIVE are designed to raise the consistency of how information is presented to investors (see Findings 'B3: HNIP products helping tackle barriers to market entry', below).

*The big issue at the minute, which HNDU and HNIP have been trying to work towards, is that standardisation aspect. Because if I come in as an investor and I can get ten [heat networks] across the country, Manchester, Leeds, Nottingham, London, and I can stick them on a financial model, all the contracts are very easily comparable, I'm basically looking at one project times ten. (Other)*

The opportunity to invest with a whole entity also increases investability, reducing the number of interfaces that must be negotiated and managed, the cost and complexity of this, and allowing scale to be established more rapidly.

Among third-party investors there is strong acceptance that green investment is becoming mainstream, but that HNIP supported projects are not sufficiently developed or uniform in structure to attract them at this stage.

A key issue for investors has been the lack of a strong policy framework. Changes to the business rates, already announced and zoning, now under active development, are seen as very positive developments. Zoning is particularly welcomed as a way of reducing demand risk and enabling expansion. Other suggestions made to us have included government loan guarantees, action to rebalance energy prices and creation of a national heat delivery body. Once a more strategic, whole system, framework is realised then the risks and economics would become much more attractive and investors are more likely to consider heat networks.

Finally, an important element of the theory of change was HNIP's role in empowering heat network sponsors to shape investable projects and plan appropriately for investment. Prior to and during commercialisation, a significant activity for many heat network sponsors will be deciding on an appropriate way to structure the project in terms of governance, ownership/partnership, operating and delivery models. The choice of model has an impact on how they can meet their own and potential investors' goals. Project sponsors need to understand the different investment models and how these relate to different operating models and to the delivery of benefits.

*For me I think it starts with empowering whoever's developing a project to understand what the benefits of those projects are, and what the kind of range of delivery models will enable them to deliver those benefits. I think if you get that right, and whether that's through HNDU, consultants or whoever, it better enables those projects to go actually, as long as I'm delivering benefits one, two and three, I don't care whether it's me investing or a variety of different investment models. (Other)*

This is still an area where progress is needed. BHIVE (see Section B3: 'BHIVE') is one of the main vehicles designed to address this.

### **HNIP projects' demonstrating viability and investability**

HNIP funded projects are addressing many of the viability and investability challenges associated with heat networks. Projects we interviewed said they saw clear demonstrator potential, especially where technology or settings was seen to be innovative, for example, the use of mine water from disused coalmines, and the development of an off-gas community heat network, demonstrating heat networks as a viable option for fulfilling Climate Change Emergencies and providing 'Levelling Up' opportunities.

*There's definitely a role for heat networks in my opinion [for demonstrating viability and investability]... the capital costs of putting in the heat networks is proportionally much lower than the energy costs used to be when gas was cheaper ... now we're seeing that's changed. [Also] because it makes it even more vital to use waste heat sources and I think waste heat sources are incredibly valuable and need to be utilised and the heat networks are almost always the best way to do that. (Project)*

There is some limited evidence from our interviews of projects attracting interest as demonstrators beyond the local area, especially where there are innovative aspects. An example is HNIP projects attracting interest from Denmark, with a longer history of widely established fossil fuel (1<sup>st</sup> generation) heat networks. However, learning beyond the local area still does not appear to be widespread. We have found some evidence of learning spreading beyond the immediate project, and of HNIP projects sparking interest outside their locality, but we did not find evidence of concrete impact. Projects look for knowledge of what is viable from beyond the UK, from consultants, and from partners such as ESCOs (see also Section 'A3: Building local maturity, skills, and knowledge').

The lack of direct evidence from interviews of projects acting as demonstrators may, however, not be surprising at the current stage of project development and our interview sample was too narrow to properly test this. However, we had expected to see more projects reporting contacts from outside their locality or region.

A key limitation is likely to be that the funded schemes are mostly at early stages, so concrete evidence of their value is limited. Evidence of actual costs and performance is

important to investors and sponsors, and this is sparse. Many customers still need to see pipes in the ground to provide confidence supply will be available. Consequently, much of the discussion here is about potential viability and investability. As projects move through the construction phase, the extent to which they are meeting forecasts will tell us more about how investable they are.

*I think through one lens you would agree with it and you would say at the moment, we don't have the learning around scheme deliverability that we'd like to. That's not just a performance of technology, that's the propensity of buildings to connect in future and lots of those things won't be learned until these schemes are built out. (Other)*

*We need to give it a little bit more time. Because for me, that ... needs to come from when these projects are operational and delivering heat at a steady state of kind of normal. (Other)*

*I think the HNIP process has created the conditions to test the commerciality and examine it and then report on it, and then build that investment case. I don't think we've proven that it's investable yet. (Project)*

*whilst we haven't got the learning yet because they're under construction, we will get that learning [once they are operational] (Other)*

## **Looking forward**

The HNIP portfolio again offers opportunities for learning. 'Appendix 6 Learning and knowledge strands', includes examples of learning strands relating to viability and investability.

A particular learning strand identified is around the different procurement, commercial and investment models available, their respective strengths and weaknesses, and how the choice of model has an impact on how they can meet their own and potential investors' goals. This is a recognised gap in the knowledge base.

BEIS (and other stakeholders) could also use learning from HNIP to contribute to knowledge of heat network market segmentation (see Section C3: 'Looking forward' below). This knowledge could inform future interventions. It is also acknowledged that some segments (e.g. rural off-gas) will require government funding support for the foreseeable future (see Section 'A1: Bridging a funding gap' above).

As for Finding B1 above, to realise the potential of the portfolio, its learning needs to be captured and communicated effectively (this is explored under 'B4: Synthesis and sharing of lessons and communication to support wider awareness and engagement', below).

## B3: HNIP products helping tackle barriers to market entry

### Overview

To enable the commercialisation and market presence of HNIP projects, TPHN and BEIS have introduced three products:

- **SOMS** – Sales, Operations and Maintenance Set. This is a suite of template heat contracts for use by anyone involved in a district heating scheme.
- **SDDS** – Standard Due Diligence Set. An explanation of the technical, legal and financial due diligence requirements of project finance lenders and investors that enables the standardisation of due diligence across the project portfolio.
- **BHIVE** – BEIS Heat Investment Vehicle is a Dynamic Purchasing System (DPS) that allows public-sector heat network owners/developers in England and Wales to procure funding and funding-related services for their heat network projects from a range of potential funders.

They are outcomes from ‘learning by doing’ over the course of the project. The benefits of introducing these products were intended to be:

- Standardising how information is presented to the market – and improving their investability,
- Improving projects’ access to investors and vice versa, and
- Reducing costs.

Of the three products, SOMS appears to have most use and to have delivered the greatest benefit to date, but its late appearance (in February 2021) has limited take up. There is less evidence of SDDS use, but its use is being encouraged, for example, via BHIVE. BHIVE has engaged some investor interest.

### The SOMS

The SOMS had at the time of our analysis been of most value. There is evidence from those who have used it, that it has made their entry to the market easier. Others we have spoken to, who have not used it, recognise its value.

Its use signals knowledge, competence and standardisation on the part of sponsors during commercialisation and procurement. It is not universally applied often because some sponsors, for example ESCOs, have in-house suites of documents and processes. Others may have already gone a long way down the road of producing documentation before SOMS became available.

*[SOMS] hasn't been for us because we're a long way down that path already. We already have what we call a design and build contractor on-board. But undoubtedly BEIS funding gives the market confidence. (Project)*

Views from projects, BEIS/TPHN and others, where provided, are positive – suggesting clear potential for their use to save money, time and effort, ease contracting and improve transparency.

One respondent found SOMS to be a significant benefit in covering most of the contracting work leaving only a few details to be added:

*[We] recognised that SOMS really were a big value-add with only a few areas where we could improve, things like contracting with an energy from waste operator, ... we were told that it would be helpful to have a specific contract there. But not much else, ... it was very much “this one little area, if you could correct that”, so for me, that was a great outcome ... It’s one of the great outcomes of HNIP. [More so than] the standard due diligence set. (Other)*

## **BHIVE**

BHIVE is designed to improve projects’ access to investors and vice versa, and make a pipeline of projects visible. However, while our project-based respondents were aware of BHIVE and its purpose, we did not find from these any direct evidence of engagement with it. In December 2021, TPHN reported only one project had used the BHIVE portal, for pre-market engagement. They received a good response from the providers:

*They got feedback from every single BHIVE equity provider, which I would say probably my number one thing, I didn’t want anyone to come through the system and not get a great response, and they got some really detailed feedback, and that feedback was around what about the proposal was attractive and wasn’t attractive to the funders. (Other)*

While this demonstrates the potential for BHIVE, it is acknowledged that BHIVE has come too late to have much impact in the context of HNIP. TPHN and BEIS believe that progress is being made in engaging investors with the market and that BHIVE is potentially a useful tool to move this forward. This view has been endorsed by the investors we talked to, but reservations about its general applicability have been expressed, for example:

- Heat networks are seen as necessarily public sector and not yet suitable for private investment.
- The BHIVE model, one of competitive procurement, may not be appropriate where investors are wanted as active partners in the development of heat networks.
- Where ESCO’s are investing as active partners, they will not want to do this via BHIVE – although we are also told that at least one investor has engaged via BHIVE both as a heat network developer and investor.

One investor we spoke to is already providing primary heat network investment but not in the UK. It was suggested that a competitive framework such as BHIVE would not fully



address this need and that mechanisms to involve investors actively in specific projects from an early stage to enable these conversations may be missing. Absence of early engagement has contributed to little consideration of the possibilities of primary investment (outside Energy Service Companies (ESCOs)).

There is recognition that BHIVE alone cannot address all the barriers to investment. Among other things, the economics of heat networks remain challenging for investors – especially for primary investment in development of the heat network (see investability above) and there may be a perception that the sector ‘is not quite ready’, that the policy framework is ‘not quite right’ yet (see ‘Investability’ above).

One respondent welcomed the news that UKIB (United Kingdom Infrastructure Bank)<sup>59</sup> and GHNF will be aligning their investment criteria. In moving towards standardisation, the same respondent sees value in the UKIB working as a hub for investors for green investment thereby providing a ‘one stop shop’ for heat networks seeking investment<sup>60</sup>.

### **The Standardised Due Diligence Set (SDDS)**

The Standardised Due Diligence Set guidance<sup>61</sup> does not form part of the HNIP application guidance and is not required for an HNIP application. It is aimed at providing heat network sponsors and developers with a better understanding of the type of technical, legal and financial due diligence that project finance lenders and investors typically focus on. Where applicants are seeking to raise third-party funding, this guidance may be relevant to understanding the due diligence requirements of lenders and investors, and, thereby, being able to demonstrate as part of their application that they are able to meet those requirements. We did find evidence of the use or value of the SDDS. It was only raised by one interviewee. Its use is encouraged by BHIVE and we suggest that this could be explored further in the next round of evaluation activity.

### **Looking forward**

Themes include:

- Continued development of the BEIS/DESNZ partnership with UKIB to improve and standardise heat network access to investment
- Investigate market penetration of the HNIP products

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<sup>59</sup> The UK Infrastructure Bank is a British state-owned development bank. It is intended to help with the UK Government's plan to reach net-zero carbon by 2050 and to support economic growth in regional and local sectors across the United Kingdom.

<sup>60</sup> The UKIB BEIS partnership means local authorities applying to the government's Green Heat Network Fund (GHNF) can now access lending from the Bank at preferential rates on the basis of the same application information submitted to the GHNF grant funding scheme. <https://www.ukib.org.uk/news/uk-infrastructure-bank-partners-beis-support-growth-local-low-carbon-heat-networks> 2012/22

<sup>61</sup> Guidance Note: Creating a Standardised Due Diligence Set (“SDDS”) for Heat Networks, page 2. <https://www.gov.uk/government/publications/standardised-due-diligence-set-sdds-for-heat-networks>



- Continuously improve SOMS with learning captured from projects, including adding more relating to partnership/ownership/commercial models when possible
- Facilitate free access to SOMS relevant advice for public-sector heat network sponsors.

Prior to and during commercialisation, a significant activity for many heat network sponsors will be deciding on an appropriate way to structure the project in terms of governance, ownership/partnership, operating and delivery models. It is important that those sponsoring heat networks understand how the choice of model has an impact on how they can meet their own and potential investors' goals.

## B4: Synthesis and sharing of lessons and communication to support wider awareness and engagement

### Overview

A considerable body of knowledge and learning by doing has been developed within TPHN and its partners. It is passed to and between projects during application, commercialisation and early development stages.

This knowledge is of continuing value to heat network and related infrastructure net zero development and investment. To fully realise value from HNIP, more needs to be done to ensure the knowledge and lessons are identified and communicated effectively to the market and that products reach the intended audience.

TPHN communications and engagement activities are welcomed, and events are well attended, but not all funded projects are aware of them. More needs to be done here to ensure learning is received and understood. Both targeted knowledge capture and dissemination (via HNIP events, the TPHN website, coaching of GHNF applicants etc), and network building and maintenance (to support knowledge diffusion<sup>62</sup>) are important.

The knowledge and experience of champions, and of sponsors some of whom may only set up a heat network once, needs to be captured and recorded. Learning needs to be synthesised from across the portfolio, and made accessible to the market and to government, so that it can inform future policy development and net zero infrastructure planning. Systems (and responsibilities) are needed for the continuous capture, maintenance and dissemination of that knowledge.

### Communications, engagement and awareness

Appendix 4, Section '4. Communication and engagement' looks at the process of communication and engagement. Here we discuss its impact.

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<sup>62</sup> By knowledge diffusion, we mean the gradual building and spreading out of knowledge via people involved in funded projects.

It should be noted that findings here are set against a backdrop of changing attitudes to environmental, social, and governance (ESG) objectives and decarbonisation within that, and the development of policy in this area, which will also have influenced the market.

### **Project awareness and engagement**

Here is one project respondent's view on knowledge transfer:

*We don't really have a lot of visibility about what's going on in this real diverse spectrum of projects, we're not getting the learning from it ... but our professional advisors probably are because some of them are working on some of these projects. So some of it's trickling through and we are benefiting but I wouldn't say there's this wider network and this great amount of knowledge sharing running across projects. (Project)*

Knowledge of projects comes from TPHN and other events, individual project initiatives, knowledge diffusion – knowledge passed to and between projects during application, commercialisation and early development stages. However, the demands of getting the project underway were sometimes so all-consuming that little time was available for finding out about projects elsewhere.

The TPHN website holds details of at least 36 HNIP events and seminars ranging between information and guidance events for applicants, subject specific events (e.g. BHIVE, procurement), and 'Meet the Project' events. Not all of our respondents were aware of the events, but those who were welcomed them. Feedback collected by TPHN from attendees has been good (see Appendix 4: Section 4: 'Communicating project exemplars').

Individual initiatives included personal contacts and events:

*We've had contacts with lots of local authorities, we've spoken at many events, both virtually and in-person. I've got no evidence [of what that resulted in]. (Project)*

*There are a number of HNIP projects that we interface with, but it's contacts we've made ourselves rather than BEIS necessarily introducing people. [But] ... I think they could be doing more network events because there's lots that we can learn from one another in a more structured way, if I try really hard to find the time, I'm super busy. (Project)*

BEIS and TPHN feel that the changing quality of engagement with potential sponsors and suppliers since the main scheme launched, suggests a maturing, more knowledgeable market.

### **Investors**

As noted above, a key target audience for HNIP is third-party investors. Engagement activities with investors have continued throughout the lifetime of HNIP.

Latterly, most investor engagement has revolved around the BHIVE investment vehicle. This has resulted in a small increase in investors signed up to BHIVE. Numbers signed up to BHIVE remain small (see Appendix 4: Section 3: 'BEIS Heat Investment Vehicle (BHIVE)').

Green investment is a strong objective in the investment community, and, despite some engagement via BHIVE, the projects appear to be insufficiently developed or scaled to generate a sufficient volume of active investment from third-party investors. The potential of heat networks for investment is however recognised and is anticipated:

*I think the investment potential is really significant. There's an understanding now in the scale of the opportunity and that's interesting enough in of itself, as I say there's a huge appetite for investments that have all the characteristics of a really well put together heat network project. (Other)*

ESCO investment via HNIP has grown considerably during the last three years of the project (more details in Section 'C2: Greater ESCO involvement' below).

*In terms of investable propositions, another thing we've seen is some large scale commercial projects come in, of which I suppose the highlight of that is (an ESCO led development) which is an interesting one because it's going to be one of the biggest heat networks in the UK when it's built. (Other)*

As well as personal networking, events remain a key mechanism for engaging stakeholders. It was a requirement of the scheme to hold an annual investor conference, and this, and the investor webinars conducted under the HNIP brand during lockdown, were well attended.

The four BHIVE events held between February 2021 and the latest BHIVE badged event in March 2022, saw on average, 70 attendees signing up for each, though not all will have attended. One hundred and fifteen people signed up for the latest event: BHIVE – Heat Networks Event. This event covered recent regulation and policy updates around heat networks, as well as sharing investors' perspectives on why BHIVE and public / private-sector heat network projects are an area of interest to them. Of the almost 90 organisations that signed up, less than 10% appear to be investors (excluding ESCOs), half of these were already signed up to BHIVE.

This perhaps reinforces the need for a more nuanced and targeted approach to engagement for this key stakeholder group.

### **Customers and consumers**

While HNIP communications have helped raise public awareness, customer and consumer awareness and engagement is still limited. Larger organisations, large commercial users, housing associations etc, may now be more aware of heat networks, but customers still need to see pipes in the ground to be confident that supply will be available.

## Public awareness

Both TPHN and BEIS feel that TPHN have been successful in promoting public awareness of the sector.

*I think actually we've seen a good uptick in all the things you might expect in terms of positive media coverage, greater penetration especially into the mainstream media and out of the trade press. (Other)*

## Looking forward

While individual learning for project participants is strong, more needs to be done to ensure learning is received, managed, and understood. This is not a trivial task.

*... certainly my personal knowledge on this is vastly greater than it was before so yes, I think HNIP are really important in this further development. I'd love to engage with them as this progresses and on how we expand that network. (Project)*

*... we've got to ... really think about knowledge transfer, it mustn't just be the mechanics of handing stuff back and handing files over and data over. We've surely got to find a way to decanting that knowledge in a way that's useful as well. (Other)*

Looking forward there are two challenges:

- If the value inherent in the project portfolio is to be fully realised, the challenge is to craft a coherent and practical system of knowledge from the diversity. This means getting beyond simply describing the projects, to an understanding of the broader knowledge they provide. This knowledge can then be used to inform market development and the contribution an expanding portfolio of heat networks can make to decarbonisation. This question of how to make use of the broader knowledge emerging from the HNIP portfolio was put to the final workshop participants. Although the challenge was recognised there was no single perspective on how to marshal and manage it as a resource beyond HNIP.

The introduction of SOMS is one example of how knowledge transfer via product development can be achieved. This could be extended into the creation of a series of knowledge products (e.g. addressing governance, partnerships, commercialisation, combining net zero ambitions with network development) that could be enhanced during GHNF and will have a life beyond it. We have made suggestions for learning strands in ['Appendix 6 Learning and knowledge strands'](#).

*We only really yield [the benefits of that knowledge] if we continue to track the performance over time and if we socialise those learning with important stakeholder groups. [For example] getting back out to the industry, how has the heat network performed in a rural (area) versus a city centre*

*[development] ... I think we should be doing some things thematically around priority areas for knowledge transfer, what are the silos that we can recognise, that we should be identifying [good practice] ... Is there something about the development, or trajectory, of things in the law or commercial agreements that underpin heat networks, that Lux Nova should be writing up and reporting back on? (Other)*

## B5: Understanding HNIP's strategic impact

### Overview

HNIP was founded with broad strategic intent - that it would be a one hit project for stimulating third-party interest and investment in heat networks. This was at a time when CHP was viewed as the primary transitional technology for decarbonisation.

Five years on much has changed. The heat network environment has developed and although some of it has been influenced by HNIP it has also been subject to major external influences such as greater climate change emergency awareness, and developments in the energy market, to name just two.

The government's approach to heat decarbonisation has changed and developed in response to these changes, and to learning derived from HNIP over the lifetime of the project. This learning has been captured, among other things, in GHNF and broader policy development.

HNIP has supported this process of learning and change by:

- Enabling BEIS and TPHN to respond effectively to the complexity, and hence change and uncertainty inherent in the green heat networks market.
- Schemes funded by HNIP responding to, and throwing a light on, developments in the market. This has provided useful learning including exploring the challenges of bringing EfW to heat networks, establishing governance mechanisms, and implementing 5<sup>th</sup> generation solutions.
- Demonstrating how national programmes can work effectively with local strategies and plans, enhancing local value and shining a light on how public funding for infrastructure development can usefully work with local strategies delivering locally negotiated solutions for a national infrastructure strategy.

These strategic learning mechanisms were not necessarily recognised and purposively built into the design of HNIP from the outset. They have emerged as a result of how the project and its delivery has responded to change.

The portfolio demonstrates several emergent strategic choices, including:

- HNIP integration with other components of the government’s decarbonisation strategy – to define a more realistic pathway towards a self-sustaining market:
  - Highlighting the need for, and information to inform, zoning and regulation
  - Selling the benefit of heat networks
  - Investor engagement via BHIVE.
- Combining:
  - National intent and ambitions for heat networks with place-based intent and ambitions, and
  - Abatement ambitions with network build-out ambitions, with possible primacy of network build-out.
- Management of the application gateway, adapting to the breadth, diversity and lower than expected number of applications to enable funding of a diverse portfolio – at the same time this raises questions about how strategic management of the gateway has been – is the helpful diversity apparent in the portfolio serendipitous, would a portfolio approach to management of the gateway have resulted in more optimal portfolio makeup?

One interviewee commented that HNIP may not be laying the framework for the types of projects that will have clear investment potential.

*[In the absence of] other essential building blocks [such as zoning means that] HNIP has perhaps created heat networks that may not have an enormous potential to expand. May not be laying the framework for the really big expanding projects that we need to see, for example. (Project)*

## Looking forward

While, it is acknowledged that features such as the market transformation features of GHNF do contribute to and enable key market developments such as zoning, regulation and supply chain strengthening, these aspects have but not, as yet, been incorporated within a system-based approach.

We suggest the following themes could be considered looking forward:

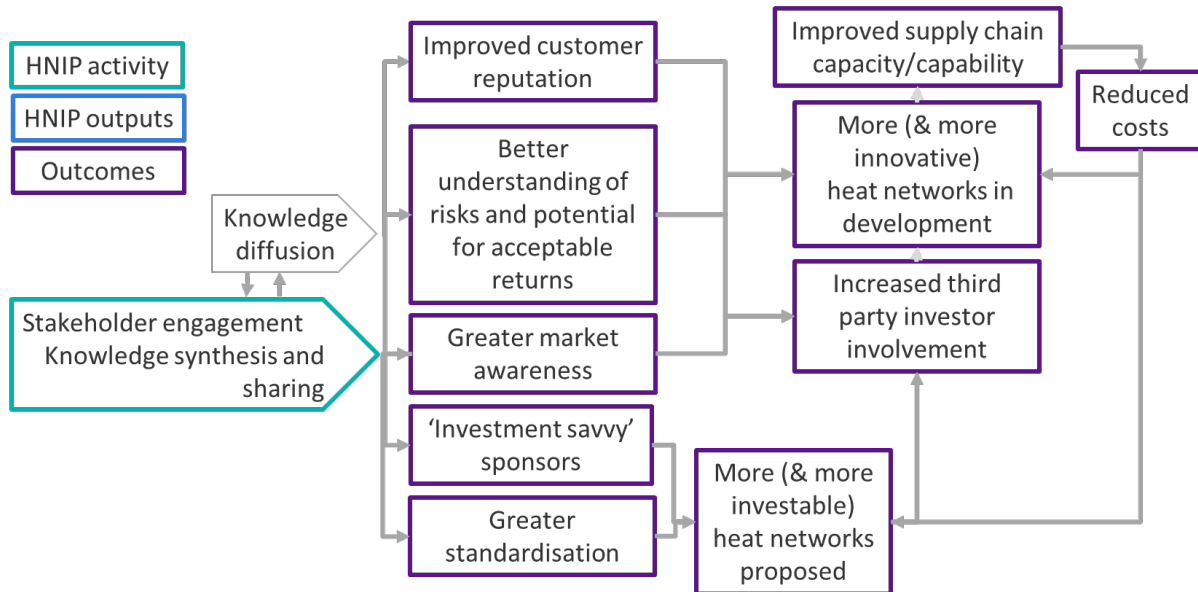
- Picking up the strategic lessons from HNIP for market development and integration of heat networks with broader net zero objectives:
  - HNIP is more about where heat networks fit in to decarbonisation and investment rather than being a stand-alone manifestation of policy.
  - BEIS could periodically step back and review the learning from HNIP alongside learning from other projects under the Heat Networks Transformation Programme (HNTTP).

- This should include, exploring with stakeholders the variety of pathways to district heating decarbonisation (i.e. the variety of components that could be part of a single, expanding heat network such as EfW, CHP, building insulation, 5<sup>th</sup> generation technology).
- To enable this, adopting a systems-based approach to future heat network project and programme design including:
  - Using and maintaining the ‘green heat network system map’ to identify policy needs and locate new policy proposals in the broader heat network landscape.
  - Developing a system-based TOC as a key step early in policy design.
  - Including formal risk assessment of the TOC to inform current scheme delivery and design of future programmes.
  - Integrating individual scheme evaluations should be integrated within an overall HNTP evaluation framework within which evaluation activities aimed at understanding the impact of each scheme can continue after the initial evaluation comes to an end.
- Establishing how HNIP learning can inform policy and practice for wider national projects delivering in a place-based way. This would include considering:
  - How national policy and practice can be designed to work effectively with local strategies and plans.
  - Whether and how the make-up of project portfolios can be managed to optimise opportunities for learning.



## C: The impact of HNIP on key market segments

**Figure 17: Focus of this section of the findings**



**The TOC narrative:** HNIP is beginning to build awareness among key market players, however, there is much still to be done to develop capability and capacity, build confidence and actively engage players with the market.

**In this section,** we consider engagement among key HNIP market players and the impact the project has had on this. We consider this under the following headings:

- C1: HNIP attracting interest among potential investors and sponsors
- C2: Greater ESCO (Energy Service Companies) involvement, but limited by supply chain constraints
- C3: The supply chain remains constrained.

### C1: HNIP attracting some interest among potential investors and sponsors

#### Overview

Overall, heat networks are not yet at a stage that will attract larger scale investment but HNIP sponsors (both LA and ESCO) have provided considerable ‘start up’ type investment. These developments begin to show ways of crossing the space between the already strong commitment to green investment among major investors and their direct engagement in heat networks. TPHN tell us that they are beginning to see positive signs through BHIVE of deeper investor engagement, and there is strong belief in potential investor attraction:



*I think the investment potential is really significant. There's an understanding now in the scale of the opportunity and that's interesting enough in of itself, as I say there's a huge appetite for investments that have all the characteristics of a really well put together heat network project. (Other)*

Going forward the task is to pick up those strands of investor attraction evident in current investment and described under Section B2: 'Investability' (e.g. standardisation, greening of heat networks, innovation) in the development of heat networks. In the following sections, we add some more detail to the emerging picture of sponsor and investor engagement, and the enablers and barriers to this.

### **HNIP building confidence in the role of third-party investment**

HNIP has helped create conditions that are encouraging to investors, but there is some way to go to build confidence, among both investors and sponsors, in a significant role for third-party private investors. It can be argued however, that the funded projects have succeeded in mobilising sponsors as investors within Local Authorities and ESCOs, by for example, providing affordable loans.

*The benefit of maturity in the market of district heating brought about by BEIS investment in that market, means that we can have lower lending rates from the council in our case than otherwise we would have done without falling foul of state aid limits. So there are many benefits that BEIS brings which are not necessarily direct, they can be indirect, and that is one key one for us. (Project)*

HNIP funding, and the combined agency of BEIS and TPHN in supporting applicants, has generated confidence in sponsor organisations – both locally, and potentially more widely:

*As soon as you get enough projects like ours off the ground where other people can watch on and understand how it's been delivered, and more importantly that it can be a success, because that's what people are waiting for, or a crash, one of the two, then that gives them confidence to then start their scheme. (Project)*

*... it's been a really, really good boost for the industry, I think it's helped give the confidence for a lot of developers to keep pushing on with quite ambitious schemes, rather than those ones which are just very, very small, serving just a couple of properties. (Project)*

The commercialisation phase has been valuable in building the confidence of sponsors, active investors and developers in the funded networks.

*I think the commercial phase has been really critical for this project in particular and without that, we would have struggled to get to where we are or we would have had to have done it at a huge risk and cost to ourselves, and*

*that would have had to be seriously considered by our board as to whether that's something we would have been willing to do, so that's really helped and I think it's a key part of the funding. And then obviously, the funding itself means the project's far more investable. They're the two key bits really. (Project)*

But barriers to significant third-party private-sector investment remain. One interviewee sees the question of third-party private investor involvement as unsuited for the stage this heat network has reached because of its own development ambitions and what was felt to be a better fit with its public finance model:

*We did ours in a particular way which didn't really fit with the HNIP model ... BEIS set up in the way they did, (because) they wanted to try and crowd in funding. But for large strategic networks, it's much more suitable to have public finance, in the early days, there wasn't an investable proposition there. I suppose because we followed that line, we've taken all that risk in the early days and we are hoping that we will get some reward out of it, from being able to have some control over the energy prices that our customers pay as well, making it attractive to do business or live in homes connected to district heating), so we don't really want to just sell out to private investors now. (Project)*

For one respondent HNIP funding contributed to some projects being able to work at a scale that could ultimately, but not yet, engage third-party investment.

*We are still in a situation where there is not a great deal of third-party finance coming into this market, especially for the larger schemes, and I think for many [...] it was the only way that they were going to get large projects away. So in that respect the funding and the ambition set behind the funding has been extremely important. (Project)*

## **Building investor confidence**

HNIP has created deeper, more active engagement by generating confidence in the viability and investability of heat networks. People are more willing to engage because they recognise its viability.

*I think yes, but there's still a way to go. So it's definitely helped [and] has got more people interested, brought more people to the market, more people considering it in areas but then there's still a gap to reach the large sustainable investment market that we talked about previously. We have private investors floating around, looking at – could we take these operational assets on for longer term?...I think zoning is going to be one of the big things to help with this. (Other)*

This respondent describes the role of existing projects in generating confidence:

*Undoubtedly with us now hopefully being more mature and successful, a lot more people are showing interest in how we did it, what we're doing, and how they might go about it, ... You don't really want to be the first off the block, you want to see somebody else do it first, make the mistakes, learn from it, get it right, and then say, "Right, how did you do that? Oh, we'll copy you then". That's the way it works. So the more investment there is in heat networks and the more heat networks that succeed, the more people are going to watch and say okay we'll do it your way. It's a confidence thing really. (Project)*

One suggestion on the generation of confidence was the offer of guarantees:

*If you're offering guarantees [against first loss] as well, then the very start of that would be different because by having the guarantee, you're reducing risk and that therefore would stimulate an investor to get a little bit more interested. But (HNIP) has set up the market conditions to have those conversations. (Other)*

The risk return rate is currently too low for many sponsors and investors.

For many investors, the return rate for the HNIP funded projects is too low, and the level of risk remains too high, both on volume risk and price risk.

- **Volume risk or demand risk** – relates to acquiring and retaining a sufficient volume of customers. One project was halted when the expected demand collapsed because one of the development partners chose an alternative to the heat on offer from the heat network.
- **Price risk is the risk of being non-competitive** when, for example, the heat network cannot offer a price that competes well against any counterfactual such as a domestic heat pump or a gas boiler.

While HNIP (and GHNF) are currently laying the foundations for investability, raising awareness and engaging as widely as possible with audiences, the benefits of this will not be seen until the policy framework is in place to help manage these risks. There is currently uncertainty both with respect to when the zoning legislation will be implemented (and in what form) and what powers Ofgem will have in the market. Without this certainty these risks remain as barriers to investment.

These risks, and the potential benefits of zoning and regulation for their mitigation, have been identified constantly by respondents through the course of our evaluation. Much will depend on how strong a framework zoning with regulation and the new building standards delivers:

*I keep saying that private investors, they don't necessarily take on risk, they take on measurable risk and one of the most important parts of measuring more risk is "what are my future cashflows?" and if my future cashflows do not*

*cover what I need from my returns, I'm not going to invest in it, so that's why zoning is so important. It doesn't remove the need in the near term at the very least, for the likes of HNIP or for the likes of the Green Heat Network Fund, whatever the next iterations end up being. (Other)*

*You need the momentum but you also need the stick, having the legislative power to mandate a connection, to mandate a heat source to provide heat (Other)*

*you would be making marginal financial returns so something like maybe 5-6% in the absence of a HNIP award, which might sound like a lot but actually for the risk you're taking, many investors would be unwilling based on our interviews, to invest at that kind of rate of return and really, it needs to be something like 10-12% on a pre-tax real basis and even that is somewhat challenging because there's uncertainty around lifecycle costs, there's uncertainty around will they actually connect when they say they will? Not to mention construction costs. A lot of that is thought to be mitigated through the zoning policy but it's not there yet ... but my hope is that zoning will help bring down that cost of capital and that starts to have a real impact on the viability of heat networks. (Other)*

### **Standardisation as an attractor and route to market confidence**

Moving towards standardisation has been a core Theory of Change component since project inception. It is recognised as a critical factor in engaging and retaining investor interest. HNIP faces the paradox of the inevitable diversity of its 'start up' aspects against the necessity of driving towards standardisation to increase the scale of investor interest. A significant step on the way has been SOMS, and to some extent SDDS and BHIVE.

*When it comes to an investor's perspective, as long as there is a standardised template, standardised approach to it, standardised documentation, that helps in terms of getting [investors] interested. As long as they can model that out and look at it, it doesn't matter if the energy source is different, it overcomplicates it ever so slightly for them because if they can start to understand it and see the value in it, if it's investable, and if they can model the cashflows, they're going to invest in it. (Other)*

This respondent, from an investment background, looks forward to the benchmarking and comparison that will be enabled by standardisation:

*When I talk about standardisation, thinking about deals I used to work on in banking which were for big energy companies so it was solar, wind, battery, there were a few different lines in the [technology of the] model ... and then it's all the same. And, as long as I can compare everything in the same way, I could aggregate it and that was easy for me, and that's where something like*

*HNIP [needs to be doing as it] makes it a lot easier for investors to evaluate in the future. (Other)*

During the life of HNIP recognition of benchmarking possibilities have emerged from operating projects and those close to completion.

*There are now several schemes in the country that could be used as a benchmark to understand the viability and what the benefits are of either being [a] publicly owned or privately owned concession. I've worked on a few of them, hence why I know... There obviously aren't many, but there are enough now for people to understand the options to market and the solutions to setting up the company that's going to run that infrastructure. (Other)*

### **The greening of investment**

This is a key factor in attracting investor interest towards heat networks and it is likely now that major investor interest will default towards green investment.

*...it's more that non green things will start to be less attractive to them because of the risk of them being stranded assets but also the reputational risk. (Other)*

*There is much in the external environment that is acting to encourage investment in this area including: UN principles for responsible investing, and the growth in significance of environmental, social and governance characteristics in investments required by the City ... institutional investors, banks, asset financiers are actively looking for investment opportunities that have the characteristics of heat networks. (Other)*

*We find now as developers, when we're attracting investors, sustainability is hugely important, they want green credentials and that's a new thing, I've only started seeing that in the last two years but if an investor's got two options and one is an incredibly green scheme, they will now always take the green scheme. (Project)*

Of value in potentially interesting green investment is innovation within HNIP projects such as the mine-water projects, carbon capture, heat from sewage and the off-gas community:

*In terms of different types of them, that's great because there's learning that can be brought out. You mentioned the mine water ones, incredibly exciting, nascent technology that HNIP have enabled there to be some insights into, so that's incredibly useful. (Other)*

Equally changes in the whole system of heat network development could influence green investment. Currently this could apply to those investing in development and regeneration projects and who are committed to reduced carbon energy solutions:

*I guess there are other [important] parts to this ... For example, we are now in a situation where planning and building regulations and its impact on heat networks is quite different to when the scheme was designed, and there is a much stronger push towards heat network designs without gas boilers, or even CHP. (Project)*

## Looking forward

Themes emerging here include:

- **Targeting the market:** More nuanced investment market segmentation for early independent investment (see below), emphasising the green aspects of heat networks.
- **Improving investability:** Seeking further investor confidence generating mechanisms following on from SOMS and BHIVE.
- **Knowledge management:** Promoting sponsor experience and knowledge as a resource for future heat network developments, promoting HNIP products.

## Responding to investor diversity

The initial Theory of Change for HNIP contained the founding expectation was that in its lifetime HNIP would have supported heat network development to the extent that it would readily attract third-party investment. Early progress showed that uniform readily investable networks were not going to be realised in the lifetime of HNIP. This did not diminish or remove the need for the active attraction of investors, but it engendered a more active approach. The development of BHIVE is a product of this.

Combined with the observation in Section B2: 'Investability' above, around the differing needs of different types of investor, this led us to question whether, in the current stage of heat network development, there is scope for developing a more nuanced approach to market segmentation. This would mean exploring which type of investors are likely to invest in which aspects of heat network development and at what stages. Investor interest could range, for example, from Heat Pumps and Pipes through to heat as a service/commodity. We put this suggestion to respondents:

*HNIP and GHNF (aren't) going to be there forever. Are there different ways we can skin the cat to mean that these networks can grow out organically as best they should for themselves? Can we create other investment opportunities? ... I'd love to try and find a way of using private capital in ways we've used them in other infrastructure markets, to try and resolve that problem differently and yes, I think lease finance, rental programmes, heat pump rental in particular, has some merit. (Other)*

Another respondent also recognised this possibility and saw ESCOs' investment via HNIP as a precursor to a segmented approach:



*It's an interesting question, the counter is that obviously yes, there's things that people can invest in, they're going to invest in them, so ESCOs were a really good example here where we're seeing those coming, well they're mainly joint ventures anyway. I think that the actual heat source itself, if we're classing that as separate to the network and the distribution, then obviously that's something that people are willing to invest in but that won't work unless there is a network to then plug into. But you could have a situation where people want to invest purely in the heat, the actual generation, and don't want to invest in the network or they want to invest in the overall thing. (Other)*

Again, the value of regulation and zoning as enabling and underpinning active investor interest was commonly raised:

*There are different and interesting investors for different stages in the lifecycle of an individual network. [Shortly] ...we will see hopefully the creation of heating zones but not just heating zones, heating zones with teeth that will genuinely mandate connections within a certain area, such that you could think of those zones as a proxy for demand assurance. (Other)*

## C2: Greater ESCO involvement

### Overview

Over the course of the project ESCOs (Energy Service Companies) have been the most significant independent investors in HNIP supported projects, mainly through the provision of capital, expertise, and supplies. Outside of HNIP, ESCOs have independent strategies for becoming significant players in the UK heat network market. There are two types of ESCO operating in HNIP:

- (1) Large international ESCOs, some of whom have been attracted to heat network development in the UK partly as a result of HNIP. All the ESCOs referred under 'Broadly' below are of this type.
- (2) Local ESCOs in HNIP projects that have developed from SPVs set up by Local Authorities as a condition of funding or as a preferred form of governance and management.

Broadly:

- HNIP gap funding can be critical in securing ESCO engagement in specific heat networks.
- ESCOs are significant stakeholders, and their engagement is often in larger scale expandable heat networks (e.g. Bristol) and smaller distinctly local networks (e.g. Wigan).

- ESCOs bring knowledge and experience and can facilitate access to well-developed supply chains in the UK and abroad (where they have them). In the longer term, they will support the developing UK supply chain (see also Section 'C3: The supply chain remains constrained')
- Factors likely to attract ESCOs include expandable larger scale networks, for example regeneration and large housing developments, that guarantee demand. A further appeal is a readily available large scale reduced carbon heat generation opportunity such as EfW.
- However, the current pace of UK supply chain development is insufficient to support extensive ESCO involvement in the UK market.

## About ESCOs

Within HNIP there are examples of SPVs established by local authorities developing into independent ESCOs. In this role they enable the continued governance, development and expansion of the heat network sometimes across Local Authority boundaries. Elsewhere large international ESCOs have taken on the role of lead sponsor for an HNIP development or have been contracted in to operate an expanding heat network initially established by the Local Authority, under a concession arrangement.

SPVs were a BEIS requirement for LA sponsored projects with a planned capital expenditure of above £2.4m. In many circumstances LAs are legally required to establish an SPV in order to operate a trading business. They have the effect of making the heat network project an independent business which can be owned by the LA or in combination with private-sector entities.

For heat networks that have ESCO sponsorship the heat network can be a mix of private and public sector interests and stakeholders. For example, they have developed in areas where LAs are actively pursuing housing development and regeneration projects in partnership with housing associations, private housing developers and local commercial enterprises. Consequently, the public and private distinction is significant as a starting point, but as they develop many of the HNIP supported heat networks represent public and private-sector partnerships.

## ESCOs enhancing Local Authority heat networks

ESCOs can come on board where a Local Authority might be reaching the limit of its capacity and expertise for heat network establishment and operation. This is particularly the case where a local authority might be developing more than a single heat network. One inner-city wide project describes the motivation for establishing a concession arrangement with an ESCO in preference to institutional investors:

*... before we got the bid in, we had some really good conversations with various institution investors and it was all really positive actually. But we*



*ended up, we wanted somebody with not just the money, also the expertise to deliver what we wanted, hence why we're with energy companies like [one international ESCO] who can bring that expertise [into our project], but also what we've done, there's very much locked in that's social value into this project. (Project)*

There has been initial misplaced scepticism about ESCOs among some Local Authorities and consumers because they are mistaken for energy suppliers. In fact, they are producing energy rather than purchasing it on the wholesale market. As heat network developers they have a significant role as partners and providers across several HNIP projects.

*People need confidence that these systems are going to be successful. Unfortunately we are tarnished by a lot of these electricity and gas companies that were set up by councils as well as smaller companies like Bulb etc who went bust, and they are all continuous in saying – how are you different? And we are very different. But it's very difficult for people to see the difference between an electricity and a gas supplier who's gone bust, and us as an energy supplier not having the same problems. So people are very sceptical about our market because of the failures of those supply companies that have happened over the last two years sadly because of the turn in the market on wholesale gas and electricity. (Project)*

## **ESCOs in UK heat network development**

HNIP is seen as a significant factor in prompting ESCO investment in the UK:

*I would say [the ESCO] came to the UK because of HNIP ... their CEO built a whole team around him ... all the projects that they've won [were] aligned with the launch of HNIP and I think it would have been nice to have seen more but still, I think that to me was testament to the fact that people were watching. (Other)*

This respondent describes HNIP as pivotal an ESCO's decision to invest in a project:

*We'll be investing into the scheme which realistically we probably wouldn't have otherwise done if it wasn't for the HNIP. I think that's definitely some proof in that and we're looking again and [another HNIP project] is bringing in different [ESCO] funders, to help with the scheme and obviously having the HNIP behind it certainly helps. (Project)*

Another respondent, representing an international ESCO, reported an increase in their UK heat network involvement since 2017 to the extent that it has now become their core UK business. He accepted HNIP has had some influence over that, but not decisively, as other factors, or incentives, have contributed. These include general market development,

the Renewable Heat Incentive, which is now closed, and the Public Sector Decarbonisation scheme, which is opening a Phase 3 in autumn 2023.

The ESCOs present in the UK for heat network development offer a limited field. Their size and reach is such that they can provide significant investment of capital and skills for single projects but their capacity to have a wider influence on broader heat network development in the UK is questioned due to supply chain restrictions:

*I think there's a really small market in the ESCO world. I mean lots of ...ESCOs know how to run projects, but they don't have their own delivery, they all go out and contract with the same small civil engineering companies to build them some pipe. Lots of them don't have in-house capability to design and build, they just know how to put things together into how to do a project. ... Some of the ESCOs we have nothing to do with because they're much more about creating an investment project and making money for their shareholders, they're not about necessarily delivering networks for other people. (Project)*

Given the important role that ESCOs have played within HNIP, it is possible that much earlier and extensive engagement of ESCOs might have done more to fulfil BEIS's market building ambitions at the outset.

### **ESCO focus on Energy from Waste (EfW) source heat networks**

From one ESCO account it also seems likely that ESCOs would regard a larger scale EfW project as a more viable investment proposition than a place-based heat pump driven project. This is reinforced by our Cluster Analysis where Cluster 5 "City Networks" contains mainly ESCO EfW projects (see 'Appendix 5 An exploration of project diversity – Cluster Analysis'). The ESCO representative also placed decarbonising networks, that are neither EfW not CHP, as financially less viable from their perspective, possibly for reasons of scale. He saw zoning plans, rather than the market, as the driver that would increase the presence of non EfW and non-CHP decarbonising solutions.

On the question of how HNIP has influenced their UK market position he responded:

*... to some extent but there's still, in many ways, a bit of a gap because the latter stage of HNIP were also moving away from CHPs for carbon reasons, which is the right thing to do, I agree with that. But to do a heat pump-based heat network is never, even if you're 50% funded from HNIP, is not going to bridge the affordability gap of just carry on as usual, run my boilers or CHP business case because it's more expensive to run a heat pump than to run a boiler and it's far more expensive to install, especially in conjunction with a heat network. (Project)*

The multi borough expansion of heat networks being achieved by ESCOs, mainly with EfW heat generation, is useful learning ground for the introduction of zoning.

## Looking forward:

Themes emerging here include:

- **A direct approach to ESCOs from the department** – Consider the more conscious courting of ESCOs as investor partners in the heat network transformation programme.
- **Capture the learning from ESCOs** for the heat network transformation programme and for supply chain development.
- **Zoning development** – Consult with ESCOs on the supra-LA structures and governance for oversight and going to scale on HN development.

## C3: The supply chain remains constrained

### Overview

HNIP has resulted in capability and capacity development associated with funded projects, it has stimulated the establishment of a Green Skills academy, and encouraged ESCOs to consider investing more in the UK supply chain. However, the HNIP timetable has reduced the opportunity for new and emerging suppliers to engage with funded projects, thus leaving it to a narrower band of established suppliers. Where larger ESCOs (Energy Service Companies) are a sponsor, or partner, they use their own established supply chains mainly based elsewhere (e.g. Nordic countries).

### The supply chain remains narrow

A sense emerges from interviews that the supply chain remains narrow, and that HNIP has had little impact on it:

*Yes, the supply chain is woefully narrow. But I think that only gets broken when you've got that greater clarity of a long-term pipeline and government behind it. (Other)*

While HNIP has attracted ESCOs to the UK this has had little obvious impact on the UK supply chain as they use their already established supply chains mainly based elsewhere (e.g., Nordic countries with long experience of District Heating supplies).

There is awareness of some attempts by new entrants to join it who are perceived to have been hampered by 'closed procurement':

*I can only comment in the sense that we are aware, and we are aware in terms of people we've had who are effectively in some ways new entrants into the UK market trying to break in, and also that work, that we are still in a situation where the pipeline is not clear to the supply chain, and that there is quite a lot of closed procurement going on. (Project)*

Added to this, the pressure of deadlines required by BEIS for meeting the spending of construction funding has resulted in projects limiting their procurement to a narrower band of established suppliers thus inhibiting new suppliers from entering the market. This will clearly have benefitted existing supply chains but has not enabled supply chain expansion:

*My regret is if there is an area [HNIP] hasn't been so impactful in, it's been in growing the supply chain, I think if anything there's a more constrained supply chain today than we've had previously because we've added in opportunity, without first increasing capacity so we've got a strangled supply chain rather than a more capacious one but in every other respect, I think it's been great. (Other)*

*There has been an element of usual suspects, because there are certain companies that have just been dominant in the heat network sector and know what they're doing.*

*But at the same time we have seen other players, so we have seen Vattenfall enter the market. We have seen interest expressed by some overseas companies. I recall being on a presentation with a [European] engineering company who are interested in getting into the UK heat network market but at the same time an element of stasis in others in that as I say the usual suspects. (Other)*

With respect to materials, many materials are imported from Europe and prices have risen but, it's not been a step change in the supply chain:

*We've not had a kind of Korean district heat company come to the UK but we have had Vattenfall, but we haven't had a say Logstore saying, "We're going to move to the UK and we're going to manufacture steel pipe using British steel in the UK." (Other)*

### **Skills development – A need for supply chain expansion**

The recognition of the need for access to training in heat network related skills and knowledge was significant among respondents:

*We've always been very vocal about the need for training in our industry because we are woefully short of skills that we need. We call upon in our case sometimes Swedish and Danish support consultancy wise, because the level of quality and the experience in this country doesn't exist. So we do need to bring training in. We have on all our contracts a very clear what we call training and recruitment policy where the contractor has to identify how many trainees they're going to bring on the project, how many apprentices they're going to bring on, what the cost is to the company, and how many days of the project's programme they're going to be working. (Project)*

Among the respondents we encountered one example of a HNIP funded project planning to establish a Green Skills Academy. This was both in response to skill shortages and to provide employment for local residents.

*We've got a green skills academy where I'd be expecting the contractors to be offering maybe, like, get involved in heat engineering, taster days, workplace apprenticeships, traineeships and so on, so yes we've put that at the front and centre of our procurement. (Project)*

Another respondent associated skills development with achieving market maturity:

*The problem with district heating is it's a very immature industry in this country compared to let's say Scandinavia. People want to come into the industry with new skills. That in itself will make it more mature. And a mature industry brings with it ... funders who have more confidence in investing in that market. (Project)*

Although ESCOs operating in HNIP may have significant workforce training and in-house academies they are seen as having little direct impact on broader skills development.

## **Looking forward**

Encouraging and enabling smarter procurement that includes skills development that will benefit both local populations and the wider workforce.

## **C4: Many customers continue to see heat networks as high risk**

### **Overview**

Many customers continue to see heat networks as high risk. The failure of one scheme, when the property developer pulled out, demonstrates that there is some way to go. While larger organisations, such as large commercial users and housing associations, may now be more aware of heat networks, many customers still need to see pipes in the ground to provide confidence supply will be available. However, recent examples appear more positive. They have included one project where there is complete policy unity between the housing developer, the ESCO and the relevant LAs in respect of meeting decarbonisation ambitions via a network. The more likely scenario now is that developers might need to be persuaded of the benefits of a network over decarbonised single building solutions such as air source heat pumps. Zoning should be helpful here.

HNIP communications around projects have helped raise public awareness, but end user (consumer) awareness and understanding of how to adapt to networked heat is still limited.

## Perceptions of risk

Aggregate customers, and individual end-use consumers, have different perspectives of risk:

### Aggregate customers:

Property developers can see the length of time and uncertainty associated with heat network development as an unacceptable risk. This respondent recognised that hospitals, universities and other public-sector organisations might be inspired by a local heat network development but for developers it can be perceived as a substantial risk:

*[Many] property developers look at heat networks with great scepticism and are reluctant to engage and that's largely because you've created a project on project risk for them, they're working to their timetable, they want to build. There are some exceptions ..., but ... the vast majority see heat networks as a risk to their project, "we're not going to have heating or it's going to cost me more than it would have done if I'd just put in a gas boiler"... One developer pulled out, despite all the council's pressure ... we had a whole scheme, all fully funded, to deliver long term low carbon heat from a heat source that was going to be incinerating waste anyway. (Other)*

Another aggregate customer's concern is that the cost of installation could be perceived as high against any counterfactuals such as household gas boilers.

### Individual consumers of heat

For individual customers the risks perceived are about control, effectiveness, and disruption. One respondent described the need for individual customers to be able to change their expectations in order to adapt to the benefits of networked heat:

*Quite a lot of people were whacking it up to 29 for an hour and then turning it off think that was the most efficient way of doing it. The only way we could get round that was actually talking to them individually and showing them the difference in bills. (Project)*

The overall impact of HNIP among consumers is believed to be very limited. Individual customer confidence in heating has recently been shaken by the gas supply crisis resulting from the effect of the war in Ukraine and cost of living crisis.

*For very different reasons outside of our control, confidence at consumer level has been shaken, people are terrified, over the life of the HNIP, we're now talking about this phrase, "the decision to heat or eat", that's a real, real tragedy, that wasn't even in our lexicon three years ago. (Other)*

The absence of regulation for heat networks, combined with lack of public awareness, can compound consumer uncertainty and lack of confidence as perceived by one respondent:



*Also, there are some heat network operators out there, who are operating what are essentially monopolies and overcharging their customers. So there are some negative stories. I think when the heat network market is officially regulated, which is coming, that will help. Also a lot of people have never heard of heat networks and don't know much about them and we have to explain from square one. (Project)*

## **Demonstrating benefits mitigates risk**

HNIP communications have helped raise public awareness, but customer and consumer awareness and engagement are still limited. While larger organisations, large commercial users, housing associations etc, may now be more aware of heat networks, many customers still need to see pipes in the ground to provide confidence supply will be available. This strengthens confidence in the technology among sponsor organisations and customers.

*... for the first six years people don't believe that you're going to create a network, and therefore customers don't really have an interest in engaging with you. But as soon as you've got infrastructure built it's like the floodgates open and everybody wants to join the party and connect because they can see it's a reality. (Project)*

*... those that have got heat on, I think it's clear, demonstrable benefits. We've certainly experienced a massive change in attitudes from our Day 1, pre Day 1 when we were talking to potential customers with a great degree of suspicion of district heating, carbon wasn't particularly an issue and gas was remarkably cheap. (Project)*

*We're spending a lot of money now on bringing all these workstreams forward under a coherent programme, our customers are giving us really good feedback saying, "keep going, we're interested in this". (Project)*

Within HNIP there is evidence that perceptions have changed and that aggregate customers are joining heat networks as a positive choice. This is reinforced by Local Authority planning requirements, such as the London Plan, that insist on reduced carbon heating solutions for new developments.

*Whereas now, certainly we're finding that the money that sits behind developers, almost every kind of sensible investment portfolio is looking to have a low carbon development so they either want heat pumps or ideally a cheaper than heat pump solution like district heating. So yes, it's been a huge change. (Project)*

*We're fully committed to this decarbonisation master plan, I think we think we're a good case study, what we're trying to do is demonstrate best practice in a geography and knit ourselves into our communities by provision of long*

*term infrastructure as well, waste management, heat sources, electricity and all decarbonised and I think we're feeling we're in a good place and very well supported by the current policy framework, I don't think there's anything more to add. (Project)*

For one semi-rural local authority running an HNIP project within a large housing development scheme the house builders were initially sceptical about the benefits of a heat network. This respondent takes up the story:

*They had to be put in an armlock at one point by the Regional Development Agency to do district heating in the first place, because other infrastructure investment was made conditional upon them doing this. They absolutely didn't want to do it. And yet I feel we are now in a position where we've got a really strong bang up-to-date policy that requires it. We've got zoning coming. HNIP has played a really key part in making that viable, and that's been an ongoing challenge. (Project)*

Aside from its Climate Emergency declaration a further incentive for the local authority was for the housing development to comply with the carbon reducing Future Homes Standard.

In an inner city Local Authority the respondent described the steps taken to fully engage the local community in the heat network project thereby achieving widespread support for it. This provides an example of how informing and engaging consumers can convert concerns and anxiety into enthusiasm and support:

*I think we've got a lot of reps and we've got heating champions, we call them, who are only interested in the heat networks. The block reps are doing the refurb as a whole, we've got a green group which has got about 40 residents on a WhatsApp group, so we can quickly do things. I think it's definitely been key in terms of trying to build that momentum. (Project)*

## Looking forward

Themes raised include:

- Zoning and regulation: These are recognised here as an approach that will bind developers to networked solutions; the London Plan, and similar requirements in other local authorities illustrate how this can work. Zoning needs to work hand in hand with strong regulation, which enforces property standards such as the Future Homes Standard.
- Ways of ensuring the effective integration of consumers into schemes are needed if they are to have positive experiences of networked heat.



## Appendix 4 Findings – Process

The process evaluation was carried out in two waves as described above. The first wave, based on field work completed in May 2020, examined ways of working between BEIS and TPHN, and the customer journey. Its conclusions noted:

- The increase in lower carbon applications compared with the pilot scheme,
- The learning culture established by BEIS and TPHN, and
- The agile, relationship-based approach to applicants and the valued role of the Business Development Managers (BDMs).

But also:

- The need to attract more applications and to increase loan applications,
- The slow start up as BEIS and TPHN learnt to work together and with the complexity and variety of the applicant projects, and
- Applicants' frustrations around the complexity of the application form and the FEAM, the state aid calculations, the number of conditions precedent and the requirement, in certain circumstances, for local authority controlled applicants to set up a separate vehicle, e.g. an SPV.

The second wave, completed in April 2022, expanded on and updated the findings of the earlier work, focussing on key process elements supporting the theory of change and the impact narrative, namely:

- HNIP award processes – supporting and assessing applications and funding awards. The application process and TPHN support has been identified above (see section headed 'A. HNIP delivered local action and impact') as being critical to generating confidence in schemes, building the skills and capability of applicants and enabling localities to take the opportunity HNIP has provided to further other local strategies. The assessment and award processes have at the same time presented challenges to applicants.
- HNIP post award processes - how TPHN and BEIS are working with projects to respond to risks, change and uncertainty. In Section 'A2: Building confidence locally', we identify this as one of the key ways HNIP has helped build confidence in local heat network plans, and ensure projects survive commercialisation. This has helped build a diverse portfolio of projects with broad potential for learning and demonstrating a range of aspects of the viability and investability of heat networks (Sections 'B1: Diversity of funded projects enabling learning' and 'B2: Projects demonstrating viability and investability').

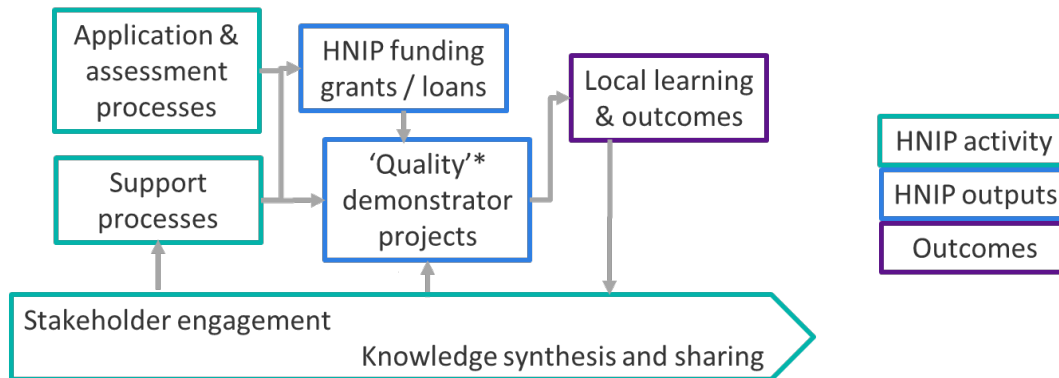
- Experience of SOMS and BHIVE - key HNIP deliverables designed to reduce the costs of commercialisation and increase investor engagement (Section 'B3: HNIP products helping tackle barriers to market entry').
- Communication and engagement – identified in Sections 'B4: Synthesis and sharing of lessons and communication to support wider awareness and engagement' as the key mechanisms for leveraging the impact of HNIP projects and products across the market.

We have structured the process findings around these four key areas, and a fifth area concerning way of working that supports all these, as follows:

1. '1. Applications through to projects' – ensuring successful applications will support creation of a portfolio of high quality projects:
  - Generating a pipeline of applications
  - The pre-application process
  - Application and assessment processes
  - Application support processes
2. '2. Post award support processes' – ensuring funded projects have the best chance of successful delivery
3. '3. HNIP products' – improving access, lowering costs, and promoting investability:
  - The BEIS Heat Investment Vehicle (BHIVE)
  - The Sales, Operation and Maintenance of heat networks (SOMS)
  - The Standardised Due Diligence Set (SDDS).
4. '4. Communication and engagement' – leveraging the impact of HNIP the portfolio of projects and HNIP products across the market.
  - Communicating project exemplars
  - Wider engagement & raising awareness.
5. '5. Ways of working between TPHN and BEIS' – relational aspects that supported project delivery.

# 1. Applications through to projects

**Figure 18: Focus of this section of the findings**



**The TOC narrative:** Through application, assessment and support processes HNIP has funded a diverse body of projects, matched to HNIP’s aims. TPHN and BEIS’s flexibility and responsive, collaborative approach, have been critical to achieving this, helping projects navigate the often complex application process. This has ensured sufficient projects have been funded to support learning, despite the smaller than anticipated number of applications and greater diversity.

**In this section,** we examine to what extent HNIP processes have supported the TOC narrative, helping generate a pipeline of applicants, manage the application and assessment process and support sponsors and their partners through this process.

## Generating a pipeline of applications

HNIP was conceived as a competitive framework through which an optimal set of projects would emerge to demonstrate heat network viability and investability, and deliver HNIP’s core objectives. The first wave of process evaluation found that the project was not attracting the scale and range of applicants anticipated.

TPHN and BEIS reviewed how to attract and engage more interest including identifying and targeting new sectors, particularly private-sector organisations and more work has been done here. BEIS adapted the scheme to help address this (for example restructuring the loan offer in 2020; with the interest rate for loans being changed to make loans more attractive and attract more private-sector clients). Nevertheless, the rate of applications remained lower than anticipated<sup>63</sup>. TPHN told us that:

<sup>63</sup> An unintended consequence of the loan interest rate reduction was an increase in the level of subsidy provided by BEIS, increasing the Gross Grant Equivalent (GGE) of our loan funding. The GGE formed an important part of calculating the project benefits. The effect of this was to drive scores downward meaning project loan borrowers fared less well in competitions. The loan product was more attractive, but harder to obtain. TPHN were able to correct this, working with the HNIP Project Board.

*It's almost a single topic what defines HNIP really, and the biggest thing we've wrestled with, our addressable market is really pretty small, [...] We've got four very precise, variations on what constitutes the strategically important heat network. [...] So when you figure all those things out, trying to find an adequate number of projects to ensure a competitive process every quarter over the last three years has been the biggest single part of the job. (Other)*

The relatively small field of applicants led to pressures on HNIP to allocate the available funding.

At the same time the development and delivery of HNIP has been influenced by contextual factors such as: supply chain weaknesses; peripheral investor engagement; stronger societal sentiment in favour of decarbonisation; and technical developments. Covid, EU-exit, the war in Ukraine and market volatility have added to the uncertainties and risks. (We explore these further under 'Risks, implications and risk management' below.)

TPHN processes have evolved to accommodate these challenges and the broader than expected project diversity. With fewer applications to deal with, TPHN have been able to develop a more supportive role both to ensure high quality applications and focusing to a greater extent, post award, on ensuring that awarded projects are well informed and supported, on the information they need to provide, and the risks they need to manage, post award and during commercialisation.

This has enabled TPHN to make the most of the projects that have come forward for funding and achieve a better set of demonstrator projects, more closely matched to HNIP's strategic aims, than might otherwise have been possible. We return to this under 'Application support processes' below.

## The pre-application process

Applicants viewed the pre-application process as straightforward. Some applicants saw it as an opportunity to test out heat network development proposals that they might not otherwise have considered putting before a funder. TPHN also sees it as an opportunity to look at applicants' plans at an early stage, to provide feedback on whether they are advanced enough to consider a full application, and determine if tailored support is required. BEIS finds this to be a valuable process for drawing in potential projects and enabling a smoother application pathway than might otherwise have been the case. HNDU have encouraged early pre-application to enable these benefits.

## Application and assessment processes

### Learning approach to scheme design

We noted above that the loan interest rate was changed in 2020 in order to make loans more attractive. TPHN and BEIS have been active in reviewing experience and modifying the scheme design where necessary. An example is the approach to scoring projects,

described below. Other examples are the changes made in response to market volatility and rising costs described under 'TPHN/BEIS response' below.

### **Changes to scoring**

The Application Guidance includes information for applicants on how their projects will be scored. The criteria address the volume of heat delivered, carbon savings, future decarbonisation and deliverability.

These are designed to reflect the objectives of HNIP, and to take account of experience gained in the pilot scheme. Our review of these scoring criteria in Wave 1 of the process evaluation suggested that they are both designed to reflect the objectives of HNIP, and so result in a suitable mix of funded schemes, and that their design had taken account of experience gained in the HNIP pilot scheme. This is particularly evident in the scoring approach taken to future carbon savings, and in the inclusion of a deliverability assessment. Previous evaluation work conducted with the HNIP pilot funded projects<sup>64</sup> suggested that if deliverability had been explicitly assessed in the pilot, projects at greater risk of not meeting the required timescales could have been identified at an earlier stage. This level of uncertainty has been resolved in the main scheme application process by the submission and review of Pre-Applications.

TPHN and BEIS continued to review the experience of applying the scoring criteria and in round 6, the scoring approach for three of the four scored criteria were changed, this had the consequence of lifting the scores. Deliverability remained unchanged. We were told by TPHN that the changes to the scoring approach were found to be generally helpful - and were well-liked by the boards and the investment committee. They did not, in themselves, result in a change to the technology mix.

### **Timescales for application and deadlines for drawdown of funding**

Deadlines and challenging timescales were frequently raised in our interviews. Time pressures come both from the need to align heat network development programmes with heat customers plans and priorities, but also from HNIP processes. Timescales for application and drawdown often do not fit well with internal LA processes and the time needed to respond to emerging issues. Projects must keep stakeholders such as elected LA members engaged in the process and LA decision-making processes necessarily take time to ensure political accountability.

*As the process is set out and the timescales imposed upon us by the programme, and having to complete within a financial year to draw down the following financial year, I think there is incredible naivety on how local authorities actually can operate given that we don't have specialist officers,*

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<sup>64</sup> We conducted nine semi-structured interviews with people involved in the delivery of HNIP pilot funded projects.

*you're having to procure everything in, and then you're having to go through decision making processes within the authority. (Project)*

HNIP deadlines were sometimes seen as positive in our pilot evaluation, providing incentives for projects and LAs to press on with activities. In the latest rounds of interviews this was not the case.

Some aspects of the scheme presented particular challenges:

- Rebalancing of grants versus loans: In certain circumstances HNIP may offer an award that differs in the balance of grant vs corporate vs project loan offered, to that requested. Projects generally agree with the re-balancing, but the process of reassessment and approvals required introduces delay, which can be significant.
- Bundling of commercialisation and construction funding: In HNIP, commercialisation funding could not be granted without a construction award. We found that this bundling of commercialisation and construction funding introduced a tension between the limited time to work through commercialisation before meeting constructing funding drawdown deadlines, and the certainty bundling of the funding provides – that the project will be able to get construction funding if the commercialisation phase goes well.

The impact of deadlines has been widespread, influencing decisions on whether to apply for commercialisation funding, causing pre-application and commercialisation activities to be completed at greater pace than ideal, constraining the choice of suppliers to those already in the market, and constraining the flexibility with which projects and HNIP can respond to change and uncertainty.

*It's probably a general statement about central government in terms of the timescales to do this. It is really difficult. If there was more flexibility around the timescales I think: 1) you'd get probably more people applying; 2) you'd get more projects done; and 3) you'd find everyone was sort of working in a much easier state with each other. [...] You can still do all the auditory processes that you need to do around it to make sure that the money is being spent in the best way. (Project)*

BEIS accept that these deadlines are a problem but sees little prospect of the situation changing.

*Needlessly accelerating programmes at breakneck speeds, putting at risk quality of delivery, this is not a good way to manage things. We have projects which understandably will of course straddle multiple fiscal years. There's no way a strategic heat network can be delivered in a fiscal year, it will of course take three to five years to deliver, and within that there will be milestones that will move. That's just the nature of it. At the moment, the way that budgets work is there's almost no flexibility. (Other)*

On occasions TPHN feel this has resulted in prioritising HNIP/BEIS profiling requirements over local project priorities; e.g. failure to tie down an anchor load by a deadline in the context of an otherwise viable and worthwhile project. This can lead to application failure or withdrawal during commercialisation. Although this might be regrettable it is seen as well within role for TPHN. The fund is competitive and essentially covers funding gaps. This requires projects to be otherwise viable so emerging uncertainty over, for example, anchor load contracting, will trigger concern.

We discuss the impact of these deadlines and how heat network projects and HNIP have responded to them further under '2. Post award support processes' below.

### **The complexity of the application process**

The application process was challenging for many projects. Challenges raised included: the complexity and amount of detailed information required and the 'black box' nature of the FEAM and assessment calculations, difficulties estimating costs, and the rules around state aid. These are made more difficult because many LAs will not have much resource, or the breadth and depth of expertise required and the timescales available at certain steps in the process e.g. to provide clarifications and as the end of HNIP approaches.

*It's incredibly complex, the application process, and it's not something that I think a local authority organisation or public-sector organisation can do on their own. I worked very closely with [a consultancy] on the bid, but it was a long, difficult process. We were up against timescales as well. So any way that they can streamline that and make that easier, that would certainly help with the process. (Project)*

The complexity of the application process has been mitigated by the quality of the support provided by TPHN, we discuss this under 'Application support processes' below. We are told GHNF has adopting a simpler, more transparent approach, and this has been welcomed.

Many of the application, assessment and subsequent drawdown challenges projects encounter (see below), arise because those administering the project, and the projects funded by it, are caught between government rules and due diligence processes required when spending public money, and the exigencies of a multi-year complex infrastructure project.

### **Application support processes**

Early in the process evaluation we found that **events held to introduce HNIP** have been instrumental in overcoming barriers to application and have improved applicants' understanding of the process and eligibility criteria. These events sit alongside more individual support.



TPHN has developed a collaborative approach to provision of support, working across the consortium and with projects. They have worked closely with projects to facilitate a pipeline of good quality applications, enable projects to make adjustments in response to investment committee (IC) decisions (such as increasing the proportion of loan to grant), and support those encountering difficulties during commercialisation to find ways forward:

*... there are so many projects where you could very easily listen to it first time round and say, "That's not going to work", or, "That doesn't fit these little boxes", and actually it's that difference of saying, "Come on, let's work together on this and help to make these projects work". (Other)*

The reasons for working in this way became apparent:

*We instinctively know what kinds of projects are stimulating the market and what kind of projects provide the potential to deliver what the HM Treasury business case right at the start of this was trying to achieve. We work fairly on them. Instinctively if a project presents itself with a very, very strong case for funding and instinctively we know it's unlikely to [get] funding, our effort will go into understanding what they haven't told us about the project so that they present their project more fairly so we can have a fair assessment of it. (Other)*

TPHN have also had to be responsive to changes in the market. This has demanded flexibility to ensure that applications are not disadvantaged because of this and because HNIP application processes and embedded assumptions (e.g. the price of gas with respect to the counterfactual) have not changed in response to changes in the market.

TPHN, in the satisfaction surveys they run, find high proportions of respondents rating their experience as satisfactory<sup>65</sup> and projects interviewed viewed TPHN support throughout their application and commercialisation phases positively (see also '2. Post award support processes'):

*However, the team have been really, really friendly and accommodating when we've wanted meetings with them to clarify questions. They are also very willing to not just work with us but also our advisers who as we advise are working with us to help us understand how to better respond to questions. (Project)*

Timescales was a common issue raised by interviewees (see above) and **monthly reporting** can be seen as labour intensive, although the need for monitoring is recognised.

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<sup>65</sup> Between September 2019 and March 2022, 97% or higher of respondents rated their experience of TPHN as satisfactory, positive or very positive. Availability scores were also good. Source: HNIP Customer Feedback Report, Document Ref: HNIP-Customer Feedback Version: 1. Issued: 31st March 2022

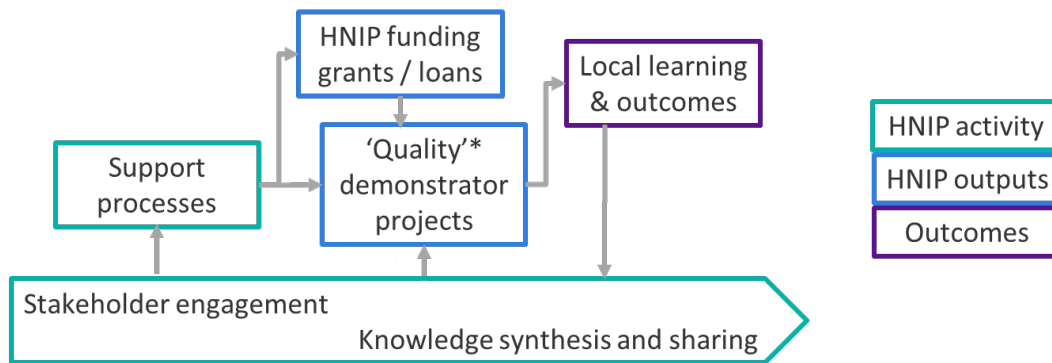
Inconsistency of messaging following handover from the BDM to TPHN’s Monitoring and Reporting (M&R) team was raised by one interviewee.

Overall, the impression we received was of a very supportive environment with TPHN seeking to provide constructive advice and working hard to enable projects, within the principles of the scheme and responding to their own experiences with projects, and project feedback to improve processes.

There was a recognition of the many different routes to success a project could take, and a desire to help projects optimise their chances of funding success. This was not the case of ‘the computer says no’ but rather a person saying ‘let’s see what we can do’.

## 2. Post award support processes

**Figure 19: Focus of this section of the findings**



\* potential to expand, develop diverse heat customers (beyond anchor loads, not just in dense urban areas) and connect to multiple diverse heat sources

**TOC Narrative:** Support post award and during commercialisation enabled HNIP to respond to the high levels of risk and uncertainty encountered later in scheme and helped projects deal with sometimes challenging timescales for drawing down funding. This allowed otherwise viable projects to ‘weather the storm’. The consortium has been able to make the most of the projects that have come forward for funding and achieve a better set of demonstrator projects, more closely matched to HNIP’s aims, than might otherwise have been possible. BEIS and TPHN flexibility and responsiveness post award, and TPHN’s ability to bring the expertise and experience across the consortium to bear effectively, has again been important here.

Managing risk is a core function of the commercialisation phase of a project, a key stage that aims, among other things, to reduce uncertainties and de-risk the project. In recent years this has been against a background of significant change:

*I think the main one [challenge] is managing change within the project as you’re going through that commercialisation phase. So whether that’s the*

*time it's taken and the strategic landscape changing. The one I've got in my head is the faster move from gas combined heat and power to a low carbon technology, for example. Or it might be your cost and revenue changes.*  
(Other)

**In this section**, we explored how change and uncertainty were impacting projects post award and how HNIP responded to this through post award support processes. Our findings are set out under the following headings.

- Risks, implications and risk management
- TPHN/BEIS response to the emerging challenges
- Projects' experience.

### Risks, implications and risk management

Interviews revealed that a complex mix of interacting factors: Covid, EU-Exit, the war in Ukraine, market volatility, constraints on supply, rocketing prices and delays in, or halting of, developments, are all affecting projects.

Heat networks are unregulated and don't have the same legal status or recognition as other utilities. This has introduced or exacerbated risks associated with Covid, route planning and construction.

*We do not have statutory undertaking rights to do that [cross others property], so we have the right as a council to generate, distribute and supply heat, but we don't have the [right to go across other property] so we're in the position of having to negotiate so many different easements.* (Project)

An additional concern for projects that have experienced significant delay, is the deadlines for drawing down funding (see above) – some projects anticipated delays and uncertainty and tell us they negotiated extension clauses in agreements, others told us they found themselves faced with hard deadlines.

Planning in these circumstances is difficult, budgets and business cases have been revised, contracts revisited, agreed price schedules abandoned, and tender periods reduced. Budget and program contingencies, contract negotiations, pre-ordering, and flexible responses, both by projects and HNIP (see next section), have helped manage the risks, but have not always been successful. Two HNIP projects in our sample (and to our knowledge, two outside the sample) had been paused or halted altogether at the time of this analysis because of lost demand and/or increased costs (exacerbated in one case by errors and gaps in the initial cost estimation).

## TPHN/BEIS response to the emerging challenges

TPHN have responded flexibly in a number of ways. They have developed processes to help projects encountering difficulties during commercialisation to find ways forward, including providing a process for granting additional funding. The potential need for additional funding was not recognised at the outset. The process requires some judgement in deciding which projects should continue to be supported and which not.

An example of one of the areas where TPHN have been able to introduce flexibility is switching between conditions precedent and subsequent:

*It [switching conditions precedent to conditions subsequent] seems quite a minor change, but that enables a project to draw down funding in order for us to meet our budgets, for a project to meet their needs on the ground, whilst maintaining important controls. (Other)*

In our early work, we were told that conditions precedent were sometimes an unwelcome surprise for projects, none of the projects we interviewed later on in the project raised this as an issue. This was just one example of TPHN and BEIS learning from experience.

Both BEIS and TPHN interviewees felt that TPHN's experience as a fund manager will have helped them respond flexibly, while managing risk and meeting funding and investment principles.

### Projects' experience

While TPHN has been cited as a cause of delay and one project thought TPHN could have been more proactive in pointing out potential issues, overall, projects view their responses to the challenges change and uncertainty bring positively:

*Excellent. Very supportive. ... I think once they were comfortable the project was still alive and actually quite healthy apart from not signing up the developer, they then did everything they could to help us ... (Project)*

*Triple Point were really helpful just in terms of giving us updates and pushing it forward etc. (Project)*

They have, for example, been flexible in interpreting drawdown of funding, as projects have approached deadlines:

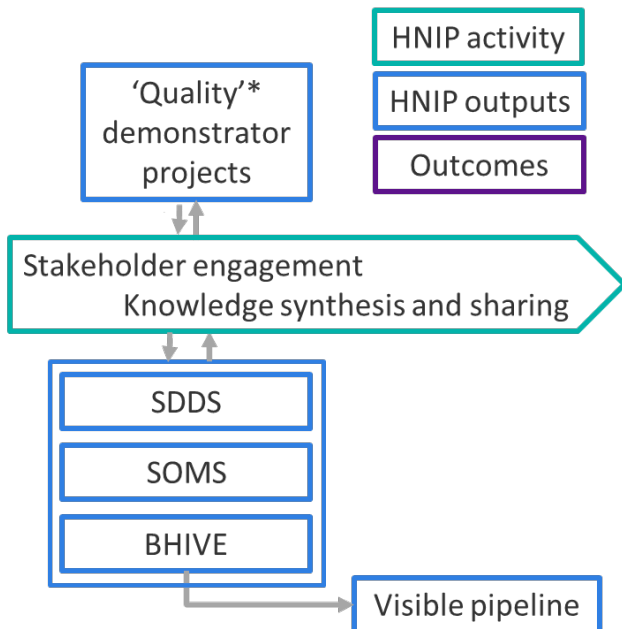
*... we've negotiated that that can be committed rather than actual spend, which again just gives us more chance. That should definitely be doable. If it was actually spending the money by March, that would be really tight. I think a lot of projects would struggle to spend it in the right way. It's never good to have to spend a lot of money in a short space of time. (Project)*

This however has left some projects uncertain about what they can do within the terms of the funding agreements. Some seem comfortable trusting that they will be able to work out a way forward with TPHN, others less so.

*It had been indicated to us before we accepted the funding that we'd need to be doing pre-ordering. However, we've now been told by our project officer at Triple Point that we don't need to be, we just need to accept the funding. So there does seem to be issues in communication between the teams supporting authorities to sign the funding agreements and then subsequent project managers. (Project)*

### 3. HNIP products

**Figure 20: Focus of this section of the findings**



**The TOC narrative:** HNIP products, and the SOMS in particular, are seen as helpful, improving standardisation, facilitating the engagement of third-party investors, and saving cost. BHIVE was designed to facilitate a coming together of the public sector and private sector to support investment in heat networks, but may not be appropriate for all investors and models of investment. However, BHIVE can only have limited impact given the current nature of the market. The impact of both SOMS and BHIVE has been limited by the late stage in the project at which they were introduced.

**In this section,** we describe processes associated with the design, development and communication of the HNIP products.

## The Sales, Operation and Maintenance Set (SOMS) template contracts

The SOMS were developed by Lux Nova for HNIP and launched in February 2021. BEIS recognised that they will require tailoring to each heat network project, but they are intended to provide a useful and advanced starting point to contract creation and negotiation.

The SOMS capture the standard market position<sup>66</sup> with respect to the following:

- Energy Centre Lease
- Easement
- Concession Agreement
- Design, Build, Operate and Maintenance (DBOM) Agreement
- Operation and Maintenance (O&M) Agreement
- Use of System Agreement
- Connection and Supply Agreement
- Connection and Supply Agreement (Plot and Building)
- Framework Supply Agreement
- Residential Supply Agreement
- Housing Association and Developer Supply Agreement
- Commercial Supply Agreement
- Meter and Billing Agreement

The suite of contracts does not cover project ownership or partnership models, because there is no standard market position with respect to these apparent yet.

The SOMS page on the TPHN website<sup>67</sup> is being used. TPHN told us that between May 2021, when tracking of this was made possible, and the 1st of December 2021, there had been 95 downloads of the SOMS. A mixture of local authorities, energy companies, law firms/legal, universities, and engineering companies and consultancies have downloaded documents. They are downloaded on a fairly regular basis. In November 2021, 11 individuals download the SOMS. The TPHN [Heat Networks – supply chain wins and market transformation](#) event in January 2023, included an introduction to the SOMS and advice on how to use them. However, not all of our project interviewees had experience of the SOMS

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<sup>66</sup> Standard market position: where the market is comfortable with a set of clauses or conditions, which may appear in different forms in different lawyers documents, but are essentially the same – so a standard way of doing things, which is ripe for formalisation through the SOMS. Source: TPHN Event: Heat Networks – supply chain wins and market transformation event, 23 January, 2023.

<sup>67</sup> <https://tp-heatnetworks.org/heat-contract-templates/>

- Heat networks with experienced suppliers, who operate a number of heat networks, have their own templates
- For heat networks funded in early rounds, they came too late – however, the SOMS may have benefitted from experience developed through these earlier projects
- Other templates are available and have been used by at least one project e.g. the FIDIC Silver Book.

There is recognition in BEIS/TPHN that the SOMS could be developed further to bring them closer to a finished product – a status template documents have achieved in other areas. TPHN are now planning to seek formal feedback from those that are using them.

### BEIS Heat Investment Vehicle (BHIVE)

Launched at the end of 2020, the BHIVE investment vehicle was designed to facilitate a coming together of the public sector and private sector to support the development of heat networks, by providing public-sector sponsors in England and Wales a route to funding and funding services, and enabling investors to take the opportunities heat networks present.

TPHN committed resources to the development of BHIVE and engaged with several potential investors in the process. Ideally BHIVE would have been in place much earlier in the project lifetime. Establishing the dynamic purchasing system (DPS) and getting suppliers onboarded was difficult, and slower than hoped. There were a number of reasons for this, including the time required to identify the best option, BEIS internal processes and the newness of the territory, both in terms of the design of the DPS, and for applicants.

As of March 2023, investor numbers on BHIVE remained relatively small and dominated by investors who had already invested in heat networks – see Box 1 (BHIVE investors) below.

The fact that HNIP products such as BHIVE were in place later than ideal, means that the impact of these tools will be more visible on GHNF than on HNIP.

Engagement work now includes:

- Actively publicising BHIVE to local authorities to strengthen the pipeline of projects and help attract more investors, and
- Activities to engage actively with the investment community via GHNF.

We return to this under '4. Communication and engagement' below.



## Box 1: BHIVE Investors

### Lot 1: Equity Finance

- Amber Infrastructure Limited (Single Entity)
- Amber Infrastructure Limited (Fund: The Mayor of London's Energy Efficiency Fund LP)
- Amber Infrastructure Limited (Fund: IPP Investments Limited Partnership)
- Asper Investment Management Ltd
- Downing LLP
- E.ON UK Infrastructure Services Limited
- Greencoat Capital LLP
- Pinnacle Power Limited (Fund: PP ESCO DIVISIONCO Ltd)
- Pinnacle Power Limited (Fund: PP ESCO HOLDCO Ltd)
- SMBC Leasing (UK) Limited
- Sustainable Development Capital LLP
- Triple Point Investment Management LLP (Fund: Triple Point Energy Efficiency Infrastructure Company Plc)

Contracting Authorities may also ask Funding Providers to provide a range of services that are ancillary to the funding under Lot 1 as set out in guidance documents

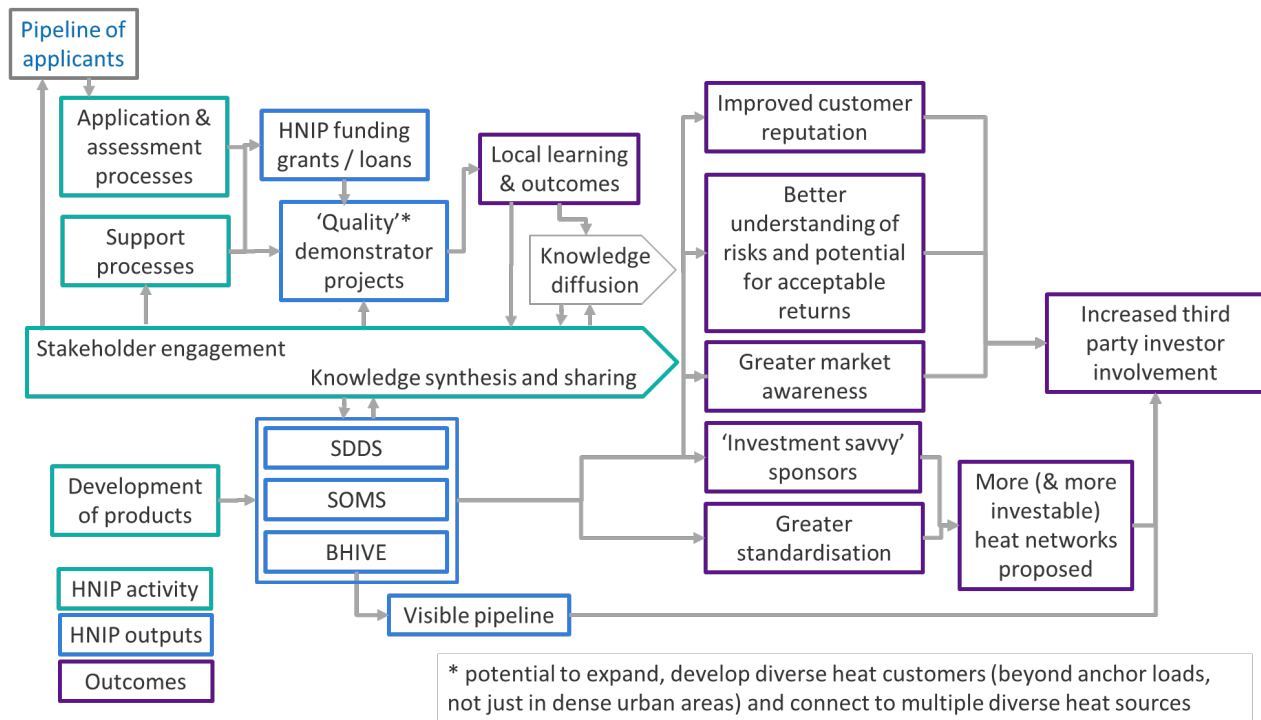
### Lot 2: Asset Finance

- PEAC (UK) Limited
- SMBC Leasing (UK) Limited
- Triple Point Lease Partners
- Triple Point Leasing Limited

Downloaded from <https://tp-heatnetworks.org/bhive/> 01/03/2023

## 4. Communication and engagement

**Figure 21: Focus of this section of the findings**



**TOC Narrative:** Communication, engagement and awareness raising lies at the heart of the TOC. Effective dissemination of the learning gained through HNIP, supported by, and enabling, knowledge diffusion, is needed to leverage the impact of HNIP projects and products more widely, leading to more active engagement with the market. This goes beyond one way communication, to a whole range of activities, sustained beyond the end of HNIP, to stimulate interest, and build the capacity and capability of the market. This could form part of a broader ‘system leadership’ which places heat networks within a supra-departmental approach to system developments and investment in zoned de-carbonised energy provision. ‘System leadership’ is about the skills necessary for leading whole system development and change beyond organisational and departmental boundaries.

**In this section,** we examine the activities carried out by TPHN to raise the profile of HNIP, its products and projects, and disseminate the learning from these across the system.

## Communicating project exemplars

A key element of the theory of change is that HNIP projects would act as demonstrators, building confidence in the viability and investability of heat networks to deliver low carbon heating solutions, thus having an impact beyond their own existence. We explored how well HNIP was working towards this under Section ‘B: The impacts of HNIP projects and products on the wider market’ above – here we look more closely at the communications around project exemplars.

### Communication about projects

TPHN share information about funded projects principally through the TPHN website, HNIP events and email announcements. They also broker introductions to projects.

Website statistics supplied by TPHN demonstrate that they were reaching an increasing audience from 2018 to 2021.

**Table 5: Website statistics year October to October (source TPHN)**

Year	Statistics
2018/2019	14,000 page views (6,500 unique page views)
2019/2020	52,700 page views (23,250 unique page views)
2020/2021	48,900 page views (22,200 unique page views)

After October 2021, TPHN saw a decline in site views as the scheme end approached.

From data available in May 2022, the most popular direct pages were: homepage (40%), contact (10%), SOMS (8%), BHIVE (5%), funded projects (5%) and apply (4%).

- 50% of users were direct i.e. via URLs in emails sent to them – TPHN have a 30-40% open rate across their email engagement.
- 50% of referrals came from the BEIS website. Referrals from other partners, i.e. trade associations, were low and TPHN were looking to build stronger relationships with gatekeepers.

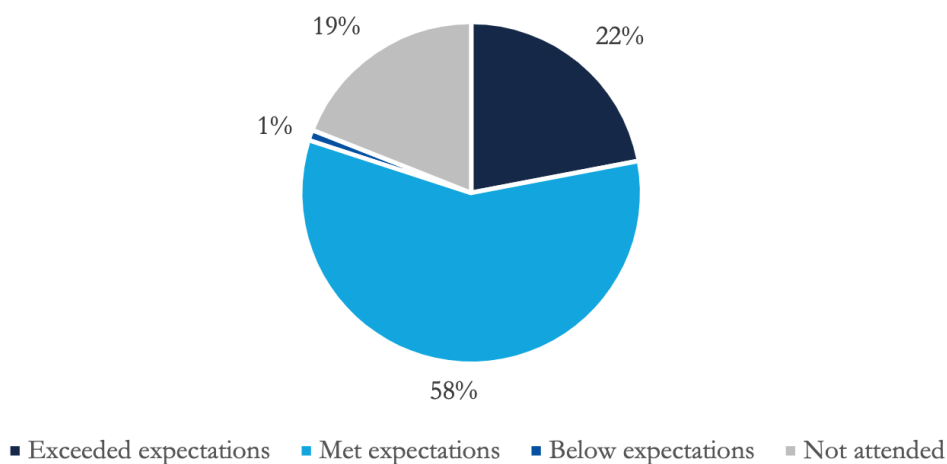
We reviewed the website in Wave 2 of the process review and found that information on projects consist of high-level summaries. We did not find many links to more detailed case studies, contacts or lessons learned.

‘Meet the Project’ events attract both potential sponsors and heat network suppliers. TPHN tell us that formal feedback on their events collected from attendees is good. For example,

in the reporting period October 2021– March 2022, seven events were held, and 99% of attendees, who responded to the feedback request, stated that the events met or exceeded expectations. These included: two BHIVE webinars with 84 and 50 attendees respectively, a heat pump focused event attended by 154 people and the final application seminar attended by 4 applicants. In total, 100 event attendees submitted feedback.

**Figure 22: Formal feedback collected by TPHN on all events held over six months from October 2021<sup>68</sup> (source TPHN<sup>69</sup>)**

How well did the event attended meet your expectations?



One interviewee who had valued the events noted that more information on lessons learnt would be valuable:

*I think some of the workshops have been really good. I think the lessons learnt from elsewhere, bringing people together and actually seeing what’s happened elsewhere, I think was really helpful. Could always do more of that. (Project)*

Not all project interviewees were aware of, or engaged with, these events. Covid and the move to online events may have affected networking opportunities, although the design of the virtual events has tried to address this by providing opportunities for groups to discuss topics of common interest.

<sup>68</sup> All of these events were held on-line due to COVID restrictions

<sup>69</sup> HNIP Customer Feedback Report, Document Ref: HNIP-Customer Feedback Version: 1. Issued: 31st March 2022

## **Demonstrating investability**

A key audience for demonstrator projects identified in the TOC are third-party investors. The HNIP funded projects were intended to provide a body of projects that would generate better understanding of risks and the potential for heat networks to generate acceptable returns over longer timescales by demonstration of the heat networks potential to expand, develop diverse heat customers (beyond anchor loads, and not just in dense urban areas), and connect to multiple diverse heat sources. In the current interviews we again see little evidence of projects acting as demonstrators for this key audience.

Potential investors we spoke to told us that they would have welcomed earlier engagement in HNIP. It would have been too early for active investment, but it would have enabled a better understanding of the emerging heat network market and investors' future place within it.

Engagement with investors is ongoing, mostly centred around BHIVE. However, there are reservations about its general applicability (see Section B3: 'BHIVE').

## **Wider engagement & raising awareness**

TPHN deliver work to raise the profile of heat networks more widely.

TPHN's wider communications (as opposed to specific support to applicants – which we discussed above) focuses on development of the heat network market, targeting all the actors in the market, including actual and potential sponsors, suppliers and investors, as well as the general public.

They use a range of media and methods including press releases, the TPHN website, HNIP events and social media. They also send out email announcements to market contacts and present at conferences.

TPHN began planning for communication and engagement from the early days of delivery of the main scheme. The team includes a stakeholder engagement firm (Acuity, who have subsequently been acquired by Gemserv). Additional public relations work was contracted from a firm called Sapience, who have helped expose HNIP to wider news markets beyond the specialist trade press, using social media such as LinkedIn.

To engage the media, they have moved away from rather 'dry' announcements of total funding amounts to more engaging narratives, focusing on community and human interest stories for example: how heat networks have the power to bring communities together and develop local supply chains.

## Looking forward: Improving communications

Suggestions for improving communications made to us include:

- More work distilling and sharing lessons from actual experience across the body of funded projects, particularly on governance, including things to avoid as well as things that went well, and
- Events focused on different stakeholder groups within the local authority e.g. finance, legal.

TPHN are starting to review and update how they communicate information about projects. Their ideas, shared with us, would go some way to addressing the points raised. They include:

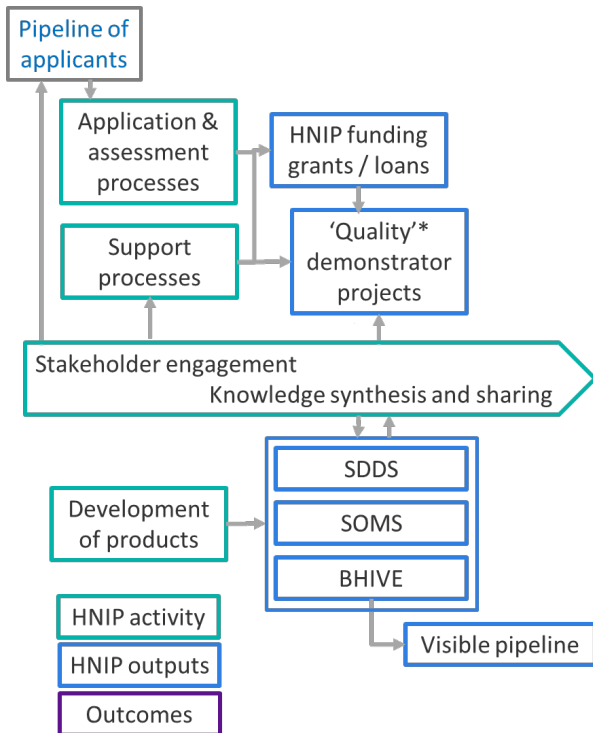
- Grouping communications about funded projects by technology. At present there are some news articles that do this on their website, but a more systematic approach would be helpful (see e.g. EfW projects – <https://tp-heatnetworks.org/waste-is-being-used-to-heat-homes-and-buildings-through-heat-networks/>).
- Placing more emphasis on place-based benefits, e.g. the role heat networks can play as a driver of green jobs.
- Presenting contrasting situations e.g. Swaffham Prior, a small, rural scheme, Cranbrook extension, a big, commercial scheme.
- Developing case studies for the individual projects post award: now that there's something happening on the ground, what can we say about the projects? What's changed? What are the challenges that they faced? Some of this is shared via LinkedIn posts but these are not always easy to find.
- Leveraging growing interest in e.g. ESG and levelling up (see e.g. [https://tp-heatnetworks.org/wp-content/uploads/2021/11/bhive-\\_placebased-investing-webinar\\_nov-2021.pdf](https://tp-heatnetworks.org/wp-content/uploads/2021/11/bhive-_placebased-investing-webinar_nov-2021.pdf)).
- Publishing some of the key metrics associated with the different projects.

In addition, we would suggest that TPHN:

- Provide more links to detailed information about projects, and contact details for people interested in exploring experiences directly with projects
- Make information and guidance derived from project experience, currently often captured in news releases or LinkedIn posts, easier to find and explore.

## 5. Ways of working between TPHN and BEIS

**Figure 23: Focus of this section of the findings**



### TOC narrative:

TPHN and BEIS agency is critical in achieving outcomes by, for example, enabling active support to applicants and projects, and ensuring fit between local priorities and perspectives and what government overall is trying to achieve – to enhance both local and national value.

**In this section**, we examine the nature of this relationship, and how this has supported delivery of HNIP.

### Start-up

The transition to working with a delivery partner took longer than anticipated. For BEIS this meant learning to work with the TPHN culture and establishing collaboration while still retaining oversight and governance.

For TPHN, members of the consortium had to learn to work together and to work with BEIS. TPHN also had to learn how to work with the complexity and variety of the applicant projects. At each stage this introduced surprises, for example in the number of clarifications they had to seek as part of the assessment process, and a (continuing) need to develop processes to accommodate this diversity.



TPHN took-over the delivery partner role from a previous incumbent, the pilot scheme delivery partner, Salix. This will have taken time, and key institutional knowledge may have been lost. This may be one reason why the delivery of enablers such as SOMS and BHIVE, and improvements to how projects are communicated, came relatively late in the project. We note that TPHN was commissioned to deliver GHNF, which means that this will not be an issue for this project.

## Learning

TPHN and BEIS have established a good collaboration with a learning culture and are continually improving the design and delivery of the scheme, for example:

- BEIS acted on the findings of the pilot scheme evaluation, for example refining the eligibility and scoring criteria to reflect feedback.
- TPHN introduced continuous improvement sessions after each round of assessment and continued to make small but significant improvements to the process based on these.
- Applicants report seeing improvement in processes, for example more rapid response to email enquiries.

See also ‘Learning approach to scheme design’ above.

## Agile, relationship management and the BDMs

The uniqueness of each project means that the emerging applications to HNIP do not follow a predictable pattern. In response to this, TPHN selected an agile, relationship-based approach aimed at getting to grips with the unique nature of each application. The BDMs have been critical to implementing this approach.

The BDMs needed time to understand and therefore perform their role optimally, and to establish working relationships with BEIS and across the TPHN consortium. Their role is now widely appreciated by pre-applicants, applicants and TPHN as enabling and supporting the navigation of the applicant journey. BDMs are the single point of contact for applicants and act successfully as a conduit and go-between for the assessors and applicants. They have been equally essential in conducting outreach work and engaging potential applicants either individually, or via HNIP publicity events, and maintaining a visible pipeline of potential applicants.

Post award, they have worked with the monitoring and reporting function within TPHN, and through personal contacts in projects, to respond, and where possible, support projects dealing with the high-levels of risk and uncertainty introduced by EU-exit, COVID, the war in Ukraine and market.

This agile approach has enabled BEIS and TPHN to respond to emerging risks encountered by projects as they moved through commercialisation and into construction

and has helped ensure HNIP has supported a high quality portfolio of projects as explained above.

### Intelligent delivery partner function

The breadth and depth of the TPHN consortium's expertise has enabled TPHN to act as an intelligent delivery partner, able to give active support to projects, within the scheme rules, and enable the flexible and responsiveness approach. Acting in this way they have been able to:

- Work effectively in support of local decarbonisation plans – to enable change within the local context – this may mean e.g. being flexible in supporting different pathways to decarbonisation.
- Reflect connections to other relevant local strategies and plans (e.g. regeneration, local-resilience) and work with them, both to enable heat network development and delivery of other local objectives.
- There is strong support for the proposition that TPHN and BEIS's responsive and supportive approach has been successful in melding the Government's national priorities and objectives from HNIP with local priorities.

### Data sharing

One area where there is a need for improvement is obtaining and sharing detailed data about projects. Data sharing between TPHN and BEIS had been poor, but is improving:

*... there's much more of a focus now on data than there was at the beginning of HNIP, we've got a kind of central database and we're in the process of migrating that to get it into a shape that fits with all our different schemes, of which HNIP would be one. It will be the first one where we're getting operational data. (Other)*

This is essential to support proper oversight and learning from projects.

# Appendix 5 An exploration of project diversity – Cluster Analysis

## Introduction to the Cluster Analysis

The uniqueness of each project means that the HNIP projects do not follow a predictable pattern. As part of the exploration of what is meant by projects' diversity within the HNIP context we have carried out a cluster analysis of the funded projects.

**Cluster analysis** or **clustering** is the task of grouping a set of objects in such a way that objects in the same group (called a **cluster**) are more similar (in some sense) to each other than to those in other groups (clusters). Statistical analytical methods are used across multiple dimensions of both numerical and categorical variables to identify these clusters. In this case we used the 'partitioning around medoids' method to develop our clusters, which is a more robust form of k-means clustering. Essentially the approach designates one of the data points (projects) as the centre (medoid) of the cluster and calculates distances from that point to all other points, minimising these distances for the selected number of clusters specified.

We have used these techniques to group the funded HNIP projects into similar groups (clusters). We tested three, four and five-cluster models, and found that the five-cluster model provided a set of five reasonably internally consistent clusters.

## Method

We started with some early sets of data and then expanded the datasets to include categorical as well as numerical variables. The data on each project was provided to TPHN and BEIS during the application process and as the projects have been progressed. The final set of 13 variables used in the cluster analysis are given in Table 6 (in the annex to this appendix: 'Annex: Variables used in the Cluster Analysis'), where we have also described how these variables have been displayed on the radar diagrams below, normalised by cluster<sup>70</sup>.

We began by looking for 'ideal' types, i.e. well defined groupings, whose members were clearly distinct from the members of other groups and represented identifiable project typologies. The extent of project diversity however made this impossible.

After some discussion between the evaluation team and BEIS, and testing of which variables would be useful and interesting to include in the clustering process, the ones selected, including funding round, heat source and a range of categorical and numerical

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<sup>70</sup> The normalised score used on the radar diagrams for each variable was calculated for a cluster by dividing the average value of the variable for the cluster by the maximum average score over all clusters.

variables, gave us a set of internally consistent clusters that gave us some insights into the types of projects that formed the HNIP portfolio. These are described below.

## The five HNIP project clusters

The absence of clear project types tells us something about the extent of variability and diversity in the project portfolio. While the clusters do not provide us with easy predictions about the types of future projects that may arise, the clusters do provide us with a way of illustrating some of the diversity within the HNIP portfolio. The five HNIP project clusters

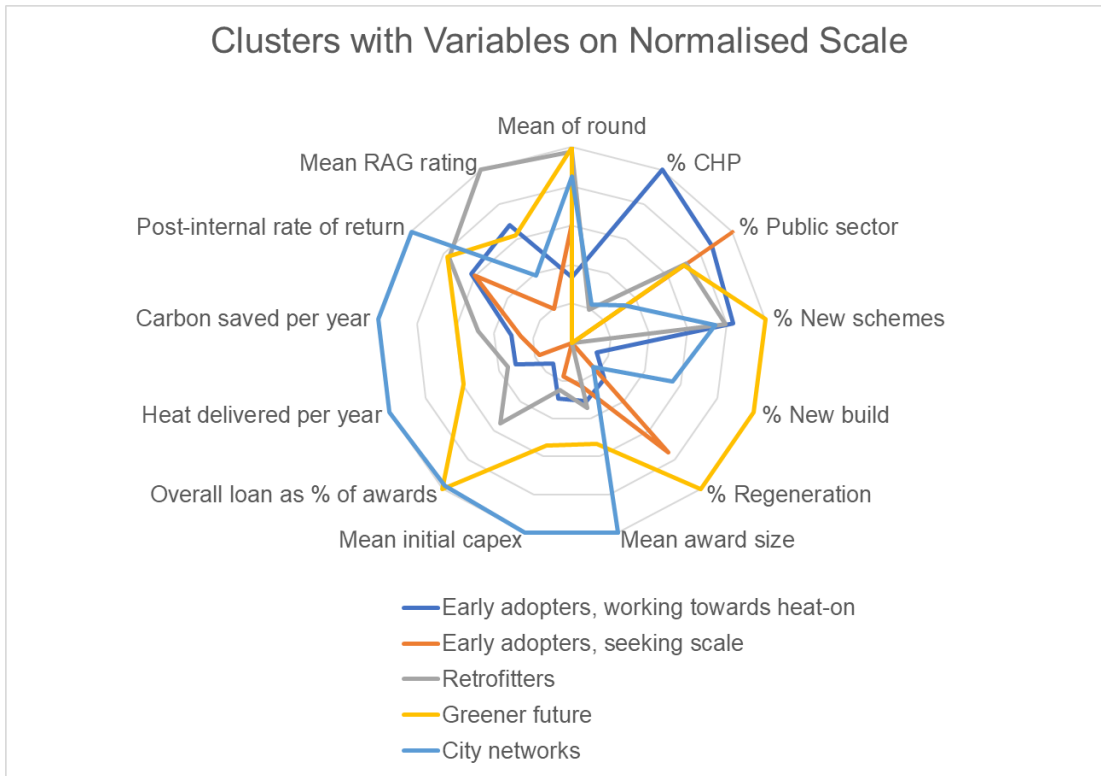
The absence of clear project types tells us something about the extent of variability and diversity in the project portfolio. While the clusters do not provide us with easy predictions about the types of future projects that may arise, the clusters do provide us with a way of illustrating some of the diversity within the HNIP portfolio. shows the five-cluster model we have developed to explore the HNIP funded project diversity and how they rank in terms of each of the variables used as input for the analysis. We have given each cluster a name, that appears to us to capture the key features of the cluster. These are:

- Early adopters, working towards heat-on
- Early adopters, seeking scale
- Retrofitters – working in communities
- Greener future
- City networks.

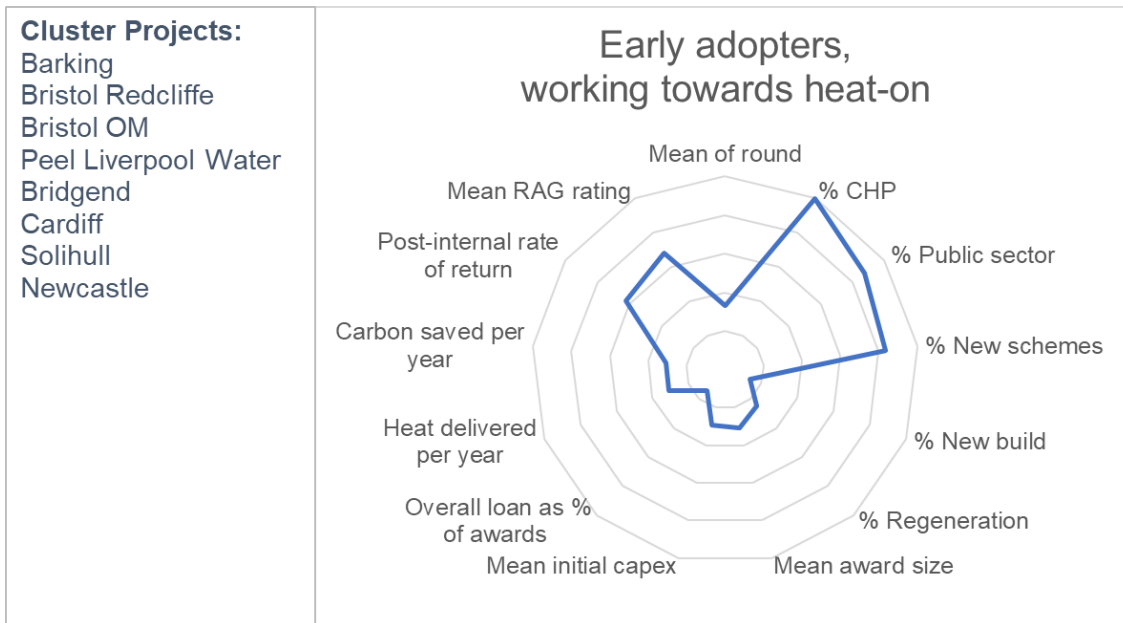
The figure shows that the clusters differ in their characteristics, expressed in terms of the 13 variables. For example, we can see that the Early adopters, working towards heat-on cluster (dark blue on the chart) has a low score against round (indicating that the schemes typically were funded in earlier rounds), are typically small (for example having relatively low scores for heat delivered per year, and mean initial CAPEX), mostly public sector led, and all CHP (at least in the first instance). This cluster has a comparatively high average RAG (risk) ranking, showing that they are still considered at some risk (either Technical, Commercial or Financial as reported in December 2022). This can be compared with City networks (light blue on the chart), which are typically large schemes, funded later in HNIP, using zero or low carbon heat sources and private sector led. They typically have low RAG ratings.

In the following sections we describe the clusters, list the HNIP projects that compose them, and describe a case study exemplar.

**Figure 24: The Five-Cluster Model of HNIP Funded Projects**



**Cluster 1: Early adopters, working towards heat-on**



**Prototypical description**

The Early adopters, working towards heat-on cluster is characterised by predominantly public sector led projects from the earliest round of HNIP, with heat derived primarily from

CHP sources (at least as the starting point, although there may be ambitions to decarbonise heat further into the future).

These heat networks are generally new schemes, with end users in both existing buildings and new developments. The projects are not centred around regeneration schemes and are generally relatively modest in scope. Despite being some of the earliest projects to be funded, progress of these projects has been relatively slow (as indicated by the relatively high RAG risk rating).

### **Case study project exemplar**

The Bridgend Town heat network was awarded a grant of £1.24m in round 3 of HNIP for commercialisation and construction of the scheme. The network will serve public buildings in the town centre as well as a new development (so both existing and new buildings). The energy centre will be based at the Bridgend Life Centre and will be a gas fired CHP, with a plan to replace it with a larger CHP unit and thermal storage tanks as the scheme grows with a further plan to decarbonise heat supplies in future.

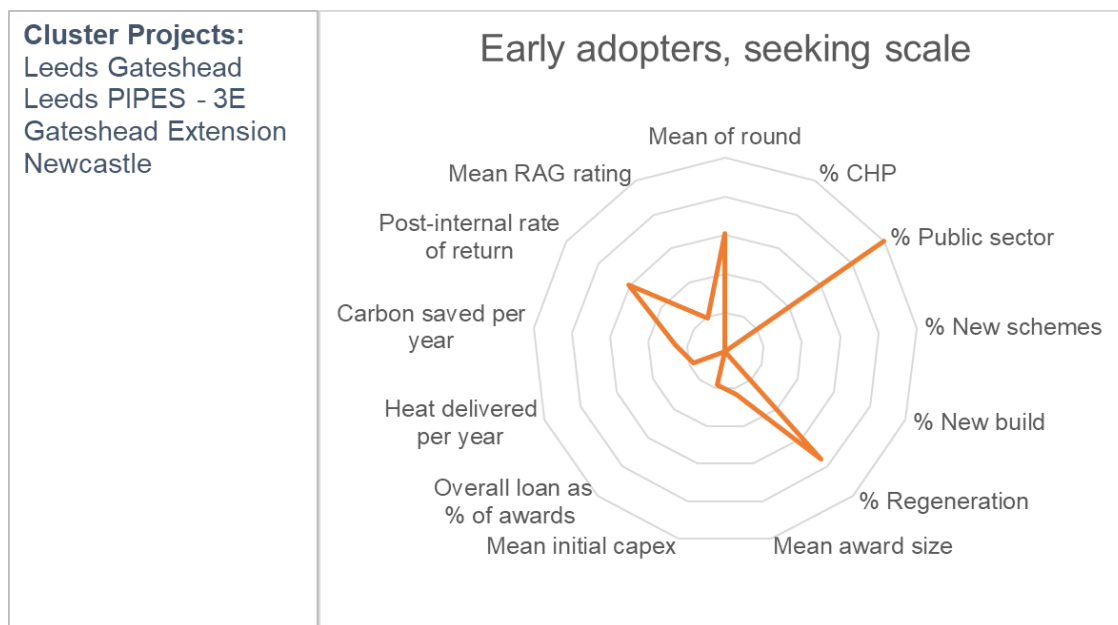
The initial capex for the scheme was planned to be £4.3m. In the Triple Point December 2022 monthly summary report on projects<sup>71</sup> the financial health of the scheme was reported as an amber risk, as project costs have increased (due to inflation and Covid/ Brexit-related issues) and may increase further. Bridgend Council has created a special purpose vehicle (SPV) called Bridgend Heat and Power Ltd to deliver the scheme – this is currently wholly owned by Bridgend County Council.

The project was one of the earlier schemes, and the intention was for it to be generating heat by 2022, it is unclear exactly what stage of development this project has currently reached.

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<sup>71</sup> Summary Monthly Report on Funded Projects, Monthly report for December 2022, HNIP Monitoring and Reporting – Triple Point Heat Network

## Cluster 2: Early Adopters, seeking scale



### Prototypical description

The Early Adopters cluster is characterised by public-sector organisations seeking to extend existing heat networks, serving both existing buildings and new properties with a focus on regeneration.

Most projects were from early rounds, although one was a continuation of an early round project that was then put forward in a later round. The projects use lower carbon energy sources (energy from waste and heat pumps – there are no gas energy sources in this cluster). All the HNIP funding in this cluster is in the form of grants.

### Case study project exemplar

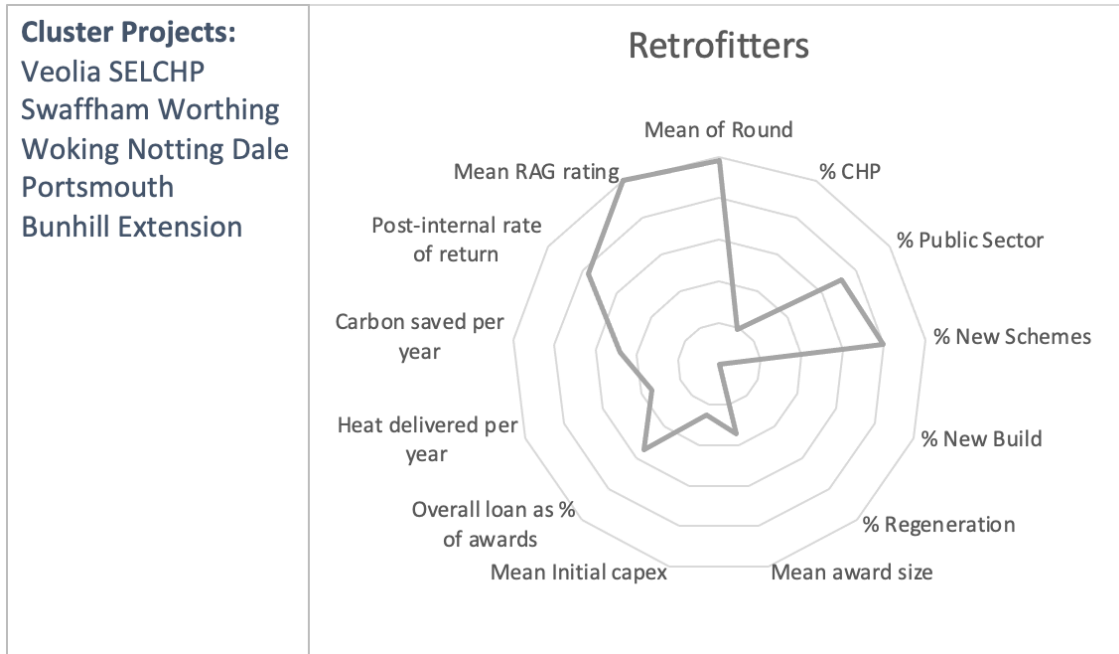
Leeds PIPES was awarded funding in both rounds 1 and 6. In round 1 the scheme was already building on an existing heat network using £2.4m of HNIP funding to extend its network to connect five council buildings and other existing developments and buildings to low carbon heat and hot water generated from waste steam created by the Recycling and Energy Recovery Facility in the city. The second scheme, in round 6, adds a further grant of £3.06m to allow a total of £7.4m of upgrades to extend the network. The overall investment in district heating according to the Leeds Pipes website is £45m<sup>72</sup>. In 2021 the heat network supplied 15,454 megawatt hours of heating and reduced the city’s carbon footprint by 2000 tonnes<sup>73</sup>. The pipes will extend more than 28 km when completed, and the intention is that any buildings and developments that want to can connect to the network once it is in place.

<sup>72</sup> <https://www.leeds-pipes.co.uk/>

<sup>73</sup> <https://tp-heatnetworks.org/funded-projects/>

This cluster shows what is possible once heat is on – these projects all build on existing networks.

### Cluster 3: Retrofitters – working in communities



#### Prototypical description

The Retrofitters cluster spanned the timescale of HNIP from first to last round – although later rounds (9-12) dominated.

Predominantly based on heat pump technology and dominated by the public sector, these schemes were mostly new schemes (not extensions of pre-existing district heating schemes), but the focus was on using the heat network approach to retrofit to existing infrastructure, rather than for regeneration and new building developments at scale. Schemes that involve the local community, medium funding, and a mixture of grants and loans form this cluster.

#### Case study project exemplar

Notting Dale heat network is a Local Authority-led project with very strong community involvement, intending to provide heat to 826 homes and several public buildings and building units in North Kensington. The project will use Air Source heat pumps technology, aiming to be zero carbon from 2030<sup>73</sup>.

The project emphasises community involvement, working with residents on every step of decision-making about the heat network plan. There is an active website where residents are kept informed of the progress of the project, and residents are involved locally in

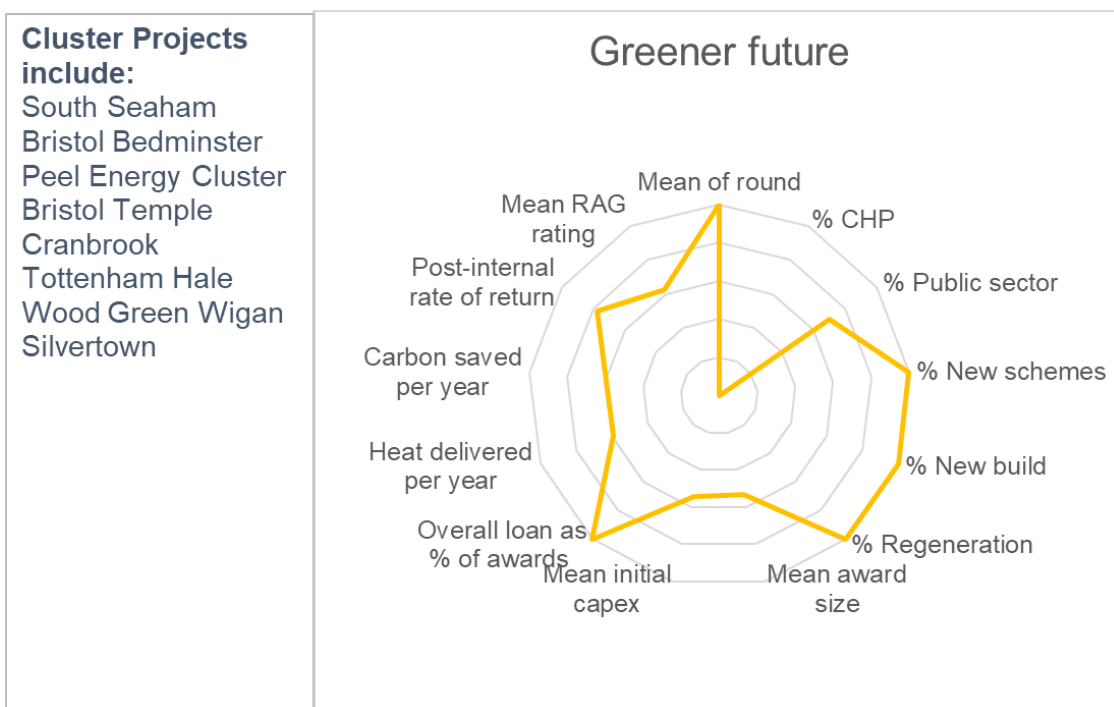


working with the team in decisions such as the location of the energy centre and in its co-design with the architect team<sup>74</sup>.

Because of the centrality of the community to the heat network they have been involved formally as well as informally. The SPV set up to deliver the heat network has been created with a board comprising two council nominees, two residents and two independent members selected for their specific skills and experience aimed at filling any potential skills gaps. The community is sensitive to price, so it has been essential to the project’s success to provide price guarantees to the end users against equivalent prices for e.g. private gas combi-boiler (the impact of current energy prices may have some impacts here, but longer term this remains unclear and prices for consumers must always be at least as low as the equivalent alternative).

Locally the council has run a ‘Goodbye to Gas’ campaign, persuading residents to replace gas appliances with electric and helping with appliances, hobs and even new pan sets, preparing residents for fully electric and also district heating. The campaign emphasised the environmental, safety and health credentials of retrofitting<sup>75</sup>.

### Cluster 4: Greener Future



### Prototypical description

The Greener Future cluster is dominated by projects from later rounds, mostly rounds 8 and 9, with two from round 12. Heat pumps and Energy from Waste are the only heat

<sup>74</sup> <https://www.wearew11.org/en/heat-network>

<sup>75</sup> <https://www.wearew11.org/en/goodbye-gas>

sources – gas is not used at all, so decarbonisation has evidently been one of the drivers for these schemes.

Primarily public sector, these are almost entirely new schemes, focussed on new developments and aimed at regeneration. Awards tend to be larger and the schemes themselves are also on the medium to large side. Many of these schemes have been given an amber risk rating for either technical, commercial or financial reasons. Several projects are awaiting clarification of issues or costs have risen due to inflation etc. There are more loan than grant projects in this cluster, and in one case all the money provided by HNIP is in the form of a loan.

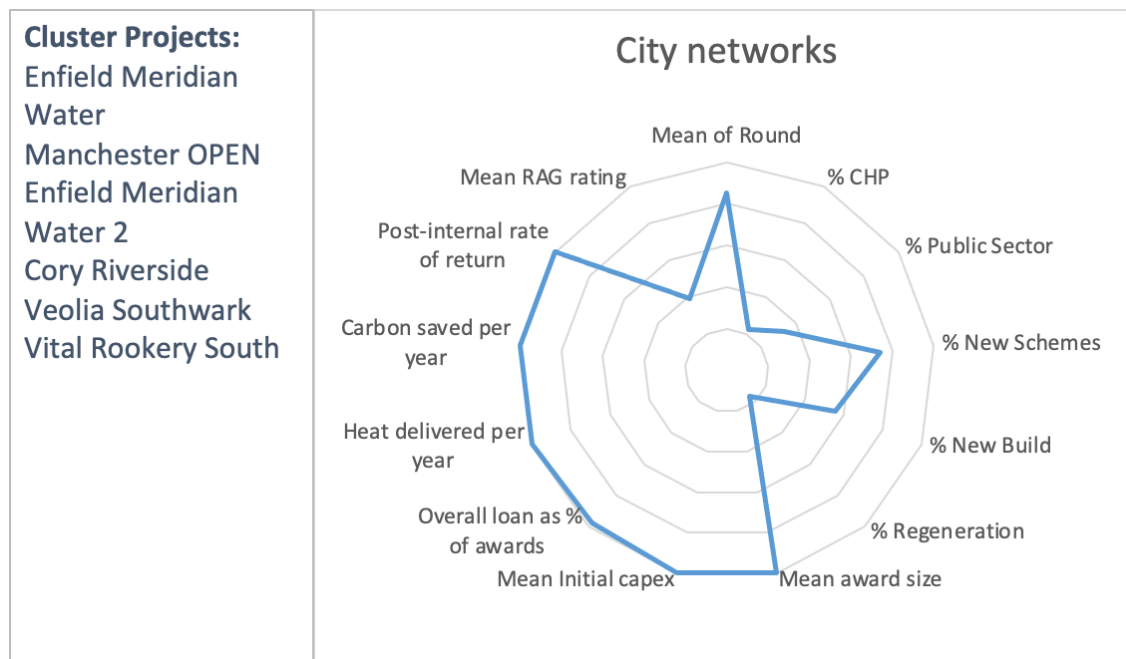
### **Case study project exemplar**

Cranbrook is a new town in East Devon. It currently has 2,800 homes and is located close to employment opportunities in Exeter and the new low carbon Skypark business park. A single heat network already serves the existing Cranbrook site and Skypark. Skypark is planned to grow to provide 6,500 new jobs, while Cranbrook will expand to around 8,000 houses. A new heat network is being developed to serve a new Exeter Science park and further housing development. HNIP is providing £10.7m funding, part grant, part loan, towards work to connect the two networks to an Energy from Waste plant. East Devon County Council has gone out to tender for a bidder to develop the design to construction stage of the scheme and the successful ESCO will own, operate and maintain the network and be responsible for customer billing. Initial heat is expected to be provided by mid-2024.

By the 2030s there are expected to be 12,000 homes across two new towns and eventually 20,000 by 2050, as well as two million feet of commercial space.

The development of the scheme by East Devon District Council represents a large undertaking, particularly compared with the current size of the district. According to the 2021 Census its population was 150,828 and its largest town is currently Exmouth with a population of around 34,500 so the development of these new towns and science parks, together with the heat networks to serve them, represent a visionary expansion. The environmental agenda within the development is clearly very important to the council. They also plan to develop local skills and jobs for the heat network.

## Cluster 5: City Networks



### Prototypical description

The City Network cluster has projects from a range of time periods, from rounds 2 to 12. It is dominated by Energy from Waste schemes and has more private than public-sector backers. These are primarily very large schemes, aiming to take the large amounts of otherwise waste heat from waste incineration and turn them into an efficiently used heat product.

Most of the schemes are new schemes and are not based around regeneration but on supplying heat into cities to existing or new buildings or both. The funding provided by HNIP in this cluster often includes loans rather than solely grant funding. The projects are considered green or amber on the risk register with no or moderate current technical, commercial or financial issues.

### Case study project exemplar

The Energetik schemes (Enfield Meridian Water and Enfield Meridian Water 2) were funded by HNIP, one in round 2 and then a second extension in round 7. The two schemes extend the pre-existing heat network across the London Borough of Enfield to enable the supply of very low carbon heat to over 50,000 homes<sup>73</sup>. These link together and work to significantly decarbonise the existing heat networks in the Borough by connecting them to the forthcoming Meridian Water energy centre, connecting to the North London Waste Authority Recovery Facility due for completion in 2026. HNIP funding enabled their planned extensions to be brought forward by several years.

Unlike some other projects, heat is already being delivered in Enfield – they already have around 1000 end user customers, and plan to have 10,000 by 2030 and 60,000 when the

network is complete – this is the scale of their scheme. Many of the homes served will be new build on new estates, but they are also serving some areas with retrofitting. It is notable that the cost of retrofitting is high, and homeowners are unlikely to want to bear this cost themselves – social housing is the priority in this area, with the local authority bearing the retrofitting costs.

## Annex: Variables used in the Cluster Analysis

**Table 6: Variables Used in Cluster Analysis**

<b>Variable</b>	<b>Variable Description</b>	<b>Variable Displayed on Radar Diagram (normalised to maximum cluster value)</b>
Round	The HNIP funding round in which the project was funded, integer values from 1-12	Mean value of Round for schemes in cluster
Heat Source Technology	Categorical variable: CHP, EfW or Heat Pump	Percent of schemes in cluster using CHP
Maximum RAG status	Categorical variable: Highest Project RAG status (Red, Amber or Green) for Technical, Commercial or Financial Risk as reported by the delivery partner in Dec 2022	Mean RAG rating for the cluster, where the R, A and G have been converted to numerical values 2,1,0 respectively
Public or private sector	Categorical variable: Project led or sponsored by public or private-sector organisation. Public sector, usually a local authority.	Percentage of projects in cluster led by public-sector organisations
New or existing scheme	Categorical variable: Project is completely new, or an extension of an existing scheme	Percentage of projects in cluster which are new schemes
New build or retrofit	Categorical variable: Project is supplying new development/s or scheme is supplying properties retrofitted to take heat, or both	Percentage of projects in cluster which serve new developments only

<b>Variable</b>	<b>Variable Description</b>	<b>Variable Displayed on Radar Diagram (normalised to maximum cluster value)</b>
Regeneration	Categorical variable: Project is part of a wider regeneration scheme (variable developed with advice from TPHN)	Percentage of projects in cluster which are part of a wider regeneration scheme
Award size	Numerical variable: Financial value of HNIP award to the project in £	Mean size of award across projects in the cluster
Initial Capex	Numerical variable: Financial capex of the HN project in £	Mean initial capex across projects in the cluster
Loan or Grant	Numerical variable: Percentage of the award given as a loan (range from 0 to 100%)	Overall percentage of loan value across all projects in the cluster
Heat delivered per year	Numerical variable: Projected annual heat expected to be delivered by the project when operational	Mean heat delivered per year across projects in the cluster
Carbon savings per year	Numerical variable: Projected annual CO <sub>2</sub> e savings expected to be delivered by the project when operational	Mean carbon savings per year across projects in the cluster
Pre and Post internal rate of return	Numerical variable: Financial rates of return without and with the HNIP award	Mean internal rate of return across projects in the cluster

# Appendix 6 Learning and knowledge strands

The portfolio offers significant opportunities for learning. We have identified some examples of learning strands that could be taken from the portfolio here:

## Enabling local heat network development

### Strand 1: Examples of HNIP heat generation and decarbonisation solutions

When they are operational, HNIP projects will provide a showcase portfolio of different technologies.

HNIP has had a catalysing effect in enabling the application of diverse heat generation approaches:

*... been important in bringing forward projects that would have been more difficult, some CHP, some EfW, some electrification. It has been important in that respect. Clearly obviously in the kind of more strategic context that is very important, particularly on the EFW and the heat electrification perspective given where the heat network sector needs to go. (Project)*

These include:

- Municipal waste incineration (EfW) – including an example of carbon capture from the burning of waste.
- Water source, air source and ground source heat pumps providing networked heat.
- Use of underground water from disused coal mines as a locally available source of energy.
- An off-gas community where a village previously dependent on oil for domestic heating is introducing a network powered by heat pumps:
- Fifth generation heat network technology planned for some of the networks particularly EfW larger volume projects.

Fifth generation heat networks distribution of water at close to ambient ground temperature. They employ distributed heat pumps: a heat pump in each building, or apartment to transfer heat in to achieve heating when buildings need heating, and to transfer heat out when buildings need cooling. Heat losses to the ground are eliminated and the cost of installing the distribution circuit is radically reduced.

Information about projects is available on the TPHN, and networks' own websites, and have been shared periodically through HNIP project days. TPHN have said they are keen to extract deeper learning, for example by comparing and contrasting different projects or pulling out common themes. Some of this is becoming evident on the TPHN website, with news releases, for example, highlighting examples of different technologies and heat sources (e.g. heat pumps and EfW), but can be difficult to find and does not, as yet, draw out deeper learning.

## Strand 2: Different procurement, commercial and investment models

A recognised gap in skills, knowledge and guidance is the lack of public sector experience and expertise in relevant procurement, commercial and investment models. The HNIP portfolio potentially provides a rich knowledge base to inform this.

Prior to and during commercialisation, a significant activity for many heat network sponsors will be deciding on an appropriate way to structure the project in terms of governance, ownership/partnership, operating and delivery models. It is important that those sponsoring heat networks understand how the choice of model has an impact on how they can meet their own and potential investors' goals. Those developing projects need to understand the different investment models and how these relate to different operating models and to the delivery of benefits. Local authorities may simply not be geared up to consider investability from a commercial perspective. Interviewees felt HNIP could usefully provide more guidance on governance and the different ownership and partnership models that could be considered (see 'Looking forward: Improving communications').

The role of TPHN has been significant in increasing the confidence and knowledge of public-sector sponsors, especially during the commercialisation process. The delivery partner's role, or its equivalent, in future infrastructure investment projects of this nature provides a rich source of practical knowledge.

## Strand 3: Moving to scale

The HNIP portfolio provides exemplars for heat networks at very different scales and with very different aspirations, including:

- **Small off-gas communities**, as described above, without ambitions for going to scale
- **Heat networks developing at scale.** Examples include the development of cross borough heat networks often powered by EfW and the connection of existing heat networks.
- **Heat networks working towards scale.** Having got the project underway sponsors seek to attract further heat off takers such as a local school, business, other local authority buildings or a hospital interested in joining the heat network.

The portfolio creates the opportunity to pick out replicable elements and those which support going to scale. On the latter there are examples of networks expanding beyond the initiating Local Authority's boundary to become supra-local. In combination with the introduction of zoning these networks provide learning on both the opportunities for, and practical limits of, heat network expansion. Questions which are now starting to be answered include: "how big can a network be?" and "how can it link to other emerging local networks?"

The policy and planning framework, which is currently being strengthened, is a key enabler of scale. New developments such as zoning, regulation and the future homes and buildings standards, and development of the CP1 technical standard address key barriers, e.g. unlocking private investment by managing demand risk, and ensuring future connectivity.

There remains much uncertainty about what regulation will contain, and whether zoning can deliver, given constraints in the supply chain and the technical and administrative challenges of managing large infrastructure projects, preparing existing and new developments to be zone ready, and working across LA boundaries. Zoning needs to work hand in hand with strong regulation that enforces property standards. The portfolio contains markers for network development and policy responses such as zoning and regulation (see also 'Strand 7: System strengthening' below).

#### Strand 4: Getting and maintaining stakeholder engagement

Working with key stakeholders to build commitment to schemes is identified as a key enabler of a heat network development. This includes officers from across the LA, with council members, with partners (including ESCOs), with customers (particularly anchor load customers), with the supply chain, and in some circumstances with end users (consumers of heat). The portfolio provides valuable examples of, among other things:

- Private-sector sponsor engagement with the local Authority, whose support, commitment and enthusiasm was experienced as a valuable component in moving to scale
- The steps taken to fully engage local communities in the heat network project in both inner city and rural locations converting concerns and anxiety into enthusiasm and support, and putting consumer needs at the heart of heat network planning. This goes beyond getting necessary agreements in place, to understanding the community and recognising and responding to local sensitivities and different information needs.
- The use of social impact requirements included in procurement processes, to 'lock-in' social benefits for residents.

Champions have played a fundamental role in most, if not all, of the projects we have interviewed, marshalling resources, stakeholders, and agendas in support of heat network development. The portfolio provides an opportunity to explore the skills and knowledge



champions bring to their role and how they have worked with HNIP to achieve shared objectives. It will provide markers for how the role of local champions can be recognised and leveraged by national policy that relies on local action to maximise value both in terms of delivery of national and local objectives.

## System and strategic learning

### Strand 5: Understanding investability

The portfolio, as projects reach maturity, will offer exemplars of different models of investment and investability. There are a range of questions that could be asked of the portfolio here, including:

- What is it about the development of the portfolio so far that makes it investable while recognising that it is not yet sufficiently developed to attract significant third-party investment? Aside from the BEIS HNIP contribution there has been considerable investment from Local Authorities, ESCOs, Housing Associations and Regeneration and Development projects to enable the establishment of Heat Networks. What learning can be captured from this?
- How can networks be enabled to continue to grow out organically by creating other investment opportunities? Can learning be derived from HNIP or from other infrastructure markets that have found ways of using private capital including using lease finance, rental programmes, heat pump rental, etc?
- How can we more effectively:
  - Transfer practical knowledge around the investment directly stimulated by HNIP for example in ESCO, Local Authorities and local suppliers – what went well, why, what went less well etc (e.g. lessons around getting easements in rural based heat networks)?
  - Segment the supply market into discrete investable opportunities for product development (e.g. heat pump development, network pipes, skill sets)?

### Strand 6: Delivering network development and carbon abatement

The portfolio provides valuable worked through examples of how, and in what contexts, the dual goals of decarbonisation and network expansion can be achieved.

The evidence reveals that that there is no strategic conflict between de-carbonisation and building out heat networks (either as initial builds, or to achieve scale). The portfolio diversity, driven as it is by place-based factors, includes networks that have emphasised de-carbonisation, others that emphasise extensive network development and some that are successfully combining both. Examples include:

- A heat network that started with a relatively low initial proportion of de-carbonised heat, using anchor load customers to unlock wider decarbonisation potential.
- Heat networks that prioritised build-out of the heat network over choice of energy on the assumption that once a network has been established it could adapt to ever improving de-carbonised heat generation over the decades.
- Heat networks that prioritised immediate adoption of de-carbonised heat generation to avoid being locked into technology that produces higher carbon levels and to meet planning requirements.

## Strand 7: System strengthening

Local examples point to system solutions beyond the immediate locality or a tight focus on carbon emissions. The portfolio contains a number of examples of this, for example:

- **EfW and grid management** provides an example of heat networks fitting in versatile carbon driven grid arrangements. EfW viability is demonstrated by the conversion of the energy it produces to heat rather than retaining it all for electricity generation.
- **Supra-area management structures** addressing the challenges of within locality network development while going beyond administrative boundaries (Bristol, Meridian, Riverside, Leeds) – a blueprint for zoning.
- **The systemic integration of heat networks within showcase and other local initiatives**, such as workforce development for network delivery and maintenance skills, strengthens the case for the heat network, marshals support and delivers co-benefits for the locality and against national objectives.
- **Workforce development 'spin offs'**, which provide evidence of sponsors' engagement in system development in order to strengthen heat network sustainability.
- **The management of connection risk**, the capacity of existing networks to expand their customer base is a further aspect of viability and investability. Customers can see that there is an operating network, delivering heat.
- **Building resilient programmes**, HNIP has demonstrated how the capacity and agility of the BEIS/TPHN partnership enabled it to respond effectively to local contingencies, change and uncertainty within the broader market system, and integration of HNIP with other components of the government's decarbonisation strategy. Nevertheless, HNIP was not operating as a systemic approach despite achieving systemic outcomes. Use of tools such as the 'green heat network system map' should enable a future heat network project and programme design to operate more effectively in this way.

## Strand 8: Delivering national projects in a place-based way

HNIP provides a demonstration of how national programmes delivered largely through place-based investment delivering learning around:

- How national policy and practice can be designed to work effectively with local strategies and plans
- Whether and how the make-up of project portfolios can be managed to optimise opportunities for learning.

This publication is available from: [www.gov.uk/government/publications/evaluation-of-the-heat-networks-investment-project-hnip-scheme](http://www.gov.uk/government/publications/evaluation-of-the-heat-networks-investment-project-hnip-scheme)

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