Department of Energy & Climate Change

Evaluation of the Heat Networks Delivery Unit

Interim report covering wave 1 research

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Executive summary

This executive summary describes the key conclusions from a first wave of research undertaken by CAG Consultants as part of an evaluation of the Heat Networks Delivery Unit (HNDU).

The HNDU was established in 2013 to address the capability and capacity issues faced by local authorities (LAs) when developing heat networks. It is a specialist unit, composed of both technical and commercial staff, hosted within DECC. The unit provides support in the form of grant funding and guidance to LAs in England and Wales that is designed to enable them to progress through the early stages of heat network development. LAs can apply to the HNDU for guidance only – a flexible package of expert support supplied by HNDU staff – or for a combination of grant funding and guidance. All LAs awarded grant funding from the HNDU receive guidance from the HNDU team. An HNDU 'project lead' is allocated to successful LAs and acts as a critical friend throughout their engagement with the unit.

The evaluation involved qualitative research with 27 local authorities that had HNDU support (HNDU LAs), 22 authorities that did not have HNDU support (Non-HNDU LAs) and nine industry stakeholders (primarily consultancies). Non-HNDU LAs included LAs that had undertaken heat network activity locally as well as those that had not. In addition it included a survey with HNDU LAs and a review of HNDU-supported outputs e.g. consultant's reports. The research was informed by an overarching Theory of Change (ToC), which key industry stakeholders were consulted on. This involved mapping the theory of the HNDU intervention (i.e. how it was expected to work) against the assumptions underpinning the theory, along with other factors that would be expected to interact with HNDU activity. Subsequently the ToC was used to identify key areas of research, for example the validity of the assumptions underpinning the HNDU intervention, as well as possible alternative explanations for observed changes in LA-led heat network activity.

Key Conclusions

The following represents a summary of the key conclusions under the seven main research question headings.

1. What outputs have been delivered (by HNDU and local authorities) during the lifetime of HNDU funding?

The HNDU ran four rounds of funding to support early stages of heat network development. These generated a total of 234 applications from 121 local authority applicants (34 applicants submitted more than one bid) of which 201 were successful. The reports from funded feasibility studies will constitute the primary direct output of HNDU support, but at the time the research was conducted nearly all HNDU LAs involved in the qualitative research were either in the process of procuring consultants, awaiting the outputs from consultant activity, or considering the findings of commissioned reports.

2. How, and to what extent, has the HNDU helped local authorities progress the development stages of low carbon heat networks?

The evidence strongly suggests that the HNDU has played a key role in helping HNDU LAs to progress their development of heat networks. Nearly all HNDU LAs involved in the qualitative research had previously undertaken work on heat networks, though much of this work appeared to have been put on hold due to a lack of funding. Many HNDU LAs in the qualitative research noted that they would not have been able to take forward new work on heat networks without financial support from HNDU. Most industry stakeholders reported that they felt that much of the current LA work would not be progressing without HNDU support, noting that they had seen a marked increase in activity since the inception of the unit. Some HNDU LAs noted that the existence of funding had helped to attract their authorities' attention to heat networks, whilst some noted that the source of the funding brought added value in the form of enhanced credibility. This was seen as being helpful in securing internal support.

There was also clear evidence that HNDU guidance was valued, particularly assistance with the effective procurement of consultancy support and the provision of general technical guidance. This was seen as helping to address deficits in technical expertise, although there was a small minority of LAs who already had in-house expertise from previous work on heat networks, and didn't require much support. Some HNDU LAs made a point of commenting on the flexibility of the guidance, suggesting that it was not just the type of support that was valued but also the approach to delivery. There was some evidence that HNDU guidance was raising the in-house capability of recipient authorities and improving the HNDU LAs ability to act as an 'intelligent client'. There was also some evidence to suggest that this expertise would be retained, at least in the short term, simply as a consequence of staff retaining their posts.

In line with HNDU requirements, nearly all HNDU LAs noted that their studies were considering, or had considered, multiple heat source options. Whilst many anticipated that their schemes would be based on gas CHP, there was some evidence of an awareness that schemes should be future-proofed to allow future conversion to lower carbon options.[1]

Although asked, only a few HNDU LAs offered views on how the HNDU might improve its service. All but one requested additional guidance time. This reflects well on the value placed on the guidance, although it should be noted that a few HNDU LAs felt the unit was over-stretched and that this impacted on the value of the guidance support.

At the time of the research, it proved difficult to find any evidence of LAs who were taking forward substantive heat network development without HNDU funding. Despite extensive efforts to identify such LAs to participate in the research, only one could be identified and they chose not to be interviewed. Several of the LAs who had received HNDU support were found to be already hosting active heat networks. It seems likely that the majority of LAs actively pursuing heat network development have applied for HNDU support.

3. What other factors, or influences, have driven progress by local authorities on low carbon heat networks?

All HNDU LAs noted the presence of strong internal drivers (i.e. the reason an organisation does something) for taking forward development of heat networks. Carbon reduction featured as one of the main drivers in both the quantitative and qualitative research, but there is some

[1] HNDU encourages LAs to investigate as wide a range of heat sources as is appropriate to find the lowest cost (technically feasible) combination of sources so that their heat network is most likely to be viable and reach construction stage.

evidence to suggest that commercial drivers such as economic regeneration, cost reduction and income generation are becoming more important relative to 'traditional' drivers such as carbon reduction and fuel poverty.

Internal champions emerged strongly as being important enablers (i.e. a factor that allows an organisation to respond to its internal drivers) of heat network activity within local authorities. The individuals identified held a variety of roles, with the only obvious common characteristic being their commitment to the issue. Champions are not currently recorded as an enabler within the Theory of Change (see annex) and this should be reviewed. Their presence or absence may become more important as projects proceed into the more demanding stages of development. Planning was seen by some authorities as playing a locally important enabling role, but some expressed concerns about the proposed changes to building regulations which were perceived as undermining the role of planning as a mechanism for enabling/driving the development of new networks.

In relation to external drivers and enablers there was clear evidence, in both the quantitative and qualitative research, that HNDU LAs had also accessed non-HNDU forms of support from a variety of regional and national public sector sources. This support was reported as having been of value to recipients but was found to be variable in nature and in most cases highly localised. Overall only limited evidence of duplication of support was found, with some of the most substantive forms of non-HNDU support proving to be historic and finished prior to HNDU involvement. Those that remained appeared to be evolving to complement, rather than duplicate, the support from HNDU.

Some factors that were assumed to be supportive of heat networks progress within the ToC did not emerge as such within the qualitative research. Specifically, the current low cost of capital and changes to regulation in the heat and electricity market – intended to better enable local authority engagement - were not identified as significant by HNDU LAs. The ToC also assumed that government policy would be viewed as supportive, but some respondents reported general concerns about perceived uncertainty within the wider government energy policy environment.

4. What, if any, other barriers are local authorities encountering despite HNDU support – either already encountered or anticipated in future?

Many HNDU LAs anticipated that securing the capital funding needed for project development would be challenging. Having sufficient revenue funding to buy external support required was also noted as a potential barrier.

Some LAs noted that they expected their schemes would only offer marginal rates of return, making them unattractive to private finance and reliant upon public investment. Future analysis of HNDU-funded reports will be useful in revealing the forecast rates of return, but it seems reasonable to assume that a number of viable schemes may prove insufficiently attractive to attract private sector capital. Evidence to support this supposition can perhaps be seen in the calls for assistance with financing recorded under Q5. Given the apparent significance of this issue it is suggested that it warrants further consideration in wave two of the research. In the first instance it may be worth conducting a further interview with those few HNDU LAs who noted that they did not see access to capital finance as a barrier.

During the qualitative research a number of HNDU LAs reported that it was extremely challenging to engage developers in potential heat network activity. This issue was also rated as the second most significant external barrier in the quantitative survey. This was not identified as an issue within the ToC, but is clearly significant for affected authorities and should be considered when developing the wave 2 research. The qualitative research also found a few

HNDU LAs, a long with many industry stakeholders, reporting problems with engaging other public sector actors in heat network development, particularly hospitals. One issue here would appear to be the complexities of NHS property ownership and management regimes. Given the importance of hospitals as potential anchor loads this may also warrant further investigation. Most respondents did not appear to have engaged with actual/potential customers but there was some evidence that this was anticipated as being potentially challenging.

In summary, respondents were able to identify a number of barriers but provided little evidence in relation to potential solutions. It is suggested that this is largely because most respondents had either not yet received, or were still considering, reports from consultants and were therefore focused on short-term concerns i.e. the technical feasibility and financial viability of their schemes. Whatever the cause, it is suggested that there is a significant level of uncertainty regarding the future progress of HNDU-supported schemes.

5. What is the demand for future skills and funding support after March 2015 for LAs at all stages of heat network development and building?

The qualitative research provided clear evidence of a demand for future government support from almost all HNDU LAs, with many industry stakeholders also viewing this as important to ensure future activity. Many HNDU LAs and industry stakeholders noted that they expected LA officer capacity and capability would continue to be barriers to HNDU LAs progressing along their heat network journey. There were some suggestions that these issues would grow in significance as projects developed and became more resource intensive. Most suggestions focussed on the need for on-going support, including revenue funding to cover the costs of external support to address this. There was little evidence of demand for future support from non-HNDU LAs.

Beyond the current forms of support some HNDU LAs requested that the HNDU develop new forms of written guidance materials to better inform engagement with the marketplace. There was strong support for this within the quantitative survey, although it is unclear to what extent respondents were familiar with the existing literature.

Concerns regarding potential access to capital finance (also discussed under Q4) were strongly reflected in the calls for future support, featuring requests for practical assistance with accessing finance and commercial skills training. Some HNDU LAs suggested the need for cross-government work on this agenda to ensure the evolution of a consistent government approach.

6. How effective were the arrangements for local authorities to engage with and access the HNDU fund?

The qualitative research found that most of the non-HNDU LAs had some level of awareness of the HNDU, with only a few reporting that they had not heard of the unit. Many non-HNDU LAs had had contact with the HNDU and provided positive feedback on this, though they had not followed up this contact with an application. There was no evidence that the application process represented a barrier with the lack of submissions being attributed to a lack of capacity or the prioritisation of other forms of activity. Responses to the quantitative survey suggested that respondents were generally very satisfied with the application process, with a high level of agreement that the information provided was useful and easy to understand, with the application process straightforward and well-supported. In summary those authorities who had investigated or received HNDU support had found the process easy to navigate and well supported.

An issue that emerged during an analysis of application data was the marked differences in the proportion of local authority ‘types’ submitting applications, with county and (in particular) district

councils under-represented compared with city, unitary and metropolitan councils. This may simply reflect differences in opportunity i.e. in terms of heat density, but may also be reflective of capacity issues (particularly in the case of district councils) and/or the perception of opportunities within these types of authority.

7. What outputs and outcomes are projected to be delivered in the future for different local authorities, and how does this differ by area context and support received?

Only five reports were available for review during this research. These contain some details of projected outputs beyond the reports themselves such as the identification of future activity and outcomes, but it is premature to draw conclusions from such a small sample. This issue will be addressed in the final report following the wave 2 research.

Introduction

CAG Consultants, in association with Narec Distributed Energy (NDE), were commissioned by the Department of Energy and Climate Change (DECC) to undertake an evaluation of the Heat Networks Delivery Unit (HNDU). The research aims to investigate whether, how and to what extent HNDU activity has assisted local authorities (LAs) to overcome barriers to their development of heat networks.

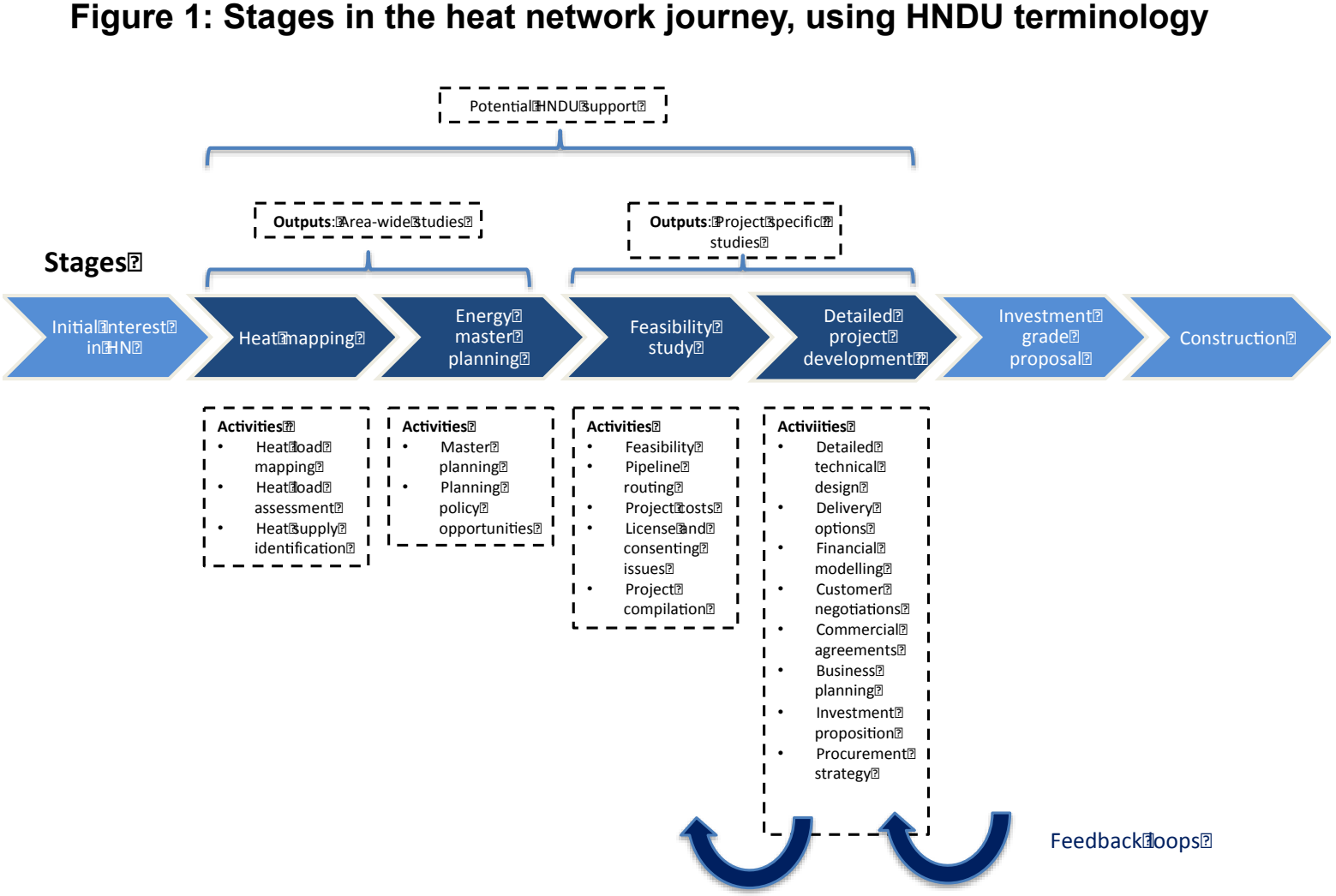
The evaluation commenced in August 2014 and is expected to be completed by the end of March 2016. This report presents the findings and conclusion from the first wave of evaluation research (September 2014 to end of March 2015). The second wave will run from September 2015 to March 2016 and will be reported separately.

Background to the Heat Networks Delivery Unit

The HNDU was established in 2013 to address the capability and capacity issues faced by LAs when developing heat networks. It is a specialist unit, composed of both technical and commercial staff, hosted within the DECC. The unit provides support (in the form of grant funding and guidance) to LAs in England and Wales that is designed to enable them to progress through the early stages of heat network development. LAs can apply to the HNDU for guidance in the form of a flexible package of expert technical and commercial support supplied by HNDU staff, or a combination of grant funding and guidance. All LAs awarded grant funding from the HNDU also receive guidance from the HNDU team. An HNDU 'project lead' is allocated to successful local authorities and acts as a critical friend throughout their engagement with the unit.

The HNDU has a budget of £9m over two years. Funding is distributed on a first come first served basis. There have been four funding rounds to date. There is no upper or lower limit for funding, but LAs are only able to apply for up to 67% of the external costs of a project. Funding can only be used for development costs; in practice this means that most funding is used to procure various forms of consultancy support. The types of work most commonly funded are heat mapping, energy master-planning, feasibility studies and detailed project development. These are considered by the HNDU to be the key development stages in the 'heat network journey' (see Figure 1).

Figure 1: Stages in the heat network journey



Aims of the evaluation

DECC commissioned the evaluation of the HNDU in order to help refine future activity; provide evidence to support business planning and inform the design of any future assistance; provide formal accountability for the spend to date; inform wider DECC and other government departments work; identify where cross-government engagement is required to support the development of heat networks; and to help local authorities improve their approach to developing such projects.

The evaluation is framed around 7 main research questions and a series of sub-questions. The main research questions were:

1. How, and to what extent, has the HNDU helped local authorities progress the development stages of low carbon heat networks?
2. What other factors, or influences, have driven progress by local authorities on low carbon heat networks?
3. What, if any, other barriers are local authorities encountering despite HNDU support – either already encountered or anticipated in future?
4. What is the demand for future skills and funding support after March 2015 for LAs at all stages of heat network development and building?
5. How effective were the arrangements for local authorities to engage with and access the HNDU fund?
6. What outputs have been delivered (by HNDU and local authorities) during the lifetime of HNDU funding?
7. What outputs and outcomes are projected to be delivered in the future for different local authorities, and how does this differ by area context and support received?

The remainder of this report is split into the following key sections:

- Section 2 presents the theoretical framework for the evaluation
- Section 3 presents the methodology for the research
- Section 4 analyses findings
- Section 5 presents overall conclusions

Methodology

The evaluation is comprised of four main stages:

- a scoping stage (September to October 2014)
- development of the ToC (October to December 2014)
- first wave research (January 2015 to March 2015)
- second wave research (due to begin in autumn 2015).

The unpublished findings from the scoping stage were used to inform the design of first wave research instruments. This report presents the findings from the first wave research.

Theoretical framework

The evaluation of the Heat Networks Delivery Unit (HNDU) is theory-based and informed by an overarching Theory of Change (ToC). A theory-based evaluation uses a theoretical framework to understand and test the mechanisms by which an intervention is expected to lead to change, whilst also considering possible alternative explanations for any observed change.

> *Theory-based evaluation approaches provide an overarching framework for understanding, systematically testing and refining the assumed connections (i.e. the theory) between an intervention and the anticipated impacts.* (The Magenta Book – Guidance for evaluation, HM Treasury, 2011)

The ToC for the HNDU is based on a logic map that commences by identifying the problems the HNDU was established to address and then charts the actions, anticipated impacts and outputs, outcomes, and planned high level impacts. The ToC is completed by including the assumptions which underpin the logic map and any external factors which might be considered likely to interact with the HNDU.

Two diagrams showing the ToC for the HNDU are presented in Appendix A[2]. Figure 3 in this appendix highlights the assumptions underlying the design of the HNDU intervention, while Figure 4 highlights the external factors that might influence the effectiveness of HNDU or might provide alternative explanations for eventual outcomes.

Development of the ToC

An initial draft of the ToC was developed in October 2014. This was informed by initial small-scale qualitative scoping research which involved both local authority recipients of HNDU funding and expert external stakeholders, along with a a review of some of the key literature.

on the 28 October 2014 this initial draft was then subjected to critical review via a workshop attended by an audience of DECC staff and expert external stakeholders.. Following the

[2] The ToC is presented in two parts as it was not possible to illustrate both assumptions and external factors on one diagram.

workshop a revised version of the theoretical framework was produced and subjected to further internal (DECC) and external (CAG) review before being finalised in December 2014.

The ToC recognises that the intervention of the HNDU is not the only factor affecting heat network development.Central to the evaluation is an investigation of the other 'external' factors which might be contributing to the development of heat network development. The mapping exercises with external stakeholders provided a route to identifying as many likely external factors as possible, which could then be explored within the fieldwork. This approach complements the 'counterfactual approach' described in the next section.

The ToC was used to inform the development of the research instruments (i.e. interview topic guides and quantitative questionnaire) with a view to exploring:

- Alternative explanations for changes in heat network development activity (e.g. other non-HNDU sources of heat network development support) and, underlying this,
- External factors affecting the intrinsic financial attraction and feasibility of low carbon heat networks (e.g. the impact of rising energy prices, changes in the cost of capital, new technologies, etc.).

Approach to the counterfactual

To assess the impact of the HNDU in addressing local authority capacity and capability barriers to heat network development, it was important to explore what might have happened in the absence of the HNDU i.e. the counterfactual.

The methodological approach to understanding the counterfactual had two elements. The first approach was to compare heat network development before and after the HNDU commenced activity. The first wave of research explored this through qualitative research with HNDU LAs and industry stakeholders to generate a picture of their activity in relation to heat networks before (the five years prior to 2013) and after the establishment of the HNDU. The aim of this approach was to generate insights into issues such as changes in the scale, speed and distribution of heat networks, drivers for change, barriers, the extent to which barriers have been addressed, and enabling factors. However, it is important to recognise that the findings in this regard are limited in that they were based on 'self-reporting' and were also dependent on the ability of the respondents to accurately recall the context for heat networks prior to the HNDU starting.

The second approach focused on local authorities in England and Wales who were actively engaged in taking forward heat network activity and comparing those that had accessed HNDU support with those which had not. In effect, the aim was to create a form of qualitative 'control' group. In practice this approach was compromised owing to difficulties in identifying local authorities taking forward new heat network activity without HNDU support (see below).

First wave research methodology

The first wave research methodology comprised three primary research components:

1. In-depth qualitative interviews

In-depth qualitative telephone interviews were undertaken with 57 organisations in total:

- 27 interviews with officers from LAs participating in HNDU (referred to as HNDU LAs in this report). The sample was selected to ensure a range of local authorities across the following variables: by HNDU funding round[3]; by local authority type; by country

[3] Aiming to interview 9 local authorities from each of the first three rounds of HNDU funding.

(England and Wales); by stage type[4]; and by prior activity on heat networks (previously active or not active);

- Nine interviews with staff from industry stakeholders, eight of which provide direct consultancy (or consultancy-type) support to LAs, and one academic institution. The focus for the consultancy interviews was on established consultancies: those with some track record of working with local authorities on heat networks, rather than newer market entrants;
- 20 interviews with officers from LAs not in receipt of HNDU support (referred to as Non-HNDU LAs in this report). These included:

  nine LAs who were 'active' on heat networks[5]. Of these, four LAs had engaged with the HNDU to some degree[6] whilst five had not engaged[7]; and

  11 LAs who were 'not active' on heat networks.[8] Of these, six had engaged with the HNDU whilst five had not.

  Two data sources were used to identify the sample for these non-HNDU LA interviews: the HNDU database, which includes information on which non-HNDU LAs the HNDU has engaged with; and a DECC database listing existing known heat networks by LA. Once lists for each subset of non-HNDU LAs were developed, the sample was selected using a form of simple random sampling.

  An additional two interviews were started with non-HNDU LAs, but these were terminated early because the LA officers did not feel they were in a position to answer the research questions.;
- A short unstructured interview with a key HNDU staff member.

With the exception of the latter, all of the interviews were semi-structured in nature, with the interviewers employing discussion guides (see appendix B) to frame the interview around the key research questions. The qualitative research was framed as heat network research in order to establish context, drivers and challenges on heat networks before asking about the influence of the HNDU. The interviews were broad in scope

, so whilst interviewers looked to ensure all questions were addressed the circumstances of individual respondents meant there was variation in the levels of detail they were able to supply.

2. Quantitative survey

81 HNDU LAs (all of the LAs receiving HNDU support at the time) were invited to take part in a short online survey. A total of 55 local authorities responded, representing a response rate of 70%. An additional 4 local authorities began the survey but stopped part way through – for the purposes of analysis they were been excluded from the data set. The survey questionnaire

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[4] Aiming to achieve a spread of local authorities receiving support on different heat network development 'stages' (e.g., masterplanning, mapping and feasibility).

[5] 'Active' on heat networks: LAs who have a heat network (or heat networks) in place or are in the process of delivering a heat network. These heat networks could be either directly managed by the LA or run by a third party.

[6] 'Engaged' with the HNDU: applied for HNDU support or had some form of engagement with HNDU, e.g. making an enquiry, liaising with HNDU or attending an HNDU event.

[7] 'Not engaged' with the HNDU: no contact or engagement with the HNDU.

[8] 'Not active' on heat networks: LAs who have no heat network but may have carried out some exploratory work on the feasibility of heat networks at some stage.

(appendix C) focused on understanding the importance of different drivers and barriers to heat network development, the effectiveness of HDNU support and future LA capacity needs.

3. Analysis of HNDU-funded outputs to date

It was intended that an analysis of ten HNDU funded feasibility studies would be undertaken, with a view to recording and 'sense checking' projected outputs and outcomes and to provide a summary assessment of the quality of these studies. In practice only five reports were available for review within the timeframe of the research and therefore reporting on this issue has been deferred.

In addition to the three elements above, the report also draws on an analysis of the HNDU participant database and relevant background literature.

Challenges and limitations of the research design

One of the challenges of comparing HNDU LAs with the non-HNDU LAs that were active on heat networks was that the numbers of the latter group were small. Identifying and then securing interviews with these LAs proved to be very challenging (as predicted prior to the commencement of the research) not least because the data used to select these groups was often found to be incorrect or out of date.

Furthermore, many of the non-HNDU LAs that were identified as hosting active heat networks were not actively developing new ones, so were simply managing an historic legacy. As such their value as a counterfactual group was diminished as the intent was to explore how local authorities not in receipt of HNDU support were currently, or had recently been, progressing heat network development. Given that a significant amount of effort was expended in trying to find non-HNDU interviewees for the counterfactual group, it is suggested that the majority of LAs who are proactively seeking to develop heat networks have (as might be expected) looked to secure HNDU support.

For the quantitative survey, the reader should note that the analysis is predominantly based upon the whole sample. Additional analyses were undertaken to explore differences and similarities in the data according to different variables (e.g. by type of local authority and HNDU funding round). However, these analyses were limited by the small overall sample size and, as a result, any observed differences could not be tested for statistical significance.

Findings

3.1 What outputs have been delivered during the lifetime of HNDU funding?

As described in the introduction, the HNDU provides funding for consultancy support to enable applicants to proceed along the 'heat networks journey', the direct outputs are therefore primarily the resulting consultants reports. The four funding rounds generated a total of 234 applications from 121 local authority applicants (34 applicants submitted more than one bid). 201 of the bids were successful. In total £9,711,019 was awarded with the average value of award being £48,313.53. All funded bids were automatically eligible for HNDU guidance. In addition, eight authorities requested guidance only.

The specific types of activity for which grant funding was sought are shown in Table 1 below. The table shows a growth in demand for financial support over the four funding rounds and appears to show some evidence of an increase in bids for funding to support more focussed later-stage pieces of work, in particular 'detailed project development', in rounds 3 and 4.[9]

Funding Round	Value (£)	Mapping	Master-planning	Feasibility studies	Detailed project development	Procurement	Other
1	£1,954,430	8%	19%	46%	0%	4%	22%
2	£1,982,215	8%	15%	41%	5%	18%	13%
2.5	£514,101	15%	40%	46%	0%	0%	0%
3	£2,265,604	9%	21%	55%	15%	0%	0%
4	£2,994,669	15%	31%	42%	12%	0%	0%

Table 2: Types of activity for which grant funding was sought

At the time the research was conducted, nearly all HNDU LAs involved in the qualitative research were either in the process of procuring consultants, awaiting the outputs from consultant activity, or considering the findings of commissioned reports. Some respondents noted that this restricted their ability to comment on their future progress, whilst most others only commented in general terms.

[9] There is some uncertainty on this matter as some of the funding allocated to 'Procurement' and 'Other' in the early rounds may have been used for more detailed forms of work.

3.2 How, and to what extent, has the HNDU helped local authorities progress the development stages of low carbon heat networks?

To what extent has the HNDU helped local authorities overcome financial barriers?

In the qualitative research, nearly all HNDU LAs made reference to the importance of HNDU funding in enabling them to take forward their work. In describing the importance and role of the funding, many used terms such as 'essential' and 'fundamental'.

> *"It's been absolutely fundamental to getting these projects to the stage they're at"*. HNDU-LA13

This is supported in the findings from the quantitative survey, where 93% of respondents agreed with the statement 'the financial support of the HNDU has been an important factor in enabling our local authority to progress heat network development activity' (including 82% who 'strongly agreed').

Nearly all HNDU LAs reported having undertaken studies on heat networks prior to receiving HNDU support. Although not a subject that was specifically probed, it would appear that much of this work had been shelved owing to a lack of finance, and that HNDU funding has subsequently been important in enabling such work to be taken forward.

> *Initially we put the money in ourselves actually, but with the budget cuts the way they've been we probably would have drawn a line under heat networks without the funding we got from HNDU actually*. HNDU-LA14

Some industry stakeholders also highlighted that HNDU funding had been an important factor in progressing heat network development activity by LAs and noted that there had been a marked increase in the procurement of development phase consultancy support since the establishment of the HNDU.

Outside of the direct financial benefits, some HNDU LAs noted that the existence of funding had helped to attract their authorities' attention onto heat networks, whilst some noted that the source of the funding brought added value in the form of enhanced credibility.

> *It's not just us saying this is important, it's the government department saying it's important*. HNDU-LA13

One industry stakeholder noted HNDU support gave projects a greater profile and helped to create greater buy-in with project partners.

Was HNDU guidance perceived as a necessary contributor to project progress?

In the qualitative interviews, nearly all HNDU LAs made reference to the guidance provided by HNDU, with the majority suggesting that this had been valuable and, in some cases, highly valuable in informing and guiding successful project activity.

> *It can't just be money alone – it's important that there is an officer who is guiding us through*. HNDU-LA12

Evidence of the value of HNDU guidance was also found in the quantitative study, where 71% of respondents reported it as being 'important' or 'very important'. Many HNDU LAs chose to characterise the guidance they had received using terms and phrases such as 'flexible', 'supportive' and as like having access to a 'critical friend', suggesting that it was not just access to the expertise that they valued, but also the way in which it was delivered.

Most HNDU LAs reported that the support they had received had increased their knowledge and expertise.

> *We've certainly got significantly more in-house skill and knowledge now and that has been very much supported by the funding and support we've got from the [HNDU] team*. HNDU-LA10

This qualitative view was supported by the quantitative research where 83% of respondents indicated that they felt that HNDU support had played an important role in addressing limitations in the availability of in-house skills. Some HNDU LAs (qualitative evidence) reported that they expected their enhanced expertise to be retained within the organisation, with only two suggesting they were uncertain on this issue. Some industry stakeholders also reported that they felt that HNDU guidance had helped to improve knowledge across the LA sector.

Some HNDU LAs reported that a lack of expertise remained a concern (see Q4), but overall the qualitative evidence suggests that the HNDU has made an effective contribution towards addressing capability needs within most of the supported authorities.

The two types of guidance most valued by HNDU LAs were assistance in developing specifications (to procure consultants) and the provision of general technical guidance. Most respondents noted that they lacked technical expertise and HNDU guidance was seen as helping to address their knowledge gaps.

A small number of HNDU LAs noted that they did not feel they had benefited much from HNDU guidance. These were either authorities who had prior heat network experience and/or in-house technical expertise, or those who did not yet feel able to comment because their projects had just started.

Nearly all industry stakeholders believed that HNDU guidance had benefited local authorities. A few suggested that HNDU support, through improving local authority capability and confidence, had helped the officers involved to take greater ownership of projects. Some expressed the view that HNDU guidance had resulted in an improvement in the design of the tender specifications that they had seen and in their engagement with local authorities during the development of projects. Some industry stakeholders also highlighted the value of HNDU staff attendance at key project meetings, which had in their view resulted in beneficial input to projects.

Has the HNDU assisted local authorities in other ways?

Some HNDU LAs reported that the HNDU had provided them with useful opportunities to exchange information with other local authorities, with the unit encouraging and enabling this through informal (putting authorities in contact with one another) and formal mechanisms, such as workshops.

> *It's been quite useful to get everybody together that's looking at heat networks and talking, and meeting regularly* as *well*. HNDU-LA14

A few respondents mentioned that they were aware a 'huddle'[10] group had been set up but noted that they had not yet participated in this.

What evidence is there that the HNDU helped progress individual projects to an extent to which would not have happened otherwise?

Nearly all HNDU LAs provided comments on the role of the HNDU in assisting their heat network activity. Many of these stated that they did not believe the project would have

[10] An online collaborative community.

proceeded at all without HNDU support and many stated that in the absence of HNDU support they would not expect to be working on heat networks. All but one of the HNDU LAs who provided information on this point noted that funding was the most important element of HNDU support.

> *[It's] been fundamental. We wouldn't have done the work without them*. HNDU-LA15

Some HNDU LAs indicated that they felt work would or might have continued, but that it would have proceeded at a slower pace and on a smaller scale.

> *The scale of the projects would have been much smaller, perhaps we wouldn't have pursued all three geographies*. HNDU-LA25.

> *I don't think it [work on heat networks] would have ground to a halt, but it would have slowed down dramatically*. HNDU-LA8

The significance of the role of the HNDU is supported by the finding that whilst nearly all local authorities reported having undertaken work on heat networks prior to the establishment of the HNDU (see Q2), most of this appeared to have been shelved owing to financial cutbacks. This is consistent with industry stakeholder comments, most of which reported that they had observed a marked increase of interest in and activity on heat network development in the last few years.

> *There's a tremendous amount now of work out there and (there) continues to be a constant stream of opportunities*. IS1

The HNDU was the most commonly cited driver for this increase in activity and demand, with one stakeholder suggesting that the HNDU has helped release 'pent-up demand'.

Most industry stakeholders thought that the HNDU had supported projects that would not otherwise have gone ahead, citing contractions in local government funding as the reason for this view.

In response to a qualitative research question on what HNDU LA respondents would have been doing if they had been unsuccessful in securing HNDU support, many HNDU LAs stated that they would not expect to be working on heat networks. Some – those from a planning, regeneration or other non-energy related background – suggested that they would have been assigned to various forms of non-low carbon duties. The majority, however, suggested that they would have been working on other forms of low-carbon activity, including the improvement of building energy performance, solar PV or other renewables and community energy.

> *Without it, we'd be working on housing retrofit, corporate retrofit, street lighting etc. Wouldn't be working on heat networks. They require commissioning of expensive bits of consultancy*. HNDU-LA5

This finding provides some evidence of an unintended consequence of the HNDU, specifically the diversion of scarce resource (i.e. local authority staff time) from other forms of low carbon project.

Is there any evidence of remaining internal barriers (despite HNDU support)?

Some HNDU LAs reported that public procurement procedures constituted a barrier. Specific concerns related to the time required to procure consultants, the challenges associated with putting together procurement when the subject matter was technically challenging, and the complexities of procurement involving multiple partners. None of these were reported as being insurmountable; rather they were seen as sources of unwanted and often unanticipated delay. No other internal barriers were reported in association with HNDU supported activity.

How might HNDU improve on the service and support they provide?

A number of HNDU LAs offered views on how HNDU support might be improved. All but one of these suggested that more time from HNDU project staff would be helpful. There is some resonance here with a separate set of comments made by some HNDU LAs and industry stakeholders, who indicated that they perceived the HNDU as being overstretched.

> *I think they're just overworked. They're a small team of experts but it looks like they've got too much on.* HNDU-LA22

Some HNDU LAs and industry stakeholders suggested that the HNDU should narrow its focus, working with fewer LAs but working with them in more depth. This approach of 'backing winners', as one industry stakeholder put it, could have the benefit of providing exemplar projects for others to follow and developing the supply chain and industry capacity and capability.

A number of HNDU LAs and one industrial stakeholder suggested that support might be best delivered at a regional or sub-regional basis although it was unclear what difference this might be expected to make. Other critical comments received from industry stakeholders included a suggestion that they had seen an increase in the uniformity of HNDU-supported consultancy specifications (i.e. briefs were less tailored to local circumstance), and that in some cases this had led to what they described as 'over-written' briefs resulting in unnecessary work being undertaken and expense incurred.

What factors influenced the local authorities' choice of heat source and technology?

All HNDU LAs participating in the qualitative study provided responses on the factors which influenced their approach to heat sources. Nearly all suggested that their studies would consider, or already had considered, a range of different heat sources; it is a requirement of HNDU funding that recipients appraise a range of heat source options and this finding provides evidence that this is occurring.

Whilst most HNDU LAs interviewed had yet to receive their reports, many anticipated that gas CHP would be the preferred choice, with some making reference to the tried and tested nature of the technology, its flexibility and its perceived financial advantages. In some cases, this presumption was based on the findings of previous studies.

> *Most schemes you'll see come forward will be gas CHP in the early days*. HNDU- LA4

Energy from waste (EfW) and biomass were the other options most frequently referenced by HNDU LAs. In some cases, these were known to be the technology choice as their schemes were designed to take advantage of existing heat sources or other infrastructure – in particular existing or planned EfW plant.

A number of respondents noted that air quality considerations would rule biomass out, with a lack of non-gas options noted by some as a critical determinant factor.

Many respondents had given consideration to future-proofing; a few of these noted that they had considered the possibility of moving to lower carbon sources in the future, in line with their low carbon aspirations. In the short term however many suggested that the choice of heat source and technology would ultimately be a matter of economics.

> *You can say you're going to put in all sorts of wonderful renewable systems in, but do they pay for themselves?* HNDU-LA17

Can we categorise local authorities in terms of their engagement with the HNDU?

Figure 2 presents a proposed typology for HNDU LAs. This aims to characterise authorities on the basis of their likeliness to pursue heat network development activity. The typology is informed by an analysis of the qualitative data, cross-referenced with geographic information (location, type of authority, size of authority and rurality). The typology is as yet unproven, so if deemed useful it might be developed and tested within the wave 2 research. Subsequently the typology might be used to help set application criteria, categorise applicants and inform the development of any future support packages – perhaps through tailored offers to different 'types' of applicant.

It should be noted that not every local authority would be expected to exhibit all of the described characteristics. Some characteristics may prove to be more important than others in determining an authority's type, with authorities expected to move between types depending upon changing circumstance e.g. the loss of a committed internal champion might result in a decline or loss of interest. The latter point is potentially important should the HNDU choose to use the typology to help them categorise applicants. If deemed useful, the typology might be developed and tested within the wave 2 research.

Type 1: Tentative interest	Type 2: Speculative interest	Type 3: Definite interest and intent
•Places high value on HNDU guidance. •Lack of or limited senior level buy in. •Weak corporate drivers – risk averse, less likely to be interested in taking a stake in a network. •Likely to be reliant upon external support - local actors (support, collaboration) may be important. •Limited investment of project staff time.	•Places high value on HNDU guidance. •High level commitment. •Strong corporate drivers – prepared to accept risk if rewards available. •Likely to be reliant, to some extent, upon external support - local actors (support, collaboration) may be important. •Significant investment in project staff time. •Committed individuals.	•May place less value on HNDU guidance. •May have staff specifically allocated to heat network activity. •May have previous experience of heat networks. •May have strong external partnerships. •Strong corporate drivers – prepared to accept risk if rewards available. •Committed individuals.

Figure 2: Typology for local authority interest and intent in relation to heat network development

3.3 What other (non-HNDU) factors or influences have driven progress by local authorities on low carbon heat networks?

This section identifies and considers other factors that have driven or enabled local authority activity on heat networks and their interaction with the HNDU.

What are the key internal drivers and enablers for local authority interest in heat networks?

Internal drivers

Nearly all HNDU-LAs commented on internal drivers (i.e. the reason for undertaking action) with most referencing multiple drivers. Four clear categories of driver were identified:

- Carbon reduction

- Regeneration
- Fuel poverty
- Income generation

Carbon reduction was the most frequently cited of these in the qualitative research and was also reported as ‘very important’ or ‘important’ by 79% of participants in the quantitative survey. For some HNDU LAs carbon was the primary driver, but in most cases it was referenced after one or more other drivers, and in some cases it was made clear that it was a secondary priority.

Many HNDU LAs noted regeneration as a driver and this emerged, albeit marginally, as the most important driver (cited as ‘very important’ or ‘important’ by 81% of the participants in the quantitative study). Regeneration was the most multi-faceted driver, but the central theme appeared to be that heat networks might provide a competitive advantage for a given area through helping to improve local energy security for businesses, offering a competitively priced source of heat and a low carbon heat source (an issue seen to be of interest to some large businesses).

> *If you can relocate within the city where we can connect you up, both from a heating and a power perspective, we can offer you that security of supply […] I think that’s going to become an increasingly important component of every city to be honest*. HNDU-LA9

Fuel poverty was cited by many authorities as a strong driver, although some authorities noted that it had declined in importance relative to commercial objectives. In the quantitative study fuel poverty was rated as an important motivation for 63% of respondents, although 19% of suggested that it was not a driver for their authority.

Income generation was stated as a driver by some HNDU LAs in the qualitative research, with this being as a response to falls in local authority income. Some authorities noted the opportunity for securing cost savings for their estates through the establishment of their own heat networks and this was identified as a driver by 54% of participants in the quantitative study.

Most industry stakeholders also identified the four key drivers identified by HNDU LAs when asked what they saw as the key reasons for local authority heat network activity. A number of bothoth ‘heat network active’ and non-active non-HNDU LAs also identified these drivers as being important.

A number of HNDU LAs noted that carbon reduction was declining in significance within their authority, with commercial factors (regeneration and income generation) coming to the fore.

> *I would say the priorities are far more around the cost benefits rather than the carbon*. HNDU-LA25

This was also reported by some non-active non-HNDU respondents and a few industrial stakeholders.

Internal enablers

Most HNDU LAs noted the importance of internal enablers (i.e. factors which enable an organisation to respond to its operational drivers). Two issues were identified as having being either particularly important or helpful in moving projects forward. Planning policy was seen by many as being important in forcing consideration of heat networks within new developments – this was regarded as helpful although not in itself sufficient to guarantee a positive outcome owing to the scope for challenge, for example one HNDU LA noted that they had not as yet secured the incorporation of heat network infrastructure in a new development via planning owing to developers asserting that it was not commercially viable to do so.

Many authorities also noted the presence and importance of internal 'champions'. One respondent noted that when talking to other organisations:

> *We're finding that there's a lot of individuals key basically to taking some of these projects forward*. HNDU-LA14

Individuals referred to as 'champions' do not appear to share any common characteristics other than an interest in heat networks: HNDU LAs identified officers of varying levels of seniority and professional background and individual elected members.

The importance of internal champions was also identified by many industry stakeholders. Two non-HNDU LAs with active heat networks also highlighted that internal champions had been important factors in progressing their heat networks.

The quantitative survey did not include a specific question about 'champions' but did ask about the importance of 'officer level commitment'. 98% of respondents cited this as being 'very important' or 'important'.

Other enabling factors identified as important by respondents to the quantitative survey included senior management support (cited as 'very important' or 'important' by 86% of respondents), followed by increased awareness of the potential benefits of heat network activity (71%), council strategy or targets (69%) and, finally, political leadership (67%).

How do other (non-HNDU) external factors (past and present) interact with the rate of heat networks development?

In the qualitative research, most HNDU LAs identified one or more types of external driver and/or enabler of heat network activity. Most HNDU LAs reported that they had drawn on other, non-HNDU, forms of support. Identified providers took a variety of forms and included historic support providers. The current status of each type of organisation listed is shown in brackets, it includes universities (current), the Homes and Communities Agency (HCA) (current), the Vanguard Network (current), APSE Energy (current), European-level funding (e.g. ELENA) (historic and current), Low Carbon Pioneer Cities (historic), and a variety of regional/sub-regional entities including LEPs (current), Core Cities (current) and the Decentralised Energy Programme Delivery Unit (DEPDU) (historic),[11] as well as the GLA more broadly.

Evidence of widespread engagement with non-HNDU forms of support was also found in the quantitative survey, where 54% noted that non-HNDU non-financial external support had been 'very important' or 'important', whilst 26% noted the value of financial support – the majority of which is understood to be historic - received from non-HNDU bodies. .

The qualitative research with the HNDU LAs indicated that the current support available through identified organisations was highly variable in form and geographic coverage, but included technical advice, knowledge transfer and programme support. Only a few limited and geographically restricted examples of support in the form of funding were identified.

The impacts of support, where reported, were similar to those secured via the HNDU i.e. increased confidence, improved capacity and capability, and an enhanced ability to address financial constraints. Most industry stakeholders noted the existence of non-HNDU support. A few noted that they felt the shared learning and good practice dissemination work carried out by initiatives such as Vanguards and APSE Energy was particularly valuable, as was their role in raising awareness about heat networks more generally.

No evidence of tension between other forms of support and HNDU was found. There was, for a brief period, some overlap between the support provided by DEPDU in London (now defunct)

[11] Some other sources have not been mentioned to protect the anonymity of interviewees.

and the HNDU, but in practice the two initiatives appear to have worked together to minimise duplication of effort. There would however appear to be some ongoing overlap between the knowledge exchange activity of the Vanguards Network and that of the HNDU. In general however, HNDU LAs appeared to view, or at least treat, other forms of current support as being complementary to HNDU. For example, a few respondents noted that local sub-regional agencies had established technical staff posts who were able to assist local authorities in their area to develop bids to HNDU and, in some cases, to provide the funding required to enable access to HNDU funding.

Other external factors

47% of respondents to the quantitative survey reported that a supportive government policy environment was either 'very important' or 'important'. Most of the remainder (40%) reported that it was of at least moderate importance. Some evidence of HNDU LA support for this view emerged when discussing future support needs in the qualitative research (see Q3) with these respondents stressing the need for a stable and consistent cross-government policy agenda.

Changes in regulation were rated as 'very important' or 'important' by 32% of quantitative study respondents in response to a specific question. However, this did not emerge as an issue for HNDU LAs in the qualitative research.

Some HNDU LAs referenced the rising cost of energy as a driver for heat network activity. A number of authorities noted that heat networks were seen as a potential mechanism for reducing their own energy costs, although it was more regularly reported as being a concern as a driver of fuel poverty and an issue for business (see previous sections). 15% of respondents to the quantitative survey noted rising energy prices as a 'very important' external driver and an additional 25% saw it as 'important'. However, 32% rated it as 'of little importance'.

Other reported external factors noted by HNDU and non-HNDU LAs and industry stakeholders include: Energy Company Obligation (ECO) and Renewable Heat Incentive (RHI); EU directives on energy efficiency; renewables, and strategic environmental assessments; national planning policy, national statutory requirements, including the Landfill Tax and the CRC Energy Efficiency Scheme; national carbon reduction targets; activity and policies related to the Greater London Authority, including The London Plan and DEPDU; and a general raising of awareness amongst LAs about heat networks and the opportunities they can bring.

3.4 What, if any, other barriers are local authorities encountering despite HNDU support – either already encountered or anticipated in future?

This section focuses on the barriers that HNDU LAs have experienced or anticipate encountering that are not addressed by HNDU support. The main concern, identified by most HNDU LAs, was whether or not they would be able to access capital investment should their scheme prove viable. Some HNDU LAs identified uncertainty in the energy policy environment and challenges engaging key stakeholders as either current or anticipated barriers. In most cases respondents had not identified potential solutions and some noted that they had not yet given thought to future barriers as they were waiting to see the findings of the studies they had commissioned. Responses to questions on external barriers in the quantitative survey showed considerable variance in respondents experience or recognition of non-capacity and capability barriers. Overall however the evidence suggests that there is a significant level of uncertainty regarding the future progress of HNDU supported schemes.

Do local authorities expect to attract the capital investment funding to progress their projects? If so, from where do they expect this to come?

Most HNDU LAs reported that they expected the securing of capital investment to pose some level of challenge, although not all provided an explanation as to why they expected this to be the case.

Of those who did, some authorities suggested that identified or anticipated low internal rates of return (IRR) on their schemes would make them unattractive to private investors – a potential barrier also identified by 47% of respondents to the quantitative survey – so there would be a need for public investment by LAs or other public sector bodies and some level of public sector ownership.

> *I can very easily imagine a situation where we've identified a scheme that financially is a goer, but we struggle to get the necessary investment*. HNDU-LA24

Securing public sector capital was seen as potentially challenging and, whilst the prospect of part/full ownership of a scheme was not directly reported as a barrier, this required an appetite for risk that some HNDU-LAs felt their authority might not have.

> *We do have an appetite for investment, but not that big. £5million would be a big chunk of our £55 million budget*. HNDU-LA19

Some HNDU LAs reported that their authorities were uncertain as to whether they should be involved with non-statutory forms of activity at a time when other services were being cut.

Although reported as a challenging issue by many HNDU LAs, none identified access to capital as an *absolute* barrier (although this may be because they are at an early stage in the process). It is also important to note that not all HNDU LAs who commented on access to capital saw this as a challenging issue, with some HNDU LAs stating that they felt they would either be able to find capital finance or had already done so. One of the latter noted:

> *I'd say the finance has not been a problem bizarrely. People seem to have been very keen to invest*. HNDU-LA22

Two industry stakeholders noted that they did not expect capital to be a barrier where a potential project offered a commercially attractive Internal Rate of Return (IRR). 37% of participants in the quantitative survey suggested they did not anticipate a lack of interest from non-public sector sources to be a barrier, but it is not clear whether or not this is because they anticipate using public sector funding.

Aside from private equity, HNDU LAs suggested that funding might come in part or whole from the following sources: Public Works Loan Board (PWLB); Green Investment Bank; European funding (directly and indirectly through intermediaries) including the European Investment Fund (EIF), European Regional Development Fund (ERDF) and London Energy Efficiency Fund (LEEF)[12]; Energy Company Obligation and Section 106 funding. Some HNDU LAs expected networks to be developed by external organisations without any form of public investment.

Uncertain policy environment

Respondents to the quantitative survey reported that an uncertain policy environment was the most significant external barrier, with 31% rating it as a barrier to a 'large/very large extent'. Some of the HNDU LAs in the qualitative research also identified this as an important issue and noted – in response to a question about future support needs (see next Q3.4) - that they felt that there was a need for a supportive, consistent and co-ordinated cross- departmental approach to

[12] LEEF and EIF were identified as offering lower interest rates than PWLB funding.

policy relating to heat networks. One authority pointed to what they regarded as a potentially significant issue in the form of proposed DCLG changes to building regulations in 2016, following the Housing Standards Review. It was suggested that this might undermine the London Plan, which they currently perceive as a key driver for heat networks in their area.

To what extent have local authorities engaged with key stakeholders?

- **Developers**

Some HNDU LAs (and an industry stakeholder) reported that they had experienced significant problems in engaging developers – both housing and commercial property developers – in potential heat network activity. 49% of quantitative survey respondents listed this as a potential barrier to a 'moderate' or 'large/very large extent'. Several HNDU LAs authorities had attempted to secure developer engagement through planning and had found this helpful, although they noted that developers often remained resistant and would seek to avoid compliance where possible. One noted:

> *We haven't had a case yet where we've managed to get a developer to install district energy*. HNDULA27

Reasons given for developer resistance included 'it's not really what they do' (HNDU-LA1), heat networks not being seen as cost effective, and concerns about the future saleability of houses. Some HNDU LAs noted that there was a need to persuade developers of the benefits of accommodating heat networks within new developments.

> *We need to find a way of increasing the confidence in the development market that district heating is a viable alternative, and I think we're a long way from doing that at the moment*. HNDU-LA9

One HNDU LA noted that they were aware of one successful new heat network scheme in their area where a separate commercial entity had undertaken to develop and run the heat network. A similar arrangement was noted by another HNDU LA.

- Public Sector Partners

A number of HNDU LAs reported that they had experienced problems when engaging with potential public sector partners on the identification of anchor loads. This emerged more strongly as an actual/potential issue within the quantitative survey, where it was reported as being a barrier to either 'a moderate extent' or to a 'large/very large' extent by 21% and 24% respectively. Many industry stakeholders identified hospitals as an important group but difficult to engage.

> *It's very difficult to get Health Trusts to engage properly in these types of projects. As a result of that I think it's fair to say that potentially good schemes will flounder*. IS5

Reasons cited by industry stakeholders for this relative lack of engagement included a lack of incentive for hospitals, 'internally-focussed' priorities and bureaucratic decision-making processes. One HNDU LA noted that hospitals posed a particular problem owing to the complexity of their organisational and financial structures.

A number of HNDU LAs noted that public procurement regulations made it difficult to agree deals with public or private partners as public sector organisations cannot simply sign up to take heat from a given source. It is necessary to go through a procurement exercise and there is no guarantee that this would lead to an award of contract to a local heat provider.

- Potential Customers

Two HNDU LAs had direct experience of customer engagement (data collection) and both reported that it had been challenging. A number of other HNDU LAs were anticipating problems

with customer engagement and expected to encounter some resistance to the technology[13], whilst 13% of quantitative survey participants expected customer engagement to be a barrier to a 'large/very large extent'. Some of the industry stakeholders also identified customer engagement as a challenge. One recommended the use of a 'customer heat charter' as a mechanism for helping to de-risk projects for potential customers.

How easy is it for projects to acquire and sustain the political support needed for all stages of project development?

Most HNDU LAs offered views or observations on the issue of political support, and most indicated that they were benefiting from having strong member support. In the quantitative survey, only 13% of respondents noted that 'limited or no corporate or political engagement' had been a barrier, with 70% suggesting it had either not been a barrier or had only been a barrier to 'a small extent'. It is not clear from the research how political support was secured, although some mentioned that their members were motivated by personal interest. A similar number noted that the general growth in awareness of sustainable energy generally, and heat networks specifically, had been helpful.

> *There is member to member peer pressure. For example, XXX have their own networks, why can't we have one?* HNDU-LA19

This suggests that there may be value in targeting awareness-raising events and information at elected members, particularly those in leadership positions. This is reinforced by the responses of the few HNDU LAs who reported that they lacked political support for more work to be done to sell the benefits of heat networks. One organisation that had secured support noted:

> *You have to be very, very creative and you really have to do a sales job on everybody*. HNDULA13

In the quantitative survey, 69% of respondents stated that awareness-raising events for elected members were 'very important' or 'important'.

Are local authorities encountering any other forms of external barrier?

Responses to the quantitative survey showed that 15% of participants rated 'difficulties accessing consultancy support' as a barrier. However, 38% suggested that this was not a barrier at all. The quantitative evidence does not provide any detail on the type of difficulties encountered but in the qualitative research some HNDU LAs made reference to the amount of time it took to appoint (owing to the time associated with procurement). Only one respondent reported having had problems accessing consultancy support, having received no responses to their initial call for tenders – although this was the exception.

Many industry stakeholders (mostly consultancies) noted that they had expanded or were looking to expand as a result of increased demand. One consultancy, for example, reported that its team had effectively doubled in the last 18 months and forecast that expansion would continue at a similar rate over the next year. However another consultancy noted that expansion was challenging due to there being a limited pool of people with the requisite expertise.

Some industry stakeholders reported that the market had expanded, with a number of new organisations now operating in the sector, including some overseas companies. One noted a

[13] Two non-HNDU LAs with heat networks serving social housing reported that retaining customer interest in mixed tenure estates was a challenge. These LAs charged a flat rate for hot water and heating to all customers. Many leaseholders opposed this charge and were opting to install individual gas boilers into their properties when given the choice.

concern about the possibility of the quality of work being undertaken suffering as a result of 'inexperienced' firms delivering heat network development consultancy and suggested that the establishment of an expert procurement framework contract might help avoid this. Another noted that they felt price inflation was occurring.

3.5 What is the demand for future skills and funding support after March 2015 for LAs at all stages of heat network development and building?

Do local authorities expect to proceed to the next stage of heat network development? If not, why not?

In response to qualitative questions regarding expectations of future progress on heat networks, many HNDU LAs noted that it was too early to judge or that it would depend upon what their consultancy reports said.

Despite recognition of the range of barriers discussed in the preceding section, there was however a sense of optimism – although this was generally tempered by recognition of various forms of dependency.

> *As long as we can now build a proper case I think we've got a good chance*. HNDU-LA3

Some noted that further progress would depend upon revenue funding from HNDU or the progress of associated infrastructure developments. However a number of authorities stated that they did expect to proceed, with three of these at an advanced stage of development. It may prove useful to revisit these projects in wave 2 of the evaluation to assess whether they have progressed and, if so, what can be learnt in relation to the critical success factors.

Do LAs have the right skills, governance and funding to proceed?

Many HNDU LAs reported that they expected capacity (i.e. staff resource) to constrain their ability to move forward with heat network development. Some industry stakeholders also reported this as a likely barrier. Both groups linked their concerns to projected contractions in local authority budgets.

Some HNDU LAs reported a lack of capability (i.e. technical expertise) as being a potential future barrier, suggesting that whilst capability had increased a significant skills deficit remained, with authorities having little or no expertise in relation to the procurement and construction of heat networks. This issue was given greater prominence by most industry stakeholders, who suggested this as a major future challenge for authorities looking to move to the commercialisation stage.

> *There is a lack of experience and a lack of capability, that's going to be one of the issues I think that holds things back*. IS5

A number of industry stakeholders noted that their local authority clients would need to develop or import greater levels of experience and expertise to enable them to act as 'intelligent clients', able to effectively plan, procure and manage heat network developments.

Some HNDU LAs reported that they expected access to revenue funding to be a problem moving forwards. There were specific references to this preventing progress into commercialisation and to future development work.

> *Beyond April 1st this year we're really going to struggle to find match-funding for the work, unless there's a really, really strong case for it.* HNDU-LA27

What are the most significant issues preventing non-participant local authorities from engaging with HNDU?

Many of the non-HNDU LAs noted that they were aware of the HNDU offer but had limited resources and had elected to prioritise other forms of activity over heat networks. It was unclear what determined their priorities, but amongst the factors reported as influencing their decision were the loss of staff that led to a reduced capacity for developing new projects, and a lack of revenue funding and reductions in the local authority estate, leading to reductions in the demand for heat.

A few other non-HNDUs suggested that they felt that a heat network would not be viable in their area as there was not likely to any suitable interest from potential heat loads or customers, although in most cases this did not appear to be a view supported by detailed study or market testing.

Other barrier issues cited by one or two non-HNDU LAs included a lack of understanding or interest in energy amongst planning officers; changes to the policy environment, namely a perceived dilution of the zero carbon homes requirements; a lack of powers to include energy requirements in planning policy, and and a lack of interest by senior decision-makers in the council.

Some non-HNDU LAs had engaged with the HNDU, but stated that they had not followed up with an application owing to a lack of internal resource.

> *Frankly, if I had one or two more people in my team I would have been able to put some resource into it – but we've got so many other different things going on that it just didn't get to the top of the list.* NHNDU-A-E3

Only one non-HNDU LA suggested that the requirement to provide match-funding was a barrier.

What forms of future support would local authorities most like to see?

Nearly all HNDU LAs and many industry stakeholders reported that they felt there was a need for ongoing government support for heat-network development.

> *I think everything around district heating is long term and that has to include government support*. HNDU-LA18

The quantitative survey also indicates a demand for future support with a clear focus on 'development finance' and 'commercial skills', with 96% saying that development finance would be 'very important' or 'important' and 91% saying the same of training on commercial skills. There is also strong demand (87%) for assistance in engaging potential investors.

Many HNDU LAs suggested that revenue funding to cover the costs of external support was the most important form of future support requirement.

> *Without being blindingly obvious funding. To get this from academic to actual is going to require some sources of funding*. HNDU-LA23

Some HNDU LAs requested the continued provision of HNDU guidance whilst 84% of quantitative survey respondents asked for technical training.

Responses to the quantitative survey indicated a strong demand for written technical guidance with (80%) seeing this as 'very important' (38%) or 'important' (42%). There was less evidence of demand in the qualitative research but a few HNDU LAs requested that future support include written guidance and, in particular, benchmark data on the costs of heat networks. It was suggested that this would better enable local authority staff to engage on a more informed basis with developers and other external stakeholders. It should be noted however that the research did not test the extent to which respondents were familiar with the existing literature.

A number also requested further work on knowledge transfer and examples of good practice. Some industry stakeholders and a few non-HNDU LAs felt that there was value in providing further assistance to enable the effective exchange of good practice between LAs. There was greater support for this within the quantitative survey, where 73% stated that identifying/communicating good practice was 'very important' or 'important'. Some, albeit lower, level of support was also expressed for awareness raising and networking events.

Many HNDU LAs stated that, in addition to the types of support currently being given, there was a need for more strategic government engagement. Some suggested there was a need for a more joined up approach.

> *I don't think it should just be left to DECC, DCLG also need to be working with DECC to develop consistent strategy for trying to deliver heat networks*. HNDU-LA2

A few specifically referred to the need for stronger and more explicit government planning guidance to support heat network development.

Some HNDU LAs suggested that heat networks needed to be seen and treated as national infrastructure, and that government should consider new approaches to financing. Finally, a number noted the need for consistency in government energy policy over time. This was also seen as important by some industry stakeholders.

> *The critical thing really is how long and to what extent will central government commitment extend*. HNDU-LA4

3.6 How effective were the arrangements for local authorities to engage with and access the HNDU fund?

The following section draws primarily on information secured through the quantitative survey and responses from non-HNDU LAs. The qualitative research with the HNDU LA group did not directly investigate this research question, other matters having been prioritised during the development of the topic guides. However, some relevant comments were recorded and these are referenced where appropriate.

Did the marketing and communications reach the target audience (all LAs where a heat network could be a suitable solution)?

Findings under this question rely primarily on evidence from non-HNDU LAs. Nearly all of the non-HNDU LA officers interviewed had some level of awareness of the existence of the HDNU. A few non-HNDU LA officers reported that they had not heard of the HNDU before, including two organisations with active heat networks in their area.

Those non-HNDU LAs that were aware of the HNDU reported that their awareness was as a result of: direct calls and approaches from HNDU staff (including instances where HNDU staff built on existing relationships they had with the LA); DECC press releases and emails, and networks and third party organisations such as the Carbon Action Network, CHPA and consultants. Some HNDU LAs noted that the HNDU had been brought to their attention by third party organisations.

Most of the non-HNDU LAs (both active and non-active) that had some previous engagement with the HNDU observed that the engagement had been helpful. For most of these LAs, the engagement had been to help in the development of an application or to help in deciding whether to begin the application process in the first place.

> *They gave lots of support, gave out a lot of useful information and also put me in touch with other local authorities who were at maybe similar stages of where we were*. NHNDU-A-E4

What were local authority perceptions and experiences of the application process?

Responses from HNDU–supported LAs to the quantitative survey suggested that respondents were largely satisfied with the application process, with high levels of agreement on key criteria such as 'the information provided was useful '(89%) and 'easy to understand' (88%), that the 'application process was straightforward' (85%) and that they were able to 'access support in a timely fashion' (85%).

There was also evidence of a good level of satisfaction with HNDU guidance, with 51% reporting that they were 'very satisfied', a further 38% 'fairly satisfied', and only 6% stating that they were dissatisfied.

More specifically, the majority of survey respondents agreed that written and verbal advice from the HNDU had been of 'high quality' (86% and 85% respectively), that HNDU project leads had been 'accessible and available to answer queries' (86%), and that project leads had been 'flexible' (85%).

It was not possible to use the quantitative survey findings to explore whether the customer journey for HNDU participants differed depending on which wave (or waves) they were receiving support from. Analysis was undertaken to explore differences and similarities in the data according to HNDU funding round, but because of the small overall sample size this analysis did not yield any findings that were statistically robust or significant enough for use in answering this question.

Is there any difference in the types of local authority engaging with the HNDU?

Table 1 below presents details of the type of applicant, number and percentage (in parentheses) of applicants from the total eligible number in England. A breakdown of application by local authority type revealed marked differences in the proportion of local authority 'types' submitting applications and the number of applications submitted. Specifically, by comparison with district and county councils, a significantly higher proportion of city, unitary and metropolitan district councils were found to be taking advantage of HNDU funding and were also more likely to submit multiple bids.

Authority type	No. of applicants	No of applications	Applications per applicant	Successful applications	Unsuccessful applications	Success rate (%)
Unitary/City	38 (68%)	79	2.1	72	7	91%
Met District	28 (78%)	60	2.1	45	15	75%
London borough	18 (55%)	36	2	35	1	97%
District	27 (13%)	41	1.5	37	4	90%
County	9 (33%)	15	1.7	12	3	80%
Town	1	1	1	1	0	100%

Table 1: Applicant type, number and percentage of applicants from total eligible population (England only)

Whilst the number of applications to the HNDU from district councils is relatively high, it represents a small proportion (13%) of the total population when compared to other types of authority. Two potential reasons for the low rate of application from district councils are proposed:

- District councils tend to be smaller and therefore less well resourced than other forms of local authority. Given that resource constraints have been identified as one of the main barriers for local authorities, it is reasonable to assume that this might be a greater

barrier for many district authorities. Indeed, some of the non-active non-HNDU LAs indicated that they felt reliant on the County Council taking a strategic lead on issues like heat networks.

- Many district authorities cover rural or largely rural areas and, as shown by the National Heat Map, are located in areas that appear to lack the concentrated heat demand required for large-scale heat networks. In short, they may not host suitable opportunities, or at least may perceive this to be the case.[14]

An actual or perceived lack of opportunity may also be the reason for the relatively low number of applications received from county councils. Whilst county boundaries often contain highly urbanised areas, the responsibility for larger settlements is often delegated to unitary or metropolitan district councils. If opportunity is a key factor, it is perhaps surprising that only 55% of London Boroughs have applied to HNDU, particularly given the area-specific drivers (London Plan) and enablers (DeMAP and DEPDU). It may be that previous support mechanisms have gone some way to enabling London authorities to investigate and, where appropriate, take forward work within London – or there may be other unidentified factors at play.

Table 2 also shows evidence of variation in the success rates for applications from different types of local authority, however the research did not generate any insight into why this may be the case.

3.7 What outputs and outcomes are projected to be delivered in the future for different local authorities, and how does this differ by area context and support received?

In the short term, the principal outputs for HNDU LAs will take the form of consultants' reports investigating the feasibility of heat networks and potential heat sources. Where these identify viable projects and local authorities are in a position to move forwards with the development of heat-networks, it is anticipated that they will deliver a range of outcomes in the form of physical infrastructure and socio-economic benefits.

Only five feasibility study reports were available at the time of research, out of an anticipated ten. These were reviewed by staff from Narec Distributed Energy and CAG, and summary reports developed for each using a template agreed with DECC. For reference, two summary tables describing key facts and brief qualitative reviews for each report are provided in appendix D.

Whilst it is premature to draw conclusions on such a limited sample, given the findings reported elsewhere in this report, it is considered useful to briefly reflect on the following points.

Choice of technology

The recommended technology choice for all five schemes is gas CHP. Consultants' recommendations are made on the basis of the most viable option. This provides some support for the supposition made in Q2 that most HNDU supported schemes would be gas CHP.

Future challenges and conditional factors

Of the four reports that make reference to proposed operating models, all recommend some form of public ownership (three LA schemes, one university). The three local authority studies all note the availability of public funding as a conditional factor in determining future progress.

Quality Assessment

[14] It is noted that there is a good correlation between the locations of HNDU applicants and areas of high heat demand (as identified by the National Heat Map).

Four of the reviewed reports had been undertaken by consultancies known to have prior experience of undertaking work on heat networks. These reports were considered to be of good quality, technically robust and, as far as could be determined, fit for purpose. The remaining report, undertaken by a consultancy not known to be active in the heat networks sector, was felt to be of an acceptable technical standard, but was perceived as requiring additional detailed work.

Appendices

A. Theory of change for HNDU

This appendix presents the Theory of Change developed during the scoping stage of the evaluation, through a process which is described in chapter 2 of the report. Two diagrams are presented in this appendix: one highlighting the assumptions implicit in each step of the theory of change, and the other highlighting the external factors which may affect the change process.

Theory of change with assumptions for each step

Figure 3 shows the basic steps in the causal chain of HNDU intervention as dark blue boxes, linked by arrows, which work upwards from the bottom of the page. Each step in the causal chain, from barriers and activities to outputs, outcomes and eventual impacts, is dependent on certain assumptions about how things work in the real world.

Key assumptions associated with each step in the causal chain are highlighted in the boxes on the right hand side of Figure 3. The conclusions section of the report discusses the extent to which Wave 1 research has generated evidence to support these assumptions, or otherwise.

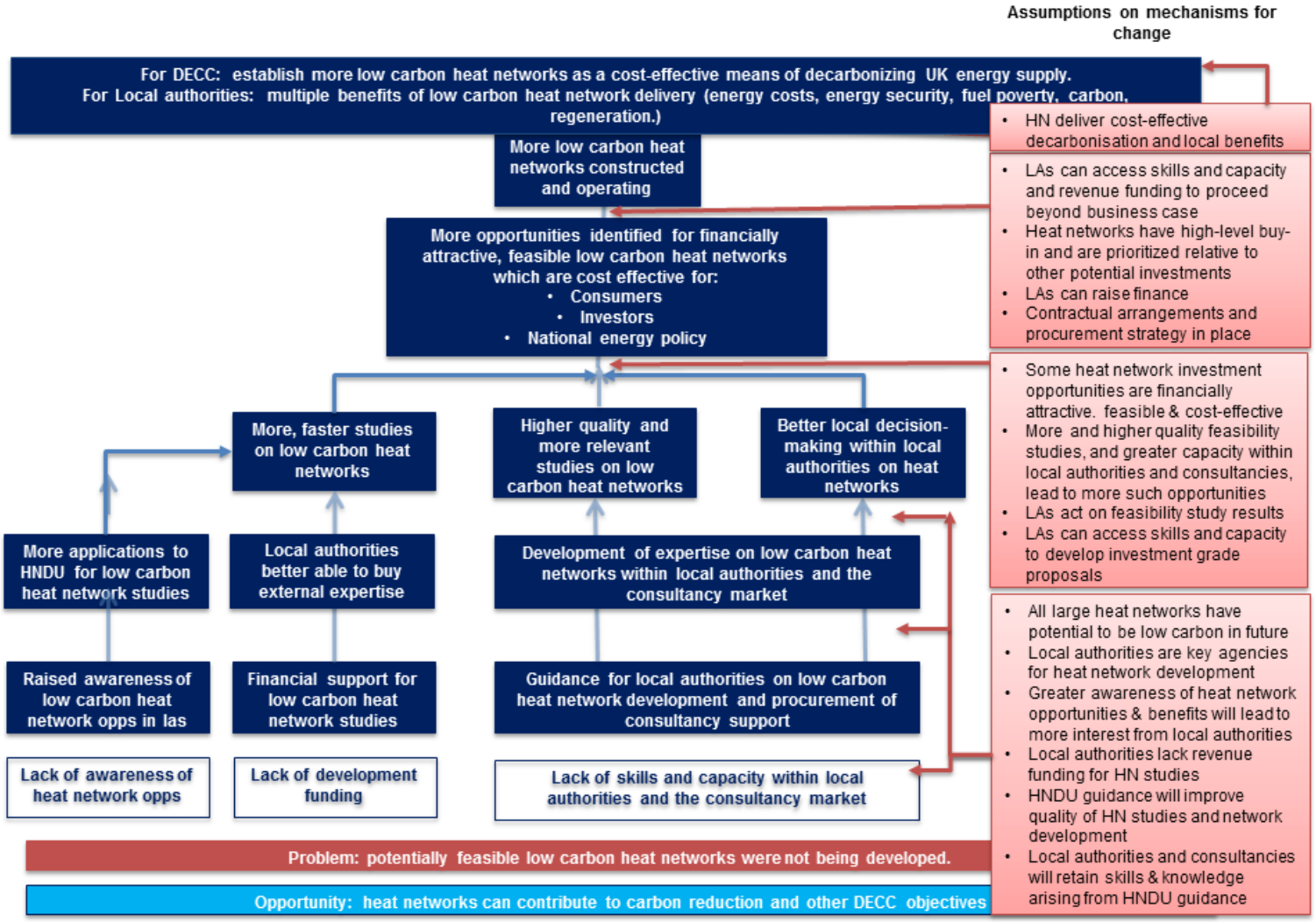


Figure 3: Theory of Change diagram – with assumptions

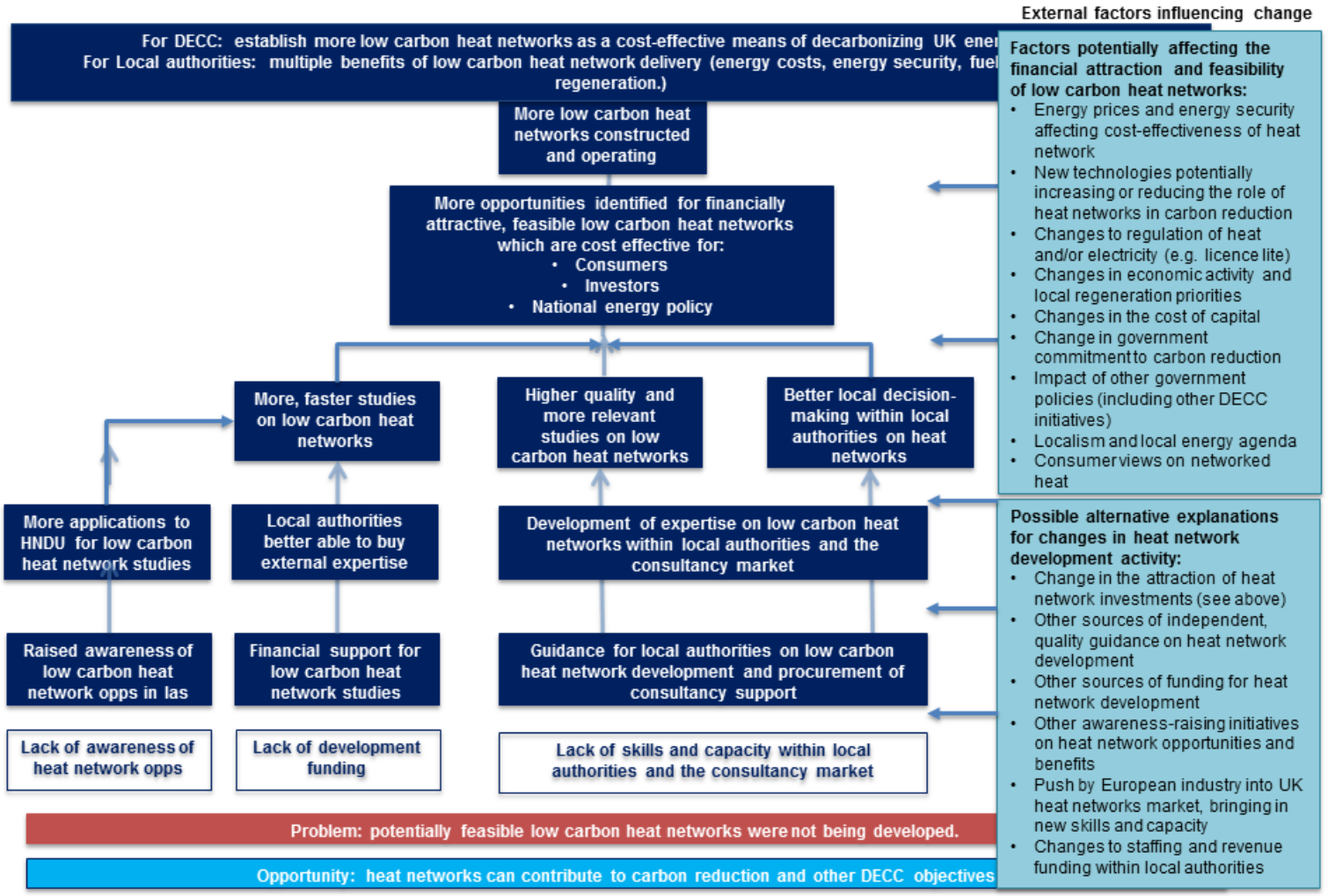
Theory of change for HNDU – with external factors influencing change

The intervention of HNDU is not the only factor affecting heat network development since HNDU's inception. It is important for the evaluation to consider other external factors which might work in the same direction as HNDU and produce similar changes in heat network development (e.g. growth in other sources of funding or support for heat network development). It is also important for the evaluation to consider external factors which may have counteracted HNDU's influence.

The external factors are presented in Figure 4 in two groups:

- Alternative explanations for changes in heat network development activity; and, underlying this,
- External factors affecting the intrinsic financial attraction and feasibility of low carbon heat networks.

Evidence about the strength and relative influence of these two groups of external factors is discussed in the conclusions chapter of this report. .


External factors influencing change
For DECC: establish more low carbon heat networks as a cost-effective means of decarbonizing UK ener
For Local authorities: multiple benefits of low carbon heat network delivery (energy costs, energy security, fuel
regeneration.)
More low carbon heat networks constructed and operating
More opportunities identified for financially attractive, feasible low carbon heat networks which are cost effective for:
• Consumers
• Investors
• National energy policy
More, faster studies on low carbon heat networks
Higher quality and more relevant studies on low carbon heat networks
Better local decision-making within local authorities on heat networks
More applications to HNDU for low carbon heat network studies
Local authorities better able to buy external expertise
Development of expertise on low carbon heat networks within local authorities and the consultancy market
Raised awareness of low carbon heat network opps in las
Financial support for low carbon heat network studies
Guidance for local authorities on low carbon heat network development and procurement of consultancy support
Lack of awareness of heat network opps
Lack of development funding
Lack of skills and capacity within local authorities and the consultancy market
Problem: potentially feasible low carbon heat networks were not being developed.
Opportunity: heat networks can contribute to carbon reduction and other DECC objectives
Factors potentially affecting the financial attraction and feasibility of low carbon heat networks:
• Energy prices and energy security affecting cost-effectiveness of heat network
• New technologies potentially increasing or reducing the role of heat networks in carbon reduction
• Changes to regulation of heat and/or electricity (e.g. licence lite)
• Changes in economic activity and local regeneration priorities
• Changes in the cost of capital
• Change in government commitment to carbon reduction
• Impact of other government policies (including other DECC initiatives)
• Localism and local energy agenda
• Consumer views on networked heat
Possible alternative explanations for changes in heat network development activity:
• Change in the attraction of heat network investments (see above)
• Other sources of independent, quality guidance on heat network development
• Other sources of funding for heat network development
• Other awareness-raising initiatives on heat network opportunities and benefits
• Push by European industry into UK heat networks market, bringing in new skills and capacity
• Changes to staffing and revenue funding within local authorities

B. Assessment of wave 1 findings against the Theory of Change

HNDU Intervention: Underpinning assumptions	
Assumptions	**Assessment against findings**
All large heat networks have the potential to be low carbon in future.	Nearly all HNDU LA participants in the qualitative research had considered a range of heat sources. Whilst most HNDU LAs interviewed had yet to receive their reports, many anticipated that gas CHP would be the preferred choice. Energy from Waste and Biomass were the other most frequently referenced potential options. Many HNDU LAs had given consideration to future-proofing, a few of these noting that they had considered the possibility of moving to lower carbon sources in the future. Many suggested that the immediate choice of heat source and technology would ultimately be a matter of economics, but all options would be expected to enable 'lower' carbon forms of provision. Conclusion: Assumption proven.
Local authorities lack revenue funding for HN studies.	Respondents provided clear evidence of revenue funding constraints and this was expected to be an ongoing barrier. Most had undertaken previous work but in many cases this appeared to have been shelved prior to HNDU support. Industry stakeholders reported that their had been a sharp increase in work since the establishment of the HNDU. Funding was reported as the most important form of HNDU support, in both the qualitative and quantitative research and many authorities stated that they would not have been able to take forward work on heat networks in its absence. Conclusion: Strong evidence to support this assumption
HNDU guidance will improve quality of HN studies and network development.	HNDU guidance was valued and well regarded by most recipients many of whom commented favourably on the flexible nature of the delivery model. Guidance was seen as helping to improve an authority's ability to engage with the market and noted by both local authorities and some industry stakeholders as improving the quality of procurement specifications. Conclusion: Strong evidence to support this assumption.

Local authorities and consultancies will retain skills & knowledge arising from HNDU guidance.	There is some evidence (qualitative) to support the view that HNDU LAs have increased their in-house knowledge and expertise and that this will be retained within the authority, albeit in many cases by default i.e. simply as a result of officers remaining in post. No evidence of capability gains was reported within the consultancy sector.[15] Conclusion: Some evidence to support this assumption
Greater awareness of heat network opportunities & benefits will lead to more interest from local authorities.	Nearly all HNDU LAs had undertaken work on heat networks prior to the establishment of the HNDU, suggesting widespread awareness of potential opportunities. There was some evidence to suggest that awareness-raising targeted at groups such as elected members could assist officers leading heat network development to secure internal support. The existence of government support (in the form of the HNDU) was reported by some HNDU LAs as helping to secure internal attention and support. Some types of local authority, specifically county and, more markedly, district councils, were found to be under-represented in the population of successful HNDU applicants. There are several possible reasons for this but awareness of the potential opportunities may be a factor in some cases.[16] Conclusion: Some evidence to support this assumption
Heat networks have high-level buy-in and are prioritised relative to other potential investments.	The quantitative survey provided evidence of the importance of high-level buy-in for developing work on heat networks to date. Some HNDU LAs in the qualitative research noted that HNDU support had helped to secure this because it was seen as adding credibility to their projects. Wave 2 of the research will consider whether this support has been sustained and the factors that determine whether or not HNDU LAs commit to move projects forward into the commercialisation stage. Conclusion: Some evidence to support this assumption
LAs can access skills and capacity and revenue funding to proceed beyond business case.	Many HNDU LAs in the qualitative research reported that they expected capacity (staff resource) to constrain their ability to move forwards on heat networks. Some industry stakeholders also reported this as a likely barrier. Some HNDU LAs reported that they expected access to revenue funding to be a problem moving forwards, but a few did not[17].

[15] It may be worth examining consultancy capability in Wave 2, for example to establish levels of expertise in non CHP technology with a view to considering the extent to which this might restrain the development of alternative systems.

[16] It is suggested that this matter should be considered in Wave 2.

[17] Consideration should be given (in the Wave 2 research) to investigating the factors which allow these LAs to be confident of future success

	There was also qualitative evidence that a lack of capability (technical expertise) would be a potential future barrier. This issue was highlighted by most industry stakeholders who suggested that this would present a major future challenge for authorities, as they moved into the commercialisation stage. Conclusion: Limited evidence to support this assumption.
LAs can raise finance	A few authorities reported that they expected to proceed into the commercialisation stage and stated that accessing capital was not seen as a barrier. However in general local authorities felt that it would be challenging to secure capital, particularly private finance, owing to expectations of low rates of return and suggested that future progress would be dependent upon some level of public funding. Conclusion: Limited evidence to support this assumption.
Contractual arrangements and procurement strategy in place	One local authority reported being at this stage of development. Conclusion: Limited evidence to support this assumption
Heat networks deliver cost-effective decarbonisation and local benefits.	No local authorities involved in this wave of research had installed new heat networks and there was therefore no evidence of benefits being achieved. Conclusion: Limited evidence to support this assumption

Factors potentially affecting the financial attraction and feasibility of low carbon heat networks	
External factor	**Assessment against findings**
Changes in economic activity and local regeneration priorities (presumed supportive)	Regeneration emerged in both the qualitative and quantitative research as one of the main drivers for local authority interest in heat networks and one that appeared to be of growing importance. Conclusion: Strong evidence to support this assumption

Localism and the local energy agenda (presumed supportive)	Localism did not emerge as an explicit theme within the research. It is however considered to be implicit within the stated regeneration and fuel poverty drivers. Comment: Some evidence to support this assumption.
Energy prices and energy security affecting cost-effectiveness of heat network (presumed supportive)	Rising energy costs were seen as a driver by most HNDU LAs in the qualitative research, but the issue was not identified as an important external factor. It was recognised as an issue within the quantitative survey where it was listed as very important or important by 40% of respondents. However 32% listed it as being of little importance or unimportant. Conclusion: Limited evidence to support this assumption
Consumer views on networked heat (presumed negative)	Two HNDU LA participants in the qualitative research had direct experience of customer engagement (data collection) and both reported that it had been challenging. Some of the industry stakeholders also identified customer engagement as a challenge. One referred to the use of a 'customer heat charter' as a mechanism for helping to de-risk projects for potential customers. There was evidence in both the qualitative and quantitative work that local authorities expected customer engagement to be a challenge. Conclusion: Limited evidence to support this assumption[18]
Changes to regulation of heat and/or electricity (presumed supportive)	Potential drivers were explored in the qualitative research but changes to regulation were not identified as an issue. It was recognised as very important, or important, by 42% within the quantitative research although a further 32% said it was of little importance or unimportant. Conclusion: Little evidence to support this assumption[19]
Changes in the cost of capital (presumed supportive)	Potential drivers were explored in the qualitative research but the cost of capital did not emerge as an issue. It was ranked as the lowest form of external factor within the quantitative research although still rated as very important or important by 29% of respondents. Conclusion: Little evidence to support this assumption

[18] It may be useful to refer to external evidence on this matter in the Wave 2 research.

[19] It may be useful to refer to external evidence on this matter in the Wave 2 research.

Change in government commitment to carbon reduction (could be positive or negative)	The importance of a stable policy environment was referenced as being an important enabler by some local authorities in the qualitative research. The lack of such was cited as the biggest external barrier within the quantitative study and when asked what types of future government support would be useful some HNDU LAs called for a stable policy environment. Conclusion: Unclear.
Impact of other government policies (presumed supportive)	Planning was referred to by some HNDU LAs as an important internal enabler. However a few respondents expressed concern about the impact of proposed changes and one respondent noted that DCLG changes to the building regulations would undermine local planning policy as a driver. Many HNDU LAs called for a more strategic, cross-departmental approach to heat networks within government. Comment: Some evidence to suggest this assumption is incorrect..
New technologies potentially increasing or reducing the role of heat networks in carbon reduction (presumed negative)	The research did not generate any information on this matter.

Possible alternative explanations for changes in heat network development activity	
External factor	**Assessment against findings**
Other sources of independent, quality guidance on heat network development	Most HNDU-LAs reported that they had drawn on other, non-HNDU, forms of support. Identified providers took a variety of forms. Evidence of widespread engagement with non-HNDU forms of support was also found in the quantitative survey. The evidence suggests that the type of support available included technical advice, knowledge transfer, programme support and in some cases funding. However some of the most significant forms of non-HNDU support were historic and no longer available. Of the remainder most are highly localised and relatively light touch. No evidence of tension between other forms of support and HNDU was found indeed some of the non-HNDU support providers appeared to be evolving to better enable HNDU LAs to take advantage of the HNDU. Conclusion: Other forms of support exist but they do not appear to be major drivers of change within the local authority sector as a whole.
Other sources of funding for heat network development.	
Other awareness-raising initiatives on heat network opportunities and benefits.	
Changes to staffing and revenue funding within local authorities	There is qualitative evidence to suggest that resource constraints may become more significant as a barrier to heat network development. Conclusion: changes are expected but these are likely to impose or increase existing barriers.
Change in the attractiveness of heat network investments	No evidence was uncovered in relation to this issue.

C. Discussion Guides

i) Discussion guide for first research wave interviews: HNDU local authorities (HNDU LAs)

The questions below are for HNDU lead officers in HNDU-supported local authorities.

The estimated interview length is **45-60 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is XXXX and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today. Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales. We're particularly interested to discuss your experiences of local authority work on heat network development in recent years, including any work you have undertaken on heat mapping, masterplanning, feasibility, construction or other forms of heat network development activity.	3 minutes

Theme	Questions/script	Estimated timing
	The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for your organisation to feed into DECC's decision making. We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you? Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external consultant? Ok, moving onto the interview proper, the first topic is…	
Topic 1 –	**Please provide a brief overview of the work your local authority has taken forward on heat networks in**	5 minutes

Theme	Questions/script	Estimated timing
Establishing heat network development track record	**recent years.** **We would like to understand what work your local authority has undertaken and how far it is motivated to support local heat network development.** **[Note to interviewer: please review information about the local authority on the HNDU database before the interview begins]**	(cumulative time – 8 mins)
Follow-up questions	(after initial response…) • What types of work have been undertaken? e.g. internal discussions & planning, heat-mapping, masterplanning, feasibility, procurement, other, commercialisation, etc • When did activity start / take place? [note: [particularly important to find out if some or all activity took place before HNDU or whilst HNDU has been set up i.e. post-Sept 2013] • Has the amount of work undertaken by your local authority on heat network development changed over time (especially the last five years)? If yes, then in what way? • Are you working (or did you work) in partnership with others (internal or external) If so who? •	
Topic 2 – Understanding drivers	**What have been the most significant drivers behind your local authority's decision to investigate or undertake heat network activity?** **What have been the key factors (both internal and external) that have enabled / helped your local authority take forward work on heat network development (at any stage)?**	10 minutes including follow-up questions (18)
Follow-up questions (as far as possible, ensure that these questions are	(after initial response…) • What have been the key internal drivers/enablers? (e.g. political leadership, officer commitment, key targets, links to other priorities, income opportunities?). In particular, who sponsored/pushed for the work internally? And who is delivering it? •	

Theme	Questions/script	Estimated timing
answered during the discussion)	• What outcomes are the local authority hoping to achieve as a result of pursuing heat networks? (e.g. fuel poverty, carbon reduction, economic regeneration, etc)? How likely are these outcomes to be achieved? • What have been the key external drivers/enablers? (external drivers/enablers that should be explored include the HNDU itself, availability of other sources of assistance/support, the low carbon agenda, Govt policy, low cost of capital, rising cost of energy, local authority powers, regulatory changes) • How, if at all, have these factors/drivers changed over time? i.e. have some drivers /issues etc become more significant? • Are some drivers / factors more important for driving different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other)? •	
Topic 3 – Understanding barriers	**What are the most significant factors, if any, (both internal and external), that have hindered your local authority in taking forward work on heat network development (at any stage)?**	10 minutes including follow-up questions (28)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What internal factors have hindered your local authority (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What external factors have hindered your local authority (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement) • How, if at all, have these factors/barriers changed over time? • How have you overcome any of these barriers (if any)? • Are some factors/barriers more important in hindering different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other) • Do you anticipate that any these barriers may change in the future? Why? **[Note: make sure it is clear whether any barriers relate to development, commercialisation or delivery**	

Theme	Questions/script	Estimated timing
	stages of heat networks]	
Topic 4 – Heat source types	**If you are in the process of developing a heat network, what heat sources are you investigating? What type of heat source do you anticipate using (or have you already employed) and why?** **AND/OR If you have a network in place already, what heat source supplies your network?** **What technology is the heat network using (or likely to use)? (e.g. waste heat, boiler, heat pump, CHP)?**	5 minutes (including follow-up questions) (33)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	[Note to interviewer: We are keen to establish to what extent the choice of heat source was a result of the local authority going through a systematic process of investigating options, What we're interested in particularly is the process which LAs are going through (or have gone through in the past) to identify the best heat source. HNDU aims to encourage LAs to do a comprehensive scan of all available sources - so that is what is critical here] (after initial response…) • What process (or processes) did the local authority go through (or is the local authority going through) in order to reach a decision on what heat source and technology is used? Why? • How many heat sources and technologies were/are being evaluated during the development stages of the heat network and what were they? • How were the heat sources and technologies (or how are they being) identified and evaluated (e.g. in terms of cost, carbon, technical constraints) • Are there plans to change the heat source over time?	

Theme	Questions/script	Estimated timing
Topic 5a – Effectiveness/impact of HNDU support	**How, and to what extent, has the HNDU supported your local authority in progressing the heat network development activity?**	5 minutes (including follow-up questions) (38)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What type(s) of support have you had from the HNDU? What support have you most valued? • What have been the direct/indirect benefits associated with HNDU support? (e.g. increased capability of key staff or stakeholders, enhanced credibility of project owing to HNDU involvement, new suppliers entering the market etc.)? • How likely is it that any knowledge gained as a result of the HNDU's support will be retained within the local authority? • Could the support from the HNDU be improved? If so, how? • Are there any other forms of support you would like to see the HNDU provide? [Note to interviewer: make sure we understand what stage of the journey any suggestions on support refer to. (refer to HDNU diagram) so that its clear and unambiguous in how the findings are understood, even if we allow people initially use their own terminology for what stage they are at]	

Theme	Questions/script	Estimated timing
Topic 5b – Effectiveness/impact of HNDU support	**Has engagement with the HNDU enabled you to take forward any work that you would not otherwise have been able to move forward?**	5 minutes (including follow-up questions) (43)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) If YES: • What sort of work has HNDU enabled you to move forward on? • Has the HNDU helped to overcome barriers to the development stages of heat networks? If so, what barriers? How? • What impact would the absence of HNDU support had on your ability to move forward? (e.g. would it have been slower, less ambitious or just the same). • What do you think the local authority would have directed its time towards (e.g. other low carbon projects) if you had not taken forward this HNDU-supported heat networks activity? If NO: - How would you have taken forward this work in the absence of HNDU support?	
Topic 5c – Effectiveness/impact of HNDU support	**Have there been any unintended consequences from the support you have received from the HNDU?**	2 minutes (45)
Follow-up questions (as far as possible, ensure that these questions are answered during	n/a	

Theme	Questions/script	Estimated timing
the discussion)		
Topic 5d – Effectiveness/impact of HNDU support	**Has your local authority received support for heat network development work from any external source other than the HNDU?**	5 minutes (50)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) If NO, move to Topic 6 If YES: - What sources have you received support from? When? • What type(s) of support have you had and how useful have you found this? Has any form of support been more or less useful? • What stages of development has this support influenced (mapping, masterplanning, feasibility, procurement, other)? • Has this external support helped to overcome barriers to the development stages of heat networks? If so which? And how? • Are there any aspects of work that your local authority would not have taken forward without this external support? What aspects and why? [ask for examples or evidence of this]	

Theme	Questions/script	Estimated timing
Topic 6 – Future of heat network development activity	**Looking ahead how do you see your local authority's work on heat networks developing over the next couple of years?** **What factors will determine your ability to move forward successfully?**	3 minutes (including follow-up questions) (53)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • Do you anticipate being able to proceed from where you are now? Please say why • What will help or hinder you from moving forward? • What commercial structures and funding sources are you exploring (or expect to explore)? [Note: thismay not be applicable depending where they are in process] • Do you expect to attract the capital investment funding to progress your projects (if so from where do you expect this to come)? What do you base this view on? • To what extent have potential customers been engaged (domestic and non- domestic)? To what extent do they support the scheme/s? • Are there other stakeholders who need to be engaged for project to continue?	
Topic 7 – Future Government support	**Do you see a role for continuing government support on heat networks?**	3 minutes (including follow-up questions) (56)
Follow-up questions (as far as possible, ensure that these questions are answered during	If so, what type of support would be most useful?	

Theme	Questions/script	Estimated timing
the discussion)		
Summing up	**Is there anything else you would like to add about heat network development support local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes (58)
	Many thanks for your time.	

ii) Discussion guide for first research wave interviews: Non-HNDU local authorities

Local authorities who are, or have previously been, involved in the development of heat networks, and who have enquired or applied for HNDU support

The estimated interview length is **40-50 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today. Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales. We're particularly interested to discuss your experiences of local authority work on heat network development in recent years, including any work you have undertaken on heat mapping, masterplanning, feasibility or other forms of heat network development activity. The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for your organisation to feed into DECC's decision making.	3 minutes

Theme	Questions/script	Estimated timing
	We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you? Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external consultant? Ok, moving onto the interview proper, the first topic is…	
Topic 1 – Establishing heat network track record	**Please provide a brief overview of the work your local authority has taken forward on heat networks in recent years.** **We would like to understand what work your local authority has undertaken and how far it is motivated to**	5 minutes

Theme	Questions/script	Estimated timing
	support local heat network development. **[Note to interviewer: please review information about the local authority on the HNDU database before the interview begins]**	
Follow-up questions	(after initial response…) • What types of work have been undertaken? e.g. internal discussions & planning, heat-mapping, masterplanning, feasibility, procurement, other, commercialisation, operation, etc • When did activity take place? [note: please ask them to map key milestones over time. Particularly important to find out if some or all activity took place before HNDU or whilst HNDU has been set up i.e. post-Sept 2013] • Has the amount of work undertaken by your local authority on heat network development changed over time (especially the last five years)? If yes, then in what way? And why? • Are you working (or did you work) in partnership with others? If so who? •	
Topic 2 – Understanding drivers	**What have been the most significant drivers behind your local authority's decision to investigate or undertake heat network activity?** **What have been the key factors (both internal and external) that have enabled / helped your local authority take forward work on heat network development (at any stage)?**	10 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What have been the key internal drivers/enablers? (e.g. political leadership, officer commitment, key targets, links to other priorities, income opportunities?). In particular, who sponsored/pushed for the work internally? And who is delivering it? • What outcomes were the local authority hoping to achieve as a result of pursuing heat networks? (e.g. fuel poverty, carbon reduction, economic regeneration, etc)? How likely are these outcomes to be achieved? Have these changed over time? If so how? • What have been the key external drivers/enablers? (external drivers/enablers that should be explored include availability of other sources of assistance/support, the low carbon agenda, Govt policy, low cost of	

Theme	Questions/script	Estimated timing
	capital, rising cost of energy, local authority powers, regulatory changes) • How, if at all, have these factors/drivers changed over time? i.e. have some drivers /issues etc become more significant? • Are some drivers / factors more important for driving different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other)? •	
Topic 3 – Understanding barriers	**What are the most significant factors, if any, (both internal and external), that have hindered your local authority in taking forward work on heat network development (at any stage)?**	10 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What internal factors have hindered your local authority (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What external factors have hindered your local authority (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement) • How, if at all, have these factors/barriers changed over time? • How have you overcome any of these barriers (if any)? • Are some factors/barriers more important in hindering different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other) • Do you anticipate that any these barriers may change in the future? Why? **[Note: make sure it is clear whether any barriers relate to development, commercialisation or delivery stages of heat networks]**	
Topic 4 – Heat source types	**If you are in the process of developing a heat network, what heat sources are you investigating? What type of heat source do you anticipate using (or have you already employed) and why?** **AND/OR, If you have a network in place already, what heat source supplies your network?**	5 minutes (including follow-up questions)

Theme	Questions/script	Estimated timing
	What technology is the heat network using (or likely to use)? (e.g. waste heat, boiler, heat pump, CHP)?	
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	[Note to interviewer: We are keen to establish whether the choice of heat source was a result of the local authority going through a systematic process of investigating options, or more the result of an arbitrary or 'opportunistic' set of factors. What we're interested in particularly is the process which LAs are going through (or have gone through in the past) to identify the best heat source. (Although these aren't HNDU respondents, HNDU aims to encourage LAs to do a comprehensive scan of all available sources - so that is what is critical here] (after initial response…) • What process (or processes) did the local authority go through (or is the local authority going through) in order to reach a decision on what heat source and technology is used? • How many heat sources and technologies were/are being evaluated during the development stages of the heat network and what were they? • How were they (or how are they being) identified and evaluated (e.g. in terms of cost, carbon, technical constraints) • Are there plans to change the heat source over time? • What scale of carbon savings have been projected? Were these delivered once built? Were these dependent on energy storage or electricity generation?	
Topic 4a – Engaging with the HNDU	**I understand you made an enquiry to the Heat Network Delivery Unit (often called the HNDU), or that you may have attended an event at which the HNDU was promoted. Is that correct?**	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these	If NO, then please move the question below (4b) instead	

Theme	Questions/script	Estimated timing
questions are answered during the discussion)	If YES, then: • Could you please tell us why you did so? • When and how did you become aware of the HNDU? Have you attended any of their events? • Were there any particular reasons why you did not follow-up your initial enquiry? • What are the most significant issues preventing you from engaging with HNDU? • Overall what was your experience of dealing with the HNDU? Was the contact you had effective and helpful?	
Topic 4b – Engaging with the HNDU	**Have you come across the Heat Network Delivery Unit at all?** [Note to interviewer: only ask this question if the answer to the above question was NO]	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If YES, then: • When and how did you first become aware of the HNDU? • Has your local authority considered making an application for HNDU support? If so, why have you not made an application for HNDU support? • What are the most significant issues preventing you from engaging with HNDU? [Note: this question is likely to have been covered in Topic 3 on barriers] If NO, then move on to Topic 5	

Theme	Questions/script	Estimated timing
Topic 5 – Effectiveness/impact of external support	**Has your local authority received support for heat network development work from any external source other than the HNDU?**	5 minutes
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) If NO: • What internal support and resources were used to take forward heat network development? [note: support and resources both in terms of officer time and externally commissioned technical work, if undertaken] • What was the process for securing this support and resource? If YES: - What sources have you received support from? When? • What type(s) of support have you had and how useful have you found this? Has any form of support been more or less useful? • What stages of development has this support influenced (mapping, masterplanning, feasibility, procurement, other)? If financial, how was this paid for? • Has this external support helped to overcome barriers to the development stages of heat networks? If so which? And how? • Are there any aspects of work that your local authority would not have taken forward without this external support? What aspects and why? [ask for examples or evidence of this]	

Theme	Questions/script	Estimated timing
Topic 6 – Future of heat network development activity	**Looking ahead how do you see your local authority's work on heat networks developing over the next couple of years?** **What factors will determine your ability to move forward successfully?**	3 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • Do you anticipate being able to proceed from where you are now? Please say why • What will help or hinder you from moving forward? • What commercial structures and funding sources are you exploring? • Do you expect to attract the capital investment funding to progress your projects (if so from where do you expect this to come)? What do you base this view on? • To what extent have potential customers been engaged (domestic and non- domestic)? To what extent do they support the scheme/s? • Are there other stakeholders who you are planning to engage?	
Topic 7 – Future Government support	**Do you see a role for continuing government support on heat works?**	3 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during	If so, what type of support would be most useful?	

Theme	Questions/script	Estimated timing
the discussion)		
Summing up	**Is there anything else you would like to add about heat network development support local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes
	Many thanks for your time.	

iii) Topic guide for first research wave interviews: Non-HNDU local authorities – enquired + no HN activity

Local authorities who enquired about HNDU but did not apply, and are not currently taking forward any heat network development work

The estimated interview length is **30 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is XXXX and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today. Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales. We're particularly interested to discuss your local authority's priorities and objectives on decarbonisation (if any), whether you have considered taking forward heat network activity previously, any barriers that have prevented you from undertaking heat network activity and whether you think your local authority may pursue heat network opportunities in the future. The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for	3 minutes

Theme	Questions/script	Estimated timing
	your organisation to feed into DECC's decision making. We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you? Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external consultant? Ok, moving onto the interview proper, the first topic is…	
	Before we begin, can I just check, has your local authority taken forward any heat network activity in recent years?	1 minute

Theme	Questions/script	Estimated timing
	[we should have established that the answer to this is NO before the interview by making sure that the local authority is in category we think they fall into, so this question is really a safety net] However, If YES, then switch to the relevant topic guide. If yes, they are likely to be either • Local authorities that are, or have previously been, involved in the development of heat networks, but who have not enquired or applied for HNDU support OR • Local authorities who are, or have previously been, involved in the development of heat networks, and who have enquired or applied for HNDU support So use the appropriate topic guide depending on which category they fall into	
Topic 1 – Establishing low carbon priorities	**What are the main priorities and objectives of your local authority in relation to the low carbon agenda, both in terms of your estates and operations and the wider community?**	3 minutes
Follow-up questions		
Topic 2 – Understanding of heat networks & drivers for any heat network considerations	**a. How aware are you (and your local authority) of what heat networks are and how your local authority might play a role in their development?**	5 minutes including follow-up questions

Theme	Questions/script	Estimated timing
	b. Has your local authority ever considered taking forward heat network development work?	
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If yes to 2b, then ask them to describe what happened (what did they consider doing, when did this happen?) What were the main internal and external drivers behind this? Are you still planning to go forward with this work in the future? Why not? If it's stalled, why? What would help them start up again? If they did move forward, are there other barriers they envisage they'd hit? Do you anticipate that some of these issues may change in the future	
Topic 3 – Understanding barriers	**What are the main reasons why (both internal and external) your local authority has not taken forward work on heat networks?** **What are the most significant factors, if any, (both internal and external), that have hindered your local authority in taking forward work on heat network development (at any stage)?**	10 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What internal factors have hindered your local authority (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What external factors have hindered your local authority (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement) • If initial work has stalled, why? What would help them start up again?	

Theme	Questions/script	Estimated timing
	• Do you anticipate that any these barriers may change in the future? Why?	
Topic 4a – Engaging with the HNDU	**I understand you made an enquiry to the Heat Network Delivery Unit, or that you may have attended an event at which the HNDU was promoted. Is that correct?**	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If NO, then please move the question below (4b) instead If YES, then: • What is your understanding of what the HNDU does? • Could you please tell us why you did so? • When and how did you become aware of the HNDU? Have you attended any of their events? • Were there any particular reasons why you did not follow-up your initial enquiry? • What are the most significant issues preventing you from engaging with HNDU? • Overall what was your experience of dealing with the HNDU? Was the contact you had effective and helpful?	
Topic 4b – Engaging with the HNDU	**Have you come across the Heat Network Delivery Unit at all?** [Note to interviewer: only ask this question if the answer to the above question was NO]	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these	If YES, then: • What is your understanding of what the HNDU does?	

Theme	Questions/script	Estimated timing
questions are answered during the discussion)	• When and how did you first become aware of the HNDU? • How effective has the promotion of the HNDU to local authorities been? • Has your local authority considered making an application for HNDU support? If so, why have you not made an application for HNDU support? • What are the most significant issues preventing you from engaging with HNDU? [Note: this question is likely to have been covered in Topic 3 on barriers] If NO, then move on to Topic 5	
Topic 5 – Future of heat network development activity	**Do you anticipate undertaking any work on heat networks over the next two years?**	3 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) If YES: • What are you likely to do, who will do this and how? • Are you aware of any external sources of support on heat networks? If so, what are they? • Do you anticipate applying for support from the HNDU or any other sources of external support (if available)? Why? If NO, are you able to identify any specific reasons for not doing so?	
Summing up	**Is there anything else you would like to add about heat network development support local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes

Theme	Questions/script	Estimated timing
	Many thanks for your time.	

iv) Topic guide for first research wave interviews: Non-HNDU local authorities

Local authorities who are, or have previously been, involved in the development of heat networks, and who have not enquired or applied for HNDU support

The estimated interview length is **45 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is XXXX and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today.	3 minutes

Theme	Questions/script	Estimated timing
	Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales. We're particularly interested to discuss your experiences of local authority work on heat network development in recent years, including any work you have undertaken on heat mapping, masterplanning, feasibility, construction or other forms of heat network development activity. The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for your organisation to feed into DECC's decision making. We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you?	

Theme	Questions/script	Estimated timing
	Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external consultant? Ok, moving onto the interview proper, the first topic is…	
Topic 1 – Establishing heat network track record	**Please provide a brief overview of the work your local authority has taken forward on heat networks in recent years.** **We would like to understand what work your local authority has undertaken and how far it is motivated to support local heat network development.** **[Note to interviewer: please review information about the local authority on the HNDU database before the interview begins]**	5 minutes
Follow-up questions	(after initial response…) • What types of work have been undertaken? e.g. internal discussions & planning, heat-mapping, masterplanning, feasibility, procurement, other, commercialisation, operation, etc • When did activity take place? [note: [particularly important to find out if some or all activity took place before HNDU or whilst HNDU has been set up i.e. post-Sept 2013] • Has the amount of work undertaken by your local authority on heat network development changed over time (especially the last five years)? If yes, then in what way? And why? • Are you working (or did you work) in partnership with others? If so who and why? •	
Topic 2 – Understanding	**What have been the most significant drivers behind your local authority's decision to investigate or undertake heat network activity?**	10 minutes including follow-

Theme	Questions/script	Estimated timing
drivers	**What have been the key factors (both internal and external) that have enabled / helped your local authority take forward work on heat network development (at any stage)?**	up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What have been the key internal drivers/enablers? (e.g. political leadership, officer commitment, key targets, links to other priorities, income opportunities?). In particular, who sponsored/pushed for the work internally? And who is delivering it? • What outcomes are the local authority hoping to achieve as a result of pursuing heat networks? (e.g. fuel poverty, carbon reduction, economic regeneration, etc)? How likely are these outcomes to be achieved? • What have been the key external drivers/enablers? (external drivers/enablers that should be explored include the HNDU itself, availability of other sources of assistance/support, the low carbon agenda, Govt policy, low cost of capital, rising cost of energy, local authority powers, regulatory changes) • How, if at all, have these factors/drivers changed over time? i.e. have some drivers /issues etc become more significant? • Are some drivers / factors more important for driving different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other)? •	
Topic 3 – Understanding barriers	**What are the most significant factors, if any, (both internal and external), that have hindered your local authority in taking forward work on heat network development (at any stage)?**	10 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What internal factors have hindered your local authority (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What external factors have hindered your local authority (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement) • How, if at all, have these factors/barriers changed over time? • How have you overcome any of these barriers (if any)? • Are some factors/barriers more important in hindering different stages of heat network development (e.g.	

Theme	Questions/script	Estimated timing
	mapping, masterplanning, feasibility, procurement, other) • Do you anticipate that any these barriers may change in the future? Why? **[Note: make sure it is clear whether any barriers relate to development, commercialisation or delivery stages of heat networks]**	
Topic 4 – Heat source types	**If you are in the process of developing a heat network, what heat sources are you investigating? What type of heat source do you anticipate using (or have you already employed) and why?** **AND/OR, If you have a network in place already, what heat source supplies your network?** **What technology is the heat network using (or likely to use)? (e.g. waste heat, boiler, heat pump, CHP)?**	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	[Note to interviewer: We are keen to establish whether the choice of heat source was a result of the local authority going through a systematic process of investigating options, or more the result of an arbitrary or 'opportunistic' set of factors. What we're interested in particularly is the process which LAs are going through (or have gone through in the past) to identify the best heat source. (Although these respondents aren't HNDU participants, HNDU aims to encourage LAs to do a comprehensive scan of all available sources - so that is what is critical here] (after initial response…) • What process (or processes) did the local authority go through (or is the local authority going through) in order to reach a decision on what heat source and technology is used? • How many heat sources and technologies were/are being evaluated during the development stages of the heat network and what were they? • How were they (or how are they being) identified and evaluated (e.g. in terms of cost, carbon, technical constraints) • Are there plans to change the heat source over time?	

Theme	Questions/script	Estimated timing
	• What scale of carbon savings have been projected? Were these delivered once built? Were these dependent on energy storage or electricity generation?	
Topic 5 – Engaging with the HNDU	**Have you come across the Heat Network Delivery Unit at all? (often called HNDU)** [Note to interviewer: only ask this question if the answer to the above question was NO]	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If YES, then: • When and how did you first become aware of the HNDU? • Has your local authority considered making an application for HNDU support? If so, why have you not made an application for HNDU support? • What are the most significant issues preventing you from engaging with HNDU? [Note: this question is likely to have been covered in Topic 3 on barriers] If NO, then move on to Topic 5	
Topic 6 – Effectiveness/impact of external support	**Has your local authority received support for heat network development work from any external source other than the HNDU?**	5 minutes
Follow-up questions (as far as possible, ensure that these	(after initial response…) If NO: • What internal support and resources were used to take forward heat network development? [note: support	

Theme	Questions/script	Estimated timing
questions are answered during the discussion)	and resources both in terms of officer time and externally commissioned technical work, if undertaken] • What was the process for securing this support and resource? • If YES: - What sources have you received support from? When? • What type(s) of support have you had and how useful have you found this? Has any form of support been more or less useful? • What stages of development has this support influenced (mapping, masterplanning, feasibility, procurement, other)? If financial, can we find out what it paid for? • Has this external support helped to overcome barriers to the development stages of heat networks? If so which? And how? • Are there any aspects of work that your local authority would not have taken forward without this external support? What aspects and why? [ask for examples or evidence of this]	
Topic 7 – Future of heat network development activity	**Looking ahead how do you see your local authority's work on heat networks developing over the next couple of years?** **What factors will determine your ability to move forward successfully?**	3 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • Do you anticipate being able to proceed from where you are now? Please say why • What will help or hinder you from moving forward? • What commercial structures and funding sources are you exploring? • Do you expect to attract the capital investment funding to progress your projects (if so from where do you expect this to come)? What do you base this view on? • To what extent have potential customers been engaged (domestic and non- domestic)? To what extent do they support the scheme/s? • Are there other stakeholders who you are planning to engage?	

Theme	Questions/script	Estimated timing
Topic 8 – Future Government support	**Do you see a role for continuing government support on heat works?**	3 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If so, what type of support would be most useful?	
Summing up	**Is there anything else you would like to add about heat network development support local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes
	Many thanks for your time.	

Theme	Questions/script	Estimated timing

v) Topic guide for first research wave interviews: Non-HNDU local authorities

Local authorities who haven't enquired about HNDU but did not apply, and are not currently taking forward any heat network development work

The estimated interview length is **30 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is XXXX and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today. Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales.	3 minutes

Theme	Questions/script	Estimated timing
	We're particularly interested to discuss your local authority's priorities and objectives on decarbonisation (if any), whether you have considered taking forward heat network activity previously, any barriers that have prevented you from undertaking heat network activity and whether you think your local authority may pursue heat network opportunities in the future. The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for your organisation to feed into DECC's decision making. We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you? Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external	

Theme	Questions/script	Estimated timing
	consultant?	
	Before we begin, can I just check, has your local authority taken forward any heat network activity in recent years? [we should have established that the answer to this is NO before the interview by making sure that the local authority is in category we think they fall into, so this question is really a safety net] However, If YES, then switch to the relevant topic guide. If yes, they are likely to be either • Local authorities that are, or have previously been, involved in the development of heat networks, but who have not enquired or applied for HNDU support OR • Local authorities who are, or have previously been, involved in the development of heat networks, and who have enquired or applied for HNDU support So use the appropriate topic guide depending on which category they fall into	1 minute
Topic 1 – Establishing low carbon priorities	**What are the main priorities and objectives of your local authority in relation to the low carbon agenda, both in terms of your estates and operations and the wider community?**	3 minutes

Theme	Questions/script	Estimated timing
Topic 2 – Understanding of heat networks & drivers for any heat network considerations	**a. How aware are you (and your local authority) of what heat networks are and how your local authority might play a role in their development?** **b. Has your local authority ever considered taking forward heat network development work?**	5 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If yes to 2b, then ask them to describe what happened (what did they consider doing, when did this happen?) What were the main internal and external drivers behind this? Are you still planning to go forward with this work in the future?	
Topic 3 – Understanding barriers	**What are the main reasons why (both internal and external) your local authority has not taken forward work on heat networks?**	10 minutes including follow-up questions
Follow-up questions (as far as possible, ensure that these questions are answered during	(after initial response…) • What internal factors have hindered your local authority (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What external factors have hindered your local authority (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement)	

Theme	Questions/script	Estimated timing
the discussion)	• If initial work has stalled, why? What would help them start up again? • Do you anticipate that any these barriers may change in the future? Why?	
Topic 4 – Engaging with the HNDU	**Have you come across the Heat Network Delivery Unit at all? (sometimes referred to as HNDU)** [Note to interviewer: only ask this question if the answer to the above question was NO]	5 minutes (including follow-up questions)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	If YES, then: • What is your understanding of what the HNDU does? • When and how did you first become aware of the HNDU? • Has your local authority considered making an application for HNDU support? If so, why have you not made an application for HNDU support? • What are the most significant issues preventing you from engaging with HNDU? [Note: this question is likely to have been covered in Topic 3 on barriers] If NO, then move on to Topic 5	
Topic 5 – Future of heat network development activity	**Do you anticipate undertaking any work on heat networks over the next two years?**	3 minutes (including follow-up questions)
Follow-up questions (as far	(after initial response…)	

Theme	Questions/script	Estimated timing
as possible, ensure that these questions are answered during the discussion)	If YES: • What are you likely to do, who will do this and how? • Are you aware of any external sources of support on heat networks? If so, what are they? • Do you anticipate applying for support from the HNDU or any other sources of external support (if available)? Why? If NO, are you able to identify any specific reasons for not doing so?	
Summing up	**Is there anything else you would like to add about heat network development support local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes
	Many thanks for your time.	

vi) Topic guide for first research wave interviews: Industry consultancies

The questions below are for consultancies.

The estimated interview length is **40-50 minutes.**

Theme	Questions/script	Estimated timing
Pre-interview briefing	Interviewee is sent briefing note setting out the background to the research, listing the main topics and explaining how information from the interview will be used.	-
Introduction	Good morning/afternoon. My name is XXXX and I am calling from an organisation called CAG Consultants on behalf of the Department of Energy and Climate Change (DECC). Thank you for making the time to talk to me today. Hopefully you will have seen, and had an opportunity to read, a briefing note that you should have received prior to this interview. If you have not seen it don't worry it will not affect the interview. In either event it is probably worth stating that this interview is part of a wider programme of activity we are undertaking with local authorities, and other stakeholders, who have experience of heat network development in England and Wales. We're particularly interested to discuss your perspectives of local authority work on heat network development in recent years, including on heat mapping, masterplanning, feasibility, construction or other forms of heat network development activity. The results will be used by DECC to inform future heat networks policy and support, so this is an opportunity for	3 minutes

Theme	Questions/script	Estimated timing
	your organisation to feed into DECC's decision making. We would like you to be as open and honest as possible during the interview. This will help improve our understanding of the reality of local authority work to develop heat networks. Neither you nor your organisation will be identifiable in our report to DECC, unless otherwise agreed with you. Before we go any further, can I just check whether you are happy for me to record this interview? [if the interviewee does not wish interview to be recorded, interviewer to switch to taking notes onto a computer or by hand]. The recording and transcript of the interview will be stored securely, in accordance with the Data Protection Act. The recordings will be deleted within three months of the research project finishing. The interview recording will be used only by the CAG researchers and will not be shared beyond CAG without your prior consent. The recording will not be shared outside the research team but an anonymised transcript of the interview will be shared with DECC. Can I just check that this is ok with you? Before we go on can I just confirm your job title, and how long have you been in post? And, just for background, could you clarify whether you are an employee of the organisation or an external consultant? Ok, moving onto the interview proper, the first topic is…	
Topic 1 – Establishing heat network development track	**Please provide a brief overview of the types of work that your organisation has been involved in relation to heat networks. We are particularly interested in any work you may be undertaking with local authorities.**	5 minutes (8mins)

Theme	Questions/script	Estimated timing
record		
Follow-up questions	(after initial response…) • What is your role as an organisation and in relation to heat networks. Why are you interested in and have a focus on this area? • What is the scale of the work you have done? (e.g. how many local authorities, what is the scope of the work you have undertaken?) • What type of heat network development work have you been supporting local authorities with? (e.g. heat-mapping, masterplanning, feasibility, procurement, other).	
Topic 2 – Evolution of heat network development demand and supply	**Has the amount of work you have undertaken for local authorities on heat network development changed over time (especially the last five years)?**	5 minutes (13mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) **[Please note: the following sub-questions are really important probes, so please prioritise these]** • If yes, then in what way? And what do you attribute this to? • Have there been any changes in the type of work local authorities are asking for, or in the way in which it's commissioned (e.g. the way in which potential sources are investigating in the feasibility stage)? If so,	

Theme	Questions/script	Estimated timing
	please describe. And what do you attribute this to? • If demand from local authorities has increased, what do you put this down to? • • What impact has any increase in demand had on your organisation and the sector as a whole? And how have you responded?	
Topic 3 – Understanding drivers	**Why do you think local authorities are interested in developing heat networks? What have been the most significant drivers for local authority interest in heat network development in recent years?** **What have been the key factors (both internal and external) that have enabled / helped local authorities to take forward work on heat network development (at any stage)?**	5 minutes including follow-up questions (18mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What have been the key internal drivers/enablers? (e.g. political leadership, officer commitment, key targets, links to other priorities, income opportunities?) • • What have been the external drivers/enablers? (external drivers/enablers that should be explored include the HNDU itself, availability of other sources of assistance/support, the low carbon agenda, Govt policy, low cost of capital, rising cost of energy, local authority powers, regulatory changes) • How, if at all, have these factors/drivers changed over time? I.e. have some drivers /issues etc become more significant? • Are some drivers / factors more important for driving different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other)? •	

Theme	Questions/script	Estimated timing
Topic 4 – Understanding barriers	**In your view, what are the most significant factors (internal and external) that have hindered local authorities in taking forward work on heat network development (at any stage)?**	5 minutes including follow-up questions (23mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What key internal factors have hindered local authorities (e.g. finance conflicting priorities, lack of resources, lack of expertise, availability of capital and competing priorities, risk aversion, lack of corporate engagement with the agenda) • What key external factors have hindered local authorities (e.g. access to finance, availability of capital, planning requirements, lack of local authority powers, regulatory changes, lack of customer demand/interest/confidence, Govt policy, issue of stakeholder engagement) • How, if at all, have these factors/barriers changed over time? • How have these barriers been overcome (if at all)? • Are some factors/barriers more important in hindering different stages of heat network development (e.g. mapping, masterplanning, feasibility, procurement, other)? • Do you anticipate that any these barriers may change in the future? **[Note: make sure it is clear whether any barriers relate to development, commercialisation or delivery stages of heat networks]**	
Topic 5 – Engaging	**How familiar are you with the work of the Heat Network Delivery Unit?**	3 minutes (including follow-

Theme	Questions/script	Estimated timing
with the HNDU		up questions) (26mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	Please describe your understanding of the HNDU's role and the level of engagement (if any) you have had with them as an organisation Are you working with local authorities who have had funding from the HNDU?	
Topic 6a – Effectiveness/impact of HNDU support	**To what extent, if any, do you think local authority work on heat network development has been influenced by the HNDU?**	5 minutes (including follow-up questions) (31mins)
Follow-up questions (as far as possible, ensure that these questions are answered during	(after initial response…) • What type(s) of support has been more or less useful for local authorities? • Has the HNDU helped to overcome barriers to the development stages of heat network development? If so, which? And how?	

Theme	Questions/script	Estimated timing
the discussion)	• Are there any aspects of work that local authorities would not have taken forward without HNDU support? What aspects and why? • To what extent has the support provided by HNDU resulted in local authorities undertaking their heat network development activity in a different way (e.g. has it caused LAs to undertake a more comprehensive mapping of possible heat sources?) [Note to interviewer: make sure we understand what stage of the journey any suggestions on support refer to. (refer to HDNU diagram) so that its clear and unambiguous in how the findings are understood, even if we allow people initially use their own terminology for what stage they are at]	
Topic 6b – Effectiveness/impact of HNDU support	**Are you aware of any non-HNDU support available to local authorities to undertake work on heat network development? (both financial and otherwise)**	5 minutes (including follow-up questions) (36mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) If yes: • What are they? • To what extent, if any, do you think local authority work in heat network development has been influenced by other external sources of support? • What type(s) of support has been more or less useful for local authorities? • Has the external support helped to overcome barriers to the development stages of heat network development? If so, which? And how? • Are there any aspects of work that local authorities would not have taken forward without this external	

Theme	Questions/script	Estimated timing
	support? What aspects and why? • Do you feel that they offer examples of good practice that the HNDU might learn from?	
Topic 7 – Future of heat network development activity	**Looking ahead how do you see local authority work on heat networks developing over the next couple of years?** **What factors will determine their ability to move forward successfully?**	5 minutes (including follow-up questions) (41mins)
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • What will help or hinder local authorities from moving forward? E.g. finance, gvt support, rising fuel prices • How do you see local authority heat network needs evolving?	
Topic 8 – Future of heat network development activity	**How is your organisation planning to respond to future local authority heat network needs?**	5 minutes (including follow-up questions) (46mins)

Theme	Questions/script	Estimated timing
Follow-up questions (as far as possible, ensure that these questions are answered during the discussion)	(after initial response…) • Do you anticipate any challenges in meeting local authority future needs? • Are you planning to expand or recruit new staff? • Are you planning to evolve what you offer to local authorities on heat networks? • Please describe the reasons for this expansion/evolution.	
Summing up	**Is there anything else you would like to add about heat network development support for local authorities?** **Would you be happy to be re-contacted if needed later in this research?**	2 minutes
	Many thanks for your time.	

D. Quantitative survey top line results

This document presents the results from a survey of HNDU recipients, conducted by CAG on behalf of DECC.

Fieldwork

The survey was undertaken online (using the Survey Monkey platform) in March 2015. A total of 55 local authorities participated out of 81 recipients of HNDU funding. This represents a very strong response rate of 70%, ensuring that the sample is representative of HNDU recipients as a collective.

The results are subject to margins of error, based on the fact that a sample of HNDU recipients has responded to the survey (rather than all HNDU recipients). For results close to 10%/90% the confidence intervals are ±5% (i.e. if 10% of respondents agree with statement x then the actual result, had all HNDU recipients been surveyed, would be between 5-15%). For results close to 30/70% the confidence intervals are ±7%, and for results close to 50% they are ±8%.

Where percentages do not add to 100% this is due to computer rounding of the raw data or multiple response questions.

As a standard research convention, where the sample size is less than 30 the responses are presented as numerical counts ('N'), rather than percentages.

An asterisk (*) denotes a value greater than zero but less than 1%.

Section 1: Identifier Questions

Q1	**What is the name of your local authority?** Base: All (55)		
	See data spreadsheet for full list of respondents		

Q2	**What is your job title?** Base: All (55)		
	See data spreadsheet for full list of job titles		

Q3	**Please indicate which of the following best describes your authority?** Base: All (55)		
	County council (upper tier)	2%	
	District, borough or metropolitan city council (lower tier)	44%	
	Unitary authority	55%	

Q4	**Please indicate which support round (or rounds) that you submitted a bid into?** Base: All (55)		
	Round 1 – November 2013	36%	
	Round 2 – January 2014	33%	
	Round 3 – June 2014	36%	
	Round 4 – November 2014	31%	
	Other	5%	

Section 2: Barriers, drivers and enablers

Q5	**We are interested to know what your local authority's motivations are for taking forward heat network development activity. How important have the following factors been in driving your local authority activity on heat network development?** Base sizes shown per question element (in brackets)					
		Unimportant	Of little importance	Moderately important	Important	Very important
(55)	Carbon reduction	0%	4%	18%	44%	35%
(54)	Fuel poverty	2%	17%	19%	28%	35%
(53)	Regeneration / development	0%	4%	15%	32%	49%
(54)	Income generation	4%	7%	26%	44%	19%
(52)	Reductions in energy bills (for your local authority)	6%	12%	31%	27%	27%
(54)	Increased energy security/ resilience	4%	7%	35%	26%	28%

Q6	**We are interested in understanding any INTERNAL issues that may have hindered your local authority's ability to pursue heat network development. Please indicate the extent to which the following have acted as BARRIERS (either pre-HNDU funding or since) to your local authority taking forward heat network development activity.** Base: All (55)					
		Not at all	To a small extent	To a moderate extent	To a large extent	To a very large extent
	Availability of in-house skills or expertise	4%	16%	45%	29%	9%
	Limitations on officer time	0%	13%	29%	36%	25%
	Limited or no corporate or political engagement and leadership	35%	35%	22%	13%	0%
	Limitations on, or a lack of, revenue funding (to procure external support/assistance)	5%	13%	29%	31%	25%
	Competing corporate priorities	16%	13%	38%	29%	7%

Q7	**IF you recognised any of the barriers listed under the previous question please indicate to what extent you agree that HNDU support has helped (or is anticipated to help) your local authority to address any of these barriers.** Base: those who recognize these internal barriers - either pre-HNDU funding or since (bases in brackets)					
		Not at all	To a small extent	To a moderate extent	To a large extent	To a very large extent
(50)	Availability of in-house skills or expertise	2%	2%	13%	49%	34%
(55)	Limitations on officer time	11%	13%	29%	25%	22%
(36)	Limited or no corporate or political engagement and	15%	25%	38%	26%	0%

	leadership					
(52)	Limitations on, or a lack of, revenue funding (to procure external support/assistance)	4%	2%	10%	29%	55%
(46)	Competing corporate priorities	20%	18%	27%	25%	9%

Q8	**We are interested in understanding any EXTERNAL issues that may hinder your local authority's ability to pursue heat network development. Please indicate the extent to which any of the following have acted as barriers to your local authority's ability to take forward the development of heat networks.** Base: All (55)						
		Not at all	To a small extent	To a moderate extent	To a large extent	To a very large extent	Too early to tell
	Limited/no interest from potential customers	22%	33%	20%	11%	2%	13%
	Limited/no interest from developers	24%	18%	24%	16%	5%	13%
	Limited/no interest from potential anchor load organisations	20%	35%	16%	11%	5%	13%
	Limited/no interest from potential suppliers of heat	44%	20%	13%	7%	2%	13%
	Limited/no interest from non-public sector sources of capital	37%	25%	12%	10%	0%	16%
	Difficulties in accessing expert consultancy support	38%	13%	22%	11%	4%	13%
	Uncertain policy environment	13%	16%	27%	24%	7%	13%

Q9	**We are interested in finding out what INTERNAL factors have been most significant in helping your local authority to undertake heat network development activity. How important do you feel the following factors have been in helping your local authority activity to take forward work on heat network development?** Base: All (55)					
		Unimportant	Of little importance	Moderately important	Important	Very important
	Political leadership	0%	16%	16%	40%	27%
	Senior management support	0%	5%	9%	42%	44%
	Officer-level commitment	0%	0%	2%	42%	56%
	Council strategy or targets	0%	5%	25%	42%	27%
	Increased awareness of the potential benefits that heat networks can deliver	0%	4%	25%	31%	40%

Q10	**We are interested in finding out what EXTERNAL factors have been most significant in helping your local authority to undertake heat network development activity. How important do you feel the following factors have been in helping your local authority activity to take forward work on heat network development?** Base sizes shown per question element (in brackets)					
		Unimportant	Of little importance	Moderately important	Important	Very important
(54)	Financial support from the HNDU	0%	0%	4%	17%	80%
(55)	Guidance (technical and commercial assistance) from the HNDU	2%	5%	22%	31%	40%
(54)	Availability of financial support from external (to the authority) non-HNDU sources	19%	17%	24%	15%	26%
(54)	Non-financial support from non HNDU external (to the authority) providers	6%	24%	17%	37%	17%
(54)	Activity of other local authorities in the region	2%	30%	37%	28%	4%
(55)	Improvements in the financial case for heat networks owing to energy price rises	7%	25%	27%	25%	15%
(55)	Improvements in the financial case for heat networks owing to the low cost of borrowing	7%	35%	29%	18%	11%
(55)	Supportive government policy environment	2%	11%	40%	36%	11%
(55)	Changes in regulation (relating to local authorities as suppliers of energy/heat)	7%	25%	25%	27%	15%

Q11	**We would like to understand what other sources of support (for developing heat networks) are available to local authorities. Please indicate whether you have received any form of assistance (technical guidance or financial) from any of the following:** Base: All (55)		
	Vanguards Network	31%	
	European Local Energy Assistance (ELENA)	4%	
	Low Carbon Pioneer Cities	9%	
	City Deal	15%	
	Mayor of London's Decentralised Energy Masterplanning Programme (DEMaP)	9%	
	Mayor of London's Decentralised Energy Project Delivery Unit (DePDU)	11%	
	None of the above	44%	
	Other	15%	

Q12	**We are interested in understanding your experience of the HNDU application process. Please indicate to what extent you agree with the following statements:** Base: All (55)					
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	The information provided by the HNDU during the application period was useful	2%	0%	9%	71%	18%
	The information provided by the HNDU during the application process was easy to understand	2%	0%	11%	75%	13%
	I was able to access support in a timely fashion during the application period	2%	2%	11%	60%	25%
	The application process was straightforward	2%	0%	13%	60%	25%

Q13	**We are interested in understanding how useful and effective the guidance and support you have received from HNDU has been. Please indicate to what extent you agree with the following statements:** Base: All (55)					
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	HNDU project leads have been accessible and available to answer queries and provide advice	4%	4%	7%	55%	31%
	HNDU project leads have responded promptly to my queries	2%	4%	15%	55%	25%
	HNDU project leads have been flexible in their approach to providing guidance	5%	2%	7%	56%	29%
	The verbal guidance provided by HNDU project leads has been of a high quality	4%	2%	9%	45%	40%
	The written guidance provided by HNDU project leads has been of a high quality	2%	4%	9%	56%	30%
	The guidance of HNDU project leads has been important in helping me progress my project	5%	4%	13%	47%	31%

Q14	**Overall how satisfied are you with the guidance (i.e. technical and commercial support and assistance) that you have received from the HNDU to date?** Base: All (55)		
	Very satisfied	51%	
	Fairly satisfied	38%	
	Neither satisfied nor dissatisfied	6%	
	Fairly dissatisfied	2%	
	Very dissatisfied	4%	

Q15	**If you have indicated that you were dissatisfied or very dissatisfied please briefly explain why** Base: All (3)		
		N	
	Guidance provided after the first draft of the tender documents had been completed	1	
	Failure to answer and address key questions and concerns raised by the council officers	1	
	Contradictory advice about the inclusion and use of wording provided by the HNDU	1	
	Expectation that officers would provide support to other borough with their proposals	1	

Q16	**We are interested in understanding the importance of the financial support that the HNDU provides and how you have secured your match funding. Have you received financial support from the HNDU?** Base: All (55)		
	Yes	96%	
	No	4%	

Q17	**Please indicate the extent to which you agree with the following statement: The financial support of the HNDU has been an important factor in enabling our local authority to progress heat network development activity** Base: All (55)		
	Strongly agree	82%	
	Agree	11%	
	Neither agree nor disagree	0%	
	Disagree	0%	
	Strongly disagree	0%	
	Skipped / no response	7%	

Q18	**Please indicate the source(s) of your match funding (for the HNDU grant):** Base: All (55)		
	Internally funded	88%	
	Funded in partnership with other local authorities	10%	
	Funded in partnership with other public sector bodies	22%	
	Funded in partnership with private sector organisations	14%	
	Other	10%	

Q19	**Do you feel that there is an ongoing need for government support for heat network development?** Base: All (55)		
	Yes	100%	
	No	0%	
	Not sure / undecided	0%	

Q20	**Please indicate how important the following forms of support would be for your local authority in the future?** Base: All (55)					
		Unimportant	Of little importance	Moderately important	Important	Very important
	Training on technical skills for local authority staff on heat network development	0%	0%	16%	51%	33%
	Training on commercial skills for local authority staff on heat network development	0%	0%	9%	31%	60%
	Awareness raising events for local authority staff	0%	9%	42%	33%	16%
	Awareness raising events for elected members	2%	7%	22%	33%	36%
	Written technical guidance	0%	4%	16%	42%	38%
	Development finance	0%	0%	4%	22%	74%
	Networking events for local authorities active in developing heat networks	2%	7%	31%	44%	16%
	Identification and communication of best practice	0%	4%	24%	42%	31%
	Engagement with potential investors	0%	2%	11%	42%	45%
	Engagement with supply chain	0%	2%	24%	40%	35%

E. Summary of HNDU-funded reports

i) Summary of key facts in HNDU-funded reports (NDE)

	Report 1	Report 2	Report 3	Report 4	Report 5	Totals
Type of report	Feasibility study	Technical option study	Feasibility study	Step 1 Feasibility Study	Energy Masterplan-Interim Report	
Cost	£58,290	£41,872	£40,200	£14,070	£13,330	
Recommended heat source	Gas CHP	Gas CHP	Gas CHP	Two proposed options. A3 Gas CHP or C11 Gas CHP + biomass	Gas CHP	
Other heat sources considered	No information	No information	Yes. Biomass, heat pumps.	Gas CHP and biomass only	Yes. References to biomass, heat pumps and geothermal.	
Stated objective(s) of scheme	To address fuel poverty	Regeneration +fuel poverty reduction	Regeneration	Commercial return (university) and carbon reduction (local authority)	Eco- community development	
Network dimensions (where available)						
Pipework	800m	2214m	970m			3984m
Area served	1km^2 (approx.)		45,346m^2		7600m^2 (initially)	62,946m^2
No. of properties	435 domestic dwellings	34 buildings (3 LA buildings, 31 maisonette blocks providing 2538 domestic dwellings)	3 local authority buildings	5 buildings: 1 local authority, 4 university.	Initially 50 domestic dwellings, 7 small non-residential buildings.	3023 domestic, 12 public sector, 6 private non-domestic
Other						
Commercial data (where available)						
Lifecycle costing applied	No IRR calculated	4.30%	7.6% (15yr) 10.8% (30yr)	Option A3 IRR 13% Option C11 IRR 13%		
Cost of proposed	Core £6.3million	£8million	Core £2.1million	Option A3 £984,000		£16,400,984

scheme (capital)				Option C11 £1,417,000		(£16,819,584)
Proposed Operating model	Local authority owned	Local authority owned	Local authority owned (via ESCO)	University owned (via ESCO)		
Projected benefits (where available)						
Carbon reduction	1300 tCO2pa	2779 tCO2pa	319tCO2pa	Option A3: 512t CO2pa Option C11: 893t CO2pa		£4,910 (5,281)
Energy bill reductions			£11,300 (reduced CRC costs only)	Option A3: £317,800 pa Option C11: £263,950 pa		£329,100 (£275,250)
Fuel poverty benefits	55% reduction on fuel bills for social housing					
Income generation			£192,000 pa	Net revenue Option A3: £89,567 Option C11: £143,938		£281,567 (£335,938)
Job creation	Not calculated	Improved air quality				
Project risks (where stated)						
Evidence of senior level buy in	Yes. £500k section 106 funding committed	Unclear	Stated strategic ambition	Not clear	For preliminary investigation	
Future challenges identified	Project only able to deliver projected benefits if council invests upfront capital. Unclear whether this available.	Potentially significant technical challenges. Low IRR makes it unattractive to private investors and therefore reliant upon unsecured public funding. ECO funding currently available but deemed ‘at risk’.	Future uncertainty around 1 major heat load building. Need to secure capital. Lack of experience.	No		
Future barriers identified	Capital. Technical assessment of main connection required.	Need to ensure that proposed location of energy centre is feasible. Need to	Need to secure capital	No, but stated requirement for further analysis of peak loads, space		

		secure funding.		constraints and other key variables.		
Conditional factors identified	Continued availability of ECO funding. Availability of LA capital.	Feasibility of installing Energy Centre at proposed site. Availability of public funding.	Scheme dependent upon capital funding from authority. Scheme dependent upon establishing long-term public sector contracts.	Analysis may be skewed by smaller heat loads at the periphery of the preferred options. Further analysis required.		

ii) HNDU-funded reports summary assessment

	How robust are the technical estimates of the projected outcomes?	**How robust are the economic estimates of the projected outcomes?**	**Overall assessment of the technical quality of the report?**
Report 1	The report appears to be a sensible district-heating plan. Heat demands appear reasonable for the residential properties and, for their size, reasonable for the commercial buildings. Whilst existing plant rooms are used where possible, the core idea of lifting residents out of fuel poverty by moving from electric heating appears sound.	Calculated using an in-house software package which appears to be sensible. Nothing stands out as being unrealistic financially.	Good district heating assessment, although the core phase is far more realistic than the later stages.
Report 2	In general terms, the figures presented are very realistic and clearly driven by a proprietary software package for selecting CHP to suit district-heating schemes. Existing building energy consumption is modelled using RdSAP, an established and common protocol. Although ECO funding is considered in the techno-economic model, carbon savings appear almost an afterthought and are not specifically calculated as in previous DH support programmes (e.g. EST Community Energy scheme). Although a technically developed scheme, the main technical issue flagged up is the use of the arches for an energy centre and the need for flues and ventilation ducts via a new 13 storey residential	Similarly to the technical estimates, the economic estimates use established methods. For example, the network costs, CHP capex, pump costs etc. all use industry benchmark prices (taken, for example, from SPONS) and appear robust.	This is a technically thorough study in many respects. It is weaker on carbon savings than other 'typical' DH feasibility studies in that only one scheme is modelled for the proposed network (rather than typically, where 3 or 4 are modelled, allowing an informed choice to be made). The scheme modelled is named 'practical 4' but has many obstacles that could prevent completion – energy centre location, CHP ventilation and flue routing, and the reliance on the new 13 storey adjacent block for flue and vent tower provision – which may impact on run hours and consequent

	block. This could be a showstopper and stating 'dialogue must continue' is probably not enough to ensure project success.		carbon savings. The arch location is also subject to several civil engineering challenges; the study flags them but continues without considering more viable energy centre locations (e.g. in the basement of the new building). This may be a requirement dictated by the previous masterplan, but it is not stated as such. Overall, there are many unanswered technical risks with this project in terms of CHP size and location.
Report 3	The methods used are robust, with heat mapping based on actual surveys and modelling of existing buildings and actual fuel consumption. Projected new buildings (e.g. on the brownfield development sites) are based on expected building floor area, building type and are modelled using benchmark energy profiles. The profiles assume construction to the relevant Part L building regulations and benchmarks are taken from The Chartered Institute of Building Services Engineers (CIBSE) publication TM46, which lists benchmarks for new buildings.	Good; the scheme economics are modelled using actual building energy consumption (for existing buildings) and best practice benchmarks for projected new buildings. The economic analyses are in line with other studies in this sector (i.e. they appear robust and follow good practice). 30-year lifecycle costing methodology was used to assess the economic performance of each of the 8 schemes evaluated for phase 1. Pipe routes chosen to minimise dig costs and use council land wherever possible. High-level estimate of the capital cost of a district heating network and energy centre to serve the development, but some costs (bridges) are stated as difficult to foresee for phases 2 and 3.	Strong technically, with great detail on pipe routes and heat mapping. Perhaps weaker on policy engagement required at senior council level to secure buy-in, but in fairness this is a technical feasibility study and it gives the impression that it is one of a number of studies that have been conducted over the last few years.
Report 4	The technical estimates for the project appear to have used robust methodologies, and existing building heating and electricity consumption is taken from actual historic use. Figures appear realistic. The sizing of the biomass boiler at 999kW could be argued to be set more on the basis of RHI tariff thresholds than demand for heat, but in fairness they do state further work is needed on load profiles in step 2	Economic estimates appear to be robust and based on actual fuel consumption and procured rates for gas and electricity. The University already has CHP plant, but its run hours are restricted partly because the buildings it currently serves do not have sufficient load profile and there is no thermal storage. The economics of crossing the main road are not costed in the proposals, although the executive summary does allude to the need for a formal cost plan so perhaps this point is covered.	Technically, the report is reasonably good quality; load profiles have been reasonably assessed. As above, the sizing of the biomass boiler appears to be based on tariff bands rather than load and there will instances in spring and autumn where it is very lightly loaded. A smaller biomass boiler may be more appropriate.

Report 5	This is an interim report; as such there is clearly further work to complete on detailed energy modelling. Good practice benchmarks have been used for the proposed domestic and non-domestic buildings, but it is clearly a work in progress.	As this is an interim report there are no economic estimates as yet.	As a district heating study, it is starting on the right tracks but has a long way to go. It is an interim report of an energy masterplan, and still has a considerable amount of modelling work to do as the author concedes in their conclusion (p.18).

Figure 4: Theory of Change diagram – with external factors influencing change

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