Developing a Heat Networks Technical Assurance Scheme in the UK

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Abstract

Heat networks are a key part of the Government's strategy to reach net zero emissions by 2050. The heat network market is set to grow rapidly, and the Government is encouraging its growth with financial support and a new regulatory regime, in recognition of the Climate Change Committee's recommendation that around 18% of UK heat should come from heat networks by 2050. In support of market development heat networks are on a trajectory to become a regulated utility, similar to gas and electricity.

Underpinning this, a Heat Networks Technical Assurance Scheme (HNTAS) is to be put in place to ensure a minimum level of performance and reliability for heat networks, with good consumer outcomes. Work has recently begun to determine the necessary governance structures, technical specifications and procedures that will be required to meet the aims for the scheme.

This paper sets out progress in designing/developing a scheme that will provide credible assurance of the quality/performance of heat networks and demonstrate compliance to technical standards.

Keywords Heat Networks, District Heating, Technical Standards, Assurance Scheme

1.0 Introduction

Heat networks are a key part of the Government's strategy to reach net zero emissions by 2050. The heat network market is set to grow rapidly, and the Government is encouraging its growth with financial support and a new regulatory regime, in recognition of the Climate Change Committee's recommendation (1) that around 18% of UK heat should come from heat networks by 2050. They currently provide about 2-3%.

In support of market development, Heat networks are on a trajectory to become a regulated utility, similar to gas and electricity. A key component of this new regulatory framework will be the introduction of technical assurance standards and procedures to ensure high performance and good consumer outcomes. Work has recently begun to develop a Heat Networks Technical Assurance Scheme (HNTAS) that will provide the necessary governance, structures, procedures and standards required to ensure a minimum level of performance and reliability for heat networks in the UK.

HNTAS will heavily reference CIBSE's Code of Practice CP1 (2020) (2), which has gained huge consensus within the market, but which is voluntary, and will move to a mandatory assurance regime that will form part of the regulatory requirements.

The objectives of HNTAS are:

- Good consumer outcomes
- Lower cost of heat, resulting from higher efficiencies
- Enhanced reliability, with fewer planned and unplanned outages
- Better quality of heat, ensuring required temperatures to consumers
- Lower carbon emissions
- Confidence in the quality of networks while promoting competition and innovation
- Proportionate processes
- An operable assurance scheme that the sector can implement

Significant engagement with working groups has already begun in order to gain widespread buy-in to the scheme rules and pathways to regulatory implementation.

This paper sets out the overall vision, aim, objectives and core principles for the assurance scheme.

The paper also sets out some early progress that has been made with regards to setting out the constituent parts of a heat network and underlying elements to be included within the assurance scheme. While this may seem a relatively straight forward exercise on the face of it, heat networks are complex systems, with multiple constituent parts that are often designed, built, owned, and operated by different parties.

Finally, the paper sets out the key components of work that are due to be carried out over the course of 2023 as part of the HNTAS project.

2.0 Policy background

Heat networks are a heat distribution technology, in which heating, cooling and hot water can be distributed from central locations to multiple customers. These networks can vary in size and scale, from communal networks which supply multiple customers in a single building to district networks, which supply multiple buildings. It is estimated that there are currently over 14,000 heat networks in the UK.

Heat networks are a mature technology which often represent the lowest cost, low carbon option for providing heat to buildings in urban areas. In Denmark and Sweden heat networks have been shown to be capable of supplying entire towns and cities.

However, a lack of widely accepted and mandated performance standards means that in the UK quality of service can be highly variable between networks, with a large proportion of heat

network customer issues and complaints able to be attributed to poor technical performance. The consequences of poorly designed, built, operated, and maintained networks can be:

- Higher heat costs;
- Outages in service provision;
- Increased carbon emissions;
- lower reliability, and;
- poorer quality of service for consumers.

As part of the landmark Energy Bill (3) currently passing though the legislative process, DESNZ (formerly BEIS) will be introducing sector regulation, providing heat network customers with the same level of protections that are provided to gas and electricity customers. Ofgem will be the regulator, responsible for setting, monitoring, and enforcing a range of customer protection measures. We expect the regulations could be introduced in early 2025, though we expect requirements will be phased in over time.

The Government's Heat Networks Transformation Programme comprises a package of support and policy frameworks to support the growth and improvement, with respect of carbon and consumer outcomes, of the heat network sector. Heat networks are a key part of the Government's strategy to reach net zero emissions by 2050, including their ability to harness economies of scale and access low carbon heat sources such as waste heat from industrial processes.

A part of this programme is the development of a heat network market framework, which DESNZ consulted on in 2020 and published a response in 2021 (4). In those documents, DESNZ set out an intention to mandate minimum technical standards and to introduce a technical quality assurance regime.

The forthcoming regulations require compliance to a technical code. DESNZ have therefore set up a project to develop a Technical Assurance Scheme. This scheme needs both *technical requirements* and *procedures & processes* to be specified, in order to form an integrated assurance scheme.

It is envisaged that the scheme will build on established technical standards and codes of practices including CIBSE/ADE CP1 (2020) Code of Practice on Heat Networks (2). The scheme will focus primarily on developing standardised processes for demonstrating compliance to established and agreed technical standards, rather than developing new technical standards. This requires research, analysis, and industry consensus to identify and agree which established standards should be in scope of the quality assurance scheme, and whether amendments or additions are required.

The assurance scheme will provide Ofgem with a means to identify whether heat network operators are compliant with the mandated standards. It will also provide clear accountabilities for requirements and performance, improving confidence in the sector, including at handover points in the heat network development process. Overall, the aim is to improve performance across cost, carbon, reliability and quality, while facilitating innovation as the market grows.

3.0 Vision, Aims, Objectives and Key Principles for Scheme

3.1 Aims & Objectives

The aim of the Heat Network Technical Assurance Scheme (HNTAS) project is to develop a heat network technical assurance scheme that ensures a minimum level of performance and reliability for heat networks in the UK.

The overall objectives for HNTAS are to:

- Reduce carbon emissions by making heat networks more efficient
- Improve affordability by reducing capital and operational costs
- Improve reliability and quality of heat supplied

- Improve reputation and investor confidence in heat networks
- Build evidence to support above objectives by better reporting of information about technical quality

Ultimately, this work will develop a HN Technical Assurance Scheme ready for the introduction of HN Regulation.

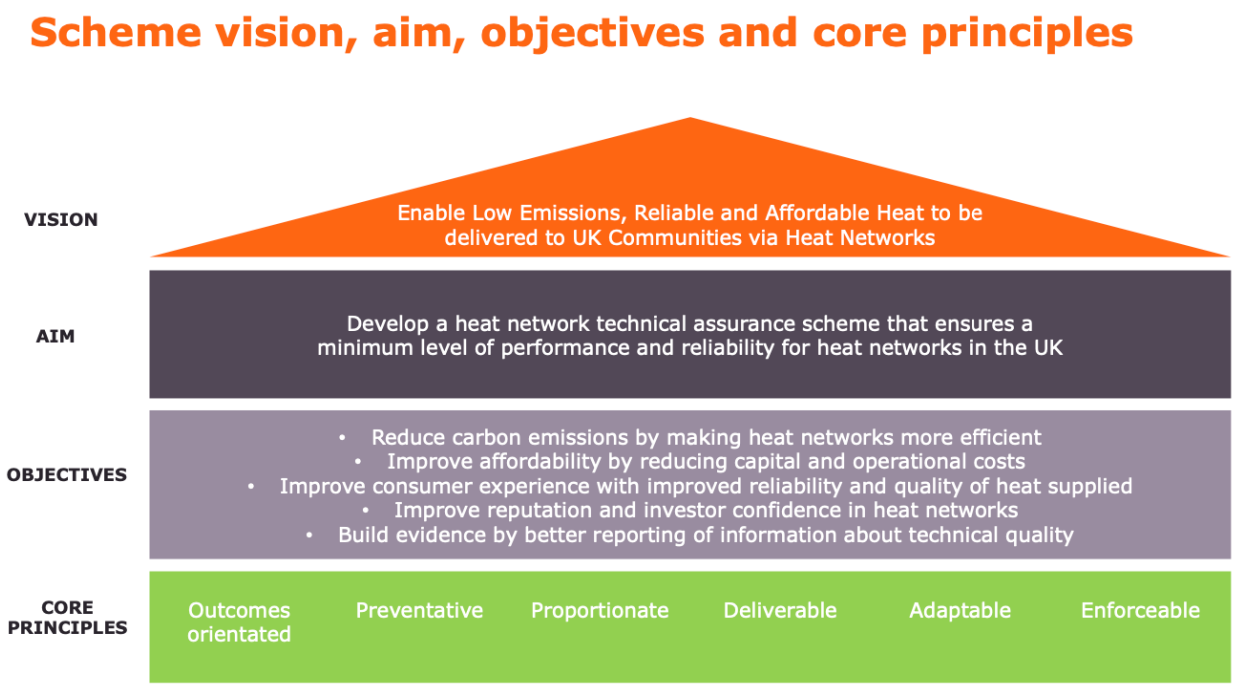

Figure 1 – Core principles of a heat network technical Assurance scheme

3.2 HNTAS Key principles

The HNTAS Project Board has confirmed that the core principles of the scheme will be:

- **Outcomes orientated**: With a focus on performance outcomes rather than process.
- **Preventative**: Focused on preventing performance issues from arising through identification of issues, rather than taking punitive approach.
- **Proportionate**: Balance the effectiveness of assurance process against the cost of compliance.
- **Deliverable**: Based on established processes, that fit with existing contractual and delivery processes, taking into account market capacity and regulatory framework.
- **Adaptable**: Able to adjust approach as market moves down the experience curve and adapt to wider changes at a regulatory and industry level.
- **Enforceable**: Sets out clear rules and consequent required actions in the case of non-compliance that are able to be enforced.

3.3 Elements of the Assurance Scheme

In common with other assurance schemes, HNTAS will have the following five elements:

1. Three party relationship: between a responsible party (making a claim), an independent assessor (as to whether that claim is valid), and the intended users.
2. Subject to assess: a claim is to be made in respect to some subject, in this case that a heat network (or some element of a heat network) is meets, or will meet, a minimum level of performance and reliability, in accordance with relevant standards.
3. Suitable criteria: the standards and minimum performance requirements that the heat network is to meet.
4. Sufficient evidence: to support the conclusion as to whether the criteria have been met.
5. Written report: certificate and accompanying notes.

In summary, HNTAS is to be a performance-based assurance scheme within which an independent assessment is to be made with regards to claims made by a responsible party as to whether minimum standards will be achieved (Validation), or have been achieved (Verification) for identifiable elements of a heat network, in order to ensure that certain performance outcomes are achieved, and maintained.

4.0 Defining Constituent Parts and Elements for Certification

To meet the core principle of being preventative, the scheme will have gateways at key developmental stages, with progress prevented until a pass has been achieved. This also acknowledges that the responsible party may change over the developmental lifecycle and ensures a requisite level of control, provided that there is sufficient granularity.

To achieve these aims, it needs to be determined what level of granularity there should be within the scheme with respect to the subject to be assessed in any claim – i.e., to determine what heat network elements are to be certificated within the scheme.

Heat networks are complex systems and have different elements (e.g., energy centre, buried pipework, communal building pipework, consumer connections, etc.) that are often designed, built, owned, and operated by different parties.

Accordingly, HNTAS will need to accommodate certification of multiple elements within any single network. More specifically, the scheme will need to certify performance at a granular enough level to ensure the responsible person has control over that element and such that achieving such an outcome can be accommodated in commercial contracts (to ensure deliverability of the scheme).

Furthermore, as the definition of a heat network within the Energy Bill encompasses “any network that by distributing a liquid or a gas, enables the transfer of thermal energy for the purpose of supplying heating, cooling or hot water to a building or persons in that building (and includes any appliance the main purpose of which is to heat or cool the liquid or gas)”, the definition of heat network elements must be flexible enough to accommodate all types of heat network.

In summary, for the purposes of certification, heat networks need to be broken down into well-defined parts, “elements”, to enable the responsible party of for that portion of that heat network’s lifecycle to be held accountable and a clear assessment as to compliance to be made, such that enforcement activities are possible. This breakdown of heat network elements needs to be able to be applied to all forms of heat networks, regardless of differences in complexity, size, and type.

Initial work has been carried out within the HNTAS project to determine what that breakdown of a heat network should be, and specifically, what heat network elements are to be certified under HNTAS, with a definition of those elements.

This has included an assessment of how these elements would apply to different typologies of heat network, to ensure that the scheme is able to accommodate the full breadth of heat networks to be covered by HNTAS.

4.1 Typology of heat networks covered

As per the current drafting of the Energy Bill (3), a “heat network” means:

a network that, by distributing a liquid or a gas, enables the transfer of thermal energy for the purpose of supplying heating, cooling or hot water to a building or persons in that building (and includes any appliance the main purpose of which is to heat or cool the liquid or gas).

There are then two types of heat networks that are defined:

A “communal heat network” means a heat network by means of which heating, cooling or hot water is supplied only to a single building divided into separate premises or persons in those premises.

A "district heat network" means a heat network by means of which heating, cooling or hot water is supplied to two or more buildings or persons in those buildings.

Accordingly, HNTAS must accommodate all networks with a transfer of thermal energy to end users, both where these networks are wholly within a single building (communal network) or service multiple buildings (district network).

While a segmentation of heat networks on the basis of distribution type (within or between buildings) does have a bearing on heat network elements, there are several other segmentations that also need to be taken into consideration when assessing the elements within a heat networks and who the responsible parties may be at different stages of the development lifecycle.

Overall, the following segmentations have been identified that will impact on the nature of elements within a network and/or responsible parties:

(i) Operating temperature
(ii) Development type
(iii) Building connections
(iv) Hydraulic separation
(v) Configuration of heat sources

Operating Temperatures

As set out by Henrik Lund et al (5), heat networks encompass a wide range of operating temperatures, with a general tendency to drop temperatures over time as the industry has developed.

From a heat network element perspective, the most significant implication of operating temperature is whether the heat network is able to meet the temperature requirements of the end consumer and/or end building.

As example, an ultra-low temperature 20°C flow "5th Generation" network, might connect to a residential development where there is boosting of temperature to a 55°C "4th Generation" distribution network, with HIUs to the domestic connections. This would effectively create an entirely new network with an additional energy centre at the boundary between the residential building(s) and the wider district heating network.

Development Types

Heat networks can be defined as being either "Developer Led" heat networks or "Network Led" heat networks.

A *Developer Led* heat network refers to a heat network that is built to service a single development. Normally the heat network would be constructed simultaneously with the wider building works, but this can also include networks retrofitted to a single building or estate. Examples would typically be communal heating systems or a self-contained district heating system where the construction of the heat network is linked to the build out of a new development.

A *Network Led* heat network is a network that is developed independently of the boundaries of any particular development, with third parties connecting to that heat network. This would cover both district heating networks that serve new building developments developed by plot developers, and those connecting to existing buildings and/or pre-existing heat networks (such as district heating networks constructed with HNIP or GHNF funding connecting to public buildings, campus networks, etc.).

While Developer Led networks can be contractually relatively simple, with a single party responsible for the delivery of the full network, Network Led networks are typically far more complex, with different parties responsible for the delivery and operation of different parts of the network.

As an example, a large network may have an offtake from a large waste heat supplier that is controlled by one party, a district distribution network that is built out and operated by a different party, then a communal network connected to the system that is developed by one party, then owned and operated by another party altogether.

Building connections

As set out within the draft Energy Bill legislation, heat networks can be segmented based on configuration of building connections.

A communal heat network provides supply only to separate consumers within a single building, whereas a district heat network provides supply to multiple buildings.

It should be noted, however, that a communal network may be connected to a district network in its lifecycle and would therefore transition from being a communal network to being part of a district network, though control of the communal portion may still remain with a separate operator.

Requirements for Hydraulic Separation

Due to certain operational and/or contractual requirements, heat networks are often segmented by way of hydraulic separation (i.e., a thermal substation). Any such separation will effectively result in the creation of a separate “child” network, with different operating parameters to the “parent” network.

This segmentation can cut across the other types of heat network segmentation. For example, due to pressure limitation, a heat network serving a single very tall building could have 2 substations at different heights within the building. This would effectively create 3 separate networks, each with different operating parameters, within a single “communal” network.

Configuration of heat sources

While most heat networks in the UK are characterised by having a single centralised heat sources (energy centre) with distribution to end users who extract heat via some form of heat transfer across a heat exchanger, the international tendency is toward smart energy systems where there are many heat sources across the network.

As such, heat networks can be segmented into those with:

a) A single centralised plant
b) Distributed sources of heat generation and offtake
c) Prosumers, where certain consumers also produces heat (thermal energy) and feed it into the network from a systems perspective.

Where there are different heat sources on a network, this has implications for the elements that need to be certified, particularly in the case of prosumers, or where the heat source is secondary to the main activity of the generator (e.g. waste heat from a data centre).

4.2 Component parts of heat networks

In the UK there is widely used terminology with regards to the “Primary”, “Secondary”, and “Tertiary” portions of heat networks, together with frequent mention of the “Energy Centre” and “Building Connections”.

However, there is some ambiguity on the use of this terminology. For instance, CP1 (2020) (2) makes reference exclusively to “primary network”, whereas the CIBSE Design guide (6) refers to “Energy Centre Primary” and “Distribution Primary”.

Furthermore, it is not entirely clear how buried pipework is treated on the development side of a substation, where there is connection to a Network Led district heating network, where there are separate operators. This network will generally be referred to as the “secondary network”.

However, within CP1 (2020) (2) secondary systems are defined as “the pipes within the buildings, and up to each dwelling in residential blocks, even if no hydraulic break is installed”.

Having reviewed the various standards, together with different example heat networks, there are 4 constituent parts that are consistent across *all* heat networks – as shown in Figure 2 below.

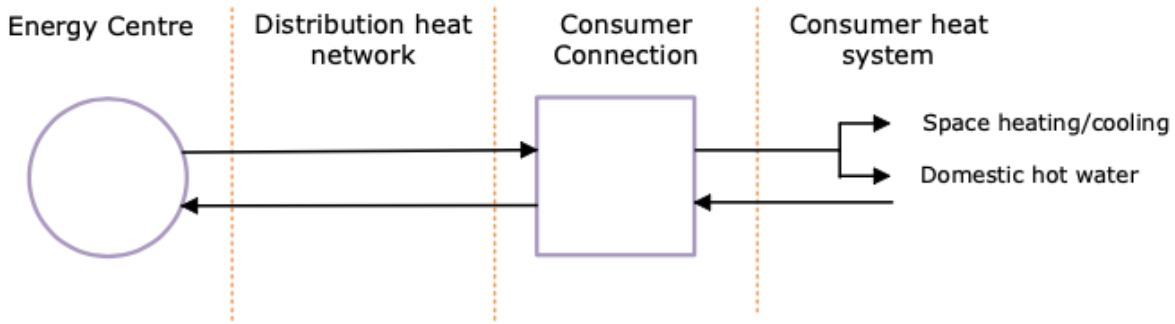

Figure 2 – Consistent constituent parts of a heat network

While these four parts are consistent across all types of heat networks, they are insufficiently granular to enable differentiation of all responsible parties across the stages of a heat network’s lifecycle, for all forms of heat networks.

Having reviewed various heat networks of different typologies, it is clear that consideration has to be made at the boundary between networks and/or building connection, with two additional parts that need to be taken into consideration: “thermal substations” and “building connections”.

It should be noted, however, that while these two may be distinct parts of a network in of themselves, there is often significant overlap between these and the four core parts of a heat network. For example, a building connection can be both a thermal substation and a consumer connection.

Conversely, it is possible to have a building connection that is neither a thermal substation nor a consumer connection, but which has specific requirements that must be met (e.g. metered as per the Heat Network (Metering and Billing) Regulations 2014 (7)).

4.3 Proposed elements for certification under HNTAS

In total, it is planned that six elements are to be defined for certification under the scheme, with a split between domestic, commercial, and industrial typologies for consumer connections and consumer heat systems, as there will be qualitative differences in the level and nature of assessment required for these.

Assurance element	**Description**
1. Energy centre	Plant room that contains heat generation equipment; and/or equipment connecting to an energy source; or a substation which contains heat generation equipment.
2. District distribution network	Any pipework system that is not within a building and distributes thermal energy from an Energy Centre to multiple Building Connections.
3. Communal distribution network	Any pipework system that is wholly within a building and distributes thermal energy from either an Energy Centre or Building Connection to multiple Consumer Connections.
4. Thermal substation	Connection between distribution networks, which contains a hydraulic break, including plate heat exchangers, pumps,

	expansion and pressurisation equipment, water quality equipment, strainers, heat meters, control valves and other ancillary equipment.
5a. Consumer connection – domestic	Connection between distribution network (either district or communal) and a single domestic consumer heating system. Includes HIU (includes plate heat exchangers and all other associated equipment), heat meters and other ancillary equipment.
5b. Consumer connection – non-domestic	Connection between distribution network (either district or communal) and a single commercial consumer heating system. Includes plate heat exchangers, pumps, expansion and pressurisation equipment, water quality equipment, strainers, heat meters, control valves and other ancillary equipment.
5c. Consumer connection – industrial	Connection between distribution network (either district or communal) and a single industrial consumer heating system. Includes plate heat exchangers, pumps, expansion and pressurisation equipment, water quality equipment, strainers, heat meters, control valves and other ancillary equipment.
6a. Consumer heat system – domestic	Heating/cooling and domestic hot water systems on consumer side of domestic consumer connection.
6b. Consumer heat system – Commercial	Heating/cooling and domestic hot water systems on consumer side of Commercial consumer connection.
6c. Consumer heat system - Industrial	Heating/cooling and domestic hot water systems on consumer side of Industrial consumer connection.

Table 1: The six elements which have been defined for certification under the scheme, with a split between typologies for consumer connections and consumer heat systems.

As such, the assurance scheme will be based on assessments at the element level, with normative documents setting out the specific performance requirements at this level, together with the evidence that must be provided, together with the assessment procedures for assessing compliance across the development lifecycle.

It should be noted that while assessment of the constituent elements will be required for any network, it is expected that the certification process itself will allow bundling of different elements – e.g., a responsible person may make a claim for multiple elements of a heat network.

As an example, in the case of Figure 3 below, which shows a simplified diagram of a communal heat network, a developer may make a claim with respect to the design of the energy centre, communal distribution network, consumer connections and consumer heat systems in a single certification process.

It should be noted, however, that concepts with respect to how the certification process itself will work have not yet been developed other than establishing that: (a) any certification will need to assess whether performance requirements at an element level will or have been met; and (b) that there will be some level of bundling allowed to reduce administrative overhead.

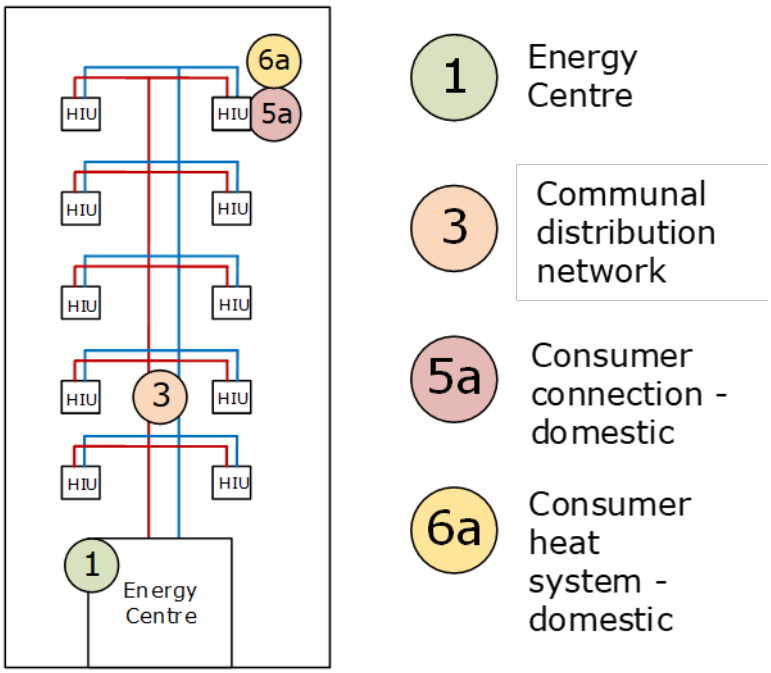

Figure 3 – Simplified diagram of a typical 3rd/4th generation communal heat network with elements identified.

5.0 Forthcoming outputs

The project is expected to last throughout 2023 and will be producing:

Normative Documents - that set out which technical requirements are in scope, how compliance to those requirements is demonstrated, and the procedures for how the regime operates including roles and responsibilities of different organisations.

Explanatory reports - underpinning each of the normative documents, setting out the rationale for the design choices. The reports should also provide a high-level impact assessment to indicate likely costs/benefits. They may also provide further guidance on interpretation and application of the normative documents.

These reports will be split between those related to Technical Specification and assurance procedures, and those related to the Framework, Procedures and Processes for the scheme.

Final report and Technical Quality Assurance Scheme design - an integrated final report to collate all the work and make recommendations on the pathway from the scheme design to operation to its application in practice and in regulation. This should also make recommendations about the future overall governance and operation of the future scheme. including recommendations on the overall governance structures required to operate the scheme.

This suite of documents will provide justification and explanation of the recommended scheme design. They will also set out the recommended pathway from scheme design to implementation in regulation.

6.0 Conclusions

- Setting minimum technical standards is a key part in moving to a regulatory framework
- Heat networks are often large complex projects with multiple stages across multiple actors and long timescales
- Certifying heat networks that meet the minimum standards will raise performance throughout the sector

- Engagement with stakeholders will bring a wide consensus and buy-in for the assurance scheme
- An assurance scheme will give network developers and operators confidence to invest in the sector
- The Assurance Scheme must be designed to dovetail into the future regulatory framework and in particular with heat network zoning.

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