ELEXON

UK HEAT NETWORKS

THE PROSPECTS OF DECARBONISATION THROUGH DEVELOPING A HEAT MARKETPLACE

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Abstract

As active energy consumers of today we need to re-think how we source our heat in our homes and businesses simply by questioning ourselves how this can be done greener, cheaper and more efficient.

Given that heat generation accounts for around a third of the country's carbon emissions, a collective action will help the UK reach its net-zero carbon emission targets by 2050.

It is widely recognised that transition to low-carbon heat could be achieved through a variety or a mix of alternative technologies and solutions, one of which is heat networks.

Heat networks distribute heat from a central source to a number of connected domestic or non-domestic buildings. Currently, heat networks in the UK are at a nascent development stage and display two common characteristics:

1) *Heat production and distribution is integrated; and*
2) *Heat networks are disparate and not connected to each other.*

Most heat networks in the UK have integrated heat production and transmission/distribution. Likewise, they consist mostly of localised networks serving densely populated residential areas or supplying heat exclusively to large facilities such as schools and hospitals. However, in countries with more advanced heat networks, heat production is a competitive commercial activity with multiple heat suppliers using the same interconnected pipe network to supply multiple customers. Ultimately, competition at the supply side of the market drives down prices for consumers and ensures efficient and effective production of heat.

At ELEXON[1], we believe that given the evolution in other countries, there is a much greater potential for heat networks in the UK. In order to facilitate the development of a heat market, clear and universally applicable market rules need to overlook all heat networks nationwide. This will help create longer-term transparency and certainty for investors, developers, operators and, ultimately, customers.

Various market frameworks and principles have been tested and proved for the liberalised electricity market and can be suitably adapted to design an unbundled low-carbon heat market. For example, we see an opportunity to apply a number of operational and technical codes from the electricity sector to heat networks. Having these key foundations in place from an early stage will eventually help create a marketplace suitable to accommodate the needs of all the participants in the supply chain.

In our paper, we will delve deeper into the main heat policy principles and how these could be reformed to facilitate the design of a heat marketplace. We will also discuss elements of the currently competitive electricity market rules such as metering, settlement and assurance and how these could be adapted and applied to liberalised heat networks. As the electricity industry is evolving to support UK's decarbonisation objectives we believe there is scope for aligning future low-carbon heat generation including the development of a new heat marketplace early on. Therefore, we will highlight the benefits from the synergies that could emerge when designing a heat market and how these can be integrated into a wider strategy within the net-zero agenda.

[1] ELEXON is the Code Manager for the Balancing and Settlement Code (BSC). We are responsible for managing and delivering the end-to-end services set out in the BSC and accompanying systems that support the BSC. This includes responsibility for the operation and delivery of balancing and imbalance settlement and the provision of assurance services to the BSC Panel and BSC Parties. We manage not just the assessment, but also the identification, specification, development, implementation and operation of changes to central systems and industry processes. This end-to-end model provides expertise in one place for both administration (especially, Change) and systems design and implementation. In addition, such expertise is then available to support the industry, Government and regulator in considering future changes and innovation against the existing industry rules, for the benefit of the consumer.

In addition, through our subsidiary, EMR Settlement Ltd, we are the Electricity Market Reform (EMR) settlement services provider, acting as settlement agent to the Low Carbon Contracts Company (LCCC), for the Contract for Difference (CfD) and Capacity Market (CM).

Introduction

Overview

In the UK, almost half of final energy consumption comes from heat. Heat, not only is the main product of our energy consumption but it also accounts for over a third of the UK's greenhouse gas emissions[2]. Therefore to meet the Government's net zero commitment, decarbonisation of heat must be achieved. The Government needs to establish a robust heat decarbonisation strategy to enable the creation of a low-carbon heat sector that works for all, at the lowest possible cost.

Natural gas has heated homes and businesses in Great Britain since late 1960s. Heating our homes in this way allowed people access to a source of fuel that was initially relatively cheap and plentiful in supply. In particular, research has shown that 85% of households in the UK are connected to the gas grid with only 5% of households using electricity to heat their premises[3]. Over the years, consumption of fossil fuels for heating purposes has led to significant destruction of our environment.

Elexon has been monitoring developments in relation to heat and we have been contributing to the debate on development of the Government's heat decarbonisation strategy. More specifically, we have been exploring the potential for other methods to heating and cooling such as heat networks and how these could be exploited further by the industry to achieve more carbon savings. Heat networks currently provide about 2% of overall UK heat demand. However, the Government believes that around 43% of heat demand could be met through heat networks by 2050. There are not enough heat networks being developed currently to meet these targets. Therefore, we believe that clear arrangements to encourage their development needs must be put in place by the Government.

Despite heat networks being a rather small industry, a number of market reforms could allow the industry to mature towards opening the market to competition shaping, therefore, a heat marketplace. We recognise that the heat sector has elements that are similar to the gas and electricity markets and for this reason we see an opportunity for the heat industry to apply a number of operational and technical standards from these tried and tested industries to heat networks.

This paper serves as a starting point to prompt industry discussions on how best to exploit established market and policy frameworks for the creation of an open heat networks sector. A decarbonised economy of the future will only be achieved through effective synergies between different industry vectors hence we will also be exploring the various role electricity arrangements could play when designing a heat market.

Decarbonisation Agenda

The UK Government has repeatedly stressed the need to decarbonise our heating and energy systems. Under the Climate Change Act 2008, the Government has committed to reducing annual greenhouse gas emissions by at least 80% by 2050[4]. Most recently, in June 2019, the Government has passed this commitment into legislation making the UK the first major economy in the world to pass laws to end its contribution to global warming by 2050.

The ambition to reaching net zero emissions requires a collective effort; Government, industry and consumers need to work together to reach the set target. This, however, comes as a great challenge to the heat sector as different industry stakeholders have different ambitions and interests. Any policy to be drafted should be adaptive to everyone's needs to deliver a best possible outcome. It is vital for policy-makers to grasp the various behavioural elements within the sector and shape a policy that fits all purposes.

[2] Heat Network: building a market framework, BEIS – February 2020
[3] Clean Growth – Transforming Heating, BEIS - 2018
[4] Climate Change Act, 2008

Heat and Electricity – towards a multi-vector policy framework

The Energy Saving Trust claims that in a typical UK household, more than half the money spent on fuel bills goes towards providing heating and hot water[5]. However, different households choose different means to heat their homes. Across the UK, the most preferable method to providing heat is conventional gas boilers whereas a number of households choose other technologies such as electric storage heaters. At present, around 23 million homes in the UK are connected to the gas grid. Decarbonising these households will not be an easy task, however, from 2025 onwards any new houses built are prohibited from connecting to the gas grid based on provisional Government guidelines. This raises a call for the sector to source new ways of heating that are both efficient and most importantly low carbon.

Electrification of heat

Electricity seems to be the way forward for many system solutions such as transport. There is now an abundance of choice of electric vehicles for consumers around the world with many countries already taking action to ban fossil fuel cars. UK has pushed this target forward from 2040 to 2035 as the Government will put a ban on selling new petrol, diesel or hybrid cars. This is somewhat similar to the 2025 ban to connecting new houses to the gas grid. Could electricity be the answer to the heat sector as well?

The technical solution of electric storage heaters is not very different from gas boilers although a more expensive choice for consumers. At the same time it has been argued that electric heaters emit more carbon than other technologies but this can be contradicted as more low carbon electricity is now feeding the electricity networks.

Discussions about electrifying heat are more common in the Government plans towards decarbonising heating and achieving its net zero targets. The use of heat pumps in existing dwellings and new builds could potentially provide heat at greater performance than gas boilers. The majority of heat pumps operate with electricity and are more commonly installed in both domestic and non-domestic buildings. Heat pumps tend to provide both heating and cooling on demand throughout the year with electricity consumption varying according to the type of heat pump. This kind of technology can drive less emissions as the more low carbon electricity is used to operate heat pumps the more the low carbon heat for consumers.

In particular, the Government has already been investing in trials for heat pumps for both domestic and non-domestic use. This was carried out with the help of Energy Systems Catapult aiming to test and evaluate consumers' behaviour throughout the installation and use of heat pumps[6]. Projects like this are vital in raising public awareness hence investment in such technologies should be enshrined in the Government's heat strategy and further encouraged through incentive and support schemes. Additionally, in late 2020, the Prime Minister has issued a 10-point plan for a green industrial revolution setting an ambition of installing 600,000 heat pumps annually by 2028[7].

Flexibility market

Electricity and heat can be interoperable. Consumers tend to vary the amount of heat they consume based on their needs and comfort levels and also on the condition of their dwellings. In the case of heat pumps, consumers can equally control the amount of electricity they use to produce heat. This could enable consumers to help distress the electricity network system when incentivised to limit the amount of electricity they use to heat their homes.

Demand-Side Response (DSR) allows consumers to 'flex' their electricity consumption based on the needs of the network. For example, once consumers turn their heat pumps off as they no longer need to heat their households they will be releasing electricity back to the system at times when it is needed the most. Likewise, at times when there is abundance of electricity flowing through the network consumers can be incentivised to absorb this excess electricity to operate their heat pumps and/or electric storage heaters. Network providers/operators will notify consumers for their options and the best course of action according to the system needs. There is also the potential for electricity suppliers to establish tariffs or contracts that will allow consumers to better flex their consumption based on how often they use their heat pumps i.e. 'Time-of-use' tariffs.

Heat could offer additional flexibility services to the system with the use of other technologies. Combined Heat and Power (CHP) plants produce both heat and electricity and can be mostly found in buildings, industrial premises and also provide heat to district heating schemes around the country. Although gas-fuelled, these CHP systems could

[5] Heating and hot water, Energy Saving Trust, 2021
[6] Electrification of Heat UK Demonstration Project, Energy Systems Catapult, 2019
[7] The Ten Point Plan for a Green Industrial Revolution, BEIS, Prime Minister's Office, 2020

satisfy the needs of both consumers and the electricity network due to their ability to push electricity back to the network when necessary. CHPs are also a conventional method to heating but they could provide some 'quick-wins' towards decarbonising the energy system until newer low carbon methods are ready to be introduced to the industry.

Elexon has been exploring the current and future prospects for flexibility markets in the UK. In a recent policy view[8] about flexibility in the electricity sector we made some recommendations towards establishing a nationwide framework that would allow flexibility exchanges in different regions across the country. Within the policy view we remarked that more efficient use of the network capacity could potentially aid decarbonisation targets.

For the above reasons mentioned, the upcoming heat policy should include intertwined elements between heat and electricity. A 'whole-system' approach to reaching our net zero targets will only be achievable if the new policy framework follows a multi-vector perspective and explores all angles of the heat sector.

District heating: what is the future for heat networks in the UK?

There are numerous opportunities behind district heating in helping towards an overall recovery of our heating system. District heating is a preferable way to provide heat in many countries around Europe and progresses steadily across localities in the UK. The Committee on Climate Change (CCC) has estimated that around 18% of UK heat will need to come from heat networks by 2050 if the UK is to meet its carbon targets cost effectively. However, only 2% of the UK heat demand[9] is satisfied by district heating with other methods such as gas boilers prevailing significantly.

Elexon has been monitoring this progression over time and appreciates the importance of district heating within the Government's decarbonisation agenda. As the current investment and policy environment around heat networks is being explored, we strongly support district heating to be considered in the Government's upcoming heat strategy.

What are heat networks?

Heat networks distribute heat from a central source to a number of connected domestic and non-domestic customers on the network. Most heat networks operate with hot water flowing through a series of underground pipework to deliver heating, hot water and sometimes cooling to a range of consumers from domestic buildings (blocks of flats) to larger scale schools, universities and hospitals. Currently, there are over 14,000 heat networks in the UK with connections reaching up to 480,000 consumers. The majority of those tend to serve groups of people in local communities (i.e. communal buildings) as they only span out locally and have fixed/dedicated connections.

Apart from being a relatively efficient and low carbon method to heating, we have identified some other characteristics of heat networks highlighting their significance towards a green recovery of the heating system:

1. Heat networks can facilitate additional connections

As mentioned earlier, already established heat networks have dedicated connections to either residential buildings, offices and/or schools or hospitals. It is economically efficient for heat networks to be established in denser areas where demand for heat is higher than other locations. Given the demand and needs of the area the heat network serves, more customers could be attached to that specific network based on the infrastructure and layout conditions. New buildings might be more suitably connected to the existing heat networks compared to older dwellings that might not withstand any additional construction works. At the same time, heat networks can be extended to offer additional connections to customers that might be located outside their range. We will explore this later in the paper.

2. Central heat can be sourced through different technologies

Another benefit of heat networks is that they are able to input heat from various sources and utilise different technologies. For example, many heat networks across the country use CHP plants to source their heat whilst latest developments also allow heat pumps to generate heat and feed heat networks. Both CHPs and heat pumps will induce less carbon emissions hence offering low carbon heating to households and businesses. In its Future Energy Scenarios 2020 report[10], National Grid estimated that heat pumps and hydrogen fuelled CHP plants are the best options towards the 2050 net zero targets. Heat producing technologies are dependent on

[8] Elexon Policy View: *Setting up Electricity Flexibility Platforms,* Elexon, 2019

[9] Energy Consumption in the UK, BEIS, March, 2018

[10] National Grid ESO – Future Energy Scenarios report, July, 2020

the developer's confidence to invest in what technology suits the different areas better. In addition, this could also promote the use of stranded assets in areas where the demand for heat is higher and equally offer increased load to the existing heat networks.

What is also important is that heat networks could recover waste heat from large industrial processes. This would be another means to generating cost efficient and low carbon heat to be able to meet the decarbonisation targets faster. For this reason, industrial (e.g. manufacturing) and commercial (e.g. data centres) sources of waste heat should be encouraged to connect to heat networks where this is feasible to do so.

Current heat networks landscape in the UK

Despite the opportunities arising from utilising heat networks, there are some concerns as to their potential to prove profitable and viable investments. Private investors and developers are less willing to fund such projects as they are an unlikely source of long-term income. There are many reasons as to why investors are reluctant to support the establishment of heat networks with the main reason being the lack of demand from consumers to connect to such networks to heat their homes and/or businesses. BEIS has acknowledged that demand risk[11] is a primary factor making heat networks less attractive to invest in than other technologies and methods to heating. For this reason, investment in heat networks is targeted at areas where they are mostly needed such as in densely residential places and larger corporate and/or industrial buildings.

Although funding such projects remains a significant barrier for potential developers, BEIS has launched the Heat Networks Investment Project (HNIP) funding scheme to provide financial aid to successful applicants. BEIS has claimed that one of the long-term objectives of the HNIP is to allow the heat networks market to flourish over the time by strategically choosing and funding projects that will then draw additional investment. Over the next three years, BEIS has pledged £320 million in support for individual projects across England and Wales[12].

Heat networks can be described to operate under a monopolistic environment. This is also one of the main barriers to implementing large scale heat networks across the country. Due to the high upfront fixed costs of heat networks, it may not be of economic interest for new investors or developers to establish heat networks in the same area. Heat networks owners are more likely to secure their existing customers and lock them into long-term contracts with limited protection or oversee by the regulatory authorities.

Another important aspect of heat networks is that it has been and still remains an unregulated market. Lack of regulation is noticeable within this sector creating therefore a level of insecurity to potential heat network investors. Unlike the gas and electricity markets, heat networks are not bound by any licencing regimes nor are regulated by the Government and/or other authority. This does not only impact investors' confidence but also has an effect on consumers deciding whether to connect to heat networks or not. Without any policy/regulation in place for both investors and consumers leaves the sector exposed to additional risks. BEIS has been liaising with sector stakeholders over the years to establish a market framework for heat networks in order to drive more security and confidence from a robust set of rules and policies.

Future heat networks landscape in the UK

We think there is a lot of potential for heat networks to contribute towards spreading low carbon heat across the UK. Although heat networks are at a nascent development stage they display two common operational characteristics that could be altered to strengthen their potential:

- **Heat production and distribution are integrated;** and
- **Heat networks are disparate and not connected to each other**.

With production and distribution of heat being integrated, leaves little room for consumer choice. Consumers with an existing connection to a heat network cannot physically disconnect and look for an alternative supplier/source. This is different to gas and electricity markets where consumers are free to 'look around' and switch to other suppliers. As

[11] Demand risk is defined by the Heat Networks Task Force as the inability to forecast heat networks demand due to the risks associated with the consumption and connection to heat networks. *Shared Warmth report, The ADE, January 2018*

[12] Heat Networks Investment Project, BEIS

mentioned earlier in the paper, heat networks have the ability to facilitate more connections to their network lines. Should more connections be allowed to a single network, production and distribution of heat could be separated and operated by more than one entity hence opening the heat networks market to competition.

Unbundling the UK heat network market could be an opportunity to unravel many benefits for a number of industry stakeholders. Open and competitive markets (similar to gas and electricity) would allow heat to be generated, transmitted and distributed on a market price basis and under contractual agreements between sector participants. Through our experience[13] in the competitive electricity market we have fully understood the many benefits and opportunities an open market can bring to both the supply and demand sides of the industry. Although unbundling the heat sector might not be within the Government's immediate plans, we believe that a future opportunity of doing so needs to be considered and in particular once the heat sector expands and grows.

We can see efforts to unbundle heat sector from other European nations[14]. For example, in Finland and Norway third parties (TPA) are allowed limited access to heat networks. We believe that once the heat sector matures, the UK market will need to explore unbundling heat generation and heat transmission as well.

A heat network system that sources heat from a number of generation sites with a dedicated operator responsible for the delivery/distribution of heat to consumers resembles existing electricity networks. We see a great number of opportunities arising from this. For example, development of larger heat networks within a geographic area/zone could see the formation of a heat grid. We envisage a heat grid to facilitate the connection of a number of sites (generation, distribution and end consumers) within the same grid and/or through interconnection points between zones as heat networks expand to accommodate increased generation. An interconnected heat network could bring a number of benefits, some of which we highlight below:

- **Competitive heat market.**
  - Creation of a competitive market could enable investment in both generation and distribution of heat. Enhanced competition could also result in lower prices for consumers, as there would be more consumer offerings, as this is the case in the competitive electricity and gas markets.
- **Consumer choice.**
  - As the current arrangements remain unregulated, we understand that consumers are reporting that they sometimes pay unreasonably high prices for their heat supply. Unlike the electricity and gas sectors, heat network consumers are unable to look for another heat supplier, who could be offering a lower priced tariff. A potential heat grid with a number of connected generation sites delivering heat to consumers will allow greater choice and a variety of offerings.
- **Greater access to existing energy centre assets.**
  - Heat networks expanded through interconnection could benefit from accessing already established energy centres. This could allow additional volumes of heat to flow through the network and cover for heat that has been compromised by faulty assets. At the same time, expanded networks could make use of stranded assets that would have otherwise been left unused.
- **More efficient use of plants allowing more low-carbon heat through the networks.**
  - Interconnection could potentially enable heat networks operators to use their plants in an efficient way coordinating their heat intake and export based on the heat generated within the network. Likewise, assets generating low-carbon heat could be encouraged to supply heat over other fossil fuel plants.

The concept of interconnecting heat networks has been previously explored by the Mayor of London office. The 2014 report London Heat Network Manual[15] outlines how heat networks within London could be interconnected to form larger scale networks to enable access to a variety of heat sources and provide greater efficiency and flexibility in heat supplies. The report also supports that **'where networks are interconnected, a genuine heat market may develop allowing competition and lower costs'**.

[13] Elexon has been operating as a code manager since the inception of the NETA (New Electricity Trading Arrangements) and later on BETTA (British Electricity Trading and Transmission Arrangements) when the wholesale electricity market was open to competition.

[14] International Review of Heat Network Market Frameworks, BEIS Research Paper Number 2019/032, February 2020

[15] London Heat Network Manual, Mayor of London, 2014

Developing a policy framework for heat networks

It has been observed that lack of regulation in the HN market has been creating a lot of public backlash. Heat networks in the UK are left somewhat unregulated with minimal support for consumers especially in the case of a monopolistic environment. A level of guidance is already in place for potential investors and developers, however, voluntary. Heat Networks Code of Practice[16] has been developed by the Chartered Institution of Building Services Engineers (CIBSE) and The Association of Decentralised Energy (ADE) in 2015 to provide a clear set of guidelines and standards to interested parties in ensuring heat networks operate effectively meeting customer expectations. Regulation in heat networks is limited only with regards to metering and billing processes based on the Heat Network (Metering and Billing) Regulations 2014 which details how heat network operators should follow a universal billing method for consumers.

Efforts to strengthen regulation in heat networks are undergone in some localities around the nation. Devolved Governments such as Scotland have already constructed their own set of HN regulations with the Scottish Government introducing the Heat Networks Act[17] earlier in 2021 to provide a higher level of confidence in investing in heat networks infrastructure. Being the first nation in the UK to legislate heat networks, the Scottish Government aims to ensure heat networks operators are formally licenced and satisfy all requirements for their development.

BEIS has recently been working with the industry to establish a regulated market for HN incorporating a set of policies and standards for new and existing HN in the UK. In their most recent public consultation[18], BEIS highlighted the need for the industry to have a robust set of policies in order to protect consumers, support market growth and develop a low carbon network.

The Government is keen to introduce a General Authorisation scheme with optional licencing for companies/operators who wish to gain more rights and powers. Elexon supports the Governments' proposed regulatory regime however establishing a compulsory licencing scheme could provide a higher level of consumer protection. A fully licencing scheme compulsory for all sizes of heat networks might not be preferable as this will be burdensome and costly for relatively new and smaller heat networks. Looking closer at the regulatory regime in the Netherlands, the local Authority carries out a licencing scheme based on a threshold where it issues a licence to heat network providers supplying a certain amount of heat to more than 10 customers (about 30 licences have been granted)[19]. The operational market arrangements in the Netherlands could lend useful lessons to apply to the UK arrangements to ensure larger heat network operators in the UK are regulated appropriately.

The established regulatory regime should be applicable to all new and existing HN. It will be important to ensure that no network is unintentionally limited or precluded from expanding their operations both at present and in the future or joining in with a regional heat grid. As mentioned above, regulations should be future-proofed, incentivise efforts towards decarbonisation targets and be able to facilitate a whole-systems approach.

How can Elexon support the expansion of heat networks?

Throughout our research into heat networks we have come to appreciate there are several electricity market design principles that can be applied to the future heat markets. We believe it is important to incorporate those tried and tested market design principles from early on in order not to preclude any future developments that would allow a competitive heat market to emerge.

Central Settlement of heat

The creation of a competitive heat market would see heat being produced, transported, and sold on a market price basis under contracts similar to how electricity or gas is produced, transported and traded. Heat as a commodity shares similar physical characteristics to electricity. Heat, like electricity is difficult to store in large amounts therefore both heat and electricity need to be consumed as they are produced.

The Balancing and Settlement Code (BSC) has provided a set of arrangements for managing electricity Settlement over the 20 years that it has existed. These arrangements require Elexon (as manager of the BSC) to obtain meter readings for output and consumption of electricity every 30 minutes. We then compare the meter readings with

[16] CP1: Heat Networks: Code of Practice for the UK, CIBSE, 2020
[17] Heat Networks (Scotland) Act 2021
[18] Heat networks: building a market framework, BEIS, 2020
[19] International Review of Heat Network Market Frameworks, BEIS Research Paper Number 2019/032, February 2020

contracted positions and calculate the 'imbalance price' for electricity in each 30 minute period of a 24 hour day. Every imbalance that occurs (e.g. if generators do not produce enough electricity, or if suppliers underestimate how much electricity consumers use) is charged at the same imbalance price. We then carry out 'settlement runs' over a 14 month period where companies either pay, or are paid to resolve any imbalances that they caused[20].

We believe that the principles of electricity Settlement can be adapted to manage settlement in the future heat market. In addition to the central settlement of heat we believe that some other principles of the BSC can be adapted to provide settlement related services for developing a heat market in GB.

Assurance of settlement arrangements

Elexon collects and processes a vast amount of metering data on a daily basis. This data is crucial in ensuring that the electricity system remains balanced and that funds are settled between respective market participants. For this reason, the BSC carries out a number of assurance techniques to ensure the accuracy and robustness of data. Similar Assurance arrangements to those applied under the BSC, could be applied to heat networks to maintain an adequate level of control for data sharing especially when the market grows significantly.

Under the BSC, Elexon oversees the inspection and assurance of metering systems. Assurance of meter equipment, both Smart and Non Half Hourly, has been key to the electricity industry. In particular, electricity settlement has benefitted greatly from assurance as it enabled close inspection of metered readings. The inclusion of meter assurance in the heat market will provide additional stakeholder support in ensuring that heat network operators are using meters that have been certified as viable for settlement. In turn, this provides certainty that consumers are billed accurately.

Code development and management

If more heat networks and a competitive heat market are to be developed there will need to be a code of practice to protect customers and promote good performance. The Code of Practice 1 (CP1) was developed by CIBSE in association with ADE as a guidance to heat network developers in maintaining the minimum required standards for district heating projects. In the recent years, CP1 has been updated to provide more detailed requirements for the development of heat networks and allows operators to check their project's performance against their initial targets. Although this code of practice remains voluntary, it could be further reviewed with an opportunity to develop a mandatory set of technical and operational requirements for heat meters associated with heat networks. This could potentially lead to the establishment of a code specific to heat networks covering the whole spectrum of activities within the sector i.e. from the development of networks to commercial and retail arrangements for enhanced consumer protection.

Conclusion

Elexon appreciates the efforts carried out by the Government and the industry in decarbonising heat. Given that generating heat for homes and businesses accounts for around a third of the country's carbon emissions, there needs to be a collective response if the UK is to reach its net-zero emission targets.

We recognise that decarbonising heat could be achieved through a variety or a mix of technologies and solutions, such as electrification (e.g. heat pumps) and district heating (e.g. heat networks). In this paper we highlighted that it will be vital to adopt a "whole-system approach" to decarbonise heat. Any new policies on heat need to align and integrate into a wider strategy and course of action covering a number of industry vectors such as heat, electricity and gas.

We also noted that future heat networks and potential heat markets are likely to have similar characteristics to existing electricity and gas networks and markets. If the government applies the gas and electricity retail models to heat networks, then these two markets have a lot to lend to the heat industry. As such, we believe that Elexon's experience in designing and operating balancing and settlement arrangements for the electricity markets could be relevant to the emerging heat markets.

We look forward to collaborating with established and new market participants, innovators, the Government and academia to explore how bringing heat and electricity together could help shape new methods to decarbonising our energy system.

[20] Simple Guide to The Balancing and Settlement Code, Elexon (2020)