Research on district heating and local approaches to heat decarbonisation

Annex 1: Overcoming barriers to district heating

A REPORT PREPARED FOR THE COMMITTEE ON CLIMATE CHANGE

November 2015

Annex 1: Overcoming barriers to district heating

Contents

Executive Summary

District heat has the potential to be an important and cost-effective part of the low-carbon transition.[1] But at present, only 1% of UK heating demand is met by district heat.[2] A step change in uptake will be required to deliver 9% by 2030 and 18% by 2050, modelled by Element Energy in their central scenario.

How can this level of district heat penetration be delivered? In this report we consider how best to overcome supply and demand side barriers associated with district heat.

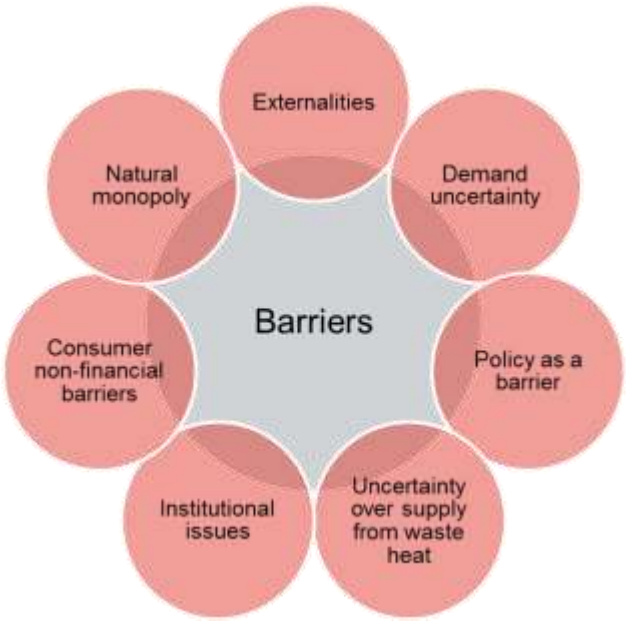
Which barriers need to be addressed?

We analysed barriers through a combination of stakeholder interviews, a review of existing research, a consideration of the economic characteristics of district heat investments as well as through a review of Element Energy's modelling. This analysis suggests that seven interrelated barriers are particularly important (Figure 1):

1 This was illustrated by modelling carried out by Element Energy in the main report. Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

2 Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

Figure 1. Summary of key barriers



Source: Frontier Economics

- **Externalities.** District heat produces fewer carbon emissions than most incumbent heating technologies. However, this carbon saving is not reflected in the price of heating. Without a policy intervention to reflect the positive externalities of district heating, uptake will be less than the cost-effective level.

- **Natural monopoly.** District heat networks are natural monopolies. Their high fixed costs mean that it is more efficient for one operator to serve each local market. The resulting limited competition can lead to poor outcomes for consumers. This in turn could cause wider reputational damage to the sector, which could hinder further take-up.

- **Demand uncertainty.** Given that the costs of district heat networks are predominantly fixed and sunk, there will be economies of scale. This means that the viability of investments will be very sensitive to the level of demand secured (Element Energy's modelling also illustrated this). For these reasons, uncertainty over the level of demand that can be attracted to a given network poses a barrier to investors.

- **Barriers associated with policy.** There is already a high degree of policy intervention in the heating sector, with multiple aims. Stakeholder

interviews highlighted that in this environment, three types of policy barriers can affect district heat.

- **Policy uncertainty.** District heat investments are highly capital-intense and have long asset lives. At the same time, heating policy can shift, as priorities change. This increases the risks for investors.
- **Policy conflicts.** Policies with different aims (e.g. to incentivise renewable heating) or policies applied to only certain sectors (e.g. the EU ETS) may reduce the incentive to invest in district heat.
- **Policy-created entry barriers**. Regulation can create barriers. For example, restrictive planning policies can both make it difficult to gain permission to install a network or heat source and then to actually install it.

- **Consumer non-financial barriers**. Awareness of district heat is low. Even where people are aware, they may lack interest. Lack of trust, the perceived hassle of connecting to a district heat network, and perceptions of poor quality need to be tackled.
- **Institutional issues**. There may be barriers associated with overcoming institutional issues within the sector, in particular relating to the adequacy of local authority resources and more general skills and knowledge gaps within the sector. This particularly came through our stakeholder interviews.
- **Barriers to supply of waste heat.** Using waste heat as a heat supply is a cost-effective option. However, it may be difficult for investors to gain information on the availability of waste heat (for example from power stations and waste incinerators).

These barriers interact. For example, externalities in the sector require policy intervention, which then introduces policy uncertainty. Consumer financial barriers may be exacerbated by trust issues associated with natural monopolies. These non-financial barriers may also exacerbate demand uncertainty. This suggests that a coordinated policy approach will be required.

What is in place elsewhere?

To help understand gaps in UK policy, we then assessed how these barriers had been overcome elsewhere, both in other countries with successful district heat sectors(Denmark, Sweden, Finland, Germany, and the Netherlands) and in other sectors (for example, gas networks in Northern Ireland).

Table 1 sets out the findings from this analysis.

Table 1. Policies in place elsewhere

Policies in place elsewhere	
Externalities	• Targeted financial incentives
Natural monopoly	• Competition authority oversight • Law on transparent pricing and contracting • Monopoly price regulation
Demand uncertainty	• District heat "mandating zones" • Use of the planning process • Use of long-term contracts • "Anchor" tenants
Barriers associated with policy	• Long-term, credible policy commitments • Framework to protect operators from government-created risk • Supportive planning laws
Consumer barrier	• Consumer protection • Initiatives to increase awareness and reputation
Institutional issues	• Clear ownership of delivery
Barriers to the use of waste heat	• Policies to encourage production of heat from waste

What is in place at the moment to address these barriers in the UK?

Drawing on the stakeholder interviews, we then assessed how barriers are currently being overcome through policy in the UK, and identified gaps. Table 2 shows that there are some important gaps.

Table 2: Gaps

Gaps	
Externalities	• Financial incentives that cover the carbon externality associated with district heat
Natural monopoly	• Clarity over future framework for district heat regulation.
Demand uncertainty	• Policies to help provide anchor loads for district heating schemes
Barriers associated with policy	• Long-term policy commitment to district heat
Consumer non-financial barriers	• Clarity over regulatory framework going forward • Measures to increase awareness and reputation of district heat – both locally and nationally
Institutional issues	• District heat strategy for sector, and allocation of responsibility • Allocation of stakeholder with lead responsibility in local sector
Barriers to the use of waste heat	• Policies to encourage use of waste heat

How could policy fill these gaps?

Our next stage was to develop policy recommendations to fill these gaps, based on the analysis of barriers, best practice and existing UK policies. We first produced a long list, based on first principles, the review of policies from elsewhere and insights from our expert interviews. We then screened these against a set of qualitative criteria to produce a shortlist:

- **Externalities: A financial incentive to address the externality in the market related to carbon emissions.** In the near term, this could be a subsidy payable to investors per connection to district heat networks. It should be set a level consistent with the value of carbon. Applying a carbon tax to all energy use across the economy may be a feasible alternative in the longer term.

- **Natural monopoly: Competition policy, in the form of CMA oversight.** In the near term, this could be cost-effective way to address natural monopoly concerns and help to ensure fair outcomes for consumers to preserve the reputation of the sector. In the longer term, as district heat

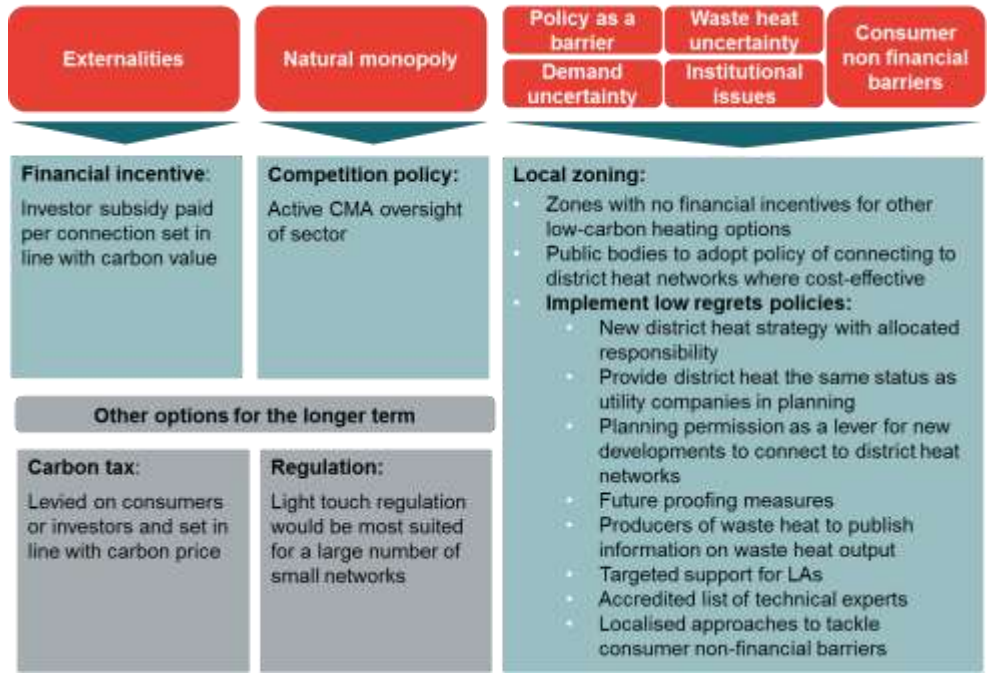
becomes more prevalent, it may make sense to introduce light touch price regulation.

- **Other barriers: Dedicated local zones for district heat.** Where district heat is deemed cost-effective, a number of other policies can be applied to tackle barriers in a targeted way.
  - **Public bodies to adopt a policy of connecting to district heat networks** where cost-effective. This aims to provide an "anchor-load" for district heat networks. This addresses barriers associated with the cost structure and uncertainty of demand for networks.
  - Other **low-carbon household-scale heating technologies are not eligible** for financial incentives. The fixed costs of district heat networks mean that high take up is required to ensure a scheme's viability. It makes sense, therefore, to ensure that customers are not being subsidised to take up alternatives to district heating, within a designated zone.
  - A range of other 'low regret' policies that we consider could produce benefits at a relatively low cost. These include localised approaches to overcoming barriers[3].

Figure 2 outlines our policy recommendations:

[3] These are discussed in detail in Appendix 1.

Figure 2. Summary of policy recommendations



Source: Frontier Economics

These policy recommendations are at a high level and questions around the best way to implement them remain. For example:

- **Financial incentive**. We have recommended an investor subsidy paid per connection for a near term policy. However there are alternative options (for example, an incentive paid upfront at the time of the network investment, or per unit of heat delivered). These should be investigated in detail before a decision is made.
- **Local zoning**. Local zoning would ideally take into account a very wide range of area characteristics, including building characteristics as well as social and economic factors. This report has not come up with an assessment of the detailed criteria that would need to be applied in the definition of these zones. Further work would be required in this area.

1. Introduction

Modelling by Element Energy shows that district heat has the potential to be an important part of the low-carbon transition, and could cost-effectively meet around 9% of UK heating needs by 2030 and 18% by 2050.[4]

However, at present, only 1% of UK heating demand is met by district heating.[5] This means that a step change in uptake will be required to deliver cost-effective levels in the next decades.

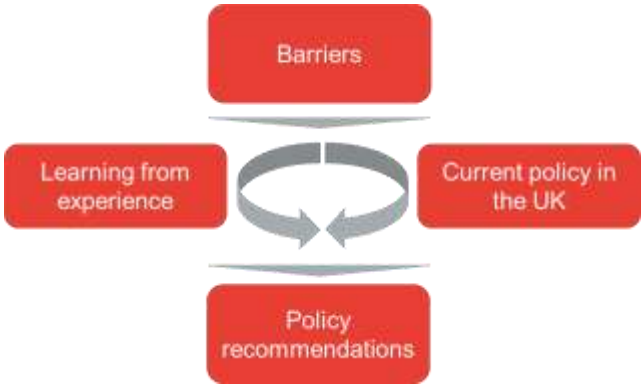
How can this step change be delivered? In this report we consider how best to overcome supply and demand side barriers associated with district heating.

- This section provides an overview of our methodology.
- Sections 2 to 9 explore each of the main barriers to district heat, looking at how these have been overcome internationally and in other sectors, and recommending new UK policies that could be put in place.
- Section 10 presents our conclusions and summarises the policy recommendations.

1.2 Methodology

Figure 3 provides an overview of our methodology

Figure 3. Overview of methodology



Source: Frontier Economics

4 This was illustrated by modelling carried out by Element Energy in the main report. Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

5 Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

1.2.1 Barriers

We determined the barriers to focus on in this study in several ways.

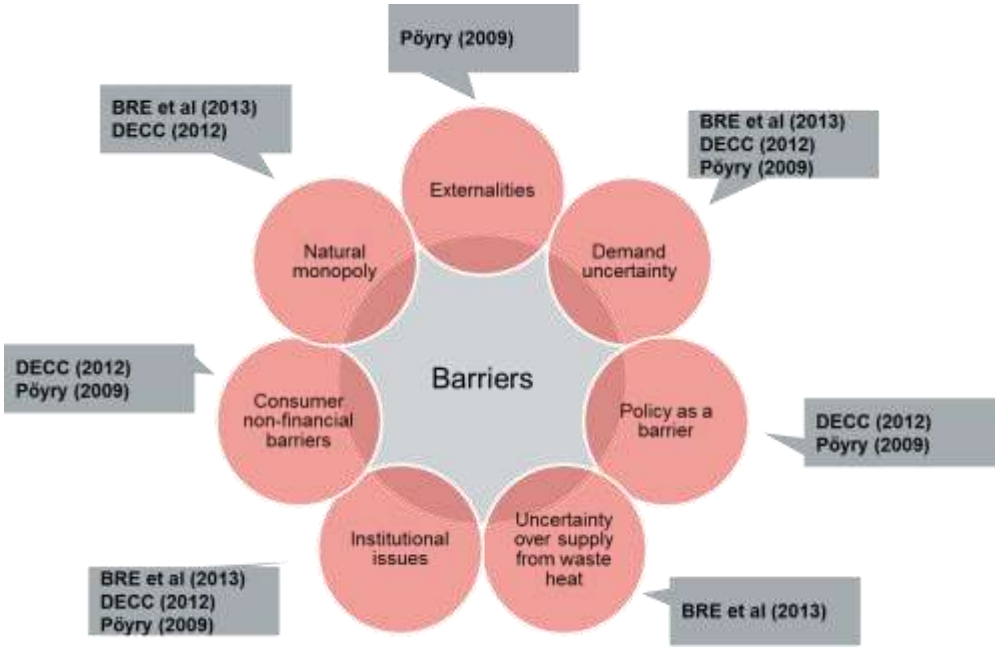
- Existing research provided a useful overview of other barriers, particularly those related to institutional issues and technical characteristics (Figure 4**).**[6]
- The modelling by Element Energy[7] highlighted the importance of some barriers. For example overcoming the carbon externality is a key driver of uptake in their scenarios.
- We also identified barriers based on the economic characteristics of district heat. For example the barriers associated with natural monopoly are driven by the high fixed costs associated with district heat investments.
- Finally, we supplemented the analysis with interviews with ten stakeholders, including academics, investors and policy-makers. This helped us determine the barriers that were most important, and to assess the developments since the existing research.[8]

6 For example, Pöyry (2009), *The potential and costs of district heating networks;* DECC (2012), *The future of heating: a strategic framework for low carbon heating in the UK;* BRE et al (2013), *Research into barriers to deployment of district heating networks.*

7 Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

8 For example, since DECC (2013) there have been a number of developments in the policy environment.

Figure 4. Summary of barriers, and key sources of insight from previous research



Source: Pöyry (2009), *The potential and costs of district heating networks*; DECC (2012), *The future of heating: a strategic framework for low-carbon heating gin the UK*; BRE et al (2013), *Research into barriers to deployment of district heating networks*

1.2.2 Learning from experience

To help understand gaps in UK policy, we then assessed how these barriers had been overcome elsewhere, both in other countries and in other sectors.

Our review of international best practice focussed on Denmark, Sweden, Finland, Germany, and the Netherlands. We focussed on these countries as:

- they all have a relatively successful district heat sector, although of differing sizes;
- they are the most comparable countries to the UK in terms of the general policy context; and
- they have adopted a range of different policies which provides a broad comparison.

While looking to the experience of other countries is informative, there are limits to the comparison. Country differences may mean the lessons are less applicable. The historical context is also important. Further, in many countries, a range of policy measures have been adopted. This can makes it difficult to assess the relative importance of particular policies. Particular issues to keep in mind include the following.

- **Response to 1970s oil crisis.** District heating was rolled out in some countries in response to the 1970s oil crisis (e.g. Denmark and Sweden). The impact of high oil prices made it a national priority to secure security of energy supply, and district heating was an important part of this response.

- **Incumbent heating technologies.** The incumbent heating technologies (prior to the roll out of district heating) are different in the case study countries compared to the UK, with the UK having a higher penetration of gas-fired central heating.

We also consider learning from other sectors, for example from the roll out of gas networks in Northern Ireland.

1.2.3 Current policy in the UK

The next stage was to understand how barriers are currently being overcome through policy. The stakeholder interviews were particularly important at this stage, in helping to highlight those policies that were making a difference on the ground.

1.2.4 Policy recommendations

Learning from elsewhere helped us identify what could be done to overcome barriers. Comparing this to what is being doing in the UK, allowed us to identify gaps. This formed the starting point for our approach to developing new policy recommendations (Figure 5).

Figure 5. Overview of approach

Source: Frontier Economics

- We started from a long list of policies. We generated the long list based on a consideration of existing policy elsewhere, through the expert interviews and through an analysis of what optimal policy should look like based on first principles.

- We then screened[9] this long list based on a set of qualitative criteria (Figure 6) to produce a shortlist of policy recommendations and to identify **'low regret'** policies (policies likely to be associated with low costs) that are also worth considering.
- For the shortlisted policy options, we also provide a high-level description, where possible, of the scale, timing and cost of the policies.

Figure 6. Qualitative assessment criteria for policy analysis

	Criteria	Description
1	Effectiveness at addressing barrier	Which barriers does the policy address? Would the sector overcome the barriers the policy is addressing anyway? What is the likely contribution of the policy in meeting the district heat uptake scenarios?
2	Efficiency	How cost effective is the policy? Is the resource cost to the UK economy likely to be outweighed by the benefit? Does it provide the right incentives for efficiency?
3	Cost to Government	What is the potential cost to Government and the taxpayer?
4	Cost to investors and/or consumers	What is the potential cost to investors and or consumers?
5	Distributional impacts	What are the distributional impacts of the policy among consumers? What are the impacts on consumer bills and how do these differ by consumer income?
6	Evidence base	Is there any evidence that the policy works? E.g. are there international or past precedents and has the policy been trialled?
7	Compatibility with existing policy	Is the policy compatible with other policies already in place? How does the policy interact with other policies (e.g. are potential policies complements or substitutes?)
8	Implementation considerations	How easy is the policy expected to be to implement? Could the policy be implemented in a reasonable timeframe?

Source: Frontier Economics

In the next sections, we apply this methodology for each of the barriers identified in Figure 4.

9 Throughout the report, we summarise our assessment using a red/amber/green rating against each criteria drawing on the preceding discussions.

2 Externalities

District heat produces fewer carbon emissions than most conventional heating technologies. However, this carbon saving is not reflected in the price of heating. We know from Element Energy's modelling[10] that without a policy intervention to reflect the positive externalities of district heating, uptake will be far lower than the cost-effective level. So how can policy best overcome this barrier?

In this section, we review examples of international action to tackle externalities in this sector. We then consider current policy in the UK before recommending further action.

Summary

Requirements to address barrier	Internalise the cost of carbon within the price of heating
Learning from elsewhere	Financial incentives targeted at district heat
Current UK action	Financial incentives that only provide limited support for district heat, and sometimes support competing technologies.
Gaps	A financial incentive for district heat that covers the carbon externality
Policy recommendations	A tax or subsidy set at a level equivalent to the value of carbon. A subsidy could be paid to investors at the point of connection

This chapter deals only with the carbon externality. We note that there may be negative air quality externalities from district heat, to the extent that biomass-fired schemes are employed.[11] Biomass makes a relatively small contribution to Element Energy's central scenario (rising to about 10%), though even at this level, local air quality could be affected in some areas. In the high scenario, biomass makes up a substantial proportion of district heat supply. We have not investigated air quality issues in this report, but they could be an important area for future research, particularly if the high scenario is being pursued.

10 This was illustrated by modelling carried out by Element Energy in the main report. Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*

11 Ricardo-AEA (2013), *Review of the impacts of carbon budget measures on human health and the environment*

2.2 Learning from elsewhere

Policy interventions to address externalities in the district heat sectors in other countries are common, and implemented through methods ranging from feed-in-tariffs on electricity generated, to carbon tax exemptions, to direct investment grants.

- **Germany.** Germany provides eco-tax exemptions for natural gas and heating oil used for CHP. The New CHP Law (2008) provides a "bonus tariff" or subsidy for CHP electricity generation and support for building and extending district heat networks with a large component of CHP.

- **Denmark.** In Denmark, a feed-in-tariff has been paid to decentralised CHP plants since 1992. Denmark also has a heat tax, for which biomass is encouraged by being exempt.

- **Sweden.** Sweden has various carbon taxes on different fuel and sectors combined with subsidies and favourable loan terms for district heat. It also has a number of investment programmes which aim to encourage environmental initiatives.

- **Finland.** Finland has carbon taxes (though there are rebates on natural gas and peat).

- **The Netherlands.** The Netherlands has a feed-in-tariff for the electricity generated using CHP plants and it also allows investors to subtract a share of investment from their tax liabilities. It also offers subsidies for micro-CHP units.

Many mechanisms are focussed on encouraging heat-only district heat generators to switch to combined heat and power, as this is more energy efficient. Therefore, they could be considered as a way of fine-tuning the generation mix of a more established district heat sector.

2.3 Existing UK action

There are a number of financial incentives aimed at low-carbon technologies in the UK. However, none are specifically associated with internalising the carbon benefits of district heat.

- **Carbon Price Support (CPS) exemptions.** District heat suppliers with good quality gas CHP[12] are exempt from paying the carbon price floor on

12 As defined by the Combined Heat and Power Quality Assurance (CHPQA) programme.

the fuel used to generate heat and, from April 2015, also for the electricity they use on site. The Association of Decentralised Energy (ADE) estimate that for 2015/16 suppliers will save over £3 per MWh under this policy.[13] However, the CPS exemptions do not include exported generation. Further, fuel used in the main incumbent heating technology (gas boilers) is also exempt from the CPS.

- **Climate Change Levy (CCL) exemptions**. The CCL taxes fuels used to heat, light and power businesses. Any suppliers with good quality CHP are exempt from paying the levy on all gas and electricity used internally. The ADE estimates that this policy saves generators almost £2 per MWh for gas and over £5 per MWh for electricity. As this policy is focussed on business use, it is likely to support building-level gas CHP, rather than suppliers of district heat networks that are connected to domestic users. As with the CPS exemptions, a limitation of the CCL is that it does not incentivise electricity generation for export.

- **Enhanced Capital Allowances**. This policy allows a business to off-set investments in energy saving measures against its tax liability over the period in which the investment was made. So, for example, if a business pays corporation or income tax at 20%, every £10,000 spent on qualifying equipment would reduce its tax bill in the year of purchase by £2,000. These types of policies have international precedent, for example the Netherland's 1997 Energy Investment Deduction Scheme. However, the design of the UK policy means it is likely to have a very limited impact on district heat suppliers. This is because district heat schemes have a long pay-back period and so it is unlikely that a scheme will earn sufficient profit to have a tax liability within the relevant investment period. The exception might be for companies with other profitable activities against which to offset their district heat investment.

- **Energy Company Obligation.** ECO is a government scheme that requires larger suppliers to deliver energy efficiency measures to domestic residences in the UK. While district heat is eligible, ECO's design is not well suited to such investments. Suppliers are required to "bank" their energy efficiencies within a two to three year period. Given long investment lead times for district heat, there is a high risk that efficiencies are not realised within this period. As such, suppliers opt for alternatives which deliver energy efficiencies sooner.

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13 ADE (2014), *Gas CHP overview,* http://www.theade.co.uk/medialibrary/2014/10/15/9a272d0c/Gas%20CHP%20Overview%20WEB.pdf

- **Renewables Heat Incentive (RHI).** The RHI provides subsidy payments for homeowners that use eligible renewable sources to heat their homes. The heat supply part of district heating schemes also qualify for these payments providing they have an eligible heat source (though the network would still require funding). The RHI has provided support to a number of biomass CHP district heat schemes. However, gas CHP schemes are not eligible.

- **Scottish district heat loan fund.**[14] The Scottish Government's district heating loan fund provides low-interest unsecured loans, typically up to £400,000 per project to be repaid within ten years. One of the objectives of the fund is to deliver affordable heat to local communities. The fund is available to local authorities, registered social landlords and SMEs and ESCOs with less than 250 employees. By 2014, the fund had provided loans totalling £4.4m, helping to connect 173 homes and 16 non-domestic buildings to district heat networks.[15]

- **Renewable Energy Investment Fund (REIF).**[16] The Scottish Investment Bank's REIF provides financial assistance to renewable energy sources, including renewable district heat. The fund can provide loans, guarantees and equity investments, all on fully commercial terms. To be eligible for funding a scheme must also be able to demonstrate a benefit to the Scottish economy and have a demonstrable funding gap. The fund aims to complement the Scottish district heat loan fund and prioritises applications for funding over £400,000.

In addition to the UK policies above, the EU Emissions Trading Scheme (ETS) exacerbates the externalities barrier for district heating. The ETS applies to district heat networks with a boiler or CHP plant over a certain size, but does not apply to domestic gas boilers. This further financially disadvantages large CHP plants.

Table 3 summarises the assessment of each financial incentive below.

14 EST, District Heating Loan, http://www.energysavingtrust.org.uk/district-heating-loan

15 EST (2015), *District Heating Loan Fund Evaluation*

16 Scottish Enterprise, Renewable Energy Investment Fund, http://www.scottish-enterprise.com/services/attract-investment/renewable-energy-investment-fund/overview

Table 3. Assessment of district heat financial incentives

Initiative	Positives	Limitations
Carbon Price Support exemptions	Provides marginal financial support for heat and internally used electricity.	No support for external electricity produced; district heat gas consumption is not treated favourably to domestic gas use.
CCL exemptions	Potentially provides support for small-scale district heat serving commercial buildings.	Not focussed on district heat; focuses on internal electricity usage.
Enhanced capital allowances	May provide occasional, limited support.	Designed in such a way that provides limited support for district heat.
ECO	May provide occasional, limited support.	Designed in such a way that provides limited support for district heat.
RHI	Provides some support to schemes with eligible heat sources.	Does not cover network costs; potentially incentivises other renewable heat sources over district heat.
Scottish District Heat Loan Fund	Provided support to a number of district heat schemes and demonstrated carbon savings.	Limited to public sector and small private investors only. Must demonstrate contribution to fuel poverty. Limited to Scotland.
REIF	Provides financial support to larger district heat schemes with a funding shortfall.	Limited to Scotland.

Source: Frontier Economics

2.4 What more is needed?

The analysis above shows that there is no policy in place to provide a financial incentive to internalise the carbon externality from district heat.

Externalities

This section considers policy solutions to address the externalities and technology cost barriers of district heating. We first discuss the level of the incentive. We then cover other points relating to its design: timing, incidence and tax versus subsidy.

Level of the incentive

The incentive should be set at a level that is equivalent to the value of the carbon savings associated with district heat. This is in line with Element Energy's central scenario where a carbon value in line with DECC's published values is applied.[17] While setting a higher subsidy could further increase uptake, not all uptake under such a subsidy would be cost-effective for society.

Timing of the incentive

The incentive could be paid:

- upfront as a lump sum grant at the time of the investment;
- as a one off grant per connection made; or
- on an ongoing basis related to the volume of heat used (the approach taken with the current Renewable Heat Incentive) .

The timing of the payment will affect the incentives on investors, operators and consumers to behave efficiently. It may also affect the cost to Government. Investors, operators and consumers are likely to have higher borrowing costs or discount rates than the Government. This means that the size of the grant required to deliver an optimal level of investment will be lower if it is provided upfront, rather than on an ongoing basis. Table 4 summarises the incentives each option creates on the efficient level of investment, connections and heat use.

17 DECC (2014), *Valuation of energy use and greenhouse gas emissions for appraisal*

Table 4. Financial incentives: timing

	Efficient level of investment	Efficient level of connection	Efficient level of heat generated and used
Upfront	• incentivises efficient increase in investment • overcomes upfront costs	• may not incentivise the investor to aim for the efficient level of connections	• no additional incentive impact on the level of heat use • no additional impact on the heat source used, however, the marginal cost of fuel should provide sufficient incentives to use optimal fuel mix
Per unit of heat used	• incentivises less than the efficient increase in investment as the signal is dampened due to the higher discount rates of investors/consumers	• incentivises efficient level of connections to better utilise network	• May incentivise overconsumption of heat (if paid via subsidy)
Per connection	• incentivises less than the efficient increase in investment as the signal is dampened due to the higher discount rates of investors/consumers	• incentivises optimal network utilisation via number of connections • incentive can be maximised using a "tiered-approach"[18]	• no additional incentive impact on level of heat use • no additional impact on the heat source used, however, the marginal cost of fuel should provide sufficient incentives to use optimal fuel mix
Summary ranking	1. Upfront 2. Per connection 3. Per unit of heat used	1. Per connection 2. Per unit of heat used 3. Upfront	1. = Upfront and per connection 3. Per unit of heat used

Source: Frontier Economics

18 This incentive would be sharpened if the "per connection" payment was tiered depending on the heat demand of the connection (e.g. if a higher payment was received for connecting a property with high energy use). There are a number of options for tiering such as per household member for domestic premises or based on SAP energy efficiency ratings. This would attract the sources of highest heat demand to the district heat network, resulting in greater carbon savings. However, there are a risks associated with such an approach. In particular, a tiering approach results in "kinks" between different payment levels which can result in bunching around particular kinks.

Externalities

Box 1: Discounted loans

A subsidy could also be provided in the form of a discount on the interest of a loan, following the example of Scotland and Sweden.

Providing a subsidy in this form could reduce costs. Government is likely to be able to borrow more cheaply than investors. If it can pass the low interest rates on to investors, this has the potential to reduce overall costs to society.

This type of subsidy could also be useful in a world where credit constraints are preventing investors from delivering district heat schemes with good returns.

Though it could play a role as part of a package of policies, we do not think this form of subsidy would be optimal.

- The main purpose of a subsidy should be to address the carbon externality. While it would be possible to do this through a subsidy on loan interest, it would be a complex way of delivering the signal.
- We have not found evidence that that there is a market failure relating to the provision of credit to district heat investors (for example, this was not highlighted as an issue in our stakeholder interviews). In general, schemes have tended to be able to secure finance providing they are financially viable and well-designed. In this environment, a system of subsidised loans risks distorting the market, and may result in a situation where less well-designed, or very risky schemes go ahead.

Incidence of the subsidy

A financial incentive could be paid to the investor/operator or the consumer. In a well-functioning market, the financial incentive would be passed on in full to consumers. In such a situation, the financial incentive would be equivalent. However even in this case, there are practical reasons why a financial incentive to an investor would be more effective. This is because there are transaction costs associated with finding out about district heat and applying for a financial incentive. Time investors spend gathering information and applying is likely to equate to a smaller percentage of the financial incentive compared to the time required by each individual consumer. In addition, behavioural barriers (such as lack of interest) are likely to be less acute for investors.

Subsidy versus tax

A financial incentive can be delivered either through a subsidy (or tax reduction) on low-carbon heating or a tax on the emissions associated with the incumbent technologies. Both act by decreasing the relative cost of low-carbon technologies.

Table 5 summarises the difference between implementing a financial incentive via a tax or a subsidy.

Table 5. Summary of subsidy versus tax

	Subsidy	Tax
Cost to government	• requires government funding	• tax will raise revenue for government
Distributional impact on consumers	• impacts on all tax payers	• a carbon tax applied to all heating could increase fuel poverty

Source: Frontier Economics

Either a subsidy or a tax could be effective in this case. In the long term, applying a tax to all carbon emissions in the economy could be the most efficient approach (an economy-wide subsidy for carbon saving measures would be more difficult to apply in practice, as it requires making assumptions on the technologies or activities that the subsidised measures are displacing).

However, the choice between a tax and a subsidy in the near term is likely to be mainly informed by political considerations (such as the need to raise revenue, versus the need to avoid impacting the fuel poor).

Summary of financial incentive design

Assessment: SHORTLIST

Based on this, we consider that the preferred financial incentive for district heat consists of a tax or subsidy, paid to or levied from investors; per connection, and set at the efficient level reflecting carbon savings.

Figure 7. Assessment of financial incentive

Source: Frontier Economics

Externalities

3 Natural monopoly

District heat networks are natural monopolies. Their high fixed costs mean that it is more efficient for one operator to serve each local market.

The resulting limited competition can lead to poor outcomes for consumers. This in turn could cause wider reputational damage to the sector, which could hinder further take-up.

This section explores what can be done to address this barrier.

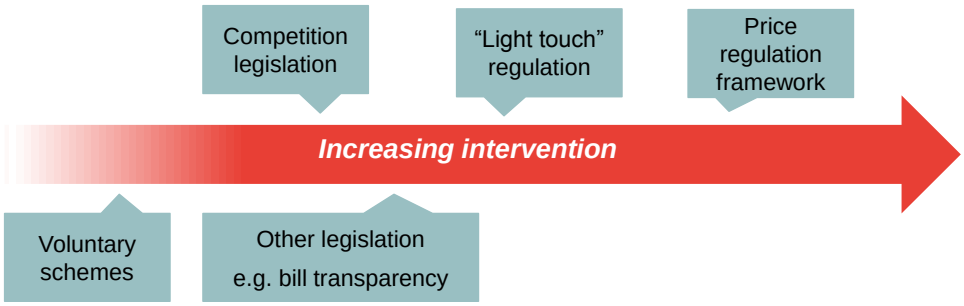
Natural monopoly: summary of findings

Requirements	• Protection for consumers from natural monopoly
Best practice internationally and elsewhere	• Competition authority oversight • Law on transparent pricing and contracting • Monopoly price regulation
UK measures in place	• CMA oversight • Voluntary Heat Trust • Metering and billing regulation
Gaps	• Clarity over the future framework for natural monopoly regulation.
Policy recommendations	• Active CMA oversight of the sector

3.1 Learning from elsewhere

Figure 8 outlines the spectrum of policy options used elsewhere to address natural monopoly concerns.

Figure 8. Policy options used elsewhere



Source: Frontier Economics

- **Competition legislation**, both general and district heat specific, is the most common tool to prevent suppliers from abusing their dominant position. A country's competition legislation sets the legal framework and investigations have been used to enforce this. For example, the German Federal Cartel Office conducted a **sector enquiry**.[19] Overall, while it found large variation in heat pricing, it found limited evidence of excessive pricing. In the seven cases where it found some evidence of potential excessive pricing, it initiated proceedings, for which the investigations are still ongoing. The Finnish Competition Authority also investigated the ten largest district heat networks between 2009 and 2012.[20] It found no evidence of excessive pricing, although did not rule out the need for price regulation in the future.

- **"Light-touch regulation"** has been used elsewhere. For example, in the French district heat sector there is some precedent of **price formulas** being tied in to the award of exclusive licences. The price formulas vary but typically involve an index of input costs that provide the parameters for price rises over time. The base price and the price formula tend to be negotiated between the network operator and the issuer of the licence, typically local authorities, during the tender process.

- **Price regulation frameworks** are less common, but are used in Denmark and some Eastern European countries. In Denmark, prices are regulated within the zones where it is mandatory to connect to the local district heat

19 Bundeskartellamt, Bundeskartellamt examines excessive district heating prices, http://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2013/07_03_2013_Fernw%C3%A4rmepreise.html

20 Finnish Competition and Consumer Authority, FCA closes its investigations on the district heating sector for now, http://www.kkv.fi/en/current-issues/press-releases/finnish-competition-authority/2012/16.1.2012-fca-closes-its-investigations-on-the-district-heating-sector-for-now/

network and where they are city-wide schemes. Price regulation frameworks impose a regulatory cost on networks through the administrative burden of preparing and analysing business plans and setting prices. Price regulation frameworks therefore tend to occur where networks are of a certain scale.

- **Transparent pricing of heat.** Some countries have created specific district heat related legislation. For example, Sweden's 2008 **District Heat Law** requires the transparent pricing of heat and contains requirements for contract conditions. It also set up a specific body to mediate in disputes between customers and suppliers.

- **Voluntary schemes** have also been adopted to help protect consumers. For example the "Fair District Heating" quality mark in Finland is a voluntary certification for district heat suppliers that prove they have open and customer-orientated operations. Suppliers of 63% of district heat customers are signed up to Finland's quality mark. Sweden's 'REKO' award is a similar scheme.

It is worth noting, however, that the competition concerns have not been completely overcome in our comparison countries. For example, the authorities in both Sweden and Germany have found some potential abuse of dominance. It is also the case that historically district heat suppliers were local government-led and usually operated on a not-for-profit basis, reducing the need to protect consumers against excessive pricing.

3.2 Existing UK action

Intervention in the UK to protect consumers from district heat monopolies is limited.

- The UK has a comprehensive competition regime overseen by the **Competition and Markets Authority (CMA)**. District heat falls within the CMA's remit. However, the CMA is not actively considering district heating at the moment following some work with the industry and the government earlier in the year.[21]

- The **2014 Heat Network (Metering and Billing) Regulations** requires suppliers to install meters on properties connected to their networks and issue bills to customers. The policy aims to improve bill transparency and give consumers better control over the cost of their heating.[22] This has

21 Email from the CMA, 10th November 2015.

22 http://www.legislation.gov.uk/uksi/2014/3120/pdfs/uksiem_20143120_en.pdf

international precedent from Sweden. A review of the UK water industry also found that metering can help to achieve fair billing for consumers.

- The recent 2015 **Heat Trust** is a voluntary scheme to encourage suppliers to sign up to meet certain standards for consumers, ranging from metering and billing to handling consumer complaints. It also established an industry led ombudsman which provides an independent complaints handling service for consumers who have exhausted the complaints process with their operator. The **Independent Complaint Handling Service** is operated by the same organisation that operates the Energy Ombudsman. The scheme, if effective, could address a number of consumer concerns around quality of service. At this stage it is not clear how many suppliers will sign-up or what effective sanctions the ombudsman has at its disposal.

Competition in the sector has also been supported by the practice of **tendering for district heat licences (Box 2).** Tenders may be released by councils or by individual developers. They can focus on discrete elements – such as constructing or operating the network – or can entail 'concession contracts' which award an exclusive licence to design, build, finance and operate the network.[23] However, tendering is unlikely to be sufficient by itself to maintain competition: it requires the body that is tendering to be able to prioritise consumers' best interests. This may not be possible in practice.

[23] Examples of local authorities tendering out 'concession contracts' include Birmingham City Council (BCC) who tendered for two "design, build, finance and operate" contracts for two district heat schemes. The tender was awarded to Cofely District Energy (CDE) on 25 year 'concession' contracts, giving CDE the exclusive right to the network for the contract period.

Box 2: Contract types

The GLA Heat Manual describes four commonly used types of contracts for heat networks.

- **Energy supply (ESCo).** An ESCo undertakes to build and operate a heat network to supply heat to consumers.
- **Wholesale supply of energy.** A sponsor appoints a single contractor to design, build, own, operate and supply wholesale heat and electricity. The sponsor retails the energy to consumers (and may be a consumer itself).
- **Network delivery and operation (DBO).** A sponsor appoints one or more contractors to design, build, operate and maintain a heat network. In this case, the sponsor remains the asset owner and contracts to supply heat and electricity to consumers. The sponsor may also purchase the fuel required.
- **Network operation (O&M).** An operator is contracted to run a heat network that has already been constructed, for example under a main building contract. The operator may also be contracted to undertake metering and billing and customers services.

Source: GLA (2013), *London Heat Network Manual*

3.3 What more is needed?

We have seen that intervention in the UK to protect consumers from natural monopoly is limited. We now consider four options for further intervention.

- active CMA oversight of the sector;
- price regulation framework;
- "light touch" regulation; and
- A consumer ombudsman.

Active CMA oversight of the sector

Assessment: SHORTLIST

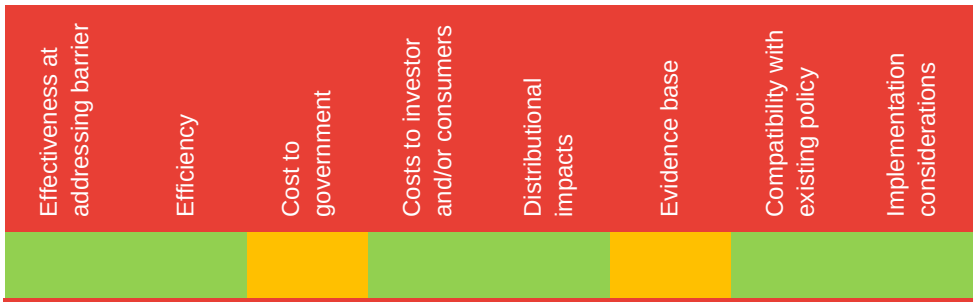
The CMA has oversight of all sectors in the UK and its responsibilities include conducting market studies and investigations in markets where there may be

competition and consumer problems.[24] As such the district heat sector already fits within the CMA's scope. The CMA has powers to investigate and prosecute district heat network operators where there are concerns about the abuse of market power.

Competition authority oversight, and the threat of ex-post investigations and subsequent proceedings provide a deterrent to networks abusing their market power, either through excessive pricing or poor quality of service to consumers.[25] Existing CMA oversight into the sector may be sufficient to overcome natural monopoly concerns in the UK district heat sector, especially in the short term as the relatively immature sector develops. However, as the sector grows, there may be an argument for the CMA taking a more active role than currently. Clarity on the CMA's proposed role in the sector going forward would also help reduce risks for investors.

CMA oversight of the sector should also be a cost-effective solution, with limited costs to the exchequer or other stakeholders within the sector. Given the CMA framework is already in place it is also easily implemented.

Figure 9. Assessment of CMA oversight



Source: Frontier Economics

Price regulation framework

Assessment: NOT SHORTLISTED

Price regulation frameworks can be adopted to protect consumers in the absence of sufficient competition within a market. A price regulation framework would involve district heat networks submitting detailed business plans to a regulator, including information on costs and revenues and potentially other metrics such as quality of service. The regulator would use this information to set a price control, ensuring the network could earn a sufficient return on its investment at

24 Competition and Markets Authority, About us, https://www.gov.uk/government/organisations/competition-and-markets-authority/about

25 Motta M (2004) *Competition policy: theory and practice*

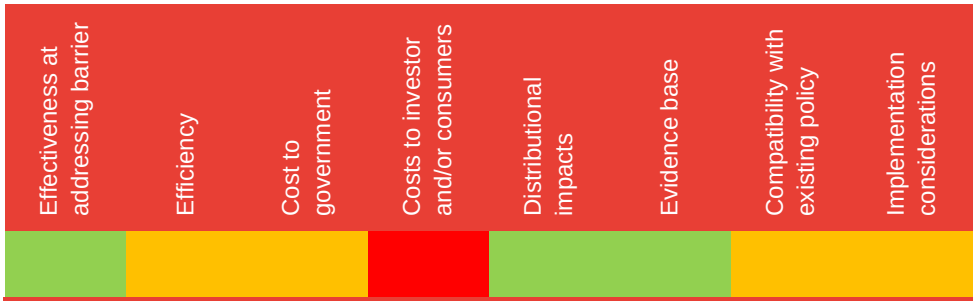
the same time as protecting consumers. Such a framework requires a certain "regulatory architecture" to operate successfully.

There is a precedent for network regulation in the UK energy sector, in particular within the electricity and gas distribution networks. Outside of the energy sector there is also price regulation in the telecoms, water and aviation industries. A price regulation framework is also seen in the district heat sector in Denmark and some eastern European countries.

However, price regulation frameworks would impose a regulatory cost on networks, because of the administrative burden of preparing the business plans and interacting with the regulator. There would also be administrative costs for the regulator associated with processing the business plans. Partly for this reason, price regulation frameworks tend to occur where networks are of a certain scale. District heat networks that are price regulated tend to be city-wide schemes, for example, Copenhagen in Denmark.

It is likely that the regulatory costs imposed by a price regulation framework are disproportionate to the current typical size of UK district heat networks. The resource cost to network operators would be high which may deter investors, or increase prices to heat network consumers as the costs of regulation are passed on. As the sector develops and networks become larger and serve an increasing share of the UK heat demand, the arguments for a more formal price regulation framework may become stronger.

Figure 10. Assessment of price regulation framework



Source: Frontier Economics

"Light touch" regulation

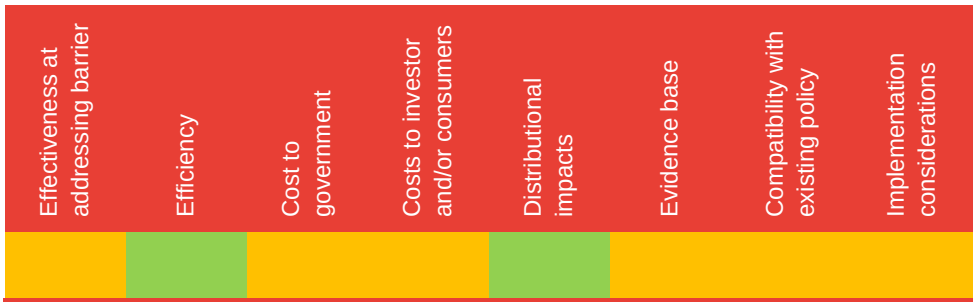
Assessment: NOT SHORTLISTED, BUT POTENTIAL FOR LONGER TERM ROLE

There are options for "light touch" price regulation that do not impose such high regulatory costs on smaller networks. For example, smaller independent electricity distribution networks in the UK are regulated with reference to larger networks (rather than solely on the basis of their own data), reducing the regulatory burden.

The effectiveness of such schemes is unclear but is highly dependent on the price formulas being constructed correctly and relies on sufficient expertise on both sides of the tendering process. There is a risk that a badly constructed price formula could result in inappropriate incentives for the network and poor outcomes for consumers.

While light touch regulation has the potential to be useful in the future, we do not recommend it at this stage. This is because of the implementation risks and the fact that CMA oversight is likely to be sufficient at this stage of market development. This does not preclude it being implemented at a local level on a case by case basis, as part of a tendering process for district heat licences.

Figure 11. Assessment of "light touch" regulation framework



Source: Frontier Economics

Consumer Ombudsman

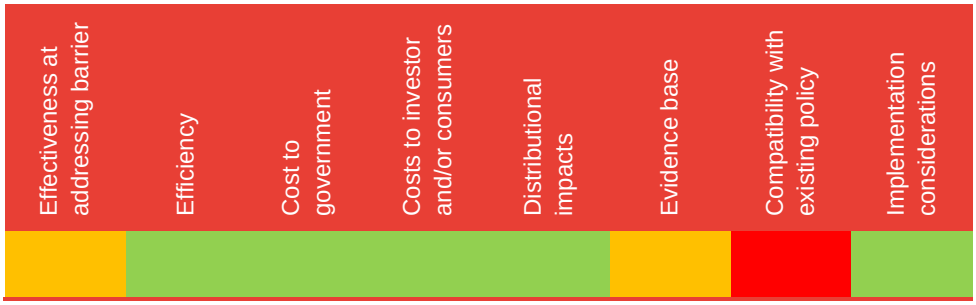
Assessment: NOT SHORTLISTED

An ombudsman is an independent person or organisation that can provide dispute resolution and oversee complaints between consumers and their suppliers. An ombudsman can play a valuable role in providing support and recourse for consumers, particularly against poor service from suppliers. Ombudsmen are common in the UK, including in the energy sector.

Recently, the Heat Trust has established an industry-led ombudsman, the *Independent Complaint Handling Service,* which provides an independent complaints handling service for consumers who have exhausted the complaints process with their operator. The service is operated by the same organisation that operates the Energy Ombudsman. Since the ombudsman is industry-led, and membership by network operators is voluntary, there are concerns around the sanctions it has open to it and its ability to enforce its findings. If these turned out to be justified, an alternative would be a government-appointed ombudsman with legal powers for enforcement. However, given this is a new development, it is not yet clear what its impact will be. Replacing it with a government ombudsman at this stage would be premature.

Natural monopoly

Figure 12. Assessment of consumer ombudsman



Source: Frontier Economics

4 Demand uncertainty

The high fixed costs of district can drive barriers to investors related to uncertainty around demand for heat. District heat networks are subject to economies of scale, which means that the viability of each scheme will be very sensitive to the level of demand secured. Element Energy's analysis illustrates this: in their modelling, cost-effectiveness is highly sensitive to the proportion of customer connected to a district heat scheme in each area.[26] Because of this, uncertainty over the demand expected on each scheme can increase investment risk.

In this section we consider how this barrier can be best overcome.

Summary

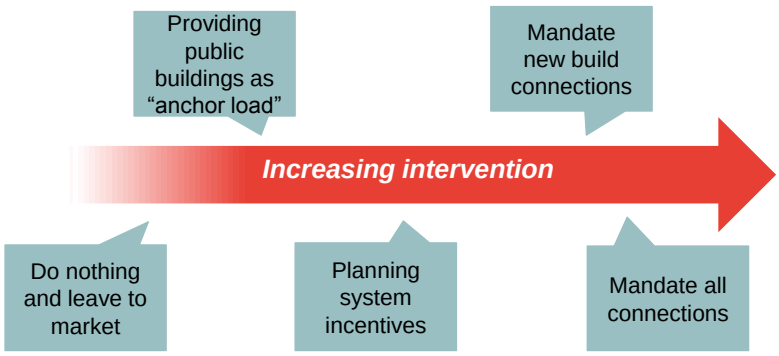
Requirements to address barriers	• Sufficient certainty of demand for investors to ensure scheme viability
Learning from elsewhere	• District heat "mandating zones" in Denmark • Use of the planning process (Sweden & Germany) • "Anchor" tenants
Current UK action	• London Plan • Building regulations
Gaps	• Long term stable policy framework
Policy recommendations	• Public bodies to adopt policy of connecting to district heat networks • Planning permission as a lever for new developments to connect to district heat networks

4.2 Learning from elsewhere

Figure 13 outlines options used to increase demand certainty, ranging from mandating all connections, to policies which ensure the provision of "anchor loads" to district heating schemes.

26 Element Energy refer to this as the "connection fraction".

Figure 13. Spectrum of policy options for increasing district heat demand certainty



Source: Frontier Economics

Examples of mandating "zones" can be seen in Denmark. New builds within the zones are required to connect to the network and existing buildings are given nine years within which to connect to the network. This period of nine years was aimed at reducing the resource cost as consumers would connect to the network once their boiler reached the end of its lifetime rather than being compelled to join sooner.

In contrast, Germany makes use of the planning process to encourage users onto district heat networks. Its Renewable Heat Law requires new buildings to use renewable energy to serve a certain share of its heat demand.[27] Long-term contracts which provide networks with a reasonably secure level of demand for the duration of the contract at least are also common in Germany. Indeed, the provision of these "anchor loads" of demand from leveraging public buildings and social housing appears to be an important feature of other international experience.

Sweden also makes use of the planning process through an obligation on the buyers of public land that requires them to connect to a district heat network. The Netherlands makes use of its rental regulation to support district heat networks and help overcome misaligned incentives between landlords and tenants. Landlords are able to increase rent if they connect a property to a district heat network, on the basis that this should lead to lower heating bills for their tenants.

27 There are exemptions for buildings connected to district heat with high-efficiency CHP or renewables.

Box 3: Uptake in the absence of mandating

Roll out of district heat has been achieved in most countries, without mandating that consumers in existing properties take it up.

But what level of connection can be expected per scheme? Evidence on this is thin.

Element Energy assume a "connection fraction" (i.e. a proportion of customers taking up district heat in a given area) of 90% in their central scenario. This is based on evidence from Malmo in Sweden. No mandation was applied in this case, but roll out was accompanied by strong planning regulations on the reduction of primary energy for developers.

This is higher than the level of roll out of gas connections achieved in Northern Ireland after 14 years (49%).[28]

4.3 Existing UK action

Policy in this area is focussed on new build.[29]

- **The London Plan** requires developers to conduct a feasibility study over whether it can connect to a district heat network and, if it is, it should connect. If this is not plausible, then proposals should be developed to evaluate opportunities for site wide CHP systems and, where CHP systems are appropriate, for extending the system beyond site boundaries. In this case, developers should "future-proof" the development to facilitate connection to a district heat network at a later date. Through this approach, the London Plan helps provide a higher number of potential heat network users and can be considered "anchor tenants" providing developers with a base load from which they can attempt to connect other users.

- **General building regulations** require developers to meet certain energy efficiency standards in the most cost effective way they choose.[30,31] While

28 Competition Commission, Phoenix Natural Gas Limited price determination, November 2012, Table 4.1.

29 Annual new builds and renovations account for only around 1% of the total building stock. See for example: see for example the following Government statistics: https://www.gov.uk/government/statistical-data-sets/live-tables-on-dwelling-stock-including-vacants and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376588/House_Building_Release_-_Sept_Qtr_2014.pdf

30 For example, Part L of the Building Regulations relates to energy efficiency standards for new builds and renovations; covering window replacements, boiler installations and insulation measures. Part L in England was strengthened in 2010 with a 25% efficiency increase in terms of carbon emissions

such regulations are likely to increase the viability of district heat schemes (which are more energy efficient), their high fixed costs means that this policy alone is unlikely to make sufficient difference to the schemes viability, particularly for smaller-scale schemes.

- **Energy Efficiency Directive.** Under the EU Directive on Energy Efficiency, Member States are required to undertake a national comprehensive assessment, which includes an assessment of the potential for high-efficiency CHP and efficient district heating and cooling. DECC and the Devolved Administrations will be submitting the assessments to the Commission at the end of 2015. These will include assessments of national heating and cooling demand over the next 10 years, heating and cooling maps and maps of existing infrastructure. They will also identify cost-effective potential for heat networks and outline policies that could support deployment.

4.4 What more is needed?

We consider the following options aimed at reducing demand uncertainty:

- policy requiring public buildings to connect to district heating schemes in certain zones (Box 4),
- the use of planning permission as a lever for new developments to connect to district heat networks; and
- mandating of consumer connections.

compared to 2006, and again in 2013 with a 6% increase for new builds. Source: The CCC, 2014, Progress Report

31 The Scottish government has announced a 21% improvement on 2010 efficiency standards from October 2015. Wales has followed England and Northern Ireland is currently creating plans for future improvements.

Box 4: Local district heating zones

Throughout this document, we recommend policies that should only be applied in certain 'district heating zones.'

We define these zones as local areas in which district heat has been assessed as being likely to be cost-effective once the value of carbon has been taken into account.

Zones are likely to be a useful policy tool for district heat because of the high fixed costs associated with networks, and the resulting economies of scale. These economies of scale mean that concentrating district heating policies on securing uptake in defined zones may be more cost-effective than applying policy incentives at a national level.

Public bodies to adopt policy of connecting to district heat networks

Assessment: SHORTLIST

Public buildings generate a significant amount of heat demand that could provide an "anchor load" for schemes to help their overall financial viability. International experience suggests that a policy that required connection of such loads could be effective at increasing district heat uptake. This approach has also been recommended by the Scottish Expert Commission on District Heating.[32]

Applying this policy to defined district heat zones (where district heat has been assessed as a cost-effective option) would help reduce any potential distortions.

32 Expert Commission On District Heating (2012), *Recommendations to the Scottish Government* http://www.gov.scot/Resource/0040/00408383.pdf,

Demand uncertainty

Figure 14. Assessment of policy for public bodies to connecting to district heat networks

Source: Frontier Economics

Planning permission as a lever for new developments to connect to district heat networks

Assessment: LOW REGRET

Planning regulations can be used as a way of mandating new developments to connect to district heat networks where available, as illustrated by the measures in the London Plan.

Applying this policy within the local zones where district heat has been shown to be cost-effective, would help mitigate this risk.

Figure 15. Assessment of planning permission levers

Source: Frontier Economics

Mandate consumer connections

Assessment: NOT SHORTLISTED

Mandating consumers to connect to a district heat network would guarantee significant uptake. Again, to help ensure cost-effectiveness, this could be applied only within certain defined zones.

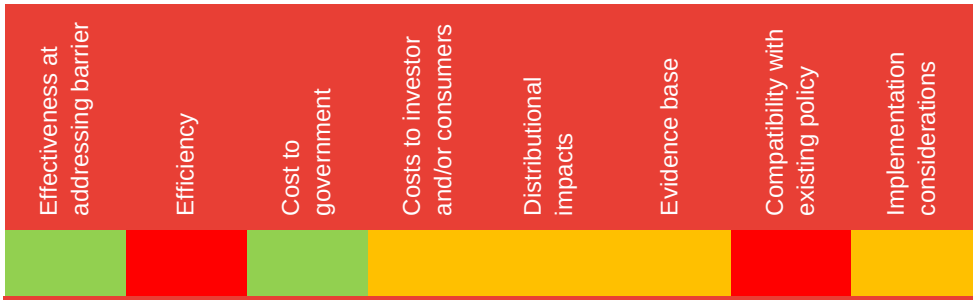
This policy could distinguish between new build and retrofit connections. New builds would be expected to connect straight away. Allowing a number of years

for retrofit customers to connect could lower the resource cost by allowing customers to connect when their existing heating system expired.

As discussed above, countries such as Germany and Sweden have developed successful district heat sectors without the need for mandating. Similarly, the roll out of natural gas networks in Northern Ireland (see Section 5) illustrates that maintaining consumer choice is possible, even when the new solution is dependent on gaining a critical mass of customers before it can become financially viable.

Overall, this policy would remove choice from consumers and could result in levels of uptake that are not cost-effective. Since there are examples of countries that have rolled out successful district heat sectors without mandating, we do not consider it is necessarily in this case.

Figure 16. Assessment of mandating connections



Source: Frontier Economics

5 Policy as a barrier

There is already a high degree of policy intervention in the heating sector. This policy has multiple aims, including around fuel poverty and support of renewable energy, and support of the low-carbon transition. There are sometimes trade-offs between these aims, and policy priorities can shift over time. In this environment, three types of barriers can affect district heat.

- **Policy uncertainty.** District heat investments are highly capital-intense and have long asset lives. The long asset lives, combined with the high degree of policy intervention, can increase the risks for investors.

- **Policy conflicts.** Policies with different aims (e.g. to incentivise renewable heating) or policies applied to only certain sectors (e.g. the EU ETS) may reduce the incentive to invest in district heat.

- **Policy-created entry barriers**. Regulation can create barriers. For example, restrictive planning policies can make it difficult to gain permission to install a network or heat source, and then to install it. Local authorities and boroughs do not have the statutory powers to put in pipes under roads and houses, unlike utility companies.

This section explores how these barriers can be addressed.

Summary

Requirements to address barriers	• Long-term stable policy environment • Avoidance of policy conflicts and policy-created barriers
Learning from elsewhere	• Long-term, credible policy commitments • Framework to protect operators from government-created risk • Supportive planning laws • Integrated planning
Current UK action	• 2013 Low Carbon Heat Strategy • Licence Lite • Scottish District Heating targets • Regulations over waste heat • National Planning Policy Framework
Gaps	• Long-term stable policy environment
Policy recommendations	• District heat strategy, with allocated responsibility • Future proofing • Zonal area with no financial incentives for other heat sources • Providing district heat networks the same status as utility companies in planning

5.2 Learning from elsewhere

Internationally, district heat roll out has tended to be accompanied by a large role for local government complemented by sustained policy support from national government.

Two examples of UK policy from other sectors are also helpful to consider.

- The experience of the roll-out of natural gas in Northern Ireland highlights how long-term policy commitments can be used to support the roll-out of new networks. The successful roll-out was supported by a long-term strategy adopted by Phoenix gas (the regulated gas company, which was licensed to transmit, distribute and supply gas in 1996), UReg (the regulator), and DETI (the government). This strategy provided a long-term commitment to roll

out, both by providing a licence to the regulated monopoly, as well as supporting investment by the regulated monopoly through regulation. [33]

- In the UK electricity generation market, the system of contracts for differences aims to reduce revenue risks for generators. Electricity generation is subject to a high degree of policy uncertainty that can discourage investors. Therefore the system was developed which essentially re-allocated risk away from generators by by reducing their exposure to volatile wholesale prices.

- There are also some examples of specific policies focussed at reducing barriers associated with the planning process. For example, the Finnish Electricity Market Act (2004) lightened the licencing requirements to build power plants, including CHP. The 1979 Heat Law in Denmark introduced a planning process around heat supply which supports district heat.

5.3 Existing UK action

DECC published a strategy for low-carbon heating in the UK which covered district heat in 2013.[34] It was supported by a number of policies aimed at district heating such as the Heat Networks Development Unit (HNDU) and the heat metering and billing regulations.

There are examples of policies that aim to facilitate "future proofing" in the face of uncertainty. For example, The London Plan requires that developers should conduct a district heat feasibility study.[35] Where it is considered feasible but there are no firm plans in place for a network, developers have to "future-proof" the development to facilitate connection to a district heat network at a later date.[36] By facilitating the future expansion of networks, this can create option value. This approach can be particularly important for heat networks, given the economies

33 Northern Ireland Authority for Energy Regulation (2005), Consultation Paper, The *Proposed Acquisition of East Surrey Holdings plc by Kellen Acquisitions Limited – Implications for Phoenix Natural Gas Limited*

34 DECC (2013), The *Future of Heating: Meeting the challenge*

35 GLA (2014) *Energy Master Plan*

36 Examples of future proofing for district heat includes providing "tees" and isolation valves in new developments, reserving space for the heat exchanger, provision in the building fabric and ensuring external buried pipe work connects to nearby roads or a similar location to ensure an easy connection to a future heat network.

of scale associated with their development.[37] The GLA manual supports the London Plan by providing guidance for meeting these requirements.

Planning policy can also create barriers to district heat. Our expert interviews indicated cases where district heat networks found it difficult to get permission to dig up roads to install or maintain their network. There are a number of measures in place.

- **National Planning Policy Framework.** Local authorities are encouraged to consider low-carbon and renewable heat networks through the National Planning Policy Framework.[38] The framework requires local planning authorities to identify opportunities for development that can draw their energy supply from decentralised, renewable or low-carbon energy supply systems. It also looks for co-location of potential heat customers and suppliers. It does this through requirements to develop supportive policies and strategies and to have a 'presumption in favour' of low-carbon developments. This aims to overcome restrictive planning policies.

- **Scottish District Heat targets.** The Expert Commission on District Heat in Scotland has altered planning regulations to help district heat schemes. It requires that developments should consider district heat and provides guidance to planners on how to do this. However, it does not go as far as having a "presumption in favour" of district heat within planning and requiring an explanation for not connecting to district heat, as they do in Denmark.

- **Licence Lite** helps small suppliers sell their electricity into the market. It lets a small supplier partner with an existing larger supplier to be responsible for some of the more costly and technically challenging parts of a supply licence. It can help gas CHP district heat schemes sell their electricity improving the financial viability of schemes. This has had a positive response from generators to date, and could encourage new generators by marginally helping schemes be viable. On the other hand, some stakeholders have expressed the view that Licence Lite makes it more challenging for electricity distribution networks to plan the development of their networks and that it could have wider implications on the electricity sector.

37 iBUILD/Leeds (2014), *Economic evaluation of systems of infrastructure provision: concepts, approaches, methods*. This study includes presents three case studies (Islington, Leeds and Aberdeen) that illustrate how option value can be created.

38 DCLG (2012), *National Planning Policy Framework*

Box 5: Links to energy efficiency policy

Element Energy's analysis describes some of the interactions that district heating can have with energy efficiency policy.

Energy efficiency measures reduce the density of heat demand. This can impact negatively on the viabiltiy of district heating networks, due to their high fixed costs and associated economies of scale.

However, a more energy efficient building stock can also allow lower temperature heat networks to be used. These low temperature networks are generally expensive as buildings can require retrofitting with new larger emitters (e.g. large radiators, or under floor heating). However, very efficient buildings may not require new emitters to work with low temperature networks. Therefore, energy efficiency may help these types of networks to be cost-effective[39].

5.4 What more is needed?

We now consider policies to fill the remaining gaps and overcome policy driven barriers.

District heat strategy

Assessment: LOW REGRET

A district heat strategy could set out clear objective for the district heat sector in the UK. This would need to be supported by a coherent set of consistent policies to help achieve this aim. Given the wide range of barriers, a government strategy can help coordinate the sector and focus attention on achieving the objective for district heat in the UK. Further, a government strategy can help reduce policy uncertainty by making a commitment to the sector.

The strategy could also help align local and national objectives. Stakeholder interviews indicated that there is a perception that national heating policy is focussed on decarbonising the sector, while local policy focusses more on fuel poverty and regeneration.

39 Element Energy (2015), *Research on district heating and local approaches to heat decarbonisation*, p. 79

Figure 17. Assessment of district heat strategy

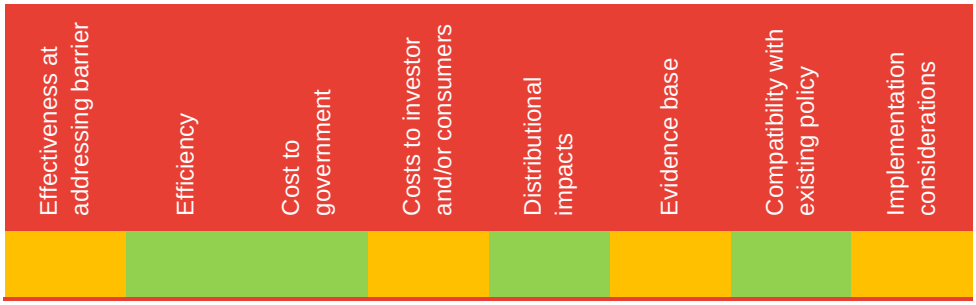
Source: Frontier Economics

Future proofing measures

Assessment: LOW REGRET

The policy of future proofing followed in the London Plan could help mitigate the impact of policy uncertainty. This policy would impose some additional costs on housing developers although the costs are likely to be relatively modest. Therefore policy should only be applied in zones where district heat has been identified as having the potential to be cost-effective.

Figure 18. Assessment of future proofing measures



Source: Frontier Economics

Zonal area with no financial incentives for other household-scale heat sources

Assessment: SHORTLIST

The Renewable Heat Incentive provides a financial incentive to support renewable heat. This may support substitute heat sources at the expense of district heat. For example, accounts from the expert interviews suggest that the RHI has encouraged schools and other public buildings to adopt a biomass boiler on-site, rather than, for example, providing the anchor load to a district heat scheme.

Policy as a barrier

The high fixed costs of district heat networks means that high take up of any given scheme is required to ensure viability. It makes sense therefore to ensure that customers are not being subsidised to take up alternatives to district heating, within a district heating zone.

One solution to this would be to create zones in areas where district heat has been assessed as being potentially cost-effective, in which alternative low-carbon household-scale heat sources (such as heat pumps) are not eligible for financial incentives.

Figure 19. Assessment of zones with no non-district heat financial incentives

Source: Frontier Economics

Providing district heat networks the same status as utility companies in planning

Assessment: LOW REGRET

Most utility companies are "statutory undertakers", meaning they have the right to carry out works under public streets relating to their network,[40] subject to being awarded a permit for the specific works.

District heat networks do not have such rights to install and maintain their networks and this can create delays and difficulties. Expert interviews provides a mixed picture of whether this is a significant barrier. It largely depends on geography and the level of local government support.

However, awarding statutory undertaking status to district heat network operators would put district heat networks on a level playing field with competing heating options. Additional costs would be limited mainly to the congestion costs associated with traffic disruption (some of which may be incurred anyway, if alternative heating systems were being installed). Therefore, we recommend it as a low regret policy.

40 https://www.gov.uk/government/publications/street-works-faq

Figure 20. Assessment of giving district heat utility status

Source: Frontier Economics

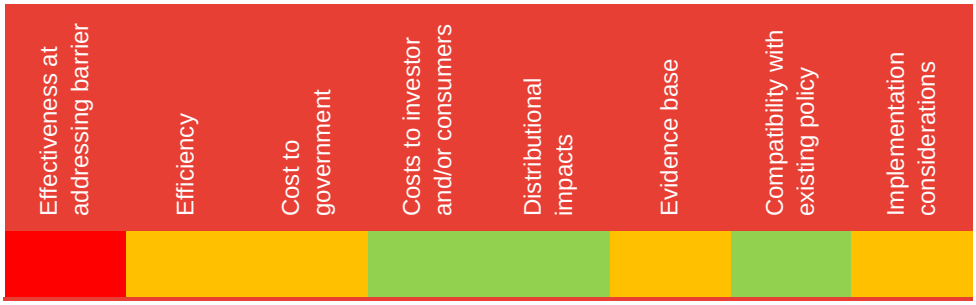
Loan guarantees

Assessment: NOT SHORTLISTED

A loan guarantee is a potential policy solution for overcoming barriers associated with policy uncertainty. The national or local government would guarantee the loan of the investor meaning they would assume the debt obligation if the investor defaulted. This guarantee makes it easier for investors to raise finance as they are considered less risky by capital markets.

However, we have found limited evidence that district heat investors are credit constrained. In general, schemes have tended to be able to secure finance providing they are financially viable and well-designed. This suggests a policy such as this is not necessary.

Figure 21. Assessment of loan guarantees



Source: Frontier Economics

Policy as a barrier

6 Consumer barriers

Consumer barriers are likely to slow the uptake of district heat. Awareness of district heat is low. DECC research found that only 15% of the public had heard of district heating.[41] Even where people are aware, they may lack of interest. Lack of trust, the perceived hassle of connecting to a district heat network, and perceptions of poor quality need to be tackled . For example, research for DECC found that gas condensing boilers were perceived most positively out of heating systems (80% of participants had positive perceptions, compared to 34% for heat networks), and reasons for this included their familiarity.[42]

In addition there are likely to be concerns around the cost of connecting and using a heat network. These may relate to the cost of connections; potentially high or unfair pricing; the transparency of billing; concerns about quality both in terms of the poor performance of the heat network and the level of service provided by their supplier.

These barriers are likely to apply to domestic consumers and SMEs, as non-energy intensive organisations.

In this section, we consider how these barriers could be overcome. Due to a lack of evidence, we do not cover best practice from elsewhere in this section.

41 DECC (2015), *Public attitudes tracking survey: wave 13*

42 DECC (2013), *Homeowners' Willingness to Take up More Efficient Heating Systems*

Summary

Requirements to address barrier	• Sufficient consumer protection • Sufficient information to help consumers overcome perceived risk
Current UK action	• Heat Trust • Resources (code of practice, manuals, quality assurance schemes) • Metering and billing regulation • Scottish district heating targets
Gaps	• Certainty of regulatory framework going forward • Measures to increase awareness and reputation of district heat – both locally and nationally
Policy recommendations	• Localised approaches to tackle consumer non-financial barriers

6.2 Existing UK action

There are a number of measures in place to increase awareness and confidence.

- Measures to increase confidence.
  - The 2015 **Heat Trust** and the **Heat Network (Metering and Billing) Regulations** – are outlined in Section 3.
  - There are a number of voluntary schemes, such as the **Heat Network Code of Practice** and the **CHP Quality Assurance** scheme[43], that aim to increase the quality of heat networks. These may improve the technical quality of district heat networks which may help with consumers' perception of quality.
- Measures to increase awareness.
  - **Scottish district heat targets.** In 2014 the Scottish government announced the overall target of 1.5 TWh of heat a year to be delivered to homes, businesses and public sector buildings by 2020. This includes

43 More detail on these schemes is provided in Section 3.

40,000 homes to be supplied with affordable low-carbon heat through heat networks by 2020.[44] The targets were also supported by Scottish district heat strategy that sets out the next steps the government are taking. These targets may increase awareness amongst consumers to some extent.

6.3 What more is needed?

This section considers two policy options to address consumer barriers to the uptake of district heat:

- localised approaches to tackle consumer non-financial barriers; and
- planning permission as lever for existing developments to connect to district heat networks.

Localised approaches to tackle consumer non-financial barriers

Assessment: LOW REGRET

Raising awareness may be most effective at a local, or scheme level. Expert interviews with district heat suppliers suggested that face-to-face engagement with consumers is both key to raising awareness and overcoming concerns. Appendix 2 describes in more detail localised approaches can be effective at helping to address consumer non-financial barriers. They may include personalised approaches and initiatives to create social norms and encourage word-of-mouth endorsements. There are a number of existing localised approaches, including policies aimed at overcoming consumer non-financial barriers to other types of low-carbon heating technologies including *Ham and Petersham Low Carbon Zone* and *Stroud District Council: Target 2050 Homes*. These may be adapted to encourage consumers to consider low-carbon technologies such as district heat.

Such approaches can be delivered in a low-cost way and implemented in a fairly straightforward manner. For example, *Ham and Petersham Low Carbon Zones* spent on average £130,000 a year between 2009/10 and 2011/12.[45]

44 http://www.districtheatingscotland.com/content/leadership

45 http://www.richmond.gov.uk/ham___petersham_evaluation_report_final_oct_2013.pdf, p.16

Figure 22. Assessment of localised approaches to address consumer concerns

Source: Frontier Economics

Planning permission as lever for existing developments to connect to district heat networks

Assessment: NOT SHORTLISTED

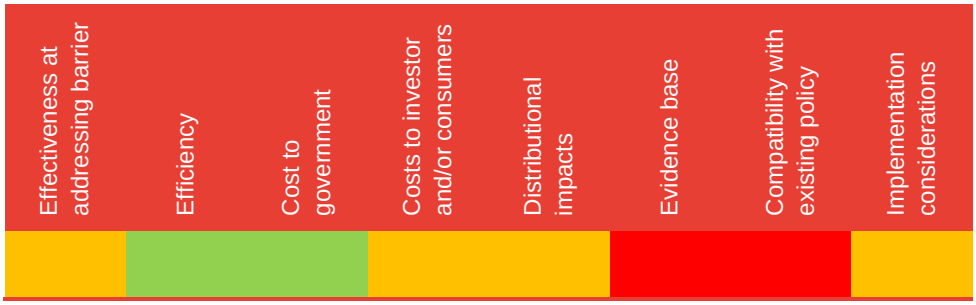
This policy would use planning permission as a lever for new developments to connect to district heat networks providing certain cost-effectiveness criteria were met. This policy would require home owners to consider joining a district heat network, if available, as part of their application for planning permission for development to their property. It would make sense to apply this policy only in the zones discussed under previous policies.

Requiring connection to a district heat network as a condition to granting planning permission would in effect bypass consumer non-financial barriers and could potentially achieve an uptake in connections to district heat networks. It could also reduce the perceived hassle (given the hassle associated with building works anyway) and would target them at an important trigger point (renovation).

Exemptions could be made for when connection was not cost-effective, though there may be significant transaction costs associated with applying for exemptions.

Overall, we do not recommend this policy. It removes consumer choice; transaction costs may be high; and it is also unlikely to be unnecessary if other local zone policies are adopted.

Figure 23. Assessment of planning permission lever for existing developments to connect to district heat networks



Source: Frontier Economics

7 Institutional issues

Our expert interviews identified that there may be barriers associated with overcoming institutional issues within the sector, in particular relating to constraints on local authority resources and more general skills and knowledge gaps within the sector. Existing research also highlighted issues in this area.

Ownership and coordination may also be an issue. There are multiple stakeholders with different objectives within the sector. Unclear responsibilities and coordination issues can result in barriers. This particularly affects the large scale, city-wide schemes that could result in the highest carbon savings and was an underlying theme from the expert interviews.

Summary

Requirements to address barrier	• Skills & knowledge within sector • Resources and capabilities to ensure LAs can facilitate district heat in their area • Coordination between stakeholders, and clarity over who is driving the process forward.
Learning from elsewhere	• Clear guidance from central government on responsibility for district heat
Current UK action	• Heat Networks Delivery Unit (England and Wales) and Heat Networks Partnership (Scotland) • London and National Heat maps • The Heat Network Code of Practice • CHP Quality Assurance • GLA Heat Manual • District Energy Procurement Agency
Gaps	• Overall strategy for sector, with allocation of responsibility • Measures to support later stages of project development • Measures to build internal capabilities within LAs • Measures to increase wider access to expertise in the sector
Policy recommendations	• National district heat target with allocation of responsibility • Targeted support for LAs

Institutional issues

	• Accredited list of technical experts

7.2 Lessons from elsewhere

District heat networks that have been successfully rolled out in other countries have almost always been led by local, or municipal, government.

There are a number of reasons why local government is well suited to this role. First, they are well suited to the long-term approach required by district heat. Second, local government can help secure "anchor load" demand through its public buildings and social housing. Third, it can coordinate with other stakeholders, such as house builders, to help overcome a lack of integrated planning. This can help reduce policy uncertainty and other policy distortions.

The role of local government was very important in **Denmark**. Since the First Heat Supply Law in 1979,[46] local authorities have had a central role in energy policy. They were required to prepare reports on heating requirements, methods and energy consumption and forecast future heat demand. County councils then used this information to write regional heat plans which included outlining the areas in which the various forms of heat supply should be prioritised and where future heat supply installations and pipes should be located.

Since 1982, local authorities and municipal governments have had the power to oblige new and existing buildings to connect to district heat networks and local authorities make the final decisions regarding heat planning and expansion.

More recently, local government involvement in the operation of district heat networks has remained strong. Municipality owned networks serve 80% of district heat demand, although this is skewed by the two state-owned commercial companies that serve 60% of the market.

In **Sweden**, the building of district heat networks was initially organised by municipal administrations, though compared to Denmark, a more decentralised approach was taken.[47] Municipalities were already responsible for other network utilities (electricity, sewage, water) and owned many public buildings that needed heating. These buildings provided a large initial customer base of schools, hospitals and municipal housing.

The Swedish government has passed various laws clarifying the role of municipalities in implementing district heating. Since 1991, municipalities have been required to have an energy plan detailing supply, distribution and use of energy and its environmental, health and natural impacts. However, by 2006,

46 Danish Energy Authority (2005), *Heat Supply in Denmark: Who What Where and - Why* ?

47 RESH-policy (2009), *Introduction and development of the Swedish district heating systems: Critical factors and lessons learned*

27% of municipalities still lacked an energy plan and there is mixed evidence that the policy has been effective. The decentralised nature of the approach may have contributed to the lower level of effectiveness when compared to the Danish approach, though it is difficult to attribute differences in effectiveness to any one factor.

More recently, the municipalities' direct role has declined as the ownership of district heat networks has been separated into independent companies, some of which have been sold to national and international energy suppliers. As of 2009, municipal energy companies accounted for 58% of district heating supplies, and national or international for 39%. However, even where they no longer own the networks, they still play a supportive role as they have control over land-use planning which they can use to support the sector.

7.3 Existing UK action

The lack of skills and knowledge internally within local authorities was seen to be challenging for the development of the sector in two ways in our stakeholder interviews. First, without it they are unlikely to be able to act as the local "champion" for district heat and help coordinate the sector. Second, it will make directly commissioning district heat networks more challenging.

The extent to which there is a district heat "champion" varies significantly by area or region, and between local authorities. However, there is no current policy aimed at addressing this.

- The Greater London Authority (GLA) has shown strong leadership on district heat. The London Plan provides guidance and direction. This is further supplemented by the GLA district heat manual.[48]

- The Scottish government have also shown leadership of district heat within Scotland. They commissioned the Expert Commission on District Heating in 2013[49] and have subsequently implemented the Heat Network Partnership, increased funding for the District Heating Loan Fund and published targets for district heating.

In terms of a more general lack of skills within the sector, the expert interviews highlighted that there was a lack of suitable consultants with practical experience of designing and implementing district heat networks and that this situation has

48 GLA (2013), *London Heat Network Manual*

49 Expert Commission on District Heating (2012), *Recommendations to the Scottish Government*

changed little over the last ten years. There are a number of existing policies in the UK aimed at overcoming the skills and knowledge gap within the sector.

- The **Heat Networks Delivery Unit** (HNDU) in England and Wales, and its equivalent in Scotland, the **Heat Networks Partnership** (HNP), are more active policies. The HNDU, launched in 2013, provides local authorities with funding and access to a centralised pool of specialist district heat experts with technical and commercial capabilities. Our expert interviews suggest that feedback from local authorities has been positive about this scheme. DECC estimates that the HNDU has supported 180 unique projects across 115 local authorities including £9.7 million of grant funding since the policies inception.[50] Our expert interviews highlighted feedback that suggests the HNDU has been most successful at overcoming barriers in the earlier design stages of a project development, for example in conducting feasibility studies and heat mapping. However, it appears further support is required later on in the process, with contracting and procurement for example. Some also raised concerns about whether being able to access the central pool of expertise reduces the incentive on local authorities developing their own internal capabilities.

- The **HNP** has a slightly different design to the HNDU. It provides a forum for collaboration between a number of different parties (Scottish Government agencies, business and industry) to provide co-ordinated support for district heating and help to bring together best practice, guidance and knowledge-sharing. The aim is that the HNP will provide more integration and coordination across areas. The HNP's collaborative design partly reflects Scotland's size so may not translate well to the UK as a whole. The expert interviews provided anecdotal evidence that this collaborative approach was working well and that such knowledge-sharing was having a positive impact on the sector.

- The **Heat Network Code of Practice** is a voluntary industry scheme that aims to improve the quality of heat networks. It sets out objectives and minimum requirements for each stage of the development of a heat network, including feasibility, design, construction and installation commissioning, operation and maintenance, customer expectations and obligations. These standards can be included in the tendering process. This makes things easier for those commissioning the project, and at the same time ensure that projects meet a certain standard.

50 DECC Heat networks delivery support, https://www.gov.uk/heat-networks-delivery-support

- **The District Heating Procurement Agency** is currently being developed, by the Association of Greater Manchester Authorities, with seed funding from DECC. This aims to help local authorities with procurement, which the backers of the scheme say can cost from 4% to 10% of project capex. Based on a Swedish model, it aims to develop specialist procurement expertise and market knowledge, and a move towards greater contractual standardisation.

- The **CHP Quality Assurance Scheme** is a voluntary scheme which enables projects classified as "high quality" to become eligible for a number of government financial incentives such as enhanced capital allowances and climate change levy exemption. The scheme aims to ensure high quality heat generation and so it doesn't consider either network design or more consumer-facing aspects of quality.

Targets

Given how recent the Scottish district heating targets were set it is hard to tell how effective they will be. However, initial indications from expert interviews suggest that it has increased the profile of district heat and moved it up the policy agenda, in particular within local authorities. These targets are not however binding which may reduce their impact.

Binding targets can be set that still allow a degree of flexibility to respond to changes in external factors. For example, Government sets carbon budgets limiting greenhouse gas emissions, based on advice from the CCC. These can be altered only if there have been "significant changes" since the decision was made. Significant changes could include changes in the scientific evidence on climate change, in fiscal or economic circumstances, or international progress to tackle climate change.[51]

Elsewhere, the Bank of England's inflation target is a good example of an effective target with accountability. The Governor of the Bank is required to write to the Chancellor if the Bank does not meet its monthly target. However, the target also acknowledges that external factors can cause the target to be missed.

7.4 What more is needed?

This section considers three potential solutions.

- national district heat target;

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51 Climate Change Act, 2008 http://www.legislation.gov.uk/ukpga/2008/27/section/21 and http://www.legislation.gov.uk/ukpga/2008/27/section/10

- targeted support for LAs;
- local centre of expertise; and
- accredited list of technical experts.

National district heat target with allocation of responsibility

Assessment: LOW REGRET

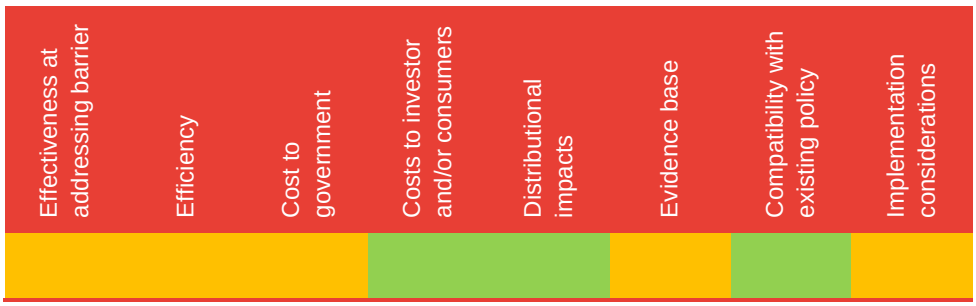
A district heat target could increase the profile of district heat among both government and consumers. It could help coordinate the wide number of stakeholders in the sector, and galvanise and increase the ambition within the sector.

District heat targets are likely to be most effective if individuals or organisations are allocated responsibility for meeting them, and where there are effective sanctions or repercussions for not meeting them.

The main risk associated with setting a target is that it is not set at the correct level, and that it incentivises inefficient outcomes. For an optimal outcome, targets should reflect a cost-effective level of district heating.

A national target could be set by government reflecting the potential cost-effective level of district heating. Local zones would be allocated a share of the target. Within the local zones, accountability for meeting the target would be given to local authorities. Local authorities would then be required to demonstrate that they are on track to meet the targets. There would be sanctions for missing the targets, for example writing to government to explain the reasons why. This would provide a strong incentive to meet the target, at the same time as allowing flexibility to reflect changing circumstances.

Figure 24. Assessment of district heat targets



Source: Frontier Economics

Targeted support for LAs

Assessment: LOW REGRET

The HNDU, in England and Wales, and the HNP in Scotland, are the current policies aimed at providing targeted resources and support for LAs.

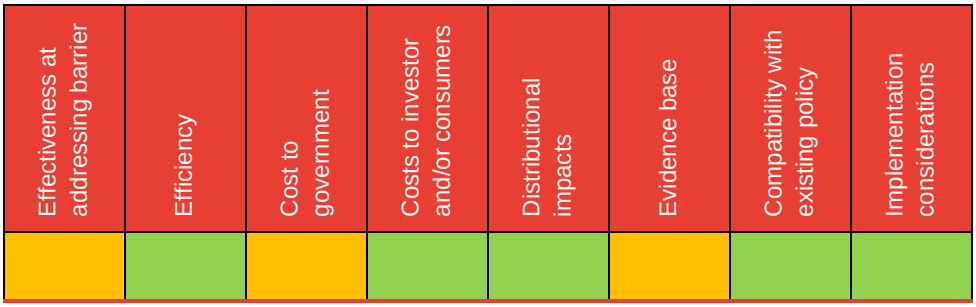
Feedback from the expert interviews suggests the HNDU is making a positive contribution. In particular, it has provided strong support in the initial stages of network development, for instance in conducting feasibility studies.

However, it could go further in providing additional support in later stages of development, for instance support with procurement. Other expert interviews considered the HNDU was providing widespread support for many local authorities to conduct feasibility studies, at the expense of sufficient in depth support. In addition, the HNDU has not always been successful at building internal capabilities within local authorities. This is important for the local authority to provide consistent support for the sector in future.

Because of this, an extension of the HDNU to provide local authorities with support in later stages of development and to help build internal capabilities would be welcomed.

The HNDU provided grant funding of £9m in addition to administrative costs. A policy like this would require funding.

Figure 25. Assessment of targeted support for LAs



Source: Frontier Economics

Local centre of expertise

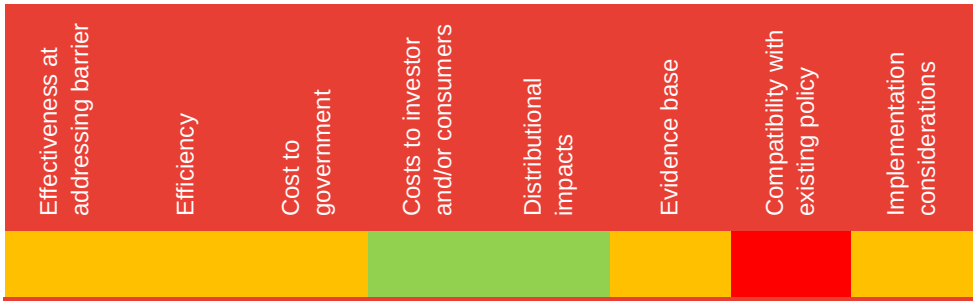
Assessment: NOT SHORTLISTED

The HNDU is an example of a national centre of expertise. Such a centre could also provide advice and support to the district heat sector at a local level, particularly to local authorities. For instance this may cover high level advice such as whether district heat is worth considering through to much more detailed help such as drafting tender documents for feasibility studies, reviewing outputs from external consultants or preparing legal documents.

However, it is not clear that a local centre would be any more effective than the HNDU which provides a national centre of expertise. As such, this policy may be

considered to replicate much of that work. Indeed, any remaining gaps of this type could be filled by adapting the HNDU's remit.

Figure 26. Assessment of local centre of expertise



Source: Frontier Economics

Accredited list of technical experts

Assessment: LOW REGRET

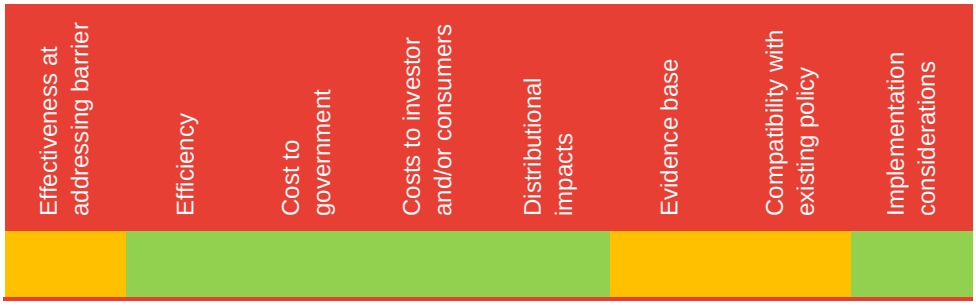
Local Authorities say that they find it challenging to find technical experts within the sector that have sufficient practical experience of how to develop, install and operate district heat networks. A government-sponsored accredited list of technical experts could help overcome this barrier. For example, the Micro Generation Certification Scheme runs a similar programme for other types of low-carbon heating technologies, such as heat pumps.[52]

Potential suppliers would apply to become accredited detailing their skillset (for example, financial or engineering etc.) and their experience. They would then be vetted before being approved and placed on the list.

This policy is likely to be associated with a modest cost. Therefore, we consider this policy a 'low regret' policy.

52 ttp://www.microgenerationcertification.org

Figure 27. Assessment of accredited list of technical experts



Source: Frontier Economics

9 Barriers associated with waste heat

Element Energy's analysis finds that the most cost-effective options for district heat involve waste heat.

- High temperature waste heat and energy from waste are the most cost-effective options at £53/MWh. These make a significant contribution. By 2030 in the Central scenario, high temperature waste heat provides 13% of heat to district heat networks, while energy from waste provides 9%.
- Low temperature waste heat plus a heat pump is the most cost-effective option in locations where high temperature waste heat and energy from are not available, at £74/MWh[53]. This provides 12% of heat to district heat networks by 2030 in the central scenario.

While these options are highly cost-effective, it may be difficult for investors to secure a supply of waste heat for their networks.

9.1.1 Learning from elsewhere

In Sweden there are regulations and taxes to incentivise energy from waste, and encourage the district heat sector. A ban on landfilling combustible waste has been in place since 2002, and waste that does go to landfill is taxed. By 2007, 46% of municipal solid waste was incinerated with energy recovery.

9.1.2 UK situation

There are UK policies aimed at encouraging the use of heat from waste.

- **Defra landfill regulations** support the use of waste incineration and require a cost-benefit analysis of connecting a waste incinerator to a district heating and cooling network.[54]
- EU and Defra **regulations over use of waste** - both heat and landfill - support district heating indirectly by ensuring planning policy supports the use of waste heat. In particular, Defra's *Waste Infrastructure Development* programme supported the creation of capacity to burn waste and create heat. There are examples of where this was possible including in Coventry, Nottingham and Sheffield.

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53 A heat pump is required to increase the temperature of the waste heat (40ºC) to the network temperature (80ºC), but the fuel spend remains low as the HP operates with a high efficiency between these temperatures.

54 *The Environmental Permitting (England and Wales) (Amendment) Regulations 2015*

9.1.3 Policy recommendations

Given the cost-effectiveness of waste heat, policies to facilitate wider use of waste may help deliver higher levels of district heat within the UK.

We consider two policies: producers of waste heat to publish information on their thermal heat output; and mandation of waste heat usage.

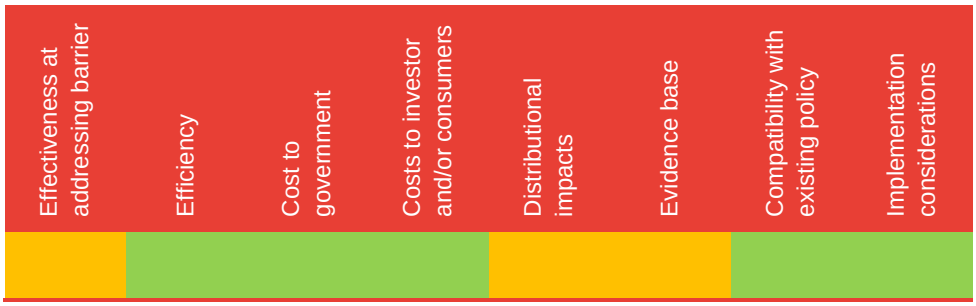
Producers of waste heat to publish information on their thermal heat output

Assessment: LOW REGRET

Information on waste heat produced is fairly limited. This makes it difficult for investors in potential district heat networks to identify suitable waste heat that could improve financial viability. A policy to require producers of waste heat to publish information on their thermal heat output would help address this.

This policy is likely to have only a marginal impact on the uptake of district heat. However, it is also likely to be a relatively low cost policy option. It would require a minimal resource cost to producers of waste heat to record and submit this information. To ensure the cost is not disproportionate it could apply to only heat sources over a certain size. It would also require an organisation to publish this information. Therefore, we consider it a 'no regrets' policy.

Figure 28. Assessment of published information on waste heat output



Source: Frontier Economics

Mandating use of waste heat

Assessment: NOT SHORTLISTED

This policy would require producers of waste heat to make available their waste heat to district heat networks at a cost-reflective price.

However, there are likely to be costs associated with making waste heat available. These would need to be assessed before mandating was introduced[55].

Figure 29. Assessment of mandating the use of waste heat

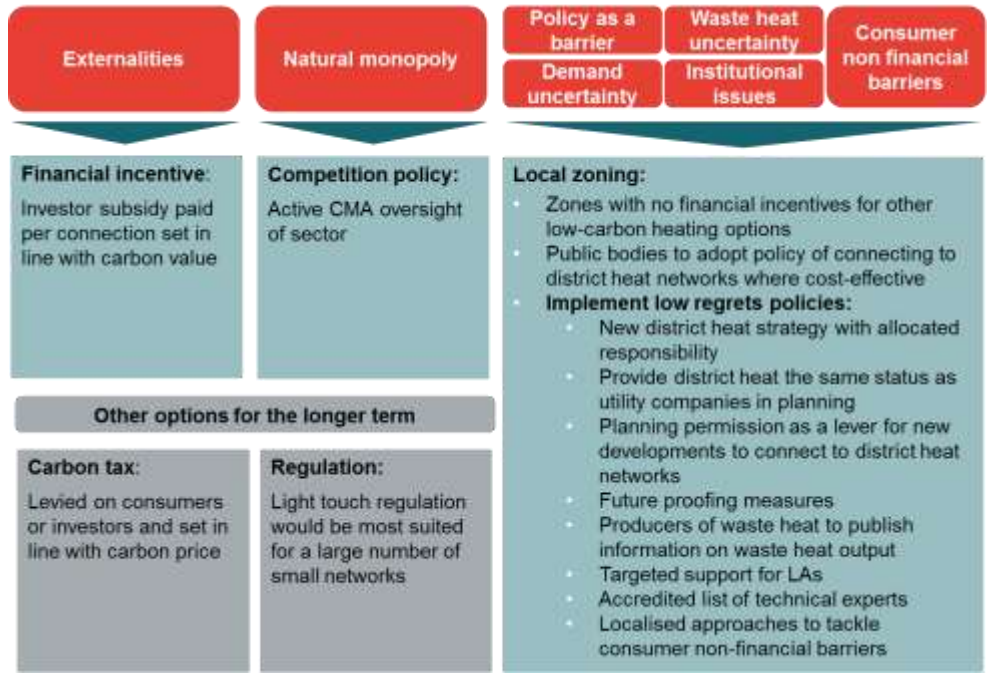
Source: Frontier Economics

55 This is in line with provisions under the EU Energy Efficiency Directive, that all new and refurbished thermal electricity generation plants must undertake a cost-benefit assessment of making heat available. DECC, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/413032/Energy_Efficiency_Directive_Update.pdf

10 Policy conclusions

This section outlines provides further detail on our policy recommendations. A high level summary of these recommendations is provided in Figure 30.

Figure 30. Summary of policy recommendations



Source: Frontier Economics

Further information on each of these is provided in Figure 31.

Figure 31. Further details on shortlisted policies

	CMA oversight of sector	Financial incentive	District heat zones	Public body connection
	Implementation			
1	This would involve a statement from the CMA outlining their proposed role, information on the scope, and how actively they intend to monitor the sector. This may involve coordination between the CMA, government and other relevant entities. It would then be up to the discretion of the CMA on whether they investigated the sector.	The policy would be applied nationally. To ensure the financial incentive is cost effective an assessment would be required on the 'average' life-time carbon savings of a connection to a district heat network, for different incumbent technologies. Further consideration would be given to whether the financial incentive would be 'tiered' based on the size and type of connection.	District heat zones would need to be identified based on those areas where district heat is likely to be most cost-effective. Cost-effectiveness could be assessed using archetypes and other typical characteristics, rather than assessing each area individually. Once identified, the zones would need to be communicated to the relevant stakeholders, including local authorities. This may involve a consultation process. It would make sense to enact these zones to match the timing of the introduction of the financial incentive.	This policy would only apply within the district heat zones identified. The policy would be designed so that public buildings were only required to connect to the district heat network if it proved to be cost-effective on a network level. This definition of cost-effective would mean the unit costs of the network would compare favourably to alternative technologies once the network was at capacity, or had a sufficiently high utilisation rate. In the transitionary period as the network approached this utilisation rate there may be additional transitional costs due to higher unit costs. It is likely a consultation process would be required, in addition to sufficient communication with the relevant public bodies to ensure they were aware and understood the policy.

	CMA oversight of sector	Financial incentive	District heat zones	Public body connection
	Timing			
2	CMA oversight of the sector is likely to be required indefinitely. Market reviews in the UK happen periodically and once one has happened, it is unlikely to be re-visited for a number of years. However, CMA oversight provides strong incentives on market participants. Depending on the development of the sector, CMA oversight of the sector may also be supplemented by price regulation in future years. This should be considered if there is a significant increase in large district heat networks in the UK, for which the regulatory burden is proportionate.	As the financial incentive corrects for a market failure by internalising the carbon savings of the schemes the policy should be available indefinitely. From a practical perspective, government commitment to the policy for a substantial period of time, such as ten years, would help minimise policy uncertainty.	In principal, the zones should remain indefinitely in order to prevent policy distortions. It is likely that the characteristics that make areas suitable to be a district heat zone would be relatively stable over time. As such, they are likely to be limited need to review the zones too often. However, practically, such a policy could be implemented for a set period of time – such as ten years – and then reviewed to assess its impact. There may be an argument for removing the zones once a step-change in district heat has been achieved in the UK.	The policy could be implemented for a set-period of time in order to help the district heat sector achieve a step-change increase in uptake. A time period of 10 to 15 years might be appropriate. After this point, and assuming the district heat sector is more mature, this policy may no longer be required in order for networks to generate sufficient demand to make schemes viable.

Policy conclusions

	CMA oversight of sector	Financial incentive	District heat zones	Public body connection
	Cost estimate			
3	The CMA receives an annual budget from the government to conduct its activities. Therefore, any potential investigation into the district heat sector in the future would be covered by these provisions.	In line with Element Energy's modelling, the incentive would need to be equivalent to a carbon value of £78/tCO2in 2030 and £333/tCO2in 2050.	This is a low-cost policy for the taxpayer. The preparatory work to identify the zones would involve some resource cost. It could be done on a more 'light-touch' basis relying on modelling. Alternatively, it could be conducted on a much more detailed scale, involving location visits and surveying. Once the zones were identified, the policy would be of limited ongoing cost.	The direct cost to the taxpayer would be very limited. Costs to public bodies could be limited by ensuring they pay the same or less for heat than under their previous arrangement.

Source: Frontier Economics

We have also identified a list of "low-regret" policies that we consider could produce benefits at a relatively low cost. We anticipate that these policies would apply within the district heat local zones. These policies are likely to complement the shortlist of policies described above.

- **A district heat strategy** covering both a national and a local level aims to address multiple barriers including policy uncertainty, policy distortions and ownership and coordination.

- **Future proofing measures** aims to overcome policy uncertainty and a lack of integrated planning.

- **District heat targets with allocated responsibility for meeting them** aims to address a lack of ownership and coordination within the sector. Local targets would be set, and responsibility for meeting them allocated to the local authority. The local authority would then be accountable to DECC and need to explain performance against their targets.

- **Supportive planning policy** aims to address policy distortions and overcome policy-created barriers.

- **Providing district heat the same status as utility companies in planning** aims to address policy distortions and make it easier to install and maintain networks.

- **Planning permission as a lever for new developments to connect to district heat networks** aims to address demand uncertainty. The requirement would apply within the local zones, with exemptions if a connection was shown to not be cost effective.

- **Targeted support for LAs** within the local zones aims to address barriers from a lack of local authority resources and expertise.

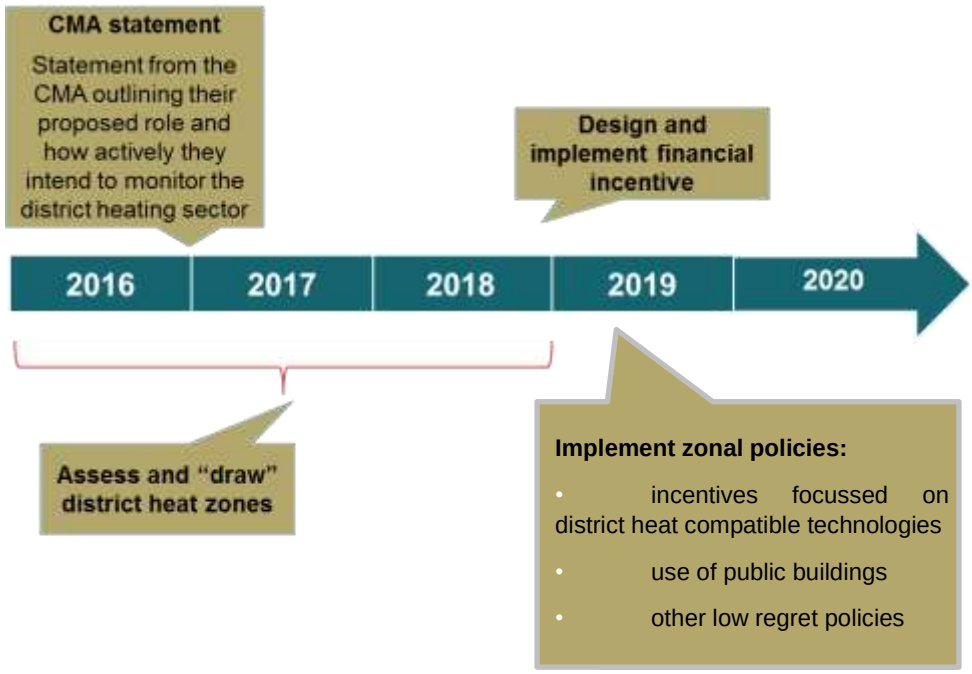
- **Accredited list of technical experts** aims to address the difficulty faced by local authorities and other stakeholders in finding suitable technical advisors.

- **Localised approaches to tackle consumer non-financial barriers** within the local zones aims to address consumer barriers which hinder retrofit connections to networks.

- **Producers of waste heat to publish information on waste heat output** aims to help district heat investors and developers identify sources of waste heat which could provide a low-cost heating source.

Figure 32 provides a high-level timeline for the implementation of the shortlisted and "low regret" measures.

Figure 32. High-level timeline for the implementation of shortlisted policy options



Source: Frontier Economics

11 Appendix 1: Decentralised approaches to tackling consumer non-financial barriers

This section looks beyond district heat to the full range of low-carbon interventions, including district heating, heat pumps and insulation.

Even when financial barriers to taking up these interventions have been overcome, non-financial barriers can constrain the uptake of low-carbon technologies. Some non-financial barriers relate primarily to the technical characteristics of the low-carbon heating interventions (for example, the additional space they take up, or noise that might be associated with them). **The focus of this section is on *consumer* non-financial barriers, defined here as those that are driven by the attitudes and perceptions of domestic consumers.**

11.1.1 Why look at local barriers?

Local approaches have several advantages that may allow them to more easily overcome non-financial barriers.

- People's attitudes and perceptions may be influenced by their friends and neighbours, for example through the creation of social norms.
- Approaches to overcome barriers can be tailored to the specific needs of the locality, taking into account demographic features, and features of the local housing stock.
- Information-intense approaches such as segmented communication may be easier to implement on a local basis. Local government may have more information on household characteristics and the building stock than national government.

This section reviews the evidence in this area.

- We first identify barriers related to consumer attitudes and perceptions.
- We then present a review of schemes from the literature.
- Finally, we discuss our conclusions on the key characteristics of successful local schemes.

11.1.2 Consumer non-financial barriers

We have identified five key attitudes and perceptions that may drive non-financial barriers (Figure 33).

Figure 33. Barriers relating to consumer attitudes and perceptions

Source: Frontier Economics

Attitudes

- **Lack of awareness.** Many consumers have low awareness of alternatives to either their current heating system or ways to improve heating efficiency. For example, over a third of those surveyed by DECC had not heard of air source heat pumps.[56] Even if they have heard of the technologies, a lack of familiarity can put people off. For example, research for DECC found that gas condensing boilers were perceived most positively (80% of participants had positive perceptions, compared to 34% for heat networks and 28% for air source heat pumps), and reasons for this included their familiarity.[57]

- **Lack of interest.** It is also difficult to gain consumers' interest in low-carbon heating technologies. For example, DECC research found that most consumers who had not replaced a heating system to date, had never considered doing so.[58] Looking at how heating systems are marketed also suggests that consumers see them as functional rather than aspirational items. In contrast to kitchens, which are marketed using phrases such as "buy the kitchen of your dreams", or "be inspired," boiler marketing tends

56 DECC (2015), *Public attitudes tracking survey: wave 13*

57 DECC (2013) *Homeowners' Willingness to Take up More Efficient Heating Systems*

58 DECC (2013) *Homeowners' Willingness to Take up More Efficient Heating Systems*

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to focus on finance, safety and efficiency. [59] This suggests that people do not tend to engage with a purchase of a new heating system in the same way as they may engage with the purchase of other major items of household expenditure.

- **Lack of trust.** Trust in energy companies has been low in recent years, with only 57% of the population trusting these companies to give them a fair deal.[60] Relationships with installers are also sometimes characterised by low levels of trust,[61] (though they can also be important sources of advice on new heating systems).[62] This lack of trust may make consumers less willing to take up discretionary improvements to their homes, such as insulation.

Perceptions

- **Perceived disruption and inconvenience.** The perceived disruption and inconvenience in switching to a new heat source or having a home insulated is likely to discourage consumers. For example, households may be put off by the thought of spending time contacting installers, taking deliveries, clearing and repairing their lofts to prepare for insulation.

- **Percieved lack of quality.** 90% of on-grid homeowners named gas boilers as their preferred measure in the future, while only 32% of consumers are confident that air source heat pumps will provide enough heat to warm their homes[63,64]. Additionally, the perception that low-carbon heating measures will change the aesthetics of their houses can be a deterrent.

11.1.3 How could local initiatives address these barriers?

This section assesses the evidence on local approaches to determine how effective they are.

Based on a review of the literature, we have:

- identified the barriers the schemes targeted;

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59 See for example: http://www.sainsburysenergy.com/products-and-services/boilers/new-boiler-fixed-price-quote.html, http://www.swaleheating.com/new-boiler-installation.aspx, http://www.markgroup.co.uk/homeowners/heating/boilers and http://www.ikea.com/gb/en/catalog/categories/departments/kitchen/, http://www.magnet.co.uk/, http://www.wickes.co.uk/Products/Kitchens/c/1000916).

60 DECC (2015), *Public attitudes tracking survey: wave 13*

61 Consumer Focus (2012), *What's in it for me? Using the benefits of energy efficiency to overcome the barriers*

62 DECC (2013) *Homeowners' Willingness to Take up More Efficient Heating Systems*

63 DECC (2015), *Public attitudes tracking survey: wave 13*

64 DECC (2013) *Homeowners' Willingness to Take up More Efficient Heating Systems*

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- assessed how effective the initiative was; and
- considered how transferable the scheme might be to other geographical areas or other technologies.

In assessing the effectiveness of each initiative, we drew on the available evidence from each scheme. This evidence varies in terms of its robustness for use in this context. For example, in most cases no control group has been used in the assessment. Often, only headline figures are reported. **Figure 34.** Figure 34 describes the rating system we have used to help determine the weight that should be given to each piece of evidence in the below discussion.

Figure 34. Rating system

Criteria	Description	
Data source	Primary (collected specifically on the scheme)	Source
	Secondary (based on other studies)	Source
Data sample	Large, representative sample	Sample
	Small, or unrepresentative sample	Sample
Data type	Experimental or observed	Data type
	Self-reported	Data type
Explanatory power	Robust quantitative analysis against a control group, or controlling for relevant factors	Explanatory power
	Summary statistics or self-reported statements and interview reports	Explanatory power

Source: Frontier Economics

In interpreting the evidence, it is also important to take account of the fact that many of the schemes used financial incentives alongside measures to tackle non-financial barriers. For example, the Kirklees WarmZone project offered free home insulation as well as a loft clearing and repairs service and a carbon

monoxide detector. This makes it difficult to identify from the success statistics the particular effect of the loft clearing and repair service. In these cases we have attempted to identify the success of the approach by looking at survey or interview reports from consumers.

11.1.4 Overview of evidence

Table 6 summarises the types of scheme we reviewed and the barriers they aimed to address.

Table 6. Overview of the evidence reviewed

Approach	Lack of interest/ awareness	Perceived disruption and inconvenience	Lack of trust	Perceptions of poor quality
Use local volunteers to promote program	✓			✓
Segmenting consumers/tailored marking material	✓			
Access to show homes			✓	✓
Initiatives to reduce 'hassle factor'		✓		
Visible local authority support			✓	
Set up a dedicated advice centre	✓		✓	✓
Provide comparative information on energy usage	✓			✓

Source: Frontier Economics

We now consider each of these in turn.

11.1.5 Use local volunteers to promote program

Hearing about a program through a trusted and impartial individual can address consumer lack of awareness and the perception that an alternative heating system may be of poor quality by making low-carbon heating systems the 'new normal'. This could be through a network of volunteers telling their neighbours about a

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project, children getting their parents involved or recommendations by a health or social care professional.

Ham and Petersham Low Carbon Zone

Source	Sample	Data type	Explanatory power

The Low Carbon Zone (LCZ) project was established in 2008 by the Greater London Authority and aimed to decarbonise London's housing stock, improve warmth ratings and include the community in these efforts.

As part of the Ham and Petersham Low Carbon Zone[65] project, local volunteers were recruited to act as 'Street Champions'. Street Champions would encourage their neighbours to sign up to the scheme and to take up energy efficiency measures, like installing draft excluders and hot water tank insulation jackets. They also provided valuable feedback to the council about the public's reaction to the project.

Which barriers did the scheme tackle?

There is some evidence that the scheme increased **interest and awareness** among consumers. For example, out of 3,750 households in the area targeted, 1,103 showed an interest by getting in contact with the project. Signing up to the project entitled participants to a Home Energy Assessment and free 'Eco Starter Kit'. Streets without a Street Champion had an average of 7.1 households sign up for the LCZ scheme. Streets with a Street Champion had an average 9.7 households sign up. We do not have the evidence to say whether or not these differences were statistically significant.

How effective was the scheme?

628 households received an assessment and 226 had 'secondary measures' installed (insulation, changing fuel type, a boiler with heating controls). This equates to 6% of households in the area (20% of those who showed an interest) making some kind of significant change.

This suggests that other barriers (like cost and inconvenience) still prevent people from instaling new measures, even once they have been made aware of their benefits.

How transferable is the scheme?

This scheme could be easily adapted to promote many different energy savings measures and could be used in different area types, though it would be most suitable for urban and suburban areas.

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65 Richmond Council (2014), *Ham and Petersham: Project Evaluation Report*. http://www.richmond.gov.uk/ham___petersham_evaluation_report_final_oct_2013.pdf

Energy Matters[66]

Source	Sample	Data type	Explanatory power

The Energy Matters programme attempted to involve parents by using children as a channel for information about energy efficiency. Energy Matters was an energy education programme conducted by the Centre for Sustainable Energy. As part of the programme, pupils completed a Home Energy Survey, analysed the data in the classroom and brought home energy efficiency recommendations.

Which barriers did the scheme tackle?

This scheme aimed to create new social norms, thereby encouraging interest and awareness, and overcoming lack of trust.

How effective was the scheme?

The scheme reported high interest in energy efficiency with 90% of parents reporting that they were now 'very interested' or 'fairly interested' in saving energy at home. However, it is not clear what the level of interest was pre-scheme.

Follow-up interviews suggested the scheme resulted in behavioural changes, as three-quarters of parents reported they made some energy efficiency savings such as turning off unused lights or controlling heating more carefully. The report noted that the level of behaviour changes was broadly consistent with typical professional sources of advice, such as from energy companies or energy efficiency advice centres.

There was also some evidence of an uptake energy efficiency measures. Follow-up interviews with parents found that 54% had installed energy efficiency measures following their children's involvement and 12% were planning to. The average amount spent was £543 per household. The most common measures were energy lamps (40%), energy efficient appliances (15%), draught-proofing (11%) and double glazing (10%). Based on the survey, it is not possible to determine what proportion of these measures would have occurred anyway. Few households installed the schemes delivering the greatest energy savings such as home insulation.

How transferable is the scheme?

This scheme would be applicable to many different areas, though would only target families with children of school age. The evidence suggests it may not help with more expensive low-carbon measures such as heat pumps and insulation.

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66 CSE (2003), *Energy Education Hitting Home: Monitoring the Impact of Energy Matters*, https://www.cse.org.uk/pdf/energy_education_hitting_home.pdf

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11.1.6 Segmenting consumers and tailored marketing

The lack of interest people show in heating interventions could be addressed by segmenting consumers based on identifiable characteristics and tailoring the marketing message they each receive to appeal to issues they might be interested in.

Newark and Sherwood Warmstreets[67]

Source	Sample	Data type	Explanatory power

The Newark and Sherwood Warmstreets project used this approach by first identifying houses that had not had insulation installed and then using a consumer database to identify customers who would prefer face-to-face contact. This subsample was then segmented into six 'types' according to likely tenure and green attitudes, and each group was sent an initial mailshot targeted to their customer type. For example, the letter to homeowners with an interest in green issues pointed out that insulation measures could add to the value of their property and help fight climate change.

Surveyors on the project then made home visits to conduct an energy survey of the house. These surveyors were given a more detailed breakdown of households into 22 types with advice about how to approach each. Most households targeted were eligible for free, or discounted, installation of insulation.

Which barriers did the scheme tackle?

This approach attempts to tackle the lack of interest barrier by focussing on the issues that a customer is most likely to care about.

How effective was the scheme?

Warmstreets reports that Newark and Sherwood has performed particularly well compared to other councils, with around nine home energy surveys a week carried out in Newark and Sherwood. They report that they observed a fourfold increase in properties signing up for home insulation in five months.[68] In addition, results from interviews with surveyors suggest that this was an effective method that made headway in areas of the district that had previously been difficult to reach.

How transferable is the scheme?

This approach would be transferable to other areas and other technology types.

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67 Newark and Sherwood District Council, *Warmstreets Customer Insight,* www.nottinghaminsight.org.uk/d/67578

68 However it is not clear whether this is statistically significant. Consumer Focus (2012), *What's in it for me? Using the benefits of energy efficiency to overcome the barriers* http://www.consumerfocus.org.uk/files/2012/06/Whats-in-it-for-me-IA.pdf, p.34

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What is the most effective channel to communicate with customers?

Finding the best way to contact customers is important to address the lack of awareness and interest that people show in low-carbon heating interventions.

- The RE:NEW scheme found that door knocking had a 73.9% success rate in getting people signed up to the scheme, compared with a 16.9% success rate for a letter drop. [69]
- A study by the Behavioural Insight Team into the effectiveness of offering a loft clearing service along with loft insulation found that 0.05% of customers who received a leaflet made further enquiries. This suggests that a mailshot marketing method can have limited effectiveness.[70]

Ham and Petersham Low Carbon Zone

Source	Sample	Data type	Explanatory power

Which barriers did the scheme tackle?

Showing people thermal images of their houses or neighbourhoods can overcome barriers associated with lack of interest by making the energy efficiency message both personal and tangible. Not only can they see how much heat is being lost and from where, they can see this for their own house. In this way the marketing message they receive is directly targeted towards them.

How effective was the scheme?

The Ham and Petersham Low Carbon Zone increased interest in energy efficient measures and resulted in a small increase in uptake of measures. Part of this impact is likely to be due to the thermal imaging. However, it is difficult to determine the specific impact of this aspect of the programme. Feedback from Street Champion volunteers suggested that showing people thermal images of their homes was very effective at engaging them with the project.

How transferable could this be?

Data protection laws may limit the extent to which this scheme could be widely applied. It also predominantly encourages insulation measures and so might not be easily adapted for new heating systems, like heat pumps or district heat.

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69 RE:NEW – Making London's homes more energy efficient https://www.london.gov.uk/priorities/environment/energy/re-new-home-energy-efficiency

70 DECC (2013), *Removing the hassle factor associated with loft insulation: Results of a behavioural trial*

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11.1.7 Access to show homes

Allowing the public access to low-carbon model homes can change perceptions about the effectiveness of measures as they can see for themselves that their homes could be made more comfortable without sacrificing its aesthetics. It may also raise awareness.

The SuperHomes project[71]

Source	Sample	Data type	Explanatory power

Which barrier does the scheme tackle?

The SuperHomes project attempts to tackle perceptions of poor quality and lack of trust. Householders who have reduced their carbon emissions by 60% through home refurbishments open their homes two or three times a year to show the public the results of their improvements. Such improvements include home insulation, biomass or condensing boilers, solar panels and heat pumps. This allows the public to feel for themselves the benefits of retrofitting their homes. The project also tackles the mistrust barrier as those promoting the measures have had them installed themselves and do not have a vested interest. People are given the opportunity to contact the installers who have retrofitted the SuperHomes and have been recommended for their work.

How effective was the scheme?

41% of visitors surveyed instaling energy saving measures within 2 years of visiting a SuperHome. Around 20% of visitors surveyed made significant improvements, spending £3,000 - £35,000 on the measures. However, it is not clear whether they would have made these investments anyway.

These results are based on primary data, taken from a 2014 survey of 78 visitors. Clearly this is a small sample size and individuals who visit model homes are already interested in green issues. Therefore, it is not clear to what extent the subsequent installation of measures was the effect of visiting model homes.

How transferable is the scheme?

The program currently operates on a national scale, with SuperHomes located all over the country.

11.1.8 Initiatives to reduce 'hassle factor'

Providing additional services, like loft clearance, could address the disruption barrier by minimising the amount of inconvenience individuals have to go through when having a new system installed. It has been observed that the 'hassle

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71 SuperHomes Research Report 2014 Highlights http://www.superhomes.org.uk/resources/superhomes-research-report-2014/

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factor' plays a significant role in preventing people from, for example, changing their boiler. For example, a choice experiment[3] conducted by the DECC recorded households' responses to certain situations, to discover homeowner preferences for heating technologies. 80% of respondents would make no change to their heating system in a non-emergency situation.

Kirklees Warmzone

Source	Sample	Data type	Explanatory power

Which barrier does the scheme tackle?

Kirklees Warmzone[72] attempted to address the hassle barrier by offering free loft clearance, scaffolding and fitting new loft hatches. These services aimed to make the process easier and less inconvenient for the customer.

How effective was the scheme?

The Kirklees scheme was very successful, with 64,472 insulation measures installed (out of all homes in Kirklees visited). This cannot be solely attributed to the additional services offered – the process involved six contact attempts and offered free efficiency measures to all homes across the borough. But customer surveys reported a high level of customer satisfaction (e.g. 76% rated the customer service provided by the Warm Zone office staff as either 'excellent' or 'good', 75% rated how clean and tidy the installation team left their homes as either 'excellent' or 'good'). It seems likely that the ease of the process contributed significantly to the success of the scheme.

How transferable is the scheme?

This approach could be adapted to other areas or to promote other measures, like district heat or heat pumps, if a budget was available.

11.1.9 Visible local authority support

Leveraging the reputation of local authorities could help overcome lack of trust quality concerns.

This could involve putting the local authority logo on any marketing material sent out, local authority employees carrying out energy assessments and a network of builders and plumbers recommended by the local authority. This would help to address the problem of the lack of trust people feel concerning 'rogue traders' and unfamiliar heating systems. According to a DECC study,[73] seven in ten

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72 Kirklees Council (2011), *Kirklees Warm Zone Scheme: End of Project Process Evaluation Report* http://www.kirklees.gov.uk/you-kmc/partners/other/pdf/warmZone_ProcessReport.pdf

73 DECC (2011), *Research Summary: Understanding Potential Consumer Response to the Green Deal* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43014/3586-green-deal-understanding-consumer-resp.pdf

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would have been more likely participate in the Green Deal if installers and assessors were skilled and accredited.

Newark and Sherwood Warmstreets

Source	Sample	Data type	Explanatory power

Which barrier does the scheme tackle?

To increase trust, Newark and Sherwood Warmstreets ensured all communications were branded with the council logo.

How effective was the scheme?

This reportedly led to a fall in calls to the council to check on the identity of visitors, which suggests this helps overcome trust barriers.

How transferable is the scheme?

This could be transferred to other localities.

11.1.10 Set up a dedicated advice centre ('one stop shop') to streamline the process

Giving consumers a single point of contact for queries about energy efficiency measures could address several non-financial barriers, including lack of awareness and interest, lack of trust and perception of poor quality. The service could:

- put customers in contact with energy assessors;
- provide advice about suitable home improvements and compare prices;
- provide advice about sources of finance (for example, checking whether consumers are eligible for free insulation with Warm Front);
- recommend installers; and
- deal with complaints.

Some of the projects, like Ham and Petersham LCZ and Kirklees Warmzone, reported that there were drop-outs between points of contact – for example, from initial contact to the energy assessment to installation. Providing one point of contact for the entire process reduces the hassle involved with collecting information and finding an installer. It should, therefore, increase the proportion of households reaching the installation stage.

An impartial advice centre could also help alleviate the mistrust people might feel towards suppliers by providing the opinion of an unbiased intermediary during the contemplation stage and accountability post-installation. Moreover, knowing

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that there is a complaints and repair system in place in case of breakdown should appeal to risk-averse consumers.[74]

A DECC study[75] reports that survey respondents thought a dedicated advice service to cover their concerns would be helpful in improving the consumer experience of the Green Deal.

Stroud District Council Target 2050 Homes project

Source	Sample	Data type	Explanatory power

The Stroud District Council Target 2050 Homes project[76] aimed to increase the uptake of energy efficiency measures from double glazing and insulation, to solar PV and heat pumps. The programme involved an expert advice programme and ongoing support. The advice was bespoke and varied by consumer and household and was given by unbiased advisors that helped customers understand the options available to them and choose the best one for them. The project also involved a local installer network that was a relatively light touch free-to-use service for installers and consumers to use. Installers had to be part of the relevant accreditation schemes and have full insurance. The project was also part of DECC's Pay as You Save (PAYS) loans programme pilot scheme. The project was publicised online, through a show-home and a conference.

Which barriers did the scheme address?

This scheme aimed to address lack of awareness and interest, lack of trust and perception of poor quality.

How effective was the scheme?

The project resulted in 248 home surveys and advice reports completed. The home surveys provided practical and clear advice, specific to the homeowner, about current performance and the savings that could be made by instaling measures specific to their home. Of the home surveys completed, 102 households are known to have acted upon the advice by taking up the energy and carbon saving measures that were recommended to them. It was estimated these

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74 Consumers tend to be risk averse in their relationship to the heating market. For example, it has been estimated that 36% of households have boiler insurance, while the wider home emergency insurance market has grown significantly, from 4.5m contracts in 2004 to 13.9m in 2012. Uswitch survey (2013), http://www.uswitch.com/media-centre/2013/10/boiler-bother-leaves-householders-facing-314-bill/ Data Monitor (2012) *UK Home Emergency Insurance 2012: An analysis of the UK home emergency insurance industry*

75 DECC (2011), *Research Summary: Understanding Potential Consumer Response to the Green Deal* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43014/3586-green-deal-understanding-consumer-resp.pdf

76 Stroud District Council (2011), *Target 2050, future-proofing homes in Stroud District and beyond.* http://www.severnwye.org.uk/downloads/read/HomesReport_read.pdf

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measures installed *could* go onto to reduce their energy consumption and carbon emissions by an average of 24%.

A range of measures were installed, with double or secondary glazing being most popular with 37 installations, followed by solar PV (35 installations) and replacement boilers (32 installations). The project found that the most common measures installed were not necessarily those that resulted in the largest carbon and energy bill savings, but often those associated with the least disruption, in particular, double glazing, solar PV and replacement boilers.

How transferable is the scheme?

This approach could be adapted for many carbon saving technologies and in many areas.

11.1.11 Provide comparative information on energy usage

Presenting consumers with information on their energy usage compared with their peer group can encourage behaviour change by creating new social norms. This combats the barrier to awareness and interest by showing consumers that they need to adopt new behaviours to fit in with what others do. It may also reduce the perception that low-carbon technologies are of poor quality if consumers can observe that their neighbours and peers have taken them up and are saving energy.

Neighbors, Knowledge, and Nuggets: Two Natural Field Experiments on the Role of Incentives on Energy Conservation[77]

Source	Sample	Data type	Explanatory power

Which barriers did the scheme tackle?

Two field trials by Dolan and Metcalf looked into the impact of social norms on energy consumption by sending households information on the average gas consumption of their neighbours ("social norm information"). They also investigated the impact of providing financial incentives on energy consumption for one of the trials.

How effective was the scheme?

Overall, they found that providing social norm information is enough to motivate people to reduce their consumption. Providing this information by post was more effective than by email.

The first trial of 500 households was with a social housing estate in London where they randomly assigned households into treatment and control groups.

77 Dolan and Metcalf (2013), *Neighbours, Knowledge, and Nuggets: Two Natural Field Experiments on the Role of Incentives on Energy Conservation.* http://cep.lse.ac.uk/pubs/download/dp1222.pdf

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Their central estimate suggests that the average household receiving social norm information and guidance on how to reduce consumption by post, decreased gas consumption by 7%.

The second field trials involved 2,000 customers across the country with above-average energy consumption between January and July 2012. They were randomly assigned to treatment and control groups. Some groups received social norm information either online or offline (i.e. via post) and other groups also received a financial incentive (a voucher of either £10 or £100). Households that receive offline social norm information reduced their energy consumption on average by 6% per month, compared to the control group.

How transferable is the scheme?

This approach could be adapted to other technologies and areas.

11.1.12 Conclusions

Evidence on the effectiveness of local schemes is patchy. However, this overview does highlight a number of insights.

- **Schemes need to tackle multiple barriers to have a significant impact on uptake**. For example, the Ham and Petersham scheme, while generating a reasonable level of interest and awareness, had a limited effect on uptake. This is, in part, likely to be because it did not address other consumer non-financial barriers such as lack of trust and disruption and inconvenience for consumers. Similarly, Stroud District Council's scheme addressed many barriers but did not tackle the disruption and inconvenience associated with installation. As a result, the uptake of the technologies with the largest carbon savings, and also involved the most perceived disruption, had a relatively lower uptake.

- **Personalised approaches can help target lack of awareness, interest and trust**. A one-size-fits-all approach to marketing is unlikely to engage all consumers simultaneously so segmentation can be a helpful tool to target the audience more personally. The Newark and Sherwood Warmstreets scheme generated interest through this channel, by personalising marketing material and their face-to-face contact. Local institutions may be better placed to carry out this tactic than national institutions due to their having a better knowledge of the local community. There is also evidence (for example from the RE:NEW) scheme that door knocking can be more effective than mail shots. However, there is not enough evidence available to assess whether the additional benefits of door knocking would outweigh the additional costs.

- **A dedicated low-carbon heating advice centre can help increase interest and awareness, and tackle trust and quality concerns**. It can

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also help to reduce the inconvenience of selecting the right intervention and finding suppliers to adopt and maintain heating interventions. Feedback from the Kirklees Warmzone showed that some consumers were confused about who to contact. This problem was avoided in the Stroud Target 2050 scheme. Consumers benefit from being guided along the process by an impartial advisor, which makes choosing the low-carbon option easier and more convenient. This intervention is likely to be more important for home retrofits involving multiple improvements (rather than for example, district heat connections).

- **Word-of-mouth endorsement is an important method by which to increase awareness and interest and correct the misconception that interventions may be of low quality.** Area-wide initiatives can benefit from word-of-mouth endorsement by creating localised community awareness of a project. Hadyard Hill Community Energy Project attempted to engage the whole community and observed widespread penetration, with 90% of the community having an energy survey and receiving an energy report.

- **Changing social norms can help increase take-up of low-carbon interventions**. This could be achieved by informing people of their carbon emissions compared to their peers, as in the Dolan and Metcalf field trials. It Trusted advisors can also influence social norms. For example the Energy Matters and Ham and Petersham Low Carbon Zone programmes both used trusted individuals to deliver their message, to influence consumer perceptions of social norms.

Table 7 summarises the results and our evaluation of the schemes reviewed

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Table 7. Summary of scheme results and evaluation

Scheme	Results	Evaluation
Ham and Petersham Low Carbon Zone	• 1,103 of 3,750 households (29%) showed interest by getting in contact; • on average 7.1 households signed up on streets without Street Champion; 9.7 for streets with a Street Champion; • only 628 received an assessment and only 226 (6% of all households) had 'secondary' measures installed.	• 3,750 households targeted (all households in area); • observational data used to give summary statistics; • reports from interviews with Street Champions; • inconclusive whether results are robust in terms of statistical significance or evaluation approach.
Energy Matters	• 90% reported to be 'very interested' or 'fairly interested' in saving energy at home; • 54% of parents had installed energy saving measures, 12% were planning to; • of those, an average of £543 per household was spent on energy efficient measures.	• 148 parents interviewed; • self-reported data during phone interviews to provide summary statistics; • results unlikely to be robust; no clear counterfactual.
Newark and Sherwood Warmstreets	• Fourfold increase in households signing up for home insulation in five months • Newark and Sherwood perform better than other Warmstreets partner councils, fulfilling on average 60% of their energy survey targets.	• 2,650 households targeted; • households targeted had been selected according to criteria; • reports from interviews with Warmstreets managers and energy surveyors; • inconclusive whether results are robust in terms of statistical significance or evaluation approach.

SuperHomes	• 41% of visitors installing a measure within two years; • 20% of visitors spending £3,000-£35,000 on these measures.	• 78 respondents (low sample size) • sample drawn from visitors to SuperHomes who had responded to survey; • people who attended the show homes are likely to be considering measures already, so unlikely to be representative of average households; • results based on survey data.
Kirklees WarmZone	• 64,472 measures installed out of all homes in Kirklees; • high level of customer satisfaction: 75% rated service of installation team as 'excellent' or 'good'	• All households in Kirklees targeted; • results based on observational and self-reported data; • no clear counterfactual.
Sheffield City Council	• Use of council officers was necessary to gain residents' trust.	• Report from interview with council on their tactics.

Appendix 1: Decentralised approaches to tackling consumer non-financial barriers

Stroud District Council: Target 2050 Homes	• 248 households had energy surveys; • Of which 102 took up energy and carbon saving measures recommended to them; • for which, estimated reduction in energy consumption and carbon emissions by an average of 24%, and their fuel bills by £406. • Stroud PAYS pilot had highest achieving of the five UK PAYS pilots. • Customers reported positively on the bespoke, unbiased advice they received	• Results based on observational and self-reported data from customers; • no clear counterfactual; • difficult to isolate impact of expert advice centre from impact of financial incentives; • energy savings and fuel fill reductions based on forecasts.
Neighbors, Knowledge, and Nuggets: Role of incentives on energy conservation	• First trial reduced gas consumption by approx. 7% on average; equivalent to 1000 kWh over 15 months; • Second trial reduced gas consumption by approx. 6% per month; carbon dioxide reductions of 5kg between June and July; • Financial incentives effective at reducing consumption, but impact lessened by sending social norm information.	• Sample sizes of 500 and over 2,000; • randomised control trial; • population of first trial is social housing estate; for second trial the population was households with higher than average energy consumption; • robust evaluation framework.

Source: Frontier Economics

Appendix 1: Decentralised approaches to tackling consumer non-financial barriers

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BRUSSELS | COLOGNE | LONDON | MADRID

Frontier Economics Ltd 71 High Holborn London WC1V 6DA
Tel. +44 (0)20 7031 7000 Fax. +44 (0)20 7031 7001 www.frontier-economics.com