Title: Heat Network Zoning Secondary Consultation-stage IA **IA No:** DESNZ035(C)-23-NZBI **RPC Reference No:** N/A **Lead department or agency:** Department for Energy Security and Net Zero **Other departments or agencies:** None	Impact Assessment (IA) **Date: 18 December 2023** **Stage:** Consultation - Secondary Legislation **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** heatnetworks@energysecurity.gov.ukwa

Summary: Intervention and Options

RPC Opinion: N/A

Cost of Preferred (or more likely) Option (in 2021 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status** N/A
£7,530m	£-80m	£3m	

What is the problem under consideration? Why is government action or intervention necessary?

To deliver Net Zero and future carbon budgets, virtually all heat will need to be decarbonised and heat networks are a crucial aspect of the critical path towards achieving heat decarbonisation in the UK. Government intervention is necessary to overcome the key market failures and barriers (high upfront costs and investor risk aversion, and co-ordination failure) that prevent low-carbon heat networks from competing against well-established high carbon heat generation alternatives (e.g., gas boilers and gas combined heat and power). Heat Network Zoning will overcome these market failures and barriers and put the sector on track to deliver a significant proportion of the UK's heating by 2050. The proposals apply to England only.

In this impact assessment, we describe the impacts of implementing primary and secondary legislation for the Heat Network Zoning policy.

What are the policy objectives of the action or intervention and the intended effects?

The consultation describes the key objectives of heat network zoning, which are to overcome the market failures and barriers which are inhibiting market growth. The policy will deliver heat networks where they are the most cost-effective solution to decarbonise heat by 2050. The SMART objectives of the policy are to:

- Deliver the **lowest cost, low carbon heat** to consumers within zones (Measured by p/kWh heat)
- **Increase in the deployment of low carbon heat networks** (Measured by TWh/yr)
- **Decrease carbon emissions** from domestic and non-domestic buildings (Measured by $MtCO_2e$ abated)
- Recycle a greater amount of **waste heat within heat networks** (Measured by TWh/yr)

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The quantified policy options appraised in this impact assessment are defined by the types of buildings that would be required to connect to heat networks within heat network zones. The options are:

- **Option 1, low option:** all new buildings, and large non-domestic buildings in zones and within connection distance to an existing or proposed heat network are required to connect.
- **Option 2, high (preferred) option:** all new buildings, large non-domestic buildings, and communally heated residential blocks in zones and within connection distance to an existing or proposed heat network are required to connect.

The 'high' policy option is the preferred option due to it achieving the greatest carbon savings and Social Net Present Value.

It also presents the greatest opportunity to maximise non-monetised benefits such as electricity system benefits, supply chain development and cost reductions, jobs and GVA. The 'high' policy option also provides the most buildings with the opportunity to decarbonise heating at the lowest cost, since alternative low carbon heating technologies are expected to be more costly for buildings within zones. Further options were explored at long list stage but haven't been considered in the quantitative short list options appraisal.

Is this measure likely to impact on international trade and investment?	No

Are any of these organisations in scope?	**Micro** No	**Small** No	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent over **5th and 6th carbon budget periods**)	**Traded:** 0		**Non-traded:** 0	
Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** N/A				

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: Martin Callanan Date: 20/11/2023

Summary: Analysis & Evidence — Policy Option 1

Description: Low Policy Option

FULL ECONOMIC ASSESSMENT

Price Base Year 2021	PV Base Year 2022	Time Period Years 40	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	**High:** Optional	**Best Estimate:** £7,350m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	N/A		£250m	**£9,900m**

Description and scale of key monetised costs by 'main affected groups'

The monetised costs associated with implementing both primary and secondary legislation are:

- Upfront capital costs of deploying heat networks, relating to the necessary generation and distribution infrastructure. Scale of capital cost is dependent on type of low carbon technology deployed (high use of waste heat will reduce cost).
- Cost to local and central government in designating heat network zones, coordinating and implementing policy.
- Cost to business of adhering to policy.

Other key non-monetised costs by 'main affected groups'

Certain costs to business have not been quantified at this stage as it hasn't been considered proportionate to do so. These costs are disruption costs associated with significant deployment of heat networks and access costs for the owners of heat sources who will be required to supply a heat network with their waste heat.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	N/A		£430m	**£17,250m**

Description and scale of key monetised benefits by 'main affected groups'

The monetised benefits associated with implementing both primary and secondary legislation are:

- Carbon savings – reduction in non-traded emissions and comparatively small increase in traded sector.
- Air quality savings – improvement in air quality

Other key non-monetised benefits by 'main affected groups'

- Whole electricity system impact - large scale heat networks could contribute to a smart and flexible electricity system with potential savings of up to £10bn per year by 2050[1].
- Supply chain development – provides regulation and strong signal to market.
- Jobs and GVA impacts – UK jobs in design, construction, and operation of heat networks. Wider economic benefits e.g. energy savings and developing operations of Energy Service Companies.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5%

Details presented in assumptions tables – number of towns/cities, voluntary connection ('infill') of non-required buildings, policy option impacts on existing buildings and new builds, scaling of analysis to national level. Mix of heat network generation technologies, estimates of cost per town/city, cost of feasibility studies, commercialisation costs, resourcing of zoning coordinators, time require per Heat Network developer/operator for familiarisation with proposals, % of exempt buildings, time required for providing information, additionality and optimism bias.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m	Score for Business Impact Target (qualifying

[1] Transitioning to a net zero energy system: smart systems and flexibility plan 2021, link: https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021

Costs: £3m	**Benefits:** £0m	**Net:** £-3m	
			NA

Summary: Analysis & Evidence Policy Option 2

Description: High Policy Option

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
Year 2021	**Year** 2022	**Years** 40	**Low:** Optional	**High:** Optional	**Best Estimate:** £7,530m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	N/A		£250m	**£10,110m**

Description and scale of key monetised costs by 'main affected groups'

The monetised costs associated with implementing both primary and secondary legislation are:

- Upfront capital costs of deploying heat networks, relating to the necessary generation and distribution infrastructure. Scale of capital cost is dependent on type of low carbon technology deployed (high use of waste heat will reduce cost).
- Cost to local and central government in designating heat network zones, coordinating and implementing policy.
- Cost to business of adhering to policy.

Other key non-monetised costs by 'main affected groups'

Certain costs to business have not been quantified at this stage as it hasn't been considered proportionate to do so. These costs are disruption costs associated with significant deployment of heat networks and access costs for the owners of heat sources who will be required to supply a heat network with their waste heat.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	N/A		£440m	**£17,630m**

Description and scale of key monetised benefits by 'main affected groups'

The monetised benefits associated with implementing both primary and secondary legislation are:

- Carbon savings – reduction in non-traded emissions and comparatively small increase in traded sector.
- Air quality savings – improvement in air quality

Other key non-monetised benefits by 'main affected groups'

- Whole electricity system impact - large scale heat networks could contribute to a smart and flexible electricity system with potential savings of up to £10bn per year by 2050[1].
- Supply chain development – provides regulation and strong signal to market.
- Jobs and GVA impacts – UK jobs in design, construction, and operation of heat networks. Wider economic benefits e.g. energy savings and developing operations of Energy Service Companies.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5%

Details presented in assumptions tables – number of towns/cities, voluntary connection ('infill') of non-required buildings, policy option impacts on existing buildings and new builds, scaling of analysis to national level. Mix of heat network generation technologies, estimates of cost per town/city, cost of feasibility studies, commercialisation costs, resourcing of zoning coordinators, time require per Heat Network developer/operator for familiarisation with proposals, % of exempt buildings, time required for providing information, additionality and optimism bias.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m			Score for Business Impact Target (qualifying provisions only)
Costs: £3m	**Benefits:** £0m	**Net:** £-3m	NA

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Evidence Base

Introduction and Background

1. Meeting our net-zero target will require virtually all heat in buildings to be decarbonised, and heat in industry to be reduced to close to zero carbon emissions by 2050. There is demand for low-carbon heating solutions in the marketplace as more local authorities declare climate emergencies and an increasing number of consumers become aware of their carbon impact.

2. Decarbonising heat is a challenging undertaking that has no single solution and will require a combination of leading-edge technologies and increased customer options to make it happen. However, heat networks will be vital to making net zero a reality. They are a proven, cost-effective way of providing reliable, low carbon heat at a fair price to consumers, while supporting local regeneration.

3. Heat networks can benefit from economies of scale and are able to decarbonise a large number of consumers and therefore a large amount of overall heat demand in one go. The carbon saving potential of a heat network is further increased when technologies which enable the use of low-carbon sources such as heat from energy from waste, or heat recovered from industry or environmental sources such as ground and river source heat are used. In this IA we refer to all these forms of heat as '**waste heat**'. Furthermore, with thermal storage they can provide demand flexibility to the energy system which is essential in the transition to a net-zero world.

4. This impact assessment supports the passage of secondary legislation measures related to heat network zoning. The proposals[2] for heat network zoning in England will see heat networks deployed in areas where they are the lowest cost, low carbon heating solution. The policy will enable the growth of the heat networks sector, allowing it to play an important role in decarbonising the UK's buildings to achieve net zero carbon emissions by 2050. The CCC estimate that heat networks could provide 18% of UK heat demand by 2050[3]. Similarly, the Department for Energy Security and Net Zero' recent *Opportunity Areas for District Heating Networks in the UK*[4]*,* study indicates that a significant portion of the UK's heating could be met by heat networks.

5. A key source of evidence that will be utilised by the zoning policy is the National Zoning Model (NZM) which will consolidate a range of evidence to identify zones where heat networks would offer the lowest cost means of decarbonising heating of buildings in England. The NZM will assess the demand for heat for buildings, as well as opportunity to recycle waste heat for low-cost supply; it will use a range of economic assumptions and mathematical modelling to assess which buildings would be served most cheaply by a heat network, in comparison to another low carbon technology. Due to the concurrent timescales for producing legislation and developing the NZM it has not been possible to utilise the full extent of evidence from the NZM for this impact assessment; however, we have included evidence from the predecessor model that was developed through the Heat Network Zoning

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[2] More information on the proposals for Heat Network Zoning can be found in the accompanying consultation.

[3] "Research on district heating and local approaches to heat decarbonisation" Element Energy for the CCC, https://www.theccc.org.uk/publication/element-energy-for-ccc-research-on-district-heating-and-local-approaches-to-heat-decarbonisation/

[4] *Opportunity Areas for District Heating Networks in the UK* is a report produced by DESNZ in response to the EU Energy Efficiency Directive requirement to conduct a National Comprehensive Assessment for Efficient Heating and Cooling in the UK, https://www.gov.uk/government/publications/opportunity-areas-for-district-heating-networks-in-the-uk-second-national-comprehensive-assessment

Pilot Programme (HNZPP). We also aim to include more evidence from the NZM in the final stage impacts assessment.

Rationale for Intervention

6. The heat networks market is characterised by a series of interlinked market failures and barriers, which will be addressed by heat network zoning. These market failures and barriers are preventing the sector from growing without government support. Growth is required to put the sector on the pathway to achieving the deployment levels indicated in the CCC's analysis. The policy will directly tackle some of the barriers, whilst it will have an indirect effect on others. The market failures and barriers addressed by the policy are listed below.

A. **Externalities.** There are uncaptured negative externalities associated with the use of conventional, gas-fired, heating technologies. The full societal costs of heating based on fossil fuel combustion should consider the emission of greenhouse gases, leading to climate change and the impacts on health (related to the air quality impacts). Likewise, the relative positive effect of low-carbon heating on air quality and emissions, and thus the lower societal cost, is not captured in its price. This is likely to result in under-investment in low-carbon heating. The benefits of adopting low carbon heating technologies grow as deployment increases, through a positive feedback effect between scale of market, learning, innovation, and cost reduction. This is not factored in individual decisions or the private price of low carbon technologies. Zoning will remove the cheaper, higher carbon counterfactual, and direct investment into the heat networks market.

B. **Connection uncertainty**. Heat networks currently are characterised by high upfront capital costs and long payback periods, which can deter investors. The risk of heat loads not connecting to networks can create uncertainty which hampers investment. Due to this perceived risk, projects need to require high internal rates of return to attract investors, even if they are economically viable. Zoning provides project sponsors and investors with connection assurance, as key loads will be required to connect to heat networks, if it is cost effective (and practical) for them to do so.

C. **Coordination failure.** Developing heat network projects requires coordination between the heat network developer and multiple parties, which can be challenging. As heat networks require a certain amount of heat demand to be viable, difficulties co-ordinating across parties often mean a heat network is scaled back or not deployed even if it would have been the most cost-effective option. Coordination failures can also slow down heat network project development for those that do go ahead. Zoning tackles this market failure by taking a central, strategic approach to heat decarbonisation and giving government the power to designate where zones are, and which buildings must connect.

7. The barriers B and C outlined above are best tackled by a regulatory intervention such as heat network zoning. Indeed, there are several examples of other countries with thriving heat networks markets, who implemented heat network zoning policies, for example Denmark who implemented a zoning policy in the 1970s. The most effective means of tackling negative externalities is through a price of carbon.

8. Throughout the policy development work, regular engagement was carried out with other countries and jurisdictions who have already implemented heat network zoning to assist the

growth of the market. More detail is provided on the zoning experiences of other countries in the proposals for heat network zoning document[2].

Description of options considered

Long-list options and Multi Criteria Analysis

9. A long list of options was developed and agreed with stakeholders as part of the initial consultation on the proposals for heat network zoning – the options are presented in Table 1 below. Long list options were split into three categories: Compulsion, Incentivisation and Structural. A 'Do nothing' option was not considered as viable for meeting policy objectives but has been used to benchmark long list options. Options have been considered independently using a Multi Criteria Analysis (MCA)[5], noting that some of the options may be developed in conjunction with one another. The long list included non-regulatory means of achieving the policy objectives.

10. Compulsion options (i.e. zoning) describe an area, designated by local government, within which heat networks are the lowest cost, low carbon solution for decarbonising heating. Within these zones some types of building must connect to their local heat network within a given timeframe.

Table 1 - Long list of options considered

Compulsion options	
Light touch	All buildings required to assess whether they should connect to a heat network.
Low	Key anchor loads are encouraged to connect. These are buildings with significant heat demands, which can be one of the first connected demands on a heat network. Other types of buildings may also be required to connect, e.g. new builds and large public sector non-domestic buildings.
High	All suitable buildings required to connect to HN.
Incentivisation options	
Central government financial support	Financial support or incentivisation coming from central government. E.g. targeted grant support or revenue support to heat network projects, or a connection fund to subsidise costs of buildings connecting to heat networks.
Awareness campaign	Raising awareness in local communities about low carbon heating and the benefits of heat networks to generate demand.
Structural options	

[5] Multi Criteria Analysis (MCA) was used in the initial long-list options appraisal in 2021, and at the time was Green Book compliant. Since then, the Green Book guidance has been updated requiring new policies to undergo a Multi Criteria Decision Analysis (MCDA), which is more sophisticated than MCA. A MCDA has not been undertaken for the zoning policy, due to the stage of policy development at the time the latest guidance was introduced.

Remove distortions between price of gas and electricity	Price re-balancing of electricity and gas to promote low carbon heating technologies, such as heat networks.
Business rates exemptions	District heating schemes exempt from paying business rates.
Do nothing	
Do nothing	Do not tackle barriers and market failures for heat networks.

11. Workshops were held to identify 'Critical Success Factors' covering the following areas:
    a. Achieving policy objectives (tackle market failures)
    b. Novelty of policy proposals
    c. Deliverability
    d. Value for money

12. Each group of success factors was given an overall weighting based on their relative importance, which was agreed by the stakeholder group in a workshop. Achieving policy objectives was deemed to be the most important due to the key barriers the policy is trying to overcome sitting in this category, therefore was given the highest weighting of 50%. A detailed description of the MCA methodology can be found in Annex 4 – Multi Criteria Analysis Methodology.

13. The results of the MCA are shown in Table 2 below. 'Remove distortions between the price of gas and electricity' was dropped from consideration as this issue is being considered in other areas of government.

Table 2 – Multi Criteria Analysis results

Critical Success Factors	Weighting	Score for each option					
		Mandatory requirement (compulsion)			Incentivisation		
		Light touch - buildings assess connection	Low - key anchor loads	High - all suitable buildings required	Central govt financial support	Generating Consumer Demand	Business rates exemptions
		a	b	c	d	e	g
Achieve Policy Objectives	50	1.5	2.9	4.4	2.9	2.5	2.4
Novelty of policy proposals	10	3.8	3.3	2.5	3.0	4.3	2.5
Deliverability	25	2.0	4.0	2.0	4.0	3.3	3.3

Value for money	**15**	**4.3**	**3.8**	**2.5**	**2.5**	**4.0**	**3.0**
		2.3	**3.3**	**3.3**	**3.1**	**3.1**	**2.7**

14. The results of the MCA exercise we carried out show that the mandatory and incentivisation options came out with the highest scores. The mandatory connection (requiring certain buildings to connect) options scored slightly higher. An interpretation of the scores being very close together is that all three are necessary to overcome the series of interlinked barriers and market failures that exist in the heat networks market. This is also reflected in the theory of change that has been developed for the policy.

15. Requiring connections to heat networks is the only means of overcoming the connection uncertainty and coordination failure barriers set out above. This is reflected in the 'policy objective' scores in the table above. Only a regulatory intervention can tackle these barriers, as has been seen in other countries such as Denmark or Sweden. Zoning overcomes connection risk by ensuring an adequate level of connection, of heat demand, to the heat network. The coordination failure is addressed by the policy also requiring coordination between the various parties to determine the optimal outcome for the heat network. Through overcoming these market failures, a zoning policy will de-risk investment in low carbon heat networks. This may reduce the costs of accessing finance to invest in heat networks and encourage private sector investment into the sector.

16. Government capital support alone, without regulation, would be poorly targeted at the underlying coordination failure that exists in the heat network sector, as it would not address it directly. Subsidy support alone could result in deadweight, which would be an inefficient use of government funding.

17. In tandem with a zoning policy, there will likely be a role for continuing to subsidise the deployment of heat networks, whilst the social impact of the investments on reducing carbon and improving air quality aren't reflected in the prices that the heat network charges for providing low carbon heating. As gas and electricity prices evolve over time, and as the cost of raising capital changes, the role for government subsidy support is expected to reduce over time.

18. As such, a non-regulatory option alone is not anticipated to achieve the intended policy objectives of heat network zoning, and hasn't been included as an option in the short list options appraisal in this IA.

Short Listed Options

19. The two preferred compulsion options (mandatory requirement for certain buildings to connect), low and high, were further defined and developed into a short list of policy options. The short list options are defined by different classes of buildings that would be required to connect to heat networks.

20. In the previous heat network zoning impact assessments and consultation, a medium option was also included to explore a wider range of options for requiring building groups to

connect; however, in response to industry feedback and in light of improved evidence, this impact assessment appraises two policy options only:

- **Low (option 1)**: all new build and large non-domestic (including public sector) buildings are required to connect to heat networks, all other buildings encouraged to connect.
- **High (option 2, preferred):** all new build, large non-domestic (including public sector) and communally heated residential blocks required to connect to heat networks, all other buildings encouraged to connect.

21. The 'low' policy option has a new definition, compared to prior impact assessments and consultations.

22. The 'high' policy option is the preferred option, due to it achieving the highest Social Net Present Value (SNPV), the greatest carbon savings, as well as being expected to have the highest non-monetised benefits including electricity system benefits, supply chain development, and jobs and GVA. In addition, the 'high' policy option presents the opportunity to decarbonise heat, at lowest cost, to the greatest number of buildings; under 'low' policy option, more buildings would need to decarbonise heating through other means, which would be more expensive since heat networks are defined as the least cost low carbon heating solution in zones.

23. The threshold for 'large' non-domestic buildings is currently defined within this IA as having an annual heat demand exceeding 100MWh, however, this does not reflect a firm policy definition and is open for consultation. The reason for including a threshold is to avoid placing undue burden on building owners and government, since individual buildings with small heat demands are not strategically important to the policy. Further discussion on why the threshold has been set at 100 MWh heat demand per annum can be found in Annex 3.

24. At this point it isn't clear whether a 'very high' option, which requires more buildings to connect, would mandate a larger group of buildings, would necessarily increase overall deployment of heat networks in zones. This is because we assume some buildings would connect voluntarily. Other policy options, including a very high option, could be evaluated in the secondary final stage IA. This will depend on policy development and changes in evidence.

25. A 'very high' option may make the deployment more deliverable, but it could also increase overall costs of the zoning policy. For example, by poorly choosing which buildings are required to connect to a heat network, there may be a higher rate of building owners applying for exemption to the policy, which would increase cost to business and government. A 'very high' option could also limit consumer choice, which is an important trade off.

Counterfactual

26. The Heat Network Zoning policy will look to decarbonise buildings in zones where heat networks offer the lowest cost option for decarbonising heat. Therefore, there are two counterfactual scenarios which are important for measuring the impact of the policy:

a. **'Do nothing' counterfactual** – buildings in zones are assumed to continue to use the same heating technologies that they currently have, which are predominantly gas boilers. Comparison of the factual and the 'do nothing' counterfactual will reflect the level of carbon savings that can be achieved by implementing the policy compared to a scenario where heating technologies do not change.

b. **'Alternative low carbon' counterfactual** - buildings in zones are assumed to install alternative low carbon heat technologies, instead of joining a heat network. Comparison of the factual and the 'alternative low carbon' counterfactual will assess the level of cost savings that could be achieved by implementing the zoning policy instead of buildings installing alternative low carbon heating technologies, in zones.

27. Since the primary aim of the heat network zoning policy is to decarbonise heat in buildings to help meet net zero targets, the default counterfactual that is discussed in this impact assessment is the 'Do nothing' counterfactual.

28. To avoid conflating the results of comparisons with the two counterfactuals, the low carbon counterfactual is only discussed in quantified terms in the section: Results - Low Carbon Counterfactual.

Policy objective

29. The main policy objective of heat network zoning is to deliver the lowest cost, lowest carbon heat to consumers, but there are further criteria against which the success of the policy can be evaluated. They are:

- An increase in the deployment of low carbon heat networks
- Carbon savings relative to a gas counterfactual
- Increased utilisation of waste heat sources in heat networks
- Heat networks contribute to lowest power system cost.

30. A Theory of Change was developed over a series of workshops to identify key routes to delivering policy objectives and to help identify SMART objectives. A simplified output from the workshops is shown in Annex 5 – Theory of Change.

Table 3 – SMART policy objectives

Policy Objective	Metric	Timeframe
Increase in the deployment of low carbon heat networks	(Low carbon) TWh/ yr	2025 - 2050
Reduction in carbon emissions	MtCO2e Abated	2025 - 2050
Increased utilisation of waste heat sources in heat networks	TWh/ yr	2025 - 2050
Heat networks contribute to lowest system cost	p/kWh	2025 - 2050

Monetised costs and benefits of each option (including administrative burden)

31. There are multiple monetised costs and benefits in the quantitative analysis, the methodology for calculating them is presented in the following section and the results are presented further down the IA.

32. **Monetised costs:**

- **Upfront capital costs** of deploying heat networks relative to the counterfactual. It is anticipated that there will be a significant deployment of low carbon heat networks due to the policy. This cost relates to the capital cost of the necessary generation and distribution infrastructure for this deployment. This cost is compared to the capital cost of heating buildings in the counterfactual, with building level heating systems. The capital cost of the generation depends on the type of low carbon heat network being deployed, for example whether the heat source is an air source heat pump or energy from waste. Heat networks are variable, and the capital cost depends on the features of the local geography. It has been necessary to generalise the capital costs for the purpose of the present IA.
- **Operating costs** of heat networks deployed in zones relative to the counterfactual. This cost covers the operation and maintenance of both the heat generation source and the distribution infrastructure for the heat network, against the counterfactual.
- **Cost to government** of implementing the policy. Implementing a heat network zoning policy will require an increase in resource at different levels of government. It is expected that there will be a role for national and local government in identifying and designating where heat network zones are, and in consulting on proposals with local stakeholders. There will also be a cost to government in enforcing the regulations.
- **Costs to business (heat network developers/ operators/ building owners)** of adhering to the policy. The policy would impose an additional burden on heat network developers and operators and building owners which are described later in the IA.

33. **Monetised benefits:**

- **Net energy savings** – Low carbon heat networks – which would be largely heat pump led - are more efficient in producing heat than the 'do nothing' (gas boiler) counterfactual. As a result, less energy demand is created. This is a benefit to society and is valued using the long-run variable cost of energy supply[6]. Some of the scenario results within this IA suggest there may be net energy costs, due to different levels of electricity and gas being required.
- **Carbon savings** – The replacement of fossil fuel will lead to a reduction in carbon emissions in the non-traded sector and to a small increase in the traded sector due to an increase in electricity use. These are monetised in accordance with appraisal values in HMT Green Book supplementary guidance.
- **Air quality benefits** –The replacement of fossil fuel will lead to improvement in air quality. These are monetised in accordance with appraisal values in HMT Green Book supplementary guidance.

Rationale and evidence to justify the level of analysis used in the IA

34. This Impact Assessment supports a consultation at the secondary-legislation stage. This is intended to be the final consultation process ahead of the policy being laid in secondary legislation. There will be a further final- stage impact assessment to support the policy's passage into secondary legislation.

35. The evidence and analysis in this impact assessment has been designed to describe the latest policy development to support the consultation process and present the latest evidence

[6] Green Book supplementary guidance: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

from the Heat Network Zoning Pilot Programme (HNZPP)[7] and other supporting projects and research, such as the Heat Network Zoning Social Research[8] and the Heat Network Consumer and Operator Survey (HNCOS)[9].

36. Whilst some elements of the policy appraisal have been improved on, compared to prior impact assessments, there remains some uncertainty of the impacts of the policy. To manage the uncertainty, extensive sensitivity analysis has been carried out on key factors which influence the costs and benefits. This will show the impact of some of the uncertainty in the analysis.

37. Through the accompanying consultation, we will continue to refine the evidence base regarding the impacts of this policy to present a final stage impact assessment in 2024.

Methodology for Analysis and Key Assumptions

Methodology - Overview

38. This IA presents the impact of the heat network zoning policy proposals on society, business, and households. The cost benefit analysis used to calculate the social net present value (SNPV) for each of the policy options has four distinct components:

a. An estimate of the **deployment of <u>additional heat networks</u>[10] in zones under the different policy options.**
b. An estimate of the **type and proportional breakdown of heating generation technologies** serving heat networks, under factual and counterfactual scenarios.
c. The **cost to government** (central and local) of implementing the policy.
d. The cost to heat network developers, operators and building owners. These costs constitute the **cost to business.**
e. The cost to heat network, gas, and electricity consumers for regulation of markets. These costs constitute the **cost to consumers.**

39. We will describe these sections separately in terms of methodology and assumptions. To help navigate the five sections of the analytical methodology, the following table has been repeated through this chapter to signal which section of the analytical methodology is being discussed.

Analytical Methodology Section Description
Deployment - methodology and key assumptions
Technology Mix – methodology and key assumptions

[7] The Heat Network Zoning Pilot Programme was a programme of work to develop a standardised model capable of identifying heat network zones across appointed cities and towns in England. The pilot model has been internal to government, however, it's successor the national zoning model will have published materials.

[8] Heat Network Zoning social research (2023): https://www.gov.uk/government/publications/heat-network-zoning-social-research

[9] Heat Network Consumer and Operator Survey (2022): https://www.gov.uk/government/publications/heat-network-consumer-and-operator-survey-2022

[10] 'Additional' heat network refers to heat network that are deployed solely as a result of the heat network zoning policy (i.e. not any other policy or scheme such as HNIP or GHNF; or already existing)

Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumers - methodology and key assumptions

40. For the quantified analysis, the policy impacts are compared against a counterfactual scenario and are then monetised using standard Green Book appraisal values. Social net present values (SNPVs) for the policy options are then derived by comparing the aggregate costs and benefits which are discounted by the social discount rate. Equivalent Annual Net Direct Cost to Business is also calculated for the business sector. Assumptions are varied to produce sensitivity analysis to show the sensitivity of SNPV with respect to changes in the assumptions used.

41. Additionally, there are a list of wider non-monetised impacts of the policy which are discussed qualitatively in relation to the different policy options. It hasn't been possible to quantify all of the impacts of the policy, either due to the nascency of the policy development or due to evidence gaps, and therefore some of the impacts have been assessed qualitatively.

42. The cost benefit analysis for the IA considers the net social impact of **only additional heat networks** deployed in zones, as a result of the policy. We have removed the stock of existing heat networks, and the deployment due to planned policies – the Heat Networks Investment Project and the Green Heat Network Fund – from the scope of the analysis, to avoid double counting. This is described in more detail from paragraph 48.

43. **Appraisal period:** The cost benefit analysis is carried out over a 40-year appraisal period. This reflects the lifetime of the distribution infrastructure which is the longest-lived asset deployed due to the policy. The exact years of the appraisal period are 2022 to 2061, which capture policy setup costs prior to the policy being enforced from 2025.

44. **Counterfactual(s):** Two counterfactuals have been presented in the IA. As described in the Counterfactual section, the default counterfactual in the main quantified analysis in this IA is the 'Do nothing' high carbon heating counterfactual (see Counterfactual section); however the low carbon counterfactual is also discussed in specific sections.

45. **Optimism bias:** Within our estimates of the impact of the policy options we have assumed a level of optimism bias on the capital costs of developing heat networks. Optimism bias reflects the systematic tendency for policy makers to underestimate the costs of infrastructure projects. The evidence base we have used reflects case study information of planned versus actual costs of environmental infrastructure projects. Following this evidence base, an increase of 21% has been applied to capital costs and operating costs to account for optimism bias[11].

46. **Additionality:** Within our estimates of the impact of the policy options we have assumed that 90% of the benefits of heat network zoning are additional. Given the market failures, low carbon heat networks are unlikely to be deployed without government support. Therefore, we

[11] Analysis found that there is an optimism bias of 16-26% in the projected emissions savings of climate policies (Environmental Audit Committee). We have taken the mid-point of this range, which is consistent with a general approach taken by other environmental policies. Link: https://publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/1110/111004.htm. Some other environmental policies may have bespoke optimism bias assumptions, if available.

assume that most of the deployment is additional, caused by the policy. As described in the deployment methodology section, the cost benefit analysis only considers new heat networks in zones. Networks deployed through other heat network policies are not in scope of the analysis.

Methodology - Deployment

Methodology Section Description
Deployment - methodology and key assumptions
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumer - methodology and key assumptions

Definitions

Additional deployment from zoning

47. The estimated ‘deployment’ of heat networks from zoning is quantified as the total heat delivered by heat networks under the policy options. This includes heat delivered to:

- Existing and future buildings that are built before 2050, that are required to connect by the policy. Required buildings are buildings that will be required to connect to a heat network under the zoning policy.
- Buildings that are not required to connect by the policy but may choose to connect voluntarily to the network. This type of connection is termed as ‘infill’ connection in this impact assessment. The scale of ‘infill’ availability will depend on the policy option and threshold for mandating buildings.

Baseline (used to calculate additional deployment from zoning)

48. The ‘baseline’ refers to heat supplied by either: existing heat networks, in zones; or heat networks that will be built due to other heat network policies, in zones. When estimating the additional deployment of heat networks caused by zoning, adjustments need to be made to the estimate to avoid duplicating costs and benefits with other policies. The components of the baseline which are accounted for in the adjustment are:

- Heat networks that exist in zones prior to 2025[12].
- Heat networks that are deployed under the Heat Networks Investment Project (HNIP) and Green Heat Network Fund (GHNF), before or after 2025.

Additional deployment from zoning and deployment from the baseline should be treated as additive when estimating total deployment across all heat network policies.

[12] This is estimated using the Experimental Statistics for Heat Networks (2018): https://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks

Improving estimation of zoning deployment (upon previous IA)

49. The methodology for estimating deployment from zoning has been revised since the previous primary final-stage IA[13]. The reasons for the revision are to:

- **Utilise evidence from the Heat Network Zoning Pilot Programme (HNZPP)[7]** – these represent case studies of how heat networks could be deployed in 17 towns and cities in England.
- **Improve the transparency of extrapolating to full policy rollout** – defining a simpler and more transparent process for projecting observed deployment in HNZPP case studies to full scale policy rollout in England.
- **Incorporate behavioural aspects into the estimation of deployment** – incorporating evidence from the Heat Network zoning social research[14] to factor rates of voluntary connection to a heat network ('infill') to the estimation of deployment.

Modelling Zoning Deployment – Overview

50. The zoning deployment model's function is to estimate the scale of heat network deployment that can be achieved for each policy option, as well as a range of scenarios. It estimates the potential for heat supplied to buildings (TWh/yr) through low carbon heat networks, as well as the number of buildings connected.

51. The output of the model is a heat network deployment profile up to 2050 (TWh/yr), which is used as an input assumption to the Cost Benefit Analysis (CBA) model (which is discussed in subsequent sections). The level of deployment is the driving factor for determining the scale of social cost and benefits (carbon emissions, air quality impacts, fuel savings, capital and operational costs) for implementing the policy, against the counterfactual.

52. There are four stages to the deployment model, which are listed below, are explained in more detail in the following sections.

- Stage 1 – Input data from town and city case studies (HNZPP)
- Stage 2 – Segmenting building stock into 'required' and 'voluntary' connection categories.
- Stage 3 – Extrapolating case study information to national scale (linear regression)
- Stage 4 – Adjustments

Stage 1 – Input data from town and city case studies

53. The model input data comes from the Heat Network Zoning Pilot Programme (HNZPP) case studies. The HNZPP studies identify areas within towns and cities where a heat network is expected to offer the lowest cost solution to decarbonising heat. The 17 towns and cities currently covered by each programme are given in Figure 1 below. HNZPP towns and cities

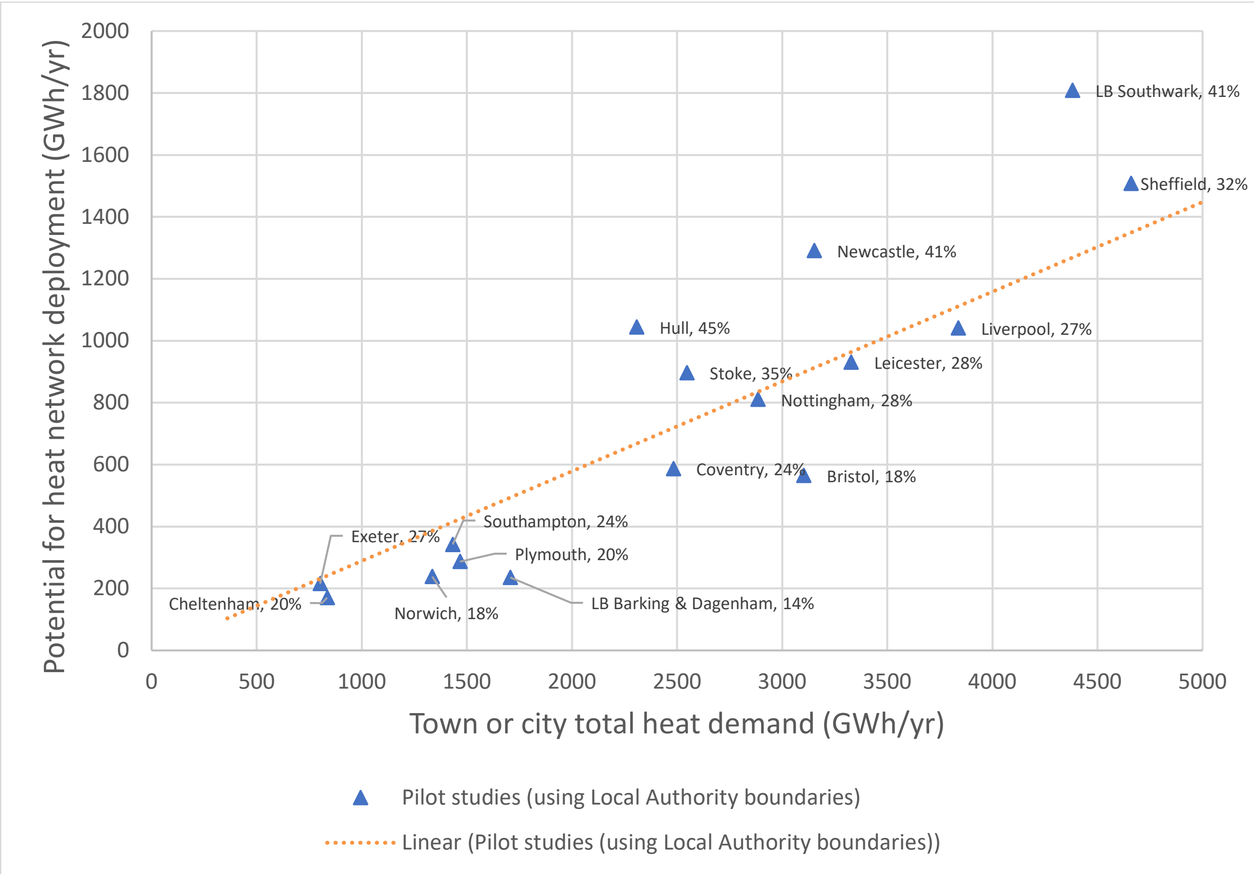
[13] The previous zoning final stage (primary) impact assessment was included in the Energy Bill which began parliamentary proceedings in summer 2022. The previous IA can be found in the IA section within the file 'Impact Assessments 7 July 2022': https://bills.parliament.uk/bills/3311/publications

[14] Heat Network Zoning social research (2023): https://www.gov.uk/government/publications/heat-network-zoning-social-research

have been selected to provide a representative sample of areas where the policy would be implemented in England.

54. It has not been possible to use the full set of HNZPP studies, due to compatibility between geographic boundaries used in the city studies, and extrapolation process. See paragraph 59 for more information.

Figure 1 – Potential for deployment of heat networks by heat demand (of town or city), HNZPP[15]



Stage 2 – Segmenting building stock into 'required' and 'voluntary' connection categories

55. To simulate a range of policy options and scenarios, case study information from the 17 towns and cities (HNZPP) have been split by:

- **building type:** non-domestic, communally heated residential, and non-communally heated residential; and,
- **building size relative to a threshold** (based on annual heat demand)**:** no threshold (all buildings to connect), 50 MWh/yr, and 100 MWh/yr.

The outcome of segmenting building stock in this way is that deployment, for each policy option and threshold scenario, can be split by 'required' and 'voluntary/infill' connections.

56. Splitting by required and infill connections allows flexibility to test the impacts of varying voluntary/infill connection rates, ranging from 0% to 100% across scenarios. The central

[15] Birmingham has been omitted from graph for presentational reasons but included within the evidence base of HNZPP case studies.

assumption for the level of voluntary connection as a proportion of total eligible connection is 70%. This assumption is based on responses to the Heat Network Zoning Social Research[14].

57. Figure 2 presents the estimated heat network deployment for each of the towns and cities. It includes a straight line of best fit to demonstrate the relationship between the size of the town/city, in terms of heat demand, and the level of estimated deployment of heat networks from the HNZPP methodology. There is a high positive correlation between the variables, as well as a moderate R-squared value (R2 = 0.72) to suggest that heat demand is a good variable for explaining most of the variance in the level of heat network deployment across the 17 towns and cities.

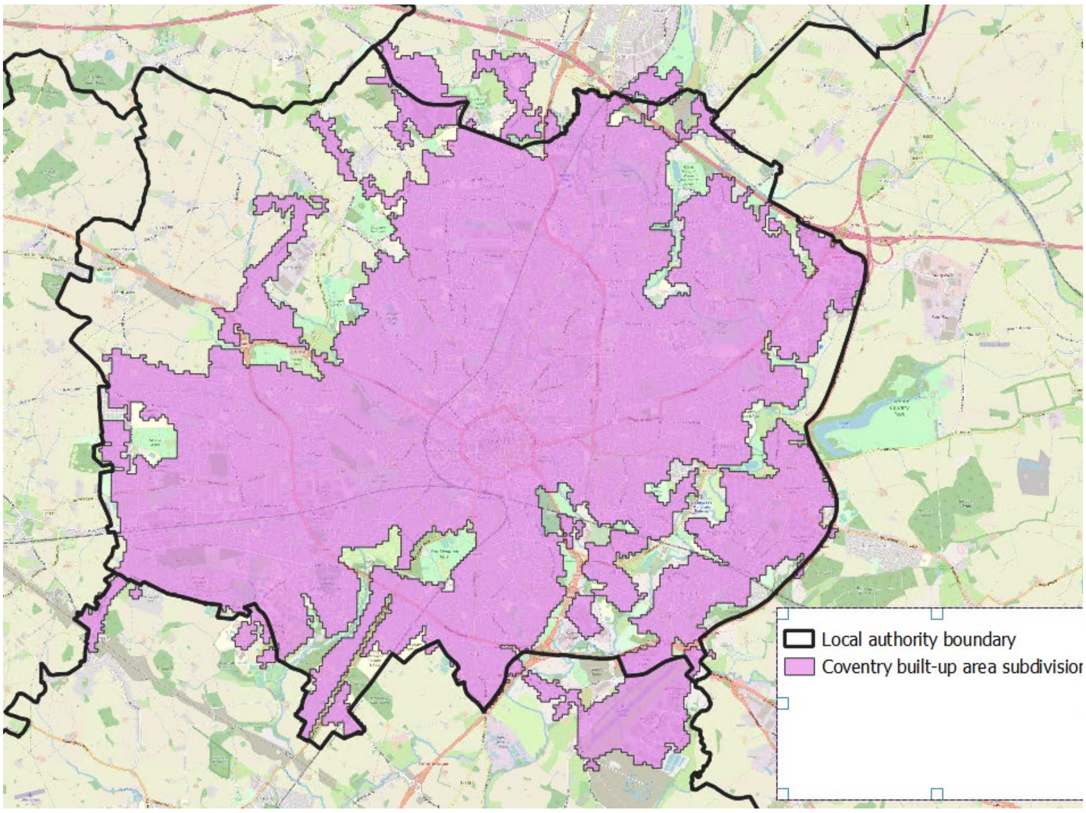
58. It has not been possible to explore more sophisticated multivariate or polynomial (non-linear) relationships to explain the level of heat network deployment in towns and cities, due to availability of only a small number of suitable case studies.

59. One known issue that affects the variance of heat network deployment across the towns and cities, is that local authority boundaries have been used to represent cities in the pilot case studies. Since local authorities can represent different geographical areas (for example city councils, district council and county councils), it is anticipated that some of the variance arises from different types of local authority boundaries being utilised. Some pilot evidence has not been possible to use in the extrapolation to national level for the reason outlined below. This is being considered for improvement as part of the next phase of work for the final stage IA.

60. Figures 2 and 3 provide examples of towns that have been included and excluded from the regression respectively, due to similarity of the Local Authority boundary (used in the HNZPP) and the Built-Up-Area (BUA) boundary (used in the extrapolation to 200 towns and cities). Where LA and BUA boundaries are significantly different (ie. Canterbury) it has not been possible to use those areas in the extrapolation, and therefore they have been omitted.

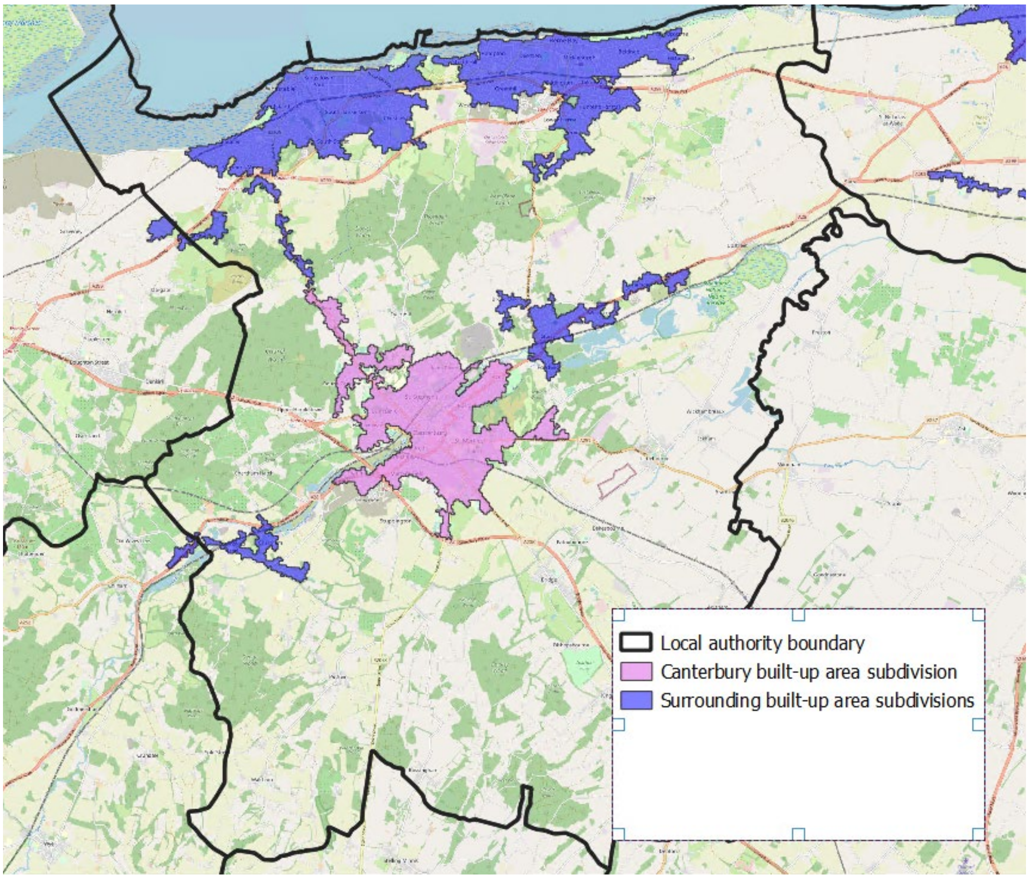
61. It has not been possible to use LA boundaries in the extrapolation, as not all LAs represent towns or cities. Likewise, it has not been possible to retrofit BUA boundaries onto HNZPP case studies. Therefore, town/city case studies have needed to be selected based on similarity between LA and BUA boundaries.

Figure 2 - Coventry Local Authority boundary and Built-Up-Area Subdivision boundary – included within the extrapolation to national level.



62. Figure 2 shows that the LA boundary and Built-Up-Area (BUA) boundaries for Coventry are similar; therefore, it has been possible to use evidence on the potential utilisation of heat networks from the pilot study for Coventry, when extrapolating to national level using BUA boundaries.

Figure 3 - Canterbury Local Authority and Built-Up-Area Subdivision boundary – not included within the extrapolation to national level.



63. Figure 3 shows that the Canterbury LA (district authority) boundary and the Canterbury BUA boundary are significantly different. The pilot case study, which assesses the potential for heat network deployment, has been carried out using the LA boundary, which means that the city of Canterbury along with several other towns, villages and hamlets have been included in the assessment. Inclusion of villages and hamlets has led to lower estimates of heat network potential for Canterbury district authority (in terms of percentage of total heat demand served by networks), which is not representative of the potential for heat networks within the city of Canterbury.

64. Since the zoning policy is expected to be delivered to towns and cities, pilot evidence using LA boundaries that are not city councils or boroughs have generally had to be discarded when assessing the potential for national level deployment of heat networks from the zoning policy.

Stage 3 – Extrapolating case study information to national scale (linear regression)

65. The linear relationship, from stage 2, between deployment and heat demand for the 17 towns and cities can be utilised to estimate total expected deployment for the policy for the largest 200 towns and cities in England. This is achieved by fitting the 200 towns and cities, based on their heat demand, to the same line of best fit that is shown in Figure 1. Heat demands for the 200 towns and cities have been sourced from the report: *Opportunity areas for district heating networks in the UK: second National Comprehensive Assessment*[16].

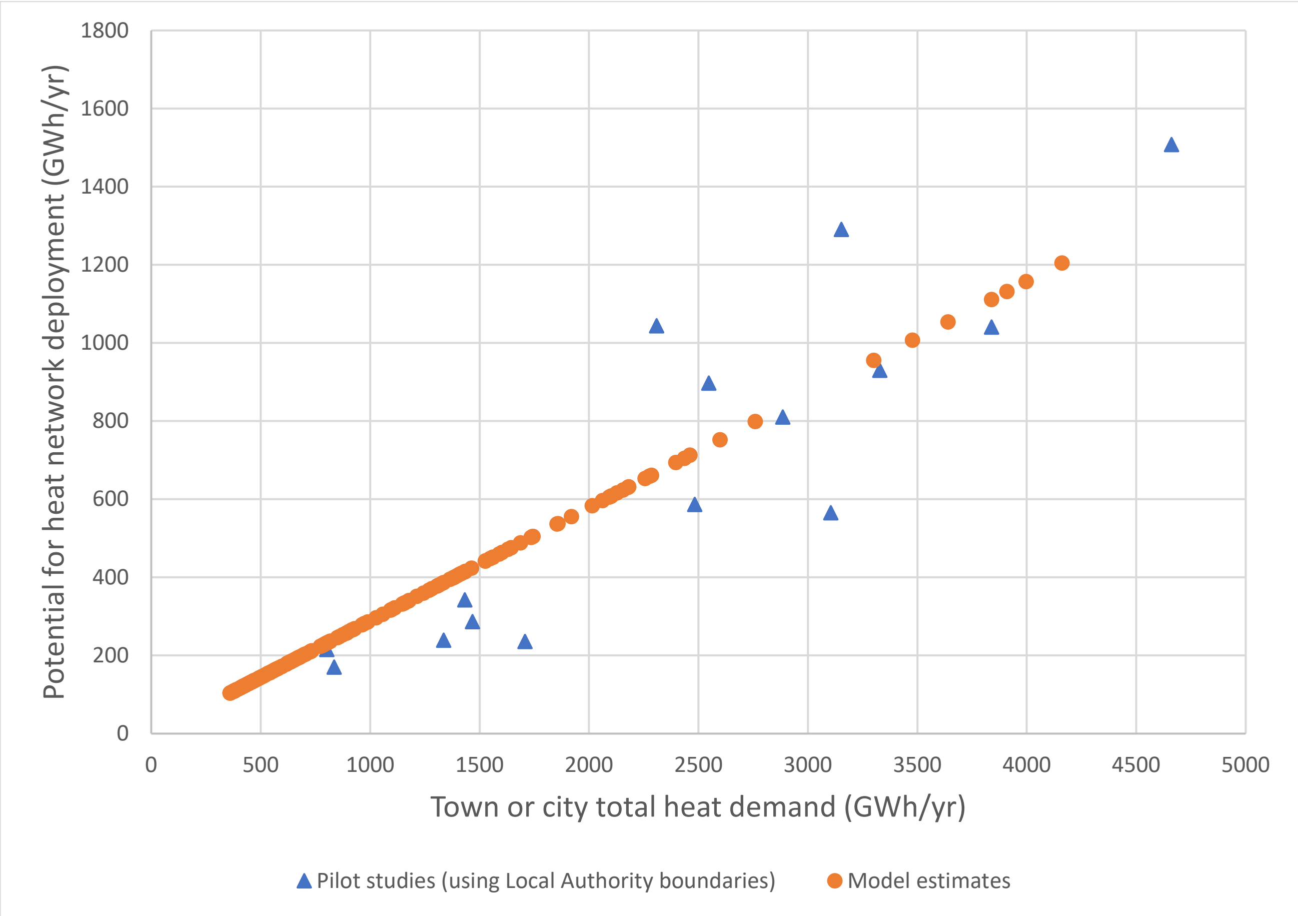
[16] https://www.gov.uk/government/publications/opportunity-areas-for-district-heating-networks-in-the-uk-second-national-comprehensive-assessment

66. Figure 4 shows estimated deployment of 200 towns and cities in England. The same method has been used to extrapolate to 100 and 300 towns and cities in England for sensitivity analysis.

67. The 200 towns and cities are the biggest by population in England, and the areas are defined the Built-Up Area Subdivisions (BUAS) which are ONS boundaries used to represent towns and cities[17].

68. The deployment estimate at stage 3 is for existing buildings only. New buildings are accounted for in stage 4.

Figure 4 – Potential for deployment of heat networks for the largest 200 towns and cities in England (fitted model)



Stage 4 – Adjustments

69. The final stage receives the estimate of gross deployment across 200 towns and cities, from stage 3, and performs three adjustments to finalise the deployment estimate for the zoning policy. The adjustments are:

- **Net-off baseline heat networks** – these are heat networks in zones that have not come into being due to the heat network zoning policy (either existing or supported by another policy/scheme).

[17] https://geoportal.statistics.gov.uk/datasets/ons::built-up-area-sub-division-to-region-december-2011-lookup-in-england-and-wales/explore

- **Incorporate expected fabric efficiency improvements** – over time buildings are expected to reduce their heat demand, due to improving fabric efficiency.
- **Add new buildings** – new buildings are not captured in the HNZPP studies; therefore, they are added after the extrapolation/projection process.

70. The specific assumptions used in the adjustments can be found in Table 4.

71. Whilst we include the deployment of new buildings in our estimates for total deployment due to heat network zoning, we do not include the impact of the new buildings deployment in the SNPV for the policy. Due to the Future Homes Standard, new build homes would be low carbon in the counterfactual for this analysis.

Deployment assumptions

Table 4 – Central assumptions for estimating deployment of heat networks in zones

Assumption	Description	Evidence	Impact on deployment
Assumed definition of the 'large' threshold for non-domestic buildings	A non-domestic building is assumed to be 'large' if its annual heat demand is above 100 MWh per year.	Judgement, and discussed in the 2021 consultation[18]	Medium, not high impact due to the assumption that the level of voluntary/infill connection will be high.
Number of towns and cities	Zones will be implemented in heat-dense areas where deployment will be cost-effective. Using HNDU feasibility studies and the case studies from the HNZPP it has been assumed that 200 towns and cities could have viable zones.	Heat Network Delivery Unit feasibility studies, and HNZPP	Medium. A low and high scenario, of 100 and 300 towns and cities has also been assessed.
Voluntary/infill connection	The central scenario assumes that 70% of eligible voluntary connections/'infill' will connect. Infill connection is discussed in greater detail below in the 'Deployment assumptions - Infill Connection' section.	Heat Network Zoning social research[19], and international examples	High, due to scale of eligible infill connection. A full range, 0% to 100%, of infill scenarios are assessed.
New building heat demand	The average heat demand of new buildings from 2025 to 2050 is 4,984 kWh/yr	Department for Levelling Up Housing and Communities	Low, due to relatively small heat loads and low prevalence. As per paragraph 70, there is no impact on the SNPV.

[18] Heat network Zoning consultation (2021): https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning. In the current consultation we seek views on the approach for defining 'large' buildings. The final stage IA will reflect the post-consultation policy position.

Building stock growth (New buildings)	Building stock in zones increases on average by 14% between 2025 and 2050, in line with national growth for domestic buildings. The growth rate has been applied to both domestic and non-domestic buildings in zones.	ONS	Low impact when combined with Fabric efficiency impacts. As per paragraph 70, there is no impact on the SNPV.
Fabric efficiency impacts	We assume that the existing building stock will be more efficient in 2050 such that its heat demand is 10% lower. We assume a straight-line increase from 0% in 2025 to 10% in 2050. This causes a reduction in deployment as it is defined as heat supplied to buildings.	Department for Energy Security and Net Zero	Medium. Low impact when combined with Building stock growth.
Minimum level of deployment for small towns	The deployment model estimates for some of the smallest towns within the top 300 have negative deployment estimates, due to the trendline. It is assumed there will be small opportunities in these towns, such as campuses; therefore, a floor value of 25 GWh/yr has been used to prevent negative deployment estimates.	Judgement	Low. No impact on the central deployment assumption (200 towns and cities).

Deployment assumptions - Infill Connection

72. A significant amount of the total deployment is reliant on non-required buildings to voluntarily connect to heat networks. Achieving the benefits set out within this IA is therefore dependent on voluntary connection. In the absence of pilot studies or suitable data from similar policies, there is minimal quantitative data that can be used to estimate the level of infill. The zoning pilot model (HNZPP) has been scoped to incorporate varying levels of infill connection when it identifies zones; however, it has not been possible to utilise this functionality for this IA, due to timing. Therefore, infill connection has been adjusted for as part of the extrapolation step and explored in more detail in the Results - Sensitivity Analysis section.

73. The Department for Energy Security and Net Zero published research in 2023[19] which assessed the views, attitudes and perspectives of people who may be affected by heat network zoning policy in six cities across England. As part of the research, 337 owner occupiers and 15 members of the private rented sector[20] participated in a survey to understand their views regarding heat network zoning. Below are some of the results, which suggest that switching to a more environmentally friendly heating system is an important consideration in changing current heating systems for private domestic residents:

- 45% of survey respondents said that environmentally friendly heating would be an important consideration if they were to replace heating while it was still working[21].

[19] Heat Network Zoning social research (2023): https://www.gov.uk/government/publications/heat-network-zoning-social-research

[20] The research targeted individuals in six cities in England: Bristol, Birmingham, Greater Manchester, Leeds, Newcastle, and Nottingham.

[21] Q7: If you were to consider replacing your heating system while it is still working, which of these would be the more important consideration in changing your heating system?

- 74% of survey respondents said they were likely to join a heat network assuming they would pay no more than they do currently, and the heat supply would be low or zero carbon[22].

74. The social research provides some useful insights into public attitudes toward heat networks, however, there may be disparity between survey responses and reality. It should also be acknowledged that the prices consumers would need to pay for being on a heat network are subject to fuel pricing trends, and price rebalancing policy; therefore, the survey question stating that consumers would "pay no more than they do currently" may be ill-founded. See the Consumer Bills section of this IA for more information on factors that could influence consumer bills.

75. The experience of Denmark's heat network zoning policy also adds some weight to the likelihood of voluntary connections. Denmark initially had a strong policy for requiring buildings to connect to heat networks, which applied to both new and existing buildings. These requirements have been revoked as heat networks are now seen as very favourable and the power to compel connection was rarely used in recent years. This suggests favourable evidence for voluntary connections, i.e. that compelling some buildings to connect may lead over time to voluntary connections and eventually no longer requiring the powers to compel connections.

76. In light of response to the Heat Network Zoning social research and international evidence, a central assumption that 70% of eligible infill would connect to heat networks within zones has been assumed. Alternative assumptions have also been explored. For the results of estimating heat network deployment in zones, please see the section: Results - Deployment of heat networks within zones.

Methodology – Technology Mix

Methodology Section Description
Deployment Model – methodology and key assumptions
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumer - methodology and key assumptions

77. Carbon emissions (and other factors such as air quality) are calculated by looking at the net change in fuel use by transitioning from gas-based heating systems (the counterfactual) to low carbon heat networks (factual) in zones. The difference between emissions in both scenarios constitute the carbon savings.

78. Heat pumps are a currently available technology, which we have robust estimates of the costs of deploying. Therefore, our analysis is limited to the impact of deploying heat pump-led heat networks and reflective of an electrification decarbonisation pathway.

[22] Q19: How likely do you think you will be to join a heat network like this if you were given the opportunity? When answering, please assume you would pay no more than you do at present and that the heat supply would be from renewable (low or zero carbon) sources.

79. This doesn't preclude the possibility of there being a hydrogen scenario, with hydrogen playing a role in low carbon heat networks and the counterfactual. It also doesn't preclude emergence of other heat generation technologies, such as deep geothermal, which are being investigated as part of the Department for Energy Security and Net Zero's wider energy remit. At this stage it isn't possible to utilise evidence for these technologies, at the scale required for the zoning policy.

Key Assumptions – Technology Mix

80. The mix of heat network generation technologies that deliver heat in heat network zones is another key assumption in the cost benefit analysis.

81. The Government wants to make it easier for consumers to make the switch to green products by 'rebalancing' prices between electricity and gas to remove existing price distortions. The rebalancing of gas and electricity prices is important for heat network zoning, as it will encourage the transition from existing heat-generating technologies, such as gas-powered combined heat and power (gas CHP), to low carbon technologies.

82. The accompanying consultation discusses the need for legislative limits to be placed on heat networks within zones to ensure that it is not possible for heat networks to develop which are not in line with the country's net-zero ambitions.

83. This has informed the assumptions we have made regarding the generation technology mix. These assumptions influence the following components of the cost benefit analysis:

- Carbon and air quality savings relative to the counterfactual
- Capital and operating costs relative to the counterfactual
- Net energy savings against the counterfactual

84. Our proposed central generation technology mix is derived in part from the recent *Opportunity Areas for District Heating Networks in the UK*[4] modelling project, which determined the availability of waste heat sources from industry which could be utilised in heat networks. This study proposed that 19% of heat network heat demand could be met with waste heat sources, including Energy from Waste (EfW), high temperature waste heat from industry, and waste heat sources that require a water source heat pump to raise the temperature. We assumed that the remainder of the heating was delivered via a mixture of air-, ground- and water-source heat pumps. There is also a role for gas as back-up boilers. The assumed split is described in Table 5 below.

85. The technology mix is assumed to be a constant proportional split of generation technologies during the appraisal period.

Table 5 – Central assumption for generation technologies supplying heat networks in zones.

Technology	% Total Heat Generation
EfW	9%
High Temp Waste Heat	4%
Low Temp Waste Heat	6%
ASHP	14%
GSHP	24%

WSHP	34%
Back-up Boilers	10%

86. Given the uncertainty surrounding the generation technology mix assumption, we have included a sensitivity analysis where the utilisation of waste heat generation is doubled.

87. In the ‘Do nothing’ counterfactual, the buildings are assumed to be heated using the current mixture of heating technologies. This has been derived from the NEED, ND-NEED and ECUK datasets[23]. According to this evidence base, 97% of heating is delivered via individual heating systems, mainly gas boilers, and 3% is delivered via heat networks. This split is assumed to continue in the counterfactual for the analysis. The 3% of heat networks in the counterfactual is assumed to be delivered via gas CHP, energy from waste and water source heat pumps.

Table 6 – Counterfactual ‘Do nothing’ assumption for heating technologies already found within zones, using current mixture of heating technologies

Technology	% Total Heat Generation
Gas Boiler Small	69%
Gas Boiler Large	17%
Electric Heater	11%
DH Gas CHP	1%
DH EfW	1%
DH WSHP	1%

Capital and Operating Costs

88. A key component of the cost benefit analysis is the capital cost of deploying heat networks relative to the counterfactual. Detailed costs can be found in Annex 1 – Detailed modelling assumptions.

89. The capital costs of heat networks are broken down by the costs of heat generation, and the costs of the distribution infrastructure (the network). A significant proportion of the capital cost of deploying a heat network is due to the distribution infrastructure.

90. The capital and operating cost of generation assets are dependent on the assumed technology mix described above and the deployment. Each of the generation technologies has a unique cost. The same is true for the counterfactual heating technologies, which tend to have lower capital costs. The assumed capital and operating costs are broken down by technology, for the factual and counterfactual.

91. As a simplifying assumption, the capital costs of the distribution infrastructure for heat networks are calculated using a single £/ MWh value. The value is £450/ MWh, made up of

[23] Based on internal analysis using the NEED and ECUK datasets. Available at https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework and https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

£150/ MWh for distribution network and £300/ MWh for ancillary costs[24]. The annual operation and maintenance cost of the distribution infrastructure is calculated as a percentage of this value. This assumption is consistent with the value used in the Heat Networks Investment Project analysis and is based on a study of the Department for Energy Security and Net Zero supported projects. The cost for distribution infrastructure is identical in the factual and in the counterfactual, where there is assumed to be limited heat network deployment.

Methodology - Cost to Government

Methodology Section Description
Deployment Model – methodology and key assumptions
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumer - methodology and key assumptions

92. The heat network zoning policy proposals, as described in the accompanying consultation, will result in costs to different parts of government. The cost to government can be split into four areas:

a. **The costs of identifying and refining zones**. This includes the costs of carrying out the modelling exercise to determine where zones may be located and subsequently refining and designating them as such. This stage also involves utilising local information to refine zones and share information with stakeholders via a digital platform.
b. **Feasibility and commercialisation activity for delivering heat networks in zones.** This includes cost to government of engaging with feasibility and commercialisation activities[25].
c. **Implementing and enforcing the zoning policy – Zoning Coordinator function.** There will be a cost incurred by local authorities who will be tasked with running consultation on zoning proposals, engaging with relevant stakeholders, and enforcing the requirements of zoning.
d. **Implementing and enforcing the zoning policy – Central Authority function.** There will be a cost incurred by central government to support the rollout of the heat network zoning by supporting the zoning coordinator function and managing centralised functions, such as an appeals process.

[24] See data benchmarking section in this report: https://assets.publishing.service.gov.uk/media/5a802b44e5274a2e8ab4e95d/heat_networks.pdf

[25] Green Heat Network Fund guidance list types of commercialisation activity that government may need to deliver or oversea delivery by a third party – this includes: negotiating and contracting energy supply; procuring network delivery; legal, technical, commercial and financial support; planning requirements; utility connections; and environmental and geological assessments.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1167772/green-heat-network-fund-r6-overview.pdf

93. Cost to government assumptions have been updated since the previous IA[26] to reflect more developed evidence that has arisen from the Heat Network Zoning Pilot Project (HNZPP); City Decarbonisation Delivery Programme (CDDP); engagement with Heat Network Delivery Unit (HNDU) supported heat networks projects; and the previous consultation[18] for heat network zoning.

Identification and refinement of zones

94. The methodology within this IA assumes that zones will be identified in 200 towns and cities in the central scenario, this is used to inform the costs of identifying and refining zones. The consultation describes in more detail the methodology for the National Zoning Model (NZM), which will be used to identify potential zones across England. It is expected that the NZM will identify potential zones in the largest 200 towns and cities.

95. The key assumptions for zone identification and refinement are presented in Table 7. The costs are generally considered to occur prior to the policy being implemented in 2025.

96. A level of attrition is assumed between identification and refinement of zones, to account for some zones which are identified not presenting a good enough opportunity to take forward.

Table 7 – Central assumptions for the cost to government for identifying and refining zones

Methodology Stage	Assumption	Description and value	Evidence	Sensitivity analysis
Digital platform	One off cost, with negligible ongoing maintenance cost.	£2.3m	HNZPP	Not explored through sensitivity analysis
Developing a National Zoning Model (to identify zones)	One off cost, with negligible ongoing maintenance cost.	£2m	HNZPP	Not explored through sensitivity analysis
Initial zone identification for towns/cities	Number of towns/cities initially screened to identify zones	200	HNDU, HNZPP	Explored in the sensitivity analysis in section
	Cost per town/city	£1,500	HNZPP	Explored in the sensitivity analysis in section
Local refinement for towns/cities	Proportion of towns/cities progressing to	85% (170 towns and cities)	HNDU studies	Not explored through

[26] The previous zoning final stage (primary) impact assessment was included in the Energy Bill which began parliamentary proceedings in summer 2022. The previous IA can be found in the IA section within the file 'Impact Assessments 7 July 2022': https://bills.parliament.uk/bills/3311/publications

	local refinement stage			sensitivity analysis
	Cost per town/city	£50,000	CDDP/HNZPP	Explored in the sensitivity analysis in section

Feasibility and commercialisation activity to enable delivery of Heat Networks in zones

97. To deliver heat networks in zones the zoning coordinator or central authority would need to undertake or manage feasibility and commercialisation activity.

98. The zoning policy seeks to enable deployment of public sector, joint public-private, and wholly private sector heat networks via different route to market processes. These three overarching options are discussed in more detail in the accompanying consultation, however, for quantification in this IA we have summarised them as follows:

- **Public sector delivery.** The zoning coordinator would have direct involvement in the feasibility, commercialisation, delivery, and ownership of the network and would retain strategic oversight of the development of the network.
- **Private sector/third party delivery.** The zoning coordinator may procure a private company to develop the heat network on their behalf and would have limited involvement in its delivery, ownership, and strategic oversight.
- **Joint public-private sector delivery.** Intermediary between 'public sector' delivery and 'private sector delivery'.

99. Table 8 presents the cost to government for undertaking feasibility and commercialisation activity for the 'public sector' and 'private sector' delivery mechanisms. The 'public sector' delivery cost represents the cost of a zoning coordinator or central authority leading with feasibility and commercialisation activity to deliver heat networks to zones; whereas the 'private sector' delivery represents government funding to resource the zoning coordinator to manage the process of delivering heat network by one or more private sector actors. 'Joint public-private sector' delivery has not been costed in this Impact Assessment, but it is expected that costs will fall in between the other two other delivery mechanisms.

100. Following on from the Identification and refinement of zones stage, we assume within the 170 towns and cities on average three zones will be identified (510 zones in total) which will undergo government funded feasibility studies, on a per zone basis. The level of government funding for feasibility work is assumed to vary based on the delivery mechanism.

101. Following on from feasibility stage we assume there will be attrition in feasible zones ahead of commercialisation stage (459 zones). The main difference between the delivery mechanisms is the level of which commercialisation activity, undertaken by government, is carried out. Under public sector delivery, commercialisation activity is carried out at the zone level (459), whereas, for private sector delivery, commercialisation activity is caried out at the town/city level (153).

Table 8 – Central assumptions for the cost to government for feasibility and commercialisation activity, by route to market option

Delivery mechanism	Activity	Assumption	Description and value	Evidence
Public sector delivery	Feasibility stage	Central or local government would undertake full feasibility studies for zones.	£100,000, per zone (510)	HNDU
	Commercialisation activity	Central or local government would undertake all commercialisation activity for zones.	£1m, per zone (459)	GHNF[27]
Private sector delivery	Feasibility stage	Central or local government would undertake 'minimal' feasibility studies for zones. Private investment would be required to undertake full feasibility studies.	£50,000, per zone (510)	HNDU
	Commercialisation activity	Central or local government would undertake only compliance checks, such as issuing licences, to enable private organisations to undertake commercialisation activity.	£200,000 per town/city (153)	HNDU

Implementing and enforcing the zoning policy – Zoning Coordinator function

102. It is anticipated that the zoning proposals, as described in the consultation, will place an additional burden on local government as they take on the role of local 'zoning coordinators'. The consultation discusses scenarios where the local government does not assume the role of the zoning coordinator and this is instead fulfilled by the central authority; however, for simplicity in the impact assessment we have assumed that the local government would take on the zoning coordinator function.

103. Zoning coordinators will be responsible for implementation and enforcement activities such as:

- Local engagement and consultation ahead of zone designation;
- Formally designating zones; and
- Enforcing local zoning requirements.

104. Since the previous IA, the assumptions for implementing and enforcing the policy have been revised to reflect updated HNDU evidence. It is now expected that fewer zoning coordinators would be appointed to reflect existing relationships between local authorities,

[27] This is the maximum limit for commercialisation support from government under the Green Heat Network Fund: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1167772/green-heat-network-fund-r6-overview.pdf

such as combined authorities and the Greater London Authority (GLA)[28]. The number of zoning coordinators that are anticipated to be appointed is estimated to be 75.

105. The number of zoning coordinators is immaterial to the cost to government calculations in this impact assessment, as costs are calculated on a per town/city or zone basis. The amount of resource required for individual zoning coordinators is assumed to vary based on number of zones that the zoning coordinator supports.

106. The average number of full-time staff that would be required per zone is anticipated to vary depending on the mechanism for delivering heat networks in zones (public, joint public/private, private). We have estimated the zoning coordinator resourcing requirements for public sector delivery and private sector delivery in this IA.

107. For public sector delivery it is anticipated that, on average, 5 full-time staff would be required per zone. It is not anticipated that all zones will be delivered at once, we estimate that on average 18 zones will be delivered per year, summing to 459 zones by 2049 (assuming a uniform distribution over 25 years). Therefore, the average full-time staff per year for the entire zoning coordinator function is expected to be 92 FTE per year. The central authority resourcing will be additional to this, see the follow section for more details.

108. For private sector delivery, there may not be a need for dedicated resource for zoning coordinator staff to implement and enforce the zone, instead the heat network developer or operator may assume greater responsibility. It is expected that under the private sector delivery a zoning coordinator would require some resourcing for approvals and assurance; therefore, a one-off payment to local authorities has been assumed to cover any staffing requirements to enforce and implement the zones.

Table 9 – Resourcing cost for implementing and enforcing zones, by route to market option

Delivery mechanism	**Description of assumptions**	**Assumption**
Public sector delivery	Staffing cost on a Full Time Equivalent (FTE), per zone, per annum basis	5 FTE per zone pa, equating to 92 FTE total pa, 2025 to 2049
Private sector delivery	One-off payment to the zoning coordinator for any staffing requirements on a per zone basis	£200,000

109. Public sector delivery assumptions for resourcing the zoning coordinators have been based on evidence from Heat Network Delivery Unit (HNDU) supported projects. Resourcing has been assumed to be uniformly profiled between 2025 to 2049, which is a simplifying assumption, due to the requirement for further analysis.

[28] Powers in the Energy Act provide that zoning coordinators can be constituted at county, district, or metropolitan level, and that several local authorities may work jointly as the zoning coordinator for a wider area.

110. Further development of these assumptions will be conducted ahead of the final stage IA – this will include an assessment of zoning coordinators resourcing requirements over time to deliver both short-term and long-term functions for the zone.

111. FTE resource costs are equivalent to an average Grade 7 salary in government. The cost is calculated using the Civil Service Median Salaries by grade[29] and applying a wage uplift of 19.2%[30].

Implementing and enforcing the zoning policy – Central Authority function

112. To support the rollout of the zoning methodology, it is assumed that there will need to be an expansion in heat networks technical expertise within the Department for Energy Security and Net Zero, beyond existing levels. In addition, some of the existing heat networks staff in the Department for Energy Security and Net Zero would be deployed to deliver the zoning policy.

113. The types of function that staff would undertake include but are not limited to (further information is available in the consultation):

- Zone identification, designation, and supporting zoning coordinators with these processes;
- Developing guidance for local government to implement and enforce zoning;
- Establishing and maintaining a monitoring and reporting framework for the policy;
- Manging of appeals process; and
- Review of designation of zones, and zoning methodology

114. For the purposes of this IA, we have assumed that there would need to be an additional 30 staff members. This has been calculated by comparing the current amount of relevant Department for Energy Security and Net Zero resource and the number of heat network projects they support. This will be kept under review and developed further through upcoming business cases for delivering the policy.

115. Staffing costs are calculated by using the Civil Service Median Salaries by grade and applying a wage uplift.

Table 10 – Number of FTE required at the Central Authority to implement and enforce zones

	Senior managers (CS Grade 6)	Junior managers (CS Grade 7)	Total FTE
Central	3	27	30

[29] Civil Service Median Salaries by grade: https://www.gov.uk/government/statistics/civil-service-median-salaries-by-uk-region-and-grade

[30] Wage uplift RPC note: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827926/RPC_short_guidance_note_-_Implementation_costs__August_2019.pdf

Variation between policy options

116. Due to the expectation that the two policy options, which require different building categories to connect, will deliver similar levels of deployment of heat networks, and that this would translate into similar numbers of suppliers, number of heat networks, number of buildings and number of customers; the cost of regulating additional heat networks has been assumed to be constant between policy options.

117. Further non-monetised impacts on government are described in the Non-monetised costs and benefits section.

Methodology – Cost to Business

Methodology Section Description
Deployment Model – methodology and key assumptions
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumer - methodology and key assumptions

118. The costs to business that have been quantified in the impact assessment cover the costs that will be incurred by:

a. **Heat network developers and operators.**
    i. Developers and operators will need to familiarise themselves with the Heat Network Zoning policy proposals.
    ii. Operators will also need to comply with the Heat Network Market Framework[31].

b. **Building owners/occupants that are required to connect to heat networks.**
    i. Building owners/occupants may need to provide information for the building to inform the identification, refinement and designation of zones and delivery of heat networks (comply with the policy)
    ii. Depending on circumstance, the building owner/occupant may apply for an exemption to the policy.

Heat Network Developers and Operators

119. Heat network developers and operators will each incur familiarisation costs to understand and comply with policy proposals. There would be a one-off cost to reading and

[31] Heat Network Market Framework proposals (2020): https://www.gov.uk/government/consultations/heat-networks-building-a-market-framework

understanding the requirements of the regulation, and then disseminating to their respective organisations. For both developers and operators, the central assumptions are as follows:

Table 11 – Central assumptions for familiarisation costs of policy proposals to heat network developers

Assumption	Descriptions and value	Evidence	Sensitivity analysis
Time per HN developer/ operator	**1.5 weeks (56 hours) FTE per HN developer/ operator** Familiarisation – read and understand the requirements of the regulation, disseminate to staff. Use same assumption as HMBR IA	Responses to HNZ first consultation[32]	Explored in the sensitivity analysis in section
Familiarisation person required	**75% HNs developers use 'Estate Manager', 25% a consultant** Same as HMBR IA. Average wage £26/ hour	HMBR IA[33]/ ONS Annual Survey of Household Earnings[34]	Not explored through sensitivity analysis
Time Period	**2025 – 2034** Cost incurred in first years of policy.	Judgement	Not explored through sensitivity analysis

120. Heat network operators will also incur additional costs under the Heat Network Market Framework[31] of notifying the regulator of their existence and reporting annually on the performance of their network. Following the assumptions set out in the Heat Network Market Framework consultation stage IA[35] we have assumed that it takes each heat network operator on average 1 day a year to collect data on the heat network and report to Ofgem.

Building owners/occupants within Zones

121. The consultation proposes a requirement for building owners/occupants within zones, or potential zones, to provide certain information and data to inform the process of zone identification, refinement and/or designation and to support the delivery of the heat network. This cost to business is defined as a 'cost to comply' with the policy.

122. The consultation describes the role of the central authority as having overall responsibility for data, as the data custodian. The data custodian will be responsible for

[32] Heat Network Zoning government response (2022): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1083318/heat-networks-zoning-consultation-government-response.pdf

[33] Heat Metering and Billing Regulations Impact Assessment (2020): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933316/hmbr-final-ia.pdf

[34] ONS Annual Survey of Household Earnings: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashetable14

[35] Heat Network Market Framework consultation stage IA (2020): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863855/heat-networks-market-framework-consultation-impact-assessment.pdf

managing dissemination of information between the central authority, zoning coordinators and heat network developers.

123. Where a building is required to connect to a heat network and has multiple owners/occupants, such as a domestic communally heated residential block; it is assumed that the cost for complying or applying for exemption would be borne by one single actor representing the whole building.

124. It has been assumed that it takes each of the building owners/occupants, on average, 2 Full Time Equivalent (FTE) days to 'comply' with the policy.

125. Buildings that are required to connect to heat networks in zones will be able to apply for an exemption from this requirement. The process for doing so is described in the consultation. It has been assumed that applying for an exemption to the policy will be mutually exclusive with complying with the policy.

126. It is expected that a 'cost effectiveness test', similar to that for the Heat Networks Metering and Billing Regulations, will be used to assess whether a building can be exempted from complying with the heat network zone on cost grounds. If a building owner/occupant can provide evidence that their building can be heated more cheaply using an alternative technology (either low carbon or high carbon) then they can be exempted from the policy.

127. The amount of information and data that building owners/occupiers may need to provide to comply with the policy may also be reduced, by sourcing information elsewhere where available, such as Energy Performance Certificates.

128. The current assumption is that 20% of buildings which are required to connect to a heat network, apply for exemption. Due to greater levels of uncertainty, it has not been possible to estimate the number of successful exemptions, nor the number of cases being escalated to the appeals process where an exemption is not granted. We will use the Advanced Zoning Programme[36] to improve our evidence base on prevalence and reasoning for building owners to apply for exemption to the policy.

129. The 'cost effectiveness test' has not yet been fully defined, therefore, for the purposes of this IA, we have assumed that the resource required to complete the test will be similar to the Heat Networks Metering and Billing Regulations cost-effectiveness test[37], which is on average, 2 Full Time Equivalent (FTE) days.

130. The Heat Network Zoning policy will place regulatory burden on building owners/occupants that are required to connect to a network, via the compliance or exemption process. However, by complying with the policy the building owner/occupier would avoid practical steps and cost for replacing their heating system with an alternative heating technology. Therefore, although the heat network zoning policy would impose regulatory burden on building owners/occupiers, it would alleviate practical burden for replacing heating supply. Displacement of practical cost of installing an alternative heating is included as a non-monetised benefit of the policy.

131. The assumptions used to calculate the cost to building owners/occupiers are presented in Table 12. These costs are assumed to occur between 2025 and 2049.

Table 12 – Costs to buildings which are required to connect

[36] The Advanced Zoning Programme (AZP) will involve collaboration between the Department for Energy Security and Net Zero and several early adopters of the zoning policy (Local Authorities and Combined Authorities).

[37] Heat Networks Metering and Billing Regulations cost-effectiveness test: https://www.gov.uk/guidance/heat-networks - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1001060/heat-networks-full-input-cost-effectiveness-tool.xlsm

Assumption	Approach	Evidence Source	Sensitivity analysis
% Comply with the policy	**80% of buildings, required to connect, will comply with the policy**	Judgement	Explored in the sensitivity analysis in section
Requirement to provide information	**15 hours** Assume two days to collect data on heat demand and sharing the information with the local zoning coordinator.	Judgement	Explored in the sensitivity analysis in section
% Exemptions	**20% of buildings, required to connect, apply for exemptions**	Judgement	Explored in the sensitivity analysis in section
Exemption cost Effectiveness Test time taken	**15 hours** Assume two days to collect data and use an online cost effectiveness calculator, similar to the HMBR calculator.	HMBR IA[38]	Not explored through sensitivity analysis
Resource rate cost (resource cost for both exemptions and compliance processes)	**75% HNs developers use 'Estate Manager', 25% a consultant** Same as HMBR IA Average wage £26 / hour	HMBR IA	Not explored through sensitivity analysis

Variation between policy options

132. We have made the simplifying assumption that the costs to business would be equal across each of the policy options. The reason for making this assumption is that the level of deployment that is estimated for each of the policy options are similar, therefore, we assume:

- The number of zones and number of heat networks would be similar; therefore, similar numbers of developers and operators would be required to comply with the policy.
- The number of buildings being required to connect to a heat network would be similar; therefore, similar numbers of compliance and exemption processes would be required to be submitted by building owners/occupiers.

133. Further non-monetised impacts on businesses are described in the Non-monetised costs and benefits section.

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[38] Heat Metering and Billing Regulations Impact Assessment (2020): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933316/hmbr-final-ia.pdf

Methodology – Cost to Consumers (heat network, gas, and electricity consumers)

Methodology Section Description
Deployment Model – methodology and key assumptions
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions
Cost to Consumer - methodology and key assumptions

134. The cost represented in this section are for additional regulatory costs for heat networks under the Heat Network Market Framework. The additional regulatory cost is due to the zoning policy significantly increasing the size of the heat network market from current levels.

135. The consultation for cost recovery proposal[39] for the Heat Network Market Framework concluded that Ofgem's and Citizens Advice's total ongoing costs of regulating the current and future heat networks, gas, and electricity markets should be spread evenly across heat network, gas, and electricity consumer bills. This option will be progressed into forthcoming legislation.

136. The latest Heat Network Market Framework impact assessment[40] considers only the impacts of regulating the current heat network market (plus a small expansion, based on current growth trajectories); therefore, we have captured the additional cost of regulating heat networks that arise from zoning in this impact assessment.

137. The methodology used to estimate the additional regulator cost for future zoned heat networks, is consistent with the methodology used in the Heat Network Market Framework impact assessments (for the existing heat network market).

138. In the final stage Heat Network Market Framework impact assessment, we will look to include the cost of regulating both the current and future heat network market. Therefore, this cost will be moved to the heat network market framework policy analysis, which will be reflected consistently in both final stage impact assessments for the Heat Network Market Framework and Heat Network Zoning policies.

139. Other potential impacts of the policy on cost to consumers are discussed in the Consumer Bills section of this impact assessment.

Non-monetised costs and benefits

140. There are several non-monetised costs and benefits that are not captured in the cost-benefit analysis, and therefore that are not included in the calculated SNPVs of the policy options.

- **Whole electricity system impact** – Large scale heat networks with thermal stores and an electric source of heat are strategically important in making a low carbon power supply sector more resilient, by delivering an option to reduce peak demand and/or maximise use of intermittent electricity generation. A smart and flexible electricity system could save up

[39] Heat networks cost recovery proposals (2022): government response: https://www.gov.uk/government/consultations/recovering-the-costs-of-heat-networks-regulation

[40] Heat networks consumer protections: impact assessment (2023): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1176219/heat-networks-consultation-ia.pdf

to £10bn per year by 2050[41]. The flexibility/storage capabilities of heat networks could contribute toward this, although there is limited evidence on the scale of potential benefits.

- **Jobs and GVA impacts –** A significant increase in investment in the heat networks sector is anticipated to support UK jobs in the design, construction and operation of heat networks. The investment in heat networks is also expected have multiplier effects in the wider economy such as: providing energy savings for users of heat networks; increasing or safeguarding UK jobs and developing the operations of Energy Service Companies (ESCos). The indirect GVA impacts are uncertain and therefore have not been quantified in this analysis.
- **Cost to government –** there are further costs to government which haven't been quantified in the IA as it hasn't been considered proportionate to do so at this stage. These costs are listed below:
    - **Capital support** – as discussed in the long-list options section of this IA, it is expected that government capital support will be required alongside regulation to deliver low carbon heat networks at scale. Total capital cost is presented in this IA; however, it is not broken down by government versus private investment. It is currently not possible to monetise the full level of government capital support required due to uncertainty of future schemes.
- **Costs to business** – there are further costs to business which haven't been quantified in the IA as it hasn't been considered proportionate to do so at this stage. These costs are listed below:
    - **Disruption costs** – there would likely be disruption costs associated with a significant deployment of heat networks. The disruption could take the form of street works where roads need to be dug up, or disruption due to buildings being retrofitted to be suitable for connection to a heat network. The magnitude of disruption costs is expected to be in-line to disruption through the low-carbon counterfactual.
    - **Delivery cost** – The heat network developer will incur cost for undertaking commercialisation and delivery activity to deliver heat networks. There is likely to be a trade-off between government and private financing of commercialisation activity. One of the main factors that would influence the proportion of government/private finance required, will be the mechanism for delivering heat networks in zones (public sector, private sector, or joint public-private sector delivery). Commercialisation cost incurred by the private sector is not costed as it is assumed that it would be recovered via the company's business model.
    - **Compulsion to supply** – the owners of an ambient or non-ambient waste heat source may be required to supply a heat network with their heat. This heat will be low carbon relative to the counterfactual but supplying it will incur a cost to the business. The magnitude of impact of the compulsion to supply on business is expected to be minimal and could offer opportunities for building owners to generate revenues through sale of heat to the network.
    - **Connection cost -** The building owner/occupants may need to pay a connection charge for joining the heat network, however, this would offset cost of installing an alternative heating solution. The prior zoning consultation[18] confirmed that the department will consider a proposal for a standardised methodology for calculating

[41] Transitioning to a net zero energy system: smart systems and flexibility plan (2021): https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021

appropriate connections costs which will be considered as part of wider price regulation work.

Research into the current heat network market[42] shows that heat network connection charges are typically costed at a price that is less than or equivalent to the technology they are offsetting, such as an individual gas boiler.

Given the level of uncertainty of the capital cost of a new low carbon heating system (heat network or alternative), and the potential role for capital support for consumers, we assume that these costs are equal in the factual, counterfactual comparison and therefore include connection cost as a non-monetised factor. We have however provided an indication of the scale of connection costs in the Small and Micro Business Assessment section.

Further discussion on cost for building owners/occupants under different heating scenarios is also discussed in Annex 6 – Potential impacts of the Heat Network Zoning policy on stakeholder groups.

- **Penalties** – A building or waste heat source owner may receive a penalty for not complying with the zoning policy - this will be subject to the outcome of an exemption and appeals process. The structure of penalties is being consulted on through the accompanying consultation. The cost of penalties for non-compliance on businesses has not been monetised in this IA, in accordance with appraisal guidance[43].

- **Benefits to business –** There will be benefits arising from the implementation of the heat network zoning policy, which haven't been quantified in this impact assessment. The benefits are listed below:
  - **Supply chain development –** by incentivising additional deployment of low-carbon heat networks relative to the counterfactual, heat network zoning will support the development of low-carbon heat supply chains. The policy will provide a strong signal to the market of government ambition and will introduce sustained public investment over a 25-year period, which is expected to have a large and sustained impact on supply chains. This will provide more certainty to the low carbon heat sector, allowing businesses to align strategies, investment plans and training, and drive forward innovation in technologies and business models.

    Whilst supply chain development is not a monetised cost, it will impact on capital and operating costs. These costs are based on current values, therefore, do not reflect cost reductions over time, through maturing supply chains. Development of the supply chain is likely to reduce these costs through competition and economies of scale. There may be cost increases in the short-term as supply chains adapt, however, through to 2050 it is anticipated that there will be large scale change to energy supply chains; therefore, there is opportunity for existing supply chains to adapt to benefit heat network supply chains.

[42] Ongoing research conducted by WSP on behalf of the UK District Energy Association. Currently unpublished.

[43] When introducing, amending or removing a regulatory measure, costs and benefits should assume 100% compliance, unless there is evidence to the contrary, in which case evidence on actual levels of compliance should be used. (BRFM 2.3.45-46). Costs and benefits that businesses incur only because they are non-compliant should not be included in the EANDCB. (BRFM 1.2.16): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/609201/business-impact-target-guidance-appraisal.pdf

- **Displacement of cost for installing an alternative heating supply** – The cost of complying with the heat network zoning regulations is monetised in this Impact Assessment to reflect additional regulatory burdens on business. However, by complying with the regulations, the building owner/occupant would displace costs for installing an alternative heating system, such as research and consulting advisory services. Instead, this service would be provided by the zoning coordinator and heat network developer.

Results of Analysis for shortlist policy options

141. This section of the impact assessment presents the headline results from the appraisal of the policy. The two headline results that are focused on in this section are:

- Total deployment of heat networks within zones, and of which is attributable to the zoning policy only.
- Social value of the zoning policy, using a cost benefit analysis.

Results - Deployment of heat networks within zones

142. For assessing the social value of the heat network zoning policy, only deployment that is directly attributable to the zoning regulations will feature within the cost benefit analysis.

143. However, for illustrative purposes, Table 13 below presents the total or 'gross' heat network deployment that could be achieved within zones as a result of combining deployment from the zoning policy, other schemes, and existing heat networks.

144. Table 13 presents the peak annual deployment of heat network in zones, measured in TWh/yr, that can be achieved under three scenarios by 2050.

145. The central scenario represents our best estimate of how the zoning policy could be delivered – both policy options are presented for the central scenario in the table. The 'lowest' and 'highest' scenarios provide a range of how the zoning policy could be delivered under different levels of regulation, and public attitudes for connecting to low carbon heat networks.

146. Deployment has been adjusted to reflect expected energy efficiency improvements that are expected for existing building stock.

Table 13 – Total deployment of heat networks in zones, by scenario

Scenario Assumptions	Central scenario - High policy option	Central scenario - Low policy option	Lowest scenario	Highest scenario
Policy option	High (preferred policy option)	Low	Low	High (preferred policy option)
Threshold for requiring buildings to connect	≥ 100 MWh heat demand per year	≥ 100 MWh heat demand per year	≥ 100 MWh heat demand per year	No threshold - all buildings in zones are required to connect.
Public attitudes - Rate of voluntary connection 'infill'	70% of buildings that are not required to connect to a heat network in a zone, connect voluntarily.	70% of buildings that are not required to connect to a heat network in a zone, connect voluntarily.	No buildings connect voluntarily.	NA based on threshold, but this scenario could also represent all buildings in zones connecting to heat networks voluntarily.

Deliverability - Number of town and cities (where zones are implemented, England)	The top 200 largest towns and cities (population > 50k)	The top 200 largest towns and cities (population > 50k)	The top 100 largest towns and cities (population > 100k)	The top 300 largest towns and cities (population > 35k)
Heat network deployment from zoning - existing buildings only (TWh/yr)	37.1	36.3	11.6	52.4
Heat network deployment from zoning - new buildings only (TWh/yr)	1.0	1.0	1.0	1.0
'Baseline' heat network deployment in zones from other schemes or pre-existing heat networks (TWh/yr)	10.7	10.7	10.7	10.7
Total heat network deployment within zones - deployed by zoning, other schemes or pre-existing heat networks (TWh/yr)	48.9	48.1	23.3	64.1

147. Table 13 shows that for the preferred 'high' policy option, under central assumptions, could lead to 48.9 TWh/yr of heat being delivered by heat networks within zones in England, by 2050; of which, 38.1 TWh/yr would be directly attributed to the zoning regulations.

148. Table 13 also shows that under the 'highest' assumptions for deliverability and public attitudes for zoning, 64.1 TWh/yr of heat being delivered by heat networks within zones in England, by 2050; of which, 53.4 TWh/yr would be directly attributed to the zoning regulations.

149. The total space and hot water heat demand for England, presented in *Opportunity Areas for District Heating Networks in the UK*[4], is estimated to be 439 TWh in 2050. Therefore, for the preferred policy option, under central assumptions, total heat network deployment in zones could account for 11% of total heat demand in England. Under the Highest scenario heat networks within zones could account for 15% of total heat demand in England.

150. There are studies undertaken by the Committee on Climate Change[3] and DESNZ[4] to assess the potential for heat networks in the UK. The studies found that 18-20% of total UK space and hot water heat demand could be served by heat networks by 2050; however, these potentials do not fully take into consideration public attitudes toward heat networks or deliverability of heat networks, which have been considered in Table 13.

151. The central deployment estimate for the low policy option does not vary by much from the central deployment estimate for the high policy option (as shown in the table above), as only communally heated residential buildings are excluded from the 'requirement to connect', however, the 70% voluntary connection assumption means that we assume many would connect anyway.

Results - Social value of the zoning policy - cost benefit analysis

152. To appraise the social value of the heat network zoning policy a comprehensive cost benefit analysis has been undertaken to capture monetised costs and benefits for the policy. See section Monetised costs and benefits of each option (including administrative burden) for more information on what has been captured in the cost benefit analysis.

153. A key influencing factor of the social impact of the zoning policy is deployment of heat networks that are attributed to the policy, as this provides the scale of heat demand from buildings which is displaced by the policy. To appraise the zoning policy through a Cost Benefit Analysis (CBA), the following adjustments are made to the deployment estimate (from the previous section):

- The deployment assumption that we input into the CBA represents existing buildings in zones that are decarbonised as a direct result of the zoning policy, 37.1 TWh/yr.
    i. We do not include deployment from new buildings in the CBA since there are other policies, such as the Future Buildings Standard (DLUHC), that require new builds to have low carbon heating systems, and there is negligible marginal gain for the zoning policy.
    ii. We do not include deployment within zones that has arisen from any other heat network scheme, as social value is attributable to those schemes.
    iii. We do not include deployment from existing heat networks within zones since we attribute the social impact of regulation of those networks under the Heat Network Market Framework.
- A ramp up profile is assumed to simulate the trajectory of deployment over time.
    i. The ramp up profile starts in 2030 and reaches peak deployment in 2050. The reason for assuming a ramp up start from 2030, as opposed to 2025, is to simulate a lag between regulation being enforced and heat networks being delivered; and to reflect that most heat networks being deployed between 2025 and 2030 are likely to be supported by (therefore social value attributed to) other heat network schemes, such as the Green Heat Network Fund.
    ii. The ramp up profile is assumed to be linear over the period. This assumption has been used as the simplest (least parameterised) solution. It is expected that the real-life deployment profile for the zoning policy will follow a S-shaped growth curve, and we are developing an evidence base

to simulate the growth curve through the heat network strategy[44]. We aim to utilise this new evidence at final stage.

154. The Social Net Present Values (SNPVs) of the policy options are presented in Table 14 below. Also shown are the constituent monetised values that make up the SNPV. Carbon savings and capital costs are by far the largest of the monetised values, accounting for most of the monetary benefits and costs of the policy respectively. Table 14 also presents the Benefit-Cost Ratio (BCR) which measures benefits per unit cost.

Table 14 – Social Net Present Value (SNPV) and Benefit-Cost Ratio (BCR) of the policy options relative to the 'do nothing' counterfactual, 2021 prices.

Monetised value (£m, 40 years)	**High policy option (preferred)**	**Low policy option**
SNPV	**7,530**	**7,350**
Capital costs	-9,030	-8,830
Operating costs	-400	-400
Carbon savings	17,230	16,860
Air quality benefits	400	390
Fuel cost	-50	-50
Cost to Government	-380	-380
Cost to Business	*-80*	*-80*
Cost to Consumers	-160	-160
BCR (%)	**174%**	**174%**

155. The quantified SNPVs of the costs and benefits described in this IA show that the impacts of the proposed policy would lead to a net benefit for both policy options.

156. The primary driver of costs are high upfront capital costs compared to the counterfactual reflecting the significant cost of the distribution infrastructure of heat networks. The 'do nothing' gas boiler counterfactual is relatively low cost in comparison, as the existence of gas distribution infrastructure is assumed as a sunken cost.

157. The primary benefit of the policy is carbon savings, a key policy objective of heat network zoning, which are achieved by displacing fossil fuel heating systems with low carbon district heating.

158. The BCR is 174% for both policy options indicating that there is a £1:£1.74 ratio of monetised costs and benefits. The high policy option has slightly higher benefits from carbon savings because it has higher deployment, due to the inclusion of requiring communally heated residential building to connect to heat networks. However, that is offset by slightly higher capital costs.

159. Cost to government for developing and delivering the policy is assumed to be constant between the policy options; therefore, there is a slight increase in Value for Money (VfM) for government to deliver the preferred (high) policy option. This is also estimated to be true for non-monetised benefits.

[44] The heat network strategy is expected to be published in 2024.

160. Some key non-monetised social benefits are also expected to be greater for the high policy option. For example, the ability for large scale heat networks to offer the electricity grid flexibility benefits is a significant non-quantified benefit of the policy. This is expected be greater under the preferred option, because of higher total heat network deployment. Likewise, the development of the heat network supply chain, under the high policy option, would see the greatest opportunity for capital costs to decrease through economies of scale and competition. The high policy option would also result in a greater number of direct and indirect jobs. This adds further weight to the high policy option being the preferred option.

161. The combined SNPV of the wider Heat Network Transformation Programme, comprising of the Green Heat Network Fund, Heat Network Market Framework and Heat Network Zoning, is estimated to have overall positive value to society. Furthermore, there has been no assessment of synergy between the individual policies, which could benefit the overall societal value of the Heat Network Transformation Programme.

Results - Carbon emissions

162. The estimated carbon savings for the policy options are presented in Table 15 and includes traded and non-traded savings. The numbers are made up of significant non-traded savings, and a slight increase in emissions in the traded sector. This is due to moving away from the fossil fuel (non-traded) counterfactual, and the factual heat networks consuming electricity which is traded.

163. Since we assume that heat networks will be deployed under the zoning policy from 2030, and the ramp up to full deployment will occur in 2050, the carbon savings during the carbon budget periods do not represent the peak carbon saving that would be delivered by the policy.

164. Carbon savings in the periods 2038-2049 and 2050-2061 have been presented to indicate the longer terms carbon savings from the policy, during the appraisal period, which better reflect the long-term carbon savings from deploying heat network infrastructure.

Table 15 – Carbon Emissions Reductions (traded and non-traded) of policy options, $MtCO_2e$

Period, $MtCO_2e$	High policy option (preferred)	Low policy option
Carbon Budget 4 2023-2027	0	0
Carbon Budget 5 2028-2032	1	1
Carbon Budget 6 2033-2037	7	7
Savings 2038 –2049	45	44
Savings 2050 – 2061	64	63

Results - Cost to Government

165. The cost to government of developing, delivering, and implementing the policy is set out in Table 16. As described in the methodology section, there are four main components of the cost to government, and the cost to government is not assumed to vary between the policy options.

166. The consultation document discusses three overarching ‘route to market’ options for delivering heat networks in zones, ‘public sector delivery’, ‘private sector/third party delivery’ and ‘joint Public/Private sector delivery’. The options vary in terms of the level of involvement that the central authority and zoning coordinators will exhibit in delivering the heat network to zones, which will result in varying levels of funding requirements. Further, the ‘public sector delivery’ is viewed as the option where the local authority would have greater involvement in

the delivery of heat networks in zones, which would provide a greater level of influence in delivering the social value of the policy.

167. 'Public sector delivery' and 'private sector/third party delivery' have been costed separately in the table below, it has not been possible to undertake a detailed assessment of how each option would impact on the capability to deliver the social value from the policy. We assume that the 'public sector delivery' is likely to have the best chance of delivering the social value for the policy, as presented in Table 14, as it will provide more resources to the zoning coordinator to deliver the policy.

168. Therefore, in the central SNPV we have assumed the cost to government for delivering the policy would be in line with the level of funding required for the 'public sector delivery'.

Table 16 - Cost to Government Breakdown by route to market option, 2021 prices

Activity, (£m, 40 years)	**Public sector delivery (Central assumption)**	**Private sector/third party delivery**
Identifying and designating zones, and digital platform	10	10
Feasibility and Commercialisation activity for delivering HNs (not including private funding)	270	30
Implementation and enforcement by the zoning coordinator	80	50
Implementation and enforcement by the central authority	10	10
Total	**380**	**110**

169. It should be noted that the feasibility and commercialisation activity will involve private investment, which is not reflected in the cost to government table above.

170. The most significant cost, under the 'public sector delivery' would come from feasibility commercialisation activity for zones. More information on what is included within commercialisation activity can be found in paragraph 90. The reason for the large difference in cost between the two routes to market options is that the 'public sector delivery' option would be led by the public sector (local authority); whereas the 'private sector delivery' option would rely on the private sector to undertake the majority of the feasibility studies and commercialisation activity. A small cost to government would be required under the 'private sector delivery' option to provide basic assurances of delivery of social value through heat networks in zones. It is possible, depending on future policy, some feasibility studies and commercialisation activity may be funded publicly, but a private sector delivery option is used for the development costs of the network.

171. As mentioned in the methodology section, we have made a simplifying assumption that the costs to government don't vary with the policy options, due to there being only small variation of heat network deployment between the policy options. This IA therefore implicitly assumes that the modelling to determine where zones should be, and the implementation of those zones doesn't vary with the policy options.

Results - Cost to Business

172. The direct monetised costs to business are described in the 'Methodology – Cost to Business' section. There are also some costs and benefits to business that can be found in the Non-monetised costs and benefits section of this IA.

173. We have made the simplifying assumption that the costs to business would be equal across each of the policy options (see Methodology – Cost to Business). The reason for making this assumption is that the level of deployment that is estimated for each of the policy options is similar.

174. The business Net Present Values (NPV) and Equivalent Annual Net Direct Cost to Business (EANDCB) values are presented below for the preferred policy option.

175. The estimates in the table below represent impacts to business following implementation of primary and secondary legislation.

Table 17 – Business Net Present Value and Equivalent Annual Net Direct Cost to Business (EANDCB)

Business NPV	**2019 Prices, 2020 Base year (£m)**
Total Business Costs	76
Total Business Benefits	0
Net Total Business Impact	-76

EANDCB	**Annualised (£m)**
Direct Business Costs	3
Direct Business Benefits	0
Net Direct Cost to Business	-3

Results - Low Carbon Counterfactual

176. As discussed in the Counterfactual section of this impact assessment, a comparison of the policy against a low carbon counterfactual has also been considered – this low carbon counterfactual is not generally referred to in this impact assessment to avoid conflation with the 'do nothing' high carbon heating counterfactual which is the main counterfactual that is discussed in this IA.

177. In the absence of a heat network zoning policy, given the government's Net Zero commitments, it is likely that most buildings would be decarbonised by individual air source heat pumps in an electrification scenario. This IA predates a strategic decision on large scale usage of hydrogen for heating, therefore hydrogen heating solutions have not been considered in this IA.

178. Given the extent of the evidence required to compare the heat network zoning policy to an alternative low carbon heating technology pathway, including the level of certainty of low carbon heating policy, we advise caution in interpreting the quantified comparison. The reason for providing a quantified comparison of the policy against an alternative low carbon heating technology pathway, is to demonstrate the main factors that justify why heat

networks are a low-cost solution for decarbonising heating in building within zones. See Table 18 below.

Table 18 – Social Net Present Value (SNPV) and Benefit-Cost Ratio (BCR) of the zoning policy relative to a Low Carbon Heating counterfactual (LCH), 2021 prices.

Monetised value (£m, 40 years)	**Zoning policy – LCH counterfactual**
SNPV	**9,380**
Capital costs	10,620
Operating costs	-480
Carbon savings	-2,570
Air quality benefits	-50
Fuel cost	2,480
Cost to Government	-380
Cost to Business	-80
Cost to Consumers	-160
BCR (%)	**352%**

179. The zoning methodology will define heat network zones as areas where heat networks offer the lowest cost means of decarbonising heat. Table 18 shows that the zoning policy, from an SNPV perspective, would be lower cost than an alternative low carbon heating pathway – with a net present saving of £9,380m over a 40-year appraisal period.

180. Table 18 shows that the zoning policy would have a net saving on capital cost and fuel cost, relative to a low carbon heating alternative. It also shows that there may be less carbon savings from the zoning policy. This is because the heat network technology mix assumes that natural gas would be required for peak heat demand. More information on the technology mix assumption for the zoning policy and low carbon heating counterfactual can be found in Annex 1 – Detailed modelling assumptions.

181. The cost to government and cost to business estimates in Table 18 only reflect cost of the zoning policy being implemented in the factual. No cost to government or business of delivering alternative low carbon heating policies has been determined for the counterfactual.

182. As well as the monetised costs and benefits discussed above, heat network zoning could, at least partially, offset these costs through lower costs of electricity grid infrastructure upgrade. Heat networks, with a large thermal store, would put less strain on the power system relative to a mass rollout of individual heat pumps. It has not been possible to monetise the cost of upgrading electricity grid infrastructure to the scale required in this IA, therefore we cannot quantify the grid savings that could be achieved by implementing low carbon heat networks in zones instead of individual heat pumps.

183. As discussed previously, we have restricted this analysis to consider only an electrification pathway as an alternative counterfactual scenario for decarbonisation of heat. The impacts and costs are more certain at this point for electrification, as we build the evidence base for hydrogen. The technology mix assumption that we have used for the low carbon counterfactual can be found in Annex 1 – Detailed modelling assumptions.

Results - Sensitivity Analysis on Social Net Present Value of the policy

184. Sensitivity analysis has been conducted to explore how the SNPV could change because of uncertain or biased evidence. To understand the risk associated with our assessment of the policy options, we have explored how the SNPV could be affected by varying the assumptions listed in Table 19 below. In this section, the assumptions are explored independently of each other; however, <u>Annex 2 - Detailed sensitivity analysis</u> also presents sensitive assumption in conjunction.

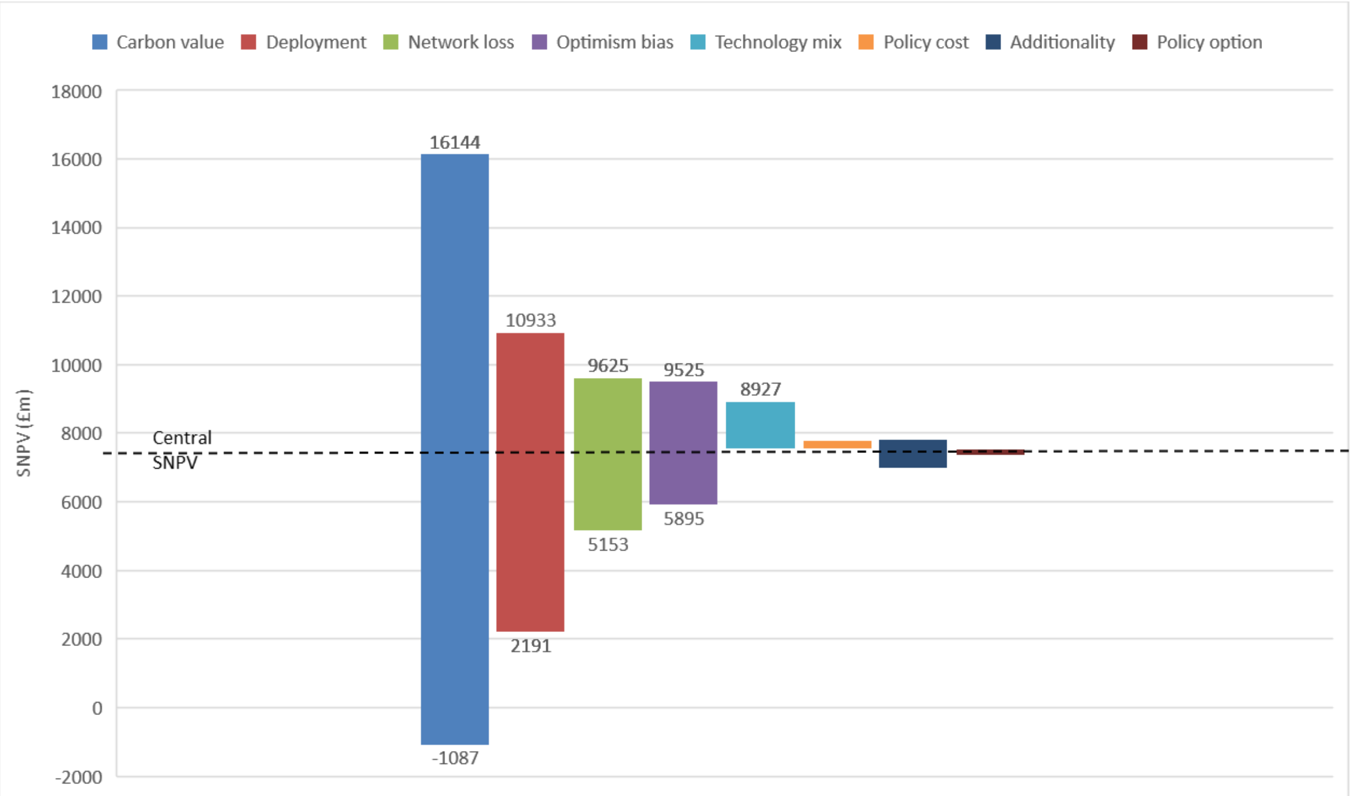
185. Table 19 presents the main assumptions that have been explored through sensitivity analysis. Figure 5 presents the outcome of varying the assumptions according to the levels presented in Table 19.

Table 19 – Assumptions explored through sensitivity analysis

Assumption	Levels for sensitivity analysis		
Carbon value	Low green book values	Central green book values	High green book values
Network loss (primary and secondary)	25%	20%	15%
Optimism bias (on capital costs)	30%	21%	10%
Deployment scenario	**Low** Zones designated in largest 100 towns and cities in England, 100 MWh/yr threshold for requiring buildings to connect, 0% voluntary connections,	**Central** Zones designated in largest 200 towns and cities in England, 100 MWh/yr threshold for requiring buildings to connect, 70% voluntary connections	**High** Zones designated in largest 300 towns and cities in England, 100 MWh/yr threshold for requiring buildings to connect, 100% voluntary connections
Additionality	85%	90%	95%
Policy cost	Public sector delivery	Private sector delivery	

Technology mix	Central technology mix EfW 9% Waste heat 10% ASHP 14% GSHP 42% WSHP 34% Back up boilers (gas) 10%	High waste heat technology mix EfW 18% Waste heat 18% ASHP 11% GSHP 18% WSHP 25% Back up boilers (gas) 10%
Policy option	Low	High

Figure 5 - Impact of varying sensitive assumptions, on the SNPV for the policy



Carbon values

186. The cost of carbon (£2021/tCO2e) has the biggest impact on the SNPV. For the SNPVs presented within this Impact Assessment we have used central green book carbon values. There are also 'high' and 'low' carbon values available which have been included as sensitivities in Figure 9.

187. Sensitivity analysis shows that only when carbon is valued at the 'low' rate, from the green book, the policy SNPV is negative.

Deployment

188. As described previously social costs and benefits for the policy such as: capital costs, operating costs, carbon savings, air quality benefits and fuel costs, are directly influenced by the scale of estimated heat network deployment, under zoning. This is due to the amount of heat demand, currently supplied by high carbon heating, that is displaced by low carbon heat networks.

189. Varying the scale of deployment has a significant impact on the overall SNPV. Deployment may vary due to the level of regulation imposed (for requiring buildings to connect), ability to deliver zones across England, and public willingness to connect voluntarily to low carbon heat networks.

Network losses

190. Network losses refer to heat that is lost through the distribution network of a heat network. For the factual scenario, where low carbon heat networks serve all connected heat demand in zones, a greater level of heat generation is required, compared to the counterfactual, due to heat being lost through distribution.

191. Across the Department for Energy Security and Net Zero's appraisal of heat network schemes and policies, a standard assumption of 20% network losses is assumed - this represents primary and secondary heat losses.

192. Within Heat Network Metering and Billing notification data, we observe a large variance in network losses within the existing heat network stock. The Heat Network Market Framework will look to establish minimum technical standards for heat networks, which will impact on, and generally improve, network losses.

193. Figure 5 presents the impact on the SNPV for the policy by varying the average network losses assumption, between 15% and 25%.

Optimism bias (on capital costs)

194. The analysis includes optimism bias on the capital costs of developing heat networks to reflect case study information of planned versus actual costs of 'non-heat network specific' environmental infrastructure projects. A buffer of 21% has been applied to uplift capital costs to account for optimism bias, within the central SNPV. This is a standardised assumption across environmental policies.

195. Figure 5 presents the impact on the SNPV for the policy by varying the optimism bias assumption, between 10% and 30%.

Heat generation technology mix

196. The mix of heat generation technologies serving low carbon heat networks also has a large impact on the policy's SNPV. Within this IA we discuss a central and alternative 'High waste heat' technology mix. The alternative technology mix draws on a greater proportion of heat generation from sources of waste heat (EfW, high, medium and low grade waste heat sources) and a lower proportion of heat generation from ambient heat pumps, than the central scenario – see Table 20 for comparison.

197. The greater use of waste heat is expected to result in costs savings due to lower capital costs and lower fuel costs, owing to greater thermal efficiency of heat generation from waste heat sources. By harnessing a greater proportion of waste heat sources, in comparison to the central scenario, there would be increases to the policy's SNPV. As well as increasing the SNPV, this would increase the size of the non-monetised benefits from zoning, such as

demand on the electricity grid (low, medium and high-grade waste heat require less electricity to reach supply temperatures, than ambient heat).

Table 20 – Heat generation (factual) sensitivity scenarios and breakdown of heating technologies

Technology mix (% Heat Generation)	Central	High waste heat
EfW	9%	18%
High Temp Waste Heat	4%	6%
Low Temp Waste Heat	6%	12%
ASHP	14%	11%
GSHP	24%	18%
WSHP	34%	25%
Back-up Boilers (gas)	10%	10%

Wider Impacts

Small and Micro Business Assessment

198. Small and micro businesses (SMBs) in the heat networks sector typically comprise of heat network developers, operators, and other technical specialists. The policy will also directly impact businesses that are consumers of heat, including new build developers.

199. Through this IA the following business types have been identified as being directly impacted by the heat network zoning policy, and have had been included in a quantified assessment of cost to business:

a. Heat network developers and operators

b. Heat customers in existing buildings in zones

c. New build developers

Heat Network Developers and Operators

200. Some heat network developers and operators, that are impacted by the policy, may be small or micro businesses. Evidence from the Heat Network Operator Survey[45] suggests that of the current district heat network operators, 17% are small businesses (10-49 employees) and 14% micro businesses (1-9 employees). Heat Network Zoning will deploy only district heat networks.

201. There will be administrative burdens for heat network developers and operators to familiarise their organisations with the policy. Cost for developers and operators to familiarise themselves with the policy have been estimated to cost £1,600 (resource cost) per organisation – the methodology used to calculate this is discussed in greater detail in the Methodology – Cost to Business section.

202. The overall familiarisation costs for developers and operators make up a very small proportion of the annual cost to business that is presented in the Results - Cost to Business section, due to the number of developers and operators, relative to other businesses.

203. These costs, as a proportion of existing costs, will likely be higher for small and micro businesses. However, an exemption from these requirements isn't appropriate given that large district heat networks will be deployed in zones, and the heat network developers and operators will be required to familiarise themselves with the legislation to ensure consumers receive the best outcome.

Heat customers in existing buildings

204. While we have proposed the broad categories of buildings in zones which may be required to connect to a heat network in this IA, the accompanying consultation is gathering views on which building types should be required to connect. This may impact on the types of small and micro businesses that are impacted by the policy.

205. Current proposals may require social landlords, housing associations and private landlords of domestic premises with communal heating systems to connect to heat networks. Some of these will be small or micro businesses. Large non-domestic buildings in zones will

[45] Heat Network Consumer and Operator Survey (2022): https://www.gov.uk/government/publications/heat-network-consumer-and-operator-survey-2022

also be required to connect, within which, small and micro businesses that own or rent space may also be impacted.

206. At present it has not been possible to accurately assess the size of businesses (by number of employees) that would be required by the policy, due to uncertainty around the size, location of heat network zones and the types of building required to connect within them. We will use the outputs of the Advanced Zoning Programme[36] to develop the evidence base on the size and types of business required to connect, and the businesses experiences of operating under the policy proposals. The potential impacts of the policy on SMBs are discussed in the paragraphs below.

207. By complying with the heat network zoning policy, heat customers may reduce the administrative burden they will incur through replacing their heating system, by displacing practical steps and cost for replacing their heating system with an alternative heating technology, such as undertaking research or consulting advisory services.

208. For buildings in zones that believe they can decarbonise their heating at lower cost following a different solution, there will be an exemption process. This is potentially the most significant administrative burden for heat consumers as it will require them to provide evidence that they can decarbonise their heating in a more cost-effective way using a different technology.

209. Whilst buildings that are owned by SMBs would not typically represent the type of building that would be required by the policy, a standardised tool will be developed for the exemption process, which will minimise any costs associated with the act of applying for exemptions, meaning that the exemption process will not pose a disproportionate burden on small and micro businesses.

210. It has been assumed to cost on average £400 (resource cost) per building to apply for an exemption (see the Methodology – Cost to Business section). This cost is expected to be incurred by a single actor for the building such as the landlord, rather than individual leaseholders/tenants.

211. Another group of heat customers that may be impacted are micro businesses operating ‘from home’ out of residential properties in communally heated buildings in zones. These types of buildings are likely to already have the infrastructure in place to allow this type of connection and therefore costs of connecting to a larger district system would be minimal.

212. Where there are administrative costs for heat customers, through compliance with the policy or applying for an exemption, it is not anticipated that these would pose disproportionate burdens to small and micro businesses. Additionally, any requirement to connect would happen in an appropriate timescale for all consumers, minimising the burden of connecting to a heat network.

New Build Developers

213. There is potential for a small additional burden on new build developers whose buildings are required to connect to heat networks, some of which will be small and micro businesses, as they may need to upskill staff and potentially pay for a connection charge to a heat network (as is the case with other utilities). The Small and Micro Business Assessment for the Future Homes Standard[46] shows that the majority of builders and developers are

[46] Future Homes Standard IA (2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040631/Domestic_Part_L.pdf

SMBs, however, this does not take into account those that would operate within heat network zones.

214. Under the Future Homes Standard (FHS) for new builds, all new build developers will be required to meet the new energy efficiency standards and install low-carbon heating systems which will reduce the carbon emissions of their developments. Comparison of the zoning policy to an alternative low carbon heating technology, shown in Table 18, shows that zoning will provide a route to the lowest cost way of decarbonising a buildings heating supply, enabling compliance with the FHS. In particular, capital costs are expected to be lower for the zoning policy.

215. The cost associated with a heat network connection to a low carbon heat network in a zone is estimated to be £580/MWh. This is made up of £450/MWh related to the capital costs of the distribution infrastructure (of which £150/MWh for distribution network and £300/MWh for ancillary costs[47].) and £130/MWh[48] associated with the heat generation capital costs (assuming the heat generation technology mix in the central scenario shown in Table 22). In comparison, a domestic individual ASHP is estimated to cost £1,060/MWh (including cost associated with additional required parts such as the fan unit, compressors or storage tanks).

216. For a new domestic building with a 5 MWh annual heat demand a low carbon heat network connection could cost approximately £2,900, compared to an individual heat pump which could cost £5,300. Both these estimates have been derived from capital cost assumptions that have been used in the cost-benefit analysis.

217. Costs of internal adaptations for new buildings are expected to be broadly comparable for ASHPs and heat network connections (such as the installation of insulation and sufficiently sized radiators). In some cases, low carbon heat networks can provide higher temperature heat than conventional individual ASHPs, requiring lower-cost ‘within dwelling’ improvements.

218. Therefore, it is not expected that there would be any additional costs to new build developers due to heat network zoning. For this reason, an automatic exemption for small and micro new build developers is not considered necessary.

Other Stakeholders

219. A wider group of stakeholders who may be small or micro businesses have also been considered, for example supply chain organisations and training providers. It has been considered that where any of these groups fall into the category of small or micro businesses, there would not be any detrimental impacts from the zoning policy, as the policy would present opportunities to these groups in terms of more business or investment opportunities, rather than additional costs.

Trade and Investment Assessment

220. Heat Network Zoning will grant local authorities the power to designate zones where heat networks become the default low carbon heating solution. Zones will be defined as areas where heat networks offer the lowest cost solution for decarbonising buildings. Within zones, certain buildings will be required to connect to heat networks. The objective of the heat network zoning policy is to grow the market for low carbon heat networks.

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[47] See data benchmarking section in this report: https://assets.publishing.service.gov.uk/media/5a802b44e5274a2e8ab4e95d/heat_networks.pdf

[48] Calculation based on cost breakdown shown in *Table 24 – Capital and operating cost per generation technology (heat networks)*

221. Therefore, the policy may be expected to increase foreign investment into the UK, particularly by European heat network developers. There is already a presence of European companies within the UK heat networks market, with organisations such as Vattenfall (Swedish) or Engie (French) having a significant presence in part due to current heat network policies. With the introduction of heat network zoning this trend may be expected to continue, and indeed there may also be inward investment from non-European companies.

222. There will be no discrimination between domestic and foreign businesses in regard to heat network zoning. The specific policy is still being developed, but it is expected that there will be a competitive process to procure heat network developers to develop heat networks within zones. The competitive process will be non-discriminatory between foreign and UK heat network developers. Additionally, it is not expected that heat network zoning will constitute a Technical Barrier to Trade (TBT) as it doesn't create any additional requirements for foreign entities to trade with the UK. New heat networks deployed in zones will be required to be low carbon and adhere to the technical standards specified by the Heat Network Market Framework. It isn't expected that either of these requirements will constitute a TBT.

223. As a result of the expertise developed through implementing heat network zoning, the UK may be able to increase exports of heat network services. Indeed, the most recent Energy Innovation Needs Assessment identified heat networks services as one of the UK's greatest export opportunities from low carbon heating in its 'Heating and Cooling' report[49].

Competition Assessment

224. Heat Network Zoning will designate areas where certain buildings are required to connect to heat networks. These areas will be defined where heat networks offer the lowest cost means of decarbonising heat, determined by a technical methodology.

225. Where an area has been designated a heat network zone, heat network developers will be procured via a competitive process. In some circumstances, one heat network developer will be procured for the whole zone, in others there may be multiple heat network developers within a single zone. In each of these circumstances, there will be a competitive process to procure a heat network developer for the final consumers. This method of procurement is intended to encourage bids from a range of suppliers and thereby deliver a heat network solution which offers the best value for money for consumers.

226. Ahead of a zone being designated, the local authority will run a consultation process with buildings that are required to connect to the heat network. Additionally, an exemption process is being developed for buildings that have been required to connect to a heat network - within a zone - but believe that they could decarbonise their heating at lowest cost in an alternative way. This ensures that consumers can implement an alternative low carbon heating solution if it would be preferable for them and provides further competitive pressure on the local heat network to offer good value for money to avoid losing otherwise profitable customers.

227. Once consumers are on a heat network, it becomes very difficult for them to switch either their heating technology or heat supplier. At this point, the heat network operator has market power which they may be able to exploit. Given that this is the case, the Department for Energy Security and Net Zero is ensuring that consumers are provided with consumer protection from the Heat Network Market Framework (HNMF). The HNMF will give Ofgem, as

[49] Energy Innovation Needs Assessment: https://www.gov.uk/government/publications/energy-innovation-needs-assessments

the national regulator, the powers to investigate pricing and to regulate quality of service standards that are provided to consumers on heat networks.

228. An important distinction regarding competition relates to cases where the customers are single owner-occupiers of buildings, or where customers are within buildings of multiple occupancy. In the former case, the customer has more ability to engage with the policy than the latter case. Where customers are within buildings of multiple occupancy, for example businesses renting out office space in large buildings, they may have less control over decisions regarding how to decarbonise the building's heating system. The detail regarding how these situations will be dealt with will be specified in secondary legislation. Through the HNMF, the Department for Energy Security and Net Zero will also ensure that these consumers are protected to the extent necessary.

Equalities Assessment

229. An equality impact assessment of the policy option has been carried out. Heat Network Zoning will directly affect future domestic customers of heat networks in zones. Precise locations will not be known until zones are designated, but the assumption based on evidence from pilot studies and international experience is that heat network zoning is best suited to urban environments. The equality implications will be kept under review to consider further relevant evidence as it becomes available. The evidence for the equality assessment has been based on the current population who are on heat networks. For the purposes of this assessment, we assume that new customers will be like existing customers on heat networks.

230. The assessment identified that people who are 65+ years of age and people from ethnic minority backgrounds are more likely to be served by heat networks, using most recent evidence[50]. There was no evidence that gender or disability had a disproportionate representation, amongst people served by heat networks.

231. We assume that groups with the protected characteristics of gender reassignment, marriage/civil partnership, pregnancy and maternity, religion or belief, and sexual orientation are unlikely to be disproportionately impacted by connection to heat networks in heat network zones compared to energy customers who do not share those characteristics. However, we have not been able to identify any evidence that would confirm or refute this assumption.

232. A key factor to assessing the impact of the policy on groups is the cost of heating relative to income. It may be considered that people who are 65+ years of age may also have increased heat demand relative to younger occupants and may be more susceptible to fuel poverty. However, it is not anticipated the zoning proposals would negatively impact these groups for the following reasons:

a. The proposal is that zoning would only apply to domestic consumers who already live on communal heat networks, therefore there should not be a change in these consumers' experience before and after heat network zoning. The proposal will also apply to new build developments.
b. The proposal includes an exemption process to be applied on request, which would remove requirement to connect where it would not be cost-effective to do so.

[50] BEIS (2017) Heat Networks Consumer Survey: consumer experiences on heat networks and other heating systems. December. Available online at https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems.

c. Under the Market Framework domestic customers have consumer protection measures in place.

233. The Heat Networks Consumer and Operator Survey[51], and Heat Network Zoning pilot studies will be designed to capture evidence on the potential impacts of the policy on groups, to improve the equalities impact assessment going forward.

Consumer Bills

234. In order to accurately compare costs of different heating systems, the total cost of heating needs to be considered. This should include additional costs such as maintenance costs and capital costs, in addition to fuel bill costs. This is because a typical heat network heat tariff covers all of these costs, whereas a consumer of an individual heating system pays these separately to their fuel bill. To ensure consumer bills are reasonable on heat networks inside zones, the total cost of heat for a heat network needs to be equal or lower to the low carbon alternative. This principle will be factored into the design of zoning. Zones will be designated in areas where heat networks will provide a lower cost, low carbon solution compared to alternatives such as individual air source heat pumps. These costs will be lower as heat networks buy fuel on commercial tariffs which should lower heat costs to consumers, additionally capital costs can be lower by having a single heating solution for multiple consumers compared to multiple individual solutions as shown in table 18.

235. While heat networks in zones will incur lower costs than a heat pump counterfactual, it is currently difficult to compare the total costs to a gas boiler counterfactual . Currently, there is a large disparity between gas and electricity prices, making low carbon heating relatively more expensive compared to higher carbon, gas-based heating systems. However, in the Heat and Buildings Strategy we committed to look at options to shift or rebalance energy levies (such as the Renewables Obligation and Feed-in-Tariffs) and obligations (such as the Energy Company Obligation) away from electricity to gas over this decade. The Government wants to make it easier for consumers to make the switch to green products by ‘rebalancing’ prices between electricity and gas to remove existing price distortions. The rebalancing of gas and electricity prices is important for heat network zoning, as it will encourage the transition from existing heat-generating technologies, such as gas-powered combined heat and power (gas CHP), to low carbon technologies.

236. The extent that gas and electricity prices will change, and when this will happen, is currently uncertain. Therefore, it is difficult to estimate the impact on the average consumer bill of heat network zoning. Further work is being carried out to establish how and against which low carbon alternative (counterfactual) the methodology will test heat networks against – in either an electrification or hydrogen pathway. In the recently published Heat and Buildings Strategy, there is a commitment to aim for cost parity between heat pumps and gas boilers by 2030 with significant cost reductions of at least 25-50% by 2025 and ensuring heat pumps are no more expensive to buy and run than boilers by 2030.

[51] Heat Network Consumer and Operator Survey: https://www.gov.uk/government/publications/heat-network-consumer-and-operator-survey-2022

Fuel Poverty

237. According to analysis of the English Housing Survey, the proportion of consumers in fuel poverty on heat networks is lower than consumers not on heat networks[52]. However, for heat network zoning we would need evidence on the likely make up of future consumers who would connect to heat networks, rather than current consumers. Data of this granularity is not yet available. As described above, this is an area we will build our evidence base on ahead of secondary legislation.

238. Under current gas and electricity prices, consumers would be likely to pay more for their heating on low carbon heat networks relative to gas-fired heating. It isn't currently possible to estimate the likely impact on bills towards the end of the 2020s, as set out in the preceding section.

239. One of the types of buildings that may be required to connect under the preferred policy option is social housing blocks with communal heating. It may be possible that there are a greater number of consumers at risk of fuel poverty within this building type. All consumers that are required to connect to heat networks will be provided the consumer protection measures which are offered by the Heat Network Market Framework. Under the Heat Network Market Framework there will be powers for a regulator to investigate fair pricing for consumers.

Regional Impacts

240. There will be strong strategic cases for implementing heat network zones across England. Table 21 presents the regional breakdown of towns and cities that we have assumed to be suitable for implementing heat network zones, within the underlying analysis in this impact assessment. The criteria for determining whether a town or city is suitable for heat network zoning, has been derived from evidence from heat network feasibility studies.

Table 21 – Representation of how zoning could be deployed across the top 200 towns and cities, using population estimates

Region	Number of Towns and Cities
East Midlands	12
East of England	21
London	31
North East	11
North West	29
South East	38
South West	14
West Midlands	26
Yorkshire and The Humber	18
Total England	**200**

241. Towns and cities have been identified using the ONS Built Up Area Sub-Divisions (BUASD) boundaries. Whilst many towns and cities are categorised under a single BUASD, larger metropolitan areas such as Greater London and Greater Manchester have multiple BUASDs which correspond to metropolitan boroughs. The top 200 towns and cities have

[52] English Housing Survey 2018 to 2019, https://www.gov.uk/government/collections/english-housing-survey'

been approximated using the top 200 BUASD ranked by ONS population estimates; the smallest BUASD is estimated to have a population greater than 50,000 people.

Jobs Impacts

242. Heat Network Zoning will support direct and in-direct jobs in England. The policy will support jobs in mapping and planning heat networks, the construction of heat networks and their operation and maintenance. As set out above, there is also expected to be an expansion of capacity within local government, central government, and the national regulator to support the implementation of the policy. It is anticipated that heat network zoning will support nearly 9,000 direct in-year jobs by 2050, under the preferred policy option.

243. Additionally, the policy will support in-direct jobs. The policy is multifaceted and therefore the jobs can take various forms. For example, there may be in-direct jobs supported to assist businesses in understanding what they are required to do under the policy. By 2050, 11,000 in-direct jobs may be supported by heat network zoning.

244. Direct and indirect job numbers have been estimated using Environmental Energy Needs Assessments[53] (EINAs) methodology for heating and cooling policies.

Interactions with other Policies

245. The Heat and Building Strategy[54] sets out how the UK will decarbonise homes, and commercial, industrial and public sector buildings, as part of setting a path to net zero by 2050. Within the Heat and Building Strategy, the Heat Network Zoning policy looks to promote deployment of heat networks in areas where they are the lowest-cost solution for decarbonising heat.

246. The objectives of Heat Network Zoning reinforce a number of policy areas within the Heat and Building Strategy, including transitioning existing buildings to low-carbon heat, decarbonisation of buildings and sectors, and development of new low-carbon buildings. In this section we will describe how the Heat Network Zoning policy interacts with wider policies set out in the Heat and Buildings Strategy.

Interaction with wider heat network policy

247. To start with wider heat network policy, the Heat Network Market Framework (HNMF) will have important and significant impacts on the success of Heat Network Zoning. The Heat Network Market Framework will appoint a regulator for the heat networks sector with powers to regulate consumer protection (including pricing and quality of service), decarbonisation, provide extra rights and powers to operators and introduce technical standards.

248. The HNMF is an enabling policy for Heat Network Zoning since it will address key market failures for heat networks by establishing a regulatory framework for the sector. One impact of the HNMF is to increase confidence in the development and adoption of heat networks. Heat Network Zoning will look to accelerate the deployment of heat networks by addressing remaining market failures for heat networks, connection uncertainty and coordination failure.

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[53] Environmental Energy Needs Assessments: https://www.gov.uk/government/publications/energy-innovation-needs-assessments

[54] Heat and Buildings Strategy (2021): https://www.gov.uk/government/publications/heat-and-buildings-strategy

Interaction between zoning and other low carbon heating technologies

249. Section 5.3 of the Heat and Buildings Strategy discusses pathways for the transition to low carbon heat, including greening the gas grid, building a market for heat pumps, transforming the heat network market, and unlocking the potential for hydrogen for heating.

250. Heat network zones will be designated in areas where heat networks offer the lowest-cost means for decarbonising heat. However, to achieve the full benefits of implementing a heat network zone, there needs to be high levels of buildings connecting to heat networks, many of which would be voluntary. High uptake of individual heat pumps and hydrogen boilers within zones could limit the benefit of the zone for providing lowest-cost heat. This would limit the size of zones and ability for buildings to connect to a heat network.

251. Therefore, it is important that the implementation of zoning is effectively coordinated with other pathways for the transition to low carbon heat to ensure that the policies work to deliver options for lowest-cost, low-carbon heating solutions, that represent consumer preference.

Interaction between Zoning and wider buildings policies

252. Section 5.2 of the Heat and Building strategy sets out a portfolio of policies that are designed to decarbonise the building stock, by sector, in the 2020s. Whilst the main focus for these policies is to improve energy performance, through fabric efficiency measures, a number of the policies will also promote the transition to low-carbon heating in the 2020s.

253. Whilst the Heat Network Zoning policy will look to decarbonise heating for buildings over a longer timeframe, from 2025 to 2050, it will target similar groups of buildings to energy performance schemes such as the Public Sector Decarbonisation Scheme, Social Housing Decarbonisation Fund and Home Upgrade Grant. Therefore, it will be important that policies are aligned to achieve long-term strategic outcomes for decarbonisation of buildings.

254. The Future Homes Standard (FHS) and the Future Building Standard (FBS) will set energy efficiency requirements that will ensure new buildings are highly energy efficient with low-carbon heating. Under each of the options for the Heat Network Zoning policy, new buildings within zones would be required to connect to a low-carbon heat network. It is not expected that Heat Network Zoning would increase costs for developing new builds, since the FHS and FBS both require low-carbon heating, and within zones, heat networks offer the lowest-cost, low-carbon heating. This is discussed further in the Small and Micro Business Assessment section.

Monitoring and Evaluation

255. We will implement robust monitoring and evaluation (M&E) during and after program delivery. Given some aspects of the policy are still being developed, our M&E plans are restricted until further policy scoping and delivery planning is undertaken; however, additional recruitment has taken place, specifically for M&E posts, to meet the requirements of the policy.

256. The evaluation will be complex due to the novelty of the policy, its geographical coverage, delivery model and range of stakeholders. The evaluation design will draw upon insight from other M&E in this space, including the Heat Networks Investment Project and the Green Heat Network Fund evaluations.

257. The evaluation plan will be derived from the Theory of Change as set out in Annex 4. The evaluation will be predominantly theory-based, and will include components of process, impact and financial (cost-benefit analysis) evaluation. It will seek to answer the questions below, taking account of what works/ doesn't work for whom and in what circumstances.

Impact evaluation

- To what extent has the regulation achieved the objectives?
- Has the number and pace of low carbon heat networks delivered increased?
- To what extent have carbon emissions decreased?
- Has there been an increase in the use of waste heat sources in heat networks deployed in zones?

Process evaluation

- How has the design of the regulation influenced the impacts that were achieved?
- How has the policy been delivered, what worked/ didn't work?

Economic evaluation

- What have the costs and benefits of the policy been?
- Across different sub-projects, how much has been invested, and what is the anticipated long-term return?
- What is the energy cost for consumers, and how does this compare to other markets, including higher carbon alternatives?

258. The data that would feed into the evaluation(s) would be collected by Ofgem, who is regulator of heat networks under the Heat Network Market Framework, as well as data coordinators working under the zoning policy. The zoning data coordinators will monitor the development of heat networks within zones and monitor and report on the performance of heat networks.

259. Under the Heat Network Market Framework, all heat networks will be required to report annually to Ofgem. Ofgem will also monitor how heat networks perform against the consumer protection and technical standards as set out in legislation. Further information on the monitoring and evaluation plans for the Heat Network Market Framework are available through the consultation stage impact assessment[55], see the monitoring and evaluation section.

260. At this point it isn't certain where the data would come from for the zoning evaluation, this will be decided as more detailed delivery planning for the policy takes place.

261. More information on our monitoring and evaluation strategy will be provided alongside the final-stage impact assessment supporting the secondary legislation.

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[55] Heat Network Market Framework consultation stage impact assessment (2023): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1176219/heat-networks-consultation-ia.pdf

Annexes

Annex 1 – Detailed modelling assumptions

Table 22 – Factual heat (network) generation technology mix

Technology mix (% Heat Generation)	Central	High waste heat
EfW	9%	18%
High Temp Waste Heat	4%	6%
Low Temp Waste Heat	6%	12%
ASHP	14%	11%
GSHP	24%	18%
WSHP	34%	25%
Back-up Boilers (Natural gas)	10%	10%

Source: Opportunity areas for district heating networks in the UK

Table 23 – Counterfactual assumption for heating technologies, using current mixture of heating technologies

Technology	**'Do nothing' counterfactual** (% Total Heat Generation)	**'Low Carbon' counterfactual** (% Total Heat Generation)
Gas Boiler - Small	69%	0%
Gas Boiler - Large	17%	0%
Air Source Heat Pump - Small	0%	69%
Air Source Heat Pump - Large	0%	17%
Electric Heater	11%	11%
DH Gas CHP	1%	1%
DH EfW	1%	1%
DH WSHP	1%	1%

*Source: NEED and ECUK a*vailable at https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework and https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

Table 24 – Capital and operating cost per generation technology (heat networks)

Generation Technology	Capex Unit	Capex Value	Opex Unit	Opex Value
Air Source Heat Pump	£/kWth	550	£/ kWh/ yr	0.003
Ground Source Heat Pump	£/kWth	600	£/ kWh/ yr	0.003
Water Source Heat Pump (WSHP)	£/kWth	900	£/ kWh/ yr	0.003
WSHP - Low grade waste heat	£/kWth	549	£/ kWh/ yr	0.002
WSHP - Medium grade waste heat	£/kWth	431	£/ kWh/ yr	0.001
Energy from Waste	£/kWth	100	£/ kWh/ yr	0.002
Heat Exchanger (high grade waste heat)	£/kWth	221	£/ kWh/ yr	0.004
Gas CHP	£/KWh	675	£/ kWh/ yr	0.01
Back-up Gas Boiler	£/KWh	23	£/ kW(th)/yr	2.250

Source: Heat Network project pipeline (DESNZ): https://www.gov.uk/government/publications/heat-networks-pipelines

Table 25 - Distribution Infrastructure Capex (factual and counterfactual)

Cost	Unit	Value
Network capex	£/MWh	150
Ancillary capex	£/MWh	300

Source: Heat Network project pipeline (DESNZ): https://www.gov.uk/government/publications/heat-networks-pipelines

Table 26 - Capital and operating cost per technology (counterfactual)

Generation Technology	Capex Unit	Capex Value	Opex Unit	Opex Value
Commercial Gas boiler	£/kWth	409	£/ kW(th)/yr	8.04
Commercial ASHP (individual)	£/kWth	1727	£/ kW(th)/yr	8.47
Domestic Gas Boiler	£/kWh	0.25	£/ kWh/ yr	0.01
Domestic ASHP (individual)	£/kWh	1.06	£/ kWh/yr	0.01
Electric Heater	£/kWth	232	£/ kW(th)/yr	3.47

Source: Non-domestic HVAC study: https://www.gov.uk/government/publications/evidence-update-of-low-carbon-heating-and-cooling-in-non-domestic-buildings. Domestic: Delta EE market intelligence

Table 27 - Thermal Efficiency (factual and counterfactual)

Heat Network/ Individual	Generation Technology	Thermal Efficiency (%)
Heat network	Air Source Heat Pump	251
	Ground Source Heat Pump	284
	Water Source Heat Pump (WSHP)	330
	WSHP - Low grade waste heat	541
	WSHP - Medium grade waste heat	690
	Energy from Waste	500
	Heat Exchanger (high grade waste heat)	97
	Gas CHP	40
	Back-up Gas Boiler	85
Individual	Commercial Gas Boiler	86
	Domestic Gas Boiler	84
	Electric Heater	100
	Commercial ASHP (individual)	284
	Domestic ASHP (individual)	244

Source: Non-domestic HVAC study: https://www.gov.uk/government/publications/evidence-update-of-low-carbon-heating-and-cooling-in-non-domestic-buildings. Domestic: Delta EE market intelligence. Heat Network project pipeline (DESNZ): https://www.gov.uk/government/publications/heat-networks-pipelines

Annex 2 - Detailed sensitivity analysis

New builds are not included in deployment and SNPVs in the table below, to minimise duplication with benefits from new build policies.

Cross tables that represent varying scenarios for deployment, heat network technology mix and cost of the policy for each policy option are below. The Results - Sensitivity Analysis on Social Net Present Value of the policy section also presents sensitivity scenarios for carbon valuation, network losses, additionality, and optimism bias.

Table 28 – Sensitivity analysis for the Low policy option

		Social Net Present Value (£m)			
		Heat generation technology scenario			
		Central		Alternative	
Deployment Scenario	Deployment in 2050 (TWh/yr)	Policy cost scenario		Policy cost scenario	
		Low	Central	Low	Central
Lower	12	2,110	1,830	2,530	2,250
Central	36	7,630	**7,350**	8,990	8,720
Higher	52	11,210	10,930	13,190	12,920

Table 29 – Sensitivity analysis for the High (preferred) policy option

		Social Net Present Value (£m)			
		Heat generation technology scenario			
		Central		Alternative	
Deployment Scenario	Deployment in 2050 (TWh/yr)	Policy cost scenario		Policy cost scenario	
		Low	Central	Low	Central
Lower	13	2,470	2,190	2,950	2,670
Central	37	7,800	**7,530**	9,200	8,930
Higher	52	11,210	10,930	13,190	12,920

Annex 3 – Analysis on buildings that are required to connect in zones

Introduction

1. Policy decisions around requiring certain buildings to connect to heat networks in zones are important because they dictate how much certainty there is for heat demand to connect to heat networks, however, there are also risks to overburdening government and businesses if requirements are too stringent, as well as reducing freedom consumers have to choose their preferred heating technology.

2. For these reasons, analysis has been carried out to explore the implications of requiring different sets of buildings to connect to heat networks.

3. The analysis in this annex is based on case studies from five cities: Bristol, Nottingham, Newcastle, Birmingham, and Leeds. The cities have been investigated using classification data for building stock from Ordnance Survey products and heat demand data from the *Opportunity Areas for District Heating Networks in the UK*[56] study.

Limitations

4. This analysis has been conducted using local authority geographical boundaries, which are not the same as zone boundaries. The local authorities from the five cities are generally city councils, which means the boundary is clipped to the city (rather than county in the cause of county councils etc…)

5. Communally heated residential buildings cannot be identified with this dataset. Therefore, an assumption has been made that any building of residential classification with heat demand greater than or equal to 100 MWh/yr is deemed as a communally heated residential building.

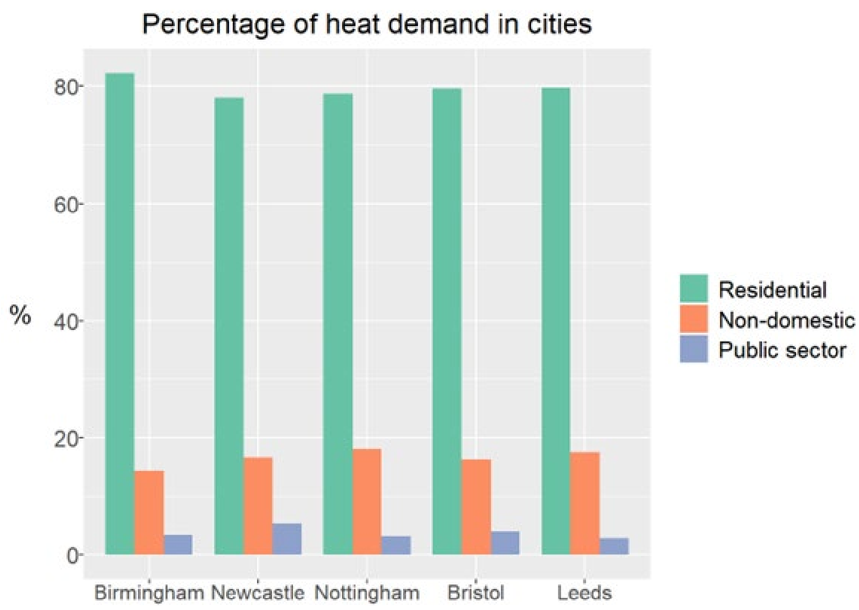
6. This analysis explores the implications of requiring buildings to connect, by exploring different thresholds for 'large' buildings by assuming that the metric is annual heat demand. This does not necessarily reflect the intention of the policy.

Findings

7. Public sector buildings account for a small proportion of annual heat demand – see Figure 6. Therefore, only public sector buildings would mean a small proportion of heat demand within zones would be required to connect and the connection certainty is low, within a local authority. Therefore, this evidence in conjunction with consultation feedback has provided justification for removing the previous low policy option, which required only new builds and public sector building to connect.

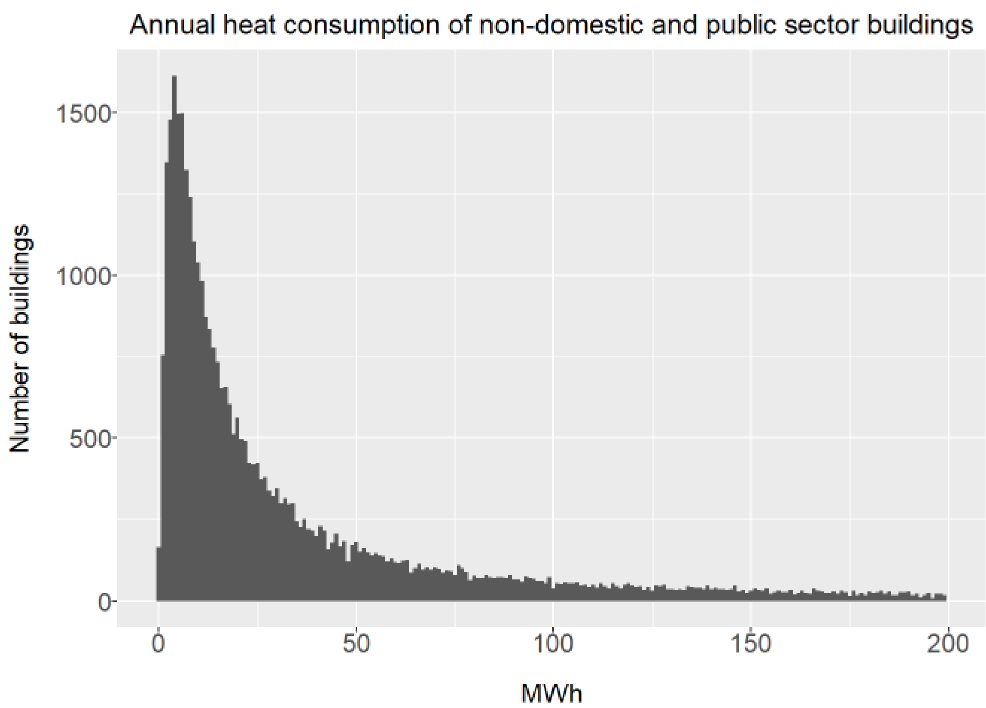
[56] *Opportunity Areas for District Heating Networks in the UK* is a government report to meet the requirements of Regulation 4 of the Energy Efficiency (Encouragement, Assessment and Information) Regulations 2014, https://www.gov.uk/government/publications/opportunity-areas-for-district-heating-networks-in-the-uk-second-national-comprehensive-assessment

Figure 6 - Proportion of heat demand that is from all residential, non-domestic, and public sector buildings within five cities.



8. Figure 7 below shows the distribution of non-domestic and public sector buildings according to their annual heat demand. We can use this to visualise the proportion of buildings within the five cities that would be required to connect to heat networks in zones depending on a threshold for 'large' buildings, such as 0, 50 or 100 MWh of annual heat demand. You can see the number of required connections fall in an exponential way, as the threshold is increased.

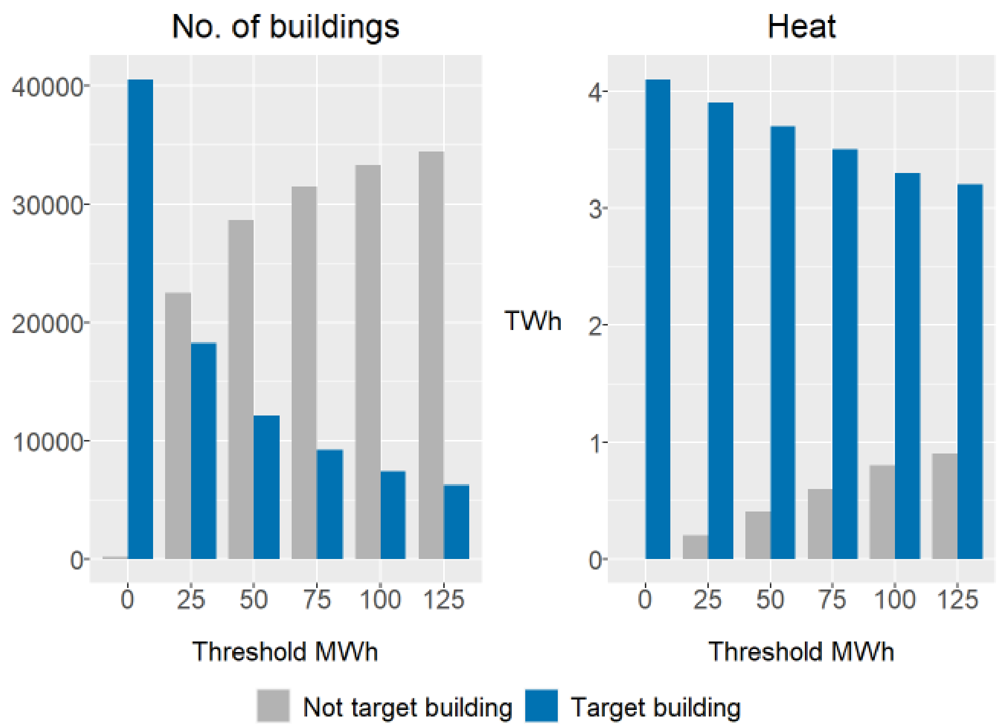
Figure 7 - Annual heat consumption of non-domestic and public sector buildings



9. Figure 8 below shows the impacts of setting different thresholds for requiring buildings to connect, using annual heat demand.

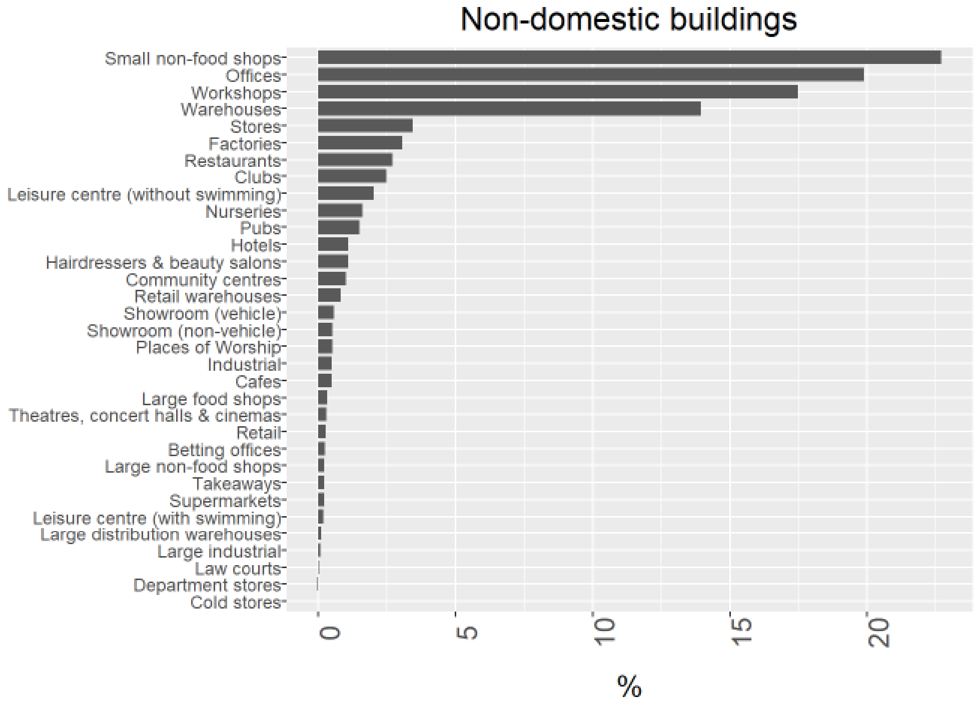
- The left-hand side chart shows that as the threshold increases, the number of buildings required to connect by the policy falls.
- The number of required buildings falls by 80% if a 100 MWh threshold is set instead of no threshold (0 MWh).
- The right-hand side chart shows that the amount of heat demand that is required to connect falls at a much slower rate as the threshold increases.
- Therefore, increasing the threshold has a large reduction on the number of buildings required to connect, however, a small reduction in the heat demand that would connect.

Figure 8 - Implications on number of buildings and heat demand that is required to connect under different thresholds for large (non-domestic and public sector buildings only).



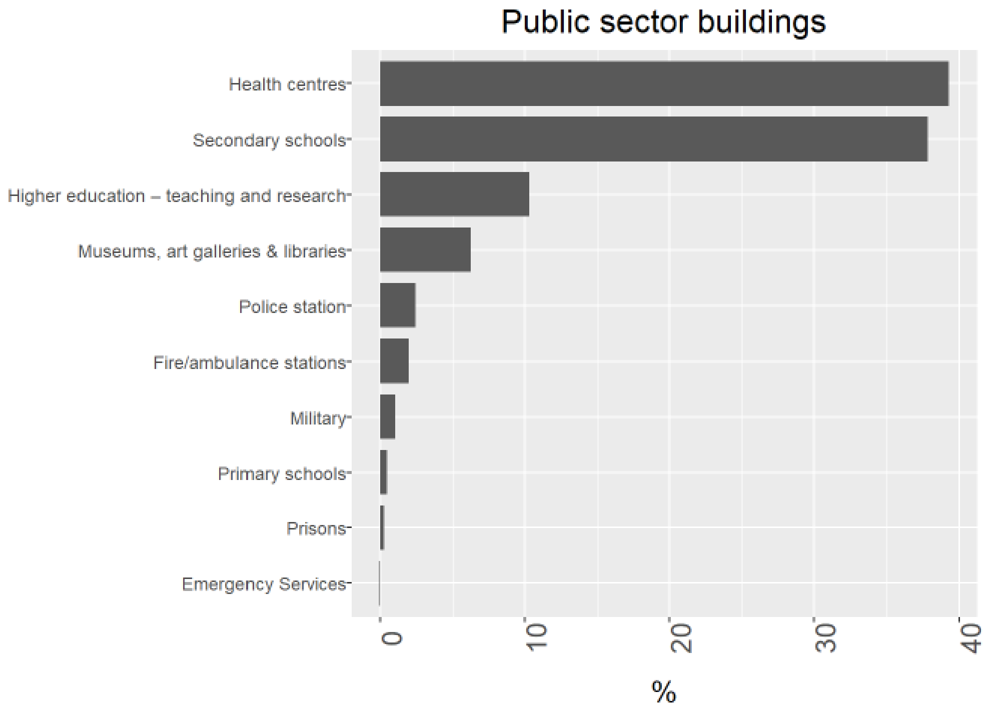
10. The most common types of non-domestic buildings are small non-food shops, offices, workshops, and warehouses, making up nearly three quarters of total annual heat demand in the cities. See Figure 9 below.

Figure 9 - Non-domestic building types as a percentage of the total number.



11. The most common type of public sector buildings are health centres and secondary schools – see Figure 10.

Figure 10 - Public sector building types as percentage of the total number.



12. Further analysis on average and variance of heat demands of building categories is required to understand the impact of applying thresholds for 'large' building that are required to connect to heat networks. However, since the principles for defining a 'large' threshold are still being consulted on, which vary significantly from the metric of annual heat demand, further analysis has not been included in this IA.

Annex 4 – Multi Criteria Analysis Methodology

Workshops were held to identify a long list of options and critical success factors. Each critical success factor grouping was given an overall weighting based on the relative importance.

Table 30 - Critical Success Factors and weightings

Weighting	Success Factor Group
50%	Achieving Policy Objectives
10%	Novelty of Policy Proposals
25%	Deliverability
15%	Value for Money

Each success factor and policy option were then considered and scored using the definitions in Table 31. A final score was then calculated for each option accounting for the weights of each group of success factors.

Table 31 - MCA score definitions

Definitions for Scoring Options against Criteria		
Score	**Definition (first 2 groups)**	**Definition (last 2 groups)**
1	Very weak alignment	Very high
2	Weak alignment	High
3	Moderate alignment	Moderate
4	Strong alignment	Low
5	Very strong alignment	Very low

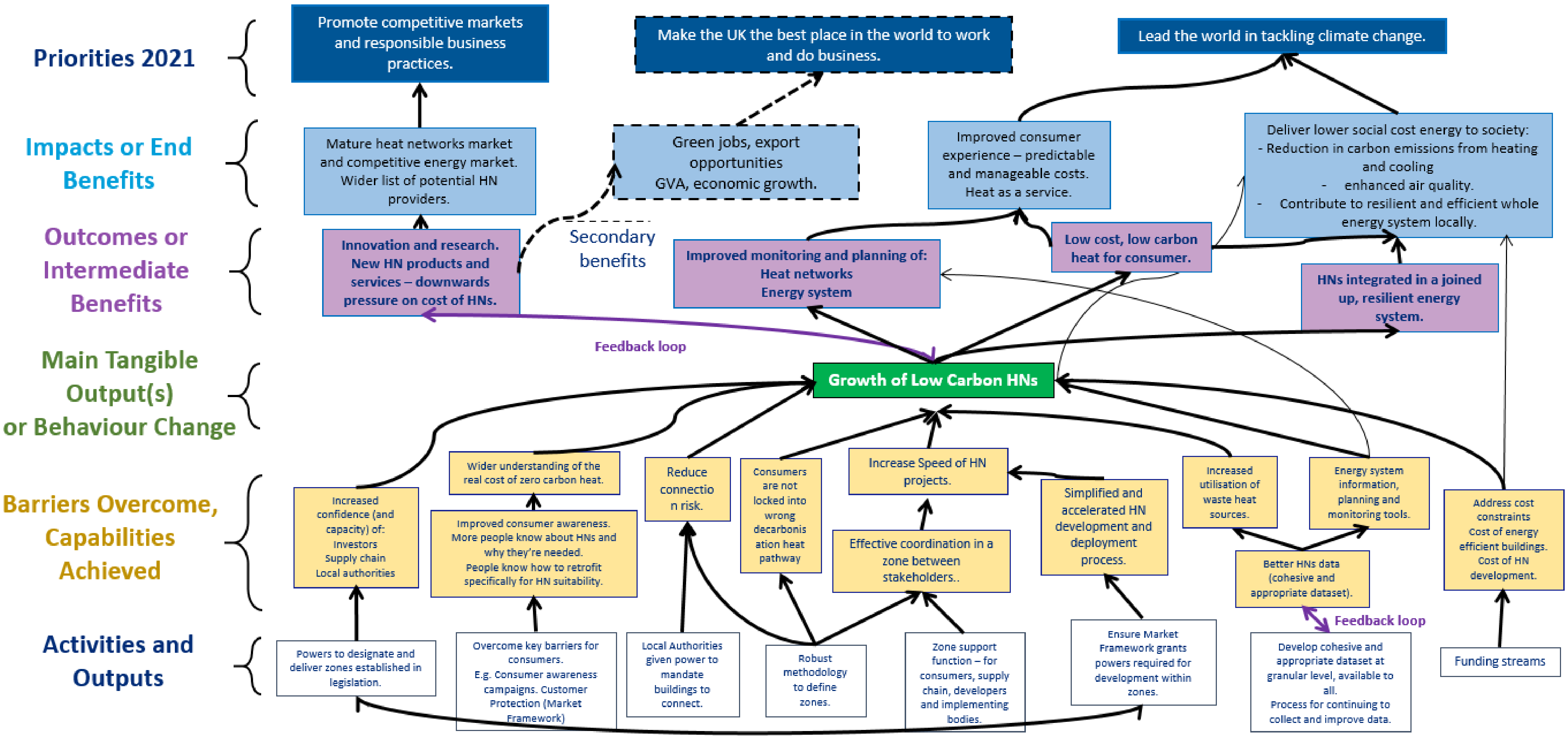
Final scores and a summary of the rationale for each score are shown in Table 32.

Table 32 – Final scores and rationale for option scoring

Critical Success Factors	Weighting	Score and rationale					
		Mandatory (compulsion)			Incentivisation		Structural
		Light touch - buildings assess connection	Low - key anchor loads	High - all suitable buildings required	Central govt financial support	Community engagement campaigns	Business rates exemptions
		a	b	c	d	e	g
Achieve Policy Objectives	**50**	**1.5** Lowest level of compulsion - minimal impact as may not increase the number of heat networks to the level needed to achieve policy objectives, or address market failures.	**2.9** Low level of compulsion (but higher than "light touch") should address some of the policy objectives but not as much as higher levels of compulsion.	**4.4** Higher levels of compulsion are likely to have the biggest impact on the policy objectives.	**2.9** Financial support will probably be necessary alongside any compulsion options, but alone would likely not be enough to impact some of the key policy objectives like connection risk and coordination failures.	**2.5** Community engagement campaigns important for increasing knowledge of HNs, but alone would not be enough to drive increases in deployment. Previous campaigns to reduce energy bills have not had a big impact.	**2.4** Could be important alongside other options but alone not likely to have big impact on **policy** objectives.
Novelty of policy proposals	**10**	**3.8** Minimal mandatory connection seen as less politically challenging.	**3.3** Low level of mandatory connection seen to have some level of political considerations but not as much as high mandatory connection.	**2.5** High mandatory connection seen as fairly challenging in terms of political considerations due to potential increase costs and taking away choice from a wider range of buildings.	**3.0** Financial support options alone would likely be less favourable but could have benefits alongside other options.	**4.3** Generally wide support for community engagement campaigns as low cost and potential to facilitate wider knowledge and acceptability of HNs.	**2.5** Financial support options alone would likely be less favourable but could have benefits alongside other options.

Deliverability	**25**	**2.0** More complex role for the implementing body in the light touch option as they would have to ensure assessments carried out properly, broker relationships between owners/developers and aligns with other area plans (due to the lower confidence about which buildings will need to connect).	**4.0** Lower mandatory connection would likely require less resource/capability. Will depend on who is the implementing body.	**2.0** Higher mandatory connection would likely require more resource/capability. Will depend on who is the implementing body.	**4.0** Low resource required as there are already some financial support mechanisms in place.	**3.3** Reasonably low resource and capability implications - may already be done in some areas. Adding HNs to existing campaigns would be fairly low additional resource.	**3.3** Medium resource required to implement. Would be a centrally implemented policy but have implications on local authorities
Value for money	**15**	**4.3** Light touch option would have fairly low cost implications	**3.8** Lower mandatory connection would be lower cost to both government and business than a high mandatory connection option.	**2.5** Reasonably high cost to business if required to connect to HNs and a cost to government in implementing.	**2.5** High cost for government as that is where funding will come from but minimal cost to business.	**4.0** Minimal cost implications.	**3.0** Government may need to compensate Local Authorities for loss of revenue. However, would reduce cost for business.
Overall Score		**2.3**	**3.3**	**3.3**	**3.1**	**3.1**	**2.7**

Annex 5 – Theory of Change



Annex 6 – Potential impacts of the Heat Network Zoning policy on stakeholder groups

This annex has been prepared to provide additional description of the potential impacts of the heat network zoning policy on stakeholder groups.

Stakeholder groups have been identified from the stakeholder mapping in the proposals for heat network zoning document[57]. In order to describe potential impacts of the policy succinctly, certain stakeholders have been grouped together - this may mean that there is slight variation of impacts between stakeholders within the same group.

The potential impacts of the heat network zoning policy are presented alongside two alternative pathways for heating buildings in zones, to provide additional context. They are:

- ‘Do nothing’ counterfactual, where buildings continue to use predominantly gas heating, in place of low carbon heat networks; and
- ‘Low carbon’ counterfactual, where buildings use predominantly individual heat pumps for heating.

Both alternative pathways are presented as counterfactual scenarios to the implementation of the heat network zoning policy, in this impact assessment.

Table 33 - Impact of the Heat Network Zoning Policy on stakeholder groups

Stakeholder group	Potential impacts on the group under factual and counterfactual scenarios	‘Do nothing’ (counterfactual 1)	Decarbonised heat networks (factual)	‘Low carbon’ (counterfactual 2)
Gas and electricity providers (network operators and suppliers)	• Gas and electricity suppliers will be impacted by changes in demand for electricity and gas, under each of the scenarios. • It is assumed that between the scenarios the unit price of fuel would vary, depending on demand, to maintain affordability for society. In turn would impact on how much consumers are billed for energy. • Electricity and gas network operators will charge developers for connection to the gas network and electricity grid. The cost of connection may vary depending on the scenario, due to the level of	• By continuing to use predominantly gas boilers, energy providers would need to supply broadly the same levels of gas and electricity demand, as the present day. • Overall, the ‘Do nothing’ scenario would have the highest dependence on gas for heating, and the lowest dependence on electricity. • Total energy demand would be highest for this scenario due to the efficiency of heating systems.	• Implementing low carbon heat networks in zones, would significantly lower levels of gas demand, but would increase levels of electricity demand, compared to the ‘Do nothing’ scenario. • Compared to the ‘Low carbon’ scenario, the demand for electricity will be lower, which should mean costs for increasing electrical capacity on the grid are lower. However, some gas infrastructure	• Implementing predominantly individual heat pumps would see gas demand for heating reduce towards zero. • Demand for electricity would be higher, compared to the other scenarios. This would likely result in the highest costs for providers to increase electricity grid capacity. • Total energy demand would be lower than the ‘Do nothing’ scenario and at a similar level to the factual scenario.

[57] Proposals for heat network zoning (2021): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1024216/heat-network-zoning-consultation.pdf

	investment required to develop electricity and gas networks.		would need to be retained as well. • Total energy demand would be lower than the 'Do nothing' scenario and at a similar level to the 'Low carbon' counterfactual.	
New build developers (required to connect to a heat network)	• New build developers will need to pay for connection to utility services, which could include gas, electricity and to the heat network, under the different scenarios. • New build developers will need to install heating and metering equipment for the building, as well as fabric efficiency measures. • Building regulations will define the energy efficiency standard which a building must meet. • New build developers may pass on costs they have incurred, for connection to utilities and heating equipment, through the sale of the building, leasing, or renting.	• By continuing to install gas boilers in new builds in zones, typically each building will need to connect to electricity and gas networks. • Developers will need to install gas boilers, and heat delivery systems. Heat storage may also be required. • The Part L 2021 domestic Impact Assessment [58]has estimated the cost of installing a new domestic gas boiler as well as solar PV, in table 8. • Section 4 of the Part L non-domestic Impact assessment[59] discusses the cost of the energy efficiency of non-domestic buildings.	• Under the factual scenario each building will need connect to a heat network, as well as the electricity network. Buildings will not typically need to connect to the gas grid. • Developers may incur an on-plot development costs to install a plantroom on the land to enable connection to the heat network. This will vary by type of development. • Developers will need to install Heat Interface Units (HIUs), heat metering equipment, and heat delivery systems. • Compared to the counterfactuals, developers may benefit from not needing to implement heat storage on-site, which may increase space savings in individual buildings/units.	• By implementing heat pumps, each building would need to connect to the electricity grid. • Developers will need to install a heat pump, heat storage, and heat delivery system. • The market-based mechanism for low carbon heat[60] aims to bring cost parity of installing domestic heat pumps, compared to gas boilers by 2028. • The Part L 2021 domestic Impact Assessment **Error! Bookmark not defined.** has estimated the cost of installing a new air source heat pump, in table 8. • Section 4 of the Part L non-domestic Impact assessment **Error! Bookmark not defined.**discusses the cost of improving the energy efficiency of non-domestic buildings, including installing

58 https://assets.publishing.service.gov.uk/media/61b880b4e90e07044462d865/Domestic_Part_L.pdf

59]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040632/Non-domestic_Part_L.pdf

60 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026488/heat-market-mechanism-impact-assessment.pdf

				low carbon heating technologies.
Building Freeholder/Landlord and Leaseholders on <u>residential communal heat networks</u> (required to connect to a heat network). Responsibilities between building freeholders and leaseholders will vary by type of leasehold, such as commonhold, those who have enfranchised, those who have the Right to Manage. Social housing arrangements will also vary. For the purposes of presenting impacts of the policy in this table it has been assumed: • The landlord will usually be required to manage and maintain the structure, exterior and common areas of the building, to collect service charges from all the leaseholders, insure the building and keep the accounts. • The landlord will generally make no financial contribution to the services but may be required to pay for services upfront before recovering the cost through charges to the leaseholder. • The leaseholder's obligations will include contribution to the costs of maintaining, insuring, and managing the building.	• Buildings that are already communal heat networks would have existing connections to the electricity and (potentially) gas networks. • Buildings that are already communal heat networks would have existing heat network infrastructure within the building, such as a plant room, heat distribution system and Heat Interface Units (HIUs). • Freeholders would need to arrange for the installation of heating equipment (such as a boiler, heat pump or connection to a district heating system) at or before end of life of existing assets for the building. The costs of arranging and installing the heating equipment will likely be passed to leaseholders. • Freeholders (or managing agent) will need to maintain the heating technology. The cost of maintenance will be passed through to leaseholders. The cost of installing/maintaining heating technology may invoke the section 20 consultation process for major works[61], if the cost of the works exceeds £250 per leaseholder for one-off works. • Leaseholders/tenants may experience disruption as a result of the installation and maintenance requirements.	• Under the 'Do nothing' scenario, Freeholders/Leaseholders will continue with the gas and electricity connections they have. • At the end of life of the existing heating system in the plantroom, freeholders (or managing agents) will need to replace the heating technology, with the same heating technology (typically a gas boiler). • Freeholders will need to arrange for the upkeep of the heating technology and communal heating system.	• Under the factual scenario Freeholders (or managing agents) will need to connect the building to the district heat network. • Freeholder may incur and on-plot development costs on the land to enable connection to the heat network. • Freeholders will need to arrange for the upkeep of the heating infrastructure within the building (previously known as the communal heating system). The freeholder would not need to arrange for upkeep of the heating technology.	• Under the 'Low carbon' scenario, Freeholders/Leaseholders will continue with the electricity connection they have. • At the end of life of the existing heating system in the plantroom, freeholders (or managing agents) will need to replace the heating technology, with a heat pump. • Freeholders will need to arrange for the upkeep of the heating technology and communal heating system.

[61] https://www.legislation.gov.uk/ukpga/1985/70

• **Building Freeholder/Landlord and Leaseholders in <u>non-domestic</u> buildings** (required to connect to a heat network) Responsibilities between non-domestic building freeholders and leaseholders will vary. For the purposes of presenting impacts of the policy in this table it has been assumed: • The landlord will usually be required to manage and maintain the structure, exterior and common areas of the building, to collect service charges from all the leaseholders, insure the building and keep the accounts. • The landlord will generally make no financial contribution to the services but may be required to pay for services upfront before recovering the cost through charges to the leaseholder. • The leaseholder's obligations will include contribution to the costs of maintaining, insuring, and managing the building.	• Freeholders/Leaseholders of existing buildings would have existing connections with electricity and gas, and some to heat networks. • Some non-domestic buildings may already operate as communal heat networks, with a centralise heating plant supplying heat to multiple business units in the building. This would mean they already have a plant room, heat distribution system and potentially Heat Interface Units (HIUs) installed. • Other non-domestic buildings may not have communal heating systems and instead rely on individual heating systems for each business unit. *Additional costs for non-communally heated non-domestic building are italicised in the factual column.* • Freeholders will need to arrange for the installation of heating equipment (such as a boiler, heat pump or connection to a district heating system) at or before end of life of existing assets for the building. The costs of arranging and installing the heating equipment will likely be passed to leaseholders. • Freeholder (or managing agent) will need to maintain the heating technology. The cost of maintenance will be passed through to leaseholders. • Leaseholders may experience disruption as a result of the installation and maintenance requirements.	• Under the 'Do nothing' scenario, Freeholders/Leaseholders will continue with the gas and electricity connections they have. • At the end of life of the existing heating system(s) in the plantroom, Freeholders (or managing agents) or leaseholders will need to replace the heating technology, with the same heating technology (typically a gas boiler). • Freeholders will need to arrange for the upkeep of the heating technology and distribution system.	• Under the factual scenario Freeholders (or managing agents) will need to connect the building to the district heat network. • Freeholder may incur and on-plot development costs to install a plantroom on the land to enable connection to the heat network. • Freeholders will need to arrange for the upkeep of the heating infrastructure within the building (communal heating system). The freeholder would not need to arrange for upkeep of the heating technology. • *For non-domestic buildings that are not already communal heat networks, freeholders (or managing agents) will need to install 'communal pipework' to link individual heat distribution systems, as well as install Heat Interface Units (HIUs), and heat metering equipment within each business units.* • *Freeholders will need to arrange for the upkeep of new 'communal pipework' and HIUs within the building.* • Freeholder/Leaseholders may benefit from not	• Under the 'Low carbon' scenario, Freeholders/Leaseholders will continue with the electricity connection they have. • At the end of life of the existing heating system(s) in the plantroom, Freeholders (or managing agents) or leaseholders will need to replace the heating technology, with a heat pump. • Freeholders will need to arrange for the upkeep of the heating technology and distribution system.

			needing to have heat storage, which may increase space savings.	
Final consumer (Owner occupied/leaseholder/ Tenant/business tenant)	• The final consumer will pay electricity/gas/heat tariffs based on their consumption of energy. • Included within their electricity/gas/heat bill will be a standing charge to cover cost of operating, maintaining, and developing the networks.	• Under the ‘Do nothing’ scenario, final consumers will pay for their heat demand as part of their gas bills.	• Under the factual scenario, final consumers will pay a ‘heat tariff’ to the operator of the heat network, for their heat consumption.	• Under the ‘Low carbon’ scenario, final consumers will pay for their heat demand as part of their electricity bill.