Title: Heat Network Zoning Consultation Stage IA **IA No:** BEIS035(C)-21-CH **RPC Reference No:** N/A **Lead department or agency:** Department for Business, Energy and Industrial Strategy **Other departments or agencies:** None	**Impact Assessment (IA)** **Date:** 27/09/21 **Stage:** Consultation **Source of intervention:** Domestic **Type of measure:** Primary legislation **Contact for enquiries:** heatnetworks@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: N/A

Cost of Preferred (or more likely) Option (in 2019 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
£530m	£-14m	£-0.7m	Qualifying provision

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 (higher costs, 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.

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. 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 MTCO2e abated)
- Utilise 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 the following:

- **Option 1, low option:** all new builds and large public sector buildings are required to connect to heat networks
- **Option 2, medium option:** all new builds, large non-domestic, and large public sector buildings are required to connect to heat networks
- **Option 3, high (preferred) option:** all new builds, large non-domestic, large public sector and communally heated residential blocks would be required to connect to heat networks

Further options were explored at long list stage but haven't been considered in the quantitative short list options appraisal.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** N/A				
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:** 1.8		**Non-traded:** -11.2	

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: ______________ Date: 15/09/2021

Summary: Analysis & Evidence

Policy Option 1

Description: Low Policy Option

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	**PV Base Year** 20204	**Time Period Years**	**Net Benefit (Present Value (PV)) (£m)**		
			Low: Optional	**High:** Optional	**Best Estimate:** £-110m

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			£50m	**£1,860m**

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

-£1,600m - Upfront capital costs of deploying heat networks, relating to the necessary generation and distribution infrastructure. Dependant on type of low carbon technology deployed and the local geography.
-£250m - Cost to local and national government in designating heat network zones and implementing policy.
-£10m - 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		£40m	**£1,750m**

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

£120m - Net energy savings – low carbon heat networks are more efficient than the counterfactual.
£1,550m - Carbon savings – reduction in non-traded emissions and small increase in traded sector.
£50m – Air quality savings – improvement in air quality
£40m – Operating cost - reduction in operation and maintenance costs

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, 'infill' of non-target 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, procurement costs, number of zoning coordinators, time require per HN developer/operator for familiarisation with proposals, % of exempt buildings, time required for providing information.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m			**Score for Business Impact Target (qualifying**
Costs: £0.7m	**Benefits:**	**Net:** - £0.7m	£14m

Summary: Analysis & Evidence

Policy Option 2

Description: Medium Policy Option

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	**PV Base Year** 20204	**Time Period Years**	**Net Benefit (Present Value (PV)) (£m)**		
			Low: Optional	**High:** Optional	**Best Estimate:** £270m

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		£170m	**£6,700**

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

-£6,400m - Upfront capital costs of deploying heat networks, relating to the necessary generation and distribution infrastructure. Dependant on type of low carbon technology deployed and the local geography.
-£280m - Cost to local and national government in designating heat network zones and implementing policy.
-£10m - 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			£170m	**£6,970m**

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

£500m - Net energy savings – low carbon heat networks are more efficient than the counterfactual.
£6,150m - Carbon savings – reduction in non-traded carbon emissions and small increase in traded sector.
£180m – Air quality savings – improvement in air quality
£150m – Operating costs – reduction in costs of operation and maintenance

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, 'infill' of non-target 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, procurement costs, number of zoning coordinators, time require per HN developer/operator for familiarisation with proposals, % of exempt buildings, time required for providing information.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m			**Score for Business Impact Target (qualifying provisions only)**
Costs: £0.7m	**Benefits:**	**Net:** - £0.7m	£14m

Summary: Analysis & Evidence

Policy Option 3

Description: High Policy Option

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	PV Base Year 20204	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	**High:** Optional	**Best Estimate:** £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	**£9,940m**

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

-£9,620m - Upfront capital costs of deploying heat networks, relating to the necessary generation and distribution infrastructure. Dependant on type of low carbon technology deployed and the local geography.
-£310m - Cost to local and national government in designating heat network zones and implementing policy.
-£10m - 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. Examples of these costs are disruption costs associated with deployment of heat networks and access costs for the owners of heat sources who may 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		£260m	**£10,470m**

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

£750m - Net energy savings – low carbon heat networks are more efficient than the counterfactual.
£9,220m - Carbon savings – reduction in non-traded carbon emissions and small increase in traded sector.
£270m – Air quality savings – improvement in air quality
£220m – Operating cost benefit, reduction in operation and maintenance costs

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 where heat network zones are designated, the number of buildings which choose to connect to zones but are not required to connect, policy option impacts on existing buildings and new builds, scaling of analysis to national level. Mix of heat network generation technologies, cost of implementing the zoning policy, number of zoning coordinators, time required per HN developer/operator for familiarisation with proposals, % of exempt buildings, time required for providing information.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m			**Score for Business Impact Target (qualifying provisions only)**
Costs: £0.7m	**Benefits:**	**Net:** - £0.7m	£14m

[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

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. 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. 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. 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 a consultation on heat network zoning. Our proposals 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[2]. Similarly, BEIS' recent *Opportunity Areas for District Heating Networks in the UK[3],* study indicates that a significant portion of the UK's heating could be met by heat networks.

Rationale for Intervention

5. 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 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

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[2] "Research on district heating and local approaches to heat decarbonisation" Element Energy for the CCC, http://www.element-energy.co.uk/2015/12/element-energy-research-on-district-heating-for-the-ccc-published-alongside-5th-carbon-budget-report/

[3] *Opportunity Areas for District Heating Networks in the UK* is a report produced by BEIS in response to the EU Energy Efficiency Directive requirement to conduct a National Comprehensive Assessment for Efficient Heating and Cooling in the UK.

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 decision 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, as long as 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.

6. The market failures 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.

7. 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 accompanying consultation document.

Description of options considered

8. A long list was developed and agreed with stakeholders. This was split into three categories; Compulsion, Incentivisation and Structural. Options were considered independently using a Multi Criteria Analysis (MCA), 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

9. 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 in a given timeframe:

a. **Light touch** – building assessed for connection

All buildings required to assess whether they should connect to a heat network.

b. **Low** – key anchor loads

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.

c. **High** – all suitable buildings mandated

All suitable buildings required to connect to HN.

Incentivisation options:

d. **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.

e. **Awareness campaigns**

Raising awareness in local communities about low carbon heating and the benefits of heat networks to generate demand.

Structural options:

f. **Remove distortions between price of gas and electricity**

g. **Business rates exemptions**

District heating schemes exempt from paying business rates.

10. Workshops were held to identify a number of '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

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 3 – Multi Criteria Analysis Methodology.

11. The results of the MCA are shown in Table 1 below. Removing distortions between the price of gas and electricity was removed from the process as this issue is being considered in other areas of government.

Table 1 - MCA results

Critical Success Factors	**Weighting**	**Score for each option**					
		Mandatory (compulsion)			**Incentivisation**		
		Light touch - buildings assess connection	**Low - key anchor loads**	**High - all suitable buildings mandated**	**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

12. The two preferred compulsion options, low and high, were further defined and developed into a short list of policy options, with the addition of a medium option to explore a wider range of buildings required to connect to a heat network.

13. As is apparent from Table 1, the non-regulatory options weren't assumed to adequately tackle the identified market failures and to achieve the policy objectives. Central government financial support is indeed expected to play a role in achieving the policy objectives. Subsidising the deployment of low carbon heat networks, either via a connection fund or support for heat network projects, without a regulatory intervention would be very costly. These options could complement, rather than substitute, the preferred option.

14. The short list of options are described in the consultation, considering different classifications of buildings that could be required to connect to a heat network. The consultation presents the 'high' option as the preferred option. An SNPV will be presented for each of the regulatory policy options. The options are as follows:

a. **Low (option 1)**: all new build and large public sector buildings are required to connect to heat networks, all other buildings encouraged to connect.

b. **Medium (option 2)**: all new build, large public sector and large non-domestic buildings required to connect to heat networks, all other buildings encouraged to connect.

c. **High (option 3, preferred):** all new build, large public sector, large non-domestic and communally heated residential blocks required to connect to heat networks, all other buildings encouraged to connect.

15. The scope of each of the policy options is England only. The chosen option will be given effect via primary legislation, with more specific requirements enacted in secondary legislation as the policy evolves. The policy is expected to come into force between 2023 & 2024.

Counterfactual

16. For the purposes of the cost benefit analysis two separate counterfactuals have been considered. The quantified analysis has been carried out using a gas counterfactual, and a qualitative assessment carried out against a low carbon ‘building level electrification’ counterfactual. The gas counterfactual is intended to represent a genuine ‘do nothing’ scenario showing the impact of there not being a policy intervention. The low carbon counterfactual presents a discussion on the impact of decarbonising the same stock of buildings with different technologies (i.e. heat networks instead of individual heat pumps for buildings).

17. The policy options are compared against a ‘do nothing’ scenario as the counterfactual in the quantified analysis. The counterfactual is therefore represented by a continuation of buildings using high carbon heating systems. Currently 97% of heating is provided by individual heating systems, and the remainder by heat networks. This split of heating is assumed to continue in the counterfactual.

Policy objective

18. There are multiple policy objectives of heat network zoning. The primary policy objective of heat network zoning is to deliver the lowest cost, low carbon heat to consumers.

19. In achieving the above objective, there are further policy objectives against which the success of the policy can be evaluated. Achieving the below objectives alone wouldn’t be sufficient to ensure that heat networks deployed in zones would deliver the lowest cost, low carbon heat :

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

20. 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 4 – Theory of Change.

21. As the policy is at consultation stage, there is a degree of uncertainty behind the target of the SMART objectives. However, it is possible to describe how the policy objectives would be measured and, the timeframe that they would be measured over. Targets will be provided for the policy objectives in the final-stage IA.

Policy Objective	Metric	Timeframe
Low cost, low carbon heat	p/kWh	2025 - 2050
Increase in the deployment of low carbon heat networks	(Low carbon) TWh/ yr	2025 - 2050
Reduction in carbon emissions	MTC02e 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)

22. 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.

23. **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. The operating cost doesn't include fuel costs.
- **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 heat network operators in the form of familiarisation costs, plus there will be further policy costs described later in the IA.

24. **Monetised benefits:**

- **Net energy savings** – Low carbon heat networks – which would be largely heat pump led - are more efficient in producing heat than the 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[4].
- **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.

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

Rationale and evidence to justify the level of analysis used in the IA (proportionality approach)

25. Given that this IA is support a consultation on heat network zoning, aspects of the policy are proposed and will be finalised after the responses have been received. It isn't proportionate to quantify all the costs and benefits that will arise due to the policy. Where there are evidence gaps, we intend to use the consultation to seek evidence from stakeholders. We welcome any consultation responses to help us improve aspects of the evidence base.

26. 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.

Methodology for Analysis and Key Assumptions

Overview

27. The IA presents the impact of the consultation 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 heat networks 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. Cost to heat network developers, operators and building owners. These costs constitute the **cost to business.**

28. We have not quantified the impacts on final consumers on heat networks as part of the SNPV. The policy defines that heat networks are deployed where they offer the most cost-effective means of providing low carbon heat to buildings. Consideration of the impacts to final customers has been discussed in paragraph 117 and the Wider impacts section.

29. We will describe these sections separately in terms of methodology and assumptions.

30. 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. Given that the appraisal period goes beyond 2050, and the quantified counterfactual is high carbon, we do **not count** carbon savings or air quality benefits beyond 2050, as we assume we meet the 2050 net zero target.

31. Two counterfactuals have been presented in the IA, one of which is quantified and the other discussed qualitatively. The analysis is quantified against a 'do nothing' counterfactual where fossil fuel-based heating systems continue to be the dominant heating choice. The other counterfactual is an alternative electrification low-carbon heating scenario which reflects that Net Zero is a legislative commitment, and where heat networks weren't deployed there would likely be building level electric heating systems (i.e. individual air source heat pumps).

32. 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.

33. Additionally, there are a series 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.

34. 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[5].

35. The cost benefit analysis for the IA considers the net social impact of **only new heat networks** deployed in zones. 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.

36. 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 assume that most of the deployment is additional to 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.

37. To help navigate the four 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 for estimating deployment of heat networks in zones
Technology Mix – methodology and key assumptions
Cost to Government – methodology and key assumptions
Cost to Business - methodology and key assumptions

[5] Select Committee on Environmental Audit, - https://publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/1110/111004.htm

Methodology - Estimating deployment of heat networks in zones under the different policy options

Methodology Section Description
Deployment - Methodology and key assumptions for estimating deployment of heat networks in zones
Technology Mix – methodology and key assumptions
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Cost to Business - methodology and key assumptions

Definition of deployment

38. The deployment of heat networks is the total heat delivered by heat networks under the different policy options. The heat delivered is a function of the following:
   a. the number of buildings connected to a heat network in a zone, and
   b. the heat demand of those buildings.

39. To reflect the policy options through our analysis we have defined 'large' buildings and communally heated residential blocks as being buildings of non-domestic, public sector or residential type with heat demand over 100MWh/yr; however, this threshold is open for feedback as part of the consultation. All key assumptions used in estimating deployment can be found in Table 3.

40. As well as target buildings connecting to heat networks in zones, non-target buildings will also be encouraged to connect to heat networks.

41. The method for estimating deployment looks at both the existing building stock and projections for domestic new builds which could connect to heat networks within zones. Separate approaches have been taken for each and are described below.

Deployment of heat networks from existing building stock

42. The approach for estimating deployment of heat networks within zones from existing building stock has been informed by recent experience from BEIS of investigating heat network opportunities as well as analysis from recent the City Decarbonisation Delivery Programme (CDDP)[6] which has tested an initial heat zoning approach across 5 cities and Greater Manchester spanning 15 Local Authority areas in England. The analysis from CDDP provides estimates of the number of buildings and heat demand that could be situated within a heat network zone, and the subset of buildings which could cost-effectively connect to a heat network.

43. We have used outputs from the six cities considered in the CDDP analysis and scaled to national level to estimate deployment. This assumes that zones would be designated in 200 of the largest towns and cities in England (by population, central case). We have used the

[6] The Future Market Framework consultation in 2020 recognised the importance of zoning and committed us to trials and research. As part of these trials, we have looked at how the heating systems of six cities across England could be decarbonised and these trials have shown that heat network zoning has the potential to help local authorities meet net-zero commitments. These trials have been titled the 'City Decarbonisation Delivery Programme (CDDP)'.

Economic Potential[7] model, developed for the report *Opportunity Areas for District Heating Networks in the UK*[3], to extrapolate from CDDP metrics.

Assessing impacts of policy options on heat networks from existing building stock

44. The methodology used in the CDDP analysis assumes that all buildings that could cost-effectively connect to a heat network do connect to a network. Therefore, the deployment measured in the CDDP analysis includes buildings that are not targeted by the policy, which we have termed as 'infill' buildings. These infill buildings would be encouraged to connect under all policy options.

45. The buildings captured within the CDDP analysis have been segmented into groups of buildings targeted by the policy and non-target or 'infill' buildings based on the definition in paragraphs 14. Since the approach used in the CDDP analysis does not reflect the varying level of deployment through the policy options, we have adapted an approach to estimate deployment under each policy option by:

   a. Assuming under the High policy option the full level of deployment from the CDDP analysis can be achieved.
   b. Under the Medium policy option, where communally heated residential buildings are not in scope of the policy, we remove a proportion of deployment that is equivalent to the estimated heat demand and number of large residential buildings (from the full level of deployment from the CDDP analysis). We have used the Economic Potential model[7] to estimate reduction that is required from CDDP metrics.
   c. Under the Low policy option, similarly to the Medium option, we remove the proportion of deployment equivalent to large residential and large non-domestic buildings (from the full level of deployment from the CDDP analysis).

46. For the Medium and Low policy options, we remove the proportions from the total deployment (including infill) to reflect both a reduction in the cohort of target buildings and non-target buildings. The reason for reducing non-target buildings is due to their dependency on larger target buildings to provide cost-effectiveness for connecting to a heat network. Table 2 presents the breakdown of target building by number and heat demand, which is used to approximate deployment under the policy options

Table 2 - Breakdown of existing target buildings from Economic Potential[7] analysis used to approximate policy options

Target Building type	% Target Heat demand	% Target Buildings
Large non-domestic	49%	41%
Large public sector	9%	8%
Communally heated residential	41%	51%

Deployment of heat networks from domestic new builds

47. New builds are included within the scope of all of the policy options. We assume that deployment of heat networks amongst new builds does not vary between the policy options.

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[7] The Economic Potential model was developed to identify areas in the UK that could present economic viability to develop heat networks. This model was used to inform the report, *Opportunity Areas for District Heating Networks in the UK* (see footnote 3 for more information on the report).

48. The approach for estimating deployment of heat network in new builds has been to grow the number of existing buildings within zones, identified through the CDDP analysis, in line with ONS projections of national housing stock growth through to 2050, to estimate the number of new builds that would be built within zones in the period. We have then multiplied the estimate of number of new builds within zones by an average assumed heat demand per household of 4,984 kWh/yr[8], to estimate heat demand.

Adjusting deployment estimates for existing heat networks and impacts of other policies

49. We need to take into account the buildings already connected to a district heat network in order to consider the additional deployment resulting from heat network zoning. We define the level of existing district heat networks and potential heat networks from other policies (e.g. the Green Heat Network Fund) as ‘the baseline’. We have estimated this baseline using estimates of heating supply from existing district heat networks in England presented in the *Experimental Statistics on Heat Networks, 2018*[9] and combining this with estimated deployment from the Heat Networks Investment Project (HNIP) and the Green Heat Network Fund (GHNF).

50. The scope for the overlap between the heat network zoning policy and ‘the baseline’ is dependent on the coverage of zones in England. The high policy option will form the largest zones, in terms of coverage, with the medium and low policy options resulting in smaller zones, and therefore would have a smaller overlap with ‘the baseline’. For the high policy option, we assume there is a 100% overlap between heat network zoning deployment and the baseline, since we assume zones would encompass areas of existing heat networks or heat networks delivered through other policies. For the medium and low policy options we assume there would be less of an overlap with the baseline since fewer types of buildings are in scope of the policy options. We have used the breakdown presented in Table 2 to reduce the size of the overlap. For example, for the medium policy option, communally heated residential buildings are no longer in scope, therefore we only deduct 59% of the baseline from our deployment estimates for the medium policy option, to reflect a smaller overlap with existing heat networks and heat networks delivered through other policies.

Key assumptions - Estimating deployment of heat networks in zones under the different policy options

Table 3 – Central assumptions for estimating deployment of heat networks in zones

Assumption	Description and value	Evidence	Sensitivity analysis
Definition of ‘large’ target buildings	‘Large’ target buildings and communally heated residential blocks to be defined as having more than 100MWh/yr of heat demand.	Judgement	Low impact on result due to ‘infill assumption’. Not explored through sensitivity analysis

[8] This figure represents an average of heat demand for all domestic building types, weighted by projected number of net completions from 2025 to 2029, presented in The Future Homes Standard 2019 Consultation on changes to Part L (https://www.gov.uk/government/publications/the-future-homes-standard-consultation-impact-assessment). These figures are subject to change in-line with changes to the Future Homes Standard regulation.

[9] https://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks

Number of towns and cities	Zones to be implemented in heat-dense areas where deployment will be cost-effective. Using HNDU feasibility studies we have assumed the top 200 towns and cities (by population) could have potential for zones.	HNDU feasibility studies	Explored in the sensitivity analysis in section for 100 and 300 towns and cities.
Scalability of CDDP metrics relative to the Economic Potential (EP) model	To estimate national deployment we combine case study insights from CDDP analysis (six cities), with the EP model (national level). The models are independent, and we expect the CDDP analysis is better suited to planning of heat networks.[10] The EP model is likely to overestimate deployment relative to the CDDP analysis, so we assume CDDP metrics scale at a rate of 80% of the areas the suitable for heat networks from the EP model.	Judgement	Explored in the sensitivity analysis in section for scaling at a rate of 60% and 100%.
'Infill' assumption of non-target buildings	The CDDP model requires all buildings (both target and non-target) to connect to a heat network. In our central scenario we assume there will be 'infill' of non-target buildings to the levels seen through the CDDP analysis. The level of infill is uncertain and tested within the sensitivity analysis.	Estimates from CDDP work[6]	Explored in the sensitivity analysis in section for inclusion and exclusion of infill.
Policy option impacts on existing buildings	The decrease in deployment in the medium and low options is estimated using the decrease in the proportions of buildings no longer in scope of the policy.	Economic Potential model	Explored in the sensitivity analysis in section for detriment to cost-effectiveness of zones.
Policy option impacts on new builds	In all policy options we assume there is the same level of deployment from new builds since new builds are required to connect for each of the options.	Judgement	Not explored through sensitivity analysis
Average new build heat demand	Average heat demand in domestic new build from 2025 to 2050 is 4,984 kWh/yr[8]	MHCLG	Not explored through sensitivity analysis
Building stock growth rate	Building stock in zones increases on average by 14% between 2025 and 2050, in line with national growth.	ONS	Not explored through sensitivity analysis

[10] The analysis carried out for CDDP is based on modelling software which has been developed to plan heat networks in local areas, it is very computationally heavy and considers many local factors when planning networks. The economic potential model is a national level model and therefore can't include the same level of detail in its calculations. The national level model may therefore predict deployment where a more local analysis wouldn't.

Linear growth of deployment[11]	Deployment as a result of the policy will follow a linear profile, starting from zero and increasing to the maximum level of deployment, between 2025 and 2050.	Judgement	Not explored through sensitivity analysis

Methodology – Technology Mix

Methodology Section Description
Deployment - Methodology and key assumptions for estimating deployment of heat networks in zones
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51. Carbon emissions are calculated by looking at the net change in fuel use by moving from gas-based heating systems in the counterfactual to low carbon, largely heat pump-led, heat networks deployed within heat network zones. The difference between emissions in both scenarios constitute the carbon savings.

52. 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. 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.

Key Assumptions – Technology Mix

53. The mix of heat network generation technologies that deliver heat in heat network zones is another key assumption in the cost benefit analysis. According to the proposals set out in the zoning consultation, there will be a requirement for new heat networks in zones to be low carbon from the outset. This has informed the assumptions we have made regarding the generation technology mix. These assumptions influence the following components of the cost benefit analysis:

a. Carbon and air quality savings relative to the counterfactual

b. Capital and operating costs relative to the counterfactual

c. Net energy savings against the counterfactual

54. Our proposed central generation technology mix is derived in part from the recent *Opportunity Areas for District Heating Networks in the UK*[3] 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, 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

[11] A linear deployment profile has been assumed due to lack of information to predict a more realistic profile. The deployment profile might not be linear in reality, we will work on developing our evidence base on growth rates ahead of the final stage IA.

air-, ground- and water-source heat pumps. There is also a role for gas as back-up boilers. The assumed split is described below:

Table 4 – 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%

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

56. In the 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[12]. 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 5 – Counterfactual assumption for heating technologies, 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

[12] 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

57. A key component of the cost benefit analysis is the capital cost of deploying heat networks relative to the counterfactual. 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.

58. 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 in Annex 1 – Detailed modelling assumptions, for the factual and counterfactual.

59. As a simplifying assumption, the capital costs of the distribution infrastructure for heat networks are calculated using a single £/ kWh value. The value is £450/ kWh, made up of £300/ mWh for distribution network and £150/ mWh for ancillary costs. 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 BEIS 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 - Methodology and key assumptions for estimating deployment of heat networks in zones
Technology Mix – methodology and key assumptions
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60. 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 categories:

a. **The costs of designating zones**. This includes the costs of carrying out the modelling exercise to determine where zones should be and subsequently designating them as such, developing feasibility studies on specific areas and procuring heat network developers in zones
b. **Implementing** the zoning policy. 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
c. **Regulating additional heat networks.** The additional heat networks deployed through heat network zoning will impact on the national regulator for the sector. There will be an additional burden due to the regulator having a greater number of heat networks to regulate
d. **Additional staff in BEIS.** To support the rollout of the heat network zoning methodology to designate zones, there will need to be an expansion of resource in BEIS.

Cost to Government – Zone Designation

61. The methodology is assumed to be deployed in 200 towns and cities in the central scenario, this is used to inform the costs of designating zones. The consultation describes in more detail the zoning methodology, which has been costed in this IA.

62. The key assumptions (set out in Table 6) that have been used to work out the total cost of carrying out the zoning methodology in 200 towns and cities are described below. The costs have been based on the costs of similar studies carried out by HNDU, and from the recent CDDP work. There is some uncertainty related to how the costs would vary as zoning is rolled out at national scale. We have, therefore, tested increasing and reducing the costs in sensitivity analysis. It is assumed that these costs are incurred over the years 2024 to 2030.

Table 6 – Central assumptions for the cost to government of designating zones

Methodology Stage*	Assumption	Description and value	Evidence	Sensitivity analysis
Stage 1a - National mapping	Cost per town/ city	£5,000	Market estimate	Explored in the sensitivity analysis in section
Stage 1a/b	Proportion of cities going forward to Stage 1b	85%	HNDU studies	Not explored through sensitivity analysis
Stage 1b - Local Refinement	Cost per city	£50,000	Estimates from CDDP work[6]	Explored in the sensitivity analysis in section
Stage 2 - Feasibility	Average number of zones per city	3	Estimates from CDDP work[6]	Not explored through sensitivity analysis
	Cost per feasibility study	£40,000	HNDU Feasibility Studies	Explored in the sensitivity analysis in section
Procurement stage	Costs of concession	£300,000 per concession	CDDP study	Explored in the sensitivity analysis in section
	Cost of DPD procurement[13]	£850,000 per town/ city	HNDU DPD Procurement	Explored in the sensitivity analysis in section

[13] DPD stands for detailed project development. This is the standard current approach to procuring heat network developers, which requires the organisation in charge of procurement to do a significant amount of project development work for the procurement.

	% cities operating a concession style procurement	75%	Judgement	Not explored through sensitivity analysis

* See the accompanying consultation document [add link] for a more detailed description of the proposed methodology for zone identification and designation.

Cost to Government – Implementation

63. We anticipate that the zoning proposals, as described in the consultation, will place an additional burden on local authorities as they take on the role of local 'Zoning Coordinators'. Zoning coordinators will be responsible for activities such as:

- Local engagement and consultation on zone designation;
- Formally designating zones;
- Enforcing local zoning requirements (e.g. determining which buildings in zones are required to connect).

64. At this point, the number of local zoning coordinators that will be set up is uncertain, as are the costs of the activities described above. We have made some simplifying assumptions to provide a sense of scale of this cost. In our central scenario, we have assumed that each of the 170 towns and cities that designate zones will have a unique local zoning coordinator. We assume that each local zoning coordinator will require 3 additional FTE over the period 2024 to 2030, to match the period the methodology costs are incurred over. The costs are equivalent to an average G7 salary in government. The cost is calculated using the Civil Service Median Salaries by grade[14] and applying a wage uplift of 19.2%[15].

65. The consultation proposes local 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. Given the uncertainty regarding where the role of local zoning coordinator will sit, we also present a sensitivity assumption where there are fewer, larger zoning coordinators.

Table 7 – Central and alternative assumption for the number and role of zoning coordinators

Sub-Option	Number of bodies	FTE per ZC	Total FTE
Central	170	3	510
Alternative	35	9	315

Cost to Government – Regulating Additional Heat Networks

66. We estimate a significant increase in the deployment of heat networks due to heat network zoning. This will impose an increased burden on the national regulator, who will be in place by 2025. The cost elements of regulation cost included at detailed in the table below:

[14] https://www.gov.uk/government/statistics/civil-service-median-salaries-by-uk-region-and-grade

[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827926/RPC_short_guidance_note_-_Implementation_costs__August_2019.pdf

Table 8 – Cost to government of regulating additional heat networks

Cost category	Description
Authorisation and licensing	Ongoing cost associated with managing and processing all authorisation and licensing applications.
Market monitoring and regulatory development	Ongoing cost associated with monitoring the heat network market, developing market insights and development of current and future regulation.
Compliance and enforcement	Ongoing cost associated with managing compliance and enforcement cases with regulated entities.
Auditing	Ongoing cost associated with the carrying out audits required with regulated entities.
Legal	Ongoing cost associated with legal resource to support compliance and enforcement cases.
Overhead and other costs	Ongoing costs associated with the operation of the regulator, the key costs include IT, information security, HR, finance, communications, operations, office costs and insurance.

67. We do not expect an increase in the monitoring required of heat networks in zones relative to the monitoring that will take place under the market framework. Similarly, we do not anticipate that the national regulator will regulate the zones themselves. As such, the increased costs of regulating mentioned below would be solely attributed to the costs of regulating a greater number of heat networks which are deployed in zones.

68. The additional costs of regulating a greater number of networks have been calculated by extrapolating modelling that has been developed since the consultation stage impact assessment for the Heat Networks Market Framework.[16] The modelling has been developed by BEIS, with input and engagement from Ofgem, Citizens Advice, the Energy Ombudsman, Heat Trust and representatives of the heat network industry.

69. In order to account for how regulator costs may change over time, factors which influence regulatory costs are scaled with the expected growth in the market due to zoning. The regulator costs are dependent on the following metrics, which are scaled up from current levels: the estimated number of heat suppliers, number of heat networks, number of buildings, number of customers.

70. Following this approach, the regulator cost modelling numbers are inconsistent with assumptions elsewhere within the IA. The modelling assumes there will be roughly 3,500 additional district heat networks by 2050, whereas in paragraph 79, we present the

[16] Future Market Framework Impact Assessment, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863855/heat-networks-market-framework-consultation-impact-assessment.pdf

simplifying assumption that there will be one heat network per each of the 510. This may put upward pressure on this cost estimate.

71. As mentioned, the regulator cost estimates are based on extrapolating the current stock of heat networks. We expect heat networks deployed in zones to be relatively larger than the current district heat networks due to greater coordination and planning of the networks under the policy. This explains the difference in these two numbers. A significant part of the cost of regulating is dependent on the number of consumers. These numbers are less likely to be an overestimate, particularly as the number of consumers would scale with heat demand more accurately than the number of heat networks.

Table 9 - Annual Costs of Regulating Additional Heat Networks

Heat network deployment scenario	2025	2030	2035	2040	2045	2050
Low	£0.02m	£0.2m	£0.5m	£0.7m	£0.9m	£1.1m
Medium	£0.02m	£0.9m	£1.8m	£2.7m	£3.5m	£4.4m
High	£0.02m	£1.4m	£2.7m	£4.0m	£5.2m	£6.5m

72. In practice, elements of regulatory costs may not scale as assumed in our modelling, which could be due to factors such as the level of consolidation in the market and/or levels of compliance with the regulation. However, it isn't possible to estimate the impact of these factors at this point, and therefore this has not been included in the analysis. We will develop our evidence base on this ahead of the final-stage IA.

73. As described in the consultation, some of the consumer protections to be introduced by the market framework may be offered to buildings in zones which do not apply to similar buildings outside of zones. This may increase the costs of regulating heat networks in zones. However, it is too uncertain to attempt to quantify this at this point.

Cost to Government – Additional BEIS Staff

74. To support the rollout of the zoning methodology, there will need to be an expansion in heat networks technical expertise within BEIS. It is currently uncertain what the extent of this expansion would be. For the purposes of this IA, we have assumed that there would need to be an additional 40 staff members. This has been calculated by comparing the current amount of relevant BEIS resource and the number of heat network projects they support. It is assumed that each of the 40 staff members would be at G7 on average. The cost is calculated using the Civil Service Median Salaries by grade[17] and applying a wage uplift.

Variation between policy options

75. We have made the simplifying assumption that the majority of the costs to government are constant across the policy options. The only cost which varies is the cost of regulating the heat networks, since this is dependent on the heat supplied by heat networks in zones. Most of the costs of determining where zones are, and designating them, described above are fixed and wouldn't vary significantly depending on the different building types in scope of the zone. We don't have the evidence base to determine how these costs would vary between

[17] https://www.gov.uk/government/statistics/civil-service-median-salaries-by-uk-region-and-grade

the policy options. We welcome any evidence on this matter through the consultation responses.

Methodology – Cost to Business

Methodology Section Description
Deployment - Methodology and key assumptions for estimating deployment of heat networks in zones
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76. The costs to business that have been quantified in the impact assessment cover the costs that will be incurred by:

a. Heat network developers
b. Heat network operators, and
c. Buildings that are required to connect to heat networks

Heat Network Developers and Operators

77. Heat network developers and operators will each incur familiarisation costs due to the policy proposals. There would be a one-off cost to reading and 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 10 – Central assumptions for familiarisation costs of policy proposals to heat network developers

Assumption	Descriptions and value	Evidence	Sensitivity analysis
Time per HN developer/ operator	**7.5 hours per HN developer/ operator** Familiarisation – read and understand the requirements of the regulation, disseminate to staff. Use same assumption as HMBR IA	HMBR IA[18]	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/ ONS Annual Survey of Household Earnings[19]	Not explored through sensitivity analysis
Time Period	**Years 2 – 6 of policy (2025 – 2030)** Cost incurred in first years of policy.	Judgement	Not explored through

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

[19] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashetable14

			sensitivity analysis

78. Heat network operators will also incur additional costs under the market framework of notifying the regulator of their existence and reporting annually on the performance of their network. Following the assumptions set out in the Future Market Framework consultation stage IA[20] 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.

79. We have made the simplifying assumption that there will be on average one heat network per zone, in the absence of evidence to suggest otherwise. It is possible that zones could have more than one network. As described above, we estimate there will be 510 zones in total.

Buildings within Zones

80. The consultation proposes a requirement for buildings within zones (or potential zones) to provide certain information and data to the local zoning coordinator. This will be used in energy planning, to ensure that the methodology for designating the zone is based on the best possible evidence. We have assumed that it takes each of the buildings required to connect on average 2 person days to collect the data and share it with the zoning coordinator. We welcome any responses to the consultation related to how long it might take to perform this activity.

81. Buildings which are required to connect to heat networks in zones will be able to apply to be exempt from this requirement. The process for doing so is described in the consultation. This process will result in an additional cost being placed on the building. This has been quantified as a cost to business because of the policy. We assume that 20% of buildings which are required to connect apply for exemption. We have not assumed the number of successful applications for exemption as this is highly uncertain.

82. Where a building type is domestic in the preferred policy option, we assume that the cost will be borne by one single actor on behalf of the whole building. The domestic buildings in scope of the policy are communally heated residential blocks. We therefore include this cost in the cost to business.

83. We assume that there will be an online calculator to complete a 'cost effectiveness test', similar to that for the HMBR, as part of the application to be exempt from the heat network zone. The remainder of the assumptions used to calculate this cost are described in the Table 11:

Table 11 – Costs to buildings which are required to connect

Assumption	Approach	Evidence Source	Sensitivity analysis
% Exemptions	**20% of buildings apply for exemptions**	Judgement	Explored in the sensitivity analysis in section

20 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863855/heat-networks-market-framework-consultation-impact-assessment.pdf

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[21]	Not explored through sensitivity analysis
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
Person required	**75% HNs developers use 'Estate Manager', 25% a consultant** Same as HMBR IA Average wage £26 / hour	HMBR IA	Not explored through sensitivity analysis

84. The consultation considers two broad options for who should pay connection costs – leaving it to contractual arrangements between network developers and building owners; or government introducing rules (potentially cost caps) to prevent over-charging. The consultation also sets out various 'trigger points' where buildings would be required to connect to a heat network, which would help avoid scrappage of existing heating systems. Given that the alternative to connection to a heat network would be the capital cost of a new heating system, and that the costs of both the heat network and alternative are very uncertain, we assume that these costs net off in this impact assessment. This is something we will look to address in the final stage impact assessment.

Variation between policy options

85. We have made the simplifying assumption that the costs to business would be equal across each of the policy options. Many of the costs to business are dependent on the number of zones, and number of heat networks. It isn't clear how the number of heat networks would vary with the deployment under the policy options. For example, as you move from the high to the low policy option you may have a similar number of heat networks, with each of them delivering less heat. We will update this ahead of the final-stage impact assessment.

Non-monetised costs and benefits of each option, not included in the Methodology

86. 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

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

to £10bn per year by 2050[22]. The flexibility/storage capabilities of heat networks could contribute toward this, although there is limited evidence on the scale of potential benefits.

- **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 regulation will also provide a strong signal to the market that government expects the sector grow, which could lead to increased investment in the supply chain. 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.
- **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 (see above); and developing the operations of Energy Service Companies (ESCos). The indirect GVA impacts are uncertain and therefore have not been quantified in this analysis.
- **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:
    a. **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.
    b. **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.

Results

87. This section presents the results of the deployment analysis, and overall cost benefit analysis, for the three quantified policy options against the counterfactual scenario.

88. The results of the deployment analysis for the three different policy options are presented in Table 12. The numbers below are additional to the current stock of heat networks, and networks that will be deployed by HNIP and the GHNF.

89. The total heat demand for England, presented in *Opportunity Areas for District Heating Networks in the UK*[3], is estimated to be 439 TWh in 2050. Table 12 presents the proportion of total heat demand in England that could be delivered by the policy options.

Table 12 – Deployment under different policy options (in addition to existing heat networks and deployment through other heat network policies)

Policy option Deployment (TWh)	2025	2030	2035	2040	2045	2050
Low	0.1	1.1	2.1	3.1	4.1	5.1

[22] 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

Medium	0.1	4.2	8.3	12.5	16.6	20.7
High (preferred)	0.1	6.3	12.5	18.8	25.0	31.2

90. The SNPVs, and constituent parts, of each of the policy options are presented in Table 13. As shown in the table, there is a significant net capital cost due to the deployment of heat networks against the counterfactual.

Table 13– SNPV results of different policy options[23]

2020 prices, Present Value base year of 2024	High Policy Option (£m)	Medium Policy Option (£m)	Low Policy Option (£m)
SNPVs	**560**	**290**	**-110**
Capital costs	-10,200	-6,800	-1,700
Operating costs	240	160	40
Carbon savings	9,800	6,500	1,600
Air quality benefits	280	190	50
Net Energy Savings	800	530	130
Cost to Government	-320	-300	-260
Cost to Business	-15	-15	-15

Discussion - General

91. 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 the high and medium policy options. The driver of the benefit is the significant monetised carbon savings compared to the counterfactual.

92. In each of the scenarios there is a large capital cost against the counterfactual, reflecting the significant cost of the heat networks, the distribution infrastructure in particular. The gas boiler counterfactual is relatively low cost in comparison. The large capital cost is offset by the benefit of increased carbon savings for the high and medium options. Operating costs are a net benefit against the counterfactual. This is due to the assumptions set out in Annex 1 – Detailed modelling assumptions, which show a relatively high counterfactual gas boiler operating cost compared to the low carbon heat network scenario.

93. The low policy option has a negative SNPV. Deployment of additional heat networks is expected to be much lower in this scenario, reducing both the capital costs and the carbon savings.

[23] The numbers in this table are slightly different to the numbers on the front pages of the IA. This table is in 2020 prices, whereas the numbers on the front page are in 2019 prices.

94. Table 13 also shows that the costs to government of implementing the policy don't scale down significantly between the different policy options. This is because a sizeable portion of the costs to government of deploying the methodology for identifying and designating zones, and the costs to local government of implementing the zoning policy, are fixed and don't vary between the different policy options.

95. It is also anticipated that some of the key non-monetised benefits would also be relatively greater for the high policy option. For example, the ability for large scale heat networks to offer the grid flexibility benefits is a significant non-quantified benefit of the policy. This is expected be significantly greater under the preferred option, relative to the other two scenarios, because of higher heat network deployment.

Discussion – Carbon Emissions

96. The estimated carbon savings of each of the policy options are presented in Table 14.

Table 14 – *Carbon Emissions Reductions of different policy options*

Total (traded and non-traded savings)	High Policy Option (MTCO2e)	Medium Policy Option (MTCO2e)	Low Policy Option (MTCO2e)
Carbon Budget 4 savings 2023-2027	0.4	0.3	0.1
Carbon Budget 5 savings 2028-2032	4.0	2.6	0.7
Carbon Budget 6 savings 2033-2037	8.7	5.8	1.5

97. From Table 14 above, each of the policy options result in carbon savings against the counterfactual. The preferred (high) policy option abates significant carbon over the 5th and 6th carbon budget periods, substantially more than the other two policy options. Whilst the quantified costs are greater in the preferred option, these are outweighed by the benefits. Given the amount of carbon than needs to be abated to achieve our carbon budget and net zero obligations, this lends greater weight to the high option being the preferred policy option for heat network zoning.

98. The carbon savings in Table 14 include both 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.

Comparison to Low Carbon Counterfactual

99. As discussed, we have also considered the analysis against a low carbon counterfactual. 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. Given the complexity of the analysis, we haven't quantified the social impact of decarbonising buildings using low carbon heat networks or individual heat pumps. As most whole systems modelling shows, both heat networks and individual heat pumps will be required to decarbonise the UK's building stock.

100. The zoning methodology will define heat network zones as areas where heat networks offer the lowest cost means of decarbonising heat. By definition, therefore, heat network zoning should be lower social cost than individual heat pumps. It is possible that the upfront

capital cost of investing in large scale heat networks would be greater than decarbonising an area with individual heat pumps, particularly due to the cost of distribution infrastructure. However, heat network zoning could, at least partially, offset these costs through lower costs of grid infrastructure upgrade as a heat network, with a large thermal store, would put less strain on the power system relative to a mass rollout of individual heat pumps. Heat pumps on heat networks may also have a higher coefficient of performance than an individual system, particularly when utilising waste heat sources.

101. From a carbon emissions perspective, individual air source heat pumps have a slightly lower coefficient of performance relative to ground and water source heat pumps on heat networks. In addition, heat networks utilising waste heat sources, with improved coefficients of performance, can be significantly lower carbon than individual systems. Therefore, it is possible that heat network zoning would offer carbon savings compared to individual air source heat pumps. However, both technologies (heat pumps and heat networks) result in significant carbon savings relative to the current status quo of largely gas-fired heating in domestic and non-domestic buildings.

102. As mentioned above, we have restricted this analysis to an electrification pathway for decarbonisation. The impacts and costs are more certain at this point for electrification, as we build the evidence base for hydrogen.

Sensitivity Analysis

103. Sensitivity analysis has been conducted to explore how results presented could change due to 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 our assumptions across the following areas:

a. Deployment, heat generation technologies and policy cost,
b. Carbon values,
c. Optimism bias, and
d. Additionality.

104. The results of sensitivity analysis across these areas are discussed in detail in the following sections. In this section, we explore the impact on the SNPV of the preferred (high) option across sensitivity scenarios. Annex 2 - Detailed sensitivity analysis presents the impact on the SNPV for all three of the policy options across sensitivity scenarios.

Deployment, heat generation technologies and policy cost

105. The process we have used to conduct the sensitivity analysis has been to explore the impacts of the following factors:

a. Deployment being higher or lower than the central case;
b. Generation technologies for heat networks being cheaper than current cost, due to higher levels of waste heat; and
c. The cost of implementing the policy options being higher or lower than the central case.

Table 15 to Table 17 below present scenarios for each of these factors – there are three deployment scenarios, two generation technology scenarios and three policy cost scenarios.

Table 15 – Deployment sensitivity scenarios and configuration of assumptions

Assumption	Description	Central	Lower	Higher
Number of towns/ cities	The number of towns and cities where the policy could be implemented	200	100	300
Scaling CDDP deployment in relation to the EP model	How deployment estimates from the from the CDDP analysis could scale in proportion to the EP model results.	80%	60%	100%
Infill of non-target buildings	How deployment estimates would be affected if fewer non-target buildings connect to heat networks	Includes infill (all non-target buildings)	No non-target building deployment and 25% reduction in target building deployment	
Policy option 'added' detriment	Under the low and medium policy options, the reduction in deployment may not be linear relative to the high option, as heat networks become less cost-effective at smaller scale. This sensitivity tests the impact of assuming that relatively smaller heat networks are deployed under the low and medium options.	Deployment is proportional to buildings in scope in option, relative to the high option	Central, with an extra 25% reduction for the Medium and Low policy option	

Table 16 – Heat generation sensitivity scenarios and breakdown of heating technologies

Technology mix (% Heat Generation)	Central	Alternative
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	10%	10%

Table 17 – Policy cost sensitivity scenarios and configuration of assumptions

Section	Assumption	Central	Lower	Higher
Methodology Cost	Stage 1, cost per city	£5,000	£2,500	£7,500
	Stage 2, cost per city	£50,000	£25,000	£75,000

	Feasibility per zone	£40,000	£20,000	£60,000
	Average zones per city	3	3	3
	Procurement cost per city	£300,000 / £850,000	£150,000 / 425,000	£450,000 / £1,275,000
Implementation	FTE per zone	3	1.5	4.5
Cost to Business	Familiarisation Cost	7.5 hours	4 hours	15 hours
	Notification Cost	7.5 hours	4 hours	15 hours
	Number of exemptions	20%	10%	40%
	Exemption time required	15 hours	15 hours	15 hours

106. We have considered the impacts of these factors in combination as well as independently and presented the key messages arising from the sensitivity analysis in this section of the document. A full account of the results of the sensitivity analysis are presented in Table 24 to Table 26 in Annex 2 - Detailed sensitivity analysis.

107. The central SNPV for the preferred policy option is **£562m**, which is based on achieving **31 TWh/yr** of additional deployment by 2050. Figure 2 presents the impact of sensitivity scenarios of the central SNPV for the preferred policy option. Figure 1 presents the impact of deployment scenarios relative to the central deployment estimate in 2050, for the preferred policy option.

Figure 1– Impact of deployment sensitivity scenarios on central deployment in 2050 (TWh/yr)

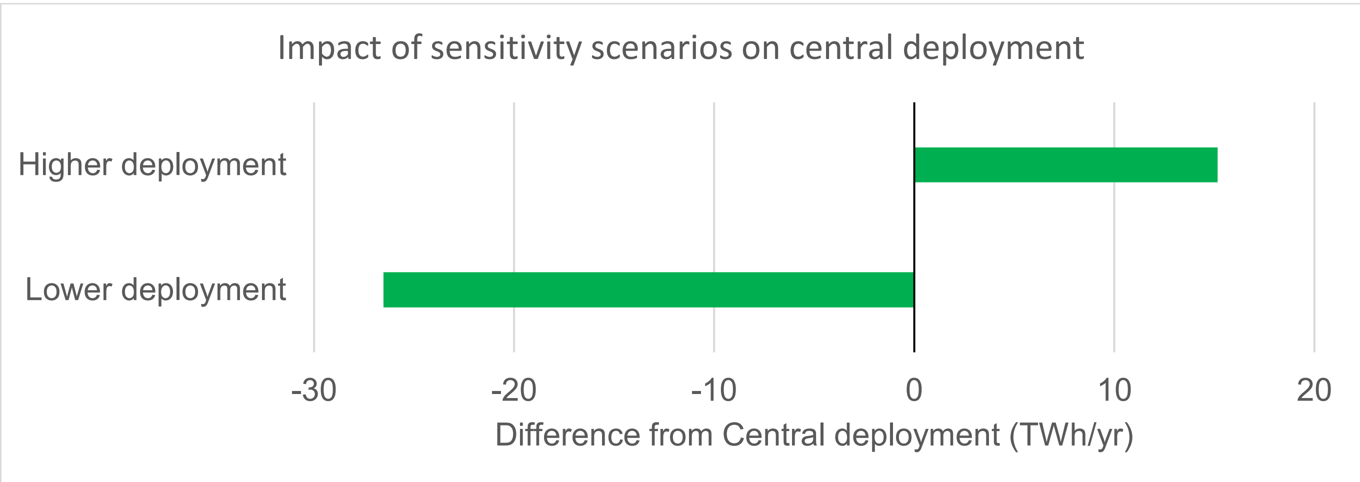
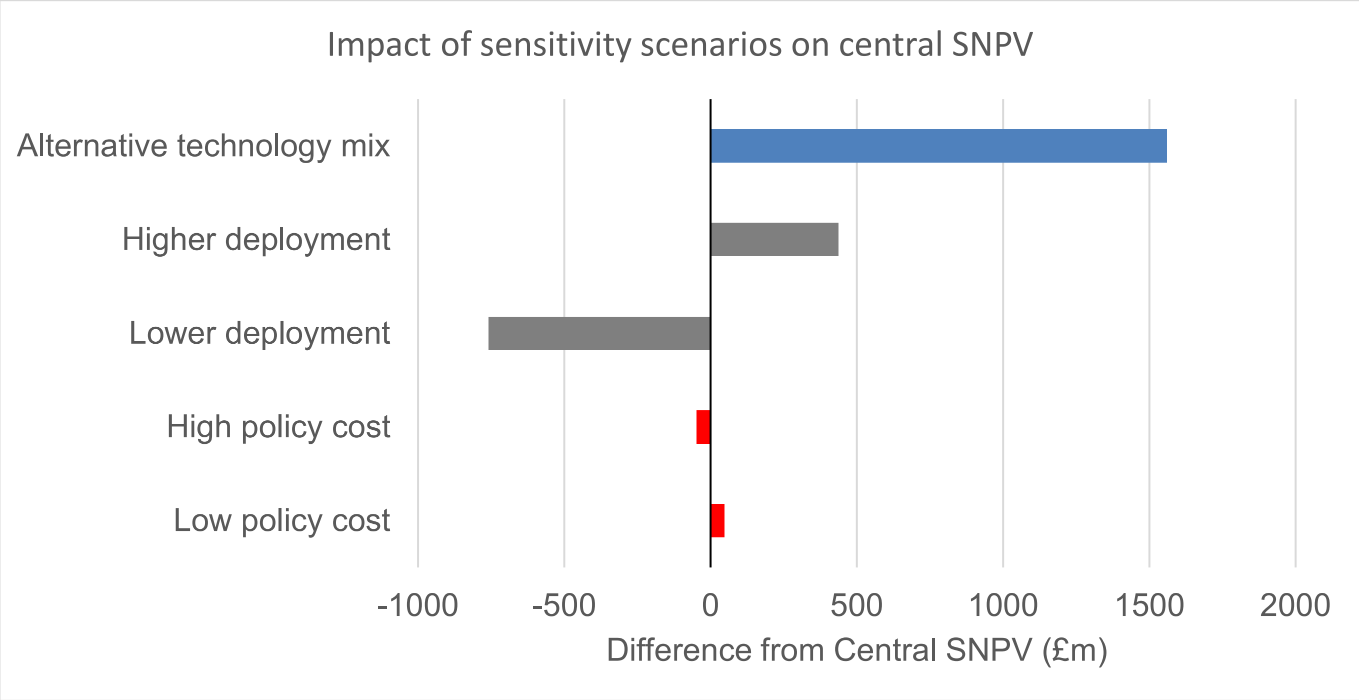


Figure 2 – Impact of sensitivity scenarios on central SNPV (£m)



108. Of the three factors explored in the sensitivity analysis, the scenarios exploring different **mixes of heat generation technologies** serving heat networks have the greatest impact on the SNPV. The alternative technology mix draws on a greater proportion of heat generation from sources of waste heat (EfW, High and Low Waste heat sources) and a lower proportion of heat generation from heat pumps, than the central scenario. 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. Figure shows that by harnessing a greater proportion of waste heat sources, in comparison to the central scenario, there would be significant increases to the SNPV for the preferred policy option.

109. The **level of deployment of heat networks** within zones has the second largest impact on the SNPV. Figure 2 shows the impact on the SNPV for the higher and lower deployment scenarios, under the preferred policy option, relative to the central deployment scenario. The lower deployment scenario has a larger impact on the central SNPV for the preferred option than higher deployment. As described in Table 15, in the lower deployment scenario we have assumed that there wouldn't be connections to buildings which haven't been mandated to connect by the policy.

110. This demonstrates the importance of the connections of 'non-target' buildings to heat networks, to achieve the estimated deployment levels in the central estimate. The high deployment option has the same proportion of target buildings as the central scenario. This explains why the impact on deployment is much greater for the lower scenario. If non-target buildings do not connect to heat networks, deployment levels could be reduced by over 70% for the preferred policy option, which would significantly reduce the SNPV. **Error! Reference source not found.**1 shows the corresponding impact of the upper and lower deployment sensitivity scenarios relative to the central deployment scenario. Lower than expected levels of deployment presents the greatest downside risk to the SNPV for the preferred and medium policy option, as shown in Annex 2 - Detailed sensitivity analysis.

111. We have also explored the impact of **varying estimated policy costs** which include costs of developing a methodology to plan zones, costs of implementing zones, and costs to business of complying with regulation. The impacts of varying costs on the SNPV are smaller than assumptions for technology mix and deployment, however, Figure 2 shows that there could be a difference in SNPV of approximately £50m either side of our central policy cost scenario as result of cost increasing or decreasing across the three areas. As described in the methodology section, there are some unquantified aspects of the policy costs at this point. The inclusion of these would result in a more significant variation in the SNPV in the sensitivity analysis.

112. As seen in Table 13, the most significant costs in the analysis are capital costs, monetised carbon savings, and fuel costs. As a result, the sensitivity analysis which influences these variables has a significant impact on the SNPV. The policy costs, on the other hand, have a much smaller bearing on the cost benefit analysis. This can also be seen in Figure 2.

Exploring the impact of carbon values on the central SNPV

113. The cost of carbon (£2020/tCO2e) has a high impact on the SNPV for the policy options. For the SNPVs presented within this Impact Assessment we have used central Green Book carbon values, which has resulted in the SNPV for the preferred policy option being **£562m**; however, by using high carbon values the SNPV increases to **£7,076m** and using low carbon values the SNPV decreases to a **net loss of £3,781m**.

Table 18 – Central SNPV using different carbon values, preferred policy option

Carbon Value	Central SNPV (£m)
High	7,076
Central	562
Low	-3,781

Exploring the impact of optimism bias on the central SNPV

114. 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 capital costs to account for optimism bias[5]. Table 19 presents how the SNPV varies under different levels of optimism bias.

Table 19 – Central SNPV using different levels of optimism bias

Optimism bias value	Central SNPV (£m)
10%	2,483
21%	562
30%	-1,010

Exploring the impact of the additionality assumption on the central SNPV

115. For this analysis we have assumed that 90% of the benefits of heat network zoning are additional. Table 20 presents how the central SNPV would be impacted if different levels of additionality were assumed.

Table 20 – Central SNPV using different levels of additionality assumptions

Additionality value	Central SNPV (£m)
85%	530
90%	562
95%	593

Direct costs and benefits to business calculations

116. The direct costs to business are described in the methodology section above, in the 'Costs to Business' section. The costs to business due to heat network zoning are various:

a. Familiarisation costs of heat network developers and operators
b. Annual reporting of additional heat networks in zones to the national regulator for heat networks
c. The costs to buildings who wish to apply to be exempt from connecting to a heat network in a zone
d. The cost of buildings complying with the requirement to provide building level information to the zoning coordinator to assist with energy planning

117. There are also non-monetised impacts to business as a result of heat network zoning, as described in the methodology section. There would likely be disruption costs for consumers as heat networks get constructed, which may be significant. There will also be benefits to business in terms of fuel savings, some of which may be passed on to final consumers. We need to undertake further work to understand the likelihood of this happening.

Business NPV	**2019 Prices**
Total Business Costs	14.4
Total Business Benefits	0.0
Net Total Business Impact	-14.4

Impact on small and micro businesses

118. A quantified Small and Micro Business Assessment (SaMBA) has not been undertaken for this initial Impact Assessment. At this stage, we do not expect that micro businesses will be directly affected by the regulatory measures proposed in the heat network zoning consultation. The policy high and medium options will target 'large' non-domestic buildings, which for the purpose of the analysis is assumed as heat demand over 100 MWh/year, and as part of the consultation we are requesting views on how 'large' should be defined. During the course of consultation and further policy development, we will continue to explore the

possible impacts on small businesses and means of ensuring through policy design that the impacts of the policy are proportional, including the potential role of *de minimis* conditions to limit the impacts on small enterprises. If deemed necessary, a full SaMBA will be included in future Impact Assessments.

Wider impacts

119. 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 heat network 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 similar to existing customers on heat networks.

120. The assessment identified that people who are 65+ years of age and people from Black, Asian and Minority Ethnic (BAME) backgrounds are more likely to be served by heat networks, using most recent evidence[24]. On the assumption that these two groups are more likely to have lower incomes than the overall average[25], they would be more sensitive to changes in heat price as a result. It is also more likely 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.
c. The consultation seeks views on whether additional protections are necessary for consumers living in a Heat Network Zone, besides those to be introduced through the Market Framework.

Monitoring and Evaluation

121. We plan to implement a robust monitoring and evaluation plan, to investigate and demonstrate the impact and outcomes of the proposed policy. A thorough evaluation plan will be developed in advance of the implementation of the regulations and will be integrated into the delivery of the policy. The evaluation plan will be derived from the Theory of Change as set out in Annex 4. We expect the evaluation will seek to answer questions such as:

- To what extent has the regulation achieved its objectives?

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[24] 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.

[25] Results from the Family Resources Survey for financial year 2018 to 2019, https://www.gov.uk/government/statistics/family-resources-survey-financial-year-201819

- How has the design of the regulation influenced the impacts that were achieved?
- What have the costs and benefits of the policy been?

122. The consultation sets out in detail the various actors that would be involved in monitoring the policy and the data that they would collect. It is envisaged that Ofgem and the local Zoning Coordinators will collect separate data that would feed into an evaluation of the regulation. As the National Regulator, Ofgem will monitor the performance of heat networks and how they perform against the consumer protection standards and technical standards set out in the legislation. Local Zoning Coordinators will collect data on the carbon emissions of heat networks in zones and monitor compliance with the policy.

123. More information on our monitoring and evaluation strategy will be provided in the final impact assessment.

Annex 1 – Detailed modelling assumptions

Table 21 – 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

Table 22 -Capital and operating cost per technology (counterfactual)

Generation Technology	Capex Unit	Capex Value	Opex Unit	Opex Value
Commercial	£/kWth	239	£/ kW(th)/yr	5.96
Domestic Gas Boiler	£/KWh	0.22	£/ kWh/ yr	0.01
Electric Heater	£/kWth	98	£/ kW(th)/yr	17.00

Table 23 - Distribution Infrastructure Capex (factual and counterfactual)

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

Table 24 - Thermal Efficiency (factual and counterfactual)

Heat Network/ Individual	Generation Technology	Thermal Efficiency (%)
Heat network	Air Source Heat Pump	321
	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)	N/A
	Gas CHP	40
	Back-up Gas Boiler	85
Individual	Commercial Gas Boiler	84
	Domestic Gas Boiler	86
	Electric Heater	100

Annex 2 - Detailed sensitivity analysis

Table 23 – Sensitivity analysis for the Low policy option

		Social Net Present Value (£m)					
		Heat generation technology scenario					
		Central			Alternative		
		Policy cost scenario			Policy cost scenario		
	Deployment in 2050 (TWh/yr)	Low	Central	High	Low	Central	High
Lower	1.6	-175	-221	-269	-92	-138	-186
Central	5.1	-68	**-114**	-162	192	146	98
Higher	7.3	0	-47	-95	369	323	275

Table 24 – Sensitivity analysis for the Medium policy option

		Social Net Present Value (£m)					
		Heat generation technology scenario					
		Central			Alternative		
		Policy cost scenario			Policy cost scenario		
	Deployment in 2050 (TWh/yr)	Low	Central	High	Low	Central	High
Lower	2.8	-177	-224	-272	-34	-80	-128
Central	20.7	336	**290**	242	1,375	1,329	1,280
Higher	30.0	604	558	510	2,105	2,059	2,010

Table 25 – Sensitivity analysis for the High (preferred) policy option

		Social Net Present Value (£m)					
		Heat generation technology scenario					
		Central			Alternative		
		Policy cost scenario			Policy cost scenario		
Deployment Scenario	Deployment in 2050 (TWh/yr)	Low	Central	High	Low	Central	High
Lower	4.7	-150	-196	-244	85	39	-9
Central	31.2	608	**562**	514	2,167	2,121	2,073
Higher	46.4	1,044	998	950	3,361	3,315	3,267

Annex 3 – 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 26 - 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 was then considered and scored using the definitions in Table 28Table 28. A final score was then calculated for each option accounting for the weights of each group of success factors.

Table 27 - 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 29.

Table 28 – 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 mandated**	**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 4 – Theory of Change