Title: The Heat Network (Metering and Billing) (Amendment) Regulations 2020	**Impact Assessment (IA)**
IA No: BEIS028(F)-20-HBE	**Date:** 06/11/2020
RPC Reference No: RPC-4346(1)-BEIS	**Stage:** Final
Lead department or agency: Department for Business, Energy and Industrial Strategy	**Source of intervention:** EU
Other departments or agencies: N/A	**Type of measure:** Secondary legislation
	Contact for enquiries: Heatnetworks@beis.gov.uk
Summary: Intervention and Options	**RPC Opinion: Green rating**

Cost of Preferred Option (in 2019 prices)			
Total Net Present Social Value: £95m	**Business Net Present Value: £-135m**	**Net cost to business per year: £12m**	**Business Impact Target Status: £60m**

What is the problem under consideration? Why is government action or intervention necessary? The Heat Network (Metering and Billing) Regulations 2014 aim to introduce fairer billing and incentivise energy savings, by requiring heat suppliers to install heat metering devices where cost-effective and to bill based on consumption. The approach to assessing cost-effectiveness was suspended in 2015 due to methodological issues. Since then, this aspect of the Regulation has not been enforced. Amendments to the Regulation are required to support the installation of customer-level metering devices, reduce administrative burden, support wider UK climate goals, and enable consistency across heat network customers and compliance with the requirements of the Energy Efficiency Directive (EED).

What are the policy objectives and the intended effects? The main objectives of the policy are:

- To ensure the installation of heat meters and heat cost allocators (HCAs) for customers on heat networks where it is cost-effective and technically feasible to do so.
- To introduce fairer billing by providing clear information on energy and heat consumption, which is shown to lead to positive behavioural change in terms of the reductions in energy consumption and associated emissions.
- To provide greater clarity over when individual-level meters are required, through the introduction of building classes. The classes define the buildings in which individual meters should always be installed ("Viable class") and the buildings which are exempted from the requirement to install individual meters ("Exempt class"). For buildings in the "Open class", a heat supplier has to undertake a cost-effectiveness assessment for heat meter and HCA installation. These steps aim to minimise the administrative burden of the amendments on businesses and are in line with the guidelines on the implementation of the EED requirements. To maximise the benefits, the amendments extend the billing requirements and the requirements for accuracy and ongoing maintenance to all installed metering devices, including those not installed under the duty of the Regulation.

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

Option 0: 'Do nothing'. A continuation of existing arrangements and the Regulations remain unchanged.

Option 1: Amended Regulations [preferred option] – Introduction of three building classes which have specific metering requirements: Viable, Open and Exempt. The mandatory metering and billing requirements are extended to include customers connected to communal networks (in addition to district heating customers) to ensure consistency within the Regulations across the market and to maximise the regulatory benefits. The cost-effectiveness assessment tool is updated and reinstated to assist heat network operators in undertaking the assessment in a methodologically robust way and install meters or HCAs where cost-effective. The requirements on the accuracy, maintenance, and billing will be extended from those meters installed under a duty in the Regulations to all installed customer-level meters and HCAs. To ensure that compliance is reported consistently, the notification template is updated, with transitional arrangements put in place for the re-notifications due in the compliance period.

The proposed amendments are expected to increase the number of customer-level heat meters and HCAs installed across the market, whilst extending the metering and billing-related protections to more customers.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 12/2024

Does implementation go beyond minimum EU requirements?		No		
Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:** -0.05 MtCO2e	**Non-traded:** -0.89 MtCO2e	

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: 05.11.2020

Summary: Analysis & Evidence Policy Option 1

Description: Amended Regulations - FULL ECONOMIC ASSESSMENT

Price Base Year 2019	PV Base Year 2020	Time Period Years 14	Net Present Value (NPV)) (£m)		
			Low: 26	**High: 173**	**Best Estimate: 118**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		10	120
High	0		134	173
Best Estimate	0		11	135

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

The main affected group in terms of costs are the heat suppliers and the end heat network customers. It is expected that heat suppliers will pass the costs of installing and operating metering devices to their end customers. The key monetised costs fall into four broad categories, which includes: a) one-off familiarisation exercises, b) the administrative tasks associated with the compliance of the new amendments, c) undertaking cost-effectiveness analyses where required, and d) capital and operating costs as a result of installing meters/HCAs and implementing consumption-based billing.

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

For businesses, there may be additional costs as a result of changes to the billing arrangements (switching from a flat fixed rate to a real-time metered rate) and temporary disruption to the heat supply while meters are installed. For consumers, the expected behavioural change arising from the installation of meters may result in under-consumption of heating which could lead to adverse health impacts and associated costs. However, these occurrences are expected to be limited (if any) by the supported housing exemption.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		17	**199**
High	0		25	**293**
Best Estimate	0		20	**230**

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

Monetised benefits are expected for both the recipients of meters and society as a whole. The installation of heat meters and HCAs is expected to result in reductions in heat usage by customers on heat networks as heat meters allow billing to be based on actual usage. This increases transparency in heat usage allowing the consumer to control their energy use in order to lower bills. As a result, there are expected reductions in energy use and consequently, carbon emissions and air quality damage. The reduced energy demand will also result in a lower input-fuel cost for heat network suppliers.

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

With better information on actual heat usage, heat suppliers will have the opportunity to optimise network performance which could result in greater network efficiency, service quality and cost reduction. Consumers with reduced energy bills could spend this saved money elsewhere in the economy, thus benefiting from this new consumption. It is not possible to quantify the extent of this benefit, given the uncertainty around how costs may be passed on and what consumers may spend saved money on. Extending the provisions of the Regulations to all customers with existing meters will also improve consumer protection across the heat networks market. For example, by providing redress in the event that meters are not working satisfactorily.

Key assumptions/sensitivities/risks **Discount rate** 3.5

There is uncertainty regarding the total number of heat networks in operation in the UK and therefore in scope of the Regulations. Since 2014 all networks were required to notify the Office for Product Safety and Standards (OPSS) of their existence and provide certain details about the network (including the number of customers, heat generation, fuel type, etc). However, not all networks notified OPSS and not all who did submitted a quality return. Therefore, we expect this to represent the minimum number of heat networks in scope. Another key uncertainty is the decrease in energy consumption. The assumed level of energy saving is based on evidence from an EU-wide study and assumes all domestic buildings face the same energy savings (and all non-domestic buildings face the same energy savings). This is a simplifying assumption for ease of modelling as it is not possible to know the energy savings at an individual level.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £60m
Costs: 12	**Benefits:** 0.0	**Net:** 12	

1. Executive summary

1. This Impact Assessment (IA) supports amendments to the Heat Network (Metering and Billing) Regulations 2014 ('the Regulations') which implemented Articles 9(1) and (3), 10 and 11 of Directive 2012/27/EU (the Energy Efficiency Directive (EED)). The amendments to the Regulations will be made in the Heat Network (Metering and Billing) (Amendment) Regulations 2020 ('Amending Regulations').

2. The Regulations place several requirements on heat suppliers, including the duty to install customer-level heat metering devices[1] in buildings on heat networks unless it would not be cost effective or technically feasible to do so. Where the installation of customer-level metering devices is mandatory, heat suppliers are required to provide customers with clear consumption-based billing.

3. Amendments to the Regulations are required to address two main issues:

    - To improve the process and methodology used to assess the cost-effectiveness of installing customer-level metering devices. This will in part be achieved by the introduction of the building classes:

      Viable Class: Heat metering devices should always be installed.
      Open Class: Heat metering devices should be installed if it is cost effective and technically feasible to do so.
      Exempt class: Exempt from installing heat metering devices.

      Alongside this, the amendments update the cost-effectiveness tool which supports the Regulations and the methodology for assessing the cost-effectiveness of installing metering devices in buildings that now fall into the Open class category.

    - Ensure that the provisions of the Regulations cover all heat networks customers with metering devices installed, including those installed outside of a duty in the Regulations.

4. The amendments are expected to reduce the administrative burden associated with the Regulations through the introduction of building classes and maximise the benefits of the Regulations by ensuring consistency across heat network customers. The amendments ensure that the Regulations best support the UK's domestic net-zero goal and contribute towards achieving the UK's carbon budgets as well as meeting the requirements of the EED.

5. The analysis which underpins this IA focuses on the costs and benefits associated with installing additional customer-level heat metering devices in the dwellings or units of currently unmetered customers as a result of these amendments. The fundamental approach taken is consistent with the Regulations' Final stage IA[2] and the associated 2019 consultation IA[3]. However, there are a number of differences between these IAs. As a result, there are differences in the analysis presented with results not being directly comparable. See Annex C for more details.

6. This IA refines some of the assumptions used in the 2019 consultation stage IA, reflecting improvements in the evidence base following the responses to the consultation and further engagement with industry. The main changes are:
    a. The assumed number of heat networks operating in the UK, revised down to 14,000 from 18,000.
    b. A proportion of voluntary installations (50%) has been included in the counterfactual.
    c. A greater variation in the heat demand profiles of different customer types has been included.
    d. Revising the pass rate of the cost effectiveness test to 14% from 65%.

[1] For simplicity, the term 'Heat metering devices' is used to refer to both heat meters and heat cost allocators. Please see Box.1 for a full description of each.
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396087/EED_Metering_Final_IA_-_signed_.pdf
[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/840128/hmbr-consultation-impact-assessment.pdf

e. As a result, the number of additional metering devices expected to be installed has been revised down to around 84,000 from 285,000.

7. The analysis in this IA estimates the impact of the amendments to the Regulations on the known population of heat network customers. This is based on analysis of the Office for Product Safety and Standards (OPSS) notification database which contains data on around 14,000 heat networks. This consists of around 12,000 Communal networks (where each network supplies one building) and around 2,000 district networks (where each network supplies multiple buildings).

8. Over the 14-year appraisal period (covering 4 years of installations and a 10-year lifetime of the metering devices), around 430,000 un-metered customers are expected to be connected to heat networks. Under the preferred option (Option 1), it is estimated that, between 2021 and 2025, 84,000 of these un-metered customers will have heat meter devices installed compared to the counterfactual (Option 0). In addition, it is estimated that around 13,000[4] customers are currently metered but receive no billing information for their heat usage (referred to as additional billing). This brings the total number of additional customers expected to be billed based on consumption as a result of the amendments of the Regulation to 97,000.

9. It is estimated that the installations will result in a Social Net Present Value (SNPV) of £95m. This includes the additional resource costs of heat supplier administration and assessments, installation, and operating costs of metering devices; and the additional benefits arising from reduced energy use, carbon emissions and averted air quality impact. It is estimated the amendments will deliver additional carbon emissions savings of around 1 MtCO2e and a reduction in energy use of 5.1TWh over the appraisal period (14 years). The Equivalent Annual Net Direct Cost to Business (EANDCB) of the proposed amendments is estimated to be £12 million per year.

10. Sensitivity analysis has been carried out to better understand the uncertainties around these results, with a particular focus on the uncertainty around the total number of UK's operational heat networks and the potential energy savings from metering device installation were assessed. This analysis suggests that even under more challenging assumptions and different market conditions, the amendments proposed under Option 1 would still result in a net benefit.

2. Problem under consideration

11. The Regulations[5] place several requirements on heat suppliers, including the duty to install customer-level heat metering devices in buildings on heat networks unless it would not be cost effective or technically feasible to do so. Where the installation of customer-level metering devices is mandatory, heat suppliers are required to provide customers with clear consumption-based billing.

12. In 2015, the Department for Energy and Climate Change (DECC)[6] suspended the "Heat Metering Viability Tool" ('the tool'), which had been developed to support heat suppliers to assess technical feasibility and cost- effectiveness, due to methodological issues[7]. Since then the requirement for individual consumption meters to be installed where it is cost effective and technically feasible to do so has not been enforced in the UK. Furthermore, in December 2016, the European Commission published guidelines to support the implementation of the cost-effectiveness requirements of the Directive which included allocating buildings into different classes, to reduce administrative burden.

13. Amendments to the Regulations are required to update the criteria considered when assessing for cost effectiveness and to update the tool's methodology. Together the amendments are expected to increase

[4] Informed by evidence from the OPPS heat networks notification database
[5] In 2014, the Heat Network (Metering and Billing) Regulations 2014, as amended ('the Regulations') were implemented to transpose Articles 9-11, and 13 of Directive 2012/27/EU, known as the Energy Efficiency Directive ('EED').
[6] Now the Department for Business, Energy, and Industrial Strategy (BEIS).
[7] This tool used generic energy benchmarking and it became apparent that very few buildings would be required to install metering devices. To prevent an undue burden on business, due to the use of a tool where the outcome was expected to be negative, the tool was suspended in July 2015.

the number of customer-level metering devices installed to support consumer protection, reduce administrative burden, enable compliance and consistency with the requirements of the EED and support wider UK environmental and climate goals.

3. Rationale for intervention

The 'Free-rider' problem and market failure

14. The cost of supplying heating and hot water to buildings on communal or district heat networks is often apportioned according to the methodology set out in the lease of the property. This means that landlords and Housing Associations often charge a fixed percentage of the total building service charge for heat to each flat based on certain characteristics.

15. As a result, consumers are not charged for the actual consumption of heating and hot water- as this information is not readily available at a customer level. Instead, customers are billed based on a fixed charge, so they face a zero-marginal cost for heat usage, meaning there is a risk consumers over-heat their homes.

16. This can generate a free-rider problem[8], whereby some consumers subsidise the use of heating for others in the same building. Installation of heat metering devices should resolve these problems by introducing a variable charge, ensuring that consumers face the cost of the energy they use. This will encourage more efficient use of heating and a more equitable charging of heating based on actual consumption[9].

Equity issues

17. Heat consumption can lead to inequitable transfers between consumers in the context of a free-rider problem, given those using more heat than the quantity they pay for are being subsidised by those paying a higher fee. This can lead to particularly adverse outcomes for households on low incomes. However, those who may be overpaying on a fixed charge, may benefit most from paying for their actual consumption of heat on a variable charge[10].

Externalities

18. Externalities represent a problem in the market, as the price within the market does not reflect the interests of all those impacted. For negative externalities, the price does not reflect the cost which is borne onto those not involved in production or consumption of the goods or service. Thus, the goods or service is overproduced relative to what is considered optimal. There are two externalities to be considered for this IA.

a) Firstly, consumption of heat imposes a negative externality on society, as the generation of this heat results in the production of greenhouse gas emissions and other pollution. These emissions impose a cost on those not involved in production or consumption of this heat, by impacting air quality for example.

b) Secondly, customers are often charged a fixed proportion of the buildings total heating cost, therefore face no additional charges for increasing their heat consumption and so there is less incentive to reduce consumption of heat. Since the supplier cannot recover additional costs of higher heat consumption from those using a larger quantity of heat than they are paying for, they will impose these additional costs on all customers. Thus, the cost of consumption is not directly borne by those using a higher quantity of heat than they are paying for, but the cost (externality) is passed on to all consumers.

[8] This differs from a 'pure' free-rider problem whereby individuals would benefit from consumption of all of a good or service without contributing towards it. Under this scenario, only a portion of heat consumption can be considered to be paid by others.
[9] It is assumed that customers do not value the convenience of a fixed charge given difficulties around estimating this
[10] There may be a similar impact on vulnerable customers with high levels of heat usage who may receive higher bills as a result of a variable charge; however, it is felt that the impact of this would be minimal

19. The installation of heat metering devices should help to rectify these externalities by introducing a variable charge, ensuring that consumers face the cost of the energy they use. It is assumed therefore that the introduction of heat meters will mean the price customers face reflects what is considered optimum. In the first case, the installation of metering devices and controls will allow customers to reduce their consumption where over heating is occurring, this will reduce their consumption, which will reduce heat production, which will reduce the negative externalities exerted on society. In the second case, those increasing their heat usage will face the costs of their consumption without impacting other consumers.

4. Policy objective and regulation requirements

20. The objective of the policy is to ensure the installation of heat metering devices and consumption-based billing for customers on heat networks where it is cost effective and technically feasible to do so. This is to incentivise energy savings by the final customer.

21. A further objective is to provide greater clarity over when customer-level meters are required, through the introduction of building classes to help minimise administrative burden on businesses. The policy also extends the requirements of the Regulations, by including metering devices not installed under a duty in the Regulations to ensure consistency across the heat network market and maximise the benefits of the Regulations.

Current Regulation requirements

22. The Regulations[11] impose certain requirements on UK heat suppliers, the requirements relevant to the changes made in the Amending Regulations are listed below:

    A) Heat suppliers must, in relation to each district heat network or communal heating operated by them, submit a notification to the Secretary of State. This notification must include certain information about that heat network.
    B) Conditions of cost effectiveness and technical feasibility do not apply in the following situations and heat suppliers must always install individual meters in:
        i. A newly constructed building supplied by a district heat network.
        ii. A building supplied by a district heat network that undergoes major renovations which relate to the technical services of that building.
    C) In other buildings on heat networks, heat meters must be installed if it is cost effective and technically feasible to do so. If it is not cost effective or technically feasible, a hot water meter and individual heat cost allocators (HCAs) and thermostatic radiator valves must be installed on all radiators within an individual apartment/unit if technically feasible and cost effective to do so.
    D) Where these Regulations impose a duty on a heat supplier to ensure that a meter is installed, the heat supplier must ensure devices are appropriately maintained and accurately measure, memorise and display the consumption of heating, cooling or hot water by a final customer. The heat supplier must also provide transparent billing based on consumption.

23. Page 6 of the European guidelines[12] states that the regulatory approach recommended is to "declare entire classes (collections, types) of buildings as either viable or exempt from the provisions of EED Articles 9-11". The guidelines then go on to define that the open class captures all remaining buildings which would be subject to the cost-effectiveness assessment.

[11] The Heat Network (Metering and Billing) Regulations 2014 as amended: http://www.legislation.gov.uk/uksi/2014/3120/contents and http://www.legislation.gov.uk/uksi/2015/855/contents/made
[12] https://ec.europa.eu/energy/sites/ener/files/documents/mbic_guidelines20170110.pdf

24. Building classes have been introduced to avoid 'gold-plating'[13], as the classes should provide a practical framework, at minimal cost, to assess whether buildings will need to install metering devices or not. This will allow for implementation of the Directive in the least burdensome way.

Box. 1 Heat Meters and Heat Cost Allocators (an explainer):

Throughout this IA the term metering devices is used to refer to both heat meters and heat cost allocators. A full description of each can be found below:

- A **heat meter** (in this context) is a device which measures the thermal energy provided by a source and, together with a temperature control device, supports control of energy use for consumers within their home or business.
- **Heat Cost Allocators (HCAs)** are affixed to radiators and calculate the proportion of heating used in a dwelling/unit to support fair apportioning of heating costs to customers within a building. They measure both the temperature of the radiator surface and air temperature. Based on these two values, the HCA can calculate the radiator usage. Radiator valves are used to control the heating. In addition to HCAs hot water meters are needed to measure the use of hot water in a dwelling/unit.

Both devices provide customers with greater information on their consumption and allow them to engage with their heat usage and give greater control over their energy use and their bills. This is expected to reduce the demand for the energy by the heat network for heat and cooling, which means reduced fuel requirements. This results in energy saving, and its subsequent benefits.

5. Description of options considered

Option 0: Counterfactual - Do Nothing

25. The Do-Nothing scenario is a continuation of existing arrangements where the Regulations remain unchanged. Heat suppliers would be required to install individual heat meters when a connection is made in a newly constructed building supplied by a district heat network and where a building supplied by a district heat network undergoes major renovations. There is also expected to be a number of meter installations in buildings where this is not mandatory under the Regulations, such as in new buildings supplied by communal heating, as metering is common practice in the industry. The cost-effectiveness assessment would remain suspended, which is expected to lead to no installations of metering devices where a technical feasibility and cost-effectiveness assessment is required. Similarly, the accuracy, maintenance, and billing requirements would remain unchanged.

Option 1: Amend Regulation (Preferred option)

26. The Regulations are amended to introduce three building classes which determine metering requirements: Viable, Open and Exempt (details set out below). The mandatory metering and billing requirements are extended (with some exceptions) to include customers connected to new communal networks (in addition to district heating customers) which ensures consistency within the Regulations across the market and maximises the benefits of the Regulations. The criteria within the Regulations for calculating estimated heat demands from a building are updated to conform to industry standard methodologies for the cost-effectiveness assessment. This will ensure heat network operators can undertake the assessment in a methodologically robust way and install metering devices where cost effective. The requirements on the accuracy, maintenance, and billing will be extended to cover all installed meters. The notification template is updated, and transitional arrangements are in place for re-notifications due during the compliance period, to ensure compliance is reported consistently for all heat networks.

27. Several non-regulatory approaches were previously considered; however, these approaches were deemed unlikely to achieve the policy objectives effectively because the requirements would not be enforceable. For example, The Heat Trust[14], which launched in November 2015, established an industry-

[13] Gold plating is defined as 'exceeding the requirements of EU legislation when transposing Directives into national law'.
[14] Heat Trust https://heattrust.org/

led consumer protection scheme for heat networks that guarantees service standards (including standards for metering and billing) from heat suppliers who are members. Separately, the heat networks Code of Practice[15], launched in 2015, defines minimum technical standards for heat networks, including metering. Although these are welcome initiatives, heat suppliers are under no obligation to join/adhere to these initiatives.

28. The amendments proposed under Option 1 have been assessed to be within the requirements of the EED, and they do not exceed EU requirements. These proposed amendments are discussed in more details in Section 6.

6. Main elements of the Amending Regulations

29. **Introduction of building classes:** The current Regulations do not provide for classes of buildings. We are introducing the concept of building classes[16] to provide a simplified approach to determining in which buildings final customer metering devices must be installed. Building classes to be introduced are:

Table 1. Overview of building classes - Summary

Class	Customer metering devices	Includes
Viable	Are mandatory	• A newly constructed building supplied by a district heat network[17] • An existing building supplied by a district heat network undergoing major renovation[18] • A newly constructed building with communal heating (where connection is made after end of transitional period) unless the building falls into the Open or Exempt class
Open	Must be installed unless not cost-effective or technically feasible	• A newly constructed building with communal heating (where connection is made during the transitional period) unless the building falls into the Exempt class • A new building with communal heating (where connection is made after end of transitional period) where - there is more than one entry point for pipes into dwellings or non-domestic premises. - the building (or a part of the building) is supported social housing, almshouse accommodation, or purpose-built student accommodation. • All other existing buildings which do not fall into the Viable or Exempt class (this includes buildings where meters or HCAs are already installed)
Exempt	Not required	• An existing building where the building (or part of the building) - is supported housing, almshouse accommodation, or purpose-built student accommodation. - is covered by an existing lease[19] (above a threshold of 10% of total number of dwellings and non-domestic premises). • A building not consisting mainly of private dwellings where heat is supplied by means of a system other than hot water or the cooling distribution system uses a transfer fluid other than water.

[15] Heat networks: Code of Practice for the UK (2015) – Developed by the Chartered Institution of Building Services Engineers (CIBSE) and the Association for Decentralised Energy (ADE)
[16] The concept of building classes is recommended in European Commission
[17] This includes buildings where this mandatory requirement applied since 2014. In new buildings (or existing buildings undergoing major renovations) supplied by a district heat network, final customer meters have been mandatory since 2014. The mandatory requirement is extended to new buildings with communal heat networks, on the basis that it is considered cost-effective and technically feasible to specify and install customer meters in newly constructed buildings. This aligns with the EED requirement to install final customer meters where it is technically feasible and cost-effective.
[18] ibid
[19] This applies only to leases which contains a provision which would prevent billing based on metered consumption.

30. A heat supplier must determine the building class for each of the buildings connected to their network. It is not expected to be either cost effective or technically feasible to install buildings in the exempt class as the cost of installing metering devices is expected to be too high , technically unfeasible or the customer types are unlikely to realise the energy saving benefits. Please see Annex A for a full description of the buildings which fall into each building class.

Enable the provision of an effective cost-effectiveness assessment

31. In 2016 the European Commission commissioned research[20] to gather evidence and provide guidelines on how to assess feasibility and cost effectiveness. Alongside the Amending Regulations, the cost-effectiveness assessment tool has been updated to overcome the methodological issues and incorporate these guidelines, to support heat suppliers with buildings which will fall into the Open class in undertaking a cost-effectiveness assessment (CET) in a methodologically robust and consistent way.

32. The cost-effectiveness tool has been updated, tested by BEIS technical experts and was quality assured to ensure it appropriately supports heat suppliers in making the assessment. Please see Annex B and the guidance[21] for a more detailed description of the assumptions and calculations used in the assessment.

Extending the requirements on accuracy, maintenance, and billing

33. Under the Regulations heat suppliers are required to ensure metering devices provide accurate readings, are appropriately maintained, and provide transparent consumption-based billing. These requirements currently only apply to metering devices installed under a duty in the Regulations. The Amending Regulations will extend these requirements to all installed heat metering devices that are covered by the Regulations.

34. The consultation stated that the installation of heating controls with metering devices is currently only required where the cost effectiveness and technical feasibility assessment applies. However, the requirement to install heating control devices already applies where final customer meters must be installed under a duty in the Regulations and therefore no further amendment was required.

35. Each of these aspects is fundamental to enable the expected energy saving and these changes have been made to ensure where possible consumers can benefit from the energy saving associated with installing metering devices. The changes to requirements are summarised in Table 2.

Table 2 – Changes to requirements

Requirements	Current Regulations	Amending Regulations
Accuracy and Maintenance	Apply to customer meters or HCAs installed under a duty in the Regulations	Apply to all installed customer level meters or HCAs
Billing	For all customers who have a meter or HCAs installed under a duty in the Regulations. Unless the cost of billing exceeds £70.	Apply to all customers who have a customer level meter or HCAs installed. Unless the cost of billing exceeds £92[22].

[20] European Commission Guidelines (2016) for feasibility and cost-effectiveness of implementation of regulations. https://ec.europa.eu/energy/sites/ener/files/documents/mbic_guidelines20170123_en.pdf

[21] The Tool guidance will be published alongside this IA

[22] Where the costs of billing exceed this amount heat network are exempt from billing based on consumption. This is informed by evidence from a report from BRE. This amount was adjusted for inflation and tested in the 2019 consultation.

Updated notification template and transitional arrangements for re-notifications

36. Under the Amending Regulations, the duty to notify will be expanded to require notification of the number of buildings supplied by a district heat network or communal heating in each class. However, there is a transitional arrangement to extend the notification period for all existing heat networks due to re-notify during the compliance period. This is to allow time for heat suppliers to implement relevant requirements of the Amending Regulations and include the required information with their re-notification.

7. Analytical approach

37. To assess the impact of the Amending Regulations, a cost-benefit analysis has been undertaken. This consists of two main elements:

    - A quantified assessment of the estimated number of additional customer level heat metering devices expected to be installed because of the Amending Regulations. The cost of adhering to the Amending Regulations, installing, and operating the heat meters/HCAs as well as the billing requirements has then been compared to the monetised expected energy saving, carbon saving and air quality benefits.
    - A qualitative assessment has been made of the wider impacts the amendments could have. These costs and benefits are expected to be borne by customers, heat network operators and wider society.

38. These costs and benefits are compared against the counterfactual scenario (Option 0). This provides an indication of the expected costs and benefits that arise from the preferred option. The impacts are considered over a 14-year appraisal period between 2021 and 2035[23]. All monetised impacts are presented in 2020 prices and are discounted in accordance with the HM Treasury Green Book.[24]

39. Key sources of evidence used for the impact assessment:

    - **OPSS notification database 2015** – data on around 14,000 heat networks in the UK. The assumptions derived from this source include the current structure of the UK heat network market, heat demands, number of buildings connected to a heat network and the number of final customers.
    - **The European Commission guidelines** - published guidelines and research which has been used to inform assumptions on the energy savings from the installation of customer level meters or HCAs[25]. These assumptions are based on evidence from other countries in Europe.
    - **The National Energy Efficiency Data-Framework[26] (NEED) and Building Energy Efficiency Survey[27] (BEES)** – used in conjunction with the OPSS data to support and sense check assumptions around domestic and non-domestic heating demands.
    - **The responses from the 2019 consultation[28]** - responses were used to provide new evidence and confirm previous assumptions made in the original 2014 Regulations IA and the consultation IA, where still appropriate.

[23] This reflects four years from 2021, when amended Regulations come into force, to 2025 during which metering devices are installed plus the assumed 10-year lifetime of those metering devices. This appraisal period has been chosen to reflect installations over one full notification cycle in which all existing heat networks are expected to come into compliance with the amended Regulations

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[25] https://ec.europa.eu/energy/sites/ener/files/documents/mbic_guidelines20170123_en.pdf

[26] NEED - https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework

[27] BEES - https://www.gov.uk/government/collections/non-domestic-buildings-energy-use-project

[28] The government response to the consultation will be published alongside this IA

40. A review of these data sources has confirmed they are the most appropriate and up-to-date sources for the analysis undertaken. Where evidence gaps have persisted, we have relied on appropriate proxy assumptions and/or evidences from the consultation. In addition, a wide range of sensitivities have been tested to ensure the robustness of the analysis supporting this IA and ultimately the changes to the Regulations.

8. Cost benefit analysis approach

Approach to Cost benefit analysis

41. The following methodology has been used to assess the monetised costs and benefits for both the counterfactual (Option 0) and amended Regulations (Option 1) scenarios.

A) Estimate the number of meters and HCAs that will be installed under the scenario
B) Construct a cost profile for the heat providers for understanding the Regulations, carrying out cost-effectiveness tests, installing the required meters and HCAs, the ongoing operating and billing costs, and the reporting requirements in the scenario.
C) Construct a benefit profile based on the monetised benefits incurred from the installation of a heat meter or HCA.
D) Sum the total cost and benefits across the appraisal period to get the net impact of the scenario.

42. The net impact of the Amending Regulations scenario has been compared to the counterfactual to provide the additional net impact of the Amending Regulations.

A) Number of meters installed

Table 2: Number of meters and HCA installed over installation period

	Domestic Meters/HCAs Installed (000s)	Non-domestic Meters/HCAs Installed (000s)	Total Meters/HCA Installed (000s)
Counterfactual	69	5	74
Open Class	49	7	56
Viable Class	25	3	28
Total	**143**	**14**	**158**
Additional billing	12	1	13

Note: The number of meters in the viable class in this table refers only to those which are additional due to the Amendments. In practice, most of the counterfactual installations would fall in the viable class but are captured in the counterfactual as these meters are expected to be installed without amending the Regulations. The Open class increases heat meters and HCAs. Figures in this table may differ from elsewhere in this IA slightly due to rounding.

43. The analysis carried out for this IA focuses on the number of additional meters or HCAs installed in currently unmetered dwellings or units as a result of the Amending Regulations.[29] There are known to be around 480,000 heat network customers in the UK, around 340,000 of these customers are unmetered[30], and this is expected to increase year-on-year as the market grows[31], in the absence of amendments to the Regulations. There is expected to be around 93,000 new heat network customers over the 4-year

[29] All currently metered customers are assumed to replace these meters as required as part of their normal business practises. Therefore, all costs associated with these have not been included in the analysis.
[30] These estimates are from the experimental Heat Networks statistics of March 2018 found here: https://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-articles
[31] It is assumed that the heat demand met by heat networks will grow at 3.6% per year, which is based on analysis of the OPSS database. As a simplifying assumption, we have assumed there is a linear relationship between the growth in the number of heat networks, buildings, and end customers.

installation period. This brings the total number of potentially unmetered customers to over 430,000 during the installation period.

44. Under the counterfactual scenario, it is estimated that around 74,000 heat meters will be installed in currently unmetered dwellings or units over the appraisal period. This is based on the heat meters that would have to be installed regardless: due to buildings on district heat networks undergoing renovations[32] (2%), all new buildings on a district heat network and a proportion of meters which are expected to be installed on a voluntary basis in new buildings with communal heating (50%)[33].

45. Furthermore, it is assumed that 13%[34] of these existing unmetered customers would be in buildings which fall into the exempt class where the installation of metering devices is not considered cost effective. This reduces the estimated number of additional unmetered customers who may require a metering device to around 310,000 in the viable and open class.

46. The cost-effectiveness test is undertaken by the heat network operator at a building level. This is assumed to take place in the first year of the appraisal period[35]. If installing customer level meters is assessed to be cost effective at a building level, then the operator is required to install customer level heat meters in all units within the building.[36] This is based on running a simplified version of the cost-effectiveness assessment on a sub-set of the OPSS notification database, a full description of the simplified methodology used can be found in Annex B.

47. The results of the cost-effectiveness test are expected to reduce the number of buildings which will be required to install customer level heat meters. The equivalent of 14% of customers pass the cost-effectiveness test for a heat meter. For those that do not pass for a heat meter, an assessment must be carried out to ascertain if it is cost effective to install HCAs and hot water meters, where the equivalent of 7% of customers are estimated to pass.

48. In total under the Amending Regulations, an additional 67,000 heat meters and 17,000 HCAs are expected to be installed. This increase is due to the inclusion of the majority of customers in new buildings with communal heat networks in the Viable class (29,000) and the updated tool and guidance for assessing the cost effectiveness of meter (38,000) and HCA (17,000) installations in buildings in the Open class.

49. There is also a proportion of customers that are already metered but receive no billing information for their heat usage. There are estimated to be around 13,000[37] customers of this type. The amendments would ensure consistency in the Regulations by bringing these customers within the scope of the billing requirements, which means these customers would now be billed based on their consumption.

B) Monetised costs from implementation of the Amending Regulations

50. A cost profile is constructed based on the administrative costs, assessment costs, installation costs, and operating costs which include billing, and is then multiplied according to the number of meters installed. A standard cost model approach is used to estimate all costs. While in practice some costs may not be passed through to end consumers, for the purpose of this IA it is assumed that all costs are passed through over the course of the appraisal period.

[32] Under as a proxy assumption - Understanding Renovation decision UKERC p.6http://tyndall.ac.uk/sites/default/files/verd_summary_report_oct13.pdf
[33] Assumed to be 50% of all new communal heat networks based on evidence from the Heat network consumer survey. https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems
[34] This is the proportion of unmetered customer expected to be exempt. This has been informed from analysis for the wider UK building stock as there was insufficient data on heat network customers. Please see Annex A and B for more details.
[35] This is simplifying assumption for the ease of modelling. In practise, In order to allow time for heat suppliers to come into compliance with the amended requirements and to reduce cost and administration associated with notifications, transitional arrangements have been put in place for the period starting when the amended Regulations come into force and ending on the compliance date 21 months later.
[36] For the purpose of the IA, the pass rate of the cost-effectiveness test is calculated as a proportion of end customers.
[37] Informed by the OPSS database, based on the number of customers with meters but are not billed on consumption

Administrative costs

Table 3: Summary of administration costs per network

	Costs per hour (£)	Hours required	Total Costs
Familiarisation with Amending Regulations and dissemination	25	9.5	242
OPSS notifying/ registering	25	15	382
Total			623

Note: the costs in this table may differ from elsewhere in this IA slightly due to rounding

51. The administrative costs associated with the Regulations involve the cost to business of familiarising themselves with the Amending Regulations[38] and notifying OPSS. This gives a total of £623 per network for administration costs which are incurred once. The cost of notifying is not affected by the proposed amendments to the Regulations as the duty to notify remains unchanged (except for the additional requirement to notify the number of buildings supplied by a district heat network or communal heating in each class).

52. These tasks are assumed to be carried out between an estate manager and an internal business consultant, split 75% and 25%[39] respectively. The weighted cost per hour and time required for these activities are presented in Table 3 based on evidence from the Office of National Statistics (ONS) on wage costs, the OPSS and BEIS technical experts estimates for the time required.

53. The responses to the consultation broadly agreed with these assumptions. However, several responses suggested that the cost per hour was too low and the estimates did not account for additional time required to disseminate information to staff. As a result, the cost per hour has been updated to recent ONS estimates and 2020 prices. An additional 2 hours has been allocated (per heat network) to disseminate the requirements within the organisation, in line with evidence from the responses. There were additional concerns raised about the variation in costs faced by heat suppliers with heat networks of different sizes and locations. However, data on this is insufficient, so a sensitivity analysis has been carried out to assess the impact of increasing and decreasing these costs by 50%, from which the results suggest the impact is small - see more in Section 10.

Assessment costs

Table 4: Summary of assessment costs per building

	Costs per hour (£)	Hours required	Total Costs (£)
Identify the class of each building in the network	25	0.5	13
Cost effectiveness test	25	12	305
Cost effectiveness site assessment	25	1	25
Total			344

Note: the costs in this table may differ from elsewhere in this IA slightly due to rounding

54. There are two areas of assessment costs heat network operators could face as a result of the Amending Regulations, the assessment of:

    a. Identifying which class, a building belongs to.
    b. Cost-effectiveness assessment carried out on buildings in the Open class.

[38] This cost also includes familiarisation with information, tool and guidance on the cost-effectiveness assessment test
[39] Based of consultation with internal BEIS Heat Network specialists

55. A heat supplier will need to identify the class of each building connected to a heat network. This is expected to be a relatively quick desk-based exercise for most buildings, and it is assumed to take half an hour per building[40]. There are no costs associated with the identification of buildings in the viable class, as this is expected to be clear following familiarisation with the Amending Regulations. Heat suppliers are expected to face the costs of identifying buildings which fall into the Open and Exempt classes.

56. The additional costs borne by heat suppliers with building/s in the Open class relate to the costs of undertaking cost-effectiveness and site assessments for the installation of heat metering devices. The IA assumes that all heat network operators with buildings in the Open class will bear this cost, irrespective of the test outcome[41]. Under the Regulations, a heat supplier can comply by installing meters without undertaking a cost-effectiveness test. In which case, the heat supplier would not face the costs of this assessment. There is very limited evidence on the number of heat suppliers who may choose to do this, a sensitivity analysis has been conducted to investigate the impact if 20% of buildings in the Open class installed meters without undertaking the cost-effectiveness test. The results suggest this would increase overall NPV by around £1m given these heat suppliers would no longer face the cost of undertaking the cost effectiveness test, see section 10 for further details.

57. To assess the cost effectiveness of installing heat meters or heat cost allocators, heat suppliers will need to collect data on each building on the network and calculate the associated costs. The costs associated with a site inspection, to ensure the building is suitably designed for the installation of metering devices, have also been included for the purpose of this IA.

58. The estimated time requirements have been informed by a sample of businesses that undertook assessments under the Regulations in 2016 and BEIS technical experts. As shown in Table 4, this gives a total assessment cost of £344 per building in the Open class as the assessment is carried out at the building level. Therefore, the total costs of undertaking this assessment for a heat network operator will depend on the number of buildings they need to assess.

Capital, installation, and operating costs

Table 5: Summary of installation costs per domestic dwelling or non-domestic unit

	Domestic	Non-domestic
Meter capital and installation costs £		
Heat meter supply and installation	389	1526
Supply data gathering system	68	68
Installation data gathering system	102	102
Total meter cost	**559**	**1696**
HCA capital and installation costs £		
Supply and installation of a Hot Water Meter	164	
Capital cost of HCAs[42]	200	
HCAs data gathering system	25	
Total HCAs cost	**389**	
Heat meter & HCA operating costs £		
Operating costs	92	
New billing costs	40	

[40] This is based on consultation with Beis Technical experts. In practise this will depend on how readily the estate manager has access to this kind of information on the building connected to the network.
[41] Heat network operators are assumed to carry out this assessment for all the building in the open class. In practise, a proportion of heat suppliers may choose to install meters without undertaking the assessment.
[42] The cost of an individual HCA is £40, total costs of installing HCAs will depend on the number of radiators in a unit. For the purpose of this IA we assume there are 5 radiators in each unit. This is estimate is informed by the unit types connect to heat networks form the consumer survey. https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems

Heating control	50	128[43]

Note: the costs in this table may differ from elsewhere in this IA slightly due to rounding

59. Capital, installation, and operating costs associated with heat meters or HCAs are assumed to be borne by heat suppliers. Cost estimates for domestic and non-domestic heat meters are informed by a report by Sustain (2017)[44], the consultation responses and engagement with industry. Costs for domestic and non-domestic buildings, are based on an average pipe diameter of 15mm and 50mm, respectively.

60. Heat cost allocators provide a less accurate indication of the quantity of heat used and are not widely used in the UK. However, they are cheaper than heat meters and can be used for cost allocation in a building (e.g. where heat is provided to a dwelling through multiple pipes). As HCAs take readings of space heating only, a hot water meter would also be required.

61. It is also assumed that both domestic and non-domestic buildings will implement a data gathering system[45]. As shown in Table 5, the assumed capital and installation cost of a data gathering system for heat meters in 2020 prices are estimated at £68 and £102 respectively[46]. The cost of a data gathering system for HCAs ranges widely and has been estimated as £25 per dwelling/unit[47]. The consultation responses agreed that the BRE (2012) report[48] estimated costs were still representative.

62. As shown in Table 5, a cost of £92 per year is assumed to be incurred to account for ongoing maintenance, data collection and operating costs, including billing. This was found to be the median value from the BRE Heat Metering Cost Benefit Analysis report.[49] This is assumed to be the same for both heat meters and HCAs. For existing metered customers who are currently not billed on consumption but will be post amendments, there is an assumed cost of £40 per customer per year[50] to heat supplier for meter readings and providing billing information.

63. The Regulations also require that customers have at least a basic level of control over their heating[51] to realise the associated energy savings. In this IA, all heat network customers are assumed to have some control over their heating. However, to investigate the potential impact a sensitivity has been added where 11%[52] of customers also require the installation of heating controls. This was found to add a small amount of additional costs, see section 10.

Monetised benefits from implementation of the Amending Regulations

64. Benefits arising from the Amending Regulations are due to the expected behavioural changes in the use of heating and hot water as a result of meter and HCA installation. The types of expected benefits are:

- Reduced primary fuel demand
- Reduced carbon emissions.
- Avoided health impact from poor air quality[53].

[43] Based on the average floor area (256m²) of a non-domestic unit derived from the OPSS and BEES data set at a cost of £50/100m².
[44] 'Establishing the unit costs of heat meters', Sustain (Jan 2017, unpublished), Department for Business, Energy and Industrial Strategy (BEIS) Regulatory Delivery Directorate appointed Sustain, part of the Anthesis Group, to undertake the task of researching and reporting relevant data pertaining to the cost of heat meters.
[45] This is at the discretion of the heat supplier, however there is limited evidence around the number of buildings with data systems installed.
[46] These figures were informed by the District Heating – Heating Metering Cost Benefit Analysis' (2012), BRE and Databuild. These assumptions were also found to be reasonable in the 2019 consultation and have been adjusted for inflation. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48389/5462-district-heating--heat-metering-cost-benefit-anal.pdf
[47] Based on consultation with industry
[48] A summary of the data has been published at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212565/summary_evidence_district_heating_networks_uk.pdf
[49] Price adjusted for inflation. District Heating – Heat Metering Cost Benefit Analysis (2012). Based on a compiled database of heat networks and consumers in the UK. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48389/5462-district-heating--heat-metering-cost-benefit-anal.pdf
[50] Price adjusted for inflation. Based on responses to the 2014 Consultation for Heat Metering and Billing for the on-going operating cost of heat meter, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396087/EED_Metering_Final_IA_-_signed_.pdf
[51] The minimum level of control required is the ability to turn the heating on and off.
[52] This Is based on evidence from the Heat network consumer survey. ibid
[53] It is worth noting that the first benefit accrues to customers whilst the latter accrues to society

65. The methodology used is consistent with HMT guidance on the valuation of energy use and greenhouse gas emissions for appraisal[54].

Reduction in primary fuel demand

66. Schedule 1 to the Regulations stipulates that an annual reduction in heat demand of 20% should be used for the assessment of cost effectiveness in domestic buildings and suggests up to 10% for non-domestic buildings [55] [56] [57] [58]. The energy saving in the first year of installation is expected to be half of the above energy savings[59]. This is based on a behavioural assumption which assumes a lag between installation of metering devices and the full impacts of energy reduction taking effect. The energy saving is assumed to be the same from both heat meters and the installations of HCAs, as they will both result in consumers being billed based on their own consumption.

67. The energy saving assumptions were tested through the consultation. There were some non-quantified anecdotal responses that the 20% energy saving figure was too high, and that metering would only produce savings from behavioural change. Conversely, a number of respondents stated that this saving could be higher due to system inefficiencies not being rectified in unmetered networks. In addition, analysis of the OPSS database also suggests metering leads to lower energy demand. However, there was insufficient additional evidence to warrant changing this assumption. Given the uncertainty with this assumption a full range of sensitivities have been carried out on this - see Section 10.

68. The starting point for assessing the benefits associated with the installation of metering devices is to estimate the reduction in energy use. To assess the saving from metering, an average energy profile was constructed based on building heat demands[60] from domestic and non-domestic buildings.

69. The energy demand, thermal efficiency and network losses are dependent on the type of building, heating technology and age of the network. The thermal efficiency and network losses are applied to a customer's reduction in energy demand to estimate the forgone heat generation. This process has been carried out for a number of representative customer types and then scaled up to represent the full population of heat network customers. The energy saving is valued at the long run variable cost (LRVC) of different fuel types, thus accounting for the primary energy sources associated with production and consumption of heat[61]. Annex B provides full details on the assumed profile of heat network customers and the assumptions used.

Table 6: Summary of energy savings by class

	Class	Total Energy Savings (TWh)	Annual average Energy Savings (TWh)	Total Value of energy Savings (£m)
Domestic	Open	2.4	0.2	59.0
	Viable	0.5	0.0	13.7
	Additional Billing	0.3	0.0	8.0

[54] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal at https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[55] http://www.legislation.gov.uk/uksi/2014/3120/pdfs/uksi_20143120_en.pdf
[56] 'District Heating – Heating Metering Cost Benefit Analysis' (2012), BRE and Databuild. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48389/5462-district-heating--heat-metering-cost-benefit-anal.pdf
[57] Siggelsten and Hansson (2010) which identifies studies that find savings between 10 – 40% ('Incentives for Individual Metering and Charging', Siggelsten and Hansson (2010): http://dspace.mah.se/dspace/bitstream/handle/2043/10791/Incentives_for[1].pdf?sequence=1)
[58] A literature review for Defra found that there was a 5-15% saving to be made from direct feedback (i.e. live monitors) and a 0-10% saving from indirect feedback (i.e. through informative billing). However, only one of these studies, from Sweden, focused on heat networks specifically and it failed to include a comparable control group.
[59] For domestic meters, the figure is 10% in the first year and 20% in subsequent years. For non-domestic meters, the figures are 5% for the first year and 10% for subsequent years.
[60] Heat demand estimates were obtained from the OPSS notification data.
[61] The LRVCs for each fuel type, is weighted by the proportion that fuel makes of the total fuel mix – this fuel mix is drawn from the OPSS database.

	Total	3.2	0.2	80.7
Non-domestic	Open	1.8	0.1	42.7
	Viable	0.1	0.0	2.7
	Additional Billing	0.0	0.0	0.8
	Total	1.9	0.1	46.1
Total		5.1	0.4	127

Note: the benefits in this table may differ from elsewhere in this IA slightly due to rounding.

Reduced carbon emissions

70. The expected reduction in heating demand and associated fuel savings will also result in a reduction in greenhouse gas emissions. The reduction in emissions has been calculated using the government emission conversion factors for different fuel types.[62] These emissions have then been valued at the projected carbon prices[63]. Associated carbon emissions are predominantly in the non-traded sector, except for some networks which are either powered by electricity or networks which participate in the EU Emissions Trading System.

Table 7: Summary of carbon savings

	Total Carbon Savings (MtCO2e)	Total Non-Traded Carbon Savings (MtCO2e)	Total Traded Carbon Savings (MtCO2e)	Total Carbon Savings (£m)	Yearly Carbon Savings (£m)	Total CB3 Saving 2018-2022 (MtCO2e)	Total CB4 Saving 2023-2027 (MtCO2e)	Total CB5 Saving 2028-2032 (MtCO2e)
Domestic	0.59	0.56	0.03	24.12	1.72	0.14	0.31	0.14
Non-domestic	0.35	0.33	0.02	23.31	1.66	0.09	0.18	0.08
Total	0.94	0.89	0.05	47.42	3.39	0.23	0.49	0.22

Note: the benefits in this table may differ from elsewhere in this IA slightly due to rounding

Air quality damage costs averted

71. Improvements to air quality are also expected in line with the energy reduction, given that less air pollution should be created. Air quality damage is valued using the air quality damage costs provided by HMT Green Book supplementary guidance[64]. As with energy savings, the air quality damage costs are calculated by the forgone consumption of each fuel type[65].

Table 8: Summary of air quality damage costs averted

	Class	Total Air quality damage costs (£m)	Yearly Air quality damage costs (£m)
Domestic	Open	26	2
	Viable	5	0
	Additional Billing	3	0
	Total	35	2
Non-Domestic	Open	19	1

[62] Data tables 1 to 19: supporting the toolkit and the guidance, available at https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[63] The value placed on changes in greenhouse gas (GHG) emissions described in point b is currently under review, as the UK has now increased its domestic and international ambitions. Accordingly, current central carbon values18 are likely to undervalue GHG emissions, though the scale of undervaluation is still unclear. The potential impact of placing a higher value on GHG emissions can be illustrated by using the existing high carbon values series, in addition to the prescribed central values. The government is planning to review the carbon values during 2020. Ibib

[64] ibid

[65] This information is taken from the OPSS database.

	Viable	1	0
	Additional Billing	0	0
	Total	21	1
Total		**56**	**4**

Note: the costs in this table may differ from elsewhere in this IA slightly due to rounding

Summary of monetised costs and benefits

72. A summary of the overall costs and benefits associated with the Amending Regulations is shown in Table 9. The costs are largely due to the capital and installation costs associated with metering. The largest benefit is the reduction in energy use. The costs and benefits outlined indicate a Social NPV of £95m for Option 1 (amending the Regulations).

Table 9: Summary of costs and benefits

	Option 1 (£m, discounted)
Installation capital costs	50
Operating costs (maintenance and billing)	75
Administrative costs	10
Total cost	**135**
Fuel saving	127
Carbon saving	47
Averted Air quality impact	56
Total benefit	**230**
Net Present Value	**95**

Note: the sum of costs in this table may differ from elsewhere in this IA slightly due to rounding

9. Key Limitations, Risks and Uncertainties

The key areas of uncertainty identified are:

73. **Number of Heat networks in the UK and number of buildings in the exempt class.** Heat suppliers are required to notify the OPSS of the details of any heat networks in the UK. The database may under report the true number of heat networks, as not all heat networks may be aware of the requirements and some may have failed to register. In addition, there is limited evidence to inform what proportion of buildings connected to heat networks will fall into the Exempt class. For the purposes of this IA these assumptions have been informed by a comparison with the wider UK building stock and consultation with BEIS heat network experts.

74. **Behaviour change –** We have assumed that total savings of 20% and 10% can be expected following the installation of either heat meters or HCAs in domestic and non-domestic units, respectively. This is based on evidence from countries in Europe, as we currently have limited UK evidence. It is reasonable to assume that the UK will experience similar reductions given similarities between heating systems. Secondly, the assumption that heat meters and HCAs will yield similar heat savings is untested, drawing on evidence from a German study[66]. This is a reasonable assumption as heat meters and HCAs both operate on a similar principle: by making actual consumption known to consumers, they are expected to reduce their heat usage.

75. **Cost effectiveness assessment –** For the purpose of this IA a simplified version of the cost effectiveness assessment was carried-out on a subset of the 2014 notification database. Therefore, this assessment does not account for any recent changes to the heat network population. Also, given this data was not

[66] Impact of Individual metering and billing presentation (study yet to be translated into English): http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/files/documents/events/3_felsmann_11.11.2013.pdf

gathered for this purpose we have been required to make assumptions on the heat tariffs and apply aggregated assumptions on efficiency to all buildings connected to a heat network. In practice there is expected to be greater variability in the tariffs charged by each heat network and the heat network operator will be able to specify the building fabric of each building in the assessment. These factors could result in differences to the overall pass rate of the cost effectiveness test, and therefore the number of meters/HCAs installed.

10. Sensitivity analysis

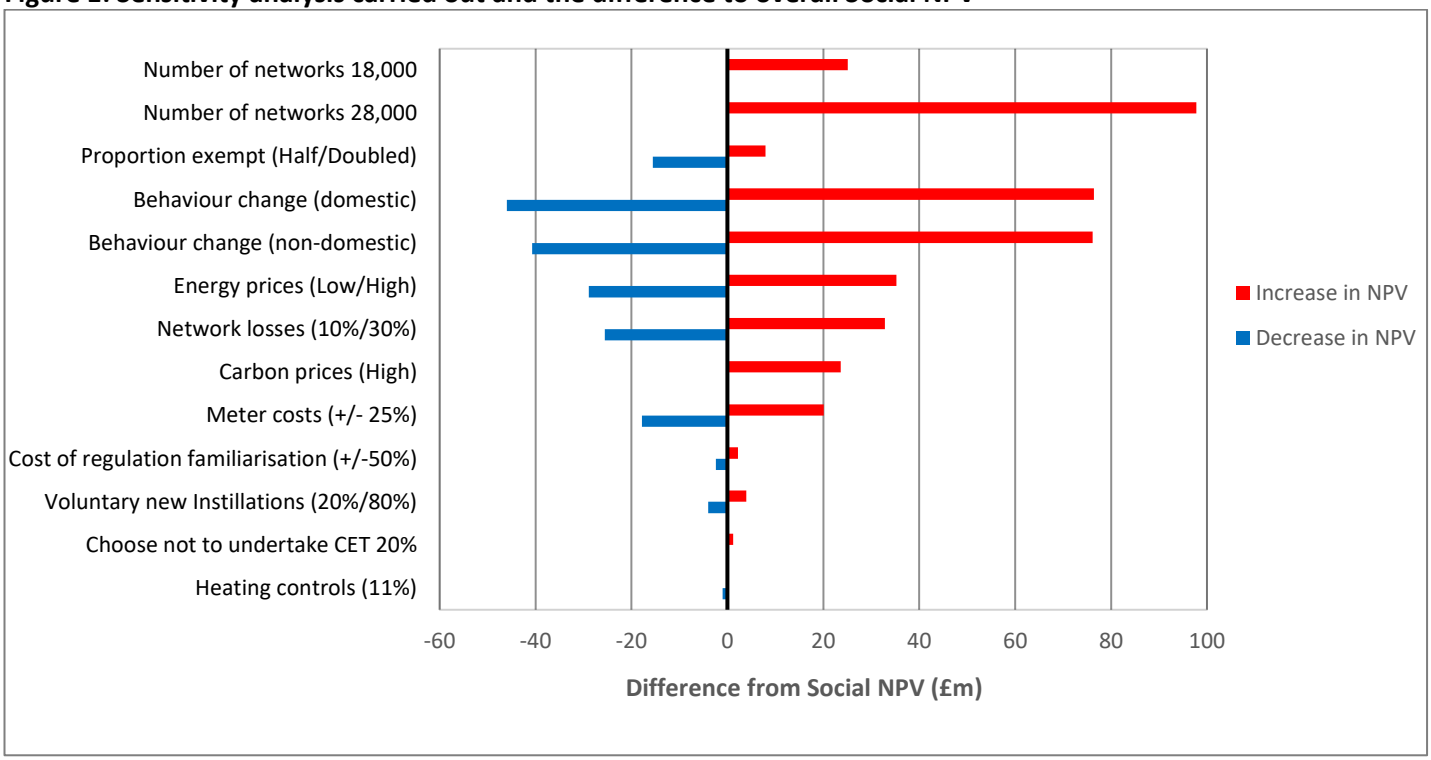
To investigate the impact of these uncertainties, sensitivity analysis has been carried out to illustrate the effects on the social net present value of varying the assumptions which have the most influence on the overall outputs. The key results from this analysis are summarised and discussed below. Please see table 10 for more detail on the full range of sensitivities tested and the rationale behind these.

Table 10. Summary of Sensitivities tested

	Sensitivities tested	Rationale
Number of heat networks	18,000	OPSS originally received 18,000 notifications (around 4,000 were removed in the quality assurance process). An extreme scenario where there are twice as many networks in the market is also tested (suggesting a 50% notification rate).
	28,000	
Proportion of exempt buildings	Half	There is very limited evidence to base this assumption on. Therefore, a wide range of sensitives have been tested.
	Double	
Cost of Familiarisation with the Amending Regulations	Half	A lower cost of familiarisation has been tested to represent a scenario where the heat supplier requires less time to understand the Regulations. In contrast, the high sensitivity accounts for any additional costs not captured in this analysis. There was limited evidence to suggest a more suitable range to test, therefore a wide range has been tested.
	Doubled	
Cost of installing heat meters/HCA and data gathering system	-25%	Lower cost represents a scenario where cheaper meters are installed, or installations are completed more quickly. The high cost scenario represents any additional cost associated with the meters, such as multiple visits. This is to reflect uncertainties over which meters may be installed and to capture a broad range the potential metering types and costs.
	+25%	
Energy saved due to behaviour change	10% domestic 5% Non-domestic	In line with the range of behaviour change in the available evidence. Lower energy saving assumption have been tested in line with the range in the EED guidelines. The high scenario is based on consultation responses that suggested higher energy savings.
	30% domestic 20% Non-domestic	
Network losses	10%	Scenarios reflect the range of network losses derived from the OPSS database, consultation responses and discussion with BEIS heat network experts
	30%	
Energy prices	Green Book low	In line with the ranges presented in the Green Book supplementary guidance.
	Green Book high	
Voluntary installations	20%	The proportion of meters which would be installed in new connections not under a duty in the Regulations. Informed by analysis of the OPSS dataset.
	80%	
Additional Sensitivities which are assumed to have no impact in the core scenarios		
Open class does not undertake CEA	20%	Investigating the impact of a proportion of heat suppliers deciding to install meters in buildings in the open class without undertaking a cost effectiveness assessment. Illustrative scenario.

Heating controls	11%	11% of customers are assumed to also require heating controls to be installed. In line with evidence from the heat network consumer survey.

Figure 1: Sensitivity analysis carried out and the difference to overall Social NPV



76. **The number of heat networks –** 14,000 heat networks is expected to be the lower bound, therefore only higher estimates have been tested. A scenario where there are 18,000 networks (in line with the number of notifications before quality assurance) and an extreme case where there is double the number of networks has been tested. Sensitivity analysis shows that more heat networks leads to more metering devices being installed therefore higher benefits.

77. **The number of buildings in the Exempt class –** there is limited evidence to inform the sensitivity analysis, so a broad judgement has been considered, halving (low scenario) and doubling (higher scenario) the proportion of exempt buildings assumed. This has a similar effect to changing the number of heat networks assumed. The lower the proportion of buildings exempt (7.5%), the higher the number of meter installations (an additional 5,500 installations) and therefore benefits estimated, and vice versa (assuming 26% of buildings are exempt reduces the number of meters installed by around 11,000).

78. **Behaviour change** - The social NPV is highly sensitive to the assumed level of behaviour change associated with metering, for both domestic and non-domestic customers. These assumptions affect both the initial cost-effectiveness assessment, determining whether meters are installed, and the benefits associated with meters which are deemed cost effective. The behaviour change assumption is fundamental to the expected energy savings. High and low scenarios have been informed by consultation responses and while benefits are reduced in the low scenario the Amending Regulations are still expected to result in a positive NPV. Conversely, benefits and the NPV increase significantly under the high scenario.

79. **Energy prices –** This sensitivity affects both the price customers pay for heat and the cost of the primary fuel input. This affects pass rate of the cost-effectiveness test by making it easier or harder to be cost effective. The overall pass rate falls to around 4% in the low energy price scenario and 20% in the high energy price scenario. These are more extreme scenarios but demonstrate how sensitive the cost-

effectiveness test is to the tariff prices. This assumption also impacts how we value the energy savings from forgone primary fuel used. In the high price scenario, the NPV falls by around £30m, whereas in the low-price scenario the NPV increases by around £75m.

80. **Networks losses –** The amount of network losses impacts on the total amount of primary fuel saved. Therefore, in the low losses scenario where all networks are assumed to lose 10% of heat, the benefits decrease. On the other hand, under the high losses scenario where 30% of heat is lost, the benefits increase. This sensitivity goes some way to demonstrating the benefits of improving the efficiency of a network.

81. **Metering Cost –** The cost of meters is expected to vary depending on the building type, so increasing and decreasing the cost of a meter by 25% has been tested. The cost of meters is a key factor in determining the cost-effectiveness pass rate and the overall cost of the scheme. Decreasing the cost of meters reduces the total costs and increases the cost-effectiveness test pass rate as a result, resulting in an increase in the NPV. The reverse is true for increasing costs. However, these impacts are to different orders of magnitude due to the non-linear relationship between the pass rate and the costs of the meters.

82. Broadly speaking the sensitivities relating to the cost of adhering to the Regulations (familiarisation, cost-effectiveness test, installation of meters, etc) have a small impact on the overall NPV of the Amending Regulations. The reason for this is twofold, these costs are relatively small when compared to the overall benefits. Also, the pass rate of the cost-effectiveness test varies depending on these assumptions, and meters or HCAs will only be installed in the Open class when it is cost effective to do so.

83. Additional sensitivities were tested on the proportion of voluntary installations, heat suppliers who choose not to undertake the cost-effectiveness test and the requirement to install heating controls. The results suggest that these elements are not expected to have a large impact on the overall NPV of the Amendments.

11. Qualitative Assessment

84. Several impacts have not been monetised due to the uncertainty involved. A qualitative assessment of these impacts can be found below:
85. **Greater consumer transparency on billing–** The Amending Regulations are estimated to increase the number of heat network customers who are billed based on their own consumption and receive clear and transparent information on their billing. This is expected to improve consumers' understanding of their consumption and make decisions based on this. This could also mean consumers are better able to identify and challenge charges which may be unfairly placed on the consumers, which is expected to support wider consumer protection in the market. This is also expected to prevent situations where low-demand consumers subsidise high demand users when bills are composed of fixed charges that only loosely reflect consumption.

86. **Jobs impacts** – The Amending Regulations are expected to increase the number of heat meters and HCA installed in new and existing buildings connected to heat networks. As a result, there are expected to be jobs supported in the installation, maintenance, and operation of these devices. The number and additionality of these jobs has not been quantified, given this is not the focus of the Regulations and due to complexities in ascertaining the additional number of jobs.

87. **Improved evidence base** - There are potential wider benefits to society that could be gained from effective use of the heat network level information collected in the notifications. The findings could be used to reduce the cost to heat suppliers of identifying potential options for energy efficiency improvements in the buildings covered. The data collected could also be used to strengthen the evidence

base underpinning policies to support development of heat networks. Provided all commercially confidential information was redacted, the aggregated results could also be made public, which would support wider analysis and debate around the role of heat networks. Robust information on the current performance and level of heat network development could also be utilised by private investors.

88. **Network optimisation** – The installation of customer level meters and data gathering systems is expected to provide the network operators with better data on the heating demand and performance of the network. This insight could be used to further optimise and improve the operation of the network. This could potentially lead to further fuel saving and reduced operating costs due to improved efficiency. This is expected to benefit heat network operators, consumers, and wider society. However, the extent to which these benefits are realised is dependent on the response of the network operator, therefore has not been quantified.

89. **Re-bound effect** - Reducing consumer heat consumption, as a result of metering, is that some of the financial savings may be spent on other energy consuming goods and services. This means that the overall impact on energy consumption is smaller (although consumers will still benefit from the welfare provided by these other goods and services). This could reduce the carbon reductions and air quality improvements associated with the amendments to the Regulations. It is not possible to quantify this, where this financial saving may be re-allocated will vary significantly between different consumers and we do not have this information available.

90. **Service disruption** - Customers may have their heating and hot water turned off for a period during installation and testing and may also incur 'hassle costs' where a technical assessment of meter installation is required. These disruptions are only expected to be minor and borne mostly when technical feasibility, installation and maintenance is carried out. Furthermore, these instances could be further minimised through effective assessment and planning. For example, heat suppliers may be able to infer from inspecting one property if meters are technically feasible in all properties of that kind, reducing total disruption.

91. **Cost pass through** – Heat suppliers are expected to bear the costs of adhering to the Amending Regulations. This IA assumes 100% of these costs are passed onto consumers through service charges or higher heating tariffs[67]. Given all meters or HCAs installed under the Regulations are expected to be cost-effective, the net impact is expected to be zero over the lifetime of the metering devices. Based on conversations with industry, it is expected that most heat suppliers would spread the up-front capital costs of installing meters over the 10-year lifetime of the assets. In practice, certain heat suppliers such as social housing providers or local authorities may choose to absorb some of the additional costs. Whereas others, such as private heat suppliers, may choose to re-coup the set-up costs within the first year.[68]

92. It is possible that some of the assumptions on costs and energy saving used in the cost-effectiveness assessment may be under or overestimates. Therefore, it is possible that consumers could see an overall increase or fall in their bill. No assessment of this has been made due to difficulty estimating this with the evidence available. The updated cost-effectiveness assessment allows for the inclusion of additional cost categories, which should limit the frequency of these occurrences. In addition, as discussed above there are additional non-monetised benefits which could help offset any additional costs of metering. The monetised benefits presented in this IA are to the wider society, therefore, these benefits would still be realised irrespective of how costs are passed on.

93. **Fuel poverty and the risk of under-heating –** Providing meters to individual customers is intended to incentivise more efficient use of heat as reductions in energy use are translated into bill savings. However, bills based on metering may incentivise people to under-heat their properties (relative to

[67] The Regulations allow for fixed as well as variable charges to be passed on to final customers. Any fixed charges for recovery of investment would need to be clearly explained in the billing information, in line with Regulation 9(7)(c). A heat supplier's costs of providing bills and billing information may be passed on to final customers provided that no profit is made from such charges. This is the case unless, in buildings with more than one final customer, billing services are undertaken by a third party, in which case reasonable charges may be passed on to final customers.

[68] Subject to individual tenancy and leasing agreements

need), to reduce their bills. This may be particularly important for customers on heat networks, many of whom are in social or local authority housing.

94. The analysis assumes consumers respond to the introduction of variable pricing alongside meter installation by reducing heat consumption. In practice, if some unmetered customers reduce their heat consumption this could lead to sub-optimal health outcomes, reduced quality of life and greater demands on health care services. In these instances, it is deemed unlikely consumers would reduce their heating consumption past a point at which it would have adverse impacts on their health or quality of life. The introduction of building classes is also expected to reduce the likelihood of these occurrences, through the inclusion of supported housing within the exempt class. However, there is little evidence on the number of fuel poor residents currently living in properties served by heat networks and their behaviour in heating their homes in properties without meters.

12. Costs and benefits to business (direct and indirect)

Direct benefits and costs:

95. This IA has considered the costs and benefits arising to business as a result of the Amending Regulations. Costs and benefits to business can be considered direct or indirect. An impact is considered 'direct' if it arises directly from the implementation of the measure. BEIS assesses these direct impacts using the standard methodology to calculate the annual net direct costs for business (Equivalent Annual Net Direct Costs for Business, or EANDCB)[69].

96. All costs within the IA are considered direct. The total direct costs to business are valued at £135m over the 14-year total appraisal period (between 2021 and 2035). All benefits within this IA are considered indirect, given that any behavioural change with regards to heat usage occurs after the installation of heat meters or HCAs, and once billing information is provided.

13. Small and micro business assessment (SaMBA)

97. The Department considers that this is not required because the proposal implements EED requirements. However, a description of the impact on small and micro business has been included for completeness.

98. There is limited evidence on the number of heat networks operated by small or micro businesses. However, it is possible some small or micro businesses may own or operate some heat networks. This is most likely in the case of communal heat networks, which supply only one building rather than district heat networks which supply multiple buildings. Heat suppliers of this type will be affected by the Amending Regulations if their customers are unmetered or do not adhere to the requirements set out above.

99. The responses to the consultation suggested that smaller heat suppliers may lack the skills required to effectively understand and adhere to the requirements of the Regulations, in particular, carrying out the cost effectiveness assessment. The responses suggested that they may be required to hire external consultants to carry out this assessment, which could come at a greater cost than assumed in this IA. The updated assessment allows users to include elements of additional costs which may vary by network. This is expected to allow different heat suppliers to account for specific costs they may have to bear, this is expected to reduce instances of meters being installed when not cost-effective. The sensitivities on costs tested in section 10 illustrates the impact higher costs could have on the NPV of the Amendments as a whole. As discussed previously this impact is expected to be small.

100. In addition, small and micro businesses who operate heat networks are also expected to benefit from the non-monetised benefits discussed in section 11.

[69] EANDCB does not consider indirect impacts. Thus, within this IA, only costs are included as benefits are considered indirect.

14. Equalities assessment

101. Under the Equality Act 2010, all public authorities are required to have due regard in the exercise of their functions on[70]:

a. Eliminate discrimination, harassment, victimisation, and any other conduct that is prohibited by or under the Act.
b. Advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it.
c. Foster good relations between persons who share a relevant protected characteristic and persons who do not share it.

102. The Act introduced nine protected characteristics for which discrimination is unlawful, they are: age, disability, gender reassignment, marriage or civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation.

103. The Department has considered the potential impacts of the proposal outlined in this Impact Assessment in the context of its duty to promote equality and eliminate discrimination. The elderly who use more heat than other age groups owing to being at home more often and requiring higher temperatures, may potentially be affected. However, analysis of households using communally heated buildings suggests that only a small minority of these households in England are in fuel poverty. Additionally, elderly people, irrespective of income, receive winter fuel payments to assist them with their energy bills. Additional support in the form of Cold Weather Payments are also available to those who meet the eligibility criteria. As a result, the expectation is that the proposals will not unlawfully discriminate or have disproportionate impacts against any persons belonging to the above protected characteristics.

15. Evaluation plan

104. Monitoring data from OPSS and consultation responses have been used to inform the amendments to the Regulations. There are however limitations of the OPSS data and given the diverse population covered by heat networks, there are challenges in monitoring and evaluating the impacts of the Amending Regulations.

105. The monitoring and evaluation will demonstrate the impact and outcomes of the Amending Regulations, providing a measure of success against the intended benefits, as well as providing evidence for future policy development. The monitoring will also be required to provide sufficient evidence to support enforcement and compliance.

106. The Regulations are anticipated to realise benefits in both user experience (i.e. transparency and accuracy of billing, energy, and bill savings) and wider environmental impacts (i.e. air quality, energy use, CO2 emissions). Post-implementation evaluation projects will provide further analysis of the impact of the Regulations. It is expected that the evaluation will seek to answer questions such as:

- To what extent have the amendments to the Regulations achieved the aims?
- To what extent are the impacts of the amendments additional to what would have happened without them?

[70] The Equality Act 2010, Public Sector Equality Duty, s. 149, available at: http://www.legislation.gov.uk/ukpga/2010/15/section/149

- How effective were the delivery of the amendments? To what extent is this offering value for money for businesses?
- Are there any lessons going forward for how heat networks notify or are operated?

107. It is expected the evaluation will follow a theory-based approach to assess the overall impact of the Regulations. If this approach is adopted then the evaluation would include further analysis of monitoring data, bespoke data collection from heat suppliers and users through surveys and interviews and wider evidence gathering to inform broader impacts. A thorough evaluation scoping exercise will be undertaken to determine the appropriate methodology to answer the main evaluation questions.

16. Summary and preferred option

108. Option 1 is the preferred option. This option is expected to ensure the installation of heat meters and heat cost allocators for customers on heat networks where it is cost-effective and technically feasible to do so, fully implementing the EED requirements.

109. The Amending Regulations are expected to incentivise energy savings by the end customers and associated reduced fuel use and negative externalities through giving information on energy use and billing customers based on their actual heat consumption. This will improve consistency and protections for customers across different types of heat networks and maximise the benefits of the Regulations.

110. This is also supported by a positive SNPV of £95m from the proposed amendments to the Regulations to wider society. The robustness of this analysis has been tested through extensive stakeholder engagement and testing a wide range of sensitivities to stress test the expected impact.

111. Further to this, qualitative benefits have been identified, which are expected to bolster the monetised benefits present in the IA. In contrast, where non-quantified costs have been identified, appropriate mitigations have been put in place to minimise their potential impact.

112. Based on this analysis, the Amended Regulations are expected to minimise the administrative burden of the Regulations and maximise the benefits, which include fairer billing, better consumer protection, better support to the UK domestic climate goals and compliance with the EED requirements.

Annex A – Description of building classes and exemptions

This section contains a brief description of the categories of buildings which fall into each building class. In line with the Regulations[71], the terms "district heat network" and "communal heating" include both the supply of heat and cooling.

Viable class

For buildings that fall into the Viable class final customer meters must always be installed. This reflects current requirements and also applies the requirements to new buildings with communal heating. However, there are a number of exceptions for new buildings with communal heating.

The Viable class includes:

- A newly constructed building supplied by a district heat network (including buildings where this mandatory requirement applied since 2014).
- An existing building undergoing major renovation supplied by a district heat network (including buildings where this mandatory requirement applied since 2014).
- A newly constructed building with communal heating where the connection is made on or after the compliance date (at the end of the 21-month transitional period) unless the building falls into the Open or Exempt class as set out below.

Open class

Buildings in the Open class must have meters or heat cost allocators installed unless it is assessed not to be technically feasible or cost-effective.

The Open class includes:

- All new buildings connected to communal heating during the transitional period (unless in the exempt class).
- A new building connected to communal heating after the end of the transitional period where
- there is more than one entry point for pipes into dwellings or non-domestic premises.
- the building (or a part of the building) is supported social housing, almshouse accommodation[72], or purpose-built student accommodation.
- All other existing buildings which do not fall into the Viable or Exempt class (this includes buildings where meters or HCAs are already installed).

In line with current requirements where a heat supplier has determined that it is not cost-effective to install meters or heat cost allocators, a further determination must be made within four years.
The term supported housing refers to low cost rental accommodation by a social housing provider where additional support is provided to the residents.[73] Examples include sheltered or extra care housing, emergency accommodation for the homeless, and accommodation which provides support to residents with a range of health conditions or vulnerabilities.

Exempt class

The Exempt class covers existing buildings, on either a district heat network or with communal heating, which do not fall into the Viable or Open class and where it is presumed the assessment for cost-effectiveness under the Open class would be negative. The installation of metering devices is not expected to be cost-effective either because the expected financial consequences would outweigh the assumed cost savings or where it is not expected the financial benefits can be achieved on account of the type of housing provided in the building. Buildings in the Exempt class are therefore not subject to a cost-effectiveness assessment to reduce the burden on heat suppliers. We have also retained two specific technical exemptions.

[71] The full amendments to the Regulations will be published alongside this IA.
[72] An almshouse is residential accommodation which belongs to a charity and is provided exclusively to meet the charity's purpose such as but not limited to the relief of financial need or infirmity.
[73] Social housing provider is defined as appropriate for England, Scotland, Wales, and Northern Ireland.

The Exempt class includes:

- An existing building where the building (or part of the building)
- is supported social housing, almshouse accommodation, or purpose-built student accommodation.
- is covered by an existing lease which contains a provision which would prevent billing based on metered consumption (where more than 10% of the total number of dwellings and non-domestic premises are subject to the lease).
- A building not consisting mainly of private dwellings where heat is supplied by means of a system other than hot water or the cooling distribution system uses a transfer fluid other than water.

Annex B – Assumptions used to estimate individual meter installations

The Exempt class contains a combination of existing exemptions and new exemptions aiming to remove undue burden where the installation of meters or HCAs is deemed very likely not to be cost-effective. Given the very limited data available on the types of buildings and customers connected to heat networks, it has not been possible to produce precise estimates on the proportion of buildings we expect to fall into these categories. Instead the assumptions used have been based on consultation with industry experts and comparisons with the wider UK building stock.

The proportion of buildings assumed to fall into the exemptions has been split out into domestic and non-domestic, to reflect the specific exemptions. The assumed exempt proportion of the domestic and non-domestic population is 14% and 10% respectively. When accounting for the split between domestic and non-domestic buildings, the total proportion of the population assumed to be exempt is 13%. Given the inherent uncertainty in these assumptions, a wide range of sensitivities have been tested. In addition, once compliance with Amending Regulations has been reported, we will have precise data on the proportion of buildings which fall under these exemptions. These exemptions will be kept under review.

Table B.1 – Portion of heat networks population assumed to be not included

Network/Building specifics	Evidence on the portion of customers
More than one entry point for the pipes	The viable class includes new builds or new connections to the network and existing buildings that undergo major renovations. It is not commonplace to have multiple entry points, if at all this is most likely in older buildings. Therefore, the number of properties of this type in the viable class is expected to be limited, if any, and assumed to be zero.
Supplied by a system using means other than hot water/ cooling is supplied by a system using a transfer fluid other than water	A communal network of this type is not a heat network, therefore we assumed there is no communal network of this type in the OPSS data set. It is possible some non-domestic buildings such as offices or hospitals connected to district heat networks may meet this exemption. Therefore 10% of non-domestic District heat networks are assumed to meet this exemption, based on discussion with BEIS heat network technical experts.
Where more than 10% of units in a building have a leasehold clause, which prevents billing based on metering	There is no evidence on the proportion of dwellings/units connected to heat networks with this provision in the lease. It is estimated that leased properties make up 18% of the English housing stock[74]. It is not possible to know the distribution of leased properties in the heat network population or know the proportion that have this condition in their lease. It is expected to be most common in social housing due to the Right to buy Scheme. Social housing is estimated to make up around 30% of the building stock connected to heat networks. Therefore, it is assumed that this exemption applies to (18% * 30%) 5.5% of domestic buildings.
At least part of an existing building consists of supported housing or almshouse accommodation	There is estimated to be 651,500 supported dwellings in Great Britain[75], this makes up around 2% of the domestic building stock in England. However, it is known heat networks are commonplace in social housing. Given the limited evidence, it is assumed the proportion is twice as high in the heat network population at 4%
At least part of an existing building consists of purpose-built student accommodation (PBSA)	There is estimated to be 659,478 PBSA units in UK[76], this makes up around 2% of the domestic building stock in the UK. However, it is known heat networks are commonplace in student accommodation. Given the limited evidence, it is assumed the proportion is twice as high in the heat network population at 4%.

Simplified Cost effectiveness assessment

The simplified version of the cost-effectiveness assessment is described below:

[74] http://researchbriefings.files.parliament.uk/documents/CBP-8047/CBP-8047.pdf
[75] DWP, DCLG 2016 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/572454/rr927-supported-accommodation-review.pdf

[76] Cushman & Wakefield 2019 - https://www.cushmanwakefield.com/en/united-kingdom/insights/uk-student-accommodation-report

The assessment will be carried out by heat network suppliers to assess if the installation of heat meters or HCAs is cost effective. It is considered cost effective to install a meter or HCAs, as per the Regulations, where the projected energy savings (to all final customers in the building) over the 10-year period following installation, are greater than the estimated costs of installing customer level meters (or HCAs and hot water meters) in that building. Thus, cost effectiveness is determined by making a net present value (NPV) calculation for each dwelling / building on the network.

$$NPV\ Energy\ saving\ over\ \ lifetime\ (10\ years) > The\ costs\ related\ to\ metering\ and\ billing = Costs\ Effective\ (\ Pass)$$

$$NPV\ Energy\ saving\ over\ \ lifetime\ (10\ years) < The\ costs\ related\ to\ metering\ and\ billing = Costs\ Effective\ (\ Fail)$$

Energy savings for individual buildings are calculated by considering the heat supplied by heat networks listed in the OPSS notification database. The heat supplied is then averaged across the number of buildings on that heat network to obtain an estimate of heat or cooling demand per building. This is a simplification necessary due to the lack of data on how energy use varies between different buildings on each network.

An assumed energy saving of 20% for domestic customers[1] is based on evidence from countries in Europe, specifically a 2015 study from the University of Dresden[77].The study also argued that a 20% reduction could be expected in other countries in Europe, including France, Sweden, Poland and Italy. In the absence of further evidence, we have assumed that non-domestic building heat savings will be half those of domestic building heat savings (10%). The rationale behind this is that non-domestic buildings are likely to have a bill payer that is different from the heat user. Thus, heat metering will induce smaller heat savings in non-domestic buildings than for domestic buildings, by reducing the incentive to reduce heat usage. In addition, it is assumed non-domestic buildings will be used for commercial purpose which is more likely to have profit maximising motives to reduce costs.

In the first year of the appraisal period it is assumed only half of the expected reductions will materialise for both domestic and non-domestic buildings. This is to allow time for consumers to become accustomed to the new billing regime and adjust their heating behaviour.

To estimate the final meter/HCA NPV, a private discount rate of 3.5% is assumed. A discount rate is used to show the value of future benefits and costs relative to benefits and costs realised in 2021. These benefits and costs are multiplied by the assumed heat tariff of between 3.9p/KWh – 7.8 p/KWh[78] (6p/Kwh in the central scenario), to estimate the final NPV at 2020 prices.

Assumed heating demand from consumers

The assumed heating demand from different customers was largely informed from analysis of the 2015 OPSS notification data set. Table B.2 provides an overview of the known UK heat network market:

Table B.2. Structure of the UK Heat network market

Number of Heat Networks	13,995
Number of Buildings	75,645

[77]'Effects of Consumption-Based Billing Depending on the Energy Qualities of Buildings in the EU' - University of Dresden (2014) https://www.ista.com/fileadmin/twt_customer/countries/content/Hungary/Documents/EED/Summary_LiteraturrechercheEinsparungHKV_final_20151218.pdf

[78] These assumptions were informed by evidence form the CMA heat network market study. https://www.gov.uk/cma-cases/heat-networks-market-study. These assumptions were scaled down for non-domestic customers based on the cost differential between domestic and commercial retail prices in the Green book supplementary guidance.

Number of customers	476,951
Number of customers with metres	134,996

Heating demand of buildings in the Viable class

The Viable class consists mainly of new heat networks, and new connections made to existing heat networks. A separate approach has been taken to derive heat demand assumptions for domestic and non-domestic buildings, given the far greater variation in the types of non-domestic units.

Domestic

Table B.3. Characteristics of Heat Network customers compared to the wider population[79]

Characteristic		Heat network sample	Population in England and Wales
Property type	Flat/maisonette	**90%**	**21%**
	House/other	**6%**	**79%**
Building age	1960 – 1999	**55%**	**88%**
	2000+	**27%**	**12%**
Size (#Bedrooms)	0 -1	**60%**	**12%**
	2 +	**27%**	**88%**

Note: *the differences between the numbers in bold are statistically significant*

The OPSS dataset contains information on total heat demand and the total number of customers at a network level. The dataset also categorises networks into domestic and non-domestic based on types of buildings connected to the network. A heat network is only considered non-domestic if it only serves residential buildings. Therefore, we have been able to derive the average heat demand of domestic dwellings connected to each heat network in the dataset. For the purposes of this IA, we have taken the average heating demand from a sample of around 7,800 heat networks. This has formed our assumptions of the heating demand of all new domestic customers.[80] This assumption has been compared to the gas demand of dwellings in the NEED dataset[81] and deemed reasonable.

Table B.4. Domestic heat demand assumption

Domestic unit	Heating demand (KWh)
Domestic Dwelling	8,500

Non-domestic

The OPSS data set does not provide information on the heat demand from specific consumers connected to the network. However, it does contain data on the number of different building types connected to a network. To overcome this evidence gap, we have used the Building Energy Efficiency Survey[82] (BEES) dataset to derive assumptions on the heat demand from different non-domestic unit types. The BEES dataset provides estimates on the average floor area of different non-domestic building units alongside the heating and hot water demand per square meter. This has been used to estimate the heating demand of these types of units. In addition, given this database is not heat network specific, it was deemed likely the buildings in the survey would already be metered. As a result, the total heating demand has been scaled up by 12.5% to represent a pre-metered level of heat demand, in line with our behaviour change assumptions. Table 12 shows the heat demand per unit and the proportion of buildings this is assumed to represent on heat networks.

[79] https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems
[80] This figure has been scaled down by 4.3%% to represent the reduced energy demand in new building. https://www.gov.uk/government/statistics/energy-consumption-in-new-domestic-buildings-2015-to-2017-england-and-wales
[81] When accounting for gas use in cooking and the thermal efficiency of individual gas boilers. NEED - https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework
[82] BEES - https://www.gov.uk/government/collections/non-domestic-buildings-energy-use-project

Table B.5. Non-domestic heat demand assumption

Non-domestic unit	Heating demand (KWh)	Share of Heat network customers
Commercial	23,000	84%
Retail	7,000	10%
Industrial	20,000	1%
Educational	154,000	3%
Public	98,000	2%

Heating demand of buildings in the Open class

Buildings which fall into the Open class are expected to undertake a cost effectiveness test to ascertain if they are required to install a customer level meter or HCA. This assessment is carried out at the building level. Therefore, meters or HCAs will only be installed in buildings where the energy saving exceeds the cost of installation and operation. The heating demand of the customers in each building and the price paid for this heat are key determining factors regarding whether meters or HCAs will be cost effective. For the purpose of this IA, a simplified cost effectiveness assessment was carried out on a sub-subset of heat networks in the OPSS dataset. Table 13 indicates the minimum energy demand required for both domestic and non-domestic buildings to pass the cost effectiveness test.

Table B.6. Domestic and Non-domestic heat demand required to pass CET

Non-domestic unit	Meters cost effective (KWh)	HCA Cost effective (KWh)
Domestic	>13,000	>12,000
Non-domestic	>50,000	>24,000

Technical heat network assumption

To estimate the full impact that consumer level energy saving is expected to have, certain technical assumptions about the population of heat networks were required. The fuel mix of the population of heat networks has been informed by analysis of primary fuel sources reported by each network in the OPSS notification database. This is a simplifying assumption; in practice most heat networks will also have secondary heat sources and back up gas boilers. This has been used as the basis for deriving assumptions on thermal efficiency. To simplify the modelling approach, oil, coal, and solid fuel heat networks have been excluded from this analysis. This was deemed reasonable given the impact was expected to be small. Similarly, as single thermal efficiency has been assumed for the different fuel types, this accounts for the proportion of generation of different technology types which use the same input fuel. Heat losses of 20% have been assumed across all heat networks, this is in line with the weighted average derived from the OPSS data set.

Table B.6. Fuel mix of heat network population

	Bioenergy & Waste	Coal & Solid Fuel	Electricity	Natural Gas	Oil
Fuel mix	2%	0.08%	5%	91%	1%
Heat network losses	20%				

Note: Figures derived from 2018 heat networks experimental statistics.

Annex C – Overview of key changes since consultation stage IA

Table C.1. Changes since the consultation stage

	Summary of changes
Number of heat networks	The consultation stage IA scaled up the number of networks to around 18,000 in line with the total number of notifications received before quality assurance was carried out. Following a review of the OPSS dataset, it was deemed more appropriate to focus on the total number of known networks in our central scenario and carry out sensitivities on the impact of more networks in the market. This is due to one of the key reasons for notification being removed was they did not meet the definition of a heat network. The Final stage IA assumes a lower number of networks, and therefore a lower number of customers who may need to install meters.
Annual heating demand	The consultation stage IA use the average heating demand for domestic and non-domestic customers derived from the OPSS database. A review of the database showed there was a small number of networks with very high heating demand, which were inflating the average disproportionally. In the final stage IA, the very high heat demand networks were removed from the analysis following consultation with consultants from Ricardo energy who are responsible for the CHP QA[83]. In addition, the BEES dataset was used to inform the likely heat demand of new non-domestic buildings, which was also significantly lower than the assumptions in the consultation stage. A lower heat demand for different building types resulted in lower expected benefits when applying the expected level of energy saving.
Cost effectiveness test pass rate	The consultation stage assumed a pass rate of 65%, whereas the Final stage IA assumes a much lower pass rate of 14%. This is due to differences in the assumptions around heat tariffs charged by heat suppliers and which networks were included. The analysis for Final stage IA also includes the relationship between metering costs and behaviour change. The consultation stage IA made an assumption over the number of customers in a building and therefore the number of meters which were required. In the final stage IA this has been informed by the specific number of customers reported by the network. The assumption around heat tariffs also differs with the consultation stage IA using estimates of generic heat prices not specific to heat networks, whereas the heat tariff price used in the Final stage IA is based on heat network data. The Final stage IA also uses higher metering and operating costs than the consultation stage IA (Due to inflation), which makes achieving costs-effectiveness more difficult.
Proportion Exempt	The consultation stage assumed 25% of customers would fall into the exempt class, based on analytical judgment. The exemption criteria have changed based on results from the consultation. Although, evidence on the proportion of heat network customers impacted by this is still limited. The final stage IA assumes a lower proportion of customers exempt in line with consultation evidence from heat network experts and a comparison with the wider UK building stock.
Administrative and assessment costs	The Final stage IA includes updated assumptions of the cost and time required to undertake administrative activities, including additional costs to allow time for heat suppliers to identify which classes their buildings fall within. This has been informed by a wider variety of evidence source detailed in this IA.

[83] https://www.gov.uk/guidance/combined-heat-power-quality-assurance-programme