Final Business and Regulatory Impact Assessment (BRIA)

New Build Heat Standard (NBHS)

Contents

1. Title of Proposal

New Build Heat Standard (NBHS)

2. Purpose and Intended Effect

2.1 Background

1. In October 2019, the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 received Royal Assent and was commenced in March 2020, setting annual and interim emissions reduction targets for Scotland on a trajectory to net zero emissions by 2045. These targets include the interim goal of a 75% reduction in emissions by 2030 (relative to the baseline period[1]).

2. Published in October 2021, the Scottish Government's Heat in Buildings Strategy[2] sets out the policy landscape surrounding the decarbonisation of space and water heating in Scotland. The NBHS was one such policy outlined as part of that Strategy.

3. Direct emissions from buildings accounted for almost 22% (8.6 MtCO2e) of Scotland's territorial greenhouse gas (GHG) emissions in 2020, the latest year for which statistics are available.[3] Of this, 7.7 MtCO2e was attributable to residential, commercial, and public combustion.[4] Meeting our legally-binding targets will require action to be taken with regard to reducing emissions from the existing stock of buildings through fabric upgrades and conversion to zero direct emissions heat, as well as ensuring new buildings do not add to the problem. This secondary legislation, The Building (Scotland) Amendment Regulations 2023, aims to address the latter.

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[1] The baseline period is 1990 for carbon dioxide, methane, and nitrous oxide, and 1995 for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, and nitrogen trifluoride.
[2] Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings - gov.scot (www.gov.scot)
[3] Scottish Greenhouse Gas Statistics 2020 - gov.scot (www.gov.scot). Calculated as the sum of *Services* and *Residential* Climate Change Plan (CCP) accounting categories for 2020.
[4] The remaining 0.9 MtCO2e comprises emissions from a variety of sources, some of the most significant being metered dose inhalers, air-conditioning, and refrigeration.

4. As they currently stand, building standards do not prohibit the use of direct emissions heating systems, such as gas boilers. However, recent amendments to building standards have been designed to encourage the use of alternative, zero direct emissions heating (ZDEH) systems. In particular, buildings constructed with a direct emissions heating system will be required to achieve challenging targets related to both energy performance and building emissions while information must be provided on how a zero direct emissions heating system could be easily retrofitted to the building in future. This lays the groundwork for the forthcoming NBHS, whilst also minimising emissions from new-builds in the meantime.

5. This policy coincides with recommendations made by the Climate Change Committee (CCC), our independent statutory adviser on climate change. *"The Scottish Government should: Legislate to prohibit the use of 'direct emissions heating systems' from 2024 in new residential and non-residential buildings"* (page 101).[5]

2.2 Objective

6. The objective of this policy is to prevent greenhouse gas emissions associated with delivering space heating, hot water, and cooling in new buildings, as well as conversions of existing buildings under specific circumstances. This will cover both domestic and non-domestic buildings applying for a building warrant from 1 April 2024 onward. This will be achieved through the prohibition of heating system installations that are not compliant with the NBHS. These non-compliant systems are termed Direct Emissions Heating (DEH) systems throughout this BRIA.

7. As laid out above in paragraph 3, the main intended outcome of this standard is that space and water heating, as well as cooling, within the curtilage of new

[5] Scottish Emission Targets & Progress in reducing emissions in Scotland – 2022 Report to Parliament - Climate Change Committee (theccc.org.uk)

buildings applying for a warrant from 1 April 2024 will not contribute to Scotland's territorial greenhouse gas emissions. Secondary outcomes include mitigation of air pollution as well as a scaled-up market for NBHS-compliant heating technologies, which in turn may be indirectly beneficial in lowering the cost of tackling emissions associated with the already existing stock of buildings which will require technology retrofits in future.

8. The Building (Scotland) Amendment Regulations 2023 sets out that a "direct emissions heating system", in relation to a building, means a fixed combustion appliance installation (other than a fixed combustion appliance installation which is a source of production from which thermal energy is distributed by a heat network) the purpose of which is to produce thermal energy by which space within the building is heated or cooled, or by which hot water is made available in the building, and which—

   a) is located within the building, or curtilage of the building, and
   b) during normal operation produces more than a negligible level of greenhouse gas emissions at the point of production of that thermal energy.

9. This policy has interaction effects with the Scottish Government's Housing to 2040 Vision,[6] the Fuel Poverty Strategy,[7] as well as Scottish building standards.[8]

10. The UK Government has signalled its ambition to ensure that all new buildings in England are net zero-ready from 2025 through their Future Homes Standard (FHS) and Future Buildings Standard (FBS).[9]

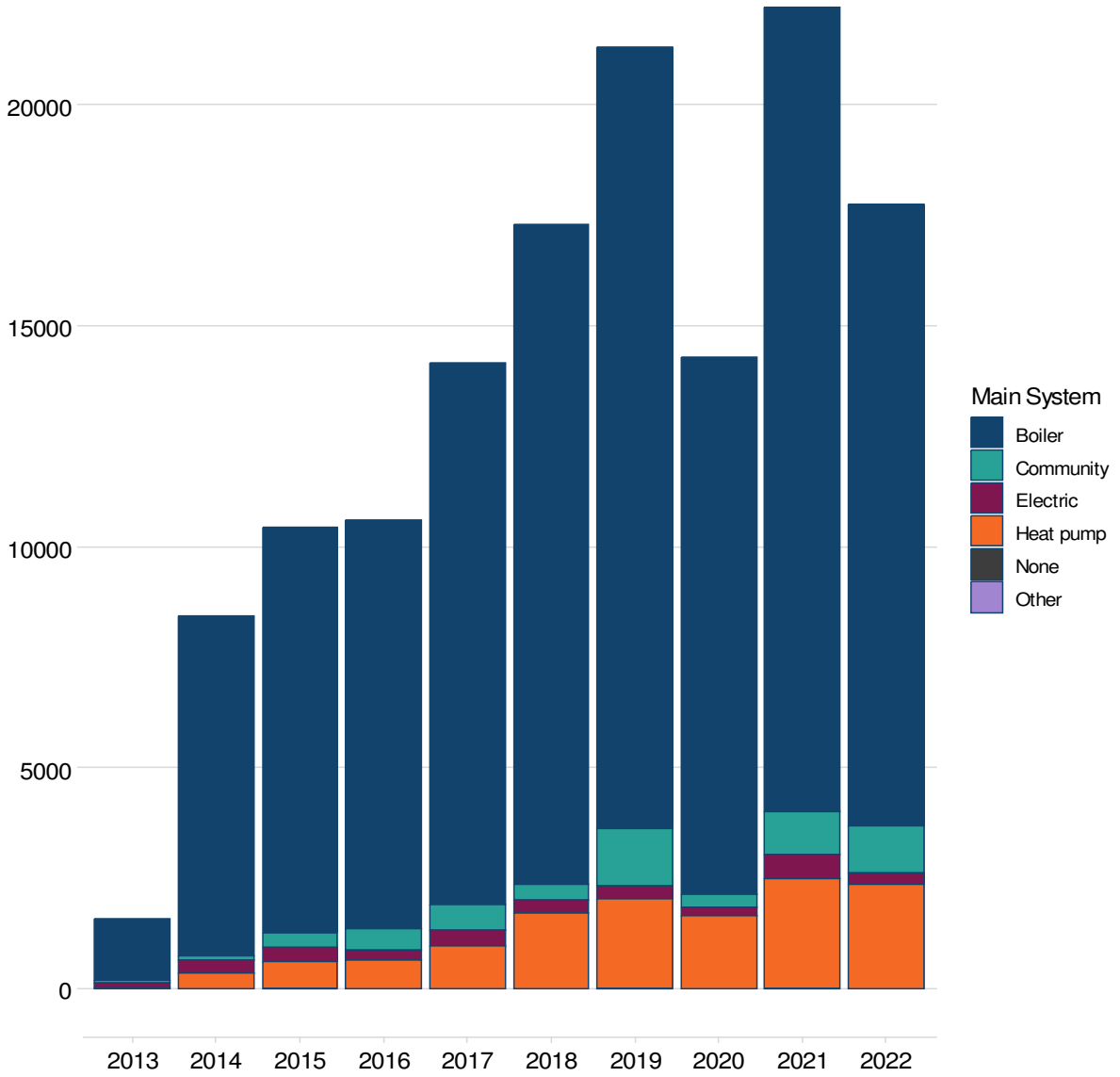
2.3 Rationale for Government Intervention

[6] Housing to 2040 - gov.scot (www.gov.scot)
[7] Tackling fuel poverty in Scotland: a strategic approach - gov.scot (www.gov.scot)
[8] Building standards - gov.scot (www.gov.scot)
[9] Heat and buildings strategy - GOV.UK (www.gov.uk)

11. **Business-as-usual.** As Figure 1 below shows, DEH systems are still installed as the main heating system in the vast majority of new-build homes. Over the past five years (2018 to 2022), around 80% of the new homes constructed use mains gas boilers as their primary heating fuel and system, and a further 2.5% use either oil or LPG.[10] This compares with 81% and 6% in the wider existing residential stock, respectively.[11] Over the next 10 years, these households may emit an estimated cumulative 0.9 MtCO2e. By 2045, all homes will have to replace their heating systems with a ZDEH alternative, with the Scottish Government announcing its intention to introduce regulations to require this from 2025 onward.[12, 13] We must ensure that new properties avoid the need to undergo expensive retrofit to adopt ZDEH systems[14] in future and avoid locking-in unabated emissions prior to their retrofit.

[10] statistics.gov.scot : Domestic Energy Performance Certificates - Dataset to Q4 2022. Accessed 10/02/2023.
[11] Scottish house condition survey: 2019 key findings - gov.scot (www.gov.scot) [Table 5].
[12] Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings - gov.scot (www.gov.scot) [Chapter 8].
[13] Scottish Government and Scottish Green Party - Shared Policy Programme - gov.scot (www.gov.scot)
[14] The costs and benefits of tighter standards for new buildings (Currie & Brown and AECOM) - Climate Change Committee (theccc.org.uk)

Figure 1: New-build homes and their main heating systems (absolute) (per annum)



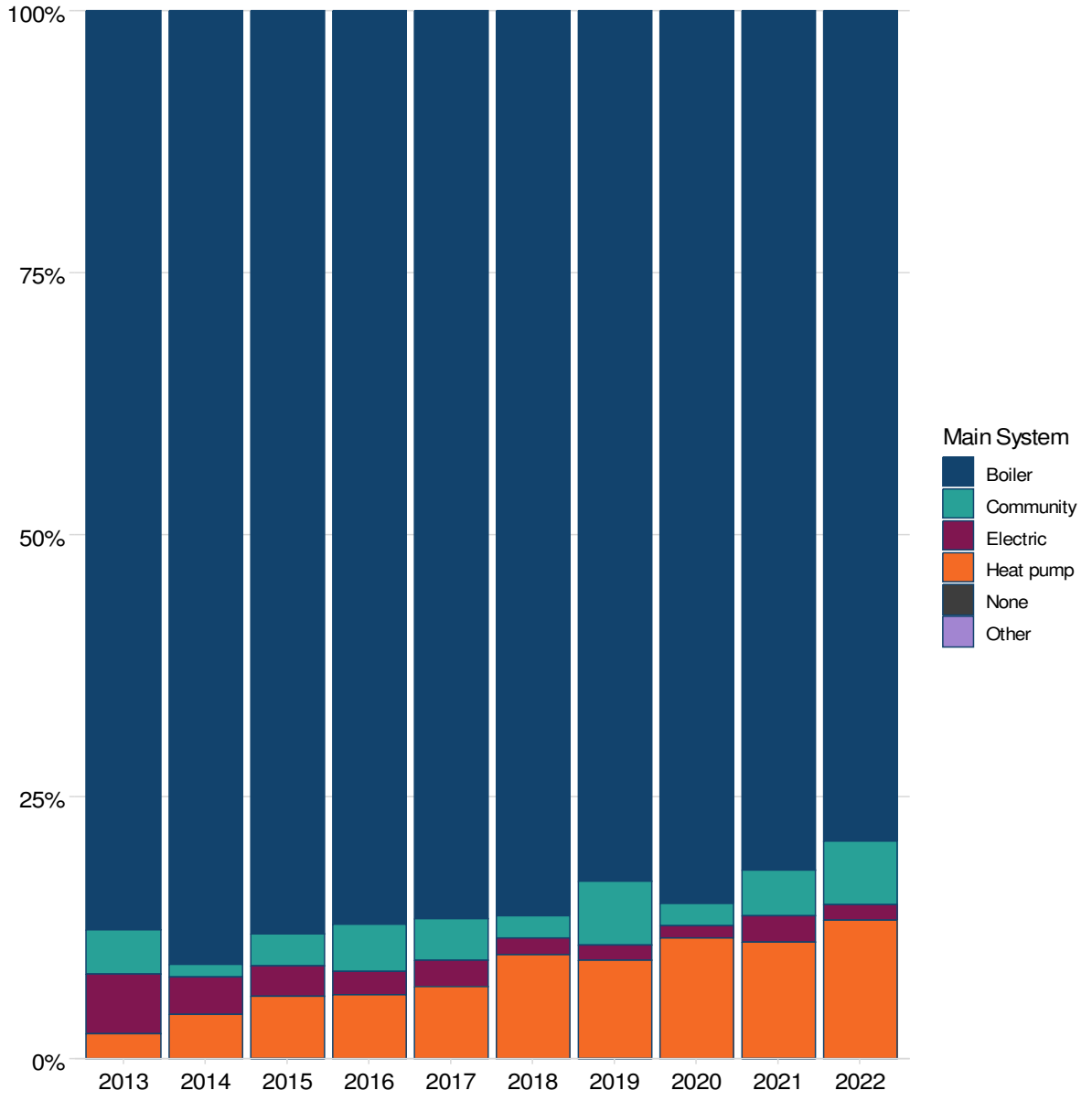
Notes: Data on each current record held on the Scottish EPC Register from Q1 2013 to Q3 2022.[15] Number of EPCs does not match National Statistics for new housing published by the Scottish Government.[16]

12. While there has been an increasing trend in homes adopting ZDEH technologies in recent years (as is shown in Figure 2 below),[17] discussions with

[15] statistics.gov.scot : Domestic Energy Performance Certificates - Dataset to Q4 2022
[16] Housing statistics - gov.scot (www.gov.scot)
[17] The share of new-build domestic properties built with ZDEH technologies has risen from a low of 9% in 2014 to 21% in 2022.

stakeholders as part of our Scottish Firms Impact Test (SFIT) indicated less progress would be made in the absence of the NBHS being implemented. This regulatory standard would see future columns in Figure 2 entirely comprised of community (including heat networks), electric, or heat pump heating systems, alongside (potentially) hydrogen boilers - if the market can deliver them. Indeed, this recent rise in ZDEH installations in new homes may be a result of the market anticipating, and thus future-proofing homes against, the prospect of future retrofits being required.

Figure 2: New-build homes and their heating systems (relative) (per annum)



Notes: Data on each current record held on the Scottish EPC Register from Q1 2013 to Q3 2022.[18]

13. **Imperfect information.** Related to the above point on the market partially anticipating the prospect of future retrofits being mandated, it may be possible that some segment of the market is already aware that DEH systems will be prohibited in the future and may be paying a premium currently to future-proof against this. However, this leaves another segment of the market which may not be aware that such retrofits will be on the horizon. Had they known, they may have chosen to purchase a new-build home with a ZDEH system. For example, recent research conducted by BMG Research for the Scottish Government found that 54% of respondents were uninformed about the Scottish Government's target to convert at least one million homes to ZDEH by 2030.[19] Likewise, polling conducted for Nesta found that 88% of respondents underestimated annual gas boiler emissions.[20] A pre-condition of market efficiency is that all participating market actors possess the information they need to make an informed transaction.[21]

14. **System lock-in.** Assuming heating technologies have a typical lifetime of 15-20 years, there is a risk that new buildings will be constructed with DEH technologies installed post-2025 or -2030, leading to premature scrappage of these systems to reach net zero emissions by 2045. In addition, adding to the stock of buildings that must then be retrofitted at a later date defers stimulating and building up the ZDEH supply chain until said later date, and may consequently lead to a higher degree of disruption to consumers in the future when a more rapid rollout of ZDEH technologies is needed. As discussed above, there is not only technological lock-in, but also lock-in of unabated emissions if new-builds are allowed to continue adopting DEH systems.

[18] statistics.gov.scot : Domestic Energy Performance Certificates - Dataset to Q4 2022
[19] Climate change - public engagement: survey results 2022 - gov.scot (www.gov.scot)
[20] A gas boiler emits more annual CO2 than seven transatlantic flights | Nesta
[21] The Green Book: appraisal and evaluation in central government - GOV.UK (www.gov.uk)

15. **Negative externalities.** DEH systems are associated with unpriced negative "externalities" that adversely impact societal wellbeing, both now and in the future. For example, when a user combusts fossil fuels for heat, they do not themselves face the full cost to society this imposes. These negative impacts include air pollution as well as GHG emissions which contribute to anthropogenic climate change. The negative externalities associated with climate change are explored extensively within the fields of economics and science.[22, 23, 24, 25] These externalities represent market failures, and as such warrant Government intervention in the market to correct them. They are also a primary reason as to why regulation is being pursued rather than voluntary regulation or self-regulation.

16. **Positive externalities.** There are also a number of possible *positive* externalities associated with the uptake of ZDEH systems that the NBHS could nurture. These include innovation spill-over benefits associated with research and development and economies of scale in the ZDEH supply chain, as well as learning-by-doing benefits which promote productivity.[26, 27] Encouraging demand for ZDEH systems could have the potential benefit of reducing their costs and consequently lowering the total cost of retrofitting the existing stock of buildings. Such innovation spill-over effects could also spur innovation in other sectors of the economy also.

17. **Recommended by the Climate Change Committee (CCC).** Building regulations and standards are an appropriate course of action for addressing the above market failures in new-builds. Indeed, the Climate Change Committee (CCC) have recommended such actions be taken. *"We have*

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[22] The Economics of the Climate - American Economic Association (aeaweb.org)
[23] What Do We Learn from the Weather? The New Climate-Economy Literature - American Economic Association (aeaweb.org)
[24] The Economics of Climate Change: The Stern Review - Grantham Research Institute on climate change and the environment (lse.ac.uk)
[25] Climate Change 2022: Impacts, Adaptation and Vulnerability | Climate Change 2022: Impacts, Adaptation and Vulnerability (ipcc.ch)
[26] Assessing the Economic Impacts of Environmental Policies: Evidence from a Decade of OECD Research | en | OECD
[27] The Environment and Directed Technical Change - American Economic Association (aeaweb.org)

previously recommended that Government strengthen new build standards to future-proof for low-carbon heating, with a further tightening in 2025 to support deployment of low-carbon heat" (page 52).[28]

18. **Alignment with National Performance Framework (NPF).** With regard to our National Performance Framework (NPF),[29] the NBHS aims to contribute positively to four of the National Outcomes, with relevant National Indicators for progress towards these Outcomes listed in the footnotes:

- We value, enjoy, protect, and enhance our environment;[30]
- We have a globally competitive, entrepreneurial, inclusive, and sustainable economy;[31]
- We are open, connected and make a positive contribution internationally;[32] and
- We have thriving and innovative businesses, with quality jobs and fair work for everyone.[33]

19. **Alignment with National Strategy for Economic Transformation (NSET).** The NBHS seeks to align with our National Strategy for Economic Transformation (NSET),[34] in particular our "greener ambition" to demonstrate global leadership in delivering a just transition to a net zero, nature-positive economy, and rebuilding natural capital.

3. Consultation

3.1 Within Government

[28] The reference to "2025" was directed at the UK Government. UK housing: Fit for the future? - Climate Change Committee (theccc.org.uk)
[29] National Performance Framework | National Performance Framework
[30] (i) Energy from renewable sources.
[31] (i) International exporting; (ii) Carbon footprint; (iii) Greenhouse gas emissions; (iv) Spend on research and development; (v) Entrepreneurial activity.
[32] (i) Scotland's reputation.
[33] (i) High growth businesses; (ii) Innovative businesses
[34] Scotland's National Strategy for Economic Transformation - gov.scot (www.gov.scot)

20. An internal Scottish Government working group was established and held its first meeting on 23 July 2020. This predominantly involved colleagues from across the Scottish Government's Directorate for Energy and Climate Change (DECC), as well as those responsible for housing and building standards located in the Directorate for Local Government and Housing (DLGH).

21. As we have continued to develop these regulations, members of this internal working group have met with the Heat in Buildings Regulations Unit in DECC on an ad hoc basis to ensure alignment with other policies across government.

22. When necessary, colleagues from other directorates impacted by the proposed changes in this new Standard have been co-opted (as required). Input has also been sought from analysts located in the Chief Economist Directorate.

23. Internal Scottish Government teams have provided input into both public consultations, participated in larger and individual meetings both internally and externally, and have also liaised closely with the regulation development team as potential impacts of the NBHS proposals on other areas within the Scottish Government were scrutinised. This has helped to identify areas of key delivery risks, as well as in ensuring consistency between proposals to regulate new versus existing buildings throughout Scotland.

24. Furthermore, a Strategic Environmental Assessment (SEA) screening was carried out in Spring 2022. This process, involving consultation with NatureScot, Scottish Environment Protection Agency (SEPA), and Historic Environment Scotland (HES), concluded that a full SEA was not required. The Scottish Government has continued to engage with HES around the treatment of conversions to historic and traditional buildings within the regulations.

3.2 Public Consultation

25. An initial public scoping consultation to seek stakeholder views on a number of key issues was launched in December 2020 and ran for 12 weeks. 92

responses were received, of which 83 were from businesses and the public sector – with the remaining nine from individuals. An independent analysis of the consultation responses received, undertaken by Why Research, was published October 2021.[35]

26. Following the initial scoping consultation, a full public consultation on the NBHS was opened 28 July 2022 and closed 20 October 2022.[36] Independent analysis of the results was commissioned to be undertaken by The Lines Between (TLB), the results from which have been published alongside this BRIA.[37]

27. During both consultations, a series of public, themed webinars / workshops were held. As part of the scoping consultation workshops, an 'industry' themed workshop was held, where views on the proposals from the building industry and other appropriate businesses across Scotland were sought. The relevant questions identified as part of the Competition Assessment requirements of this BRIA (Section 9) were incorporated into the questions that the attendees were asked. A brief overview of the feedback received is noted in Section 9.

28. In addition to the above public consultations, an external working group was established in May 2020 to provide advice and expertise on the development of the NBHS. This group – independently co-chaired by Professor Lynne Sullivan OBE (Architect, LSA Studio and Chair of the Good Homes Alliance) – met remotely on two occasions in 2020. Scottish Government officials continued to maintain contact with the working group throughout 2021 to keep members informed of progress, and the group met again in May and December 2022. Membership of the external working group is detailed in Table 1.

29. Alongside the above external working group, a non-domestic subgroup was established in the summer of 2020 to explore how the NBHS could apply to, and consequently impact, new non-domestic buildings. This external subgroup

[35] New Build Heat Standard - scoping consultation: analysis - gov.scot (www.gov.scot)
[36] New build heat standard consultation: part II - Scottish Government - Citizen Space
[37] New Build Heat Standard Consultation: Part II Analysis - Scottish Government

met in August 2020, March 2022, and January 2023. Its members are also detailed below in Table 1.

Table 1: Membership of external working groups

Member	Working Group Membership	
	General	Non-Domestic
Architecture and Design Scotland	Yes	Yes
BRE Scotland	Yes	No
Built Environment - Smarter Transformation	Yes	Yes
Federation of Master Builders	Yes	No
Heating and Hotwater Industry Council	Yes	No
Hjaltland Housing Association	Yes	No
Homes for Scotland	Yes	No
Independent Networks Association	Yes	Yes
NHBC Scotland	Yes	No
Scottish Federation of Housing Associations	Yes	No
Scottish Property Federation	Yes	Yes
Scottish Renewables	Yes	Yes
SGN	Yes	Yes
SP Energy Networks	Yes	Yes
SSE	Yes	Yes
UK Green Building Council	Yes	Yes
Industry and Commercial Energy Association	No	Yes
Scottish Futures Trust	No	Yes
Chartered Institute of Building Service Engineers	No	Yes
Royal Institute of Chartered Surveyors	No	Yes
Heriot-Watt University	No	Yes

30. Representatives from local authorities were also approached to participate in the main working group.

3.3 Business

31. As part of the Scottish Firms Impact Test (SFIT), a total of 12 businesses spanning multiple sectors which the policy could affect were consulted on a one-to-one manner. The results of the SFIT are discussed later in Section 8.

32. Of the 12 businesses consulted, two could be classed as micro Small-to-Medium Enterprises (SMEs), seven could be classed as regular SMEs, one a large developer, and two international enterprises.

33. While all of these businesses operated throughout Scotland, they were predominantly based across the following areas:

- Aberdeenshire
- Ayrshire
- Edinburgh
- Falkirk
- Glasgow
- Highlands
- Lanarkshire
- Renfrewshire

34. The sectors in which these businesses operated spanned residential and commercial developments, home construction, architectural consulting, energy, heating consulting, and Heating, Ventilation and Air Conditioning (HVAC) manufacturing.

4. Options

4.1 Option 0 (Do Nothing)

35. At present, no regulations prohibit DEHs from being installed in new-builds. As a result of this and the various market failures present, we may expect the counterfactual to consist of the majority of new-builds adopting mains gas as

their main heating fuel in the short-run, as observed in the data from the Scottish EPC Register (SEPCR) referenced above in Section 2.3.

36. As set out in paragraph 4, the recent changes to Scottish building standards may result in an increased deployment of ZDEH technologies in new-builds. However, considering these new standards concern only those buildings applying for a building warrant from 1 February 2023, it is difficult to predict what impact these changes may have. Regardless, these changes are to support the transition to the NBHS and will not themselves ensure that DEH system deployment in new buildings ceases.

4.2 Option 1 (Market incentives to adopt ZDEH systems)

37. One option considered in the policymaking process was the introduction of an incentive-based approach to the adoption of ZDEH. However, owing to the limitations of our devolved competence, the Scottish Government would be reliant on action taken by the UK Government or on voluntary action by suppliers.

38. For example, the Scottish Government does not have the necessary powers to intervene in the energy market to impose obligations on suppliers that would enable them to share costs, nor the powers necessary to enable them to recover costs from consumers via energy bills - as has been the case with previous incentives introduced by the UK Government, such as the Energy Company Obligation (ECO) scheme, where costs have been recovered in this way.[38]

39. As a result, this option was not pursued further.

4.3 Option 2 (NBHS)

[38] Energy Company Obligation (ECO) | Ofgem

40. The Scottish Government's **preferred option** is to introduce regulations which will prohibit DEHs in new-builds and in effect require new buildings, applying for a building warrant from 1 April 2024 onwards, to use only those heating or cooling and hot water systems which produce zero direct greenhouse gas emissions at the point of use. The analysis of responses received to the full public consultation[39] found that 62% of respondents who provided an answer to Q1[40] were supportive of this approach. Likewise, 54% of respondents who provided an answer to Q5[41] were supportive of the treatment of conversions under the NBHS.

41. It is proposed that this policy would be implemented using the Scottish Government's fully devolved building regulations by prohibiting the installation of direct emissions heating systems in new buildings.

5. Sectors and Groups Affected

5.1 Local Authorities

42. The NBHS would require amendments to published material forming the Building (Scotland) Regulations 2004 and modification of the supporting guidance given within the Technical Handbooks that support said regulations. As the principal enforcers of the building standards as set out in the Building (Scotland) Act 2003, local authorities will be responsible for scrutinising building warrant requests prior to approval, as well as for completion certificates. Alongside enforcement, local authorities would also be responsible for sanctioning and monitoring.

43. A total of 8 local authorities submitted a response to the second consultation on the NBHS. When including the initial scoping consultation, a total of 18

[39] New Build Heat Standard Consultation: Part II Analysis - Scottish Government
[40] *"Do you agree with the approach set out in 2.1 to regulate direct emissions heating (DEH) systems in new buildings?"* The referenced Section 2.1 can be found in the full public consultation paper: New build heat standard consultation: part II - Scottish Government - Citizen Space
[41] *"Do you agree with the approach to conversion as set out in section 2.3?"* Source: ibid.

responses were received from 16 unique local authorities. A full list of the 32 local authorities and whether or not they responded to at least one of the two public consultations is available in Section 19.1.

44. The initial scoping consultation responses from local authorities indicated that:

- A small number of local authorities suggested the proposed timescale was challenging;
- A need was identified to integrate the Standard within existing Building Standard arrangements; and
- There was a need to ensure consumer understanding of the technology options available and how to operate new heating systems.

45. From the second consultation, it was found from among the responding local authorities that:

- All agreed with the proposed approach to regulate DEH systems in new buildings;
- However, 90% indicated there could be unintended consequences;
- Responses as to whether bioenergy may be needed were mixed – 42% thought there would be specific situations for bioenergy systems, 25% did not, and 33% were unsure. The most common theme was for rural communities to be exempt from a prohibition on bioenergy technologies. Further details regarding the treatment of bioenergy as part of these regulations are contained within paragraphs 59 to 64 below;
- 73% of local authorities agreed with the approach to conversions, but almost all (91%) indicated there could be unintended consequences; and
- Most (70%) could anticipate some eventualities where DEH systems in non-domestic buildings could be required.

5.2 Consumers

5.2.1 Quality considerations

46. A risk of the standard which was raised during our SFIT discussions with businesses was the potential for exploitation of consumers when it comes to poor installations of ZDEH technologies. In turn, poor standards could lead to public backlash against the NBHS or the heat transition as a whole through word-of-mouth. The Scottish Government has sought to establish a quality assurance policy framework for mitigating these cases, with actions being taken laid out in our Heat in Buildings Strategy Quality Assurance Policy Statement (QAPS).[42] This risk is further mitigated in new buildings, as any heating or cooling system installed is required to be commissioned and inspected on completion, regardless of technology type.

47. Furthermore, an obligation already exists for written information to be provided to the building owner or occupier regarding the operation and maintenance of the building services and energy supply system. This also includes a Quick Start Guide, which should assist the homeowner in identifying "*all installed building services, the location of controls and identifying how systems should be used for optimum efficiency.*"[43]

5.2.2 Costs

48. With regard to capital costs, the average price for a new-build residential property in Scotland was £253,445 in Financial Year (FY) 2021/22.[44] If the cost of a typical gas boiler including labour and ancillary components were £6,723 and the cost of a typical air-source heat pump £15,148 (see Section 19.3), then the net capital cost to the typical new-build household – assuming the costs are passed on in a 1-to-1 manner – would be around £8,425 or an extra 3%. Note that the technology costs exclude Value Added Tax (VAT), and the cost differential may be more or less than £8,425 depending on the design and specification of the system, as well as prevailing market conditions.

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[42] Heat in Buildings strategy - quality assurance: policy statement - gov.scot (www.gov.scot)
[43] 6.8 Written information - Building standards technical handbook 2022: domestic - gov.scot (www.gov.scot)
[44] UK House Price Index: reports 2021 - GOV.UK (www.gov.uk)

49. Responses to both public consultations highlighted concerns with regard to the impact of this Standard on fuel poverty rates across Scotland. Fuel poverty in homes will fundamentally depend on (i) individual households' costs to heat their homes to meet a defined heating regime,[45] (ii) their incomes after housing costs, and (iii) the appropriate minimum income standard. The first of these will depend on a variety of factors such as the design and quality of the heating system, user operation, the energy efficiency of the property, and prevailing market prices for energy.[46, 47] For these reasons, as well as the fact that new-builds will be built to a high degree of fabric efficiency and – from the perspective of today – do not yet exist, we cannot quantify the impact this Standard will have on fuel poverty. The accompanying Fairer Scotland Duty Assessment (FSDA) explores fuel poverty impacts, and wider socioeconomic considerations, further.[48]

50. It is important to note that fuel poverty is based on the energy required to meet a household's heating regime and not a household's actual energy consumption. As many fuel poor households will implement coping mechanisms such as self-rationing, wearing extra layers, or simply bearing the cold,[49] their actual metered energy consumption can be lower than that which would be required to meet their heating regime.

51. Related to fuel poverty is the question of running costs. It is our view that it is not possible to say definitively whether running costs would be higher or lower than under a counterfactual wherein a gas boiler is adopted. As is explained above, the cost to an individual household to heat their home will depend on a variety of factors, one of which is the prevailing retail prices of gas and

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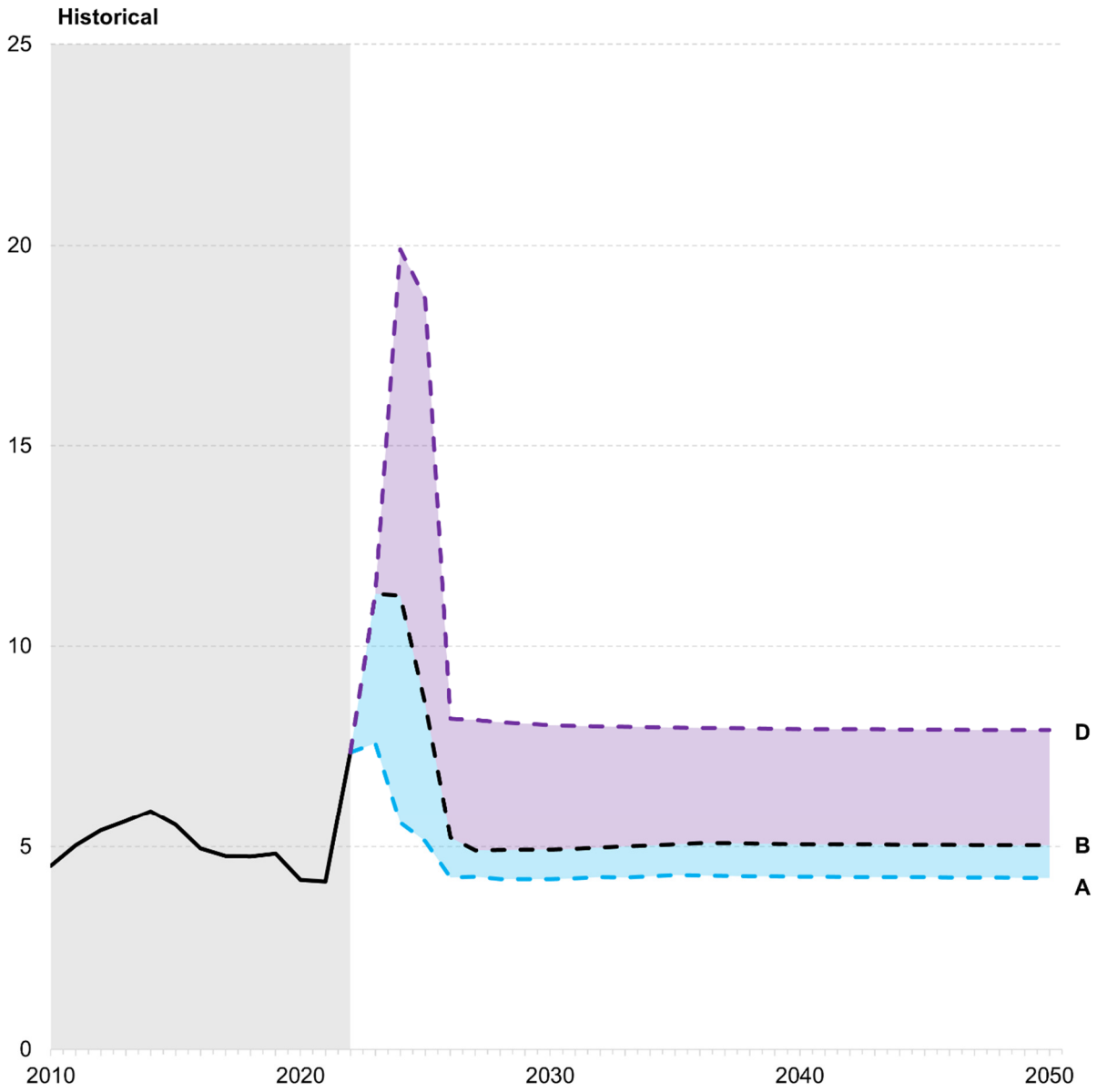
[45] Depending on the characteristics of the household, the relevant "heating regime" is defined within Section 3 of the Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019 and The Fuel Poverty (Enhanced Heating) (Scotland) Regulations 2020. A household's heating regime requires that the household be heated to a requisite temperature for a requisite number of hours.
[46] How fuel poverty is measured in the UK - Office for National Statistics (ons.gov.uk)
[47] Tackling fuel poverty in Scotland: a strategic approach - gov.scot (www.gov.scot)
[48] New Build Heat Standard: Fairer Scotland Duty Assessment (FSDA) - Scottish Government
[49] Lived experience of fuel poverty: research - gov.scot (www.gov.scot)

electricity.[50] Figure 3 and Figure 4 below highlight the degree of uncertainty surrounding both of these prices in the residential market.

Figure 3: Domestic retail gas prices (real 2021 p/kWh)

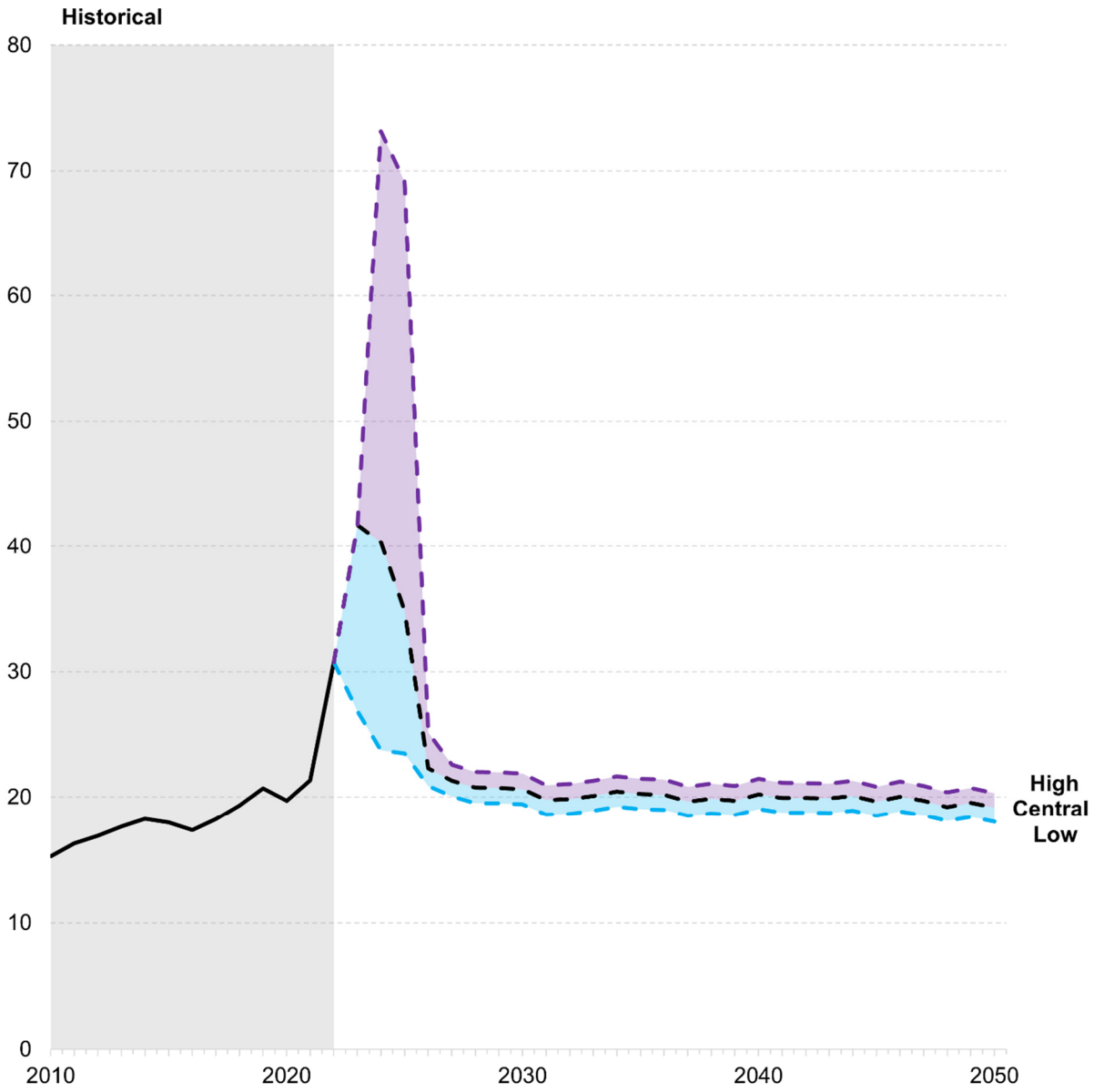


Notes: Based on Department for Energy Security and Net Zero (DESNZ) (April 2023), Data Table 5.[51] Excludes scenario C.

[50] Unlocking the Benefits of Heat Pumps: The Role of Electricity and Gas Prices | UKERC | The UK Energy Research Centre

[51] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

Figure 4: Domestic retail electricity prices (real 2021 p/kWh)



Notes: Based on DESNZ (April 2023), Data Table 4.[52]

52. Taking a simple approach to looking at this problem, whether one would see their energy bill rise when moving from a gas boiler to a heat pump depends on (i) the relative efficiencies from the two systems, and (ii) the relative difference in retail price for electricity versus that of gas. Secondary factors include an

[52] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

assumption that those on a heat pump could avoid reliance on gas, and hence a gas standing charge.

53. Taking into consideration both (i) and (ii) above, Figure 5 below plots the ratio of the effective electricity retail unit price to the effective gas retail unit price in the residential sector over time, using values under different scenarios provided by the Department for Business, Energy and Industrial Strategy (BEIS) as part of the Green Book.[53] It should be noted that the effective electricity unit price is assumed to be obtained using a heat pump operating with a coefficient of performance of 3. In interpreting the graph, a ratio strictly above 1 (i.e. parity) would suggest that the effective unit price of electricity exceeds that of gas, and one would experience a rise in their energy bill when moving from a gas boiler to an electric heat pump, all other factors held constant.[54] Likewise, a ratio strictly below 1 would imply savings on their energy bill. As is clearly illustrated, the range of ratios sits on both sides of parity from 2026 onward, so we cannot definitively say whether running costs will rise or fall in the medium- to long-run.

54. At the moment (April to June 2023), under the Energy Price Guarantee, the effective ratio sits at around 0.95 to 0.96,[55] implying that a heat pump operating with a coefficient of 3 would be marginally cost-advantageous relative to a gas boiler with regard to fuel costs. However, the unit rates available under the Energy Price Guarantee are due to change 1 July 2023, as per the latest Spring Budget.[56] Furthermore, professional forecasters are anticipating the Default Tariff Cap for Q3 and Q4 of 2023 coming in *under* the Energy Price Guarantee,[57] suggesting the unit rates under that Cap – set by Ofgem – would

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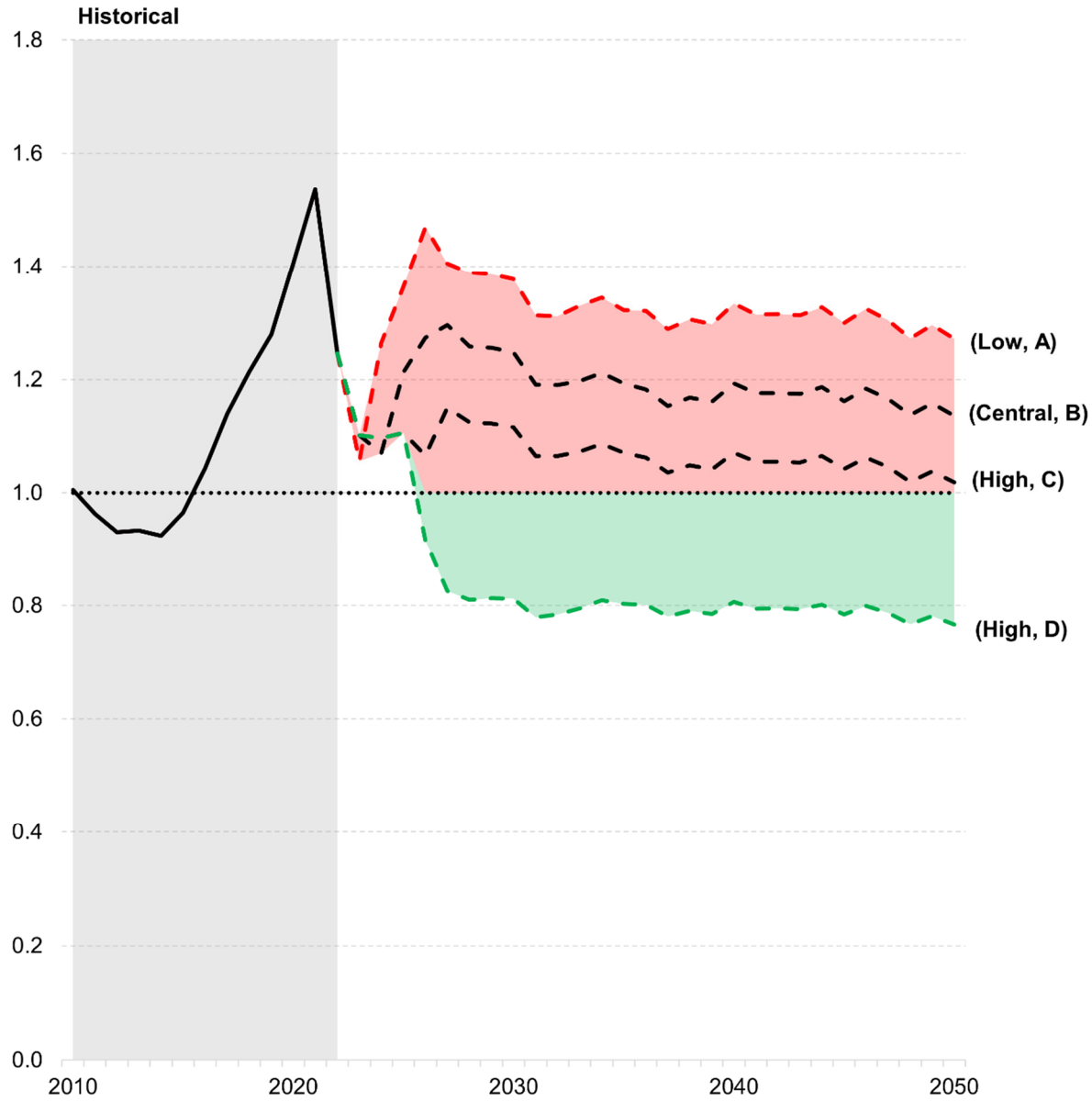
[53] Ibid.
[54] Note that we have set to one side the issue of gas standing charges. Were the ratio to sit slightly above 1, we may expect savings on energy bills if the gas standing charge could be avoided by the household using the electric heat pump.
[55] Using unit prices of electricity and gas in Southern Scotland of, respectively, 31.34 and 9.78 p/kWh in current (nominal) prices, as well as respective prices in Northern Scotland of 31.01 and 9.78 p/kWh. Assume a gas boiler efficiency of 89.5%. Source: Energy Price Guarantee - GOV.UK (www.gov.uk)
[56] Spring Budget 2023 - GOV.UK (www.gov.uk)
[57] Cornwall Insight release price cap predictions for July and October 2023 - Cornwall Insight (cornwall-insight.com)

become dominant in determining the ratio. As such, the ratio may change come summer.

Figure 5: Ratio of “effective” domestic retail prices for electricity and gas



Notes: Based on DESNZ (April 2023), Data Tables 4 and 5.[58] Comparisons take form (W, Z), where W is electricity price (Low, Central, High) and Z is gas price (A, B, C, D). Assumed gas boiler efficiency of 89.5 and heat pump coefficient of 3.0.

[58] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

55. Though not the same thing as retail energy prices, the social appraisal carried out as part of this impact assessment does quantify the Standard's effect on energy savings using Long-Run Variable Costs (LRVCs).[59] As will be shown in Section 17, whether the Standard has a net beneficial effect for energy costs (reducing them) depends on future gas prices.

56. It is important to point out that the comparison of electricity and gas prices above takes into account UK Government policies as of January 2023. Since then, the UK Government has committed to rebalancing electricity and gas prices by the end of 2023-24 as part of their Powering Up Britain plans, published March 2023.[60] This could result in the narrowing of the large disparity in the unit costs of electricity and gas, which may improve the competitiveness of highly efficient electric heating technologies such as heat pumps when it comes to running costs, and thus their attractiveness.[61, 62]

5.2.3 Compliance with future Heat in Buildings Standard

57. Previous research undertaken by Currie & Brown and AECOM on behalf of the CCC explored the potential costs of fitting ZDEH systems in new-build properties, both domestic and non-domestic, at point of construction versus later via retrofit.[63]

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[59] Information on the difference between retail energy prices and LRVCs is provided in supplementary guidance accompanying the Green Book. In brief, LRVCs strip the fixed costs, carbon costs, and taxes embedded in retail prices out, and should be used in social appraisal. Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

[60] *"We know that, in the long run, green products are more efficient and cheaper. However, current distortions in electricity and gas prices do not always make this the case. We want to make it easier for consumers to make the switch to green products by rebalancing prices between electricity and gas to remove these distortions. We accept the Skidmore Review recommendation that Government should commit to outlining a clear approach to gas vs. electricity 'rebalancing' by the end of 2023/4 and should make significant progress affecting relative prices by the end of 2024. Rebalancing will generate the clear short-term price signal necessary to shift both households and businesses to lower-carbon, more energy efficient technologies like heat pumps."* Powering up Britain - GOV.UK (www.gov.uk)

[61] The electricity-to-gas price ratio explained | Nesta

[62] Review of gas and electricity levies and their impact on low-carbon heating uptake (climatexchange.org.uk)

[63] The costs and benefits of tighter standards for new buildings (Currie & Brown and AECOM) - Climate Change Committee (theccc.org.uk)

58. The above research concluded that retrofitting new homes with ZDEH technologies and higher fabric standards could cost three to five times more than at the outset. For non-domestic buildings, *"the costs of achieving higher standards via retrofit is between approximately 3 and 10 times the costs of delivering them in the new building"* (page 78). A caveat to the findings is that they compare the nominal undiscounted costs in 2020 and 2030 to one another.

5.2.4 Treatment of bioenergy

59. The Part II consultation sought views on the following two questions:

- (Question 3) Are there any limited, specific situations where the use of bioenergy systems would be required in new buildings?
- (Question 4) If 'Yes', what do you believe the criteria should be for introducing such an exemption? Please provide evidence to support your answer.

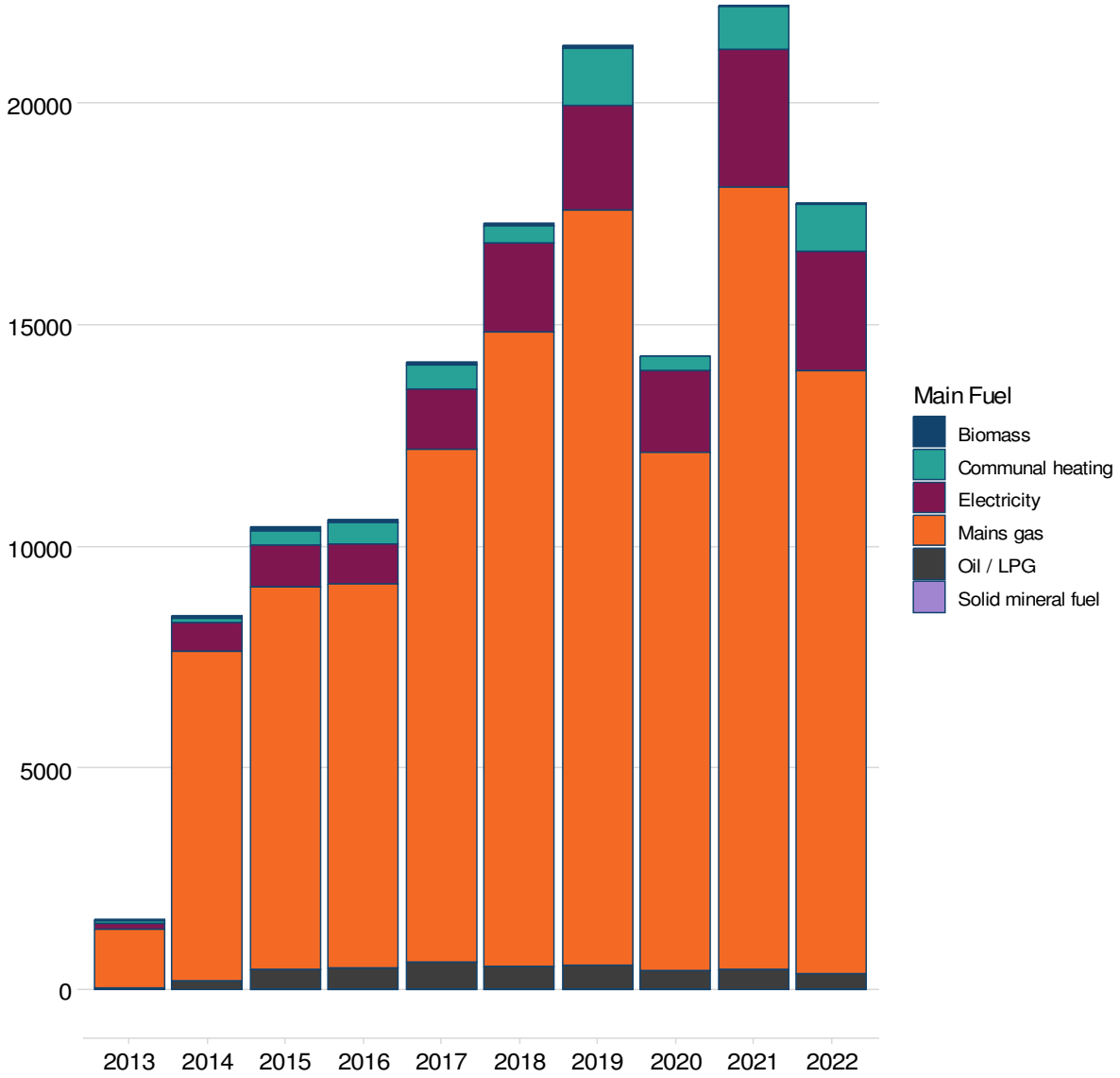
60. Similar to the pattern identified amongst local authorities (as detailed in paragraph 45 above) independent analysis of consultation responses found that views on bioenergy were split: 23% believed there would be no specific situations where bioenergy systems would be required in new buildings, 35% believed there would be, while 42% of respondents to this question were unsure.

61. Of those who answered 'Yes' to Question 3 above, the most common theme was an 'ask' for exemptions for rural and off-grid areas. This was, predominantly, due to a perceived lack of robustness of the energy networks in these areas, and to provide an emergency back-up where supplies were at risk from events such as Storm Arwen. The analysis found that this was raised by a diverse range of stakeholder groups encompassing individuals, local authorities, property developers, and others. Concerns were also raised

regarding the prohibition of sustainable bioenergy, in particular, by respondents.

62. As Figure 6 below shows, the number of new-build homes using biomass as their main heating fuel is small, with the total number constructed over the past 12 years – for which we have valid EPCs – being approximately 510. This compares with a total of approximately 16,040 new-build homes constructed with electricity as their main fuel type, and a further approximately 5,540 with communal heating arrangements, constructed over the same timeframe. For further context, over 112,000 were constructed with mains gas as their main fuel type over the same timeframe. Figure 7 shows similar information but for the non-domestic stock.

Figure 6: New-build homes and their main heating fuels (absolute) (per annum)



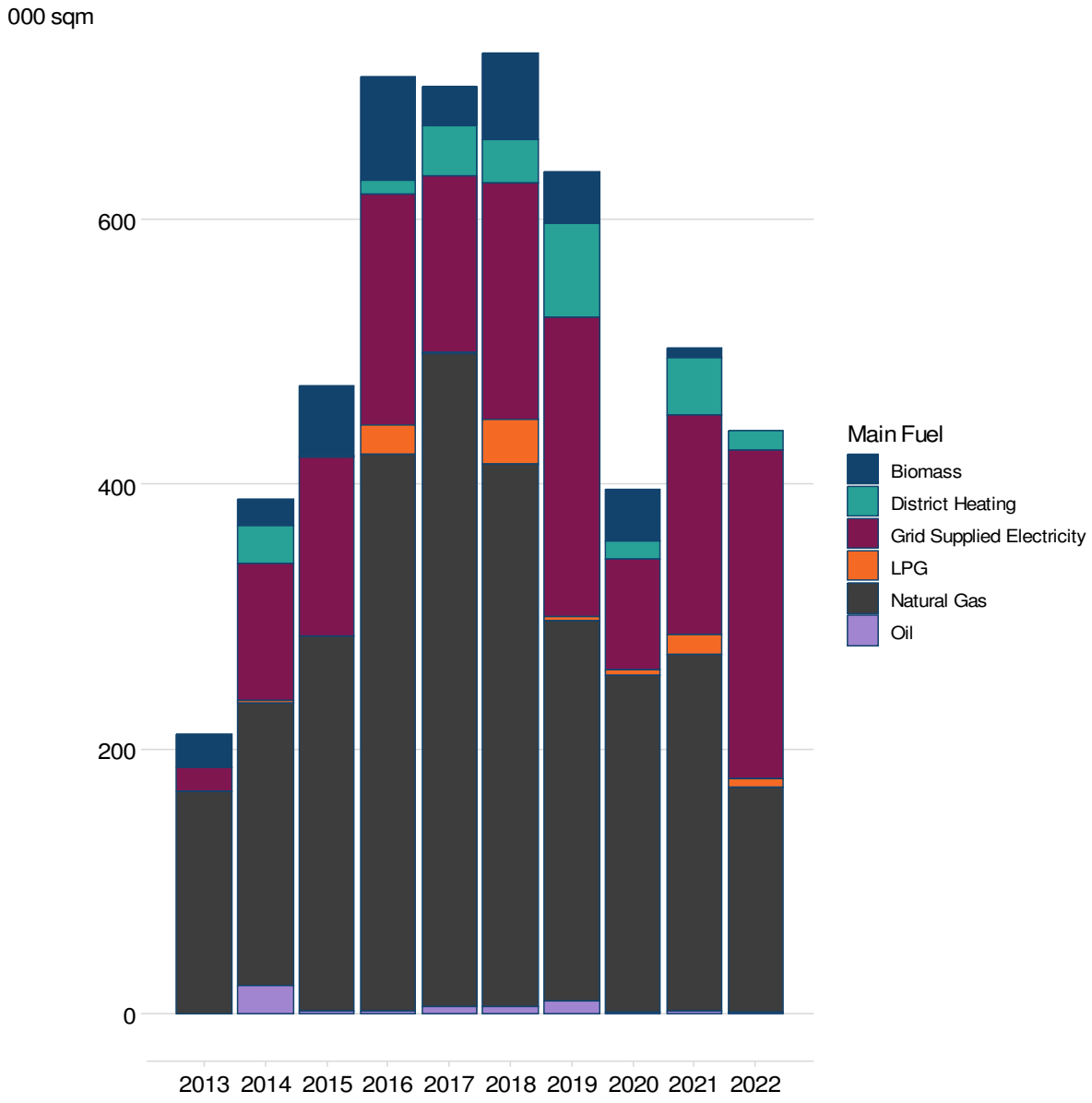
Notes: Data on each current record held on the Scottish EPC Register from Q1 2013 to Q3 2022.[64] Number of EPCs does not match National Statistics for new housing published by the Scottish Government.[65]

63. If we broaden the scope to count all domestic properties that have adopted wood as either their (i) main heating system, (ii) secondary heating system, or (iii) hot water system, then the number rises to a total of approximately 6,100

[64] statistics.gov.scot : Domestic Energy Performance Certificates - Dataset to Q4 2022
[65] Housing statistics - gov.scot (www.gov.scot)

properties over the past 12 years, or just over 4% of all domestic new-build EPCs lodged with the SEPCR.

Figure 7: New-build non-domestic floor area and its main heating fuels (per annum)



Notes: New-build non-domestic EPCs identified based on purpose listed for assessment being carried out, namely 'Mandatory issue (Property on construction)'. Floor area used rather than individual EPCs on the basis of the non-domestic stock's high degree of heterogeneity.

64. Having considered the consultation feedback, it is proposed that the NBHS regulations will not extend to the provision of any "emergency heating" source.

In the context of the regulations, this relates to any fixed combustion appliance installation which is installed to be used only in the event of the failure of the heating or hot water service system, which is designed and installed for use during normal operation of the building. It is envisaged that the accompanying technical guidance will detail the limitations around this provision. Further, heat networks and communal heating are considered 'zero-rated' within the content of the Standard and, therefore, not subject to the DEH system definition.

5.3 Businesses

5.3.1 Mortgage market

65. The mortgage market is seeing strong overarching drivers to accelerate the growth of expanded green financial products available to homeowners and these include: the UK Taxonomy to promote green sustainable investing,[66] the UK Government's consultation on improving home energy efficiency through lenders,[67] as well as the European Energy Efficiency Mortgage Initiative (EEMI) [68] which seeks to support the transition to green mortgages through a greener, more sustainability-focused means of buying, renovating, and living in homes.

66. Further, environmental, social, and governance (ESG) investing has created a set of standards for a company's behaviour used by socially conscious investors to screen potential investments. Environmental criteria consider how a company safeguards the environment, including corporate policies addressing climate change. As part of the Edinburgh Reforms in December 2022, the UK Government committed to ensuring improved transparency and good conduct in the ESG ratings market, and HM Treasury is currently consulting on a potential regulatory regime for their providers.[69]

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[66] Task Force on Climate-Related Financial Disclosures | TCFD) (fsb-tcfd.org)
[67] Improving home energy performance through lenders - GOV.UK (www.gov.uk)
[68] EEMI – Funding the hope for a better … (energyefficientmortgages.eu)
[69] Future regulatory regime for Environmental, Social, and Governance (ESG) ratings providers - GOV.UK (www.gov.uk)

67. The regulations will create ‘green’ domestic properties, which are likely to be well supported by the mortgage industry as it will contribute to their own drive to become more environmentally sustainable businesses.

5.3.2 Property market

68. As the sale price of a new building is determined by individual developers and takes into account a range of variables related to building construction costs and local housing markets, it is difficult to quantify the impact that the introduction of these regulations may have on the Scottish property market.

69. The new-build residential property market was valued at £3.3 billion in FY 2021/22 compared to £22.2 billion for the residential market as a whole.[70] Furthermore, new-build residential sales accounted for almost 11% of the 110,248 residential property sales observed in 2021/22. Official statistics for new-build non-residential sales are not available, but the non-residential market as a whole was valued at £4.3 billion in FY 2021/22.[71] Of this, 77% (£3.3 bn) comprised commercial sales. Given the small size of the new-build market in both value and sales terms, we may expect limited direct impact on the property market as a result of these regulations, though cannot rule out indirect spill-over effects.

70. In interviews conducted by Scottish Government officials during the second consultation period as part of the Scottish Firms Impact Test, a range of different business types – including housing developers of various sizes – were asked for their views regarding potential market responses to the introduction of the NBHS regulations. Participants were asked the following two questions:

[70] Property market report 2021-22 - Registers of Scotland (ros.gov.uk)
[71] Covers commercial sales and leases, as well as sales of titles classed as forestry, agriculture, or land.

- (Question 13) Do you envisage any increase in costs relating to the use of ZDEH systems would be passed onto buyers, or would your organisation expect to absorb these costs?
- (Question 14) Do you envisage the introduction of the NBHS having any impact on the supply of housing across Scotland?

71. The majority of respondents (8) to Question 13 believed that costs would be passed onto consumers, while a minority of respondents were of the view that costs may be absorbed by developers. While responses to Question 14 varied, no participants definitively said 'Yes', while 4 said 'No'. The remaining 8 were uncertain.

5.3.3 Heating, Ventilation and Cooling (HVAC) market

72. There are currently almost 4,700 businesses listed on the Gas Safe Register in Scotland, with just over 8,700 registered engineers qualified to work on boilers.[72] It is also estimated that there are 500 heat pump installers currently in Scotland,[73] potentially with some degree of overlap with the Gas Safe registered engineers. It would be expected that those existing DEH installers unfamiliar with ZDEH technologies would require retraining. Support for this is laid out in our Supply Chains Delivery Plan (SCDP).[74] It is important, however, to highlight that existing plumbing and heating engineers have many of the core skills required to design, install, and maintain ZDEH systems such as heat pumps. For these skilled workers, upskilling can be supported through short courses (typically around 3-5 days) at a financial cost of £400 to £1,000.[75] Including the opportunity cost in the form of foregone revenue, the total economic cost of upskilling for one trader may be in the region of £1,200 to £2,500.[76]

[72] Communications with Gas Safe Register [e-mail]. Received 24 October 2022.
[73] Clean heat and energy efficiency workforce assessment (climatexchange.org.uk)
[74] Towards an Industry for Green Heat: heat in buildings supply chains delivery plan - gov.scot (www.gov.scot)
[75] How to scale a highly skilled heat pump industry | Nesta
[76] Ibid.

73. In terms of the Standard Industrial Classification (SIC) of Economic Activities,[77] the subsectors likely to be most affected in manufacturing include 25.21, 28.21, and 28.25. In the construction sector, the subsectors most likely to be significantly affected include 43.21 and 43.22. Please see the notes accompanying Table 2 below to see what sectors these encompass.

74. Using data from the Business Register and Employment Survey (BRES) for Scotland, employment in the above sectors amounted to 52,540 in 2021, with the vast majority of this being concentrated in installation activities (97%) rather than manufacturing.[78] The median gross annual pay of jobs in these sectors ranges from a low of around £27,400 in sectors falling under SIC 25 to a high of around £37,400 in sectors falling under SIC 28.[79]

Table 2: Employment in sectors deemed to be significantly affected (Scotland)[80]

SIC	Year						
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
25.21	160	110	140	160	150	170	220
28.21	80	40	70	50	60	170	150
28.25	1,640	1,480	1,715	1,415	1,395	1,595	1,295
43.21	19,950	16,770	18,000	14,620	16,200	17,435	26,925
43.22	15,435	16,760	17,790	16,895	18,625	14,725	23,950
Total	**37,265**	**35,160**	**37,715**	**33,140**	**36,430**	**34,095**	**52,540**

Notes: 25.21 corresponds to the sector “Manufacture of central heating radiators and boilers”; 28.21 corresponds to the sector “Manufacture of ovens, furnaces and furnace burners”; 28.25 corresponds to the sector “Manufacture of non-domestic cooling and ventilation equipment”; 43.21 corresponds to the sector “Electrical

[77] UK SIC 2007 - Office for National Statistics (ons.gov.uk)
[78] Business Register and Employment Survey : open access - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk). Accessed 10/01/2023.
[79] Earnings and hours worked, UK region by industry by two-digit SIC: ASHE Table 5 - Office for National Statistics (ons.gov.uk) [Table 5.7a]
[80] Business Register and Employment Survey : open access - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk). Accessed 10/01/2023.

installation"; 42.22 corresponds to the sector "Plumbing, heat and air-conditioning installation"

75. Employment in these four sectors as a share of total employment is highest in West Lothian at 7% in 2021, with this being followed by North Lanarkshire at 6%, Midlothian at 3%, and Moray also at 3%. These are the only four local authorities for which the share is higher than the average share across all 32 local authorities (2%).

76. In terms of the Standard Occupational Classification (SOC), the latest Annual Survey of Hours and Earnings (ASHE) suggests the median gross annual pay of Scottish electricians and electrical fitters (SOC 5241) was between £30,900 and £37,800 in 2022, with the median gross annual pay of plumbers and HVAC installers (SOC 5315) sitting between £33,100 and £41,300.[81] These compare with a Scottish median gross annual pay across all SOCs and full- and part-time workers of just over £27,700.[82]

5.4 Third sector

77. It is envisaged that the impact on the third sector should not be any different from those other sectors identified above. There were no specific impacts identified within analysis of the consultation responses received. Three respondents made references to charities or third sector organisations in response to the scoping consultation. However, the points made were similar to those made for non-third sector organisations (e.g., the need to increase consumer awareness).

6. Costs and Benefits

[81] Earnings and hours worked, region by occupation by four-digit SOC: ASHE Table 15 - Office for National Statistics (ons.gov.uk) [Table 15 (4).7]
[82] Earnings and hours worked, region by occupation by two-digit SOC: ASHE Table 3 - Office for National Statistics (ons.gov.uk) [Table 3.7a]

78. The approach taken in estimating the direct costs and benefits of Option 2 (NBHS), including assumptions, is laid out in Section 19.3. The assessment of costs and benefits operates at the level of a social appraisal, where the appraisal is based on guidance laid out as part of HM Treasury's Green Book.[83] Social value includes all significant costs and benefits that affect the welfare and wellbeing of the population, not just market effects.

79. In Section 17, we present the Net Present Social Value (NPSV), a summary measure of whether or not the Standard has a net beneficial impact. The NPSV is the present value of benefits minus the present value of costs, so can be viewed as a summary measure of the overall impact of the policy on social welfare. If it is positive, then this implies the policy has a net beneficial impact (the benefits outweigh the costs); if it is negative, then this implies the policy has a net negative impact (the costs outweigh the benefits).

80. Where non-monetised costs or benefits are significant, the NPSV alone will not capture the full impact of the policy. Similarly, the NPSV may fail to adequately reflect the full range of potential costs and benefits to society if there are significant risks attached to the policy that have proved challenging to quantify. It may be unrealistic to produce a single numerical NPSV that adequately captures the full impact of the policy.

81. Furthermore, a cost-benefit approach to appraisal is limited in its assessment of non-marginal change. Given this, non-monetised costs and benefits of the policy are discussed in a qualitative manner below, and as such the quantitative estimates of costs and benefits should not be viewed in isolation from these wider impacts and strategic considerations. For the numerical NPSV, a sensitivity analysis is also included in Section 19.4.

82. In line with Green Book guidance on the appraisal of buildings and infrastructure, the timeframe for the assessment spans 2024 to 2083 (60

[83] The Green Book and accompanying guidance and documents - GOV.UK (www.gov.uk)

years). The framing of the assessment assumes that, in the absence of the NBHS not being adopted, some[84] of the new-builds constructed between 2024 and 2045 would need to be retrofitted with ZDEH technologies in 2045 to coincide with Scotland's net zero ambitions and the Heat in Buildings Strategy's position on an all-tenure zero emissions heat standard backstop.[85] This all-tenure zero emissions heat standard backstop would also effectively act as the NBHS being adopted in 2045 in the counterfactual (i.e. no new-builds would be allowed to install DEH technologies following 2045).

83. It is important to note that the counterfactual (Do Nothing) scenario also assumes the stock of new-builds constructed between 2024 and 2045 are *not* affected by any technology retrofit programmes or regulations that are introduced after the intended start date of 1 April 2024 for the NBHS but before the all-tenure zero emissions heat standard backstop in 2045. BEIS guidance as part of the Green Book[86] stipulates that an impact assessment should consider overlaps with other policies, wherein all policies to which the government is committed and which have funding are absorbed into the counterfactual Do Nothing scenario. At the time of writing, the NBHS is planned to be one of first major regulations as part of the Scottish Government's Heat in Buildings Strategy. As such, the framing of the assessment ignores the impact of future Heat in Buildings regulations, the form of which are yet to be confirmed.

6.1 Monetised Costs and Benefits

84. **Additional capital costs (inc. premature scrappage).** The appraisal of the policy draws upon capital cost estimates informed by research conducted for

[84] We say "some" as it is only those new-builds warranted between 2024 and 2045 that were built with a gas boiler *and* which have not swapped out their gas boilers for a ZDEH system by the time 2045 materialises that would be affected by the all-tenure zero emissions heat standard.
[85] *"This would be subject to technological developments and decisions by the UK Government in reserved areas, […] with all buildings needing to meet this standard no later than 2045."* (page 95)
[86] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

BEIS, [87, 88] the Department of Energy and Climate Change,[89] and the CCC.[90, 91] The capital costs differ depending on whether the heating system is a virgin install in a new building, whether it is a retrofit, or whether it is replaced like-for-like.[92] Avoided gas connection costs under the Standard are accounted for using standard connection charges published by SGN.[93] As explained above in paragraph 82, the counterfactual (Do Nothing) scenario against which costs and benefits of the NBHS are compared sees an all-tenure zero emissions heat standard being adopted in 2045. The costs of premature scrapping of DEH technologies in this year is therefore accounted for under the counterfactual. It should be noted that the cost of DEH technologies (in real 2021 prices) is assumed to be static over the time horizon of the appraisal, with the 2045 backstop assumed *not* to affect the capital cost of a heating unit.

85. **Net energy savings**. As per BEIS guidance as part of the Green Book,[94] changes in fuel consumption are monetised using Long-Run Variable Costs (LRVCs) of energy. These have recently been revised by BEIS in light of energy market volatility observed since late 2021, and guidance recommends that central appraisal estimates use the "B" and "C" scenarios for the LRVC of gas. As such, this leads to us producing two central NPSVs. Further LRVC scenarios for gas and electricity are explored further as part of the sensitivity analysis (Section 19.4). Scenarios A to C's long-run trend for gas is based upon supply curve assumptions described in the Fossil Fuel Price Assumptions report produced by BEIS.[95] This is the best long-run information we have for

[87] Cost of installing heating measures in domestic properties - GOV.UK (www.gov.uk)
[88] Evidence update of low carbon heating and cooling in non-domestic buildings - GOV.UK (www.gov.uk)
[89] The scope for cost reductions in a mass market for low carbon heating technologies - GOV.UK (www.gov.uk)
[90] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk)
[91] Analysis of alternative UK heat decarbonisation pathways (Imperial) - Climate Change Committee (theccc.org.uk)
[92] Due to a paucity of information on costs in the non-domestic sector, such nuances in capex and repex are not adopted when evaluating the impact on non-domestic buildings.
[93] Connections documents and charges | SGN Your gas. Our network.
[94] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)
[95] Fossil fuel price assumptions: 2019 - GOV.UK (www.gov.uk)

appraisal purposes, with BEIS currently working to update them for future updates.

86. **Carbon savings**. Likewise, changes in fuel consumption are monetised using carbon values provided by BEIS as part of Green Book guidance. Carbon values are used across government for valuing impacts on GHG emissions resulting from policy interventions. They represent a monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e). Carbon values are used in the framework of broader cost-benefit analysis to assess whether, taking into account all relevant costs and benefits (including impacts on climate change and the environment), a particular policy may be expected to improve or reduce the overall welfare of society.[96] Feedback from the Fraser of Allander Institute on the issues associated with using these carbon values in the Scottish context is acknowledged, but is ultimately beyond the scope of this impact assessment.[97]

87. **Air quality benefits**. Changes in fuel consumption are monetised using air quality values provided by BEIS also. These are discounted by the relevant health social discount rate[98] so as to reflect increases in willingness to pay for avoided health outcomes over time. The updated activity costs take into account an improved understanding of health impacts, based on the latest advice from UK Health Security Agency (UKHSA) and the Committee on the Medical Effects of Air Pollution (COMEAP). Fuel combustion is associated with emissions of primary particulate matter (PM) and nitrogen oxides (NOx), among other air pollutants, with these negatively impacting respiration and cardiovascular function.[99]

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[96] Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK (www.gov.uk)
[97] Improving emissions assessment of Scottish Government spending decisions and the Scottish Budget (climatexchange.org.uk)
[98] *"Discounting is based on the concept of time preference, which is that generally people prefer value now rather than later. … In government appraisal costs and benefits are discounted using the social time preference rate"* Source: The Green Book and accompanying guidance and documents - GOV.UK (www.gov.uk)
[99] Chief Medical Officer's annual report 2022: air pollution - GOV.UK (www.gov.uk)

88. **Maintenance costs**. It is assumed that all heating systems under consideration in domestic new-builds face an annual maintenance cost of £100. Therefore, relative to the Do Nothing scenario, these costs are simply netted off. For non-domestic new-builds, estimates of opex (excluding fuel costs) per kW of installed capacity for specific technologies[100] are rolled into the capex estimates.

89. **Familiarisation costs**. We account for the direct costs associated with professionals familiarising themselves with the new Standard using median hourly (gross) pay from the Annual Survey of Hours and Earnings (ASHE),[101] number of professionals working in construction industry from the Annual Population Survey (APS),[102] and an assumption of one hour for familiarisation. Given the relative simplicity of these regulations, we believe this to be a reasonable assumption. In line with treatment of costs and benefits, familiarisation costs are deflated to 2021 prices.

90. **Residual values.** In line with Green Book guidance, assets' residual values at the end of the appraisal period are also included. In our case, the assets are the heating systems. Therefore, the value of heating systems that have not reached the end of their lifetimes before the end of the appraisal period is prorated by their lifetime assuming a linear amortisation. This value is then rebated in the analysis. For example, if a heating system is only 60% through its lifetime in 2083, then 40% of its upfront capital cost is rebated.

6.2 Non-monetised Costs and Benefits

91. **Supply chain development**. By providing certainty to industry that new-builds will require ZDEH technologies, the standard will support investment in supply

[100] Evidence update of low carbon heating and cooling in non-domestic buildings - GOV.UK (www.gov.uk)
[101] Earnings and hours worked, region by occupation by two-digit SOC: ASHE Table 3 - Office for National Statistics (ons.gov.uk) [Table 3.5a; Scotland, Business, media, and public service professionals; median hourly pay of £21.48]
[102] annual population survey - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk). Accessed 09/02/2023

chains for these systems. Were this to drive cost reductions, this could confer benefits in the future when the existing stock of buildings is retrofitted with these technologies, lowering the overall cost of the heat transition. If monetised, we would expect these impacts to make the NPSV *more positive*.

92. **Disruption associated with the 2045 backstop.** The assessment takes a simple approach to estimating the costs of retrofit under the counterfactual Do Nothing scenario, wherein the cost of retrofit is assumed to be static (fixed). In reality, were there to be a large spike in demand in response to the 2045 all-tenure zero emissions heat standard backstop without sufficient supply chain preparation and expansion for this, we may expect the cost per retrofit unit to balloon. This would be as a result of demand outstripping supply. Furthermore, this spike in demand should be considered alongside the need to retrofit the already-existing stock of buildings, of which there may be more than[103] 2,183,000 homes[104] and more than 94,000 non-domestic properties.[105] Therefore, if the NBHS were not adopted, there might not only be a spike in demand for ZDEH retrofits in the run-up to 2045 driven by the stock of buildings that exist today, but also added pressure from a spike in demand for ZDEH retrofits from the stock of new-builds constructed in the future. If this disruption were monetised, we would expect the impact to make the NPSV *more positive*.

93. **Anticipation effects.** It is possible that developers may attempt to overcome the 1 April 2024 start date of the Standard by applying for building warrants prior to the Standard coming into force. This may lead to a spike in warrant applications and disruption in the warranting process. If monetised, this effect may make the NPSV *less positive.*

94. **Innovation and general equilibrium effects**. Second-order effects on the general economy may include innovation spill-overs and multipliers associated

[103] "more than" used to account for new builds constructed between the time of the Scottish House Condition Survey (2019) and 1 April 2024.
[104] Scottish house condition survey: 2019 key findings - gov.scot (www.gov.scot) [Table 5]
[105] Energy Saving Trust (2022). *Non-Domestic Analytics v1.1* [dataset]. Unpublished.

with investment in ZDEH supply chains. If monetised, we would expect these impacts to make the NPSV *more positive*.

95. **Grid reinforcement**. The cost of electricity network reinforcement and flexibility solutions are not included in the impact assessment. However, the Scottish Government recently commissioned WSP to undertake research into such costs for electricity distribution networks across Scotland operated by Scottish & Southern Electricity Networks (SSEN) and Scottish Power Energy Networks (SPEN).[106] This report focused on the electrification of *domestic* heat and transport. The cost estimates presented below should be viewed bearing in mind that electrification of non-domestic heat and transport was *not* included within the scope of the research, and the research assesses the impact of electrification of both existing and new-build homes constructed over the time period. As such, it is not possible to attribute a cost of grid reinforcement specifically to the NBHS, nor even to electrification of heat alone.

96. Across the three net zero-aligned Distribution Future Energy Scenarios (DFES) considered in the aforementioned report, the discounted investment cost over the period 2020 to 2050 ranged from almost £1.6 bn to almost £2.5 bn, with the upper-end estimate being associated with the scenario most aligned with Scottish Government ambitions for the electrification of domestic heat and transport. This range is reduced to £1.1 bn to £1.6 bn when flexibility solutions are implemented.[107]

97. The business-as-usual scenario[108] in which net zero is *not* achieved sees discounted investment costs over the period amounting to almost £1.5 bn in the case of no flexibility solutions, and £1.0 bn in the case where flexibility solutions are implemented. The *net* cost, therefore, of electricity distribution network reinforcement needed to achieve the Scottish Government's ambitions for

[106] Forthcoming via ClimateXChange
[107] Examples of flexibility services include demand-side response, energy storage systems, time-of-use tariffs, hybrid heat pumps, and smart electric vehicle charging schemes.
[108] Referred to as Steady Progression (SP) in the report.

domestic heat and transport could conceivably be viewed as being in the range of £0.6 bn to £1.0 bn with and without flexibility solutions, respectively.

98. If it were possible to attribute costs of grid reinforcement specifically to the NBHS, then this would make the NPSV *less positive*.

7. Regulatory and EU Alignment Impacts

7.1 Intra-UK Trade

99. Part 1 of the United Kingdom Internal Market Act 2020 sets out market access principles of mutual recognition and non-discrimination for the treatment of goods traded across the UK. Since Option 2 (NBHS) does not relate to the sale of DEH technologies, these market access principles are not relevant.

100. Part 2 of the United Kingdom Internal Market Act 2020 sets out market access principles of mutual recognition of authorisation requirements and discrimination in the regulation of services. This is not relevant for Option 2 (NBHS).

101. Other Parts of the United Kingdom Internal Market Act 2020 are not relevant for Option 2 (NBHS).

102. The policy area is not covered by any existing Common Frameworks.

7.2 International Trade

7.2.1 Does this measure have the potential to affect imports or exports of a specific good or service, or groups of goods or services?

103. Yes, the policy could conceivably indirectly impact imports of ZDEH technologies, primarily from continental Europe, by increasing them. On the other hand, exports of DEH technologies may rise as domestic manufacturers

attempt to substitute reduced domestic demand with demand from foreign markets.[109] In the medium- to long-run, the policy could positively impact export potential for ZDEH technologies through indirectly developing local manufacturing and supply chains.

104. The impact of the NBHS proposals was assessed with regard to the World Trade Organisation (WTO) Technical Barriers to Trade (TBT) Agreement, which sets out that a measure must be notified if:

- it is a technical regulation (lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory);
- it has an impact on international trade (positive or negative); and
- is not based on international standards.

105. As the NBHS proposals are not a technical regulation (as they will not make any changes to product characteristics, processes, or production methods), there is no requirement to submit a TBT notification to the WTO.

7.2.2 Does this measure have the potential to affect trade flows with one or more countries?

106. No, not significantly.

7.2.3 Does this measure include different requirements for domestic and foreign businesses?

107. No. Both imported and locally produced goods and services are treated equally, and no particular countries are directly disadvantaged when compared to others.

[109] As is noted above in **Error! Reference source not found.**2, employment in HVAC manufacturing sectors in Scotland is relatively limited.

7.2.4 If the answer to the above question is yes, is the basis for different treatment anything other than it enables foreign businesses to operate on a level playing field in Scotland?

108. Not Applicable (NA).

7.3 EU Alignment

109. The policy aims to deliver progress towards delivering Scotland's 2045 net zero target laid out in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. Progress towards this outcome aligns with European Union (EU) law under the European Climate Law,[110] so the policy can be viewed as maintaining and advancing the high standards that Scotland shares with the EU.

110. Furthermore, the existing Energy Performance of Buildings Directive (EPBD) has already been transposed and currently requires that all new buildings be *"nearly zero-energy buildings."*[111] The draft recast of the EPBD is targeting a zero emissions building stock by 2050.[112] The European Commission is seeking to introduce requirements that, as of 2030, all new buildings must be zero-emission buildings, with new public buildings having to be zero-emissions starting from 2027. Annex III of the draft recast lays out that a *"zero-emission building shall not cause any on-site carbon emissions from fossil fuels."* Therefore, the NBHS helps ensure EU alignment in this area.

8. Scottish Firms Impact Test (SFIT)

111. The full list of questions put to businesses involved in the one-to-one discussions can be found in Section 19.2.

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[110] *"Union-wide greenhouse gas emissions and removals regulated in Union law shall be balanced within the Union at the latest by 2050, thus reducing emissions to net zero by that date, and the Union shall aim to achieve negative emissions thereafter."* Source: Article 2(1) of Regulation (EU) 2021/1119 of the European Parliament and of the Council.

[111] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast) (legislation.gov.uk)

[112] COM/2021/802 final

112. Businesses were broadly supportive of the introduction of the NBHS, noting that it was an important step in ensuring net zero emissions by 2045. One business noted that the Standard would avoid pre-mature scrappage of DEH systems having to be incurred, and that significant uptake of ZDEH systems in new-builds otherwise would not be accomplished in the absence of the policy being enacted. A recurring concern among three businesses was the timing of 1 April 2024, with the view being that the supply chain may be slow to respond.

113. When asked about trends in heating systems over the last 5 years, respondents generally noted that there has been a recent rise in consumer awareness of ZDEH technologies such as heat pumps, with some suggesting this as being the result of energy price volatility or concern about climate change. However, it was also generally noted that natural gas was the default option for new-builds with access to the grid. Following this, when asked whether anything would change over the next 5-10 years assuming the NBHS were *not* adopted, 8 of the 12 respondents strongly suggested that no change from the past 5 years would be observed; in other words, mains gas would remain dominant.

114. Depending on the sector they operated in, businesses viewed the Standard as bringing with it opportunity on the one hand, or increased costs on the other. With opportunity came suggestions of increased sales and business, certainty over the direction of travel for the market, and positive effects on training and upskilling. It was noted that adverse impacts on the DEH market could be mitigated by businesses investing in retraining and pivoting towards the production and sale of ZDEH technologies. Costs associated with the Standard predominantly stemmed from the currently higher capital costs of ZDEH technologies relative to DEH technologies, as well as costs associated with retraining. Higher capital costs faced by property developers were likely to be passed onto buyers or landowners (in the case where the developer is purchasing land).

115. All 12 businesses pointed to heat pumps being a key technology for installation in new-builds in the presence of the NBHS. A number of businesses also suggested solar PV with storage, as well as heat networks and communal heating arrangements. However, it was noted that the current regulatory framework for district heating made it a less attractive option. Hydrogen was also tentatively identified as an option for heating.

8.1 Impact on Small Businesses

116. Table 3 below shows the number of enterprises located in Scotland operating in SIC manufacturing subsectors 25.21, 28.21, and 28.25, as well as construction subsectors 43.21 and 43.22.[113] These subsectors were discussed earlier in Section 5.3 and are deemed most likely to be impacted by the NBHS. As can be seen from the table, enterprises are heavily concentrated in the microbusiness end of the spectrum when it comes to their employment size. This finding echoes findings from Nesta which found that heat pump installation companies *"tend to be small,"*[114] though it appears this conclusion could be generalised to the HVAC sector as a whole beyond just heat pumps (at least in Scotland), as well as firms operating in Scotland's economy generally.[115]

Table 3: Enterprises in sectors deemed to be significantly affected (2021) (Scotland)[116]

SIC	Employment Size Band				Total
	Micro (0 to 9)	Small (10 to 49)	Medium (50 to 249)	Large (250+)	
25.21	5	0	0	0	**5**

[113] Please see notes accompanying Table *3*. Broadly speaking, they cover the HVAC sector, both manufacturing and installation services.
[114] How to scale a highly skilled heat pump industry | Nesta
[115] *"The business ecosystem in Scotland lacks a critical mass of large scale-ups."* (Scotland's Productivity Challenge: Exploring the issues - The Productivity Institute); *"high concentration of small, lower-productivity firms"* (Productivity Research Launch: Wealth of the Nation — David Hume Institute)
[116] UK Business Counts - enterprises by industry and employment size band - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk). Accessed 24/03/2023

SIC	Employment Size Band				Total
	Micro (0 to 9)	Small (10 to 49)	Medium (50 to 249)	Large (250+)	
28.21	5	0	0	0	**5**
28.25	35	5	0	0	**40**
43.21	2,605	205	30	0	**2,840**
43.22	2,535	180	30	5	**2,750**
Total (% of 5,645)	**5,185** (92%)	**390** (7%)	**60** (1%)	**10** (0%)	**5,645**
Scotland (% of 175,400)	**154,440** (88%)	**17,565** (10%)	**2,715** (2%)	**680** (0%)	**175,400**

Notes: 25.21 corresponds to the sector "Manufacture of central heating radiators and boilers"; 28.21 corresponds to the sector "Manufacture of ovens, furnaces and furnace burners"; 28.25 corresponds to the sector "Manufacture of non-domestic cooling and ventilation equipment"; 43.21 corresponds to the sector "Electrical installation"; 42.22 corresponds to the sector "Plumbing, heat and air-conditioning installation"

117. Support is available through our enterprise agencies to provide support to Scottish businesses to adapt and respond to economic opportunities and challenges. This includes the Green Heat Innovation Support Programme[117] for companies with innovation to accelerate the rollout of green heat solutions.

118. In developing this BRIA, consideration has been given to the impact on micro and small businesses. To assist in this, the following issues have been considered:

- The variation in the regulatory burden between a self-employed, micro, small, medium, and large business;
- Whether compliance flexibility options could assist a micro, small, or medium business to meet the requirements of the proposal; and

[117] Green Heat Innovation Support Programme - Scottish Enterprise (scottish-enterprise.com)

- The distribution of benefits of the proposal between a self-employed, micro, small, and medium business.

119. Of those organisations who participated in the SFIT, nine of the twelve companies classify as SMEs. Representatives of these micro-, small-, and medium-sized enterprises were supportive of plans to introduce the NBHS. This was not on a scale significantly different from the other organisations interviewed.

120. Across the interviews, there were points raised regarding how best to see acceptance and adherence to the new standard. Very little concern was expressed in terms of the impacts that would be likely to be felt by SMEs, on the whole. As demonstrated below, there were conflicting views around the impact of the regulations on smaller ZDEH installers in particular:

- "Small businesses in these areas who are doing heat pumps, (I) can only see things improving for these types of businesses."
- "SME heating contractors most impacted. Upskilling of whole workforce means change is forced. Options to leave the industries, retrain or leave the sector."
- "Heat pump business area looking up, though some small heat pump companies may find difficulties."

121. The workshops hosted during both consultations did not bring up any further issues specifically relating to the impact on SMEs from the introduction of the NBHS.

122. The Future Homes Delivery Plan (developed to inform the UK Government's Future Homes Standard) did, however, highlight a number of challenges for small house builders.[118] While the Scottish Government's intention to regulate was initially announced within the 2019-2020 Programme for Government, and

[118] Future Homes Hub Delivery Plan and Roadmap

subject to two public consultations, we recognise smaller businesses may have less flexibility in responding to regulatory change.[119] We will continue to work with our external working group to support the successful implementation and delivery of the NBHS throughout 2023, and are seeking further evidence on whether further support is required – with engagement being a key part of this.

123. Furthermore, we are working to overcome supply chain constraints and fill the skills gap. Many of the core trades and professions needed to support our transition to net zero already exist across the Scottish economy, and can be supported through upskilling. We are actively considering additional ways in which we can support all businesses – of all sizes – to upskill their staff.

124. **The extent of compliance by a self-employed, micro-, small-, or medium-sized business versus by a large business.** No information is recorded on the rate of non-compliance with building regulations in terms of company size. Therefore, it is difficult to determine the extent of compliance by a self-employed, micro, small, or medium business versus by a large business.

125. **The relative impact on a self-employed, micro-, small-, or medium-sized business of penalties for non-compliance**. The maximum penalty for non-compliance with building regulations is £5,000 - £10,000 (Level 5 fine).[120] The level of fine is not influenced by the size of the organisation. The introduction of the NBHS will not amend the existing penalties imposed.

9. Competition Assessment

9.1 Will the measure directly or indirectly limit the number or range of suppliers?

[119] Protecting Scotland's Future: the Government's Programme for Scotland 2019-2020 - gov.scot (www.gov.scot)
[120] Building (Scotland) Act 2003 (legislation.gov.uk)

126. As part of the business / industry themed workshop, this question – as well as the following three Competition and Markets Authority (CMA) competition assessment questions below in Sections 9.2 through 9.4 – were used as an initial assessment of competition during the scoping consultation process.

127. Feedback from the workshop attendees suggested that the answer to this question would be no. The main reasons given were that there has already been an increase in the number of suppliers of equipment and, using heat pumps as an example, it was noted that there was no dominant manufacturer(s) yet – which was considered a positive for competition. However, analysis of MCS-certified heat pump installations *does* suggest a dominant manufacturer, with Mitsubishi capturing over 35% of the market between January 2010 and September 2021.[121] This is followed by Daikin, NIBE, and Vaillant with approximately 15%, 10%, and 8%, respectively. A further six manufacturers are identified, each with 5% or less of the market over this time period.

128. This aligns with the following set out in the Heat in Buildings Strategy BRIA,[122] in relation to the transition to zero emissions heat more broadly: "*The transition to zero emissions heat will alter the market for heating systems, energy efficiency and energy. However, this need not have a detrimental impact on the number or range of suppliers as existing firms are likely to be able to switch from supply associated with fossil fuel to zero emissions, and policy development will seek to ensure barriers to entry are minimised, and firms are supported to switch to ensure a just transition."* (page 25)

9.2 Will the measure limit the ability of suppliers to compete?

129. Feedback from the workshop was that the introduction of these regulations would have the opposite impact in that more competition would be created.

[121] How to reduce the cost of heat pumps | Nesta
[122] Heat in buildings strategy: business and regulatory impact assessment - gov.scot (www.gov.scot)

Examples included manufacturers having the ability to utilise products already in use in continental Europe, and upgrade production capacity.

130. Concerns were noted regarding the urgency in upskilling and training required in order for suppliers to capitalise on this opportunity. However, without increased demand for ZDEH technologies, there is little incentive for installers to retrain in installing these.[123, 124] The NBHS, through increasing demand for such technologies via new-builds, serves a supporting role in addressing this gap in incentives.

9.3 Will the measure limit suppliers' incentives to compete vigorously?

131. Feedback from the workshop attendees was that, as the NBHS would be technology neutral, this in itself would promote competition. Furthermore, there was recognition that investment and innovation in ZDEH technologies would continue to grow, creating more competition between suppliers.

132. Against this question, the Heat in Buildings Strategy BRIA did highlight that regulations may limit consumer choice.[125] However, it was also noted that: "*By supporting development of zero emissions alternatives, such as heat network connections or hydrogen, that are currently unavailable to individual consumers (for example, due to infrastructure limitations), the total range of options available need not reduce in all cases."* (page 25)

9.4 Will the measure limit the choices and information available to consumers?

133. Feedback from the workshop attendees indicated that this would not be case – particularly as the ZDEH supply chain continues to grow.

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[123] Heating and cooling installer study - GOV.UK (www.gov.uk)
[124] Installer Survey | Vaillant
[125] Heat in buildings strategy: business and regulatory impact assessment - gov.scot (www.gov.scot)

134. However, a number of attendees were of the view that it was for the Scottish Government, not industry, to lead here in an effort to improve consumer awareness. In an effort to address this, as committed to within our Heat in Buildings Strategy, work is underway to develop a new Heat in Buildings Public Engagement Strategy to publish in 2023.

10. Consumer Assessment

10.1 Does the policy affect the quality, availability, or price of any goods or services in a market?

135. Yes, the NBHS will prohibit the installation of direct emissions heating systems in new buildings. As a result, this standard will see a significant increase in the use of ZDEH technologies in new homes and non-domestic buildings.

136. ZDEH systems can provide equivalent levels of comfort and reliability in terms of ensuring new homes are warm and have hot water and, in some cases, ZDEH systems can also bring benefits of being a cooling system too - not just heating.

137. As set out within this BRIA and our Heat in Buildings Strategy, the Scottish Government is taking measures to strengthen supply chains to ensure we have the capacity to deliver at the pace and scale needed, both in terms of these regulations and the larger challenge of transitioning our existing building stock to ZDEH alternatives. We published our Heat in Buildings Supply Chains Delivery Plan (SCDP) in November 2022, setting out the practical steps we are taking to support the growth of the green heat sector.[126]

138. Ensuring high standards and quality assurance for consumers is at the heart of our approach to supply chain development, and our Heat in Buildings Quality

[126] Towards an Industry for Green Heat: heat in buildings supply chains delivery plan - gov.scot (www.gov.scot)

Assurance Policy Statement (QAPS)[127] outlines the standards required for installers on Scottish Government schemes, along with ways to tackle fraud and mis-selling. This will encourage a greater level of skills and competence in the industry more generally and foster a more secure sector that customers can be confident in.

10.2 Does the policy affect the essential services market, such as energy or water?

139. Yes. As above, the NBHS will prohibit DEH systems in new homes and non-domestic buildings, changing the way we heat our new buildings.

10.3 Does the policy involve storage or increased use of consumer data?

140. No.

10.4 Does the policy increase opportunities for unscrupulous suppliers to target consumers?

141. No. The Quality Assurance Policy Statement (QAPS), mentioned in paragraph 138, includes our approach to protecting consumers and giving them confidence in using suitable installers.

10.5 Does the policy impact the information available to consumers on either goods or services, or their rights in relation to these?

142. No.

10.6 Does the policy affect routes for consumers to seek advice or raise complaints on consumer issues?

[127] Heat in Buildings strategy - quality assurance: policy statement - gov.scot (www.gov.scot)

143. No.

11. Test Run of Business Forms

144. NA – no new forms will be introduced.

12. Digital Impact Test

12.1 Does the measure take account of changing digital technologies and markets?

145. Yes.

12.2 Will the measure be applicable in a digital / online context?

146. No.

12.3 Is there a possibility the measures could be circumvented by digital / online transactions?

147. No.

12.4 Alternatively, will the measure only be applicable in a digital context and therefore may have an adverse impact on traditional or offline businesses?

148. No.

12.5 If the measure can be applied in an offline and online environment, will this in itself have any adverse impact on incumbent operators?

149. NA.

13. Legal Aid Impact Test

150. NA – the NBHS will not create a new procedure or right of appeal to a court or tribunal, or any change in such a procedure or right of appeal.

14. Enforcement, Sanctions and Monitoring

151. The NBHS would require amendments to published material forming the *Building (Scotland) Regulations 2004* and modification of the supporting guidance given within the Technical Handbooks that support said regulations.

152. All matters relating to enforcement, sanctions, and monitoring will be carried out under the existing processes, which form the building standards system in Scotland, as set out under the *Building (Scotland) Act 2003*. Parties responsible for operation of this system are currently the 32 Scottish Local Authorities, appointed as verifiers under the Act on behalf of Scottish Ministers.

153. Work to form a new building is subject to the *Building (Scotland) Regulations 2004* and requires that (i) a building warrant be obtained before work commences and (ii) a completion certificate be accepted once works are finished.

154. Where a building warrant is required, proposals are subject to the scrutiny of verifiers prior to approval of the building warrant and acceptance of a completion certificate. Local Authorities have enforcement powers under the Act to ensure compliance with approvals and the regulations. Where an offence is committed under the Act the Local Authority may take a case to the Procurator Fiscal and persons found guilty of offences are liable on summary conviction to a fine not exceeding Level 5 on the standard scale (currently £5,000 - £10,000).

15. Implementation and Delivery Plan

155. Scotland's Programme for Government 2019-20 initially made stakeholders aware of our intention to introduce these new regulations.[128] This was reinforced within the Programme for Government 2020-21,[129] which announced our intention to launch a scoping consultation in 2020 on standards for new buildings, which would require them to use ZDEH from 2024 onwards. Two public consultations have since concluded and, during both, a series of public workshops were held to seek further input from impacted stakeholders.

156. Outwith these formal consultations, discussions with developers and other key stakeholders have been ongoing, to ensure that all relevant stakeholders are aware that regulations will be introduced and have had an opportunity to provide feedback during the development phase.

157. Our external working group have continued to meet to provide crucial insight into the development of these regulations and have been kept informed of developments throughout 2020-2023.

158. With regard to the implementation of this Standard, this will be achieved through changes to Scottish building regulations. We propose that legislation for the NBHS will be laid nine to twelve months in advance of the 1 April 2024 in-force date.

159. With input from the NBHS external working group, it is the Scottish Government's intention to publish revised guidance within relevant Technical Handbooks in late 2023. This will ensure that designers, contractors, and verifiers will have at least seven months to familiarise themselves with the changes in advance of the 1 April 2024 in-force date.

160. Following engagement with Local Authority Building Standards Scotland (LABSS), a potential risk identified to the successful implementation of this

[128] Protecting Scotland's Future: the Government's Programme for Scotland 2019-2020 - gov.scot (www.gov.scot)
[129] Protecting Scotland, Renewing Scotland: The Government's Programme for Scotland 2020-2021 - gov.scot (www.gov.scot)

policy would be a large influx of building warrant applications prior to 1 April 2024. Historically, this has resulted in an increased workload for local authorities – however, this has also resulted in increased income for local authorities through the fees associated with building warrant applications.

16. Post-Implementation Review

161. At present, there is no set date for a review of these regulations planned. However, further changes to building regulations are scheduled to take place in December 2024, which offers a general opportunity for any further refinement of these regulations (if necessary).

17. Summary and Recommendation

162. In conclusion, it is being recommended that Option 2 – the New Build Heat Standard (NBHS) – be adopted. The NBHS prohibits the installation of Direct Emissions Heating (DEH) systems in new buildings and conversions of existing buildings, both domestic and non-domestic. This would apply to building warrants applied for from 1 April 2024 onward.

163. The objective of adopting this policy is to prevent greenhouse gas emissions associated with delivering space heating, hot water, and cooling in new buildings, helping Scotland to achieve net zero emissions by 2045. On a Climate Change Plan (CCP) accounting basis for emissions,[130] the NBHS is expected to deliver cumulative savings of around 5.2 MtCO2e over 2024 to 2083 under central assumptions, with this broken down as 2.3 MtCO2e saved in the Residential sector and 3.0 MtCO2e saved in the Services sector.[131]

17.1 Summary of Costs and Benefits Table

[130] Such an accounting basis sees emissions arising from natural gas combustion in buildings for non-industrial purposes allocated to the sectors Residential and Services, and emissions from electricity use attributed to the Electricity Generation sector. This differs from the abatement estimates provided in Table *4* which are net abatement (accounting for the rise in emissions from electricity generation).
[131] Figures do not exactly sum to total CCP abatement due to rounding.

164. As discussed in Section 6, we present the Net Present Social Value (NPSV) of the policy below in Table 4**.** The NPSV is the present value of benefits minus the present value of costs, so can be viewed as a summary measure of the overall impact of the policy on social welfare. If it is positive, then this implies the policy has a net beneficial impact (the benefits outweigh the costs); if it is negative, then this implies the policy has a net negative impact (the costs outweigh the benefits).

165. As is shown in Table 4, our central NPSVs are positive, suggesting the NBHS has a net beneficial impact on social welfare, with the vast majority of benefits comprising avoided retrofit scrappage costs in 2045 and avoided greenhouse gas emissions. Depending on the future evolution of gas prices, the energy savings as a result of the policy could be positive (under a future with high gas prices, C) or negative (under a future with moderate gas prices, B).

166. Further sensitivity analysis for the NPSV is discussed in Section 19.4, but the headline finding from said analysis is that the NPSV remains positive across all sensitivities considered. This suggests the policy confers a robust net benefit for social welfare.

167. Comparison of the Non-Traded Carbon Cost-Effectiveness (NTCCE) with the Non-Traded Cost Comparator (NTCC) in Table 4 indicates that the emissions are – on average – being abated in a cost-effective manner by the policy. Further information on how these cost-effectiveness indicators are constructed is provided in supplementary guidance to the Green Book,[132] but also briefly explained in the footnotes accompanying Table 4.

[132] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

Table 4: Quantified costs and benefits (PV base year 2024, real 2021 prices)

	Option 2 (preferred option)	
	Gas LRVCs B	**Gas LRVCs C**
Net Present Social Value (NPSV) (£m)	**1,000.1**	**1,176.0**
Quantified benefits (£m)	**930.2**	**1,106.0**
Carbon savings (non-traded)	1,076.8	1,076.8
Energy savings (LRVC)	(150.8)	25.0
Net air quality benefits	34.8	34.8
Residual value	(30.6)	(30.6)
Quantified costs (£m)	**(69.9)**	**(69.9)**
Capex	720.2	720.2
Repex	264.2	264.2
Retrofit	(1,154.6)	(1,154.6)
Carbon costs (traded)	99.8	99.8
Familiarisation costs	0.5	0.5
Carbon savings (MtCO2e)	**4.8**	**4.8**
2023 – 2027	0.2	0.2
2028 – 2032	1.0	1.0
2033 – 2037	1.7	1.7
2038 – 2042	1.6	1.6
2043 – 2047	0.4	0.4
Non-Traded Carbon Cost-Effectiveness (NTCCE)[133] (£/tCO2e)	**15**	**(19)**
Non-Traded Cost Comparator (NTCC)[134] (£/tCO2e)	**205**	**205**

Notes: Figures in parentheses denote negative values. Assessment period spans 2024 to 2083.

[133] A positive number indicates a net cost per tonne of CO2e, whilst a negative number indicates a net benefit per tonne of CO2e.

[134] If the cost-effectiveness indicator is lower than the cost comparator, then the emissions are – on average – being abated in a cost-effective manner. Otherwise, the emissions are not being abated cost-effectively.

18. Declaration and Publication

I have read the Business and Regulatory Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits, and impact of the policy, and (b) that the benefits justify the costs. I am satisfied that business impact has been assessed with the support of businesses in Scotland.

Signed: 

Date: 17 May 2023

Minister's Name: Patrick Harvie

Minister's Title: Minister for Zero Carbon Buildings, Active Travel and Tenants' Rights

Scottish Government Contact Point: 2024heatstandard@gov.scot

19. Annex

19.1 Consultation: Local Authorities

168. Please note that, in some cases, responses from local authorities only represented certain voices from the local authority council, such as those responsible for building standards or housing.

Table 5: Whether or not a given Local Authority responded to the NBHS consultations

Local Authority	Part I	Part II	Overall
Aberdeen City	No	No	No
Aberdeenshire	No	Yes	Yes
Angus	No	No	No
Argyll and Bute	No	No	No
City of Edinburgh	Yes	No	Yes
Clackmannanshire	No	No	No
Dumfries and Galloway	Yes	No	Yes
Dundee City	No	No	No
East Ayrshire	Yes	No	Yes
East Dunbartonshire	Yes	No	Yes
East Lothian	No	Yes	Yes
East Renfrewshire	No	No	No
Falkirk	No	Yes	Yes
Fife	No	Yes	Yes
Glasgow City	Yes	No	Yes
Highland	No	No	No
Inverclyde	No	No	No
Midlothian	No	No	No
Moray	No	No	No
Na h-Eileanan Siar	No	No	No
North Ayrshire	Yes	No	Yes
North Lanarkshire	Yes	Yes	Yes
Orkney Islands	No	No	No
Perth and Kinross	Yes	Yes	Yes
Renfrewshire	No	No	No
Scottish Borders	Yes	No	Yes
Shetland Islands	No	Yes	Yes
South Ayrshire	No	No	No
South Lanarkshire	Yes	No	Yes
Stirling	No	No	No

Local Authority	Part I	Part II	Overall
West Dunbartonshire	No	Yes	Yes
West Lothian	No	No	No
Number that responded	**10**	**8**	**16**

19.2 Scottish Firms Impact Test

169. This section details the questions put to businesses in the one-to-one discussions held as part of the Scottish Firms Impact Test. In total, 14 questions were prepared in advance of discussions. These are given below.

- The Scottish Government is currently consulting on prohibiting the use of DEH systems in new buildings from 1 April 2024 onwards through our New Build Heat Standard (NBHS). Are you supportive of the introduction of the NBHS? Why / why not? Please give your reasons.
- In your opinion, how has the use of DEH systems (such as fossil fuel boilers, etc.) changed over recent years (e.g., in the last 5 years)?
- How would you expect the use of these items to change in the next 5-10 years in the absence of the NBHS being introduced?
- In your opinion, what will the biggest potential impacts be (both costs and benefits) of introducing the NBHS on your business or on those which you represent? Which businesses, in your opinion, will be most affected by the regulations? Please provide evidence where possible.
- What technologies do you expect to replace DEH systems in new builds?
- Has your business or have the businesses you represent taken any steps to mitigate any anticipated impacts or costs associated with the NBHS? If so, please expand your answer.
- Does your organisation or association have specific comments on how the NBHS might impact businesses in more remote areas of Scotland? Please expand on your answer.
- To what extent do you expect the NBHS to put your business, or those which you represent, at an advantage or disadvantage, nationally or internationally? Please provide evidence where possible.

- Do you have any comments on the NBHS affecting competition amongst your suppliers, or those of the businesses which you represent? If so, could you elaborate?
- When the NBHS comes into force, will your business switch to alternative zero direct emissions heating (ZDEH) systems, or do you anticipate stopping the use, sale, or production of the DEH systems altogether? Please expand your answer.
- If your business will be substituting DEH with ZDEH alternatives (as part of your sales or production), how quickly do you expect this transition to take place? Do you anticipate any opportunities or difficulties prior to or during this transition? Please expand your answer.
- Are there any unintended consequences you may anticipate for your business or the businesses you represent as a result of the NBHS?
- Do you envisage any increase in costs relating to the use of ZDEH systems would be passed onto buyers, or would your organisation expect to absorb costs these costs?
- Do you envisage the introduction of the NBHS having any impact on the supply of housing across Scotland?

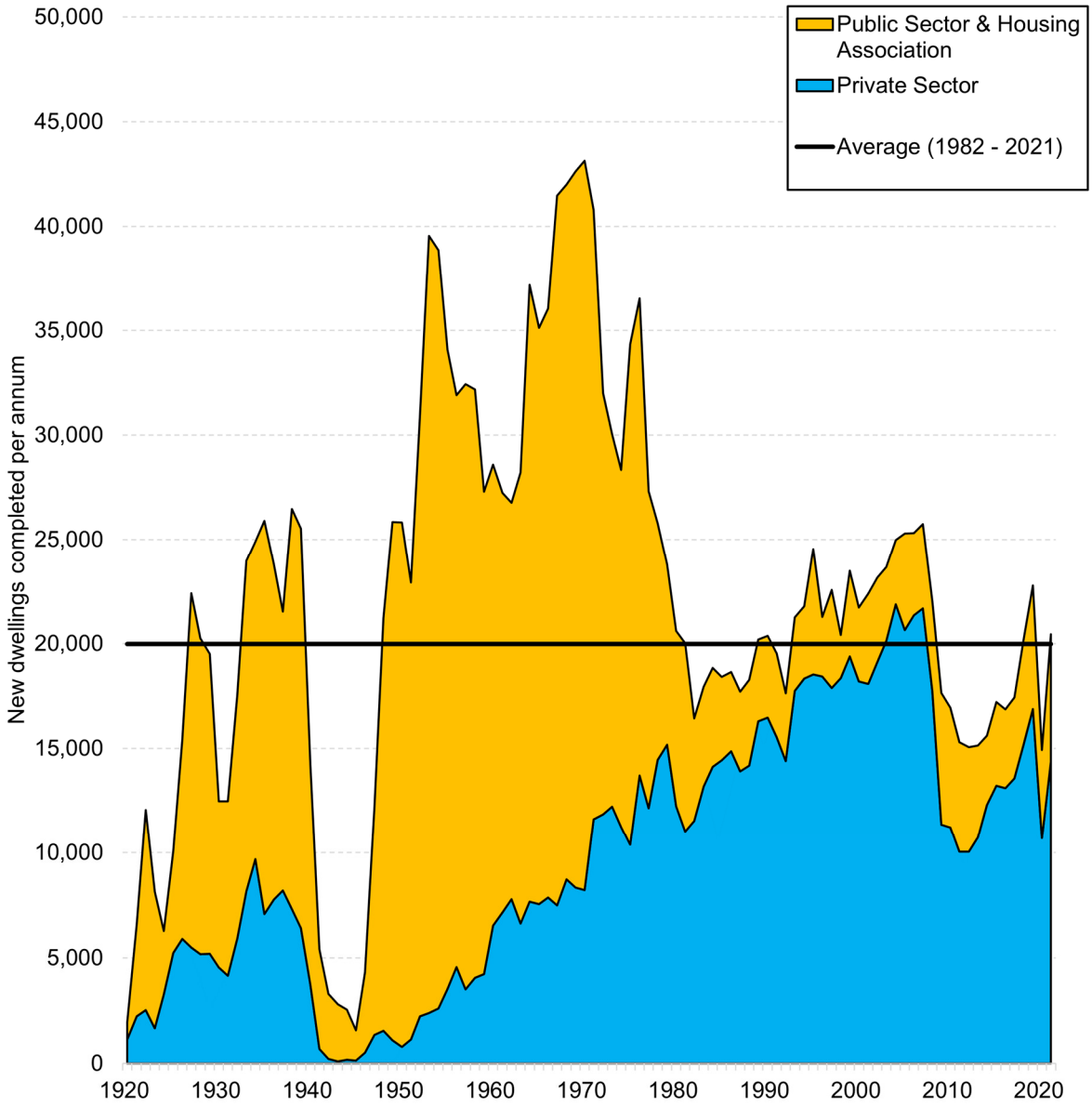
19.3 Costs and Benefits

170. Over the last 60 years (1962-2021), over 1,450,000 homes were completed in Scotland.[135] The domestic side of the assessment assumes 19,975 new-build homes are completed each year, with a further 630 net conversions being added to the domestic stock annually. These annual additions are based on the averages observed for 1982 to 2021 and 1986/87 to 2020/21, respectively, with this being shown in Figure 8 and Figure 9 below. In the early years of the standard coming into force, a build-out parameter is assumed to capture the effect of time-lags between a building warrant being granted and a completion certificate being accepted.[136] In total, approximately 1,235,000 new homes are

[135] Housing statistics quarterly update: new housebuilding and affordable housing supply - gov.scot (www.gov.scot) [long series]
[136] Building regulations - new domestic buildings - modelling of proposed energy improvements: research report - gov.scot (www.gov.scot) [Table 1.11j]

added to the domestic stock over the period of the assessment, with 1,195,000 of these assumed to be subject to the NBHS (after accounting for the lag in build-out in the initial few years).

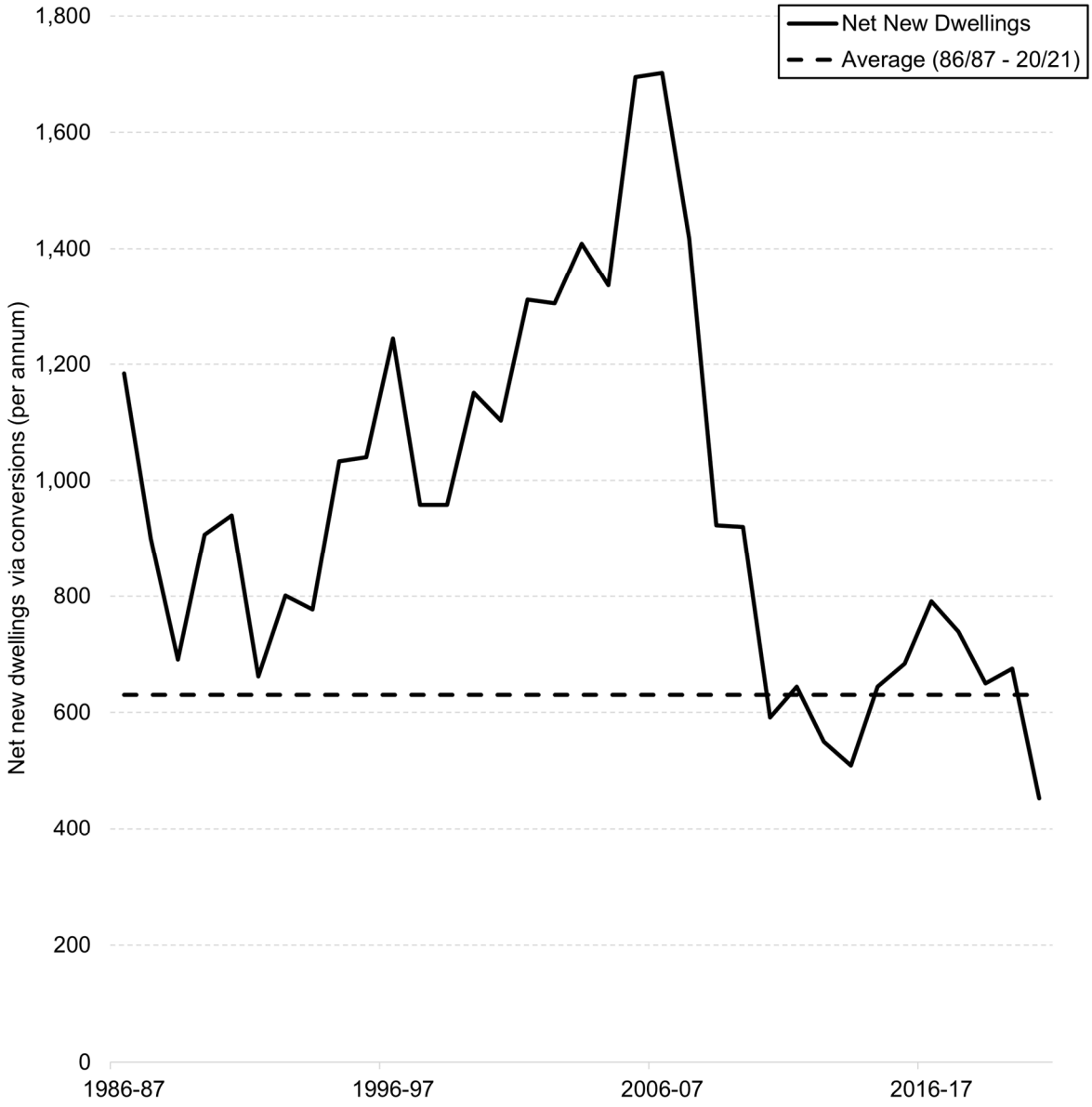
Figure 8: New dwellings completed per annum in Scotland



Notes: Sourced from Scottish Government, accessed 10/11/2022.[137] Average for 1982 to 2021 is approximately 19,975 new dwellings per annum.

[137] Housing statistics quarterly update: new housebuilding and affordable housing supply - gov.scot (www.gov.scot) [long series]. Accessed 10/11/2022

Figure 9: Net new dwellings added via conversions, per annum, in Scotland



Notes: Sourced from Scottish Government, accessed 10/11/2022.[138] Average for 1986/87 to 2020/21 is approximately 630 net new dwellings per annum.

171. Under our central approach to modelling domestic new-builds, we use data on EPCs for new dwellings where the date of assessment took place in 2022.[139] From this data, we construct a 2 x 3 matrix containing the share of new-builds

[138] Housing statistics: Conversions and demolitions - gov.scot (www.gov.scot) [tsScotSummary]. Accessed 10/11/2022

[139] statistics.gov.scot : Domestic Energy Performance Certificates - Dataset to Q4 2022. Accessed 08/11/2022

that fall into each technology (ZDEH, DEH) and Energy Efficiency Rating (EER) band (A, B, C) grouping. The share using ZDEH technologies is assumed to be around 21% in 2022. In the absence of the NBHS being adopted, it is assumed that this share would naturally grow to 100% by 2037, with this assumption being based on the growth in the share observed for 2014 through 2022 from EPC outturn data.

172. We also obtain the median floor area for each EER band (A-C), conditional on the property using a DEH system, and combine this with metered gas consumption statistics for new-builds published by BEIS to obtain gas consumption for each EER band A to C.[140, 141] This is then used alongside an assumed gas boiler efficiency of 89.5%[142] to obtain the heat demand of the property.

173. We assume all DEH-using properties will use mains gas as their fuel in the counterfactual. For comparison, analysis of the EPCs assessed between 2018 and 2022 finds that around 2.5% used oil or LPG, and 0.2% used biomass as their main fuel type. This assumption is deemed to be insignificant, but ultimately plausible as building standards tighten in the future, making oil/LPG adoption in new-builds increasingly unrealistic.

174. It is important to point out that our reliance on the BEIS metered gas consumption statistics is a potential limitation of the analysis. The data is for English and Welsh new-builds which recorded an EPC since the start of 2014, with the consumption data pertaining to the year 2017. This may lead to us overstating the benefits of the policy intervention if Scottish new-build gas consumption would be lower than this amount (and hence the carbon savings lower). This could, for example, be plausible as a result of more stringent building standards. On the other hand, we argue that the use of metered

[140] Energy consumption in new domestic buildings 2015 to 2017 (England and Wales) - GOV.UK (www.gov.uk)
[141] For reference, the average gas consumption per square-metre (sqm) for band A properties using gas was 93 kWh/sqm. For band B, this was 95 kWh/sqm, and for band C it was 114 kWh/sqm.
[142] Building standards technical handbook June 2023: domestic - gov.scot (www.gov.scot) [Table 6.1]

consumption data is preferable to Standard Assessment Procedure (SAP) estimates of fuel consumption as these can suffer from what has come to be known as the "energy performance gap." This is the gap between modelled fuel consumption versus actual fuel consumption.[143, 144] As such, use of the BEIS metered fuel consumption data under central assumptions is deemed preferable.

175. It is also important to note that fuel poverty estimates are based on the modelled energy use required for a household to meet a satisfactory heating regime and not based on actual household consumption. The Scottish statutory definition of fuel poverty is set out in the Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019, while statutory heating regimes are set out in out in the Fuel Poverty (Enhanced Heating) (Scotland) Regulations 2020. As the analysis in this report is based on actual metered consumption and not the energy required to meet a households statutory heating regime, energy use figures and costs quoted will not reflect fuel poverty estimates.

176. Information on the technological assumptions made in the domestic side of the assessment is available in Table 6 below, with these assumptions being based on evidence from a variety of sources.

Table 6: Assumptions for DEH and ZDEH technologies (domestic) (2021 GBP)

Technology	Cost (£)	Lifetime (years)[145]	Efficiency (%)[146, 147]
Gas boiler	6,723 (4,670) [NA]	15	89.5
Air-to-water heat pump	15,148	20	300.0

[143] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk)
[144] The costs and benefits of tighter standards for new buildings (Currie & Brown and AECOM) - Climate Change Committee (theccc.org.uk)
[145] Market-based mechanism for low carbon heat - GOV.UK (www.gov.uk)
[146] Building standards technical handbook June 2023: domestic - gov.scot (www.gov.scot) [Table 6.1]
[147] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk) [Table M3.1]

Technology	Cost (£)	Lifetime (years)[145]	Efficiency (%)[146, 147]
	(7,368) [7,973]		
Electric	4,757 (4,648) [6,205]	15	100.0

Notes: Figures outside of parentheses and brackets are the capex for an installation in a virgin new-build, whereas figures in parentheses are repex, and figures in brackets are retrofit costs. Capex for virgin installations are discounted by 10% in line with research on new-build installation costs.[148] Capex of heat pump installations falls by 20% by 2030, bringing capex to just over £12,100 from 2030 onward.[149] Repex and retrofit costs above already include this assumed reduction. All costs converted to 2021 base year prices using CPIH 05.3.1.4 "Heaters, air conditioners" information.[150]

177. The capex for the gas boiler pulls on research for BEIS[151] and comprises the following: (a) a high-end 18 kW non-combi boiler, (b) a highly insulated unvented cylinder, (c) cost of fittings for a new installation, and (d) a labour fee for installation in an unoccupied / easy-access building. The sum of the above costs is then multiplied by the cost multiplier associated with using a regional installer, and then the cost of digital controls and a large heat distribution system is added to the result. The total cost is inflated from 2017 to 2021 prices, then reduced by 10% in line with research on new-build installation costs.[152] The repex includes (a), (b), the cost of standard fittings (not fittings for a new installation), and a standard labour fee (as opposed to one for an unoccupied / easy-access building). Again, the sum is multiplied by the regional installer cost multiplier and inflated to 2021 prices.

[148] The scope for cost reductions in a mass market for low carbon heating technologies - GOV.UK (www.gov.uk)
[149] Ibid.
[150] Consumer price inflation time series - Office for National Statistics [dataset]
[151] Cost of installing heating measures in domestic properties - GOV.UK (www.gov.uk)
[152] The scope for cost reductions in a mass market for low carbon heating technologies - GOV.UK (www.gov.uk)

178. The capex for the air-to-water heat pump at the beginning of the assessment pulls on the same BEIS research and comprises the following: (a) a mid-range 6 kW heat pump, (b) a central estimate of the cost of fittings, (c) a medium-sized buffer tank with a highly insulated unvented water cylinder, (d) high-end controls, (e) labour fee associated with a simple installation, and (f) the cost of a heat distribution system for a 3-bed home (underfloor downstairs, radiators upstairs). The sum of (a) through (f) is then inflated to 2021 prices and reduced by 10% in line with research on new-build installation costs.[153] Over time, this capex is reduced by a further 20% by 2030 in line with the same research previously referenced.

179. The repex for the heat pump comprises (a) and (c), as well as a low estimate of the cost of fittings (as some of the old system's components can be reused) and the cost of labour for a standard installation. Since the first like-for-like heat pump replacement does not occur until 2044 in the assessment, we build the "20% by 2030" cost reduction into the repex estimate. The retrofit cost comprises (a), a low estimate of the cost of fittings, a low estimate for the cost of a buffer tank and water cylinder, a low estimate of the cost of controls, a central estimate of the cost of labour, and a high estimate of the cost of replacing radiators. The first retrofit does not occur until 2039 in the assessment, so we build the "20% by 2030" cost reduction into the retrofit cost estimate. As with treatment of prior heating system costs, these repex and retrofit costs are expressed in 2021 prices.

180. The capex for the electric heating system pulls on the same BEIS research and comprises the following: (a) a mid-range 7 kW High Heat Retention (HHR) storage heating system, (b) standard controls, (c) new circuit board and breaker, and (d) 1-day installation labour fee. The sum of these is inflated to 2021 prices and reduced by 10% in line with treatment of other virgin installation costs.

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[153] The scope for cost reductions in a mass market for low carbon heating technologies - GOV.UK (www.gov.uk)

181. The repex for the electric heating system comprises (a), as well as a central estimate of the cost of disposing of old units and half a day for installation labour fees. The retrofit cost comprises (a), as well as the cost of basic controls, a high estimate of disposal costs, replacement of circuit board, and 2 days of installation labour fees. These are converted to 2021 prices.

182. Build-out rates for the non-domestic sector use information provided by Scottish & Southern Electricity Networks (SSEN) as part of their Distribution Future Energy Scenarios (DFES) for the Scottish Hydro Electric Power Distribution (SHEPD) licence area.[154] These are then extrapolated based on the current ratio of SHEPD to Scottish Power Transmission (SPT) customers to inform non-domestic build-out rates for southern Scotland. Information on the average floor area of new-build non-domestic properties from the Non-Domestic National Energy Efficiency Data-Framework (ND-NEED) is then used to calculate an average number of non-domestic buildings constructed over the time horizon of the appraisal.[155] In total, over 50,000 non-domestic buildings are added between 2024 and 2083, with around 40,000 being subject to the NBHS.

183. Information on the technological assumptions made in the non-domestic side of the assessment is available in Table 7 below, with these assumptions predominantly being based on assumptions made by the CCC in their Sixth Carbon Budget which were informed by research carried out by BEIS.[156, 157]

[154] Local forecasts of a global transition: net zero in 2050 - Regen [Figure 75]
[155] Non-domestic National Energy Efficiency Data Framework (ND-NEED), 2022 - GOV.UK (www.gov.uk). Accessed 23/12/2022
[156] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk) [Table B3.3]
[157] Evidence update of low carbon heating and cooling in non-domestic buildings - GOV.UK (www.gov.uk)

Table 7: Assumptions for DEH and ZDEH technologies (non-domestic) (2021 GBP)[158]

Technology	Cost (£/kW)	Lifetime (years)	Efficiency (%)	Size (kW)[159]
Gas boiler	231 (5)	15	89.5	300
Air-to-water heat pump	1,333 (5)	20	283	150
Air-to-air heat pump	697 (9)	20	283	150
Electric	183 (3)	15	100	150

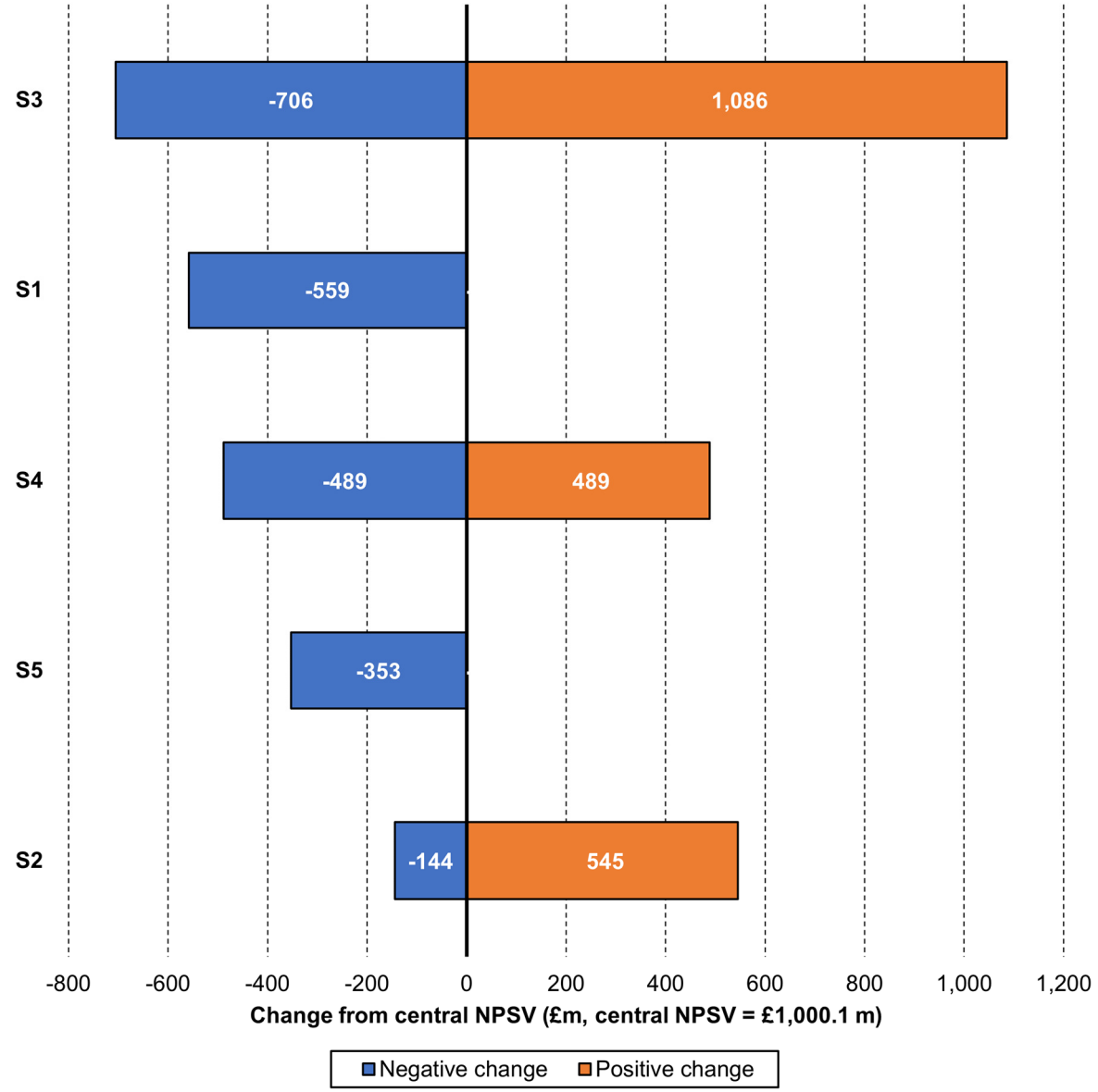
Notes: Figures outside of parentheses are the capex, and this is also used as the repex due to a lack of evidence for these specific costs. The retrofit cost is assumed to be 7.5% higher than capex in line with research.[160] Figures within parentheses represent opex, excluding fuel costs. Capex for virgin installations are not discounted by 10% due to a lack of an evidence base for this assumption in the non-domestic sector. Capex of heat pump installations falls by 20% by 2030, bringing capex to just over £1,066/kW from 2030 onwards for air-to-water and £557/kW for air-to-air. This feeds through to repex and retrofit costs. All costs converted to 2021 base year prices using CPIH 05.3.1.4 “Heaters, air conditioners” information.[161]

19.4 Sensitivity Analysis

184. This section explores the sensitivity of our NPSV estimate, using the scenario B gas LRVCs NPSV. Sensitivities investigated are discussed below, alongside their effect on the NPSV, shown in Figure 10.

[158] Ibid.
[159] Analysis of alternative UK heat decarbonisation pathways (Imperial) - Climate Change Committee (theccc.org.uk)
[160] The scope for cost reductions in a mass market for low carbon heating technologies - GOV.UK (www.gov.uk)
[161] Consumer price inflation time series - Office for National Statistics [dataset]

Figure 10: Change from central NPSV (£m, central NPSV = £1,000.1 m)



185. **S1: Air-to-water heat pumps in the non-domestic sector.** This sensitivity check has a large negative impact on the NPSV of the standard. Under our central set of assumptions, new-builds in the non-domestic sector are assumed to adopt air-to-air heat pumps on the grounds of (i) their lower capital costs and (ii) evidence that suggests the need for cooling capability (which air-to-air heat pumps can provide) is higher in the non-domestic sector.[162] Since the cost of

[162] *"Cooling has historically been dominated by the non-domestic sector … There is uncertainty over the number of cooling systems sold into the new build [non-domestic] sector but research for this*

an air-to-water heat pump sits around £1,333/kW compared to that of an air-to-air heat pump of almost £697/kW, assuming that air-to-water heat pumps are installed in new-build non-domestic properties pushes up the capital costs incurred within the non-domestic sector. However, while the NPSV falls, it does not become negative. In reality, the technology mix in new-build non-domestic buildings is likely to consist of both air-to-air and air-to-water heat pumps, alongside other ZDEH options such as heat networks and electric heating systems.

186. **S2: Scenarios A and D for gas LRVCs.** BEIS guidance recommends testing the sensitivity of the results using the A and D scenarios for the LRVCs of gas. Relative to the scenario B NPSV, A reduces the NPSV by almost £150 mn. On the other hand, scenario D is an additional scenario which assumes that high gas prices will remain constant in the long run. Under such a scenario, and using central electricity LRVCs, the NPSV increases relative to our central estimate by almost £550 million.

187. **S3: Pessimism and optimism.** In order to check the effect a set of pessimistic assumptions has on our results, we assume low LRVCs for gas (scenario A), high LRVCs for electricity, and low carbon values.[163] Under optimistic assumptions, we assume high LRVCs for gas (scenario D), low LRVCs for electricity, and high carbon values. Under the set of pessimistic assumptions, the NPSV retains its sign and remains positive. This set of assumptions has the largest negative effect across the scenarios considered as part of this sensitivity analysis. Under more optimistic assumptions, the NPSV more than doubles (giving us the largest positive effect as part of this sensitivity analysis).

188. **S4: Carbon values.** We check the sensitivity of the results to using low and high carbon values and find that the NPSV remains positive.

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project suggests this is in the range of 50% - 80% of overall sales." Source: Cooling in the UK - GOV.UK (www.gov.uk)

[163] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)

189. **S5: Electric heating in both sectors.** Our central set of assumptions assumes heat pumps are adopted as the main technology in both the domestic and non-domestic sectors. This sensitivity check assumes direct electric heating is adopted. As is shown in Figure 10, this assumption has a negative impact on the NPSV. However, it still remains positive, suggesting a net benefit for social welfare.