Department for Energy Security & Net Zero

Improving Boiler Standards and Efficiency

Summary of responses received and Government Response

March 2024

Any enquiries regarding this publication should be sent to us at: domesticboilersconsultation@energysecurity.gov.uk.

Contents

Introduction

Summary of consultation proposals

This document sets out the government's updated position on the proposals contained within the consultation on 'Improving boiler standards and efficiency', which was launched on 13 December 2022 and closed on 21 March 2023.[1] Please note this document does not attempt to repeat the context and background for the proposals set out in the consultation document. The consultation document and the government response should be read in conjunction.

In the consultation we set out a range of proposals relating to gas boilers, hydrogen-ready boilers and hybrid heating systems that include gas boiler and heat pump elements (henceforth referred to as 'hybrids') which help deliver two broad objectives:

1. to reduce domestic gas consumption to lower consumer bills and carbon emissions and improve our energy security
2. to prepare for the transition to low-carbon heat – transitioning to heat pumps or a potential hydrogen conversion

On domestic boiler efficiency, in the consultation we proposed:

- requiring that all domestic gas boilers are placed on the market with ecodesign and energy labelling Class VI boiler controls
- including system and regular boilers in our new proposals
- requiring that all combination boilers should be able to modulate down their output, such that the system can operate at 10% of its maximum output
- increasing minimum tested efficiency standards – exploring whether to increase current test standards to 93% or 94%

We also explored:

- whether efficiency requirements should apply to boilers sized ≤45kW or ≤70kW
- introducing a requirement for all gas boiler installers to undertake low temperature heating system design training
- ways to encourage or ensure heating system maintenance is carried out
- the collection, use and presentation of real-time efficiency information

The consultation proposed introducing a requirement for all domestic-scale (≤45kW) gas boilers to be hydrogen-ready from 2026. It sought to test that the key conditions for such a policy could be met:

[1] Department for Energy Security and Net Zero (DESNZ) and the Department for Business, Energy & Industrial Strategy (BEIS) (2022), 'Improving boiler standards and efficiency', https://www.gov.uk/government/consultations/improving-boiler-standards-and-efficiency.

- that, once converted to operate on 100% hydrogen gas, hydrogen-ready boilers can satisfy regulatory requirements, including on performance and safety
- that should hydrogen-ready boilers be introduced market-wide, price parity with natural gas boilers can be achieved
- that a single market-wide definition of hydrogen-ready boilers can be agreed, with products meeting this definition able to prepare homes for potential conversions to 100% hydrogen heating – a proposed definition was included in the consultation

The consultation also proposed:

- that all installers of hydrogen-ready boilers would have to complete a relevant hydrogen gas training module
- that the components and kit necessary to convert the boiler should only be produced/supplied at the point of conversion.
- that hydrogen-ready boilers should have to meet current minimum efficiency levels for natural gas boilers

We also explored whether hydrogen boilers could meet lower NOx levels than the current standards set out in ecodesign regulations.

On the role of hybrids within our decarbonisation plans, the consultation proposed that further steps may be required to ensure:

- the delivery of carbon savings
- that deployment is focused on appropriate sectors of the building stock (avoiding displacing potential installations of standalone heat pumps), while providing consumers with choice
- the development of appropriate installer skills, standards and consumer protections

The consultation stated that feedback received will form a key plank in further developing the government's position on hybrids. The consultation sought views on:

- product standards and smart controls to enable low-carbon operation
- how to ensure hybrids are installed where most suitable
- training and standards for those installing hybrid systems
- the potential of hybrids to play a substantive long-term role in heat decarbonisation

Summary of feedback received

The consultation was published on GOV.UK and we received 195 responses, of which 135 were received via Citizen Space and 60 were submitted via email. A list of organisations that responded to this consultation can be found in Annex A: List of respondents.

Consultation responses by type or organisation

Respondent type	**Number of responses**
Heating appliance manufacturers (or related trade associations)	58
Members of the public	30
Non-governmental organisation (charities, consultancies)	28
Heating engineers (sole traders, installer groups)	22
Manufacturers other than direct heating appliances (controls, gas piping, meters etc.)	17
Energy supplier (including networks and energy providers)	14
Devolved administration / local government	4
Other (academics, housing associations, standards agencies, advice groups)	22

As respondents represented a range of interests and were not obligated to answer all questions when submitting a response to the consultation, some questions received more responses than others.

We appreciate the effort and time put into the views presented by the range of contributors. All the responses have been recorded and carefully considered. Please note that this document does not attempt to respond individually to every comment received during the consultation period but responds to the most significant issues that respondents raised, pertinent to the consultation topic. This government response is based on a balance of factors and not necessarily based on the majority view alone. Some of the key themes of responses received are included below.

Boiler efficiency

There was little consensus regarding our proposals related to boiler controls or the exact type of control that would most benefit a natural gas boiler. However, there was agreement that, where possible, all controls should be able to modulate the boiler and lower the flow temperatures. There was a clear majority in favour of the use of ‘open protocols’ to enable

controls to operate with maximum functionality. There was no consensus on the type of open protocol that should be used.

Most respondents acknowledged the benefits of increased modulation rates. However, there was a feeling, mainly from industry, that the exact proposals would be too challenging and costly to deliver for all boiler ranges compared to the efficiency benefits realised and that amendments to the proposals were required. There were differing views from respondents about whether and which proposals should also apply to system and regular boilers.

There was broad agreement that the scope should not be increased to include boilers up to 70kW, and that 45kW was the appropriate maximum boiler size for these policy proposals.

For natural gas boilers, most respondents agreed that efficiency levels should be set as high as possible. However, the majority of respondents also agreed that tested efficiency will have very little impact on real-world efficiency, which was based on how boiler and heating systems are designed, commissioned and maintained. For hot water cylinders, the majority of respondents recommended that the government should focus on heat pump preparedness and other factors, rather than raising efficiency rating requirements from C to B.

Most respondents who expressed a view in relation to boiler maintenance believed that the government should strengthen maintenance, with a significant number saying it should be required for efficiency and to extend boiler life. The majority of respondents felt that low temperature heating system design training should be required for boiler installers.

Hydrogen-ready boilers

Views as to whether the government should mandate hydrogen-ready boilers were quite evenly split, often reflecting respondents' general views on whether hydrogen should be part of the net zero heating decarbonisation mix. Those who expressed a view thought the scope should be limited to boilers sized up to 45kW. Amongst those in favour of a hydrogen-ready mandate, there was consensus toward delaying a mandate until 2028. Other respondents suggested waiting until after the decisions on the role of hydrogen for heating are taken in 2026.

There were differing views regarding the potential costs of hydrogen-ready boilers. Many respondents pointed to the cost commitment by the boiler manufacturers whereas others were concerned that, due to a lack of policing or regulation, this would be difficult for the government to enforce.

There was broad support for the government's proposed definition being the basis for a definition to be used in regulation. Some feedback requested that specifics related to hydrogen-ready boilers are added to the definition.

The majority believed natural gas boilers should have to maintain their minimum efficiency when converted to hydrogen, but manufacturers and others noted the links between hydrogen efficiency ratings and nitrogen oxide (NOx) emissions that may be a key limiting factor. Regarding air quality specifically, many respondents were concerned about the levels of NOx emissions from hydrogen-ready boilers. Other respondents pointed to testing which shows that

hydrogen boilers are able to emit far lower NOx levels than current natural gas boiler standards set in ecodesign regulations.

There was a majority view that conversion kits for hydrogen-ready boilers should only be supplied at the point of conversion, so as to prevent waste and associated carbon emissions inherent in other options. There was also a majority of respondents who did not agree that a hydrogen training module should be required for hydrogen-ready boiler installs. However, they recommended that installers should have to undergo this training before being permitted to convert boilers from natural gas to hydrogen.

Hybrids

Some of the most common themes in responses to Chapter 3 were around prioritisation of the installation of standalone heat pumps (SHPs), where suitable, and calls for action to improve the affordability of hybrids – whether to offset capital costs or to reduce running costs.

Most respondents were in support of setting minimum efficiency requirements, though fewer supported setting a minimum heat pump output. Many noted the benefits of alignment with other markets to avoid additional costs to consumers, and the benefits of controls capable of responding to price signals alongside action by the government to rebalance gas and electricity costs.

There was significant agreement that installers of hybrids should have the same skills as SHP installers and the majority called for clearer standards and guidance for hybrid installations.

Limited evidence and data were provided on the technological and cost reduction potential of hybrids, and many stated the need for more evidence to inform a decision on a widespread role for hybrids.

Summary of the government response to stakeholder feedback

Following the consultation, the government has carefully re-considered its proposals in light of the feedback received and, where appropriate, has made changes to address concerns raised whilst not compromising on the effectiveness of the proposed measures.

On 20 September 2023, the Prime Minister announced a pathway to reaching net zero by 2050 that reduces costs on families while still meeting our legally binding Carbon Budgets and fulfilling our wider international commitments to address climate change. The policy proposals stated in this government response align with and complement the announcements made by the Prime Minister, by seeking to save consumers' money off their energy bills and reduce emissions towards net zero.

Unless otherwise stated, we are planning to use the forthcoming consultation on ecodesign and energy labelling planned for 2024 to test regulatory amendments to implement these proposals.

To improve boiler efficiency, we are proposing to introduce changes through ecodesign and energy labelling regulations which will prevent certain products being placed on the market in Great Britain (GB). This includes preventing heating Control Classes I-III (the worst performing, simple controls) from being placed on the market by 2026. In addition, the government will look to mandate that combination boilers and all controls need to be capable of using open protocols by 2026. If a new open protocol is not available the government will require OpenTherm, which is used already by a significant portion of the market, to be used. By 2028, we will propose that boilers (45kW and under) should be capable of modulating their heat output down to 15% of their maximum output without on/off cycling, while operating at least the same useful efficiency as when tested at part load.

We will seek to require that gas boiler installers and eventually all hydronic heating appliance installers need to undertake low temperature system design training. We will also consider options for strengthening heating system maintenance. The route for implementation of these areas is not definitive at the moment. However, we will look to work across government and with regulators and arm's length bodies, such as the Health and Safety Executive and Building Safety Regulator, to find the most appropriate route.

The government plans to take a decision in 2026 on whether, and if so how, hydrogen will contribute to heating decarbonisation. Only if a decision is taken that hydrogen will play a substantive role in heat decarbonisation will the Government move to require domestic-scale gas boilers be hydrogen-ready, and then only from 2030. These timelines are based on feedback from boiler manufacturers that they require at least 4 years to invest in supply chains and convert production processes across all of their product ranges. In the meantime, we propose to consult on and introduce standards for hydrogen-ready boilers to be placed on the GB market. This includes a definition and minimum efficiency level for hydrogen-ready boilers.

The feedback received has reinforced our position that low-carbon operation and quality installation of hybrids is essential to deliver consumer and system-level benefits. Following the consultation, we plan to:

- enable low-carbon operation of hybrids – by (1) proposing new Minimum Energy Performance Standards (MEPS) for hybrids in our upcoming ecodesign and energy labelling consultation and (2) incentivising and encouraging greater use of the heat pump element through price rebalancing, supporting development of agile tariffs, and consulting on smart control standards in our upcoming smart and secure electricity system consultation
- enable high quality installation of hybrids where they are most suited – by (1) reviewing the information currently provided by the government regarding hybrids, (2) reviewing the level of financial support currently available to consumers for hybrids, and (3) working with other government departments and external organisations to enable and ensure that hybrid installers have clear guidance and standards to refer to, and have the skills they need to deliver high quality installations
- reap electricity system benefits from hybrids (such as reducing/delaying electricity generation and network reinforcement needs) – by incorporating hybrids into our broader policy on smart and secure electricity systems
- continue exploring the future potential of hybrids – by updating our analysis, assessing their impact in different net zero pathways, and seeking further views in upcoming consultations

No decision has been taken on whether hybrids should have a significant widespread role in heat decarbonisation and whether this could/should be achieved though minimum efficiency requirements. We will continue to build our evidence base before making a decision. We intend to gather further views, through our upcoming consultation on ecodesign and energy labelling. In the meantime, the government is taking a pragmatic, market-led approach to hybrids and has set out the role they should play within the Clean Heat Market Mechanism in our government response.[2]

[2] DESNZ and BEIS (2023), 'Clean heat market mechanism', https://assets.publishing.service.gov.uk/media/6567cbfb2ee693000d60caed/clean-heat-market-mechanism-government-response.pdf.

Summary of responses

Chapter 1 – Boiler efficiency

Reforming boiler control standards

Eighty-seven respondents provided views in response to questions 1–4. Respondents' answers to individual questions often overlapped with many choosing to view the individual proposals as a potential package of changes focused on controls as a whole.

> Question 1: Do you agree that all gas boilers should be placed on the market with controls that meet Energy Labelling Class VI? Yes/No. Please expand on your views.
>
> Question 2: Do you think we should require all gas boiler controls to meet Energy Labelling Class VI, irrespective of whether they are placed on the market with a gas boiler?

Multiple respondents to the first question noted that only a very small number of boilers are placed on the market with controls, meaning the proposal would represent a major change. There were concerns this would lead to wastage, given there is no requirement for the controls to be installed even if they are supplied alongside the boiler. Others argued delivering minimum standards through product standards would result in high levels of compliance.

Regarding the appropriate minimum standard for controls, forty-five respondents, including manufacturers and others from the energy/heating sector, agreed with the central premise of requiring Class VI controls. Forty respondents disagreed. It was widely acknowledged that Class VI controls will improve boiler performance due to lowering flow temperatures. However, seven respondents, including manufacturers and heating installers, raised concerns around the complexity of installing Class VI controls. The limiting factors listed included Class VI controls requiring access to an appropriate north facing wall or the internet.

Many respondents suggested Class V (load compensation) controls should be the minimum standard or an alternative. These were seen as being easier to fit while delivering the same level of efficiency improvement. A minority of these respondents referenced a 2021 report produced for the trade association, BEAMA.[3] The report identified Class V controls as delivering the most savings compared to standard simple controls and a slightly greater improvement in colder seasons than Class VI controls.

A minority of respondents were in favour of making Class IV (Time Proportion Integral) controls the minimum standard. While Class IV controls do not satisfy the original Boiler Plus standards unless part of a 'smart' control, respondents argued that the government should reconsider a greater role for Class IV controls, with some suggesting the removal of all controls lower than Class IV from the market (i.e. banning Class I – III controls). One respondent proposed also allowing Class II (simple weather compensation) controls to still be sold.

[3] BEAMA (2021), 'Assessing the energy savings from advanced room thermostat controls in a whole house test facility', https://www.beama.org.uk/resourceLibrary/salford-tests-on-load-and-weather-compensation-.html.

Question 3: Should Energy Labelling Class VIII controls be allowed as an alternative route to compliance? Yes/No. Please expand on your views, including which boiler systems or property types are most suitable for these controls.

Fifty-one respondents expressed a view regarding Class VIII (zonal) controls. Thirty-seven were in favour of allowing Class VIII controls as an alternative. They tended to acknowledge that these types of controls, while the most expensive, had the potential to deliver greater levels of efficiency that Class VI controls. However, 6 respondents noted that these controls would only work for larger properties, where it may be appropriate to create multiple heating zones in a property. Those against Class VIII controls noted their high cost or lack of applicability for other low-carbon technology, such as heat pumps.

Question 4: a) Is it necessary to mandate that all available boilers and controls use open protocols? Yes/No. Please expand on your views. b) Is an appropriate route for achieving this through a government mandate that boilers are sold with open protocol adaptors? Yes/No. Please expand on your views.

Seventy-nine respondents expressed a view on open protocols. Open protocols allow controls and boilers produced by different manufacturers to communicate with each other, enabling interoperability. We understand that, at present, two of the largest UK boiler manufacturers – as well as other manufacturers with a smaller presence in the UK – sell boilers that utilise the open protocol OpenTherm, while the remainder of the market only sell boilers that use closed protocols. If a third-party control is combined with a boiler manufactured by an organisation that uses closed protocols, functionality is limited.

Fifty-nine respondents agreed with introducing mandatory open protocols, while 20 disagreed. Fourteen thought the best way of achieving this was through the sale of boilers with adaptors, however others felt this was unnecessary as there were other ways of achieving the same outcome. An alternative route would be to make all controls plug in cartridges to enable ease of install and open communication.

The benefits of open protocols in enabling controls to communicate and work as intended with all boilers, and thereby enabling consumer choice, were widely cited by respondents, with many referencing their existing use. Some, however, felt more testing would be needed to prevent any potential issues in combining boilers with third party controls.

A point of difference between respondents in favour of using open protocols was regarding the most common open protocol (OpenTherm) and whether a new open protocol should be developed. Nineteen respondents expressed a preference for the development of a new open protocol. There were suggestions that these changes should take into should account PAS 1878[4] and the recent consultation, Delivering a smart and secure electricity system: the interoperability and cyber security of energy smart appliances and remote load control[5].

[4] The British Standards Institute (2021), 'PAS 1878:2021 Energy smart appliances. System functionality and architecture – Specification', https://www.bsigroup.com/en-GB/about-bsi/uk-national-standards-body/about-standards/Innovation/energy-smart-appliances-programme/pas-1878/.

[5] DESNZ and BEIS (2022), 'Delivering a smart and secure electricity system: consultation on interoperability and cyber security of energy smart appliances and remote load control',

A minority of respondents from this group were explicitly against the use of OpenTherm. They tended to express concerns that OpenTherm was an old system and should not be the option selected if the government wants a system fit for the long term. Respondents in favour of creating a new open protocol noted that it would take some time to develop and require cross industry collaboration.

Ten respondents were in favour of using OpenTherm, due to its historical use in industry across many years, its widespread use among control manufacturers, and its ready availability and easy access. Respondents argued these factors meant its mandatory use could be implemented very quickly.

Whether OpenTherm or a new open protocol was developed, a minority of respondents (mostly manufacturers) doubted whether third party control would be able to fully access a boiler's information and error diagnostics. The restriction is for safety reasons and due to design differences. However, while this useful information would be separate from the control, respondents noted that it would still be possible for open protocols controls to use it to improve boiler performance.

> Question 5: a) Should Flue Gas Heat Recovery (FGHR) systems be required as an alternative or additional requirement to Class VI controls, for example, alongside larger combination boilers over 35kW? Yes/No. Please explain your answer. b) If so, should this be limited to certain types of FGHR systems, for example, limited to inbuilt Passive FGHR systems with thermal storage? Yes/No.

There were 60 responses to question 5a, with 25 respondents answering 'Yes', 35 answering 'No' and 28 answering 'Don't know'.

Respondents who supported 5a noted the benefits of passive FGHR systems with thermal storage in increasing heating system efficiency and reducing energy consumption, with some respondents arguing such systems should come as standard with all boilers.

Responses to 5a came from a range of stakeholders including industry. Eighteen respondents stated that the cost rises would be too high and 4 said that there would be little efficiency improvement. They all appeared to agree that the inclusion of these appliances alongside boilers would increase their cost significantly for little return.

There were 78 responses for question 5b, with 7 respondents answering 'Yes' , 31 answering 'No' and 40 answering 'Don't know'. A common reason for supporting the proposal was that all options to increase efficiency and reduce energy consumption should be used, with some respondents, including industry bodies, saying FGHR should come as standard for all boilers. Twelve respondents had concerns that an approach which recognised specific types of FGHRs might restrict innovation. Others noted that these systems would be less effective as part of systems operating at low temperatures.

Government response to questions 1-5

The government acknowledges the risks posed by requiring boilers to be supplied with Class VI controls – that such controls may not be suitable for all properties and may in some cases

https://www.gov.uk/government/consultations/delivering-a-smart-and-secure-electricity-system-the-interoperability-and-cyber-security-of-energy-smart-appliances-and-remote-load-control.

not be installed and therefore wasted. It remains the government's position that all controls should be able to modulate and lower the boiler's flow temperatures as standard, at least for combination boilers. However, given property variance, in our view it is not possible at this point to prescribe the type of compensating control that should be supplied. As such, and in keeping with previous updates to ecodesign and energy labelling policy, the government will seek to prevent the worst performing products from being placed on the market. In the upcoming ecodesign and energy labelling consultation we will propose measures to prevent boilers with Classes I-III controls from being placed on the GB market from 2026 onwards.

Regarding open protocols, the government's view is that a form of open communication between boiler and control is required for heating systems to work at their best, especially given the market prevalence of controls manufactured by parties other than the boiler manufacturers. Therefore, the upcoming ecodesign and energy labelling consultation will propose that from 2026 all heating controls and combination boilers must utilise open protocols and will test whether this should also apply to system and regular boilers. The government does not have a firm preference on which open protocol should be used. Should a new open protocol not be available to be integrated in proposed regulations, it is expected that an existing open protocol such as OpenTherm will be prescribed.

Regarding FGHR systems, the government acknowledges the role these types of systems can have in improving boiler efficiency in the right circumstances. While these will not be mandated, the government hopes the technology can continue to have a role in improving boiler efficiency where appropriate and cost-effective.

Boiler oversizing

> Question 6: Do you agree that all domestic-scale gas combination boilers should be able to modulate to 10% of their maximum output without on/off cycling? Yes/No. Please expand on your views.

There were 104 responses to this question. Fifty agreed with the proposal, 25 disagreed and 29 did not know.

The most common response, from those who agreed, was that wider modulation is beneficial, will reduce cycling and is more efficient than having less modulation. Two heating engineers felt we should go further than 10% and others noted that at very low heat demand there will still be some cycling.

Amongst those who disagreed with the proposal, a group from the manufacturing industry argued that requirements should align with the European Commission's proposals. The majority of these explicitly stated the requirement should be for 1:7 or 15%.

Other respondents argued that meeting this requirement would be costly (some linked to divergence from the EU), and that implementation in 2025 or 2026 is not possible. Some respondents argued for more direct means to address boiler oversizing or other ways to improve boiler efficiency that emphasised overall heating system design. A minority of respondents highlighted safety and flame stability concerns, as well as the current availability of boilers which meet this standard as the main challenges to the proposal.

Question 7: Should minimum boiler outputs be capped, and, if so, at what level? Please expand on your views.

There were 93 responses to this question. Thirty-one agreed that minimum boiler outputs should be capped, 21 disagreed and 41 answered 'Don't know'.

Most respondents who agreed suggested a cap level, with 5kW (7 respondents) and 3kW (4 respondents) the most common suggestions, with a general consensus between 2kW – 5kW.

Of those who agreed with a cap, 8 responded that it should be in place to ensure safe operation and functionality. Many respondents agreed due to the need for modulation requirements to account for smaller boilers. Others focused on the installer role as opposed to boiler design, arguing correct commissioning and system design should limit oversizing.

Amongst those who disagreed, a few argued that commercial boilers should be exempt from any changes. Others argued a cap is unnecessary alongside a wide modulation requirement.

Government response to questions 6-7

Following stakeholder feedback, particularly from those in the manufacturing industry, the government recognises concerns that it is not possible to implement a 10% modulation ratio across the full range of domestic boilers and that requiring such a change over the short-term could increase the cost of boilers. However, the government's view is that combination boilers should be able to modulate down, as close as possible to 10% of their maximum output, to align with heating demands throughout the year, especially during shoulder seasons. Therefore, our new position is to require that from 2028 all domestic-scale (<45kW) combination boilers should be able to modulate down to at least 15% of their maximum output without on/off cycling. We will consult on draft legislation to this effect in the forthcoming ecodesign and energy labelling consultation.

We will continue to explore whether larger domestic-scale combination boilers, such as those over 32kW, should be required to modulate down further, to 10% of their maximum output without on/off cycling, and will include any updates to our position in this regard in the ecodesign and energy labelling consultation.

Given the new 15% modulation requirement proposal, we do not feel it is necessary, as an alternative or in conjunction with this requirement, to implement a cap below which boilers will not be required to modulate output. A 15% requirement can be implemented across a wide range of boiler outputs, including for smaller combination boilers.

System and regular boilers

Question 8: Do you agree that we should extend the revised requirements to include system and regular boilers? Yes/No. Please expand on your views.

There were 101 responses to this question. Fifty-two agreed that the revised requirements should include system and regular boilers, 21 disagreed and 28 answered 'Don't know'.

Some respondents answered relating to the full package of potential measures including heating controls, modulation and FGHRs whereas others only about heating controls. This may have created greater variance in the responses to the question. The responses to modulation and FGHRs are covered in the summary of responses to question 10 and 11.

The responses demonstrated that the heating industry is clearly divided on the benefits of fitting compensating controls with system and regular boilers, often presenting opposing views.

The most common reason for wanting to combine compensating controls with system and regular boilers was the view that previous concerns over the risk of legionella had been overcome. They felt legionella could be effectively mitigated or actively managed such as with controls with anti-legionella cycles. The other group that focused on legionella were more sceptical but agreed with applying controls to system and regular boilers as long as legionella could be managed. Some respondents suggested technological or design solution such as the use of different valves, priority domestic hot water piping or a cartridge system. Other respondents focused on consumer understanding of these boilers and regular boilers needing a longer lead-in time.

Concerns presented by those in industry who disagreed were that older boilers may need to have their piping and wiring completely changed, as they have been installed with basic 230V on/off wiring which may prevent consumers changing boiler due to the disruption. Others felt that commercial systems have more complex controls than our proposal. Some of these respondents disagreed but said if implemented, road maps and legionella safeguards would be required. Others felt there is a lack of familiarity for installers with system and regular boilers.

> Question 9: What additional installer training, if any, would be needed to support system and regular boiler inclusion in these requirements?

There were 69 responses to this question.

Twenty-two respondents, mainly heating installers and those in the heating manufacturing industry, felt that manufacturer training was sufficient and 6 that little or no training is needed. Some specified the type of training installers may need: the installation of compensating controls, anti-legionella cycle testing and priority domestic hot water piping installation.

If responses specified a route for further training it was mainly via manufacturer training, some as refresher training, which could be delivered through manufacturer sponsored training days. Other formal training routes were suggested, with inclusion in Ofqual referenced multiple times.

Barriers to further training were cited, including costs and loss of work hours. They suggested that training should be free or subsided by the government.

> Question 10: Do you agree that the minimum modulation range should apply to system and regular boilers? Yes/No. Please expand on your views.

There were 96 responses to this question. Forty-three agreed that the minimum modulation range should apply to system and regular boilers, 24 disagreed and 29 answered ‘Don’t know’.

There was little consensus on the reasoning between those that agreed with applying minimum modulation to system and regular boilers. Some focused on the benefits of efficiency

that this would deliver, and that system and regular boilers can still be oversized. Others felt that applying it across all boiler types sets a level playing field and that it benefits boiler longevity. Some that agreed suggested a similar cap level to the responses given to question 7, ranging from above 1kW – 5kW.

Of those that disagreed, sizing was the most common concern for the manufacturing industry and heating installers. They suggested that system and regular boilers are more accurately sized compared to combination boilers. Additionally, many responses mentioned that correct system design, sizing, commissioning and rating is important, and there was further concern about how this would work with commercial boilers.

Others argued that if implemented, system and regular boilers would need a different target compared with combination boilers and another that modulation should only focus on combination boilers. Some raised concerns that modulation ratios or caps would not be as efficient for system and regular boilers.

Question 11: What role, if any, can FGHR systems have with system and regular boilers?

There were 60 responses to this question, including 5 ‘Don’t know’ responses.

The most common response was that FGHRs will have a limited or no role with system and regular boilers. Many argued this is because FGHRs are too costly and too complex to install. Some thought there may be a legionella risk and another that the government should focus on bigger efficiency gains. Others saw FGHRs as impractical, hard to use with system and regular due to the separate cylinder or wanted the government to use a system approach and not focus on one technology.

Those that were more positive about FGHRs saw a role for them working for system and regular boilers, believing that they will improve efficiency and save energy, and should be encouraged where there is high hot water use. However, positive responses to this question were limited. Some felt that they should be in-built to boilers and 9 that the installation of FGHRs should be left to consumer and installer choice.

Government response to questions 8-11

As set out in the government’s response to questions 1-5, we intend to prevent Class I-III controls from being placed onto the GB market and will consult on draft legislation in the forthcoming ecodesign and energy labelling consultation. The government recognises concerns made in some responses over requiring Class VI and other compensating controls with system and regular boilers. The revised control proposals will allow these boilers to be installed with Class IV controls and above, mitigating part of industry’s concerns over piping and wiring changes with compensating controls.

The government recognises that it may not be possible in all cases to install compensating controls with a system or regular boiler. However, since there was strong feedback that this is possible and that such set-ups are currently available to consumers, it is the government’s preference that this becomes the norm as far as possible. Therefore, Class V or VI should be installed where possible, noting that Class IV will remain an option. Concerns were raised by some over wiring and piping changes that could be required in order to install compensating controls, however, the government would encourage this piping and wiring to be changed

where possible and cost-effective to do so through engagement with industry and the link to low temperature heating system training – see question 19.

The government does not propose, at present, to require system and regular boilers to run on open protocols, as is the requirement for combination boilers (see question 4). However, we would expect installers of compensating controls with system and regular boilers to select compatible boilers and controls, such that the additional efficiency benefit of the control can be realised, and with anti-legionella cycles. We will keep this under review and engage with industry prior to consulting on draft legislation in the forthcoming ecodesign and energy labelling consultation.

The government agrees with the majority of responses to question 9 that manufacturer training is sufficient, especially to support our revised control proposal. The initial Boiler Plus review[6] found installers frequently reported receiving training on the new Boiler Plus standards, including on load and weather compensators (2 of the 4 options for additional energy saving technologies required under the new standard). Previously, training was provided by large companies either sponsored or run by boiler manufacturers. Following on from this previous training, we would expect manufacturers to play a role in supporting installers to understand how to install compensating controls with system and regular boilers by offering relevant training and guidance, as they have done previously with the condensing boiler mandate in 2005 and when the Boiler Plus Standards were introduced in 2018.

The government will not require system and regular boilers to have a specific modulation requirement or use FGHRs. However, the government welcomes system and regular boilers that have a wide modulation range.

Tested boiler efficiency

> Question 12: Should the tested minimum energy performance standard for a domestic sized gas boiler be increased to a) 93% or b) 94%? Please explain your answer.
>
> Question 13: What real-world efficiency benefits might be realised by such an increase to minimum energy performance standards?
>
> Question 14: What risks or disbenefits might arise from such an increase to minimum energy performance standards?

Seventy respondents provided views in response to questions 12–14. Twenty-nine respondents were supportive of raising minimum tested efficiency, 41 were against. There were two themes shared by respondents both for and against: the first, that 93/94% ErP efficiency represents the theoretical maximum level natural gas boilers will be able to achieve; the second, raised by 27 respondents, that raising minimum tested efficiency would not translate into real-world savings, making little to no difference to bill and carbon savings.

Respondents in favour pointed that out setting higher efficiency removes the worst performing products from the market. Some respondents, including industry organisations, claimed that many boilers on the market already state/claim that they can meet 93% to 94%. Twenty-four

[6] DESNZ and BEIS (2021), 'Boiler Plus: initial policy review', https://www.gov.uk/government/publications/boiler-plus-initial-policy-review.

respondents expressed a preference for what the new minimum efficiency should be: 9 for 93% and 15 for 94%. One respondent, an NGO, stated the government should raise efficiency to 110%, which would essentially remove standalone boilers from the market.

The most prevalent reason against raising minimum efficiency was that focus should instead be on improving heating system efficiency to ensure low temperature operation, including measures on controls, system design and servicing. Another reason against raising minimum efficiency was that it may increase disparity between lab tested efficiency and in-home, real-world efficiency and may, as a consequence, "erode confidence in the testing system". Other respondents felt that the current testing system needed to be reformed to improve accuracy and better reflect real-world conditions.

Government response to questions 12-14

The government's view is that the in-home performance of boilers should be the focus and that increased tested efficiency requirements should only be pursued if this supports real-world efficiency gains. It appears the maximum tested efficiency that could be achieved by a natural gas boiler is around 93%. However, we do not believe raising tested efficiency further would improve real-world benefits.

Low flow temperature factory settings

The government is considering whether another means to improve efficiency and correlation between in-home and tested efficiency would be to require that boilers are supplied with a low temperature default factory setting. The requirement could be set, for example, at 60 degrees Celsius (°C), aligning with the advice given to consumers as part of the government's energy saving campaign, the 'Help for Households' communications campaign which aims to help households reduce their energy bills over the Winter though the default setting could be adjusted during installation where deemed necessary by the installer and consumer.[7] These proposals will be tested in the forthcoming ecodesign and energy labelling consultation.

Hot water storage

> Question 15: Do you agree that the government should set a requirement for all cylinders to have a minimum efficiency rating of B? Yes/No. Please expand on your views.

There were 84 responses to this question with just under half agreeing with the proposal.

Respondents from various perspectives, including industry, supported the proposal. The most common reason given was that raising minimum efficiency would future-proof cylinders and support heat pump uptake. Others stated that raising efficiency would reduce carbon emissions and lower running costs for consumers.

Those against the proposal were mostly manufacturers which tended to focus on two areas: that there would be a significant increase in installation difficulties; and that there would be far

[7] HM Government (2022), 'Help for Households Energy Saving Campaign', https://helpforhouseholds.campaign.gov.uk/.

higher product costs across the board. Sixteen respondents viewed the potential product cost that would face consumers as far outweighing any efficiency benefits.

Many respondents felt the government should focus on other areas such as coil size in the cylinder and improving heat pump compatibility.

> Question 16: What additional measures may be required to ensure that cylinders are future-proofed for use alongside heat pumps?

There were 84 responses to this question. The majority of answers came from a wide variety of stakeholders, mostly from industry, with the most commented on measures being cylinder size and correct coil sizing.

On the former, 12 respondents saw incorrect sizing as being the biggest problem, wasting energy and negatively impacting consumer bills. There were also concerns consumers may switch to a combination boiler if they could not get a cylinder sufficient to provide the home with enough hot water or that was too large, due to increased insulation, to fit into their current airing cupboard. If the space was lost, it may discourage consumers from switching to a heat pump.

It was suggested that the government could provide advice about the correct coil size (used to heat water inside indirect water heating cylinders) with one respondent suggesting the minimum coil size for a range of hot water cylinder sizes, i.e. 90-150L coil size suitable for 6kW heat pump, 150L-210L coil size for 5,6,8,10kW heat pump, 210L-300L coil suitable up to 17kW heat pump

Other suggestions included that the government talk about thermal storage rather than hot water cylinders as this is a more technology-agnostic term, and having clear labelling for consumers and installers regarding heat pump readiness. This was seen as a way of ensuring consumers and installers could select the cylinder and avoid replacement if they were to purchase a heat pump in the future.

Government response to questions 15-16

The government will not move forward raising the minimum efficiency to B for all hot water cylinders.

Based on responses, we will continue to explore whether the minimum efficiency should be raised for different cylinder sizes, or if there should be potential restrictions for hot water cylinders based on coil size. Further consideration will also be given to promoting the interoperability of hot water cylinders and heat pumps.

Improving system commissioning and maintenance

> Question 17: a) What additional information can be collected or recorded by installers to ensure full commissioning for boiler installations take place, for example, should heat loss calculations be recorded? b) What available technologies can be used to speed up this process, including more time-consuming practices like hydraulic balancing?

Eighty-four respondents expressed a view in response to the questions. The responses to both parts of the question tended overlap.

The majority of respondents agreed that more information should be recorded when boilers are installed. Fifty-four respondents agreed that heat loss calculations should be recorded. They noted the availability of digital tools that supported heat loss calculation including heat loss calculation applications that could be downloaded onto smart devices. A government backed heat loss calculator was proposed to ensure consistency.

Other respondents recommended that additional practices should be carried out and recorded including radiator sizing, water treatment, radiator servicing (bleeding & sludge removal), and setting flow and return temperatures. The benefits for these practices included ensuring efficiency and correct heating system design. Some respondents suggested that providing this information would help improve consumer understanding and bridge the gap to heat pumps. Some respondents, including heating installers, were concerned whether additional practices would be carried out or recorded without government regulations. They recommended inclusion in the Building Regulations. They also suggested that greater scrutiny and enforcement of installations was required, given the lack of consumer awareness.

Sixteen respondents suggested that the benchmark commissioning checklist should be used to record installation information. Some suggested that benchmark needed to be expanded to include new areas such as heat loss calculations. A subset of respondents noted that records needed to be easily accessible. However, some heating engineers expressed concerns due to increased paperwork but noted that digital benchmark may avoid this.

The specific practice of hydraulic balancing[8] was raised by respondents on 39 occasions. A subset suggested it should be mandatory, whereas other respondents noted that enforcement issues meant installers were not carrying this out. Another proportion of respondents did not think balancing was needed for all systems, that modulating controls were sufficient and that some systems were impossible to balance.

On 29 occasions, auto-balancing Thermostatic Radiator Valves (TRVs) were referred to as a convenient way to ensure balancing is correctly carried out. There were differing views as to whether these should be mandated or whether their use should be encouraged. However, some respondents felt that for auto-balancing TRVs to be installed, there needed to be a reference to them somewhere in the Building Regulations. A significant number of respondents noted the benefits of balancing in conjunction with auto-balancing TRVs. This was to ensure efficient boiler operation and associated bill savings; the most common suggestion was an 8.8% bill reduction. Two respondents provided estimates of balancing costs - £129 and £155.

Government response to questions 17

Based on the feedback received, the government will consider the options for encouraging the recording and provision of information including heat loss calculation. One option the government will consider is to make better use of the benchmark checklist, especially the

[8] Hydraulic balancing is the process of ensuring the correct distribution of water around the heating systems radiators, so heat is correctly distributed.

digital version, as proposed by industry. We will consider ways to support the widespread use and expansion of digital benchmark. With regards to hydraulic balancing, we will reiterate that it is an expected practice to be undertaken when a boiler is installed. The government welcomes the recommendations from respondents to use tools, such as auto-balancing TRVs, and looks to encourage their deployment in homes to ensure balancing is undertaken. The other option which government will consider further is the feasibility of including more commissioning practices and ways of completing practices within the Building Regulations.

> Question 18: How can regular heating system servicing be encouraged, what practices should be included and what are the potential benefits and costs consumers should expect?

There were 70 responses to this question.

Twenty-five respondents from a variety of different fields, including manufacturers and trade bodies, called for heating system servicing to be mandatory, potentially through new legislation.[9] Twelve respondents suggested that a heating system service should be treated the same as an MOT for a car. Respondents also expressed concern that servicing is not occurring.

Fourteen respondents suggested servicing could be linked to Energy Performance Certificates (EPCs), to ensure the current performance of the boiler and heating system are correctly scored in property ratings. Options short of mandating included strengthening the use of warranties or simply keeping the current system.

Many respondents listed the benefits of servicing, including: extending boiler life, preventing boiler degradation/maintaining efficiency, and the associated carbon and bill savings. In addition, gas safety was also referenced as an important benefit of servicing.

It should be noted that, regardless of the potential benefits, some respondents felt requirements would be too costly, with those who are least able to pay most impacted. They expressed concerns that there would be non-compliance unless those on low incomes were supported.

Respondents who provided cost estimates for servicing suggested it would be in the region of £80 to £200. There was a mix of views about whether this was affordable or expensive. With regards to regularity, the majority with a view thought servicing should take place on an annual basis, with a minority suggesting every two years. While a few respondents felt that the standard gas safety check was sufficient, many respondents recommended the inclusion of additional servicing requirements including a system flush, hydraulic balancing, and water treatment.

[9] At present, boiler servicing is recommended on an annual basis by the Health and Safety Executive and is often linked to boiler warranties. It is currently only mandatory for the private rented sector. Current servicing, when carried out, often only considers the boiler as opposed to the whole heating system. HSE guidance on 'Maintenance - gas appliances and flues' is available at: https://www.hse.gov.uk/gas/landlords/gasappliances.htm.

Government response to question 18

The government will look to strengthen servicing for gas heating and consider if the conditions for mandatory servicing have been met. The government is already taking action to encourage servicing through the Help for Households website energy saving tips, which includes boiler servicing.[10] Care will be taken when considering the introduction of a mandatory servicing requirement, which some groups may find more difficult to finance. This will entail undertaking more comparative analysis and developing an appropriate implementation route with government partners.

> Question 19: Should low temperature heating system training be mandatory for gas boiler installers to help ensure Building Regulations are met? Yes/No. Please expand on your views.

There were 90 responses to this question. Sixty-two respondents agreed that low temperature training should be mandatory for gas boiler installers and 24 disagreed. Two respondents answered 'Don't know'.

Several respondents noted the short-term benefits of requiring this training for installers, including improved efficiency, ensuring boilers meet advertised efficiency and lowering consumer bills. The longer-term benefits noted by respondents were focused on the creation of a skilled workforce ready for net zero. There was a view that undergoing such training could future-proof domestic heating installer skills in a way that would benefit all wet heating systems and prepare some installers to transition to heat pump installations.

Respondents proposed mechanisms for implementing this requirement. The most popular was the inclusion of low temperature heating system design as part of ACS qualifications to be on the Gas Safe Register. Respondents set out that it would ensure all gas installers would undergo the training within 5 years of introduction. A minority of respondents suggested that these skills should not be 'evergreen' and that constant refresher training would be welcome.

Twenty-four respondents were against introducing low temperature training as a requirement. Eight suggested that low temperature training should remain voluntary. Some respondents suggested that mandatory training would create too much pressure on installers or that retraining would be unfair to already trained installers. Others flagged that there may not currently be an appropriate mechanism for achieving this aim, as Gas Safe's focus is gas safety. Training costs were an additional issue flagged by trade bodies and installers. They considered training costs to be too high because of the combination of a loss of earnings and having to pay for training. This led to some suggesting that the government should pay or offer some form of compensation. Two respondents suggested that total training costs would amount to £100m if the government was to cover the entire cost for all eligible installers.

[10] The information to help households 'Get ready for winter' is available at: https://helpforhouseholds.campaign.gov.uk/get-ready-for-winter/.

Government response to question 19

People installing heating systems and self-certifying that their work complies with the Building Regulations must be competent to sign off all aspects of the work, including energy efficiency matters. Competence is checked against the Mandatory Technical Competence (MTC) criteria covering gas heat producing appliances and the installation of heating and hot-water systems served by those appliances. The MTC includes a reference to low temperature training as a prerequisite for gas engineers to demonstrate that they are competent to carry out this type of work.

Based on the feedback and the need to ensure compliance with building regulations, the government intends to move forward with introducing the requirement for low temperature training for boiler installers. The department will work with relevant stakeholders and organisations to discuss implementation and an appropriate timeline.

Real world performance monitoring

> Question 20: What appropriate technological solutions currently exist or could be developed for collecting and displaying real-time efficiency information? Please explain your answer.

There were 64 responses to this question.

Twenty-three responses provided suggestions on existing or potential technological solutions. There were differing views from respondents as to whether monitoring technology already existed and could be applied to boilers as well as low-carbon appliances. The most referenced solution was smart controls including smart control apps and smart meters. Other responses suggested data sets that should be collected to show real-time efficiency, including energy usage, flow temperatures to demonstrate % of time in high efficiency mode, flue gas losses, and boiler run time/cycling time.

A group of responses from the heating industry expressed concerns about the accuracy of such displays. They cited the limitations of boiler technology and the potential reliance on flow temperatures as the main reasons. They suggested combination boilers could be the most inaccurate due to providing hot water on demand. Gas variability and the widening of the Wobbe range would also contribute to inaccuracies.[11] In addition, 18 responses stated that all monitoring options would be too costly, and this increase would be transferred to consumers.

Many responses focused on the consumer benefits/challenges of displaying efficiency information. Respondents either felt that providing this information would help consumers reduce consumption or they would find it confusing and not engage. Those in favour of providing consumer information felt that more should be done by industry.

Government response to question 20

The government will not pursue mandating real world efficiency monitoring displays in boilers at this time. We recognise the potential benefits for all heating products and that it could

[11] The Wobbe range is a measure of the energy value of natural gas by volume.

empower consumers. It is the government's view that smart meters are currently the best way to display this information to consumers.

The government understands that some top-of-the-range boiler products may be able to display data related to real time efficiency. We are expecting further development in this space and will continue to monitor industry developments.

Implementation

> Question 21: Do you agree that the proposals for new boiler and hot water tank product standards should be applied to new boiler installations from 2025? Yes/No. Please expand on your views.
>
> There were 101 responses to this question. Forty-eight agreed that the proposals for new boiler and hot water tank products should be applied from 2025, 33 disagreed and 20 answered 'Don't know'.

Of those that agreed, some made clear that the proposals should be implemented as soon as possible, citing the need to combat climate change, whereas another suggested the new regulations should align with the implementation of the Future Home Standard (FHS). For some respondents concerned with hot water cylinders, they recommended 2025 to support heat pump readiness. Others who agreed suggested that a two-year lead-in time for industry is reasonable, with a respondent suggesting that some products which meet the proposals may be available before 2025.

Of those who disagreed, some in the heating manufacturing industry responded that product development will take at least 4 years. Ten responded that the boiler efficiency proposals should be combined with a suggested hydrogen-ready mandate in 2028. Their reasons being that implementing before a hydrogen-ready mandate will avoid dual research and development costs.

> Question 22: a) Could the proposals be applied to new boiler installations earlier to help lower bills for consumers sooner? Yes/No. Please expand on your views.

There were 91 responses to this question. Thirty-one agreed that the proposals could be applied sooner, 36 disagreed and 24 answered 'Don't know'.

Of those that agreed, many responded that earlier implementation would deliver benefits sooner, reducing carbon emissions and consumer bills, and that products which meet the proposals are already available on the market.

Others agreeing argued that proposals related to heating controls could be implemented sooner through updating the Building Regulations.

Of those that disagree, the majority were part of the heating manufacturing industry and felt that 2025 is too soon. Some of these followed-up that government aims could be achieved through simpler means, such as better design, commissioning and requiring heat loss calculations. Despite disagreeing, some respondents made similar points as those agreeing such as implementing earlier and through the Building Regulations. Others felt that the supply

chain and installers would not be ready for earlier implementation with one response suggesting the proposals could become recommended practice prior to implementation.

> Question 22: b) What additional steps or refinements may be required to support an earlier implementation date?

There were 51 responses to this question.

The most common response to this question was that the government aims could be achieved through focusing on system design factors, such as heat loss calculations, which could allow for earlier implementation, but others saw this as not possible. Additional suggestions included: advertising and information campaigns, to both installer and consumers, free training or training support. Others pointed out that a phased introduction may be needed to support earlier implementation, however one respondent thought no refinements are needed.

> Question 23: What are your views on the cost implications of the various proposals for the average boiler installation? Please expand on your views.

There were 51 responses to this question.

Many responses to this question expressed concern about the potential cost implications of the original proposals with more unsure than were in full agreement.

Some focused on the cumulative impact of the full package of policies as set out in the consultation document whereas others picked out the individual measures they viewed as prohibitive. The individual measures which generated the most concern were requiring FGHRs, Class VI controls (if placed on the market with boilers) and modulation if the level was set to 10% of output for boilers.

However, many other respondents, including manufacturers, noted that amended proposals such as re-setting the modulation level at 1:7 and allowing Class V controls as opposed to only Class VI would mean minimal cost increases while still delivering benefits. A view expressed, by respondents from the energy sector, was that the increased capital costs from the proposals will pay back in a relatively short amount of time, through annual bill savings.

> Question 24: Do you agree that the government should use Ecodesign legislation to implement the proposals? Yes/No. Please expand on your views.

There were 55 respondents who expressed a view including heating engineers, members of public, trade associations, charities and consumer groups, and heating appliance manufacturers.

A fairly even split, including manufacturers, energy companies and consumer advice groups, agreed and disagreed that ecodesign should be used as the implementation method. Thirteen respondents suggested that the Building Regulations should be used as well or instead of ecodesign.

Those who expressed support for using ecodesign felt that this would be appropriate for preventing the worst products from being placed on the market and apply to modulation requirements and heating controls.

Concerns expressed about solely using ecodesign included that most changes also needed to apply to installers and some proposals could not work through ecodesign including installer training requirements, system maintenance and other measures to improve installation practice.

Alignment with European standards and regulations was also referenced throughout the consultation, especially by appliance manufactures, some of whom noted that deviations from Europe require a long lead in time.

> Question 25: What are your views on extending the regulations to cover all gas boilers up to 70kW? Please expand on your views.

There were 60 responses to this question, including 1 ‘Don’t know’ response.

Fifteen respondents supported extension to 70kW with reasons including that this size of boiler will benefit from improved efficiency and reduced gas consumption, and that it ensures that all boiler sizes are treated the same.

Others felt that 70kW boilers are oversized, so should be in scope of the proposals. There were differing views as to whether they should be in scope but with exemptions, and one respondent felt the government should be considering boilers beyond 70kW.

Eighteen responses were against the extension, the majority of whom are in the heating manufacturing industry. The most common response was that commercial boilers are technically different and more complex than under 45kW boilers, which most domestic boilers are, and that extending up to 70kW will bring non-domestic and commercial boilers into scope. Ten responses explicitly pointed to potential issues with systems in cascade. Those in industry felt government should work with them to develop better definitions of domestic and commercial boilers.

Government response to question 21-25

In terms of scope, the government will limit all proposals to boilers less than or equal to 45kW which captures the domestic market. This is due to the additional regulation and challenges stemming from boilers designed for the commercial market.

It is clear that different policy proposals will require different implementation routes.

We are mindful that the market for heat is markedly different in Northern Ireland compared with GB due to the lower penetration of gas boilers. In accordance with the Windsor Framework, EU ecodesign and energy labelling regulations applies in Northern Ireland. It is the government’s intention to implement energy-related product policy proposals via an update to ecodesign and energy labelling regulations in Great Britain. We plan to publish an updated assessment of potential impacts, and further consult on these policies and draft legislation, in 2024.

Our proposals build on existing ecodesign and energy labelling requirements to increase efficiency and deliver the associated energy, cost and carbon savings. The proposals in this document go above and beyond current legal requirements in both Great Britain and Northern Ireland. Accordingly, products produced in line with the proposals for Great Britain will also

meet the current standards of the Northern Ireland market and would then be able to be placed on the market anywhere in the UK.

Similarly, any products produced in Northern Ireland to relevant standards can be placed on the GB market, in accordance with the principles of mutual recognition and non discrimination set out in Part 1 of the UK Internal Market Act 2020 and in line with the Government's unwavering commitment to ensure Northern Ireland traders have unfettered access to the GB market.

Accordingly, nothing in these proposals will affect the movement of boilers either from Northern Ireland to GB or GB to Northern Ireland.

We acknowledge that other proposals will not be implemented using ecodesign and energy labelling legislation – such as requiring low temperature heating system training. Government intends to implement this requirement through the Mandatory Technical Competencies that apply for installation of gas heat producing appliances and the installation of heating and hot-water systems served by those appliances. The department will work with relevant stakeholders and organisations to discuss implementation and an appropriate timeline.

Throughout Chapter 1, we have presented alternative proposals and the future policy direction. It appears clear that, despite the government and many respondents' preference for the earliest possible implementation dates of the product focused proposals, this will not be possible for industry to achieve against all the proposals.

Therefore, the government proposes to prevent control Class I-III from being placed on the GB market and introduce a requirement for all combination boilers and all heating controls to be capable of using open protocols by April 2026. However, the government would welcome engagement with industry to assess whether this can be bought forward.

As covered previously in the response, the government is not recommending a specific open protocol at this stage. However, if industry cannot agree a suitable alternative, it will require already available open communication technology to be utilised. The issue of including system and regular boilers in the open protocol requirement will be returned to in the ecodesign and energy labelling consultation.

We propose to introduce the modulation requirement through the ecodesign and energy labelling consultation but at a slower timeframe. This would mean by July 2028 all combination boilers sold must have a modulation ratio of 1:7. However, we expect new products introduced earlier than this to be able to meet this higher standard by 2026. It is our expectation that the cost of these changes will not impact consumers given the responses received. However, they will be examined in an Impact Assessment to accompany the ecodesign and energy labelling consultation.

In regard to commissioning, installer training and heating system maintenance, the benefits of these proposals are clear, and the government will continue to collaborate with the relevant stakeholders and organisations as we introduce changes.

Chapter 2 – Hydrogen-ready boilers

Mandating hydrogen-ready boilers

> Question 26: What opportunities and challenges would requiring all newly installed domestic-scale natural gas boilers to be hydrogen-ready from 2026 present? Please provide evidence and reasoning to support your answer.

There were 133 responses to this question. A wide variety of views were expressed, highlighting many potential opportunities and challenges posed by a hydrogen-ready mandate. Nearly all the respondents used this question to set out their views on the general advantages and disadvantages of pursuing the use of hydrogen to decarbonise domestic heating. Comments about the potential role of hydrogen have not been included in detail. However, those expressing doubts regarding hydrogen for domestic heating either questioned whether it should still be kept as part of the net zero mix, largely due to inefficiencies with hydrogen production, or whether the government should focus on other policies or other technologies at present and return to hydrogen in the future. A subset of these respondents felt the decision to introduce a hydrogen-ready mandate should occur when decisions on the approach to the decarbonisation of heat are taken in 2026. Those in favour of the use of hydrogen tended to say that rolling out hydrogen-ready boilers is low regrets and that the use of hydrogen would be a more attractive consumer choice.

Responses to this question came from the full cross section of manufacturers, heating engineers, trade bodies, members of the public, think tanks, charities and academics. The views between all these groups were split with representatives from each stakeholder type being for and against the use of hydrogen for domestic heating generally.

The themes raised in support of a hydrogen-ready mandate included:

1. that cost parity between natural gas boilers and hydrogen-ready boilers is achievable

   Nearly all supportive respondents referenced the representations made by the large boiler manufacturers, Baxi, Ideal, Vaillant and Worcester Bosch arranged by their trade association, the Energy and Utilities Alliance, which set out that once production of hydrogen-ready boilers reaches current levels of production for natural gas boilers, their costs will be equivalent.

2. that there are no significant technical barriers to the development of hydrogen-ready boilers

   Many respondents pointed to the department's Hy4Heat[12] programme, through which prototype hydrogen-ready boilers were developed, alongside other testing projects such as H21[13] and HyHouse[14].These were seen as proving the use of hydrogen in homes.

3. that deployment of hydrogen-ready boilers is less disruptive than that of heat pumps

   Heat pump comparisons were drawn upon to make the case for hydrogen-ready boilers. Hydrogen-ready boilers were often described as 'like-for-like' replacements in comparison to the 'disruption' caused by heat pump installations. This was mainly focused on the number of changes required to homes to make them suitable for heat pumps. They made the case that, other than changing the gas in fuelling the boilers, no home upgrades would be required.

4. the hydrogen-ready boilers will support future hydrogen conversion and investment

   Respondents stated that the purpose and benefit of hydrogen-ready boilers is to reduce the overall costs of a future hydrogen conversion by minimising the amount of boiler scrappage. Respondents felt it would support jobs and skills, with a few explicit references to manufacturing, and that it would stimulate investment in hydrogen production.

Key themes raised by respondents against the mandate were often linked to concerns about hydrogen for heating, namely:

1. that a hydrogen-ready mandate may delay moves towards net zero

   A frequent response was that a hydrogen-ready mandate would transfer resources from industry and consumers away from investments that will support net zero, with some respondents describing it as a distraction. Examples given were that it would reduce/prevent investment in heat pumps and home upgrades.

2. that future hydrogen deployment will be limited

   Another cost set against a hydrogen-ready mandate was that hydrogen for heating is unlikely to represent a significant amount of domestic heating and will not be countrywide. Therefore, consumers will be required to buy products that will not be used as intended. Respondents referenced recent reports from the CCC[15] and the Mission

[12] A government funded research programme with the aim of establishing if it is technically possible, safe and convenient to replace natural gas (methane) with hydrogen in residential and commercial buildings and gas appliances. This included supporting the development of prototype hydrogen-ready boilers for domestic purposes, which are considered in this consultation.
[13] H21 Leeds City Gate report aimed to show that converting UK gas network to 100% hydrogen was both technically possible and could be delivered at a realistic cost.
[14] HyHouse is a project testing the use of hydrogen in house.
[15] The Climate Change Committee, 'Progress Reports', https://www.theccc.org.uk/publicationtype/0-report/02-progress-reports/.

Zero: Independent Review of Net Zero - final report[16] led by Rt Hon Chris Skidmore MP that focused on a smaller role for hydrogen in heating. Others inferred that a localised conversion is more likely, linking it to hydrogen's role in decarbonising other sectors such as heavy industry.

3. that a mandate will create consumer confusion, with risk of greenwashing

   Respondents were concerned that the delay between purchase and a potential hydrogen conversion will create consumer confusion and lead to lots of mis-selling and "green" marketing for products that will burn fossil fuels.

4. that cost parity with natural gas boilers may not be achievable

   Some respondents were sceptical of the cost parity promise made by manufacturers, viewing it as lacking evidence. Some pointed to research produced in 2018 which suggested that hydrogen-ready boilers would be slightly more expensive to produce at scale, whereas others were more concerned about government's ability to enforce a cost commitment.

Timing

The timing and manner of a hydrogen-ready mandate was also raised, with disagreement as to whether 2026 was the correct date. Respondents who commented on the timing of an introduction came from both supportive and sceptical hydrogen perspectives and centred around 3 different recommendations.

1. The majority of respondents who commented on the timing stated that it would be more appropriate for new boiler ranges to be hydrogen-ready from 2026 with 2028 the year for a full mandate, allowing more time for manufacturers to develop their full range of hydrogen-ready boilers. However, respondents noted the government would be required to confirm this decision by the beginning of 2024 at the latest for this to be achievable.
2. An alternative view, from some of those in favour of hydrogen roll out, suggested 2026 or an earlier implementation date.
3. Finally, a common view from respondents who were more sceptical of the role of hydrogen was that introducing a hydrogen-ready mandate now would be premature. Many suggested delaying decisions on the deployment of hydrogen-ready boilers until decisions on hydrogen for heating are made in 2026, or that these decisions should be taken at a local level (and focused on hydrogen producing industrial areas). These respondents also tended to suggest that the safety case and trials should be completed prior to a decision being made about a hydrogen-ready mandate.

[16] DESNZ and BEIS (2022), 'Mission Zero: Independent Review of Net Zero - final report', https://www.gov.uk/government/publications/review-of-net-zero.

Government response to question 26

The government acknowledges the range of views expressed in relation to this question and that respondents were often either strongly in favour of the potential benefits or concerned about the potential challenges that exist with hydrogen for heating.

The government is working with industry, regulators and others to deliver a range of research, development and testing projects to assess the feasibility, costs and benefits of using hydrogen for heating. This work includes a neighbourhood trial ("H100") in Fife. The government plans to take a decision in 2026 on whether, and if so how, hydrogen will contribute to heating decarbonisation.

As set out in the government's response to the Committee on Climate Change 2023 progress report[17], it is the government's view that, while there remains the potential for hydrogen to play a role in slower time in some locations, heat pumps and heat networks will be the primary means of decarbonisation for the foreseeable future and furthering the deployment of these technologies should remain the focus while questions remain about the role of hydrogen for domestic heating.

In this context, and based on the responses received to the consultation, the government has determined that it would not be proportionate to mandate hydrogen-ready boilers across the market ahead of the decision government plans to take in 2026 on whether, and if so how, hydrogen will contribute to heating decarbonisation.

If a decision is taken in 2026 that hydrogen will play a substantive role in heat decarbonisation, it is our intention to then mandate that domestic-scale gas boilers will be hydrogen-ready from 2030. This is based on feedback from boiler manufacturers that they require at least 4 years to invest in supply chains and convert production processes across all their product ranges.

We will, in the meantime, consult through the forthcoming ecodesign and energy labelling consultation, due to be published this year, on underpinning regulations creating appropriate standards for hydrogen-ready boilers. Doing so now will create a common definition for what can and cannot be marketed as a hydrogen-ready boiler and allow manufacturers to begin product development, preparing the ground for any future mandate, so that it can be implemented as quickly as possible. A further amendment to these regulations would then be required to introduce a hydrogen-ready mandate.

In addition, we reconfirm the position that hydrogen-ready boilers should not be termed low-carbon appliances in marketing materials or materials that accompany the appliance. At the time of this government response, we are aware that the Competition and Markets Authority (CMA) is investigating the marketing of hydrogen blend-ready boilers, that is, boilers that have been tested to use a blend of 20% hydrogen with 80% natural gas. While the CMA is an independent, non-ministerial department and the government was not involved in the decision to launch this investigation, the government is clear that no potential 'greenwashing' or mis-selling should occur with products that will potentially not be converted to 100% low-carbon hydrogen. We will take into account the outcome of the CMA investigation when developing future proposals. Once areas have been confirmed for hydrogen conversion in the future, the

[17] HM Government (2023) 'Responding to the Climate Change Committee's (CCC) 2023 Annual Progress Report to Parliament', https://assets.publishing.service.gov.uk/media/65393f4ae6c968000daa9b0e/ccc-annual-progress-report-2023-government-response.pdf.

government will re-examine whether they should be considered low-carbon appliances and therefore reassess their categorisation.

Hydrogen-ready boiler costs

> Question 27: If made mandatory, can hydrogen-ready boilers match the cost of current natural gas boilers? Yes/No. Please provide evidence and reasoning to support your answer.

There were 112 responses to this question. Fifty-one respondents agreed hydrogen-ready boilers could match the current cost of natural gas boilers if mandated. Twenty-two did not think price parity could be achieved, while 39 respondents did not give a firm answer either way.

Of the respondents that agreed cost parity could be reached, 27 referenced the cost promise made by the big four boiler manufacturers, with the majority stating it requires economies of scale. Those in the heating industry noted that hydrogen-ready boilers are a similar product to natural gas boilers with a similar manufacturing process, which will control costs. Whereas other respondents viewed a mandate as giving confidence to invest in efficient supply chains. Respondents also pointed to market competition to prevent cost increases. Some respondents who agreed with cost parity linked the economies scales to other markets, such as in Europe.

Conversely, respondents who did not agree that cost parity could be achieved argued that economies of scale would not be large enough, noting policy divergence from European markets. Respondents also noted that the big four cost promise is not binding and if there are increased costs, they will be passed onto consumers.

Respondents concerned about potential cost increases suggested that other potential consumer expenses needed to be considered alongside the initial capital costs, including running costs, system transformation and conversion costs, as well as wider public costs.

Thirty-nine respondents stated they did not know if cost parity was possible, with some suggesting that further analysis on the cost of hydrogen-ready boilers is needed.

> Question 28: Do you anticipate the installation of a hydrogen-ready boiler to take the same time as a natural gas boiler replacement? Yes/No. Please expand on your views.

There were 104 responses to this question, with 64 respondents saying the installation time would be the same, 16 disagreeing and 24 not sure.

Twenty-three respondents argued that natural gas boilers and hydrogen-ready boilers are similar or virtually the same product, with some arguing that no additional works or property assessment should be required to install them. Benchmark was referenced by those in industry as way of recording a hydrogen-ready boiler installation – some flagged this may add a short amount of additional time to the installation.

Other responses agreed while acknowledging more time will be needed to convert the appliance. Gas piping changes were also referenced as potentially being required in some cases to make a property suitable for hydrogen usage.

Those respondents who thought the installation time would take longer focused on additional changes to a property or wider infrastructure to make an area ready for a hydrogen conversion, as opposed to installing a hydrogen-ready boiler to operate using natural gas. The examples given included additional safety measures and checks; and changes to pipework, radiators or ventilation.

> Question 29: a) For early adopters of hydrogen-ready boilers, in advance of a government mandate, can consumers expect to pay more for hydrogen-ready boilers? Yes/No. Please expand on your views.

There were 103 responses to this question, with 53 respondents believing early adopters can expect to pay more, 23 disagreeing, and 27 answered 'Don't know'.

Twenty-three respondents argued that appliances would cost more prior to the hydrogen-ready mandate being introduced as there will be smaller economies of scale, with a few noting divergence from the European market. Some respondents stated that a mandate is key to ensuring price parity.

Other respondents anticipated that even when they are new to the market, cost increases should not be an issue, noting that increases would only be small. However, a small number argued hydrogen-ready boilers will be more expensive to manufacture and that government grants should be available.

Amongst those who disagreed some referred again to the manufacturers' commitments around costs. Others noted that consumers would have a choice as to whether to select a more expensive boiler prior to the mandate, and that consumer pressures due to the availability of natural gas only boilers would be a control on prices.

> Question 29: b) What protection can be put in place to support consumers?

There were 57 responses to this question. Twelve responses stated that no protection for consumers is needed. Other responses supported the provision of consumer information and government intervention or support to manage consumer costs.

Regarding information for consumers, some respondents suggested action was required to ensure consumers are not misled on the likelihood of hydrogen, including timing of grid conversion. They also recommended that consumers should be protected from buying hydrogen-ready boilers where a hydrogen conversion is unlikely to happen, or that purchasing should be limited to areas where hydrogen is likely.

Regarding costs, eight respondents suggested protecting consumers with grants or incentives, such as reducing VAT on boilers. Others responded that consumers are currently paying more for heat pumps than the government expects them to cost later in the decade.

Other respondents proposed the following measures to support consumers: future support for hydrogen conversion, hydrogen fuel cost protection for lower income households, trained technologically neutral installers who are better able to advise consumers and offer them different products, and an independent ombudsman to be responsible for overseeing the mandate and associated cost changes.

Government response to questions 27-29

Public commitments from the major boiler manufacturers are clear that hydrogen-ready boilers should not cost more than natural gas boilers once sales volumes reach current levels. It seems reasonable to conclude that there will not be any cost increases, or they will be relatively small and related only to production costs. We do not anticipate any cost rises from increased labour costs, given that hydrogen-ready boilers, at the time of install, will be a simple replacement to natural gas boilers. It is noted that consumers who choose to purchase a hydrogen-ready boiler before a mandate comes into effect may do so at a cost premium compared to natural gas only boilers due to limited market penetration.

The department is still assessing and exploring the use of hydrogen for heating. The total costs of potential hydrogen conversion will be determined through evidence collected.

Hydrogen-ready boiler definition

> Question 30: Do you agree with the proposed basis for a definition for hydrogen-ready boilers? Yes/No. Please expand on your views.

There were 106 responses to question 30. Fifty-nine respondents agreed with the government's proposed definition. Nineteen did not agree and suggested amendments and alternatives, while 28 respondents did not give a firm answer either way.

Many respondents noted the importance of a hydrogen-ready boiler definition, to avoid consumer and installer confusion, or potential miss-selling, and others noted that a definition was required to avoid hydrogen blend boilers[18] being sold as hydrogen-ready boilers and the need to ensure consumers were aware their boiler would initially run on natural gas and may never be converted to hydrogen.

A number of respondents, mostly from the heating sector, agreed with the definition but felt more detail was needed to develop a full version, with a subset stating the government should collaborate with industry on this basis. Some specified further detail to add to the definition including on the conversion time, process and the installation site. Some of those in the heating sector also argued the definition must remain design agnostic, allowing for innovation and others pointed out the link with the PAS4444 standards.

Respondents who disagreed with the definition called for further clarification to be added. They suggest a full definition should include the requirements around pipework, furnace material and flame detection systems to ensure it is hydrogen compatible as well as clarification on the conversion time, process and conversion kits. Others focused on clarification of the minimum energy efficiency performance standard and the primary energy factor of hydrogen.

Some respondents argued that before conversion they should not be referred to as hydrogen-ready boilers. Concerns were also expressed about having a different definition in the UK and the EU.

[18] Hydrogen-blend boilers are gas boilers able to run on a blend of 20% hydrogen and 80% natural gas.

Government response to question 30

Based on the feedback received, it is the government's position to further consult on using the following definition in forthcoming ecodesign regulations:

A domestic hydrogen-ready boiler is a gas boiler of any type (Regular, System or Combination) that "out of the box" is ready to be connected to the Natural Gas Network and is technically prepared to be converted, normally within 2 hours, into a safe boiler that can use 100% hydrogen as a fuel and maintains the minimum energy efficiency performance standard. Conversion kits will be supplied by the boiler manufacturer if and when hydrogen conversion is confirmed in the area where the boiler is installed.

This definition will be utilised in the forthcoming ecodesign and energy labelling consultation and accompanying draft regulations. We will collaborate with industry to assess if any further refinements are required.

The government also intends to strengthen communications including potentially through the official definition that hydrogen-ready boilers should not be considered low-carbon when operating in natural gas mode. This will need to be clearly stated in any materials accompanying or referring to the boiler. It should remain clear to consumers purchasing hydrogen-ready boilers, including in communications from manufacturers, retailers and installers, that hydrogen-ready functionality provides no assurance that low-carbon hydrogen will be available within the lifetime of the appliance, and the appliance will need to be converted to actually run on hydrogen.

Tested hydrogen-ready boiler performance

> Question 31: a) Do you agree that domestic-scale hydrogen-ready boilers should continue to meet 92% ErP efficiency? Yes/No. Please expand on your views.
>
> b) If ErP efficiency standards for gas boilers were raised to 93% or 94%, as set out in question 12, could hydrogen-ready boilers meet this increased standard, when operating using both natural gas and hydrogen? Yes/No. Please expand on your views.

There were 74 responses to this question. Respondents included heating appliance manufacturers, heating engineers, think tanks, consumer advice, environmental charities and members of the public. It should be noted that the tested efficiency being considered at the moment assumes that the primary energy factor of hydrogen and natural gas will remain the same. This decision is still to be taken by the government.

It was acknowledged that raising the tested efficiency to levels higher than 92% offer very little in-home performance benefit in comparison to improvements that can be made to the heating system itself, especially where these ensure the heating system runs at low flow temperatures.

Forty-seven respondents agreed that 92% ErP should be the minimum standard, with 13 of these making clear that this requirement should only apply when the boiler is running in natural

gas mode. Others proposed that boilers running in hydrogen-mode should match whatever the minimum efficiency is for natural gas.

Some respondents, mainly from the manufacturing industry, noted that the maximum efficiency level currently achievable for boilers in hydrogen mode is 90%, and that at higher thresholds there may be a tension between ensuring high efficiency and reducing NOx emissions (as covered in question 32).

Other respondents, including from consumer advice groups, took the view that hydrogen heating systems should be as efficient as possible while using both fuels, and so preferred 93% or 94%, with others explaining that this was possible for natural gas but not hydrogen.

Government response to question 31

Based on the responses to question 12, we are minded to keep the minimum tested efficiency of boilers using natural gas as 92% ErP. It remains the government's preferred position for there to be no drop off in efficiency between hydrogen-ready boilers operating in natural gas mode and hydrogen mode, and therefore to maintain the equivalent of a 92% ErP efficiency requirement for hydrogen-ready boilers when operating in hydrogen mode. We will keep this position under review.

We understand that there is a discrepancy between tested boiler efficiency and how they perform in homes and are attempting to address this through Chapter 1 of this document. Even if the minimum efficiency for hydrogen is currently set at 90%, if a hydrogen boiler is at optimal low temperatures year-round it will surpass typical natural gas boiler performance. This would require a hydrogen boiler to be combined with a low temperature heating system.

Hydrogen-ready boilers and air quality

> Question 32: Could hydrogen-ready boilers meet lower nitrogen oxide emission limits, when running on hydrogen gas? Please provide evidence and reasoning to support your answer.

There were 55 responses to this question. The types of stakeholders to respond included manufacturers, energy consultancies, charities, members of the public, trade associations and academics.

The maximum NOx emissions currently permitted by gas boilers is 56mg/kWh.[19] Forty-one respondents (mostly from industry) held the view that in hydrogen mode boilers could meet more stringent NOx standards while 12 disagreed, and 2 were unsure.

Those who disagreed and questioned whether boilers could have lower NOx included Green Charities, local government and academics, suggesting a full assessment was needed. They were concerned that NOx emissions may increase when trying to reach higher tested efficiency. Others noted that any level of NOx emission is too high and that it could potentially

[19] The National Archives (2018), 'Commission Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for space heaters and combination heaters, Annex II, Division 4', https://www.legislation.gov.uk/eur/2013/813/annex/II/division/4#.

lead to higher NOx emissions if in home performance is not corrected. These respondents also called for stricter NOx levels in general for combustion appliances.

Those who agreed that lower NOx levels were achievable for hydrogen burning boilers suggested the following levels: 15mg/kWh, 25mg/kWh, 35mg/kWh to as low as 5.5mg/kWh, far lower than the current natural gas standard.

Many pointed to evidence sources which demonstrated the lower level of NOx boilers burning hydrogen can reach. This included official testing undertaken by boiler manufacturers, the government's Hy4heat programme and H21.

Government response to question 32

As a result of these responses, the Department for Energy Security and Net Zero will discuss with the Department for Environment, Food and Rural Affairs, which leads on government air quality policy, what level NOx should be lowered to following the introduction of hydrogen-ready boilers. A separate consultation will be required to set a new NOx emission level and the current proposal is to set out any potential changes for further consideration in the ecodesign and energy labelling consultation planned for this year.

Scope

> Question 33: Do you agree that any requirement for domestic gas boilers to be hydrogen-ready in 2026 should be made through an update to UK Ecodesign legislation? Yes/No. Please expand on your views.

There were 54 responses to this question.

Thirty-six agreed that ecodesign is the appropriate route for introducing product requirements related to hydrogen-ready boilers and 16 disagreed, proposing alternatives.

Twenty-five respondents, mostly from the heating industry, agreed that ecodesign is the easiest or most appropriate vehicle to deliver a hydrogen-ready mandate, principally because the standards are product focused.

Eleven of these agreed in principle but cited potential limitations with using ecodesign. Some noted that prior to a hydrogen conversion, hydrogen appliances and associated scores will need to be added to SAP as well as ecodesign regulations, and that this may impact existing property EPC ratings (resulting from necessary differences in the Primary Energy Factors (PEF) for natural gas and hydrogen).

Of the respondents that disagreed with the use of ecodesign, alternatives and reasons presented included the time needed for the market to adjust, and concerns about the accuracy of ecodesign as it was unable to reflect real-world conditions. They sometimes suggested using building regulations in line with previous regulatory changes.

Labelling was another area mentioned, with ten respondents advising that a hydrogen-ready boiler should carry a natural gas label to be updated when the boiler is converted to hydrogen-

mode, to show the ErP band of the hydrogen product. Respondents advised the definition of hydrogen-ready should be controlled to prevent ‘green washing’.

Government response to question 33

If the government decides in 2026 that hydrogen will contribute to heating decarbonisation, it is our intention to mandate that domestic-scale gas boilers will be hydrogen-ready from 2030. This will provide industry with the necessary lead-in times to make the investment required to ensure all their boiler ranges are hydrogen-ready.

We consider ecodesign and energy labelling, as it is product focused, to be appropriate for introducing underpinning regulations for hydrogen-ready boilers. We will consult on standards through the forthcoming ecodesign and energy labelling consultation.

To introduce a mandate, a further amendment to ecodesign and energy labelling will be required.

> Question 34: Would you support increasing the scope of the hydrogen-ready mandate to include gas boilers with capacity of up to 70kW in 2026 or at a later date? Yes/No. Please expand on your views.

There were 99 responses to this question. Forty-one supported the inclusion of larger boilers, 31 were against, and 27 answered ‘Don’t know’.

A number of respondents agreed but argued that expanding the scope to larger boilers would require a later implementation date, generally suggesting 2-3 years after domestic implementation and after the 2026 decisions related to hydrogen for heat. Some noted that larger hydrogen-ready boilers are at a much earlier stage of development compared with domestic boilers.

Many respondents noted that larger boilers make up a far smaller market, so there would be reduced economies of scale, and these boilers would cost more than natural gas boilers. Some suggested component parts may become more readily available after a domestic-scale mandate.

Conversely, multiple respondents argued larger hydrogen-ready boilers should be introduced at the same time as in the domestic market. Some respondents argued their introduction would provide a signal to industry and facilitate a grid conversion to hydrogen, while others argued all boilers should be treated the same. Some in favour noted the need for clearer definitions of commercial boilers.

Of those disagreeing, a few respondents expressed a preference for electrification in the commercial sector. Others disagreeing made similar points to those agreeing, stating 2026 is too soon but they could support a later implementation date, while noting the smaller market.

Government response to question 34

If the government decides in 2026 that hydrogen will contribute to heating decarbonisation, it is our intention to mandate that domestic-scale gas boilers will be hydrogen-ready from 2030. Based on the feedback received, the mandate is limited to domestic-scale boilers, those with a

capacity of 45kW or less. However, given that a further amendment to regulations will be required to introduce the hydrogen-ready mandate, the question of requirements for larger boilers could also be considered then.

Conversion – parts management

> Question 35: Do you agree that hydrogen-ready boiler conversion kits should only be supplied when a hydrogen grid conversion of an area has been confirmed? Yes/No. Please expand on your views.

There were 111 responses to this question. Seventy-eight supported the proposal that conversion kits should only be supplied at the point of conversion, 15 disagreed, with 18 answered 'Don't know'.

Twenty-four respondents supported the government's position on the basis that it would limit wastage created by other options, with 18 linking this directly to uncertainty about hydrogen. Other respondents were concerned that the advanced production of conversion kits would increase boiler costs and that these would be transferred to the consumer. Six respondents thought it was unreasonable to ask consumers to take responsibility for conversion kits.

Seventeen respondents supported the proposal as it would reduce the cost and time required at the point of conversion. Others agreed but felt consideration was needed for manufacturers that may leave the market, suggesting manufacturers should hold some kits in reserve.

The minority that disagreed with the government's position tended to do so over concerns of manufacturers leaving the market. Some tended to prefer placing conversion kits on the market with the boilers and making consumers responsible.

> Question 36: Do you agree that information regarding the location and model of the hydrogen-ready boiler needs to be collected in an easily accessible format for manufacturers and networks to ensure a smooth future hydrogen conversion and roll out? Yes/No. Please expand on your views.

There were 62 responses to this proposal. Fifty-three agreed with the proposal, 5 were against and 4 answered 'Don't know'. Respondents provided views on reasons for and against the collection of information, suggestions about who should hold the data and recommendations about what information should be collected.

The most common reasons expressed for collecting and storing installation information was that it will support future conversion and reduce disruption. It was also flagged as a way of helping to encourage better maintenance and better-quality installations.

Those against collecting install data, including consumer advice groups, expressed concerns about protecting consumer information. Others were sceptical about creating more bureaucracy. They suggested that area surveys will be required in advance of conversion, meaning installation data collection offers little benefit.

Twenty-one respondents proposed using Benchmark to store information, with the focus being on the digital Benchmark system as opposed to the paper-based version, as it enables multiple

fields such as commissioning information and serial number to be kept in the same place. Some, including heating engineers, suggested Gas Safe records as the correct body to hold installation data. However, there were concerns expressed by various respondents that there is under-reporting against Gas Safe requirements generally and that additional enforcement is required. Other suggestions by energy consultants and trade bodies were that Local Authorities' Building Control should hold the information or that manufacturers should take responsibility.

Respondents including manufacturers, gas networks, merchants and standards agencies suggested that the location should be recorded. Some agreed with the importance of capturing serial numbers to assist in supplying conversion kits.

Government response to question 35-36

The government agrees with respondents that wastage and cost need to be minimised. As such our position is that conversion kits should only be supplied once conversion is confirmed.

The government's view is that there are clear benefits to collecting information about the location and model of hydrogen-ready boilers and it will support a hydrogen-ready conversion, even if this is supplemented by further surveys. This information will also need to be made accessible at the very least to organisations like the gas networks. We acknowledge that appropriate safeguards will need to be in place and will work with relevant stakeholders and organisations to determine who and how this information should be collected.

Conversion – additional works and maintenance

> Question 37: Building on question 18, we welcome views as to whether the change to hydrogen-ready boilers is likely to mean the government should look to strengthen the amount of regular maintenance required on boilers throughout their life span, given the need to ensure their fitness for hydrogen conversion can be preserved? Please expand on your views.

There were 73 responses to this question. Forty-six were in favour of increased maintenance, 22 were against and 5 answered 'Don't know'.

Many respondents argued that hydrogen is as safe as natural gas. Some pointed to this as a reason not to increase the amount of servicing and were concerned that an increased requirement for servicing may create negative consumer perceptions around hydrogen boilers. However, the majority of those who made this point were in favour of additional servicing, given its wider benefits (as discussed in question 18) including extension of boiler life, efficiency etc. Based on these benefits respondents, including gas networks trade association and manufacturers, tended to be in favour of mandatory servicing and repeated this position and that it should also apply to heat pumps.

A minority, including energy consultancies and environmental charities, were concerned about the safety of hydrogen, noting the potential for leaks, and pointed to this as reason for increased maintenance. A significant minority of respondents to this question thought that post

conversion all the boilers will require an additional service. Some respondents argued tighter requirements for servicing may be difficult to enforce and would increase costs, and that changes were unnecessary.

Government response to question 37

At a minimum, a full service will be required when a boiler is converted to hydrogen. Beyond this, as in the response to question 18, the government will look to strengthen servicing for gas heating and consider if the correct conditions for mandatory servicing have been met.

Installer skills

> Question 38: Do you agree that installers should be required to complete a module in hydrogen training prior to being permitted to fit hydrogen-ready boilers? Yes/No. Please expand on your views.

There were 130 responses to this proposal. Thirty-eight responses agreed, 80 disagreed, while 12 answered ‘Don’t know’. Industry representatives, including manufacturers and installers, were split between being for and against the requirement.

The majority viewed hydrogen-ready and natural gas boiler installations as being the same, noting that, at the point of install, the boilers are expected to run on natural gas for the foreseeable future. As such, there would be no need to complete additional training in advance of the initial installation. However, a hydrogen training module will be required prior to an installer being able to convert a hydrogen-ready boiler to burn hydrogen. Some proposed including it in as an Accredited Certification Scheme (ACS) module to be on the Gas Safe Register after the decisions on hydrogen for heating are made.

Other respondents recommended encouraging installers to focus training days on other areas such as low temperature system training, especially given there is no guarantee at this stage that boilers will be converted to hydrogen.

The main reason referenced by those in favour of mandatory training was safety. They expressed the view that training should be required to work with this new fuel and ensure the boiler is installed correctly.

Government response to question 38

Based on the responses, the government will not move forward with requiring hydrogen training while installers are fitting hydrogen-ready boilers to operate in natural gas mode.

However, the government agrees that once hydrogen conversion has been confirmed, hydrogen training should be available through ACS.

Installers of hydrogen-ready boilers to operate in natural gas model will continue to be subject to the rigorous training and competency controls in place at present for existing natural gas boilers, ensuring the quality and safety of installations.

Chapter 3 – Hybrids

For the purposes of this government response, we will use ‘hybrid’ or ‘hybrids’ to refer to hybrid heating systems that include a gas boiler and a heat pump. A full glossary of key terms and acronyms is included in Annex B.

Low-carbon operation

Seasonal Space Heating Energy Efficiency ($\eta_{s,h}$ or ‘SSHEE’) is the metric used to set Minimum Energy Performance Standards (MEPS) in ecodesign regulation and to set the energy efficiency classes included on each product’s energy label. The total calculated SSHEE of a hybrid heating system should consider which heat source is designed to be utilised at different external temperatures, the performance of that heat source at that bin temperature, the primary energy of the fuel used, and any relevant corrections.

The government consultation proposed establishing a minimum SSHEE value for hybrids, giving an example value of 125%.

> Question 39: What is a reasonable minimum SSHEE value for hybrid heat pumps? Please provide evidence and reasoning to support your answer.

There were 42 responses to this question. The most proposed SSHEE value was 110%, advised by 22 respondents, primarily manufacturers and members’ associations. Twenty of these respondents cited previous EU proposals for a minimum SSHEE value of 110% for hybrids, recommending that the UK align with this. Respondents noted that manufacturers often operate across Europe and that divergence in product requirements between EU and GB markets could lead to differing supply chains and manufacturing processes, which could increase costs. Other respondents suggested a range of SSHEE values between 100%+ and 250%.

Those in favour of a lower SSHEE noted that MEPS were originally designed to remove the lowest performing products from the market, that higher requirements could reduce consumer choice, that divergence from EU requirements could increase costs to GB consumers, and that too high a standard may make hybrids less attractive in harder-to-treat homes. Those in favour of a higher SSHEE value noted lower values may deliver limited usage of the heat pump element.

> Question 40: What is a reasonable minimum seasonal heating output, from the heat pump, for a hybrid system? Please provide evidence and reasoning to support your answer.

There were 28 responses to this question. Eleven respondents provided recommendations of minimum seasonal heat pump outputs ranging from 50% to >80%. Many others noted that 70% heat pump space heating output is achievable, as demonstrated through multiple trials,

including the Freedom Project and Electrification of Heat Demonstration Project.[20] Ten respondents suggested that the government should consider setting different requirements according to the properties' EPC rating.

Those in favour of a higher minimum space heating output for the heat pump noted the additional carbon savings this would deliver. Those in favour of a lower requirement advised a higher minimum might make hybrids unsuitable for harder-to-treat homes and noted this would reduce appliances' flexibility to switch between gas boiler and heat pump, which would remove or reduce the scope for system cost optimisation and increase running costs.

Some respondents also argued against the principle of a minimum heat pump output requirement on the basis it is a blunt tool which does not take the specifics of the property into account and would be difficult to enforce.

Government response to questions 39-40

The government is committed to increasing the environmental performance of energy-related products through greater energy efficiency and resource efficiency. In line with the responses received to question 39, the government proposes to set a minimum SSHEE for hybrids of more than 100%. We are minded to further explore a minimum SSHEE of around 125% for hybrids. The government does not currently propose to also set a minimum output from the heat pump in a hybrid system through ecodesign legislation. Instead, we intend to build a framework to enable and encourage greater heat pump use.

We will consult further on the appropriate level and timing for introduction of new SSHEE requirements for hybrids through the upcoming consultation on ecodesign and energy labelling.

We note the majority of respondents' recommendations regarding SSHEE values and the benefits and risks of creating a niche GB market that could result in higher costs for consumers. We will remain mindful of the impacts of divergence between markets when developing our SSHEE proposal for hybrids.

> Question 41: Do you think specific smart controls standards, that go beyond those for smart heat pumps, are needed for hybrid heating systems? Yes/No. Please expand on your views.

There were 86 responses to this question, with 34 respondents answering 'Yes', 26 answering 'No' and 26 answering 'Don't know'. Forty-eight respondents also expanded on their answer.

Those in favour of a specific control standard for hybrids cited the need for the controls to adequately manage the two elements of the system, and thereby optimise by carbon or cost,

[20] Freedom Project Final Report (2018) Western Power Distribution and Wales & West Utilities, Passiv Systems Imperial College London, Delta-ee and City University https://www.nationalgrid.co.uk/downloads/12221/freedom-project-final-report.pdf and Energy Systems Catapult for DESNZ (2023), 'Electrification of Heat Demonstration Project Interim Heat Pump Performance Data Analysis Report',https://es.catapult.org.uk/wp-content/uploads/2023/03/EoH-Interim-Heat-Pump-Performance-Data-Analysis-Report-1.pdf.

recognised the need for the system to be able to respond to price signals and advised a standard is required to maximise heat pump use.

Those against the introduction of a specific control standard for hybrids noted this might hinder innovation or restrict the market, or argued existing controls are of a sufficiently high standard, making further requirements unnecessary.

Government response to question 41

Deploying low-carbon technologies in a smart and flexible way can help alleviate pressure on the energy system. As outlined in the consultation on 'Delivering a smart and secure electricity system', the government is introducing a requirement, from the mid-2020s (2026-27), for electric heating appliances with the greatest flexibility potential to have smart functionality.[21]

As outlined in the consultation response, smart electric heating appliances are 'an electric heating appliance which is communications-enabled and able to respond automatically to price and/or other signals by shifting or modulating its electricity consumption'. A smart hybrid meeting this definition would therefore be able to respond to price signals.

We will set out our latest thinking on the smart electric heating appliance requirements and how they may apply to hybrid heat pumps in our upcoming second consultation on smart and secure electricity systems.

> Question 42: Do you think other measures are required to support low-carbon operation of hybrid heating systems? Please expand on your views.

There were 75 responses to this question, covering a range of themes.

Some respondents noted hybrids are excluded from some government funding schemes, in particular the Boiler Upgrade Scheme, while in the past grant schemes have supported the installation of hybrids. Further feedback regarding support for capital costs for hybrids was provided in responses to question 43.

Some advised improving insulation of the housing stock is vital alongside other carbon reduction measures, and that this would reduce heat demand and, therefore, running costs and carbon emissions from hybrids. A few also noted that a key benefit of hybrids is that they can spread the cost of such fabric efficiency improvements over a longer period than might be the case for standalone heat pumps.

Some respondents noted the key role for installers in supporting consumers to make informed decisions about which options are suitable for their properties. Further feedback regarding information and advice was provided in responses to question 43.

[21] DESNZ and BEIS (2022), 'Delivering a smart and secure electricity system: consultation on interoperability and cyber security of energy smart appliances and remote load control', https://www.gov.uk/government/consultations/delivering-a-smart-and-secure-electricity-system-the-interoperability-and-cyber-security-of-energy-smart-appliances-and-remote-load-control.

Another set of respondents advised of the need for further definition and standardisation regarding the design and installation of hybrids and their controls, to ensure they deliver government policy goals. Further feedback regarding standards was provided in responses to question 46.

Respondents also noted the role of energy price rebalancing to incentivise heat pump installation and use and advised improving availability and consumer understanding of 'time of use' and 'type of use' tariffs to further reduce running costs.

Government response to question 42

Fabric efficiency and whole-building approach

As outlined in the Heat and Buildings Strategy, the government maintains that improving the energy efficiency of the fabric of our buildings can reduce energy demand and reduce carbon emissions, while delivering bill savings.[22]

We continue to encourage and financially support activities to improve building fabric efficiency, including through the Sustainable Warmth competition, Social Housing Decarbonisation Fund (SHDF) and the Energy Company Obligation.

The effect of energy prices and tariffs

We note the findings of Energy Systems Catapult's Electrification of Heat performance report, which shows that the median heat pump energy output (as a percentage of total space heating output in hybrid systems) was 38.6%, when optimised for cost.[23] The current pricing of electricity and gas in the UK does not incentivise consumers to make green choices, such as switching to electric heat pumps, caused by significantly lower gas prices compared to electricity prices and policy costs added onto electricity bills rather than gas bills.

The government accepted a recommendation in the 2022 Independent Review of Net Zero to make significant progress on rebalancing of gas and electricity prices by the end of 2024.[24]

Smart meters can record the amount of energy consumed or exported within every half an hour of the day, acting as an enabler for new products and services, such as 'time of use' tariffs. The Office of Gas and Electricity Markets (Ofgem) is responsible for the delivery of a Market-wide Half-Hourly Settlement (MHHS), incentivising suppliers to offer products that empower consumers to reduce their demand away from high priced periods. This can encourage more flexible use of energy and helps consumers lower their bills potentially saving consumers up to £4.5 billion by 2045.[25]

[22] HM Government (2021), 'Heat and buildings strategy', https://www.gov.uk/government/publications/heat-and-buildings-strategy.
[23] Energy Systems Catapult for DESNZ (2023), 'Interim Insights from Heat Pump Performance Data', Section 5.5, Table 5.6 and Figures 5.8 and 5.9, page 19, https://es.catapult.org.uk/report/interim-insights-from-heat-pump-performance-data/.
[24] DESNZ and BEIS (2022), 'Mission Zero: Independent Review of Net Zero - final report', https://www.gov.uk/government/publications/review-of-net-zero.
[25] According to Ofgem analysis, which is cited on Ofgem's 'Electricity settlement reform' webpage at: https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/electricity-settlement-reform#:~:text=Our%20analysis%20predicts%20that%20market,elective%20half-hourly%20settlement%20work.

On a longer timeline, the Review of Electricity Market Arrangements (REMA) programme is considering changes to unlock greater investment in low-carbon flexibility, make better use of price signals to support low-carbon flexibility and to enable consumers to drive maximum benefits from energy that will be more variable in price with significant periods of very low cost. The retail market should be a key enabler of the reforms that we are exploring under REMA.

Installation

> Question 43: What further measures can the government and industry take to support consumer choices and ensure hybrids are installed where most appropriate?

There were 82 responses to this question. The two main recurring themes were the provision of relevant information and advice and the availability of financial support for consumers installing hybrids.

Financial support

Many respondents called for financial support for hybrids as a means of ensuring they might be installed where appropriate. Some argued for support to be made available through new or existing schemes, with 30 respondents recommending expanding the Boiler Upgrade Scheme – with a smaller grant for heat pumps installed as part of a hybrid system in comparison to SHP.

Information and advice

Many respondents noted the need to further improve consumer awareness and understanding of hybrids, though existing government actions in this space were recognised. There were many recommendations for public awareness-raising activities to involve collaboration between central and local government, industry and the third sector. There were also suggestions for the necessary content and coverage of such awareness-raising campaigns to include topics such as the installation process, suitability and operation of systems, likely costs and sources of funding.

The most common information channels recommended for providing consumer advice were through installers, a government-led nationwide public information campaign, an online information hub or a ‘one-stop-shop’ (like ‘Home Energy Scotland’ and ‘France Renov’).

A key role for installers

Though many respondents felt that the choice should ultimately be down to the consumer, many agreed that installers have considerable influence and a key role to play in ensuring installations of hybrids are targeted where fully low-carbon heating solutions are not suitable.

Many respondents provided suggestions relating to installer training, and creation of and compliance with standards, to ensure high quality installation and low-carbon operation of hybrids. Some respondents encouraged collaboration between industry and the government to develop training programmes for heating installers to equip them with the relevant expertise to provide appropriate advice to consumers and ensure effective system design, installation and

maintenance. Further feedback relating to hybrid installer skills and hybrid standards was provided in responses to question 44 and 46 respectively.

Indicators of suitability – including EPCs

Many respondents provided suggestions for indicators of consumers/buildings that may be more suitable for hybrids (such as building constraints, indoor and outdoor space, electricity network connection and local grid capacity, and cost of fabric efficiency upgrades).

Some suggested using Energy Performance Certificate (EPC) metrics to indicate hybrid suitability in different types of buildings, though they noted that current EPC metrics can disincentivise consumers from making low-carbon heating choices and called for an update to EPCs and the underpinning metrics to address this.

> Question 44: Do you agree that installers of hybrid heating systems should develop all of the skills required to install standalone heat pumps, to be considered competent to install hybrid systems (excluding when installing a compact hybrid)? Yes/No. Please expand on your views.

There were 103 responses to this question, with 72 respondents answering ‘Yes’, 15 answering ‘No’ and 16 answering ‘Don’t know’. Seventy-three respondents elaborated on their answer.

Many respondents noted aligning the skills required of hybrid and heat pump installers would yield a larger overall installer population and make it easier for consumers to find installers. However, some felt that not all retrofit, packaged or integrated hybrids required the same skills as required for the installation of standalone heat pumps and argued requiring alignment may create additional, unnecessary costs.

Many respondents referenced specific training and skills they deemed relevant for hybrid installers including heat loss calculation and low flow temperature system design training, system and control optimisation, and product-specific training from manufacturers. A few respondents also recommended training on hydraulic balancing and on providing consumer advice.

Overall, most respondents agreed that hybrid installers should be encouraged to develop all the skills required to install standalone heat pumps, though some did not feel that this should be required.

Respondents outlined a range of topics that hybrid installers would need an understanding of to effectively install systems and some argued for necessary skillsets to be established through standards and frameworks. These issues are considered further under question 46.

> Question 45: Do you think there is sufficient guidance available on ensuring that hybrid installations comply with appropriate regulations e.g., Gas Safety Regulations and Building Regulations? Yes/No. Please expand on your views.

Question 46: Do you have suggestions on how the relevant standards regimes (e.g., Building Regulations, competent person schemes) should be expanded or altered to adequately cover hybrids systems? Please expand on your views.

There were 84 responses to question 45, with 18 respondents answering 'Yes', 34 answering 'No' and 32 answering 'Don't know'. Forty-three respondents elaborated on their answer to question 45. There were a further 50 written responses to question 46. The substantive responses to questions 45 and 46 have been considered together as many similar themes and arguments were made in both questions.

A small number of respondents recommended that there should be no additional guidance or standards for hybrid installation because what is available now is sufficient. Some referenced guidance, standards and certification available for standalone heat pumps (e.g., BS7593 and MIS3005) and argued this should be applied by installers of retrofit and packaged hybrids. Others noted a key role for product-specific training by the manufacturer to ensure high quality installations.

Similarly, some respondents also argued that Gas Safe registration was sufficient to demonstrate competence for some hybrid systems (such as compact hybrids), especially if complemented by manufacturer training. Some called for a review and expansion of Gas Safe criteria to ensure hybrid installers meet requirements for safety, quality, sustainability and performance. Others advocated using Gas Safe registration, renewal assessments, and/or mandatory annual training to improve hybrid installer competence.

Other respondents argued that registration with a competent person scheme (CPS) that covers heat pumps is required for hybrid installations[26] and many argued that specific Mandatory Technical Competencies (MTCs) for hybrid systems under competent persons schemes should be developed.

Others advocated for building regulations to be updated to cover hybrid systems, with installation and specification requirements detailed in Approved Documents L. Respondents also noted the potential role for national standards to guide hybrid installations, through new or revised PAS standards, BSI standards, and MCS' Microgeneration Installation Standards.

Many respondents provided views regarding the reporting of hybrid installations – most calling for simplification of and clarity around the notification process. Some recommended creation and use of a single commissioning sheet for hybrid heat pumps.

There were also further responses relating to training, which covered many of the same areas as under question 44.

[26] Installations of heat pumps must comply with building regulations. If installers are not a member of a CPS, they would need to arrange a building control inspection to be compliant with building regulations.

Government response to questions 43-46

To enable high quality installation of hybrids, where they are most suited, the government will further consider actions to enable the availability of appropriate information and advice on hybrids and the necessary installer skills, training, standards and competency frameworks.

Information and advice for consumers

In July 2022, the government launched a digital support website on GOV.UK, offering personalised recommendations for home improvements, empowering individuals to adopt greener practices, ultimately leading to reduced energy consumption and lower energy costs. To support this, the government has also launched a new retrofit phoneline service (0800 098 7950), which provides a digital assist service for consumers unable to access the website and provides further tailored advice to consumers on their home energy retrofit journeys. In August 2023, the government launched the Local Energy Advice Demonstrator (LEAD)[27]. The LEAD competition provides up to £20 million grant funding to projects across England to test new and innovative approaches to providing energy efficiency and low-carbon heating advice at a local level. LEAD projects focus on providing in-person advice to consumer groups that are most likely to benefit from this style of advice and those living in homes that are harder to retrofit.

We note respondents' recommendations regarding EPC metrics. As set out in 'Responding to the Independent Review of Net Zero's Recommendations'[28], the government is overhauling the building physics model and methodology underpinning EPCs to make them fit for purpose to support net zero, taking account of proposals from the CCC[29] and the Independent Review of Net Zero[30]. The government aims to consult on this new EPC methodology this year. The government also has a continuing programme of user research to improve the way in which information is presented on energy performance certificates.

Information about an appliance can also be communicated through energy labels. We will consult on if and how information about hybrids should be communicated through energy labelling in our upcoming consultation on ecodesign and energy labelling.

Installer skills and competence

In December 2021, the government updated Approved Document Part L to provide additional guidance on the standard expected of heat pump installations, and the new guidance took effect from June 2022. The government also intends to use powers within the 2022 Building Safety Act to make new regulations that will impose additional requirements on anyone carrying out any design or building work to be appropriately competent for their roles.

[27] DESNZ (2023), 'Local Energy Advice Demonstrator Competition: successful projects', https://www.gov.uk/government/publications/local-energy-advice-demonstrator-competition-successful-projects.
[28] DESNZ (2023), 'Independent Review of Net Zero: government response', https://www.gov.uk/government/publications/independent-review-of-net-zero-government-response.
[29] Climate Change Committee (2023), 'Letter: Reform of domestic EPC rating metrics to Lee Rowley MP', page 13, Table 2, https://www.theccc.org.uk/publication/letter-reform-of-domestic-epc-rating-metrics-to-lee-rowley-mp/.
[30] DESNZ and BEIS (2022), 'Mission Zero: Independent Review of Net Zero - final report', https://www.gov.uk/government/publications/review-of-net-zero.

The Health and Safety Executive (HSE), as Building Safety Regulator, is reviewing and updating the competence requirements for competent person schemes, working with a range of stakeholders through Competent Persons Forum Mandatory Technical Competency task groups. The relevant microgeneration and renewables task groups are developing Mandatory Technical Competencies to support the installation of hybrid heat pumps.

Installers of hybrids should reasonably expect that training courses will be comprehensive in providing them with the skills and knowledge needed to achieve the competence requirements to join a relevant competent person scheme. We intend to work closely with industry to ensure this is the case. The government also acknowledges the benefits of product-specific training for installers of hybrids in developing further expertise.

In line with our government response to question 19, the government intends to move forward with introducing a requirement for low temperature training for installers.

The government will further consider whether more intervention is needed to ensure that consumers can reap the benefits of hybrids, including whether a hybrid standard is necessary, for example through a Public Available Specification (PAS).

Affordability and financial support

The government notes respondents' concern around the availability of financial support for hybrid installations. Support for hybrids in some defined circumstances is available through government schemes such as the Social Housing Decarbonisation Fund and the Local Authority Delivery element of the Sustainable Warmth competition.

The Boiler Upgrade Scheme (BUS) does not provide support for hybrid heat pumps. Rather, the scheme's priority is to direct funding towards technologies that offer the greatest carbon savings, rather than those that involve the burning of fossil fuels. On 30 March 2023, the government announced that it will extend the BUS until 2028 and, from 23 October 2023, grant levels were increased to £7,500 for both air- and ground-source heat pumps. There will be an additional budget allocation in each year up to 2028, which will be announced at a future fiscal event.

We remain committed to working with industry to help consumers make sustainable choices in line with our net zero ambitions. In light of the feedback received, we will continue to review the financial support available to reduce capital costs of hybrid installations for consumers and whether this is sufficient, appropriate, and in line with our net zero ambitions.

Flexibility

Question 47: Do you agree with our assessment of the significance of the flexibility benefits provided by the deployment of hybrids, in the time frame until 2028? Yes/No. Please expand on your views.

There were 91 responses to question 47, with 35 respondents answering ‘Yes’, 24 answering ‘No’ and 32 answering ‘Don’t know’. Sixty-seven respondents elaborated on their answer.

Thirty-three respondents noted hybrids’ potential to deliver flexibility benefits – given their ability to draw from different sources of energy – which, when aggregated, could have energy system level impacts – reducing demand for generation and network reinforcement. Some also noted that hybrid controls can reduce use of high carbon sources for electricity generation at peak times. Some respondents mentioned key conditions for heat pumps and hybrids to deliver flexibility benefits, including effective pricing and smart controls.

Many also agreed that the Department’s electricity networks modelling shows that the networks’ planned capacity is sufficient to cater for the deployment of standalone heat pumps up to the targeted level of 600,000 in 2028. Some respondents also used this question as an opportunity to voice views in favour of deployment of heat pumps as a priority ahead of hybrids, with an equal focus on grid decarbonisation.

Some argued we had underestimated the relative flexibility benefits from hybrids, with references to local level flexibility benefits and potential overestimation of the flexibility benefits standalone heat pumps deliver through pre-heating buildings. Sixteen responses highlighted additional system level benefits beyond 2028.

Those answering ‘Don’t Know’ generally felt more evidence was needed before conclusively agreeing or disagreeing with our assessment. Some felt the government should continue to update data and modelling to inform its view.

Government response to question 47

Given the responses received, the government feels that the conclusion of our analysis stands – that widespread deployment of hybrid heat pumps between now and 2028, as part of wider heat pump deployment targets, is not necessary to alleviate pressure on the electricity network up to 2028. However, we will continue to update and refine our existing analysis. We will also continue to work with Ofgem, electricity network operators and other actors, to deliver the planned upgrades to the electricity network.

We note the system level network flexibility benefits that hybrids can offer and will work to support the realisation and utilisation of these benefits through our work on smart and secure electricity systems (as discussed in our government response to question 41).

Hybrid deployment beyond 2028

> Question 48: Do you agree with our current understanding of risks and benefits of widespread deployment of hybrids from 2028? Yes/No. Please provide evidence and reasoning to support your answer.

There were 85 responses to question 48, with 20 respondents answering ‘Yes’, 28 answering ‘No’ and 37 answering ‘Don’t know’. Fifty-seven respondents elaborated on their views.

Respondents noted significant benefits of widespread deployment of hybrids, including their consistency with different pathways to net zero, allowing a gradual transition for consumers, in some cases allowing delay to fabric upgrades and reducing peak electricity demand.

Some respondents shared their views on the risks, issues and challenges with widespread hybrid installations, such as the potential displacement of standalone heat pump installations, the risk that keeping too many technology options open causes diseconomies and the uncertainty around exact levels of carbon savings delivered, especially for retrofit hybrids.

There were specific challenges, risks and issues raised regarding compact hybrids – mainly around their size and weight and the requirement for an additional flue – making them not an exact like-for-like replacement for a combination boiler.

Overall, a minority of respondents were explicit in their view that the potential upside and benefits of mass hybrid heat pump deployment far outweigh the risks, while the majority acknowledged at least a role for hybrids in the technology mix. Only a small number of respondents commented on the consultation's suggestion that widespread deployment of hybrids might be pursued, for example, by using product legislation to raise the Minimum Energy Performance Standards of space heating appliances to above 100%, with no consensus and an even split of views among those who considered this.

Some respondents felt that further evidence is needed to fully assess the impacts of the widespread deployment of hybrids, and it was too soon to take a decision. Respondents called for more data on the installation of hybrids in representative building stock, the levels of capital investment required and potential running costs, and the impacts to energy system costs from widespread deployment.

Some respondents also called for action by the government to ensure the appropriate and effective deployment of hybrids, including actions to support demand growth for hybrids, consumer engagement and information campaigns, and clarity around the potential long-term role of hybrids.

> Question 49: What levels of energy efficiency and carbon-intensity may be achievable for compact hybrids or other hybrid technologies with further innovation and investment? Please provide evidence and reasoning to support your answer and please specify to which types of hybrid system your answer refers.

There were 28 responses to question 49. Very few respondents offered quantified views on potential energy efficiency and carbon intensity levels for hybrids. A few noted the role of controls in maximising gains (as considered under question 41). A small minority noted the potential for further innovation in compact hybrids as a relatively new technology type. Others noted the potential for new refrigerants to deliver additional gains.

More generally, some noted the dependency on the fabric efficiency of the building or the design of the wider heating system in determining overall system efficiency.

Ten respondents mentioned that the fabric efficiency of the building will need to be improved (e.g., through insultation) to improve the efficiency of the heating system, which can increase carbon savings. Some noted that this can enable a move to a standalone heat pump.

> Question 50: What further technological developments can be expected from compact hybrid systems, or hybrids of other types, to support the widespread roll out of hybrids across the UK building stock? Please provide evidence and reasoning to support your answer and please specify to which types of hybrid system your answer refers.

There were 31 responses to this question. Respondents expected improvements in hybrids' ability to link with other low-carbon technologies and systems, for example, solar panels and batteries, and improved interoperability with smart controls and energy management systems, using type- and time-of-use tariffs.

Respondents advised further research and development could bring about product improvements such as reducing the size and weight of compact hybrids and further development of a hydrogen hybrid. Some advised that monitoring data on how hybrids function is critical for making further product improvements.

> Question 51: What scale of cost reductions is possible for compact hybrids, or hybrids of other types, and what are the conditions required to deliver such cost reductions? Please provide evidence and reasoning to support your answer and please specify to which types of hybrid system your answer refers.

There were 29 responses to question 51. Responses to this question were varied, with some focusing more on current cost differences between standalone heat pumps and hybrids, some focusing on running costs and others focusing on future capital cost reduction.

Those commenting on current costs ranged in views – from suggesting installations of hybrids and standalone heat pumps could cost roughly the same, to suggesting hybrids could be significantly cheaper, while some also noted the potential for choosing a hybrid to allow for delays to building fabric upgrades.

Some respondents agreed there is potential for cost reduction for hybrids, but that this is linked to the reduction potential for standalone heat pumps, especially as heat pump components are an expensive part of a hybrid system. The main noted drivers of capital cost reduction were economies of scale and installation time reduction. Some also noted the dependency on other factors, including the scale of the market, communications from the government, building efficiency and heat demand and consumer use of product. The majority felt that there is limited potential for cost reduction, while a very small number of respondents gave a view on the scale of cost reduction offering figures between 30 and 40%.

Some respondents focused on running costs, again noting the potential for hybrids to work flexibly in response to price signals. Respondents noted that running cost savings could be increased through time- and type-of-use tariffs and other approaches to flexibility (including thermal storage) and by boosting consumer understanding of hybrids. Respondents also noted

the cost saving potential of internal heating system efficiency improvements and fabric efficiency improvements.

Government response to questions 48-51

The government remains of the view that hybrids can play an important role in heat decarbonisation up to 2028 as part of the target to reach 600,000 heat pump installations a year by 2028. Beyond this point, the potential benefits of further widespread deployment of hybrids are significant, though we note also the points raised by respondents, as set out above, regarding the potential challenges posed by this.

The Energy-related Products Policy Framework, published in November 2021, and the Improving Boiler Standards and Efficiency consultation both referenced the possibility of phasing out the installation of standalone natural gas boilers, with hybrids as their successor, for example, by setting Minimum Energy Performance Standards for heating appliances at a level greater than 100%. Few stakeholders provided views on this. The government has also noted respondents' feedback regarding further evidence that could inform our thinking, the potential for further technological developments and for market developments, including in response to new product standards in other markets, and actions that could create an environment more conducive to widespread deployment of hybrids in the UK.

No decision has been taken on the long-term role of hybrids within the decarbonisation of heat and on policies to support the widespread uptake of hybrids. We will continue to develop our view and gather further evidence, for example, regarding the suitability of hybrids for the UK building stock and their performance across building types, including consideration of the latest data from the Electrification of Heat Demonstration Project, and regarding the flexibility and energy system benefits of hybrids.

We will also monitor product and market developments in the UK and product and regulatory developments in related markets and continue to work with stakeholders and international colleagues to learn insights about the deployment of hybrids.

Building on the above, we will continue to consider the role of hybrids and the necessary supporting conditions for hybrids to play a widespread role, as part of wider thinking ahead of decisions on the approach to decarbonising heat in 2026. We intend to gather further views on their role through our upcoming consultation on ecodesign and energy labelling.

In the near-term, we will continue to support the development of the hybrid market and products in the UK, though the actions outlined earlier in this chapter and by supporting hybrid deployment through a range of proportionate and pragmatic government policies, including the Clean Heat Market Mechanism.

Public Sector Equality Duty

> Question 52: Do you have views on whether, and to what extent, the policy proposals here might disproportionately impact upon certain types of consumer, with a particular focus on those in groups with protected characteristics? Please provide evidence and reasoning to support your answer.

There were 49 responses to this question.

Over half of respondents referenced consumers who struggle to pay fuel bills, noting policy changes could cause these groups to struggle more. Others noted that some technologies, such as controls, cost more and that those with lower incomes may be priced out.

A number of respondents noted potential long-term costs relating to hydrogen including the conversion and wider system changes, impacting low-income groups the most. One respondent also noted the potential high running costs of hydrogen and the impact of this on low income groups. A few noted the additional cost to convert to another low-carbon technology, if hydrogen is not used in heating.

Respondents also noted other groups who may be disproportionately affected by policy changes such as the elderly, lone parents or pregnant women, disabled people, ethnic minorities and renters. A few advised there would be no impact on those with protected characteristics and a number advised there could be a positive impact, such as if hybrids are installed to a high standard and cost-optimised, as well as increased efficiency through low temperature systems. One advised that new parts of the heating industry may create opportunities for women, as the heating industry is currently male dominated.

Government response to question 52

In line with the responses, our current assessment is that it is unlikely that our policy proposals will have disproportionate direct negative impacts on population groups with protected characteristics under the Equality Act 2010. However, we recognise the risks highlighted among responses to this question, such as issues with controls for those who are not confident with technology or have other accessibility challenges. We will therefore continue to examine what further steps may be needed to ensure that all consumers can be confident of receiving the right information to enable them to use new technologies effectively.

We also recognise that the costs of switching to low-carbon heating may remain a barrier for some lower income households. The principal benefits of the policy are society-wide: carbon emissions reductions, as well as an expanded supply chain which can support cost reductions and the wider transition to low-carbon heating in the long run. However, we will continue to assess what further support may be needed to support low-income households in that transition, building on the targeted action in existing schemes such as the Home Upgrade Grant, Social Housing Decarbonisation Fund, and Energy Company Obligation.

We will continue to assess the potential impacts on equalities of the proposals during further policy development.

Other feedback

Question 53: Do you have any further views to make on our proposals that are not already captured in your responses to the previous consultation questions?

There were 76 responses to question 53.

Respondents used this section either to summarise their overall views on the consultation or to make specific recommendations. Respondents included heating appliance manufacturers, heating engineers, think tanks, consumer advice/green charities and members of the public.

Regarding boiler efficiency, specific suggestions included looking at the whole system rather than just the boiler (where the efficiency gains are marginal), different options for controls, open protocols and additional training for engineers.

There was a mixed response on mandating on hydrogen-ready boilers. Those in favour felt it was a “low regret” option, with the potential cost implications being minor regardless of whether hydrogen was subsequently used. However, several respondents were keen to emphasise that the source should be green hydrogen, with some questioning whether the volume needed could be created. Other respondents requested clarity on government policy regarding other hydrogen-ready appliances including hobs.

Timescales were a particular point many of those in favour of hydrogen wished to emphasise in two major ways – that 2026 would be too soon for a mandate (with 2028 finding more favour) and that a decision on whether hydrogen will be pursued as a domestic heating preference should be made ahead of any mandate, ideally as soon as possible. They stated that these options would better allow supply chains (for R&D, manufacturing and training) to be in place to meet demand. There were also some concerns about the viability and/or timing of having a domestic hydrogen network in place for the majority of homes to make the policy pay dividends.

Of the 76 respondents, 19 were overtly against pursuing hydrogen for domestic heating with reasons including safety concerns, cost concerns and seeing electrification (whether via heat pumps or hybrids) as making more sense, stating that it takes 5 times more clean energy to produce hydrogen than electricity. Some also saw hydrogen as a distraction from electrification. Others did not state a negative position on hydrogen, but rather emphasised that they wanted to see higher prioritisation of heat pumps and/or hybrids.

Government response to question 53

The responses to question 53 have been considered and included in our government responses to other questions, as appropriate.

Next Steps for Government

The government will continue to refine policy detail, building on the positions set out here and informed by the responses to the consultation. We propose to further consult on the implementation of many of the policies through the forthcoming consultation on ecodesign and energy labelling, changing the standards that products on the GB market are required to meet through a legislative amendment. This consultation will cover the technical changes that are needed to deliver on the policy commitments set out throughout this government response. In relation to gas boilers, the consultation on ecodesign and energy labelling is expected to cover product-focused policies on controls, modulation, factory set flow temperatures, as well as appropriate standards for hydrogen-ready boilers and efficiency requirements for hybrid heat pumps. For the non-product focused policy areas, the department will collaborate further with stakeholders and organisations to bring forward low temperature training provision and assess the merits of strengthening installation oversight and servicing. We look forward to continuing engagement with interested stakeholders as we seek to implement these policies.

The government is continuing work to develop and assess options for refining the detail of hybrid policies to set new hybrid minimum efficiency requirements, to encourage greater use of the heat pump in a hybrid, to enable high-quality installation of hybrids where they are most suited, to maximise and utilise electricity system benefits from hybrids, and to continue to explore their future potential. This involves further consultations (on ecodesign and energy labelling, and smart and secure electricity systems), reviewing the information and the financial support available to consumers, and working with other government departments and external organisations to review and consider expanding the guidance and standards for hybrid installations. We look forward to continuing engagement with interested stakeholders throughout policy development.

Our initial assessment, in line with the Environmental Principles Policy Statement, is that the policies' environmental impact will be positive and significant in reducing environmental harm from climate change by reducing gas consumption and associated carbon emissions. We have not identified any likely negative environmental impacts requiring further adjustment to the policy design. This will be kept under review and further considered as we seek to test and introduce changes to ecodesign and energy labelling through the forthcoming consultation.

Annex A: List of respondents

A list of organisations that responded to the consultation via Citizen Space or via email. This is not an exhaustive list of all organisations, as some have been removed to protect the respondents' identities.

Advance Appliances

ALH Systems

Adey Innovation

Alpha Therm

Arcadis

Aliaxis

AVK UK

Baxi

BEAMA

Beckett Thermal Solutions

Beyond Housing

Believe Housing

Benchmark

British Research Establishment

BU-UK

Calor

Cadent

Centrica

Chartered Institute of Plumbing and Heating Engineering (CIPHE)

Citizens Advice

CLASP

Connected Response

Cooks Plumbing and Heating

Develop Training

Dragon Recycling Solutions

Drayton/Schneider Electric

E.ON UK

EDF

EDMI Europe

E3G

Elmhurst Energy

Energy & Utilities Alliance (EUA)

Electrify Heat

Energy Networks Association

Energy Savings Trust (EST)

Energy Assets

Energy UK

Enertek International

Equans

ESi Controls

Eurogas

Exquisite Heat

Fernox

Flonidan

FT Pipeline Systems

Gas Safe Register

George Wilson Industries

Greater London Authority

Green Heat

Greenpeace

Grundfos

Heat Pump Association (HPA)

Honeywell

Hot Water Association

Hydrogen Science Coalition

Hydrogen UK

Ideal Boilers (Groupe Atlantic)

Independent Networks Association

Industrial and Commercial Heating Equipment Manufacturers Association (ICOM)

Institution of Engineering and Technology (IET)

Institution of Gas Engineers & Managers (IGEM)

Intergas

Kensa

Kingston upon Hull City Council

Last Mile Asset Management

Leeds City Council

LiveWest

McDonald Water Storage

McElroy Manufacturing

MCS Charitable Foundation

MCS Company

MeterSit

Micrographia Bio

Mineral Products Association

Mitsubishi Electric

Myenergi

National Association of Professional Inspectors and Testers (NAPIT)

National Energy Action (NEA)

National Gas Transmission

National House Building Control (NHBC)

Natural Gas Solutions (UK)

Neomitis

Nesta and The Heating Hub

NIBE

North West Hydrogen Alliance

Northern Gas Networks

Octopus Energy

OYA Energy UK

Parents for Future UK

Peabody Trust

Progressive Energy

Protium

Pupils 2 Parliament

Regen

Regulatory Assistance Project (RAP)

Rinnai UK

Scottish Council for Development and Industry (SCDI)

Scottish and Northern Ireland Plumbing Employers Federation

Scottish Power

Secure Meters (UK)

SGN

SIME

Skewb

Steve Vick International

Sustainable Bramhall

Sustainable Energy Association (SEA)

SWS Group

Synthotech

Tepeo

The Association for Decentralised Energy (ADE)

The Association for Renewable Energy and Clean Technology (REA)

The Heating & Hotwater Industry Council (HHIC)

The Smart Data Communications Company (DCC)

Thermal Storage UK

TrustMark Ltd (2005)

UK Green Building Council

University of York & National Centre for

Atmospheric Science and Imperial College London

Vaillant

Viessmann

Vokera

Wales and West Utilities

Wolseley

Worcester Bosch

WWF-UK

Annex B: Glossary

Key terms

Term	Description
Boiler cycling	Boiler cycling causes the boiler to repeatedly turn on and off during a heating period. This is sometimes referred to as on/off cycling. This can occur for a number of reasons such as the boiler system replicating a lower output in order to maintain a desired room temperature.
Boiler interlock	Boiler interlock refers to a wiring arrangement that ensures the boiler is switched off when there is no demand for space heating or water heating. For a combination boiler this can be achieved simply by having a room thermostat. For a system or a regular boiler, the controls need to be wired such that the boiler and pump will turn off when neither the space heating nor the hot water cylinder requires any heat input.
Boiler modulation	Boiler modulation is a boiler's ability to dynamically reduce its output from its maximum output. This allows boilers to use less energy by using a lower output to meet the desired room temperature.
Class I Controls[31] – On/off room (simple) thermostat	A room thermostat that controls the on/off operation of a heater. Performance parameters, including switching differential and room temperature control accuracy, are determined by the thermostat's mechanical construction.
Class II Controls[31] – Weather compensation (simple modulating)	For use with modulating heaters. A heater flow temperature control that varies the set point of the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. Control is achieved by modulating the output of the heater.

[31] Descriptions of temperature control classes as per the Ecodesign and Energy Labelling Regulations for Space and Combination Heaters. Further information on all eight heating control classes is available in the European Commission (2018) 'Guidelines accompanying Regulations (EU) No 811 & 812/2013, 813 & 814/2013, and 2015/1187 & 1189', https://energy.ec.europa.eu/document/download/c61475ba-4419-4ed9-9e00-033b6a926c55_en?filename=GuidelinesSpaceWaterHeaters_FINAL.pdf, 6.3.1.2. Temperature control, pages 15-16.

Class III Controls[31] – Weather compensation (simple for on/off heaters)	Weather compensator control, for use with on/off output heaters. A heater flow temperature control that varies the set point of the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. Heater flow temperature is varied by controlling the on/off operation of the heater.
Class IV Controls[31] – Time Temperature Proportional & Integral (TPI) heating	TPI room thermostat, for use with on/off output heaters. An electronic room thermostat that controls both thermostat cycle rate and in-cycle on/off ratio of the heater proportional to room temperature. TPI control strategy reduces mean water temperature, improves room temperature control accuracy and enhances system efficiency.
Class V Controls[31] – Load compensation	A load compensator is a device that measures the gap between the internal temperature of the home and what the controller is set to, then modulates the temperature and/or output of the boiler output so that it is hot enough to provide the extra heat needed. This allows the boiler to operate in condensing mode for more of the time, lowers the chance of overshoot of room temperature, thus saving more fuel than just standard time and temperature control.
Class VI Controls[31] – Weather compensation (Advanced/Modulating)	Weather compensator and room sensor, for use with modulating heaters: A heater flow temperature control that varies the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. A room temperature sensor monitors room temperature and adjusts the compensation curve parallel displacement to improve room comfort. Control is achieved by modulating the output of the heater.
Class VII Controls[31] – Weather Compensation (advance for on/off heaters)	Weather compensator and room sensor, for use with on/off output heaters. A heater flow temperature control that varies the flow temperature of water leaving the heater dependent upon prevailing outside temperature and adjusts the compensation curve parallel displacement to improve room comfort. Heater flow temperature is varied by controlling the on/off operation of the heater.
Class VIII Controls[31] – Zonal Heating	Multi-sensor room temperature control, for use with modulating heaters. An electronic control, equipped with three or more room sensors, that varies the flow temperature of the water leaving the

	heater dependent upon the aggregated measured room temperature deviation from room sensor set points. Control is achieved by modulating the output of the heater.
Combination, system and regular boilers	There are three main types of gas boiler used in domestic properties: • **A combination boiler** (also known as combi boilers) combines both water heating and central heating in a single unit. They provide hot water directly at the time that it is required, rather than it being stored in a separate hot water tank or cylinder. • **A system boiler** heats hot water in advance, storing hot water in a separate hot water tank or cylinder. The hot water tank is fed directly from the mains water supply rather than a cold-water storage tank. • **A regular boiler** is fed by a cold-water storage tank (usually in a loft or attic) resulting in lower heat distribution system pressures. Hot water is heated in advance and stored in a separate hot water tank or cylinder, from which it is released when needed (independently of the boiler being fired).
Condensing boiler	Condensing boilers collect the latent heat from the water vapour created during combustion of natural gas. In a non-condensing boiler, this water vapour is expelled to the atmosphere through the flue without reclaiming the available energy. Condensing boilers are more efficient than non-condensing boilers. Since 2005, condensing boilers have been mandatory to install in the UK.
Ecodesign	Ecodesign is the legislative framework for setting the minimum efficiency performance standards (MEPS) for energy-related products, including for space heating appliances. Ecodesign aims to phase out the least efficient energy-related products from the market through these standards. The Boiler Plus standards set a minimum performance standard of 92% ErP for domestic gas boilers in English homes.
Flow temperature	Flow temperature is the temperature that the water is heated to in the boiler and then travels to heat emitters via the distribution

	pipework. Boilers are more efficient when operating at lower flow temperatures. The return temperature is the temperature of the water after it leaves the heat emitters and returns to the boiler, this temperature is highly influential in determining the efficiency of the boiler and whether it condenses or not.
Heat emitter	A heat emitter is a product that gives out (emits) heat, such as radiators. Heat emitters are used by heating systems to create warm conditions in specific spaces, remote from the central heating appliance.
Hybrid	A heating system that combines an electric heat pump with another heat generation technology with common controls used to manage how the component technologies operate together. For the purposes of this government response, a 'hybrid' is generally used to describe a hybrid heating system consisting of a heat pump and gas boiler. See 'Integrated hybrid', 'Packaged hybrid' and 'Retrofit hybrid' for details of different sub-categories of hybrids.
Hydraulic balancing	Hydraulic balancing is a process to ensure, through valve restriction setting, that a suitable flow of heating system water passes through each radiator in the system. When a central heating system is properly balanced, radiators will heat up throughout the house at the same rate, accounting for the pressure losses in pipework that may reduce flow to radiators further from the boiler. If the system is out of balance, higher flow rates may reach closer radiators than others in the home resulting in uneven and inefficient heating of the home.
Hydrogen-ready boiler	A boiler that is initially designed to run on natural gas and after a short conversion process will run on 100% hydrogen gas.
Hydronic space heating system	A hydronic space heating system (wet system) is when a heating appliance produces hot water which is distributed around the property to heat emitters.
Integrated hybrid	A hybrid where some or all parts of a heat pump and gas boiler are integrated within a single unit. Compact hybrids (a subset of

	integrated hybrids) are used to describe hybrids where the whole appliance is integrated in a single (usually indoor) unit.
Modulation ratio	A boiler's modulation ratio is the maximum output compared to the minimum output. A boiler with 24kW heat output and a minimum heat output of 4kW has a modulation ratio of 1:6.
Operating protocols	Operating protocols are the communication systems utilised between boilers and heating controls. Open protocols should enable any boiler to be fully controlled, across a multitude of functionalities including lowering flow temperatures, by a heating control produced by a third-party manufacturer. OpenTherm is the most common example. Closed protocols mean only a control made by the same manufacturers will be able to follow interact and affect the boiler.
Packaged hybrid	Separate boiler and heat pump products/units combined to operate as a single heating system – these may be 'packaged' at point of sale or at point of installation.
Retrofit hybrid	Heat pumps bought and installed alongside pre-existing boilers to create a hybrid heating system.
Room thermostat	A central or room thermostat allows consumers to set their preferred temperature in their home. If the heating is turned on, the boiler will send hot water to the radiators such that the temperature on the thermostat is reached and then maintained, but not exceeded. Without a thermostat or any other heating controls, the boiler will keep heating the home until the heating is switched off, thereby using far more energy, and resulting in higher bills.
Smart control	Under the Boiler Plus Standards, smart controls (thermostats) were defined as products that let consumers remotely control their home temperature via a tablet, smartphone or desktop. To comply with Boiler Plus, a smart control can include either load or weather compensation, otherwise it must include both of: • Automation, where the device automatically controls the heating system output in response to programmed demand or occupancy detection (for example using the GPS on the users' smartphones).

	• Optimisation, meaning the device works out what time it should switch the boiler on so that it gets to the temperature on the thermostat at the chosen time, while using the least amount of energy.
Timer	A timer allows consumers to set the heating to come on at specific times of the day to meet their routines without daily action on their part. Some systems have a 24-hour timer, which allows consumers to set the heating to switch on and off at the same time each day. More advanced timers, or timer functions within a programmable or smart thermostat, allow for different times to be set on different days, for example to reflect varying weekday and weekend routines.

Acronyms

Acronym	Term	Description
CC	Conversion Coefficient	The term used by the EU for the coefficient for primary energy per kWh electricity. The UK typically used the term ‘primary energy factor’.
CPS	Competent person scheme	The purpose of competent person schemes is to allow approved persons to self-certify the compliance of controlled work in buildings that are subject to the Building Regulations. It avoids the need for work to be checked by Local Authority Building Controls. This includes heating and hot water installations as defined in the regulations. A person operating under a government approved competent person scheme has a duty to comply with all aspects of the Building Regulations, not just the core aspects of the work being undertaken. The competence of installers is evaluated by scheme operators under a common assessment procedure, having regard to qualifications, assessment and experience as routes of demonstrating competence for scheme members. One of the requirements for an installer to be a member of a CPS is that they must be able to demonstrate appropriate competence to undertake the work. These requirements are set out as Mandatory Technical Competencies (MTCs).
EPC	Energy Performance Certificate	Energy Performance Certificates provide information for consumers on the energy performance of a building. EPCs produce an energy efficiency rating (EER) based on the estimated running costs of the property and provide recommendations to improve this rating.
ErP	Energy-related products	ErP policy has historically consisted of minimum environmental performance standards and energy labels set through (formerly) EU ecodesign and energy labelling regulations. These have been moved into UK law in

		2021. The UK government has the power to change ecodesign and energy labelling legislation in GB.
FGHR	Flue Gas Heat Recovery	FGHR systems recover heat from waste flue gases to preheat the cold drinking water entering the combi boiler, lowering the amount of energy needed to warm the drinking water up to the required level. This means that the effectiveness of FGHR does not depend on householders using it in certain ways or making any sort of adjustments to their behaviour. Some FGHR systems use electricity to power them, while others (known as Passive FGHR) do not.
HP	Heat pump	There are many types of heat pump, which differ in their source of heat (e.g. air, ground or water), the refrigerant they use (or if they use any), how the heat is distributed in the building (e.g. changing the air temperature or heating water in a central heating system). In this government response, HP usually refers to an air-source heat pump used with a wet heating system using radiators to distribute the heat.
MEPS	Minimum energy performance standard	Minimum energy performance standards, and other ecodesign requirements, remove the least energy and resource efficient products from the market through ecodesign and energy labelling regulations.
MTC	Mandatory Technical Competencies	One of the requirements for an installer to be a member of a competent person scheme is that they must be able to demonstrate appropriate competence to undertake the work. These requirements are set out as Mandatory Technical Competencies.
PAS	Publicly Available Specification	A PAS is a standardisation document that defines good practice for a product, service or process. According to the British Standards Institute (BSI), A PAS is: • sponsored by industry leaders, government and public sector, trade associations and professional bodies

		• co-branded with BSI • developed by a steering group of stakeholders, selected from relevant fields and led by BSI • a route to international standards
PEF	Primary Energy Factor	Primary energy is 'energy from renewable and non-renewable sources which has not undergone any conversion or transformation process'. For example, the chemical energy contained in fossil fuels is a source of primary energy. However, a unit of electricity generated by burning that fossil fuel would not be considered primary energy because it has gone through a conversion process. Primary energy factors convert the calculated energy requirements of a defined end use into a primary energy demand figure. The EU Commission uses the term 'conversion coefficient'.
SAP	Standard Assessment Procedure	SAP is the national methodology for modelling the energy performance of homes and is used to produce EPCs. It considers factors such as: the fabric of the building, insulation measures, lighting, efficiency and control of the heating system, ventilation, and renewable technologies. It is a set of calculations, assumptions and data that result in a standardised estimate of a home's annual energy consumption, running costs and carbon emissions. For existing buildings, a simplified version of SAP called Reduced Data SAP (RdSAP) is used to assess the energy performance of dwellings. An RdSAP assessment will use a set of assumptions about the building based on conventions and requirements at the time the building was constructed.
SCOP	Seasonal Coefficient of Performance	Average coefficient of performance of the unit in active mode for the designated heating season.

SHP	Standalone heat pump	In contrast to a hybrid heating system, a standalone heat pump is the sole technology delivering the (space and water) heating needs to a building.
SSHEE	Seasonal space heating energy efficiency (η_{sh})	Seasonal Space Heating Energy Efficiency is the metric used to set minimum energy performance standards in ecodesign regulation. The SSHEE value of a space heating product reflects the products performance under laboratory test conditions.
TPI	Time proportional and integral control	TPI controls are a device, or feature within a device, which maintains the temperature inside the building by cycling the boiler on and off in a ratio that is proportional to the difference between the required and measured temperatures inside the building. These are referenced in Class IV controls.

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