IET responds to the Department for Energy Security and Net Zero open consultation - Exploring the role of alternative clean heating solutions

About the IET

The IET is a trusted adviser of independent, impartial, evidence-based engineering and technology expertise. We are a registered charity and one of the world's leading professional societies for the engineering and technology community with over 157,000 members worldwide in 148 countries. Our strength is in working collaboratively with government, industry and academia to engineer solutions for our greatest societal challenges. We believe that professional guidance, especially in highly technological areas, is critical to good policy making. For further details on the evidence submitted, please contact policy@theiet.org.

Recommendations

1. **Property Dependent Solutions:** The IET recommends that the deployment of clean heating solutions be considered on a case-by-case basis, taking account of cost, space constraints, and overall system integration. Policy should prioritise solutions that are appropriate to the characteristics of individual premises rather than encouraging widespread adoption of a single technology.
2. **Correctly identify and prioritise high emitting buildings:** Efforts to decarbonise buildings should be focused on properties that continue to rely on fossil-fuelled heating.
3. **Solution prioritisation:** To maximise their impact, government policy should prioritise solutions that are compact, scalable, and suitable for mass production and installation.
4. **Investment in proven technologies:** While investment in promising technologies is important, priority should focus on proven decarbonised heating solutions with the potential for large scale deployment.
5. **Renewable energy production:** The implications for renewable energy production must be considered, given the very low round trip efficiencies associated with biofuel production as an energy carrier.

Introduction

There is no doubt that alternative heating technologies will be a vital component in achieving the UK's ambitious target of decarbonising properties. However, there are several important issues not addressed in the consultation that must be considered if this objective is to be realised.

First, future policy should avoid the risk of prescribing specific technologies and instead recognise that the focus must be on identifying the most appropriate solution for individual premises. A key challenge in decarbonising heat is that, even among broadly similar premises, a solution that is suitable for one may not be optimal for another. Numerous factors influence the suitability of a heating solution, including the characteristics of the building fabric, insulation levels, existing heating systems, available space, and planning constraints. In addition, heating systems are evolving rapidly, not only in terms of technology but also cost,

performance, and integration through smart system technologies. For these reasons, we suggest that the consultation should focus on the development of a specification that is solution-focused rather than technology-focused.

Secondly, the consultation places emphasis on space heating while largely overlooking water heating. In our view, space and water heating should always be considered together, as a solution that is well suited to space heating may be less appropriate for water heating. This does not necessarily mean that different technologies must be deployed for each, but it does mean that both should be assessed in combination when determining the most appropriate overall heating solution.

Finally, In the accompanying report to this consultation "Analytical Note on Alternative Low Carbon Heating Technology Costs – November 2025)" Annex A discusses the electricity supply constraints associated with peak electrical demand. It states that: *"... a single-phase electricity supply can support a current draw of up to 100A, many homes have fuse limits below this, but District Network Operators (DNO) can upgrade a home's fuse limit to 80A or 100A. Modelling of electrical supply constraints conservatively assumes heat pumps with a current draw of up to 60A could be supported by a home with a single-phase supply."*

This may be correct with respect to the connection from the premises to street circuit, but it does not apply upstream of the street circuit due to the diversity factor that would have been applied when the circuit was designed. For example, the typical number of domestic premises connected to a street circuit is 100 and the typical rating of the electric cable is 400A. Hence the maximum continuous rating of the circuit will be circa 276kVA (230V*400A*3 phases) which results in a maximum continuous demand for an individual premises of 4A or 2.76kVA. In practice, there is a significant diversity factor that would have been applied. So, for example, UKPN's engineering design standard[1] in table 6-1 tabulates After Diversity Maximum Demand (ADMD) based on:

- Heating system (gas or heat pump)
- Size of premises (bedrooms – 1-2, 3, >3)
- Number of premises (5, 10, 20, 50+).

So, for 50, >3 bedrooms premises, the ADMD assumption is 3.38kVA/premises compared to 1.58kVA for a premises with gas heating. Hence, in the above example the circuit would need to be uprated from 2.76kVA/premises to 3.38kVA/premises. However, loading is not the only factor when designing electrical distribution circuits. These include

- Voltage drop
- Voltage dip
- Harmonics
- Earth loop impedance
- Protection
- Connected generation and voltage rise

[1] https://media.umbraco.io/uk-power-networks/5kthu2kv/eds-08-2000-lv-network-design.pdf

Consequently, the wide scale deployment of electric heating is likely to require network reinforcement and should be evaluated when considering electric heating solutions.

Consultation Questions

1 - Do you agree that electric boilers should play a limited role in decarbonising heat, given their comparatively low efficiency and limited ability to load shift, leading to high running costs for consumers?

- Yes, we agree that electric boilers should play a limited role in decarbonising heat given their comparatively low efficiency and limited ability to load shift, which can result in high running costs for consumers.

Electric boilers ("an electrical device designed to generate heating by heating the water in a hydraulic circuit that runs through the different rooms of a house") should play only a limited role in the decarbonisation of heat. Where electric boilers are already installed within a premises, it is generally most practical for them to remain in use until a suitable low-carbon heating alternative becomes available. However, there is little justification for investing in new electric boiler installations for space heating purposes, even as a transitional or "bridge" technology, given their previously mentioned flaws.

2 - Do you agree that (a) thermal energy storage systems and (b) electrical energy generation and storage (solar PV and batteries) can enable electric boilers to become a more efficient and cost-effective option to decarbonise heat?

- We agree that (a) thermal energy storage systems and (b) electrical energy generation and storage (solar PV and batteries) can enable electric boilers to become more efficient, but we doubt it would offer a cost effective solution. We urge that any deployment be assessed on a case-by-case basis, taking account of cost, space constraints, and overall system integration.

In addition, battery storage can support the operation of other low-carbon heating technologies, such as heat pumps, once installed. As such, these technologies may be considered "no-regret" measures that can deliver benefits beyond their interaction with electric boilers alone.

However, the scope for these technologies to materially improve the cost-effectiveness of electric boilers for space heating remains limited, with their application more realistically confined to hot water provision. Thermal water storage is typically significantly less expensive than battery storage, although batteries offer advantages in terms of space efficiency, requiring less physical space per unit of stored energy than thermal storage. Any deployment should consider, cost, space constraints and system integration solutions.

3 – Do you have any evidence or views on the role infrared heating could play in decarbonising heat?

While infrared heating could play a role in the decarbonisation of heat, we consider this role to be limited and highly context-specific. In domestic settings, infrared heating may be most appropriate in well-insulated buildings with low heat losses, where there is also some scope for demand-side management. Emerging applications, such as underfloor printed heating systems incorporating carbon-based materials, illustrate potential niche uses of this technology.

4 – Do you agree that panel heaters and electric radiators should play a smaller role in decarbonising heat, given their comparatively lower efficiency (than heat pumps) and limited ability to load shift, leading to high running costs for consumers?

While panel heaters and electric radiators may have a role in the decarbonisation of heat, this is likely to be limited to well-insulated buildings where the heat requirements are low and where the capital cost of more more expensive heating solutions such as heat pumps are difficult to justify. Even so the ventilation requirements of such buildings may justify alternative solutions such as mechanical ventilation with heat recovery (MVHR) which combined with air-to-air heat pumps, providing both heating and cooling more efficiently.

5 – In what circumstances, if any, would panel heaters or electric radiators be more suitable than heat pumps, thermal energy storage systems, biomass heating systems or hybrid heat pumps?

In general terms the more efficient heating solutions such as heat pumps should be the first option, but there may be circumstances where panel heaters could form part of a heating system providing supplementary heat or where installation of heat pumps are difficult or expensive. for example, as heating in an annex/outbuilding where a heat pump is excessively expensive for the particular use case or installations at height where the extra costs of installation for the external parts of a heat pump system could become prohibitive. These can only be assessed on a case-by-case basis. Therefore, each technology should be considered on its merits as part of the heating system.

6 – Do you agree that high temperature heat pumps could play a key role in decarbonising heating of buildings?

Yes, we agree. Efforts to decarbonise buildings should be focused on properties that continue to rely on fossil-fuelled heating. High temperature heat pumps, when combined with modern controls—including external temperature measurement and flow temperature management—can achieve very high efficiencies for the majority of operating conditions. During exceptionally cold periods, the flow temperature can be increased to 60°C or higher. While efficiency may decline temporarily under these conditions (often below 200%), this occurs only

for a limited duration, allowing the system to provide effective decarbonised heating without oversizing the installation.

In the context of multi-family dwellings, high temperature heat pumps are often the only viable heat pump option due to the higher flow temperatures required, further underlining their importance in decarbonising the housing stock.

7 – What are the key barriers that are preventing the installation of high temperature heat pumps in (a) domestic properties and (b) non-domestic buildings? How could these barriers be removed?

N/A

8 – Do you agree that air-to-air heat pumps could play a key role in decarbonising heating of buildings without wet central heating systems?

- Government support should focus on enabling adoption and addressing design and installation challenges, rather than mandating distribution of the technology.

We agree that air-to-air heat pumps could play an important role in decarbonising buildings without wet central heating systems, although their suitability will depend on the characteristics of the individual property. Air-to-air heat pumps offer very high efficiencies, often achieving a coefficient of performance (COP) exceeding 4 and can provide a suitable high efficiency solution to decarbonising heating of buildings without wet central heating systems but only in the right circumstances,

Although air-to-air heat pumps cannot provide domestic hot water, this limitation can be addressed through the installation of a small electric boiler.

9 – What are the key barriers that are preventing the installation of air-to-air heat pumps in (a) domestic properties and (b) non-domestic buildings? How could these barriers be removed?

N/A

10 – Do you have any evidence on the potential for air-to-air heat pumps to use alternative refrigerants?

N/A

11 – Please provide any evidence or views on a) the promotion of passive cooling measures to increase their uptake, so that active cooling is only used when and where needed, and b) local network impacts during extreme weather events.

N/A

12 – Do you agree that networked heat pumps may have a key role to play for buildings with limited outdoor space for individual heat pumps per dwelling?

Yes, we agree that networked heat pumps represent a valuable solution for the limited number of cases where individual heat pumps cannot be installed, such as apartment blocks or properties with constrained outdoor space. These systems can operate at the scale of whole-building networks or district heating loops, providing efficient alternatives to individual solutions.

Several pilot projects are under consideration in the UK, including in Cambridge and Worcester, which may provide useful lessons for scaling up networked heat pump deployment. International experience also offers insights: in Germany, a range of private and municipal providers operate local networked heating solutions based on combined heat and power (CHP) plants. The UK government should draw on these examples to inform policy and investment decisions, ensuring that decarbonisation of homes is both effective and practical.

13 – Do you have any evidence or views on a) which business models would be most effective at bringing forward networked heat pumps, where appropriate, and b) what steps would be necessary to support the development of such business models?

N/A

14 – Do you have any evidence or views on a) the public appetite to make use of clean heat solutions relying on shared infrastructure, b) where clean heat solutions that rely on shared infrastructure have been implemented, and c) what steps have been most effective at persuading households to participate in projects?

N/A

15 – Do you have any evidence or views on the role exhaust air heat pumps could play in decarbonising heat?

N/A

16 – Do you have any views on whether exhaust air heat pumps should be targeted primarily at buildings with a) limited outdoor space b) a higher risk of air-tightness c) lower heat demand d) new-builds?

N/A

17 – Do you have any evidence or views on the role heat batteries could play in decarbonising heat?

N/A

18 – Do you have any views on what further criteria, in addition to existing scheme criteria (e.g. MCS certification and SAP-eligibility), should be required for heat batteries that are supported through government grant schemes to prevent systems from drawing energy at peak times?

N/A

19 – Do you have any evidence or views on how future developments in the thermal energy storage market might help reduce strain on the electricity grid and how this could work with other technologies (like heat pumps or electric boilers) to become more cost effective?

Thermal energy storage that supports demand-side flexibility and integrates effectively with heating and hot water systems can play an important role in managing electricity system demand. Even relatively simple technologies, such as smart-controlled hot water immersion heaters, provide a form of thermal storage when operated to align with consumer needs and grid conditions.

To maximise their impact, government policy should prioritise solutions that are compact, scalable, and suitable for mass production and installation. When combined with heat pumps or electric boilers, thermal storage can shift demand away from peak periods, reduce running costs, and improve the cost-effectiveness of low-carbon heating technologies. Further evidence and examples can be found in initiatives such as Home Response: supporting smart energy use in London | London City Hall

20 – Do you have any evidence or views on the role storage heaters could play in decarbonising heat?

Smart storage heaters can play a viable role in decarbonisation heat and hot water. Optimal operation involves charging the heaters during periods of lower grid demand or high renewable energy production, using automated or smart settings where possible, so that stored heat is available during peak usage in the afternoon and evening. By shifting heating

loads in this way—and with the potential to expand demand-side response flexibility beyond overnight operation—storage heaters can play a valuable role in addressing peak seasonal heating challenges while reducing pressure on the electricity network. There are solutions which can provide individual charging patterns that match heat needs to users' needs in ways that are very different to the old time switched Economy7 or Economy10 systems.

21 – Do you have any views on what further criteria, in addition to existing scheme criteria (e.g. SAP-eligibility), should be required for high heat retention storage heaters that are supported through government grant schemes, to prevent systems from drawing energy at peak times?

N/A

22 – Do you have any evidence on any other types of electric heating that could play a significant role in decarbonising heat?

For well-insulated buildings, mechanical ventilation with heat recovery (MVHR) systems supplemented by air-to-air heating and cooling may provide an effective solution for electric heating to contribute to decarbonisation. However, this approach is likely most suitable for new buildings or properties undergoing substantial renovation, particularly where the installation of ducting is required. Government policy should therefore focus on deploying this technology in scenarios where it is most appropriate, rather than promoting its widespread application.

23 – Do you have any evidence or views on the role solid biomass boilers could play in decarbonising heat?

Experience from schemes in Northern Ireland indicates that the role of solid biomass boilers in decarbonising heat is limited and raises significant environmental and economic concerns. Without strict regulation, biomass boilers can emit pollutants including carbon monoxide, nitrous oxide, methane, fine particulate matter, and soot, which present health risks. Additional challenges include the high cost of equipment, the limited UK-based supply of wood fuel, and the need for specialised modern boilers with built-in filtration systems.

While technically capable of contributing to decarbonisation, biomass boilers represent a substantial investment and are generally less practical than other low-carbon heating options, such as heat pumps. Any deployment should therefore be carefully targeted, particularly in rural areas, where there is a higher availability of local biomass and it is likely to coincide with a lower electricity network capacity. Policy should prioritise solutions that are appropriate to the characteristics of individual premises rather than encouraging widespread adoption of a single technology.

24 – Do you have any evidence on the types and/or characteristics of properties which would not be suitable for a heat pump or a heat network, but would be suitable for a biomass boiler?

The number of properties unsuitable for heat pumps yet suitable for a biomass boiler is very limited. Only a small subset of properties have sufficient space to store the large volumes of fuel required and accommodate a biomass boiler, while simultaneously lacking the conditions necessary for a heat pump installation. While biomass boilers could be integrated with a heat network in specific cases, fully effective and cost-efficient deployments are likely to remain niche.

This further emphasises the principle that decarbonisation policy should focus on identifying the most appropriate solution for each individual property rather than promoting the blanket adoption of specific technologies.

25 – Do you have any further evidence or views on the sustainable implementation potential for renewable liquid heating fuel production in the UK?

The Climate Change Committee's Sixth Carbon Budget highlights significant interest in renewable liquid fuels; however, detailed evidence remains limited. First-generation biofuels are inherently constrained by the availability of raw materials, which compete with food production and may contribute to deforestation, with negative climate impacts. Second-generation fuels, such as lignocellulose-based biofuels or those derived from municipal solid waste, remain unproven at scale, either technically or economically. E-fuels are likely to be an order of magnitude more expensive than their fossil equivalents and typically exhibit round-trip energy efficiencies below 10%.

Large-scale deployment of renewable liquid heating fuels could also increase import dependency, given the UK's limited domestic biomass resources. The use of these fuels often requires specialised heaters with filtering and regular maintenance, as well as infrastructure for storage and fuel transfer. These additional requirements represent substantial capital investment, which must be carefully weighed against alternative decarbonisation options such as local heating networks or heat pumps.

26 – Do you have any further evidence or views on the cost at which renewable liquid heating fuels – produced from sustainable feedstocks - could be made available to UK consumers?

Currently, the most readily available renewable heating fuel is Hydrotreated Vegetable Oil (HVO), which is approximately 10–30% more expensive than conventional diesel. Beyond HVO, Sustainable Aviation Fuel (SAF), which is chemically similar, can cost up to five times the price of kerosene. While increased production volumes may generate learning effects that reduce prices, this could be constrained by the scarcity of suitable biological feedstocks.

The production of renewable liquid heating fuels is inherently more complex than refining fossil fuels. Whereas oil refining is a highly optimised process, biofuels require breaking down raw materials into small molecules and reconstructing them into longer-chain fuels, accompanied

by extensive purification stages. As a result, renewable liquid heating fuels remain substantially more expensive and are currently not cost-effective for widespread use by UK consumers.

27 – Do you have any evidence or views on the potential of renewable liquid fuels to be used in buildings where other low carbon solutions may not be the best solution?

Renewable liquid fuels should be considered only in buildings where no alternative low-carbon solutions are feasible. As previously noted, these fuels are expensive, limited in supply, and compete with harder-to-decarbonise sectors such as aviation and marine transport. Their use in buildings should therefore be strictly prioritised for situations where other decarbonisation options, such as heat pumps or networked solutions, are unsuitable.

28 – Do you have any evidence or views on the practical implications that may arise if some off-grid consumers start using renewable liquid heating fuels?

Off-grid consumers face particular challenges in using renewable liquid heating fuels. Given their small numbers, these users will not benefit from the economies of scale that larger cohorts can generate, resulting in higher costs per household. This is further compounded if at a later date, UK policy is to phase out oil for heating. Additionally, the limited availability of sustainable feedstock means that prioritising these fuels for off-grid buildings may not be the most effective use of resources. Renewable liquid fuels are likely to have a greater impact if allocated to sectors where alternatives are less feasible, such as aviation and marine applications.

29 – Do you have any evidence or views – especially on cost and availability of sustainable feedstock - to demonstrate that a possible initial blend approach could be increased to a 100% renewable liquid fuel solution for consumers?

While Hydrotreated Vegetable Oil (HVO) is already used in blended supply, there is currently no clear pathway to scale production of sustainable feedstocks to achieve full 100% renewable liquid fuel solutions at affordable prices. As noted in previous responses, limitations in feedstock availability, high production costs, and competition with other sectors make a complete transition to 100% renewable liquid fuels unlikely to be feasible in the near term for UK consumers.

30 – Do you have any evidence or views on the role that hybrid heat pumps, comprising of a heat pump and an appliance using 100% renewable liquid fuels, could play in decarbonising heat?

Hybrid heat pumps can peak lop, avoiding the future electricity system having to be capable of meeting maximum heat demand. In rural areas, where the electricity grid capacity is limited

and upgrade costs per household would be particularly high, this may offer a cost effective and more technically feasible solution in decarbonising rural heat.

31 – Are there any other alternative low carbon heat sources not discussed in this consultation which you consider could offer further benefits if installed as part of a hybrid heat pump system compatible with net zero?

N/A

32 – Do you have any evidence or views that could help inform future decisions on whether to implement a Renewable Liquid Heating Fuel Obligation, and if so, how?

For the reasons given in questions 25-29, we recommend a rigorous study on affordability, scalability and liquid fuel competition before introducing any such obligation. This study should bear in mind that fuel poverty is already potentially an issue in rural communities.

33 – Do you agree that evidence of affordability to consumers, and availability at scale of sustainable feedstock are key factors in determining if the government should pursue the implementation of a Renewable Liquid Heating Fuel Obligation? If not, what other factors do you think are significant and why?

Yes, we agree, as our answer to question 32 outlines. In addition to scalability and affordability we recommend that competition for liquid fuels from other end uses should be taken into consideration. We also recommend that the implications for renewable energy production is also considered, given the very low round trip efficiencies associated with biofuel production as an energy carrier.

34 – Do you have any views on what other steps government or industry could take to develop the market for renewable liquid heating fuels, ahead of making a decision on whether to implement a Renewable Liquid Heating Fuel Obligation?

As above, we note the dangers in defining a solution rather than an outcome, particularly when that solution faces such challenge and uncertainty.

35 – Do you have any views on whether the introduction of the Renewable Liquid Heating Fuel Obligation would be an effective tool in fully decarbonising oil heated homes or whether it is a transitional solution to decarbonisation (if either)?

As noted above, defining a specific solution rather than the desired outcome presents clear dangers, particularly when that solution faces such challenge and uncertainty.

36 – Do you have any evidence or views on the role other low carbon heating systems, not discussed in this consultation, could play in decarbonising heat?

N/A

37 – Do you have any evidence or views on what steps the government could be taking to support the development of early-stage heating technologies that have legitimate potential in decarbonising properties?

To support the development of early-stage heating technologies with genuine potential to decarbonise properties, the government should provide continuous, long-term R&D funding. Ongoing engineering assessment is critical, and consideration should be given to trials to gain practical experience covering design, planning, deployment and operation to evaluate real-world efficiency and performance.

While investment in promising technologies is important, priority should focus on proven decarbonised heating solutions with the potential for large scale deployment.

38 – Do you have any additional evidence on how people with protected characteristics under the Equality Act 2010 may be affected by the installation of any of the alternative heating technologies included in this consultation?

N/A