



Department for Energy Security and Net Zero consultation

The Home Energy Model: Future Homes Standard Assessment

Submission from CIBSE

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THE RESPONDENT

The Chartered Institution of Building Services Engineers (CIBSE)

CIBSE is the primary professional body and learned society for those who design, install, operate and maintain the energy using systems, both mechanical and electrical, which are used in buildings. Our members therefore have a pervasive involvement in the use of energy in buildings in the UK with a key contribution to sustainable development. Our focus is on adopting a co-ordinated approach at all stages of the life cycle of buildings, including conception, briefing, design, procurement, construction, operation, maintenance and ultimate disposal.

CIBSE is one of the leading global professional organisations for building performance related knowledge. The Institution and its members are the primary source of professional guidance for the building services sector on the design, installation and maintenance of energy efficient building services systems to deliver healthy, comfortable and effective building performance.

CONSULTATION RESPONSE

EXECUTIVE SUMMARY

The consultation has been problematic for industry to effectively respond to.

The launch of the two HEM consultations coinciding with the Future Homes and Buildings Standard Consultation and the Heat Zoning consultation over an annual holiday period has been problematic for industry. We believe the industry has put their best efforts into responding to the Future Homes and Buildings Consultation but has not had enough time to digest and effectively consult on the Home Energy Model consultations. The 3-week extension was not sufficient time to co-ordinate any meaningful evidence gathering (which is planned at the start of the consultation process based on the closing date of the consultation period) to support our consultation responses due to the late notice of the extension, and since it was not a simple extension, but a necessary one to re-visit some of the earlier analysis and draft responses.

The consultation period given to respond has also been compromised by the following issues:

- the three FHS / FBS / HEM consultations had the same time frame for responses, and a similar timeframe to the heat zoning consultation,
- the time frame given was over an annual holiday period,
- the consultation packages are among the largest and most significant consultation packages the industry has received to date making it difficult to focus efforts on all consultations at the same time,
- the consultation is essentially about a python code that the industry lacks expertise in understanding, thus they are unable to effectively identify issues within the coded language. This creates a barrier for industry to effectively contribute and raises concerns around the tool being a 'black box'; when testing using the pilot online tool they are unable to determine the reason why certain inputs do not provide the desired outputs.
- the consultation lacks evidence of how it has been tested (e.g., certain equipment has been found not to perform as expected within the FHS wrapper and this has raised questions as to the robustness of the testing specifically with regard to PV diverters and

- batteries – this continues to be the case, after the issues acknowledged by DLUHC which led to the extension); we have been provided supporting information and would be happy to share this with DLUHC on request.
- the consultation documentation lacked important details (e.g., how will the core HEM tool be protected, what safeguards will be put in place to prevent altered versions of HEM being used for compliance, what is the proposed timeframe for implementation and plan for training and upskilling the industry and what is the proposed plan for the PCDB). These large overarching questions make it difficult to ascertain responses on the specifics around the methodologies and smaller questions given in the consultation (e.g., what are your thoughts on the choice of name for the new model?).
 - the consultation package was not complete when launched (e.g., some supporting information was not published or not made available in the public domain (i.e., the publication “*Domestic Hot Water Use: Observations on hot water use from connected devices*” is still awaiting publication by DSNEZ, and BS EN ISO 52016-1:2017 referred to in Q16 of the HEM consultation needs to be purchased in order to review it as part of the consultation) and the online tool had various issues (i.e., it was not available for various periods during the consultation period and was found to have an error approx. 3 weeks before the consultation deadline).
 - the supporting Q&A sessions held by DESNZ did not explain in any detail what was included within the consultations and were not best placed to answer the majority of questions relating to the specifics of the consultation, pushing these questions instead to DLUHC (e.g., proposed changes to the PCDB and the cost/testing ramifications on existing products in the PCDB, methodologies that underpin HEM, validation exercises carried out).

As a result of these issues, and despite our great efforts to engage with our members, we have received limited comments and so our response is not as comprehensive and detailed as we think this consultation deserves.

KEY ASPECTS

CIBSE **welcome the move to a half-hourly time resolution and the use of local weather data**, rather than a single location (East Pennines) currently used for all dwellings. **However, we are concerned that the proposed application is far too limited:** the local weather file would also be applied to the notional building applying a moving target rather than a consistent level of performance throughout England, as the consultation itself states, it will be possible to comply with the same fabric specifications regardless of location, the only change being the estimated heat pump sizing. This means that householders in the north will continue to risk being exposed to higher heat demand and energy bills than those in the south. It is also felt that an opportunity has been missed within the Future Homes Standard Wrapper regarding the **lack of inclusion of variable fuel prices and CO₂ emission factors** which will become of greater importance as when we use energy, will become increasingly important, not just how much we use. There are also concerns regarding the **unrealistically low estimates of space heating demand** which were identified in the government's own assessment of the Camden Passivhaus. The **standardized inputs are also felt to be overly complex for early stage building design** and we have proposed some potential solutions for this.

The industry requires **more detail around the future implementation of HEM:FHS** including training, upskilling, detail around future for implementation plan so they can prepare and feedback constructively. Previously the industry has had a poor experience with releases of revisions of SAP and the changes proposed in both of the HEMs consultations are significantly greater for the industry to adapt too.

The industry have not had sufficient time to grasp or effectively test the HEM:FHS wrapper and thus our feedback on the assumptions and metrics is limited. It has also been raised that in the early stages of the Future Homes Standard a clear distinction was proposed to be made a distinction between flats and detached houses within the notional building, as it was felt that **‘the one size fits all’ approach leads to compatibility problems**. We are disappointed that this seems to have been removed.

QUESTION RESPONSES

Chapter 2: The Future Homes Standard assessment: a wrapper for the Home Energy Model

1. What are your views on the choice of inputs that have been standardised (i.e. the standardisations as set out in Chapters 3-5) vs left open as user inputs (i.e. as in the consultation tool)? Please explain your reasoning and provide any supporting evidence.

What is a standardised input vs what is a user input is not made clear in the consultation material. This is especially true in the context of the PCDB and is key here as central plant can often make/break an assessment. It needs to be clear which measures are included and excluded in the input options on the model, as some solutions may be effectively prevented. For example, is ancillary radiant heating to supplement heat pumps in extremely cold weather permissible?

2. What are your views on the ease of populating or sourcing data for those user inputs? Please explain your reasoning and provide any supporting evidence.

Some inputs seem too detailed and therefore assumptions would need to be included, for example it asks for the thermal mass of piping and the pipe length from the DHW cylinder to the shower, and this will make early stage designs difficult. This could also result in gaming of the metrics at the pre-planning stage and make it difficult for the model to be interrogated.

Potentially, this could be covered by a standardised wrapper for early HEM compliance assessments (e.g. equivalent to planning application stage) which could provide some limitations/ default input bounds to those variables which essentially become fixed at planning e.g., heating system type, form, façade specification etc..

Chapter 3: Occupancy and energy demand Occupancy assumptions

~~3. What are your views on the proposed standard occupancy assumption? Please explain your reasoning and provide any supporting evidence.~~

~~4. What are your views on the assumptions for metabolic gains? Please explain your reasoning and provide any supporting evidence.~~

Space heating and cooling assumptions

5. Do you think the FHS assessment wrapper should keep two thermal zones for all dwellings?

Yes/No. Please provide your reasoning and any supporting evidence.

This adds significant time and complexity to the inputs, for unclear benefits. It would be more accurate to have an input whereby the number of heating zones are defined based on the ability of heating infrastructure of the property to control each zone's temperature.

6. If the FHS assessment wrapper keeps two thermal zones, do you think we should introduce inter-zone heat transfer?

Yes/No. Please provide your reasoning and any supporting evidence.

Having inter-zone heat transfer is a more realistic assumption and should be grounds for including it within the calculation.

7. What are your views on heating setpoints for (a) one zone; (b) two zones without interzone heat transfer (i.e. the current assumptions given above); and (c) two zones with inter-zone heat transfer? Please provide reasoning and supporting evidence.

None of the above – please see our responses to Questions 5 and 6.

21°C would be suitable for living rooms and 20°C for non-living spaces such as utility rooms, bathrooms etc.

Please feel free to contact us for clarification on the points made above.

8. What are your views on the assumptions for space heating hours? Please provide your reasoning and any supporting evidence.

Concerns have been raised as to why it is proposed to not include a heating season within the assumptions. We suggest that the morning heating period should end at 9.00am, on the basis that we assume occupants leave their homes to go to work during the weekday.

However, based on working trends post-Covid and the popularity of hybrid working it may be more realistic to factor in some allowance for those working from home within the assumptions. In our view the weekend heating period seems excessive and the overlap of heating hours between the weekday living area and the non-living area may result in greater heat losses when opting for the multi-zone heating setpoint with heat transfer. We are unsure if the assumed hours should be the same.

We would also like to highlight how currently the HEM:FHS significantly underestimates the space heating demand compared to other models and measured data. This was evidenced within the consultation's validation documentation, in the comparison carried out on the Camden Passivhaus. It has been suggested that the HEM Future Homes Standard wrapper estimated space heating demand from the Part L 2021 notional spec Option 1 & 2 to be around 20 kWh/m²/annum (almost Passivhaus levels of performance) which is approximately one third lower than the typical estimates SAP provides. Further analysis has been undertaken by LETI and we refer you to their evidence base.

Please feel free to contact us for clarification on the points made above.

~~9. What are your views on the ability to specify a control scheme (e.g. setback temperatures and “advanced start” periods) that works for the system being installed? Please provide your reasoning and any supporting evidence.~~

10. What are your views on the treatment of the heating season vs non-heating season (months where the heating is assumed to be off regardless of the temperature)? Please provide your reasoning and any supporting evidence.

We are unsure of the intent of these changes and feel it would be worthwhile if the consequences (unintended or otherwise) are reviewed prior to implementation.

We believe that the introduction of a heating/non-heating season will have a negligible impact on the results (especially as HEM:FHS seems to under-estimate space heating anyway, as noted in Q8 above) .

Additionally, when carrying out dynamic energy models unusual peaks in heating or cooling demand may occur when set-points change instantaneously on the hour. This sometimes appears to represent a summertime heating demand. These peaks usually do not exist in reality as they are managed with control response loops (as well as actual limits on heating/cooling system capacities).

It is felt that these peaks should be avoided in HEM by using ramp profiles and capacity limits. The approach of switching off heating in summer would also avoid some of the impact but feels like treating the symptom rather than the cause.

11. What are your views on the proposed assumptions for the use of space cooling systems? Please provide your reasoning and any supporting evidence.

The cooling system calculations are aligned with heating calculations even though cooling is likely to be less intensely used than heating due to reduced occupation during peak cooling hours (i.e., in the afternoon).

It is felt that SAP 10 appeared to significantly underestimate cooling energy consumption therefore if changes have been made this needs to be assessed further to avoid any unintended consequences. We believe the shift to hourly calculation means the sensitivity of the results in relation to occupancy and operation profile could be significant. A range of profiles should be tested against a range of dwellings to check for unintended consequences.

Guidance on consistent calculation of equivalent free area should be published, alongside guidance on how to consider use of window restrictors. Will window opening in noisy locations be restricted as per Part O?

Domestic hot water assumptions

~~12. What are your views on the assumptions for the volume of hot water demand? Please provide your reasoning and any supporting evidence.~~

13. What are your views on the pseudo-randomly generated hot water use schedule, including the algorithm generating it? Please provide your reasoning and any supporting evidence.

Hot water demand is a key factor for high performing buildings, particularly in apartment buildings which have high performing facades (as per FEE), as most of the heating load is related to DHW as opposed to

space heating. Therefore, accurate hot water usage and efficient generation should be scrutinised.

~~14. What are your views on the proposed hot water / mixed water temperature assumptions? Please provide your reasoning and any supporting evidence.~~

~~15. What are your views on the assumptions for water heating hours? Please provide your reasoning and any supporting evidence.~~

~~16. What are your views on the cold water feed temperature assumptions? Please provide your reasoning and any supporting evidence.~~

Lighting, cooking, and appliances assumptions

~~17. What are your views on the proposed assumptions for lighting demand, time of use, and thermal gains availability? Please provide your reasoning and any supporting evidence.~~

~~18. What are your views on the proposed assumptions for cooking energy demand, time of use, and thermal gains availability? Please provide your reasoning and any supporting evidence.~~

~~19. What are your views on the assumptions for appliance energy demand, time of use, and thermal gains availability? Please provide your reasoning and any supporting evidence.~~

~~20. What are your views on the assumptions for cold water and evaporative losses? Please provide your reasoning and any supporting evidence.~~

Chapter 4: Weather assumptions

21. What are your views on the use of climate projections rather than historical averages for the weather assumptions within the model? Please provide your reasoning and any supporting evidence.

We have received no comments from our members on the move from historical averages to climate projections (specifically CIBSEs Test Reference Year, High (50th percentile) 2020s TRY), but we would like to comment on the move to local weather data, and in the absence of a question related to this change we have included our comments here.

Overall, we warmly welcome the move to local weather data specific to the location of the building. However, we are concerned that the proposed application is far too limited: the local weather file would also be applied to the notional building i.e., applying a moving target rather than a consistent level of performance throughout England: as the consultation itself states, it will be possible to comply with the same fabric specifications regardless of location, the only change being the estimated heat pump sizing.

Chapter 5: FHS compliance metrics

Metrics

22. What are your views on the additional metrics produced by the FHS assessment wrapper (i.e. metrics produced in addition to the FHS compliance metrics)? Please provide your reasoning and any supporting evidence.

There are concerns as to whether FEE are fit for purpose as it disregards building form factor. As mentioned in our previous consultation response to the Future Buildings Standard consultation in 2022 we strongly recommend exploring the following metrics:

- Space heating demand: this has the disadvantage of not being directly measurable, but it is a clear reflection of overall space heating performance, allows comparisons between buildings, and has a track record through Passivhaus and similar schemes.
- Heat transfer coefficient: this has the disadvantage of varying with climate (i.e. the same HTC in Scotland and Cornwall would result in different heating needs), but it is directly measurable.
- Our recommendation: A combination of both i.e. space heating demand as compliance metric, which would be evidenced at the as-built stage by calculations using tested as-built airtightness and HTC.

EUI would also be useful as a metric, as it provides an overall assessment of the home and can be simply understood by occupants. Some members express concerns that smaller spaces (= more densely used) will typically find it more difficult than larger ones to meet an EUI limit – similar alternatives could be looked into, for example energy use per bedroom, rather than per sqm.

See also our suggestion for an indicator of demand management, in response to Question 24.

23. What are your suggestions for additional metrics (i.e. metrics produced in addition to the FHS compliance metrics) not currently produced by the FHS assessment wrapper? Please make suggestions, explaining your reasoning, and providing any supporting evidence.

Please refer to our FHS response on metrics.

Fuel assumptions (emissions and primary energy)

24. What are your views on the methodological approach to define the emission factors and primary energy factors used within the Home Energy Model: FHS assessment? Please provide your reasoning and any supporting evidence.

It is strongly felt that:

- carbon factors should consider a larger time frame, to better reflect the impact of systems as the grid decarbonizes, rather than assessing them on the basis of today's factor.
- the assessment should be able to reflect the implications of variable energy prices, to reward demand management and on-site generation.. The ability to reflect variable CO₂ emission factors should also be considered, however opinions are divided on this topic, because the assessment is then quite reliant on assumed profiles of energy use, and because variations will reduce in absolute terms over time, even if they remain significant relatively speaking.

The period that the Future Homes Standard regulations will be in place will be a period when electric vehicles become standard, which will drive the majority to have variable energy tariffs. When we use energy will become increasingly important. Currently the HEM core model is not able to reflect the benefit of features such as batteries or heating your hot water tank at night, etc. This could be done using variable pricing and carbon intensity in the HEM core model, or other indicators to reflect demand management. We strongly recommend that this should be reviewed and incorporated if possible. This will

be a really important aspect for residents in the future. Currently, it is not clear if this is possible to achieve through the HEMs core model and previously slow uptake of carbon factors heavily influenced the design of buildings unnecessarily.

25. What are your views on the proposed emission and primary energy factors for electricity? Please explain your reasoning and provide any supporting evidence.

As noted elsewhere and in previous responses:

- the use of varying carbon factors may be considered, for example to reward demand management and on-site generation. We note however that opinions are divided on this topic, because the assessment is then quite reliant on assumed profiles of energy use, and because variations will reduce in absolute terms over time, even if they remain significant relatively speaking
- the use of longer-term carbon factors (which can still be updated on a regular cycle) provides a more representative assessment of the impact of building systems over their lifetime, rather than being assessed on today's situation alone.
- we do not think the methodology for calculating primary energy factors is clear enough, nor justified enough.

~~26. What are your views on the penalisation of energy shortfall and the energy shortfall factors? Please provide your reasoning and any supporting evidence.~~

Chapter 6: Validating the assumptions used in the FHS assessment wrapper

27. What are your views on the inter-model validation work that has been carried out (i.e. against SAP 10.2, PHPP and ESP-r)? Please provide your reasoning and any supporting evidence.

From the government's own assessment of the Camden Passivhaus the FHS wrapper is producing unrealistically low estimates of the space heating demand. It has been suggested that the HEM Future Homes Standard wrapper estimated space heating demand from the Part L 2021 notional spec Option 1 & 2 to be around 20 kWh/m²/annum (almost Passivhaus levels of performance) which is approximately one third lower than the typical estimates SAP provides.

Further analysis has been undertaken by LETI and we refer you to their evidence base.

~~28. What are your views on the monitoring data case study validation work that has been carried out? Please explain your reasoning and provide any supporting evidence.~~

~~29. What suggestions do you have for further validation exercises that could be undertaken to refine the Home Energy Model: FHS assessment? Please make suggestions, explaining your reasoning, and providing any supporting evidence.~~

Public Sector Equality Duty

~~30. What are your views on the equality considerations of these assumptions and their evidence base? Please provide your reasoning and any supporting evidence.~~

Environmental Principles Policy Statement

31. What are your views on the possible environmental impacts of the Home Energy Model: FHS assessment itself? Please provide your reasoning and any supporting evidence.