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Department for Energy Security and Net Zero consultation

The Home Energy Model:
Making the Standard Assessment Procedure
fit for a net zero future

Submission from CIBSE

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THE RESPONDENT

The Chartered Institution of Building Services Engineers (CIBSE)

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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.

<div align="center">**CONSULTATION RESPONSE**</div>

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 Standards 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 still 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:

- o   the three FHS / FBS / HEM consultations had the same time frame for responses, and a similar timeframe to the heat zoning consultation
- o   the time frame given was over an annual holiday period,
- o   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,
- o   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.
- o   the consultation lacked 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,

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- o 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?).
- o the consultation package was not complete when launched (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).
- o 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 under pin 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** although feel that an opportunity may have been missed within the Future Homes Standard Wrapper and the HEMs core model regarding the **lack of inclusion of variable fuel prices and CO_2 emission factors** which will become of greater importance as when we use energy, will become increasingly important, not just how much we use. The industry feels that, given the introduction of significant additional complexity which HEM represents, an **opportunity was missed to produce a fully dynamic compliance tool** that could have assisted in streamlining the regulatory process as opposed to just assisting Part L compliance, especially as much dynamic modelling now has to happen for Part O compliance.

The industry requires **more detail around the future implementation of HEM** inc., 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 to.

There are concerns around the **transparency and security** of the open-source code given that this is not something that can be easily understood and therefore similarities are being drawn between the proposed HEM tool and 'black box' tools, where you are unable to determine issues. It is also unclear as to how the core model will be protected to ensure that end-consumers (i.e., home buyers) are not misled by claims from non-compliant HEMs tools due to the open-source nature of the tool.

However, there is **support for the overall concept** and modularity of the tool that can be used for multiple purposes. Future wrappers should include a Part O, Whole Life Carbon, Early design stage (e.g. Planning/Pre-planning Stage) and a 'Design wrapper' have been proposed to help streamline the design

and compliance processes and improve productivity. The feasibility and potential uses of a Part F wrapper could also be considered.

QUESTION RESPONSES

Chapter 2: The need to replace SAP

1. What are your views on the choice of name for the new model? Please provide your reasoning and any supporting evidence.

It has been suggested that the abbreviation HEMs may be confused with 'Home Energy Management Systems (HEMS)'. However, we are uncertain on how well known and established this is.

2. What are your views on the choice of name for the version of the model which is to be used to demonstrate compliance with the Future Homes Standard? Please provide your reasoning and any supporting evidence.

3.What are your views on the potential implications of this proposed name change? Please provide your reasoning and any supporting evidence.

Chapter 3: A new home energy modelling ecosystem

An open-source methodology

4.What are your views on using the open-source code as the approved methodology for regulatory uses of the Home Energy Model? Please provide your reasoning and any supporting evidence.

The overall **concept** of a modular, multipurpose tool that can be adapted for multiple needs has generally been welcomed by members. As further wrappers are made available it is envisaged to improve productivity. However, concerns have been raised regarding the level of **transparency** there is regarding the tool. The Python code language presents a challenge for industry as they are unfamiliar with this and the **lack of supporting documentation** which translates the code has been problematic during the consultation process. Although industry can test inputs and outputs and flag potential issues, they are unable to always ascertain why the issues have arisen. Even though it is 'open source' the lack of explanation of the code makes it like a 'black box' model and a 'black box' model presents great challenges for the industry. There are also concerns regarding how the core HEM code will be **protected and identifiable as authentic** as this will underpin compliance with Building Regulations. Additionally, how will end consumers, prospective house purchasers etc. not be misled or confused by claims from non-compliant HEM model outputs. There are also concerns that if software developers take ownership of the core code this also creates a barrier as changes and updates may be driven by the commercial needs of the software.

5.What forms of collaboration would you be interested in for future development of the Home Energy Model codebase? Please provide further details.

Changes to the delivery model and provision of software

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6.What are your views on our assessment of issues with the current SAP delivery model? Please provide your reasoning and any supporting evidence.

Process inertia is an issue with SAP currently, but this is also to do with the time-lag in updating key inputs, such as carbon factors, which can lead to design decisions that are unnecessary in real conditions.

7.What are your views on the concept of a centralised, cloud-based version of the Home Energy Model, to be used for regulatory purposes? Please provide your reasoning and any supporting evidence.

Benefits and disadvantages to a centralised, cloud-based version have been received from members. It is felt that a centralised platform could help bring consistency to the assessment procedure (similar to BREEAM) but there may be issues with regard to accessing the model on remote sites and it may not be be bug fixed or updated as quickly as the current approach where software developers are incentivized to update as quickly as possible to satisfy consumers.

A revised database of product characteristics

8. What are your views on revising the database of product characteristics (currently the "PCDB") for the Home Energy Model? Please provide your reasoning and any supporting evidence.

An approved database to reward and drive innovation in the market is desirable. However, it is not clear from the tool or the consultation document how the design conditions can be altered as a previous study by Energy Catapult (and co-funded by the BEIS Energy Innovation Programme) entitled "Electrification of Heat Demonstration Project" identified how the system set up and design conditions have a greater effect on the performance of a heat pump than the selection of the manufacturer and its associated efficiencies.

Concerns have also been raised about the lack of clarity on the changes for existing products on the PCDB database in terms of what additional data is required and who will be paying for this. Existing manufacturers need clarification on this so they can plan and decide whether this is a worthy investment for them.

9. What changes would you recommend to the PCDB data collection procedures? Please provide your reasoning and any supporting evidence.

10. What changes would you recommend to the PCDB data requirements for particular technologies? Please provide your reasoning and any supporting evidence.

11. What are your views on our assessment of issues with the way SAP currently recognises new technologies (currently the "Appendix Q process")? Please provide your reasoning and any supporting evidence.

Appendix Q has been reported to be a laborious process and not suitable for all technologies. Certain technologies are put at a disadvantage due to the process. Improvements to the assessment process and implementation onto a new database should be discussed with manufacturers that represent a broad

range of technologies.

12. What are your views on the principles for how the Home Energy Model will recognise new technologies once it is in use? Please provide your reasoning and any supporting evidence.

13. What are your suggestions for how to integrate new innovative products into the Home Energy Model? Please provide your reasoning and any supporting evidence.

Using "wrappers" to distinguish different use cases

14. What are your suggestions for other wrappers that could be developed for the Home Energy Model in future? Please provide your reasoning and any supporting evidence.

Given the additional complexity which HEM represents compared to SAP, members are disappointed that a more sophisticated, fully dynamic tool was not developed that could then be simplified with wrappers. However, generally they are supportive of the modularity and flexibility of the tool via wrappers.

The industry is supportive of a whole life carbon and an EPC wrapper. Additionally, they have suggested that design focused wrappers that could help combine the design modelling process with compliance modelling would be welcomed as they would help streamline this process and improve productivity. In the HEM:FHS consultation for Q2 we highlighted how some inputs seem too detailed and this would be problematic at the pre-planning stage. Therefore, standardised wrapper(s) for the planning application stage 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. for early HEM compliance assessments.

It has been suggested that in terms of:

Design output for space heating & hot water: The industry would want to be able to size room heat emitters, heat generators and associated systems.

Design input: The industry would like the ability to better understand whether the compliance assumptions meet the design brief requirements. To avoid the need for separate design calculations.

In regard to the latter, there has been strong support for a Part O wrapper that streamlines the process of simplified calculations, and one that could support the dynamic thermal method of compliance would also be welcomed. However, as the tool is not fully dynamic, we envisage that this cannot be achieved. A Part F wrapper may also be useful (this is a less common suggestion than the Part O wrappers, for which there is strong support). CIBSE would like to highlight that there was not sufficient time to obtain more detailed information on these points and so we would be happy to facilitate further discussions with those members that contributed to our response.

Chapter 4: The new Home Energy Model – an overhaul

15.What are your views on the increased time resolution offered by the Home Energy Model? Please provide your reasoning and any supporting evidence.

The move to a half-hourly time resolution from a monthly time resolution is a welcomed change and will provide more accuracy in the calculations of heating and cooling demand, and thus energy consumption. However, it has been suggested that the incorporation of variable fuel prices and CO_2 emission factors will become of greater importance as when we use energy will become as important as how much we use it. Currently, it is not clear if this is possible to achieve through the HEMS core model. There are also some concerns about how easy it will be to troubleshoot issues as previously these were easily identifiable when SAP was Excel based and it was easier to identify what was having a positive/negative effect on the model.

16. What are your views on the choice of BS EN ISO 52016-1:2017 (in its half-hourly form) as the basis for the Home Energy Model? Please provide your reasoning and any supporting evidence.

17. What are your views on the ability of the Home Energy Model to model energy flexibility and smart technologies? Please provide your reasoning and any supporting evidence.

Chapter 5: What is inside the Home Energy Model?

Space heating and cooling demand

18a. What are your views on the methodological approach for calculating space heating and cooling demand? Please provide your reasoning and any supporting evidence.

Concerns have been raised about how IR panel heaters will be represented with the change from air temperature to operative temperature.

18b. What are your views on the methodological approach for calculating fabric heat loss? Please provide your reasoning and any supporting evidence.

18c. What are your views on the methodological approach for calculating thermal bridges? Please provide your reasoning and any supporting evidence.

18d. What are your comments on the methodological approach for calculating infiltration and/or controlled ventilation? Please provide your reasoning and any supporting evidence.

18e. What are your views on the methodological approach for calculating thermal mass? Please provide your reasoning and any supporting evidence.

18f. What are your views on the methodological approach for calculating solar gains and solar absorption? Please provide your reasoning and any supporting evidence.

18g. What are your views on the methodological approach for calculating shading? Please provide your reasoning and any supporting evidence.

Domestic Hot Water (DHW) demand

19a. What are your views on the methodological approach for calculating Domestic Hot Water demand? Please provide your reasoning and any supporting evidence.

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The supporting documentation "Domestic Hot Water Use: Observations on hot water
use from connected devices." was not published when the consultation was launched and (as of the 23ʳᵈ
February 2024) is still not available in the public domain.

19b. What are your views on the methodological approach for calculating heat losses from Domestic Hot Water pipework? Please provide your reasoning and any supporting evidence.

19c. What are your views on the methodological approach for calculating heat losses from hot water cylinders? Please provide your reasoning and any supporting evidence.

19d. What are your views on the methodological approach for calculating incidental gains from domestic hot water? Please provide your reasoning and any supporting evidence.

Heating and cooling systems

20a. What are your views on the modelling of heat pumps in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20b. What are your views on the modelling of electric resistive heaters in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20c. What are your views on the modelling of electric storage heaters in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20d. What are your views on the modelling of heat networks in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20e. What are your views on the modelling of boilers in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20f. What are your views on the modelling of heat batteries in the Home Energy Model? Please provide your reasoning and any supporting evidence

20g. What are your views on the modelling of air conditioning in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20h. What are your views on the modelling of other Domestic Hot Water heating (e.g. immersion heaters, point-of-use, solar thermal) in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20i. What are your views on the modelling of heat emitters in the Home Energy Model? Please provide your reasoning and any supporting evidence.

It has been suggested that IR panel heaters may not be represented well when modelled due to the shift from operative temperature to air temperature. Please contact us for further details.

20j. What are your views on the methodological approach for calculating pumps' and fans' energy consumption in the Home Energy Model? Please provide your reasoning and any supporting evidence.

20k. What are your views on the modelling of controls for heating and/or hot water in the Home Energy Model? Please provide your reasoning and any supporting evidence.

Electricity generation, self-consumption, and storage

21a. What are your views on the current priority order for allocating electricity supply and demand in the Home Energy Model? Please provide your reasoning and any supporting evidence.

21b What are your views on the modelling of solar PV in the Home Energy Model? Please provide your reasoning and any supporting evidence.

Industry members have conducted initial modelling and found that in the FHS Option 1, PV targets are difficult to achieve; it is thought that this is related to the assumptions on PVs specific to the notional dwelling and we have therefore highlighted this in our FHS response, but are repeating it here; it needs to be resolved as otherwise it will restrict the flexibility in the design of buildings i.e., designs may need to have southern orientation to comply.

Please contact us for further details.

21c. What are your views on the modelling of electric batteries in the Home Energy Model? Please provide your reasoning and any supporting evidence

It has been suggested that these are not well represented when modelled. The issue seems to be related to the lack of dynamic primary energy and carbon factors. It does not appear to be taking the clean electricity generated by PV and utilising it at times of peak demand.

It appears to not view the electricity generated by PV and the exported renewable energy as being different in terms of primary energy or carbon. Therefore, the calculation only shows the losses in charging/discharging as the difference and does not seem to change any energy related parameters so you are unable to determine if a cost saving is provided. From the outset it seems to be encouraging all renewable energy to be exported.

Please contact us for further details as some evidence has been gathered on this that may be possible to share.

21d. What are your views on the modelling of PV diverters in the Home Energy Model? Please provide your reasoning and any supporting evidence.

It has been suggested that these are not well represented when modelled. Please see our response to Q21c. and contact us for further details as some evidence has been gathered on this that may be possible to share.

Future features development

22. What are your views on future features development for the Home Energy Model? Please make suggestions, explaining your reasoning.

It is strongly thought 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 and variable CO_2 emission factors.

The period when 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 whether this is possible to achieve through the HEM core model and previously slow uptake of carbon factors heavily influenced the design of buildings unnecessarily.

23. What data or evidence do you have which could support the future development of features within the Home Energy Model? Please provide further details.

Chapter 6: Validating the Home Energy Model

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

25. What are your views on the validation work that has been carried out against realworld case studies (i.e. IEA Annex 58, Camden Passivhaus, and Marmalade Lane)? Please provide your reasoning and any supporting evidence.

26. What are your views on the lab testing validation work that has been carried out (i.e. on boiler cycling and heat pumps providing DHW)? Please provide your reasoning and any supporting evidence.

27. What examples of real-world case studies do you suggest be used to further validate the Home Energy Model? Please provide further information.

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

Public Sector Equality Duty

29. What are your views on the impact of proposed changes to the modelling ecosystem on those with protected characteristics? Please provide your reasoning and any supporting evidence.

Environmental Principles Policy Statement

30. What are your views on the possible environmental impacts of the Home Energy Model core engine itself? Please provide your reasoning and any supporting evidence