Home Energy Model: replacement for the Standard Assessment Procedure (SAP)

CIEH response to a Department for Energy Security and Net Zero consultation

March 2024

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Responses to consultation questions

Chapter 3: A new home energy modelling ecosystem

Changes to the delivery model and provision of software

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

> *It is correct to say that Standard Assessment Procedure (SAP), and its Reduced Data (RdSAP) derivative, suffers from sluggish updating, particularly in areas around new technologies, and, historically, some difficulties relating SAP ratings to earlier assessments.*
>
> *Although regular updates are issued, the complexity of the system has meant that there is poor overall understanding by property owners, agents or tenants, particularly about the cost-benefit aspects of retrofitting properties.*
>
> *Many of the practical problems around the use and delivery of energy assessments are not part of this consultation but would need to be considered if these proposals are implemented.*

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.

> *There are significant advantages in having a centralised, cloud-based version of the Home Energy Model, both for consistency and for minimising misinterpretation of calculations.*
>
> *However, the consultation proposal that "modifications or improvements to be rolled out quickly on the central platform" could make regulation much more difficult. For example, it has been suggested that a future Minimum Energy Efficiency Standard (MEES) could form part of a Decent Homes Standard that landlords will have to meet under the Renters (Reform) Bill.*
>
> *Current proposals suggest that the Property Portal could automatically be populated with data from (for example) an EPC database, with local authorities charged with verifying the data to check compliance with the Decent Homes Standard. If changes to the Home Energy Model are constantly being made, it may become very difficult to assess whether a property has improved to meet the standard because of changes to the fabric, or because of other Home Energy Model calculation factors that have not necessarily reduced health risks (such as occupancy assumptions, white goods assumptions).*

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.

Although this is superficially attractive, it will depend on staffing of the compliance-checking mechanism and the speed of changes being made to the PCDB. For further evidence, see changes made historically on the "SEDBUK" boiler efficiency database previously used for RdSAP, where fully-modulated boiler efficiencies were not recognised until after long delays. Notably, this proposal identifies boiler modulation ratios as an example of what would be needed.

We have similar concerns with several other products in pre-existing properties, particularly where there is a known differential in deterioration over time – a good example of this is mechanical ventilation systems (also proposed to be on the PCDB or available as a generic choice) where performance may rapidly fall off in dusty/dirty environments (e.g. iris type ventilation systems). An "Energy Performance Certificate (EPC)" based on the performance of products as if they were new will be inaccurate. This has to be carefully considered before the next stage of consultation.

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

See response to question 8. It would be useful to have independent verification of manufacturers' claims if responsibility for uploading to the database is to be devolved.

A very important consideration in the private rented sector is that the database of the performance and efficiency of obsolete and defunct heating products should also be independently maintained.

Large numbers of products that have stopped being manufactured or imported are still installed in rented properties. Many of the products are very inefficient and represent a threat to the health of the occupants. Replacement of these should be prioritised in any EPC wrapper, in a way similar to the priority sequence in the existing EPC.

Details of these systems may not be available to energy assessors if the manufacturers no longer exist or imports have stopped (and therefore no product details are entered on the PCDB) and it is vital that in such cases an energy efficiency assessment does not have an "assumed" average level of efficiency that might be optimistic and misleading.

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

A MTBF (Mean Time Between Failures) could be factored in – this could either be based on manufacturers' own data on failure cycles and/or evidence-based data on typical time-based reductions in efficiency.

These considerations are particularly important in existing properties, where appliance deterioration will a) give misleading energy-efficiency calculations and b) lead to localised health issues (especially damp and mould or excess cold or heat).

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.

It would be very useful to give specialist consideration to wrappers that would deal with specific groups of existing (frequently substandard) private rental sector properties, and in particular hostels, large units of temporary accommodation, large houses in multiple occupation, converted (or occupied) shops or industrial properties used for accommodation.

The last group (conversions of shops or industrial units) are omitted from the Future Homes Standard Impact Assessment (see 6.34 onwards) where there are likely to be specific problems of thermal bridging, lack of thermal mass and potentially greater zonal differences in heating.

Any specialist wrappers for these types of properties would still need to be able to assess individual units (as now) rather than having a "whole building standard" (as referred to in the Future Homes Standard – see FHS Impact Statement 6.45 onwards) to reflect the different energy use, for example, between ground floor and top floor accommodation units (where there may be very different levels of insulation).

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.

This is potentially misleading in any non-standard properties or occupancy – see specific answers to questions 18a, 19a, 28 and 29.

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.

With more detailed configuration, the Home Energy Model can probably model energy flexibility and smart technologies for developers and planning a zero-carbon future. However, if wrappers that contain default information are included in the calculation, it will be of little value for the occupiers of substandard properties and those where the occupant's behaviour does not match those of the defaults (such as

people with disabilities and people living in fuel poverty) and may actually be counter-productive for enabling consumer choice and improved public health.

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.

There seem to be several practical flaws in the modelling here, particularly where it relates to existing properties – and especially in relation to rental properties and their occupants.

Two key issues are that there may be significant differences between occupancy (and thus demand) models mainly based on owner-occupation and the reality of rented properties, and also that the calculation of demand for heating/cooling has to be based on an earlier decision about whether predicted ambient temperatures are based on climate-change predictions or on historical data.

Space Heating Demand:

In the Home Energy Model: Future Homes Standard Technical Paper 1 (HEMFHS-TP-01) a default standard occupancy is set (based on the English Housing Survey). Although the occupancy level is set higher than the English Housing Survey data, the paper still acknowledges that this is based on under-occupancy. However, this does not reflect the actual levels of occupancy in the private rented sector; for example, in the Home Energy Model, occupancy of a 5-bed property is set at 3.9 people, whereas in the private rented sector there would (for commercial reasons) be a minimum of 5 people. This entirely skews all the modelling, particularly under-estimating space heating and hot water demand.

In addition (see HEMFHS-TP-02 FHS space heating and cooling assumptions), the assumption is that the demand temperature in Zone 1 (main living areas) should be 21C and in Zone 2 (the rest of the accommodation) should be 20C. In most private rented properties this is unrealistic and unlikely to be adhered to by the occupants, and inter-zonal heat transfer is therefore likely to be much higher.

These will be very important factors to be taken into account in the consultation about a future EPC.

Cooling demand: *Assumptions about additional ventilation are extremely misleading, particularly anywhere where the occupants cannot safely leave windows open (e.g. crime and anti-social behaviour) – thus assuming 100% opening of all available window area is unrealistic.*

In addition, no evaluation seems to be made of the aim to install heat pumps (as part of the Future Homes Standard) and the fact that most of these systems are air-to-water systems that have no cooling capability; a very significant and important consideration if the assumptions are to be based on climate-change predictions. If climate-change temperature assumptions are used, then the timestep assumptions about cooling may also need to change.

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

This seems inconsistent. Part 5 (p. 8) states that for consistency with SAP 10.2 there is an assumption of thermal resistance to allow for blinds and curtains being closed for half the year, but Part 3 (p. 7) states that in the main calculation "no additional thermal resistance for window covering (curtains/blinds etc) is assumed". A good base model would be better based on there being no curtains or blinds.

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

The methodological approach appears logical, but lacks a plain English interpretation; this is highly significant for existing properties where these are likely to be the focus of damp and mould issues, and may make regulation and improvement (retro-fitting) much more difficult. If a landlord cannot readily identify or recognise an area of poorer insulation (such as a concrete lintol, gutter or cantilevered balcony, or a half-brick thick section of wall in a back addition, being a cold bridge) then it will be much more difficult for all concerned to be amenable to change and difficult for landlords to understand the remedial work needed.

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.

Overall, the methodology appears logical. However, if it is based on a list of hot water draw-off events, then the choice of whether these are user-specified or come from a schedule defined in a wrapper (e.g. defaults) will need to be carefully approached in the final "EPC"-style model.

Both options seem to be misleading for the Private Rented Sector because, if a default option is used, modelled on low levels of occupation (see response to 18a), then the system, particularly in houses with more bedrooms, will underestimate the amount of hot water used, giving a significantly lower energy use than would be the case in reality. The alternative, of calculating the "EPC" based on user-specified occupancy at the time of the assessment, could be manipulated by the assessment being carried out at a period of low occupancy.

More tenure-specific research seems to be necessary before any "EPC wrapper" design is started, particularly around assumptions based on the English Housing Survey, rather than attempting to base a model on occupancy-levels that are an average between owner-occupied, social rented or private rented. An assessor could then choose the appropriate tenure that would either use more accurate occupancy levels or enter details of the actual occupancy.

An important consideration of heat-pump technology is that flow and return temperatures for both efficient space and water heating are lower than with gas boilers. Allowance has to be made for reheating water after draw-off, with the implication in a private rented sector property with higher than "average" occupancy that more water storage and buffering will be needed.

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.

The modelling seems to accurately reflect heat pump installations in new-build properties (although a small additional load may come from legionella cycles, where water is heated to a specified temperature, often on weekly cycles).

Future development seems to omit integration with existing solar hot water systems, and, if there is to be successful roll-out of heat-pump retrofitting in existing dwellings, then the modelling may need to include the impact of alternative water storage systems (for example where there is no internal space, for example where there has been a combi-boiler) and for the impact of less-than-optimal pipe distribution in retrofit situations (for example where convection currents draw heat which has not been demanded at the emitters). See also comments under 20h which would impact on SCOP.

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.

This is highly relevant to the Private Rented Sector, where there is a legacy of significant numbers of electric storage heaters. The modelling does not seem to cover a common issue encountered - the energy requirements of having to boost the heater output (in cold daytime or evening temperatures) using on-peak electricity, or having to supplement it with convector heaters, using expensive on-peak electricity

Although specific models may be chosen from the PCDB in the future, this should incorporate energy requirement data for boosting input (a common feature of older, non-fan-assisted storage heaters).

The focus of this consultation is on carbon reduction, but it is important to remember that inefficient, unresponsive heating systems like these, used in energy-inefficient homes, result in extremely unhealthy homes where carbon emissions are also very

high because of the need for supplementary heating. The design of the EPC wrapper should recognise and prioritise such combinations of sub-standard heating and fabric.

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.

The HEM-FHS User Guide and the associated HEM Heat Emitter Input Estimator seems to suggest standardisation of emitters (radiators) at delta 50K – the difference between wet system flow and return temperatures - (with steel radiators).

As the proposed changes to the Future Homes Standard all seem to envisage heat pumps as the primary heating source, it would be useful to have delta 30K (at which most heat pumps operate optimally) as an option, together with requirements for optimally sized radiators and pipework This would normally include increasing the size of radiators (particularly steel ones) and replacing undersized pipework (particularly microbore piping).

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.

This needs to be re-evaluated in the context of the decarbonisation priorities for road vehicles. Current standards for linking properties to mains electricity may mean that it is not possible to retrofit both a high-speed electric vehicle charger and a heat pump.

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

A significant omission appears to be degradation rate when age of installation is combined with pitch – shallower pitches result in reduced output (from dirt, algae and lichen growth) that appears much higher than the quoted 0.1-1.1%/year. It might be useful to have an algorithm that combines installation date with pitch to produce this. Modelling should also include technologies such as "Solar Edge" where panels can operate individually, permitting higher overall output than systems with single inverters, where the output from each string of panels is limited overall when one panel is obscured or shaded.

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

This seems very limited, given increases in uptake. Areas that need further consideration are the likely life expectancy (manufacturers usually give 10 years) and

the offset from utility companies paying for the use of distributed storage – this would also presumably result in lower energy costs at the property, even if it does not affect carbon reduction.

If electric batteries are going to be a new-build or retrofit upgrade option for properties, then several additional factors need consideration. The batteries are large and heavy, and could be considered a fire hazard. So there needs to be consideration about where they can be safely sited (if room is available) particularly near flammable cladding or insulation, whether floor reinforcement is necessary (if indoors) and whether there will need to be additional fire detection in the vicinity.

Future features development

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

It would be useful to have a retrofit-specific wrapper that would recognise optimal permutations of products. At the moment local authorities and partner organisations have to develop these (for example as part of "green grants"). A wrapper that informed landlords, suppliers and occupiers of the impacts of installing "best practice" products would simplify and encourage installation.

Chapter 6: Validating the Home Energy Model

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.

No comment was provided on the well-being and living conditions experienced by the occupants of the Camden Passivhaus nor the Marmalade Lane group. These would have been useful for consideration of perceptions of warmth in high insulation-ventilation system versus wet heating systems. Information on relative humidity levels (versus perceived comfort) would also be useful in any form of retrofit wrapper (see response to Q.14).

It is unfortunate that (even with submitted data and plans) significant amounts of data could not be directly obtained. This reflects the real-world difficulties with planning retrofit upgrades in older properties that have been significantly changed over time.

Occupation numbers provided for calculating metabolic gains within the Passivhaus model are based on 35m^2 per person (see comments in response to Q.18a), but the rationale for choosing different levels for the Home Energy Model seem arbitrary.

Assessments of the Warm Front grant scheme noted that the occupants of properties that had been upgraded with grant assistance did not heat their properties to higher temperatures than before the upgrades. People (particularly those in fuel poverty)

may simply be unable to afford heat their homes to the assumed Zone 1 and 2 temperatures, even after energy efficiency upgrades. Affordability must be considered in the modelling so that upgrade options do not allow for "cherry-picking" of individual upgrade options that do not improve overall liveability.

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.

Older housing stock frequently has higher ceiling heights than those used in the modelling. These need to be modelled using the half-hour time resolution so that any "EPC-style" wrapper can reflect the additional heat input required with any combination of heating systems (especially slow response systems).

The ceiling heights in the Passivhaus Camden and Marmalade group properties were higher, but this factor was not considered as a contributor to heat input requirements, possibly because they had more modern, responsive heating systems that may not reflect the reality of many older, existing properties.

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.

Assumptions in the modelling are likely to be misleading – particularly around heat and hot water demand, where higher ambient temperatures (described as "comfort heating" in the Future Homes Standard) are needed in both Zone 1 and Zone 2. A specialist wrapper may be needed to cope with this, potential lower occupancy levels (because of larger wheelchair or bathing area requirements) in both purpose-built and adapted homes.

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.

The core engine calculations will only be as good as the data that is input. If this includes large amounts of defaults and averages that give an over-optimistic assessment, then it will give calculations that will be unrealistic about existing homes, especially in the private rented sector. Any defaults used in an eventual EPC wrapper should therefore be pessimistic and realistic.

A failure to do this will have a serious impact on people's health, and in doing so will have a major direct negative environmental impact because of the knock-on multipliers of additional NHS and Social Services use, as well as an indirect impact on education and work.