

Response ID ANON-XEPA-CB8U-Z

Submitted to Home Energy Model
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About you

What is your name?

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What is your organisation?

Organisation:

We usually publish a summary of all responses, but sometimes we are asked to publish the individual responses too. Would you be happy for your response to be published in full?

Yes

How did you hear about this consultation?

How did you hear about this consultation?:

Other (please specify):

Newsletter or Mastodon, probably.

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.

Please respond here.:

Seems reasonable.

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.

Please respond here.:

Seems reasonable.

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

Please respond here.:

Chapter 3: A new home energy modelling ecosystem

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.

Please respond here.:

I strongly support the open source (and data) model in general and for this purpose.

One advantage of making this open source is that academics and (especially small) innovators and product developers can work at low cost against what they know to be the canonical model, especially for purposes such as PCDB and programmes such as ECO.

This avoids many potential impedance mismatches and black-box commercial implementations that caused my (eventually PCDB) novel product a lot of headaches and expense and worse.

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

Please respond here.:

Development/availability of versions with finer time resolution for more accurate simulation for product development and academic work.

Provision of manufacturer-provided plugins (via the PCDB) for accurate simulation of particular products, especially with novel behaviours, without third parties having to badly and expensively re-invent the wheel for each use.

Development of grid-interactive control systems and products, eg based on low-carbon generation availability, including orchestration of multiple elements such as electric and heat batteries, heat pumps, zonal controls, and occupancy detection and prediction.

Chapter 3: A new home energy modelling ecosystem

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

Please respond here.:

Generally agreed. I felt some of the problems described.

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.

Please respond here.:

Having a free cloud-based version is probably good, though brings some GDPR-type issues, but an off-line open-source equivalent (ie running the same core model code) running on a number of common platforms should (I suggest maybe *must*) be supported for at least these reasons:

* Working in places where Internet provision is permanently poor or absent, or has a temporary outage. Being unable to issue an EPC for a home in a permanent coverage gap would be worse than silly.

* Privacy, eg for speculative or confidential scenarios, and for highly-privacy-seeking users generally,

Chapter 3: A new home energy modelling ecosystem

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.

Please respond here.:

Yes, improve the PCDB.

Though I suspect that in many more interesting products, for whom HEM could be much more favourable than SAP, it is highly unlikely that existing data is up to the task of showing this, so this implies a repeat and possibly expensive data re-gathering / simulation exercise. It may be necessary to allow some old implied data to stand.

It may also be useful or necessary to have manufacturer-supplied plug-ins to accurately simulate their product behaviour, and I suggest that simulation at 30 mins and 1 min intervals (see later answer) be supported by these for future proofing and to allow better integrated simulations by third parties where beneficial.

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

Please respond here.:

For product behaviours not well-represented in the core model, it may also be useful or necessary to have manufacturer-supplied plug-ins to accurately simulate their product behaviour, and I suggest that simulation at 30 mins and 1 min intervals (see later answer) be supported by these for future proofing and to allow better integrated simulations by third parties where beneficial.

It may also be useful to have lodged on the PCDB at least one (significant, complete 1 year) data run / simulation to demonstrate compliance at this level and act as a test case.

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

Please respond here.:

As above, especially for novel products.

Chapter 3: A new home energy modelling ecosystem

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.

Please respond here.:

The coarse time grain and so on of SAP caused huge problems from my product: a lot of value was lost in the impedance mis-match between something operating (reactively and predictively) on the scale of minutes with something operating at best on the scale of days or months.

I suggest allowing simulations to run at least as fine as 1-minute steps in part to allow for responsive technologies not yet developed, ie some future proofing.

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.

Please respond here.:

As above, for products that are not well represented in core model behaviours, manufacturers should provide/publish a plug-in (the replacement to a 'bolt-on' for SAP), possibly in the PCDB, that can be used by all simulations/calculations involving that product.

That published version may have to be simplified somewhat in some case to protect intellectual property (eg algorithms) incorporated in the product.

It may be allowed to have the equivalent of SAP points derived from an unpublished higher-fidelity simulation plug-in, but that brings its own issues of trust and so on.

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.

Please respond here.:

As above.

Chapter 3: A new home energy modelling ecosystem

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.

Please respond here.:

Standard wrappers/libraries that represent key elements of English housing stock (eg by archetype and/or actual usage pattern, now and projected through 2050) could be published for (a) manufacturers and (b) academics to benchmark against without reinventing and recalibrating their own.

These should allow much better time resolution than 30 minutes: I suggest a supported timestep of no more than 1 minute to be shorter (see Nyquist) than activation of many modelled elements such as DHW draw-down time, and likely for (say) grid-responsiveness to frequency.

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.

Please respond here. :

30 minutes is very good compared to SAP, but possibly only just good enough for many purposes right now, and not good enough already for high-fidelity simulations now or in the future.

For example, many common phenomena in homes are of much shorter duration but test key elements that HEM might wish to model accurately:

* Running DHW for washing up or showers is likely often much shorter than 30 minutes, even baths.

* Domestic price signals in the GB electricity market may not remain restricted to HH (half-hourly) at best: note Australia's five minute settlement rule.

* Kettles and other common appliances may exceed battery maximum power support and cause imports, but on ~1 minute timescales, as will may fridge/freezer start-up and PV output generation.

For example, McKenna, Eoghan and Pless, Jacquelyn and Darby, Sarah J. Solar (photovoltaic self-consumption in the UK residential sector: New estimates from a smart grid demonstration project, Elsevier BV, 2018-07, Energy Policy, volume 118, ISSN 0301-4215, doi:10.1016/j.enpol.2018.04.006, article/pages 482–491) suggests that "This illustrates that using data averaged over 30 min (a typical resolution for smart meters) can significantly underestimate the calculation of imports and exports, around 15% for the specific month of data chosen here." This is one item being considered by Elexon issue 109 Workgroup.

At the very least the model and all plug-ins should be able to operate at 30-minute or 1-minute timesteps, and preferably finer where the user has the

computing resource and the need.

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.

Please respond here.:

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.

Please respond here.:

This will become increasingly key and one area where innovation may break model assumptions. (I already did it with SAP, to my cost - HEM would likely have behaved far better!)

Designing a HEM development path to allow the core model and wrappers to adapt quickly and gracefully to unexpected developments (technical, geopolitical) may be important.

It will also be important to be able to play grid-behaviour tapes alongside weather tapes as the two are correlated, often strongly, and in an electrify-everything Net Zero world, flexibility is meaningless without responding to that correlation.

Chapter 5: What is inside the Home Energy Model?

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

Please respond here.:

This seems to be an improvement over SAP.

This also seems to imply perfect even heating/cooling with a very short time constant, which seems less good. That's simply not how existing emitters and so on behave, and with some effects much shorter than the proposed 30 minute resolution, and some much longer.

This also seems to assume that very tight temperature regulation is optimal, eg for comfort.

Time varying or dynamic setback temperatures should be allowed for.

This also does not seem to allow for smarter controls than the HEM controls to be used, and this might very much be a place where innovation will help energy saving and comfort.

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

Please respond here. :

Not dealing with internal heat flows may be a major oversight, for example see this preprint DOI 10.20944/preprints202312.1608.v1 where the internal flows may make a very significant (+/- ~15%) effect on heat-pump energy consumption depending on internal temperature controls.

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

Please respond here.:

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

Please respond here.:

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

Please respond here.:

(Side note: thermal 'capacity' or 'capacitance' please, if nothing else to separate what HEM is doing from a bunch of unscientific bad folklore in circulation.)

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

Please respond here.:

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

Please respond here.:

Chapter 5: What is inside the Home Energy Model?

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

Please respond here.:

Most DHW events are far shorter than the proposed 30 minute resolution. Nyquist frequency/sampling suggests that this introduces noise and inaccuracy, especially for innovations involving fast response to such events and the grid and microgeneration environment. HEM should allow higher resolution, 1-minute or better, to model these more accurately where important.

Also, the assumption that instant hot-water heaters can always meet all demand is not reasonable eg where grid demand is capped, possibly dynamically for flexibility, for homes including instantaneous heaters and other intermittent high-demand electric appliances such as ovens and kettles. As a householder I think I'd prefer my shower to run cool for a moment then for my main fuse to pop given a choice. Maybe not all householders would take this view, but in France I could have a lower standing charge already for this.

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.

Please respond here.:

HEM should allow for (since these all happen in the real world):

- * pipework buried in walls, insulated and uninsulated
- * pipework runs creating unintended countercurrent heat exchangers
- * pipework runs not entirely within the thermal envelope

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.

Please respond here.:

Not all DHW cylinders stratify, and some deliberately destratify.

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.

Please respond here.:

Chapter 5: What is inside the Home Energy Model?

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

Please respond here. :

HEM should be built to allow heat pump and surrounding modelling to change as experience builds, eg using them as flexible / "dynamic demand" / "demand response" assets. Not all models have sane firmware that behaves in a sensible manner when forced to setback or off in evening peak periods for example.

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.

Please respond here.:

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.

Please respond here.:

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

Please respond here. :

Not all heat networks have HIUs.

Some heat networks charge for volume of water drawn (and/or the temperature of returned water) as well as extracted kWh, and this may be important to be able to model, ie favouring systems that extract a higher fraction of the available energy.

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

Please respond here.:

It is very good that the effect of return temperature is modelled.

It is good that cycling is modelled.

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

Please respond here.:

HEM should allow for heat batteries should allow for heat batteries for use in space heating (eg load shifting),

HEM should allow for heat batteries as pre-heat for, or in parallel with (CombiSol/Intasol type arrangement), a DHW cylinder for heat-pump and other heat sources.

eg: <https://www.earth.org.uk/energy-systems-diagrams.html#Thermino>

HEM should allow for heat batteries, eg low-temperature phase-change, to be used instead of a DHW water cylinder.

HEM should allow for heat pumps in any of the above scenarios to be (co-)heated by PV diversion, or from grid especially when renewables are abundant and/or price is low.

HEM should allow for multi-point temperature or other high-precision (eg Joule counting) monitoring of heat battery state, top-up and drawdown.

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

Please respond here.:

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.

Please respond here.:

HEM should allow for multi-point temperature or other high-precision (eg Joule counting) monitoring of DHW store state, top-up and drawdown.

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

Please respond here.:

HEM should make some effort to properly model the convection and radiant elements of radiator heat delivery, including possibly with partial obstruction from furniture and curtains.

HEM should make some effort to model TRV-style controls by where they are placed on the radiator (eg top or bottom, flow or return) in terms of the temperature they see, for wax/oil-heat mechanical TRVs and smarter electronic devices.

Assumptions of perfect even heating as best or as what happens do not reflect comfort or thermal/energy behaviour, especially on the 20 million or so UK homes that are older stock, not yet retrofitted significantly, and that will still be in use in 2050.

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.

Please respond here.:

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.

Please respond here.:

HEM should allow for better TTZC (Time and Temperature Zone Controls), including novel products and services not yet invented. So there should be a good extensible API for a plug-in. And the ability to run in timesteps of no larger than 1 minute.

Weather compensation should probably be a default with a heat pump as the heat source.

Chapter 5: What is inside the Home Energy Model?

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.

Please respond here.:

1. Instantaneous use (or "self-consumption")
2. Electric battery storage

There should be a 2.5 of allowing a non-trivial amount to spill to grid where its higher exergy is valuable but not so large as to contribute to flooding the grid near noon on sunny days, eg see:

<https://www.earth.org.uk/eddi-diverter-export-margin-analysis.html>

3. PV diverter to a hot water cylinder
4. Grid export

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

Please respond here.:

Netting in 30 minute units significantly understates battery and grid flows and losses. My own home PV data down to 1-minute intervals supports this.

See Elexon Issue 109 Workgroup and McKenna paper mentioned above.

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

Please respond here. :

Adding a notion of a maximum charge/discharge power and in general a 'C'-style rate (how many hours does it take to fully charge or discharge) is important. For example, I have a ~5kWh grid-coupled battery with a 1kW power limit ('C/5') which means that it cannot fully carry heating loads (kettle, dishwasher, washing machine) nor fully absorb PV output much of the time outside of winter months.

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

Please respond here.:

HEM should support PV diversion to (DHW-supporting) heat batteries.

HEM should support non-zero export margin (spill to grid) before diverting.

HEM should support diversion to slower-to-start-and-stop loads with a larger minimum load such as heat pumps, and interaction with batteries.

HEM should possibly support diversion to multiple loads.

Chapter 5: What is inside the Home Energy Model?

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

Please respond here.:

Keep it open.

Open the data supporting it.

Keep a development model which can accommodate innovations (eg in products and services, and geopolitical landscape such as more energy shocks) gracefully, maybe with a fixed 12 month release cadence. Treat this like other major infrastructure software such as major languages that balance stability against timely improvements and their competing interests,.

Allow running on much finer timestep than 30 minutes.

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.

Please respond here.:

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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.

Please respond here.:

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

Please respond here.:

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.

Please respond here.:

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

Please respond here.:

Make use of Salford Energy House(s) or similar. Including under predicted climate change possibilities.

Provide a library of instances/wrappers and validate against representative dwelling archetypes occupied and unoccupied, the latter with various representative tenancy types. This is likely possible with hundreds of homes at most, eg per the Energy Systems Catapult Living Lab. This would also generate very useful insights on the performance gap (design vs actual) for other purposes.

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.

Please respond here.:

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.

Please respond here.:

Amongst real-world testing should be cases that cover relevant protected characteristics.

Though HEM can continue to model the building behaviour of itself, it is relevant to find if assumptions made in doing prejudice such individuals, and might allow more generic high-level adjustments to improve such outcomes.

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.

Please respond here.: