

# **A consultation on proposed changes to the Government's Standard Assessment Procedure (SAP)**

## **Introduction by DECC**

This consultation is being undertaken by BRE on behalf of the Department of Energy and Climate Change (DECC) to set out the changes that are being proposed to improve the accuracy of SAP assessments and provide a mechanism whereby stakeholders can give feedback and influence the development of the SAP methodology.

It is anticipated that an amended version of the SAP methodology (SAP 2009) will be published in the last quarter of 2009 and that it will come into force in 2010, as determined by legislative changes such as the forthcoming Amendment to Part L of the Building Regulations for England and Wales. Further reviews and revisions of the SAP are expected in 2012 and 2015, prior to expected amendments to Part L in 2013 and 2016, which are the announced steps to zero carbon homes.

Whilst the timing of the SAP reviews and revisions are being driven by the forthcoming amendments to Part L of the Building Regulations for England and Wales, the SAP and its base model BREDEM are used to underpin a number of other key energy and environmental related policy initiatives, such as Warm Front, Carbon Calculator, Stamp Duty Land Tax Exemption for Zero Carbon Homes, Energy Performance of Building Directive and the production of Energy Performance Certificates, local authority stock reporting, Building Regulations in Scotland and Northern Ireland, Code for Sustainable Homes, Carbon Emissions Reduction Target, etc.

Consequently, it is important that all stakeholders are made aware of and take advantage of this opportunity to influence the development of this important energy performance assessment tool. You are, therefore, cordially invited to respond to this consultation.

Please bring this consultation to the attention of others you know that may have an interest in this matter.

Alan Christie DECC  
Whitehall Place  
London

## **Proposed changes to SAP**

The Standard Assessment Procedure (SAP) is used to assess the energy performance of dwellings and thereby helps deliver many of Government's energy and environmental policy objectives.

For new dwellings SAP is used as the vehicle for demonstrating compliance with the relevant building regulations for England and Wales and for the Devolved Administrations. Energy standards for new homes are being amended in 2010 in England and Wales (Part L), in Scotland (Section 6) and in Northern Ireland (TB F). Such proposed changes will in due course be the subject of separate consultations by the Administrations responsible.

To support the forthcoming 2010 Amendment to Part L of the Building Regulations for England and Wales (conservation of fuel and power), the changes of which will be subject to a separate consultation, and which is a step towards delivering zero carbon homes in 2016, DECC has undertaken a review of the SAP. This review has indicated that a number of improvements are required to better deal with extremely low energy dwellings, and the proposed changes aim to address this. Other improvements have also been introduced wherever possible. Thus, a separate consultation is being undertaken regarding the proposed changes to SAP\*.

There are a number of documents that form a part of this SAP consultation. The key one is the revised SAP specification but there are also some technical documents that provide details of the reasoning behind the main changes. A general guidance document on SAP is also included in the consultation (this is largely included for additional information rather than as a formal consultation document, but feedback on it would nonetheless be welcome).

All of these documents can be accessed at [www.bre.co.uk/sap2009](http://www.bre.co.uk/sap2009).<sup>†</sup> Further more-detailed research documents on a number of specific topics are available on request to [sap2009@bre.co.uk](mailto:sap2009@bre.co.uk).

The reviews of SAP that are envisaged in 2012 and 2015 will primarily address improvements to the procedure to take account of developments in technology and to incorporate experience gained from the application of SAP to very low energy dwellings. Improvements may be possible also through the availability of new data (for example, there is a proposal for an Energy Follow up Survey to the English Housing Survey to take place in 2011, and this could provide useful data for refining some aspects of SAP).

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\* Note that any impacts from the proposed changes to SAP will be assessed as part of the Impact Analysis for the Building Regulations Part L amendment and will form part of that consultation.

<sup>†</sup> Paper copies are available on request: please contact Alan Christie, DECC, 3 Whitehall Place, London, SW1A 2HD.

This consultation document also indicates some potential future developments, in particular relating to options regarding the weather data to be used for calculating SAP ratings, and invites comments on these. Various other issues that might affect future development, including the approaches used by other low energy assessment methodologies and how these differ from SAP, and proposals for change that might come via Europe, are also briefly mentioned either in this document or in the accompanying technical documents. Views on any of these issues would be welcome.

## **How to respond**

This document is intended to provide the mechanism for submitting responses to the consultation. It lists the main changes that have been proposed and asks questions relating to them. The responses to these questions will be used to review the proposals and to prepare a final version of SAP, to be known as SAP 2009, for use in connection with revised UK Building Regulations.

Comments are invited and should be sent:

either by e-mail to:

sap2009@bre.co.uk

or in writing to:

Alan Christie

Department of Energy and Climate Change

3 Whitehall Place

London SW1A 2HD

not later than 4 September 2009.

Technical queries should be sent to sap2009@bre.co.uk

Other queries should be addressed to alan.christie@decc.gsi.gov.uk

If responding by e-mail please simply type responses to individual questions within the relevant boxes. The boxes will expand to accommodate your entries.

For written responses please also write within the boxes. If a box is not big enough to contain your response then simply continue on a separate sheet (or sheets) and indicate clearly that you have done this, numbering any continuation sheets sequentially, and clearly indicating at the top which question they refer to.

## **Amendment 1 – adoption of a monthly calculation**

For conventional dwellings the calculation of energy use can be undertaken using a simple seasonal method and this will generally be of sufficient accuracy for the purposes. Thus, SAP has previously adopted this approach, using a degree-day based methodology. For the very low energy dwellings that are now envisaged such an approach is likely to become unsatisfactory and the energy balance should be considered at different times through the year. Thus, a monthly calculation has been proposed for SAP 2009. This has a number of ramifications for various parts of the calculation.

**Q1: Do you agree that a monthly calculation basis is now required for SAP 2009? Are there any negative impacts from such a change?**

Excellent method to bring UK into line with calculations elsewhere in Europe

## Amendment 2 – use of updated weather data

SAP has previously made use of long term (20 year) average weather data dating from the 1960s and 1970s. Given the marked warming that has happened since then, for SAP 2009 it was considered important to update the weather data. Therefore, the Met Office was commissioned to provide the necessary data. Temperature data, solar radiation data and wind speed data have all been updated to represent recent long-term averages.

There has been no attempt made to project the weather data for the purposes of SAP. This could be considered for any future updates (although it must be recognised that the accuracy of such projections diminishes the further one projects, so it would probably be appropriate to limit any projection to the period for which the particular version of SAP was in use).

**Q2: In future updates, would you think it useful for SAP to make use of projections of the weather data?** *(see also Q12 regarding the possible use of regional weather data for SAP calculations)*

We believe that there is probably an upward trend in external temperature which is important for predicting summer overheating (only if part P is now useable). But given that predictions have inbuilt uncertainty, we should not link warmth assumptions to fabric analysis so that insulation appears less valuable. The overall response needs to be robust to climate change and long-term random fluctuations, whatever these throw at us. In the 20thC the UK has had mild periods of several decades followed by equally long periods with a larger number of cold winters.

## Amendment 3 – carbon dioxide emission factors

A comprehensive methodology has been developed for determining the CO<sub>2</sub> emissions associated with a range of different fuel types<sup>‡</sup>. These revised emission factors take account of the impact of CO<sub>2</sub> and other greenhouse gases (N<sub>2</sub>O and CH<sub>4</sub>) in terms of CO<sub>2</sub> equivalent<sup>§</sup>. They also take in a much wider consideration of the upstream emissions, which includes fugitive emissions as well as emissions from energy used during extraction, processing, transformation and delivery to the final user<sup>\*\*</sup>. A consistent methodology has been applied across all fuel types (including a range of biofuels) and is based on the most recent data on emissions and UK fuel supply<sup>††</sup>. Inevitably there are some areas in which full data is not available and suitable estimates have had to be made. It is intended that these factors will remain fixed for the life of SAP 2009, which is expected to be from 2010 to 2013. The emission factors will be reviewed again in 2012.

### **Q3: Do you agree that the carbon dioxide emission factor methodology that has been developed is appropriate?**

We are pleased that there is now generally more agreement with figures from the rest of Europe, including Ireland, and also with the actual UK electricity generation mix. However, we still wonder why the Gemis database used by PHPP predicts figures around 10% higher (allowing for GCV/NCV). We think that the figures for piped gas in particular may prove to be an underestimate if all indirect energy uses are added; e.g., energy is used for the liquefaction and subsequent evaporation of LNG. There are other more hidden energy uses too.

There is no guarantee at all, except via processes such as FSC certification, that wood which is burned is compensated for by trees being planted. The CO<sub>2</sub> absorption takes place typically 50 years after the wood from a site is burned, which is a problem if we are especially concerned at the CO<sub>2</sub> emissions in the period 2010-30. Some evidence should therefore be required that these emissions are being compensated for by afforestation.

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<sup>‡</sup> Technical Document STP09/CO202 - Methodology for the Generation of UK Emission Factors for Use in the National Calculation Methodologies

<sup>§</sup> Considered over a 100 year time horizon.

<sup>\*\*</sup> The consideration of emissions does not extend to energy used to produce the infrastructure and machinery and materials used in fuel production, nor does it consider the impact of alternative uses e.g., land use change.

<sup>††</sup> Technical Document STP09/CO203 – Revised Emission Factors for use in the National Calculation Methodologies: data sources and assumptions (available on request).

**Q4: Please indicate any other fuel types which you think should be included?**

We think that biomass emissions and sequestration should be distinguished, as they are totally independent activities. The emissions from wood combustion are typically around 0.38 kg/kWh and this figure should be used in calculations.

Where renewable electricity generation is considered, if it is eligible for ROCs or feed-in tariffs, then the entire energy generated can be considered to contribute to the national generation mix and the carbon emission factor for grid electricity; renewable generation attached to a building should not therefore confer an additional benefit. It follows that all electricity consumed on the site must be at the national standard carbon emission factor.

**Q5: Do you have any information that could be used to address areas where there is missing data and thereby further improve the proposed emission factors?**

Also, according to Swedish and US data, older wood-burning appliances emit trace greenhouse gases such as methane and are reportedly as bad or worse for climate change than an oil-fired boiler

## Amendment 4 – boiler systems

The proposals include different treatment of heating systems with gas and oil boilers. They affect boiler efficiency, controls, the range of fuels, and community heating, and are explained in more detail in a separate document<sup>††</sup>. Given the proposed monthly calculation it follows that the boiler efficiencies that are applied need to reflect variations throughout the year. A distinction is required between winter (space and water heating) and summer (water heating only) efficiencies. Separate hot water performance data for combi boilers is expected to become available from recent test standards and should be recognised in SAP. A study has shown that efficiencies in independent boiler tests are consistently lower than those from tests undertaken for manufacturers. Alterations to the SEDBUK boiler efficiency calculation method are needed for these reasons, and proposals have been set out with full technical details in supporting papers.

**Q6: Boiler heating systems, including hot water performance, controls, and community heating, need to be handled differently for a number of reasons set out in the supporting papers. Do you consider the proposed new treatment in SAP is the most effective way of dealing with them? If not, what would you propose?**

We are surprised that resources have been used to generate these complex proposals to accommodate a technology which should not be necessary if boilers were operating efficiently and were correctly rated.

The assumption that the system losses in hot water generation can be dealt with via an adjustment to boiler efficiency does not reflect the reality of the situation and provides no encouragement for improvement. Calculation and measurement indicate that the additional losses are mostly from the primary circuit, both steady state heat loss and also cool-down loss, the latter of which is not addressed by pipe insulation. System design is a major factor on the losses, both pipe volume, and also the interaction between cylinder volume and controls.

**Q7: There is evidence to show that the efficiency of boilers is lower than has been previously assumed. Does the proposed methodology compensate for this in an equitable manner? If not, what would you suggest?**

We would prefer that heating system controls be made mandatory which achieve respectable seasonal efficiencies from oil, gas and LPG condensing boilers. Monitored examples in the UK suggest that First Law (i.e., ignoring the difference in energy quality) efficiencies of 95-96 percent (on piped gas)

<sup>††</sup> Technical Paper STP09/01 : *Changes to the treatment of boilers (gas and oil) in SAP 2009* – see [www.bre.co.uk/sap2009](http://www.bre.co.uk/sap2009)

should be fairly readily achievable using weather compensation of flow temperature (or equivalent), proper hydraulic balancing of systems and a few TRVs to trim the room temperature in rooms and spaces which are subject to overheating. These systems achieve seasonal efficiencies higher than SEDBUK mainly because the return temperature is consistently kept low and so the boiler efficiency remains in the high 90s% as seen for low load on a typical condensing boiler efficiency curve. Note that the TRVs in such a system are not primary temperature controls, and should not be used as such. We can provide more information on request.

**Q8: In community heating schemes the energy performance and distribution losses vary widely but are estimated without reference to specific scheme data. Such data could be collected and made available for assessments via a database (though not in time for SAP 2009). Would that be practicable and effective? If not, what would you propose to improve the method of assessment of community heating schemes? Do you agree that the tabulated distribution heat losses in SAP 2009 Table 12c should be restricted to schemes above a specified linear heat density?**

Heat losses from new community heating schemes should be based on realistic default assumptions. However, calculations in an approved format should be available to encourage good practice which reduces these losses. See; e.g., the calculator provided by the firm [www.logstor.com](http://www.logstor.com) which shows the major benefits of using newer piping types and using relatively low flow and return temperatures.

As a separate issue, a UK national standard could be drawn up which requires certain maximum flow and return temperatures and direct connection or at least limited losses from heat exchangers, in line with practice in Denmark. For several reasons, Denmark appears to be the best model for the UK to follow; Danish DH is provided primarily to low-rise housing districts which are similar to those in the UK, and so there has been more work aimed at reducing pipe losses in such districts.

## Amendment 5 – inclusion of thermal mass and cooling calculations

Thermal mass can play an important role in moderating temperature swings in highly insulated dwellings and it is therefore important to include this when considering the need for cooling. Cooling has now been included explicitly within SAP (previously, this was only considered via an assessment of the risk of overheating) following the approach of an ISO Standard. The inclusion of cooling leads to some difficult questions (in particular, it raises the question of whether SAP ratings should continue to always be calculated using UK average weather - which clearly does not make sense as far as cooling is concerned - or whether they should ultimately become regional).

**Q9: Do you think the proposed treatment of thermal mass and cooling is appropriate?**

We are concerned about the robustness of part P Summer overheating module, particularly when we compare the results with those from other software such as PHPP which we currently use in preference.

**Q10: Should a cooling load always be calculated, or should it be calculated only when air conditioning is known to be present?**

No - indication of cooling load in results will encourage unscrupulous promotion of air-conditioning in homes.

**Q11: If a reversible heat pump is installed for heating, what assumptions should be made about the extent to which it will be used for cooling?**

Assume used above 24 deg C. If possible also provide some authoritative consumer information on ways to keep cool in heatwaves, because UK householders appear to be unaware of relatively simple methods such as keeping the heat from the sun from entering a home by the appropriate use of shutters, blinds and curtains.

**Q12: Looking ahead, should SAP ratings be made regionally dependent?**

Yes. Essential for cooling, because summers are 5K warmer in Kew than in Lerwick or the west coast of Scotland where to put in mild cooling is not a very important issue especially if the basic building orientation and layout is right.

Likely to be worthwhile in future for heating. However, we do not believe that the heating predictions in SAP are yet realistic. So our position is yes to

regional cooling data, but that we should collect heating data from inter alia the Met Office database for use as soon as possible in the future.

We suggest that we try to use regions centred upon a weather station which has reliable long-term temperature and solar radiation data; e.g. possibly such places as Plymouth, Cambridge, Ross-on-Wye, Kew, Bedford and many tens more. It should also become compulsory to correct for significant differences in height above mean sea level. These differences become very important in hilly regions; e.g. there are sites in mid Wales which have lower mean annual temperatures than Denmark.

We note that small countries such as Switzerland in PHPP come with about 40 sets of weather data. Austria, Belgium and Netherlands come with about 10-25 each. Even within the Benelux countries, which are relatively flat, space heating energy varies significantly from one site to another.

We are not sure that the Met Office or other sources could provide quite this high density of weather data across the UK. However, the UK should definitely move away as soon as possible from modelling all new dwellings as if the country is a single climate zone. In reality, space heating energy in a given low-energy dwelling can be 20% greater in Inverness than in Derby and, at the other extreme, it is 15-20% less in Plymouth or Penzance than in Derby. This difference gets magnified on moving to standards such as Passivhaus.

## Amendment 6 – hot water energy use

Supply of hot water can represent the largest single energy use in well insulated dwellings. Thus, for SAP 2009, it was appropriate to review the assumptions about the hot water demand and energy characteristics. Field monitoring undertaken by the Energy Saving Trust (measurements made on over 100 dwellings) provided the evidence for suitable amendments to the procedures, whilst also allowing the calculations to be undertaken each month. The findings of the trial, briefly, were that the volume of hot water used was very similar to what SAP assumed already (but this has nonetheless been modified accordingly), but that the temperature rise assumptions needed changing.

**Q13: Do you think the amendments that have been made to the hot water heating procedures are appropriate?** *[NB: the water heating efficiency of boilers is dealt with in amendment 4]*

The amendments to the hot water calculation are welcomed in that they reflect actual hot water consumption more accurately than the previous overestimates. This should reflect better the importance of building fabric on overall energy consumption. The split into varying volume as well as cold supply temperature is confusing as it probably does not reflect a variation in actual hot water use in terms of baths and showers, just the fact that the end-use is at around 40C and not 55C; the impact of varying incoming mains water temperatures is therefore more significant.

The 5% reduction for meeting a design target of 125 litres/day/person is fairly arbitrary, since some methods for meeting this target, such as rainwater recycling, save no hot water at all and in fact increase domestic energy consumption. If water conservation measures are to be accounted for in hot water consumption, they should specifically focus on shower flow rate and bath volume.

**Q14: SAP makes fixed assumptions as regards primary pipework losses and secondary (distribution) losses. Should either or both of these be made variable according to size of dwelling and/or actual lengths of pipework?**

This is a serious omission as we approach low energy buildings, because it can be dramatically altered by good design, both in the layout of wet rooms and the design of the distribution system (see AECB water standards). It is reasonable to estimate the frequency of draw-off, and hence secondary losses. PHPP bases estimates on occupancy, so this is related to building size. The other factor is pipework volume, not length.

We are highly sceptical about the claim that hot water energy demand is larger in reality than space heating energy. While this is indeed predicted by

tools such as PHPP to be theoretically possible, with the space heating load in a very efficient small house being perhaps 1,000-1,500 kWh/yr and the hot water load being 2,000 kWh/yr, as far as we aware it has yet to be borne out in practice in any project on a larger scale than an individual detached house.

## Amendment 7 – auxiliary energy use (lights and appliances / cooking) and internal heat gains

The energy used for lights and appliances and cooking is important both because it can be significant in its own right and because it contributes to internal heat gains that can offset the amount of energy required for space heating. This is particularly important in very low energy dwellings where the gains can be sufficient to meet the heating requirements in at least a part of the heating season.

Unfortunately, this is an area in which there is limited information available and so it has been necessary to use data from the late 1990s (principally from the Energy Follow-up Survey to the 1996 English House Condition Survey), together with educated estimates of what has happened since then (e.g. making use of Market Transformation Programme material). The gains figures thus derived represent estimates of what is typical within the stock and these are considered entirely appropriate for calculating SAP ratings.

For design purposes (i.e. for calculating the DER) there is an argument for using lower levels of gains so that insulation standards are not reduced on the basis of internal gains which might not be present in practice. Other low energy assessment methodologies, such as the PassivHaus Planning Package, follow such principles. Thus, we have proposed using gains that are about one-third lower than typical for this purpose. This is based on assuming that A-rated appliances and low energy lights are present throughout.

**Q15: Do you agree that the lights and appliances and cooking assumptions that we have made are reasonable given the limited data? If not, do you have any data that would allow them to be improved?**

We need not only the algorithms for current use, but we need to develop methods for calculating their reduction over time. Although this could be argued not to be part of SAP, it is vital to have a coherent whole dwelling approach to address lighting, appliances and cooking energy use for future work in this area.

**Q16: Do you agree with the proposal to use lower gains for design purposes or do you consider the same assumptions should be made for all calculations? And do you agree that the reduction applied is appropriate? If not, do you have evidence for using some other assumptions?**

Absolutely. PHI is still robustly defending its 2.1 W/m<sup>2</sup> as being easily achievable. In fact, in its view 2.1 W/m<sup>2</sup> is still too high as the actual gains in the first four Passivhaus dwellings were below or around 1.4 W/m<sup>2</sup>. Some of our members' experience with mainly 150-300 m<sup>2</sup> detached houses and 2-4 occupants is that, using the better A++ appliances now available in the UK,

these projects often have actual gains in the range 0.7-1.4 W/m<sup>2</sup>. While we would agree that large detached houses are not wholly typical of the new dwelling stock, it is a clear pointer to the potential situation in more normal dwellings, such as an 80 m<sup>2</sup> semi-detached house if such a dwelling were fitted with the kind of energy-efficient electrical equipment that might be mandatory in the future.

Based on this discussion, we would expect and hope that the gains used will be no more than the standard figure in PHPP. A dwelling built now will probably still be in use in the 22<sup>nd</sup> C and we doubt that "merely" A-rated appliances will be remotely acceptable by then, implying that heat gains could well be lower and space heating loads correspondingly higher than in the early life of the dwelling.

It should be remembered that internal gains are not equal to internal power consumption. Some power consumption does not contribute as hot water vapour or hot air are ejected from the building via the drains or ventilation (eg by washing machines, dishwashers, tumble driers, cooking - all big energy users).

Also internal gains are offset by heat losses not accounted for in the HLP such as incoming cold water and evaporation.

## **Amendment 8 – Number of occupants related to floor area**

For SAP it is important to apply various standard assumptions in order that fair and meaningful comparisons can be made between dwellings. This means not taking account of the specific characteristics and preferences of the individual household that might occupy the dwelling. For this reason, the number of occupants is assumed to be related to the floor area of the dwelling. The relationship between number of occupants and floor area has been reviewed and updated for SAP 2009. Data from the English House Condition Survey was used for this purpose.

**Q17: Do you agree that it was appropriate to update the relationship between number of occupants and floor area?**

Yes, but this needs to be clearly stated as an output of the calculation, as the relationship to dominant services such as water heating, lighting, cooking and appliances will affect the regulated energy consumption.

## Other comments on the proposed changes

**Q18: Do you have any comments relating to the proposed SAP amendments which are not covered by the above? If so, please elaborate below.**

Anything that can close the gap between the theory and practice has to be welcomed. The UK is far from being the only European country where the nationally-approved software tool for calculations has been found to be too imprecise when applied to low-energy dwellings. But we consider that the gap which has emerged is unacceptably great.

If complete precision is not possible, it would actually be more desirable to have a model whose input numbers tend to slightly overpredict consumption. Having a model which clearly underpredicts space heating energy by quite large margins has lulled many parties into a false sense of security about the levels of insulation to keep energy use for space and hot water heating low. This is not very helpful, given the urgent need to tackle climate change.