Consultation Paper: CONSP:16

Review of default U-values for existing buildings in SAP

Issue 1.0

DOCUMENT REVISIONS

Documents will be revised by issue of updated editions or amendments. Revised documents will be posted on the website at www.bre.co.uk/sap2016.

Technical or other changes which affect product recognition requirements (for example) will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

Users of this document should ensure that they possess the latest issue.

DOCUMENT REVISION LOG

DATE	VERSION NO.	AMENDMENT DETAILS	APPROVED BY
28/06/16	1.0	First issue	Paul Davidson

TABLE OF CONTENTS

1. INTRODUCTION 4
2. EVIDENCE FOR CHANGE 5
3. PROPOSED AMENDMENTS TO TABLES 7
4. CONSEQUENCES OF CHANGES 11

1. INTRODUCTION

For new homes the U-values of walls are calculated specifically using the procedure described in BS EN ISO 6946. However, for existing dwellings a detailed calculation is not generally possible because the precise wall construction is usually unknown and a quicker assessment is used (RdSAP). In this case default U-values are used based on the type and age of wall, taken from tables in Appendix S of SAP. This appendix cannot be updated until after the full SAP procedure is complete, hence it will be left blank in the first edition of SAP 2016 then added later, as in previous iterations. However, it has been decided to include a proposed updated table of default wall U-values for existing buildings in the SAP 2016 consultation on the basis that this is a potentially significant change and because there is no separate RdSAP consultation process. The values are provided to give a sense of the likely direction and scale of change; however, research is continuing on this subject, so it is possible there will be further refinements before these figures are used for RdSAP.

DECC has commissioned a significant amount of work looking at wall U-values over the last few years after earlier studies found that in-situ wall U-values did not always agree well with those assumed in SAP calculations[1], potentially leading to a significant 'performance gap'. This is particularly relevant when it comes to calculating the savings from wall insulation, which appear to have been overestimated in the past, at least in part due to the use of pessimistic U-values for uninsulated walls and optimistic U-value for insulated walls. This has resulted in the application of large 'in-use' correction factors being applied to modelled savings in schemes where savings from energy efficiency measures are calculated, like Green Deal and the Energy Company Obligation.

The proposed amendments to tables S6, S7 and S8 presented in this document aim to bring the default U-values assumed in RdSAP assessments into line with the findings

[1] The most recent report on that work is available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409428/In-situ_u-values_final_report.pdf

from the latest studies. Further work is continuing on wall U-values (focussing on new age bands), so it is possible further updates will be made in future.

2. EVIDENCE FOR CHANGE

The default wall U-values in RdSAP calculations are based on either building regulations requirements for particular eras, or typical building practices at the time of construction. In the former case (i.e. for pre-1976 dwellings) standard thermal properties of construction materials are assumed in order to calculate the U-values. The materials data this relies on was derived a number of years ago, and appears to have been intended originally for use in 'design heat loss' calculations for sizing heating system components. For such calculations it is generally preferable where there is uncertainty or variability in material performance to assume conservative (higher) U-values to avoid under-sizing. Therefore it is thought that thermal properties at the worse end of the range would have been chosen which then became established as normal. This was a reasonable assumption to make at the time, but the data is now being used for a different purpose, such that median values may be more appropriate.

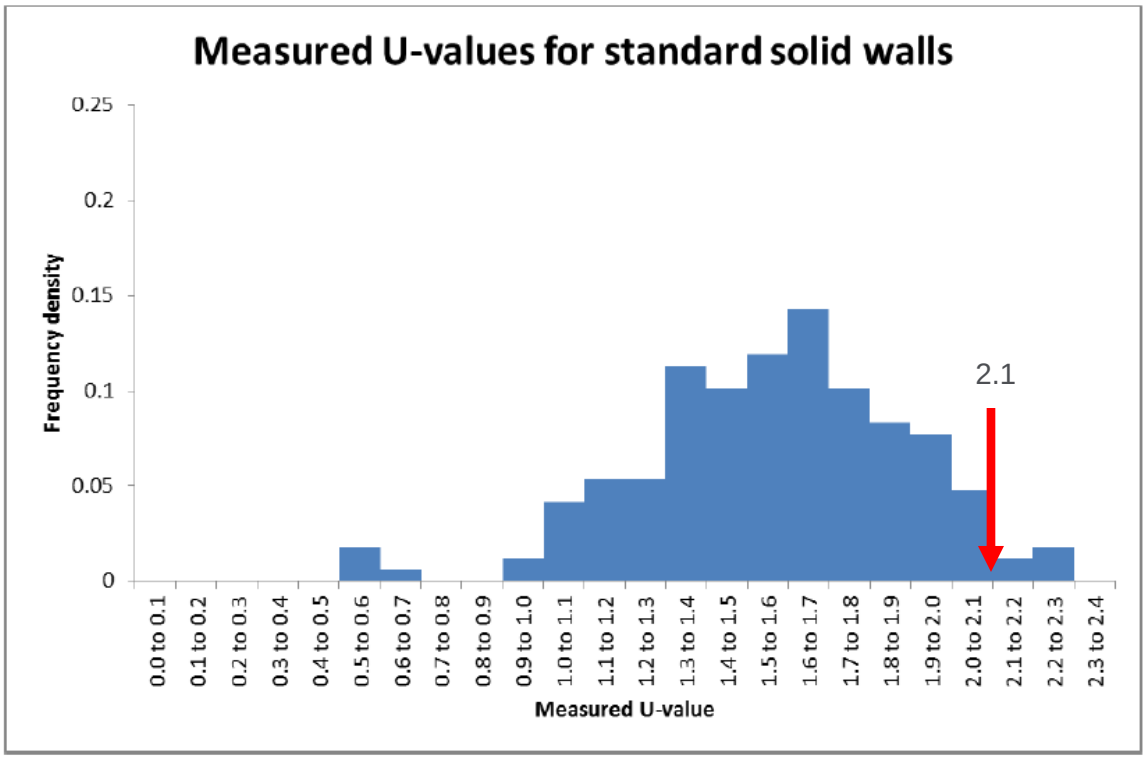
The DECC report *In-situ measurements of wall U-values in English housing* (referenced earlier), describes work undertaken over the last few years to measure the in-situ performance of a large number of walls in UK dwellings. Comparing these with the default values in RdSAP suggests that some values may need to be updated. The following table summarises the key results for walls built before 1976:

Wall type	Cases	Measured U-value (median)	Corrected* measured U-value (median)	RdSAP assumed U-value
Solid wall	85	1.59	1.69	2.1
Uninsulated cavity	50	1.43	1.52	1.6
Insulated cavity	109	0.63	0.67	0.5

* A 6% increase in U-value was applied based on the finding, after the DECC report was published, that the heat meters used read between 4 and 8% low because of their own thermal resistance.

This suggests that the U-values currently assumed in RdSAP are pessimistic in the case of uninsulated solid walls and uninsulated cavity walls, but optimistic in the case of insulated cavity walls. In particular the U-value assumed for a solid wall is around 24% higher than the median value found in the field study.

It should be noted that a large range of results was found for each wall type (for example see distribution below for solid walls), implying that there are limitations in using a single figure for each wall type. In future it may be sensible to further subcategorise wall types if this is found to be practical for assessors.



It can be seen that the existing U-value assumed in RdSAP for a solid wall (2.1 W/m²K) is within the spread of values found in the study[2], but at the upper end of the range. This is consistent with the hypothesis that a conservative value has traditionally been used to avoid under-sizing heating systems in design heat loss calculations. There are also likely to be other factors, such as air-voids in nominally 'solid' walls leading (fortuitously) to better U-values. However, given that SAP is now being used to underpin financial incentives, placing greater demands on the accuracy of input values, it is prudent to use

[2] The values in the graph have not been corrected for the 6% measurement offset. If they were the whole distribution would be shifted slightly to the right making the figure of 2.1 slightly less peripheral.

a value, or values, that are nearer the median found in practice. There is, therefore, a rationale for updating the default wall U-values in RdSAP to better reflect the findings from the field trials.

3. PROPOSED AMENDMENTS TO TABLES

On the basis of the evidence accumulated so far, updates are proposed to the default U-values for solid and cavity walls for older (pre-76) dwellings in tables S6, S7 and S8 in Appendix S of SAP, which describes how to use RdSAP data to perform a SAP calculation. Updated figures are proposed in the following tables – the same changes are made in each.

The proposed changes to the U-values of uninsulated walls has a consequent (small) effect on the U-value of the same walls once retrofitted with insulation, hence slight adjustments to those values are also proposed.

Ongoing fieldwork may suggest changes to figures in newer age bands are required in future.

[Tables begin on next page, with proposed amended values highlighted]

Table S6 : Wall U-values – England and Wales

Age band	A	B	C	D	E	F	G	H	I	J	K	L
Wall type												
Stone: granite or whinstone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Stone: sandstone or limestone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Solid brick as built	1.7	1.7	1.7	1.7	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Stone/solid brick with 50 mm external or internal insulation	0.55	0.55	0.55	0.55	0.55	0.45*	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Stone/solid brick with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Stone/solid brick with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Stone/solid brick with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*
Cob (as built)	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.35	0.30	0.28
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.35	0.45†	0.35†	0.30†	0.28†
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.21*	0.21*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.17*	0.16*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.14*	0.14*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.12*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.35	0.30	0.28
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	0.35†	0.30†	0.28†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*

Table S7 : Wall U-values – Scotland

Age band	A	B	C	D	E	F	G	H	I	J	K	L
Wall type												
Stone: granite or whinstone as built	a	a	a	a	1.6 b	1.0	0.60	0.45	0.45	0.30	0.25	0.22
Stone: sandstone or limestone as built	a	a	a	a	1.5 b	1.0	0.60	0.45	0.45	0.30	0.25	0.22
Solid brick as built	1.7	1.7	1.7	1.7	1.7	1.0	0.60	0.45	0.45	0.30	0.25	0.22
Stone/solid brick with 50 mm external or internal insulation	0.55	0.55	0.55	0.55	0.55	0.45*	0.35*	0.30*	0.30*	0.21*	0.19*	0.17*
Stone/solid brick with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*
Stone/solid brick with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*
Stone/solid brick with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*
Cob as built	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.30	0.25	0.22
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.21*	0.19*	0.17*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.45	0.45	0.30	0.25	0.22
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.30*	0.30*	0.25*	0.19*	0.17*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.21*	0.21*	0.19*	0.17*	0.14*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.17*	0.17*	0.15*	0.14*	0.12*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.45†	0.45†	0.30†	0.25†	0.22†
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.25*	0.17*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.19*	0.14*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.15*	0.12*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.10*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.30	0.25	0.22
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	0.30†	0.25†	0.22†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.45	0.45	0.30	0.25	0.22
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.30*	0.30*	0.21*	0.19*	0.17*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*

Table S8 : Wall U-values – Northern Ireland

Age band	A	B	C	D	E	F	G	H	I	J	K	L
Wall type												
Stone: granite or whinstone as built	a	a	a	a	1.6 b	1.0	0.60	0.45	0.45	-	0.30	0.28
Stone: sandstone or limestone as built	a	a	a	a	1.6 b	1.0	0.60	0.45	0.45	-	0.30	0.28
Solid brick as built	1.7	1.7	1.7	1.7	1.7	1.0	0.60	0.45	0.45	-	0.30	0.28
Stone/solid brick with 50 mm external or internal insulation	0.55	0.55	0.55	0.55	0.55	0.45*	0.35*	0.30*	0.30*	-	0.21*	0.21*
Stone/solid brick with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.28[‡]	0.24*	0.24*	0.21*	-	0.17*	0.16*
Stone/solid brick with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21*	0.18*	0.18*	0.17*	-	0.14*	0.14*
Stone/solid brick with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*
Cob as built	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	-	0.30	0.28
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	-	0.21*	0.21*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	-	0.21*	0.16*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	0.20	0.14*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	-	0.12*	0.12*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.45	0.45	-	0.30	0.28
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	-	0.21*	0.21*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	-	0.17*	0.16*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	-	0.14*	0.14*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.45[†]	0.45[†]	-	0.30[†]	0.28[†]
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	-	0.25*	0.21*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	-	0.19*	0.16*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	-	0.15*	0.14*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	-	0.12*	0.12*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	-	0.30	0.28
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40[†]	0.40[†]	0.40[†]	-	0.30[†]	0.28[†]
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.45	0.45	-	0.30	0.28
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.30*	0.30*	-	0.21*	0.21*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	-	0.17*	0.16*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	-	0.14*	0.14*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*

4. CONSEQUENCES OF CHANGES

The energy consumption of a dwelling predicted using SAP is very sensitive to wall U-value. The proposed changes to the default wall U-values will therefore result in significant changes to the predicted building performance and in particular to the savings from insulating walls. Since the savings from insulation are, to a good approximation, proportional to the change in U-value which results from the addition of insulation, it is possible to estimate the impact for a given scenario directly from the change in U-values, as shown in the following example.

Example: Insulation of solid brick walls
Using existing RdSAP default U-values:
U-value before = 2.1, U-value after (100mm) = 0.35
Improvement in U-value = 2.1 - 0.35 = **1.75 W/m²K**

Using proposed U-values:
U-value before = 1.7, U-value after (100mm) = 0.32
Improvement in U-value = 1.7 - 0.32 = **1.38 W/m²K**

Reduction in expected savings as a result of changes to wall U-values proposed
= 1 - (1.38 / 1.75) = **21%**

Other potentially significant impacts are:

- The SAP rating and EPC band for existing dwellings with uninsulated walls will improve. For example, solid walled homes in bands F or G will rise to a higher band in some cases. This could be significant in relation to the planned policy to prohibit the rental of properties rated worse than band E.
- The apparent cost-effectiveness of insulating walls will be made worse. However, for purposes where 'in-use factors' are applied to savings these should be relaxed to compensate for the use of corrected U-values, so any impact will be negated.