SAP Targets and Affordability in Social Housing

eaga partnership charitable trust

Bill Wilkinson
Energy Audit Company
2006

Acknowledgements

This research was made possible by a grant from the Eaga Partnership Charitable Trust. My thanks go to Naomi Brown, Trust Manager, and Trustees for their helpful comments and advice. Thanks too to Professor Paul Fleming (De Montfort University) for his advice in the initial stages and to David Pickles O.B.E. (Newark and Sherwood Energy Agency) and for his help in steering the project, to those in local authorities and housing associations who kindly provided information and to Bruce Pittingale (Chair, HECA Fora) who kindly circulated the questionnaire on my behalf. Finally, thank you to Marion Hart for editing and producing the report.

Bill Wilkinson
2006

Bill Wilkinson
Energy Audit Company
Wandylaw House
Chathill
Northumberland
NE67 5HG

Tel 01665 589243
bwilkinson@energyaudit.co.uk

Contents

1. Background

Social housing is key to achieving the targets of eliminating fuel poverty set out in the UK Fuel Poverty Strategy (2001) and Action Plan (2004). Housing managers need to have clear policies and strategies in place to bring the energy efficiency of their housing stock up to a level that will ensure that homes are affordable for tenants.

The work described in this report will allow social landlords to set energy efficiency and affordability targets, and to develop an annual reporting mechanism to demonstrate progress towards the elimination of fuel poverty.

2. Executive Summary

Setting standards for social housing using SAP offers a number of advantages. Average SAP ratings are already part of the annual reporting for all local authorities and Registered Social Landlords (RSLs). Accurate individual SAP ratings will be needed as part of the Energy Performance Certificate from 2008/2009. All that is needed in addition is a mechanism for reporting on the numbers or percentage of homes that are below the SAP needed for affordability.

The model proposed here suggests recommended and minimum SAP standards based on different household types and regional variations in climate. Being relatively simple to introduce, administer and explain it offers housing managers a way to identify and quantify the problem of fuel poverty and to ensure the right measures are put in place to combat it effectively.

However, there is a need to address shortcomings in current data collection and calculation methods, which have been shown to give SAP ratings that are around 5 SAP points too low on average, with wide variations at individual house level. Recommendations for improving accuracy are discussed.

Recent increases in the price of domestic fuel are clearly an important factor in the design of targets. Fuel prices used in the SAP calculation are normally fixed for 3 to 4 years. Here a simple method of adjustment is described that can enable target setting to take account of fuel price fluctuations.

3. Recommendations

To Social Housing Providers:

a. Affordability targets[1] based on SAP should be set by all social landlords as follows:

Location Band	1	2	3	4
Recommended SAP	66	71	74	78
Minimum SAP	51	56	59	64

[1] Adjusted for location, see Section 8 c)

b. Timescales and action plans to achieve the targets should form part of an affordable warmth strategy. Annual reporting should detail the properties that are not affordable. Consideration should be given as to whether those below the minimum should be let to tenants in receipt of housing benefit.

c. Targets should be reviewed annually in the light of changing fuel prices

To DCLG and the Housing Corporation

d. SAP (adjusted regionally) targets should be set as part of Decent Homes Guidance.

e. Reporting on the energy efficiency of the housing stock should be amended to include the percentage of homes below the minimum level as well as the average SAP.

f. As a short term solution to rising fuel prices central government should consider financially compensating low income tenants, using the SAP rating to determine the level of compensation. This can be done on a sliding scale using fuel vouchers to pay part of the fuel bill.

4. Introduction – the case for SAP targets

The UK Fuel Poverty Strategy (2001) and Action Plan (2004) set target dates for the elimination of fuel poverty, as required by the Warm Homes and Energy Conservation Act 2000: 2010 for vulnerable households, and 2016 for non-vulnerable private sector households. Work by social housing providers to bring the standard of their housing stocks up to that envisaged by the Decent Homes Act was expected to play a major part in achieving the Government's overall aspiration.

If this is to be achieved, housing authorities and managers need practical ways to identify, quantify and approach the problem in their housing stocks. Fuel poverty, as has been noted before, is a moving target since household circumstances change, people move home, and incomes vary in relation to fuel costs. A simple, targeted approach is needed to assist managers to better plan, prioritise and allocate resources to improvement works and to be clear about outcomes in terms of the improved affordability of homes, provided they have a way to assess their affordability in the first place.

In many cases such an approach can be developed from existing practice with relatively small changes.

Firstly we propose that, since it remains the case that the majority of social housing tenants are on low incomes, *all* social sector properties should be affordable, not just those that happen to be occupied by low income households at a particular point in time. Any other sort of approach is likely to lead to resources being used inefficiently first to identify those households at risk, then to carry out improvements in a sporadic way and finally to evaluate the long term effects of those improvements on levels of fuel poverty.

Next we suggest that for all sorts of reasons targets that make use of the SAP energy rating system represent a straightforward and sensible way forward.

Again these provide a scoring mechanism that is easy to understand, can be "future proofed" and make use of the data that is routinely collected in any case. SAP targets have the additional benefit of also being relatively sophisticated if needed, allowing for very detailed analysis to support policy decisions and resource allocation.

This type of strategy has been adopted by a number of authorities and housing associations. In particular is has been the approach taken for some years by Newark and Sherwood District Council with great success and described in our article "SAP targets and affordability"[2].

This report explains in detail the basis of the strategy and its application in the social housing context taking account of the experiences of some social housing providers, looks at how it might work in practice and what steps managers would need to take in order to make use of the approach in future.

5. Defining fuel poverty

The UK Strategy takes the standard approach to this question, defining a household in fuel poverty as one that would need to spend more than 10% of its income on energy costs in order to maintain satisfactory standards of warmth[3]. However income is defined in two ways. The "full income" definition includes any housing benefit paid to meet rent payments or income support for mortgage interest (ISMI). The "basic income" definition, used by most professionals working in the fuel poverty field, excludes housing benefit or ISMI. Average Rent levels are highest in London, and are larger in RSLs when compared to local authority housing. Based on the "full income" definition, the income of a social housing tenant would be around £3-£4,500 pa higher using average rent levels in 2005 for a 3 bed property[4].

Estimates based on the "full income" definition suggest significantly lower numbers in fuel poverty and it is the Government's preferred definition for target setting. However it results in some glaring anomalies. For instance the inclusion of housing benefit as part of assumed income means that households are effectively removed from fuel poverty if their rent is increased sufficiently. Identically constituted households, living in identical houses, with the same running costs but different rent levels, may or may not be in fuel poverty.

In practical terms a strategy that overly concerns itself with real incomes is not really helpful. Accurate information about tenants' incomes is extremely difficult to come by, particularly given data protection considerations, and even more difficult to keep up to date.

The simple approach recommended here relates affordability to the basic income definition for fuel poverty, and running costs to the dwelling's SAP rating. It suggests targets for affordability based on basic minimum income levels of vulnerable households. Non-vulnerable households (those under 60, able to work and without children) are less likely to have permanently low

[2] Pickles, D. and Wilkinson, B. (2005), *Energy Action*, Issue 96, pp 18-19, N.E.A.
[3] Department of Trade and Industry (DTI) / Department for Environment, Food and Rural Affairs (Defra), (2001), *The UK Fuel Poverty Strategy,* The Stationery Office
[4] http://www.dataspring.org.uk

incomes, and are more likely to be living in smaller properties with lower running costs. The basic *minimum* incomes for this group are much lower however, and SAP targets of the level necessary to eradicate the risk of fuel poverty for this group would be very difficult to achieve in existing housing. Another form of response may therefore be necessary to address the residual level of risk amongst this group.

6. Measuring performance in social housing - standards and targets

In the case of new social housing in England there have been minimum standards of energy efficiency for some years. Originally the Housing Corporation set minimum SAP[5] ratings for new housing and refurbishment schemes, based on unit floor areas. These were replaced by Carbon Index standards when the Building Regulations changed in 2002.

For existing housing, warmth or “a reasonable degree of thermal comfort” is a key criterion under the Decent Homes Act 2000. The Government’s aim is that all local authority and housing association housing will comply with Decent Homes criteria by 2010 and that conditions for vulnerable households in the private sector will have been improved by means of local authority private sector housing renewal strategies. The thermal comfort criterion has been criticised for its lack of a clear performance standard, although very recent guidance for the Housing Health and Safety Rating System (HHSRS) suggests that a SAP rating of less than 35 should be regarded as a category one hazard, leading to a Decent Homes failure[6]. Authorities are required to report annually on the proportion of non-decent homes amongst their own stock, and the percentage improvement on the previous year’s performance.

The devolved administrations have set minimum standards. In Wales, the National Assembly has set SAP standards for social housing related to floor areas[7]: For a home of $80m^2$ the target is a SAP of 65 (calculated under SAP 98, not SAP 2001).

The Scottish Executive has adopted an NHER[8] of 5.0 as part of the Scottish Housing Quality Standard, with a proviso that a SAP of 60 can be used for homes with electric heating.

A SAP target of 65 to be achieved “wherever practicable” has been used in Warm Front since June 2005.

Though there is no specific minimum standard for local authority housing in England, in 2000 the guidance to local authorities on reporting of fuel poverty under the Home Energy Conservation Act suggested: *“…they might want to develop an indicator that said, for example, that all authority-owned housing with a SAP of less than ”x” would be improved to at least “y” within 5 years.”* All social landlords have for a number of years been required to report the *average* SAP of individual housing stocks, as Best Value Performance Indicator 63 for Local Authorities and in the Regulatory Statistical Return for Housing Associations.

---

[5] Housing Corporation, *Scheme Development Standards* (1995)
[6] Department for Communities and Local Government (DCLG) (2006), *A Decent Home: Definition and Guidance for Implementation*, available from www.communities.gov.uk
[7] Based on SAP 98
[8] National Home Energy Rating

For fuel poverty the average is much less important than the numbers of homes with low SAP ratings. For private sector housing (this does not include housing association stock), in their statistical return for the Housing Investment Programme, local authorities are required to provide the average SAP, together with the percentage of homes with a SAP below 35 (previously 30), or the SAP of the lowest quartile.

What is SAP?

The SAP (Standard Assessment Procedure) was developed by BRE in 1993 to unify the existing rating systems of Starpoint and National Home Energy Rating (NHER), which had been in use since 1990. The Starpoint system has now been discontinued, to be replaced by SAP, though NHER continues, and is intended to provide a more accurate assessment of total running costs. The NHER is on a scale from 0 to 10, and for most homes is very roughly equivalent to the SAP divided by 10.

SAP is an estimate of the cost of space and water heating and the electricity in central heating (needed for fans and pumps) per m^2, under specified conditions. The cost is scaled by floor area so that the SAP for different sized, but otherwise similar homes is essentially the same. SAP has been used in Building Regulations since 1996, with a legal requirement since 2000, largely ignored, to display the SAP rating in new homes for sale or rent.

The SAP calculation is periodically reviewed and updated and new versions were issued in1999 (SAP 98) and 2002 (SAP 2001). SAP 2005 (issued in 2006 to coincide with new Building Regulations) is a very comprehensive update that incorporates changes required by the EU Directive on the energy performance of buildings 2002/91/EC (EPBD), and provides a simplified route to demonstrating compliance with the new Part L1A.

The main change to the new SAP (2005) version is a move from the current 1 to 120 scale, to a 1 to 100 scale. A home scoring 100 on the new scale will have essentially no running costs for space, water heating and lighting; (a score of more than 100 is possible though will require net export of electricity to the grid for instance from PV or micro chp).

Other main changes are the inclusion of thermal bridging (sometimes referred to as cold bridging) around doors windows and floor/wall junctions, and the inclusion for the first time of a cost element for lighting.

Social landlords are required to switch to SAP 2005 for reporting purposes from April 2007.

Social housing providers are affected by another change brought in by the EU Directive, which was translated into national law in January 2006. An Energy Performance Certificate will have to be made available when a building is constructed, rented or sold. This will be based on SAP, will include recommendations for improvements and be issued by authorised SAP Assessors.

In the new homes market the directive will be implemented under the new Part L of the Building Regulations. Homes built to the newer regulations will need the SAP certificate for Building Regulations and as part of the EPBD. Implementation will be delayed beyond 2006, and possibly beyond 2007 for existing homes in the rented sector. An EST funded Innovation Programme project is currently underway to test ways of providing the certificate to prospective tenants of social housing. These include having trained staff carrying out energy surveys as part of void inspections, or having all homes inspected and certified during the next year.

7. The value of an approach based on SAP targets

The case for the approach discussed here has strong practical grounds to recommend it.

- **The information is already collected and held**

Over 80% of social housing providers have an energy database[9] that holds information about each property and the SAP rating. Low scoring properties can be easily identified and necessary improvements analysed.

- **Targets can be set at a local level and monitored**

We suggest that social housing providers set a SAP target for all housing and a higher target for those properties designed for the over 60s. Annual reporting can be on the basis of progress in reducing the numbers of homes that are below the target.

- **SAP and running costs can be closely related in social housing**

The SAP label is related to the cost of space and water heating, and is not intended as a guide to overall running costs. There does however appear to be a significant correlation between higher SAP ratings and a lower risk of fuel poverty in all sectors of housing.

Table 1 Percentage of fuel poor by SAP band[10]

	SAP value greater than 60	SAP value greater than 65
	% Fuel Poor	
Full income definition	6.8	2.8
Basic income definition	12.5	6.4

The NHER and several other commercial software programs can be used to calculate total running costs using the BREDEM 12 [11] calculation method. Running costs in BREDEM 12 are related to the energy efficiency rating, floor area, number of occupants, heating patterns and location factors[12]. It is possible to verify that there is good correlation between SAP and overall running costs provided the key variables of property size, occupancy, and location are fixed, as they are in the design of our proposed model.

---

[9] National Energy Services Ltd and Elmhurst Energy Ltd (2006), *Report on the results of the survey of RDSAP data held by Social Landlords*, produced on behalf of Building Research Establishment, Defra and the Office of the Deputy Prime Minister

[10] Defra/DTI (2006), *UK Fuel Poverty Strategy 4th Annual Progress Report* available from www.dti.gov.uk

[11] Anderson, B. et al (2002), *BREDEM-12 Model Description 2001 update*, Building Research Establishment

[12] It is likely that the changes introduced to the new SAP 2005 version will also be incorporated into the BREDEM 12 calculations. If so, predicted running costs will increase slightly as a result of the inclusion of thermal bridging.

8. Designing the model

Although the SAP and the BREDEM 12 calculation make use of the same information about heat losses from the home, heating type and efficiency, the running costs also vary with floor area, heating pattern, number of occupants, and location. If these are set to be appropriate for social housing, the SAP and running costs can then be closely linked.

a) Property size

The most common type of local authority housing is the 2 or 3 bed semi-detached or end terraced house built between 1930 and 1976[13] with a mean floor area of 77m^2. Here a 80m^2 house type is used for modelling purposes, though floor areas up to 100m^2 do not result in appreciable differences - see Appendix 6.

b) Number of occupants and heating pattern

The effect of occupant numbers on running costs for an 80m^2 house with a SAP of 65, and a heating pattern of 16 hours a day is shown in table 2.

Table 2 Effect of occupant numbers on running cost

Occupants	1	2	3	4	5
	Running Cost (£s)				
Space heating[14]	421	401	378	356	335
Water heating	39	53	66	79	93
Cooking gas	11	13	15	17	19
Cooking electricity	20	24	28	30	34
Lights and appliances	134	172	209	247	284
Standing charges	102	102	102	102	102
TOTAL	**727**	**764**	**797**	**831**	**866**

Although running costs rise with larger numbers of occupants, the increase is less than £40 a year (about 5%) for each additional occupant. The increase in minimum income related to each additional person for those on benefits is much greater than £40 a year (£2,377 for a child), with the result that fuel poverty as currently defined is concentrated very largely amongst households with 1 or 2 occupants. Taking the basic income definition, households occupied by one person make up 64% of the fuel poor, with two person occupancy adding another 25%.

[13] Own analysis of data from 2001 English House Condition Survey (EHCS)
[14] The BREDEM calculation for space heating assumes that much of the heat contributed by other uses such as water heating, cooking, and lights and appliances will offset energy used for space heating. As the non space heating uses increase with larger numbers of occupants, the fuel needed for heating is reduced.

Table 3 SAP needed to avoid fuel poverty in 80m^2 house

Household type	Income[15] £	Maximum fuel cost £	SAP needed in East Midlands
1 Adult <60	2,995	300	>120
2 Adults <60	4,698	470	100
1 Adult >60	6,159	616	73
2 Adults >60	9,275	928	50
1 Adult + 1 child	6,220	622	75
1 Adult + 2 children	8,591	859	58
2 Adult + 1 child	7,922	792	63
2 Adults + 2 children	10,299	1,030	48
2 Adults + 3 children	12,675	1,268	37

The income of the (non vulnerable) 1 person household is so low that on the basic income definition it would be almost impossible to ensure affordability on energy improvements alone. However, with 2 adults and 3 children in the three bedroom house, the SAP of 37 needed is easily achieved.

As incomes rise with occupant numbers the SAP needed to avoid fuel poverty is more easily achieved. As a result, families are much less likely to be in fuel poverty as their incomes are higher.

The ***minimum*** standard for SAP has been based on the 1 adult 2 children family running costs and income. It is proposed as being readily attainable by most social housing providers in the short to medium term (see d) and therefore represents a reasonable interim standard.

The worst case, long term scenario is where a one person over 60 household occupies the former family home. Here this is used to establish a ***recommended*** rather than a minimum SAP level.

The SAP needed for the 1 adult 1 child family in a three bedroom house is similar to that for the one person over 60, since the running cost is only slightly higher and income is almost identical.

Attaining the minimum SAP would not guarantee affordability for one person over 60 households, or those consisting of 1 adult and 1 child, even where they occupy smaller properties. Achieving the recommended SAP will allow all vulnerable households to have affordable warmth.

c) Location

The space heating component of running costs varies, as one might expect, for the different regions of England, Scotland, and Wales to account for their different climate conditions. This is not reflected in the SAP rating, which uses a fixed location to calculate space heating costs.

The NHER takes account of the regional climate data (degree days) in calculating running costs. An NHER of 8.0 with a running cost of £619 would ensure affordability anywhere in the UK for the 1 person household suggested as the recommended target (see above). However the NHER rating system is not part of the reporting mechanism for social housing in England and Wales

[15] Department of Work and Pensions, May 2006

(although it is in Scotland). As SAP is used to report to DCLG and to the Housing Corporation, it is necessary to derive a set of indicators based on SAP that allow for the regional variation in climate.

In table 4 the NHER rating has been used to group the regions into four distinct bands. The (degree day) regions are made up of groups of counties. Running costs and equivalent NHER for the house with a SAP target of 70, which could be appropriate for much of Southern England and Wales, are given in four bands.

The NHER of 8.0 in the table for the Home Counties corresponds to a running cost of £619.

Table 4 NHER and running cost for house with a SAP of 70, dependent on location

	NHER	£	Band
South West	8.5	570	1
Home Counties	8.0	619	2
Southern	8.1	607	2
Severn Valley	8.0	620	2
Central Wales	7.9	625	2
South East	7.7	643	3
Midlands	7.7	648	3
West Pennines	7.6	653	3
East Pennines	7.7	645	3
East Anglia	7.7	642	3
North West England	7.4	672	4
Borders (England)	7.3	701	4
North East	7.2	695	4
Borders Scotland	7.1	703	
South West Scotland	7.4	672	
West Scotland	7.3	684	
East Scotland	7.1	703	
North East Scotland	6.8	735	
Highlands	7.0	710	
Western Isles	7.1	707	
Orkney	6.8	734	
Shetland	6.4	774	

Although Scotland is often cited as being much colder than England, the majority of Scottish households are located in areas which are no colder than the North East of England. There is a larger variation in running cost (£130) between the North East and South West of England than between the North East of England and Shetland (£73).

As the SAP rating increases (due to better insulation, glazing, and heating), the difference in running cost between Aberdeen (North East Scotland) and Cornwall (SW) narrows. At a SAP of 100 the difference is only £60, but at a SAP of 55 there would be £250 of additional expenditure in Aberdeen compared to Cornwall.

Adjusting for location

Figures 1 and 2 show SAP ratings for 4 location bands for England and the corresponding running costs for 1 and 3 person occupancy. The suggested SAP ratings for each of the four locations can be read off the graph using the minimum income figures for a one person over 60 household (recommended SAP) and one adult two children (minimum SAP). The tables in Appendix 8 show the running cost corresponding to each SAP figure. The resulting SAP targets for each location band are shown in Table 5.

Figure 1 Running cost for 1 person occupancy by SAP

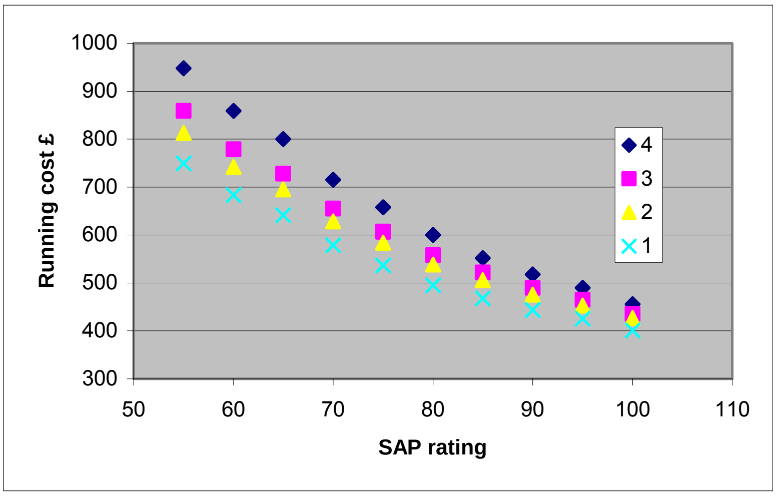


Figure 2 Running cost for 3 person occupancy by SAP

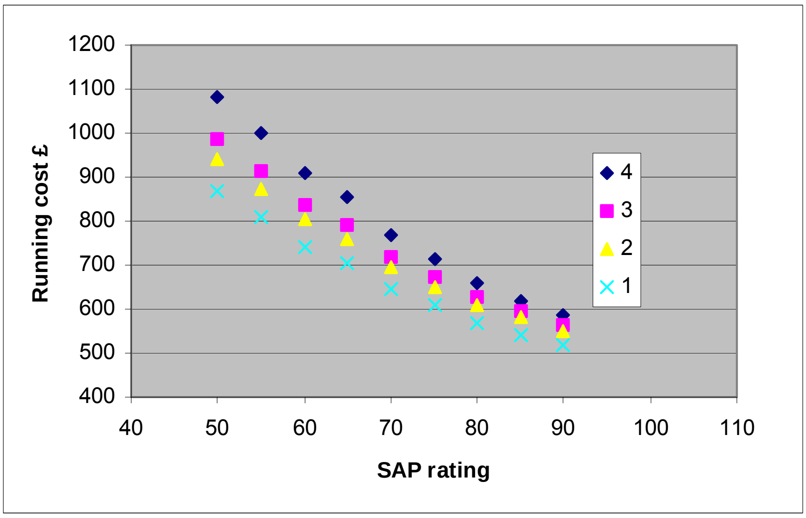


Table 5 Suggested SAP targets by location

Location Band	1	2	3	4
Recommended SAP	66	71	74	78
Minimum SAP	51	56	59	64

d) Achieving the target

The SAP for the various combinations of heating, glazing, and insulation for the standard 80m^2 house type is shown in table 6 as an illustration of the effects of various energy improvements and heating types.

Table 6 Effect of improvement measures on SAP ratings

	Solid wall		Insulated wall	
Heating type	**Single glazed**	**Double glazed**	**Single glazed**	**Double glazed**
'Old' gas	47	51	67	72
New gas	65	69	83	91
Storage (new)	36	41	58	68
Coal	39	44	60	69
Oil (new)	61	66	82	90
GSH Pump	52	58	75	84
ASH Pump	45	51	65	75
Wood boiler	45	51	67	79

The minimum SAP cannot be achieved for the 'Hard to Treat ' combination of solid wall and off mains gas in Band 4 locations, without major expenditure and disruption. In contrast, in areas with mains gas, the minimum can be achieved even with solid walls and single glazing.

9. Accuracy of the data and calculation

Clearly for a strategy like this to be effective it is important to address issues of accuracy and reliability, otherwise properties could be wrongly classified as unaffordable.

The "full" SAP calculation requires that heat loss areas are fully defined and heating completely specified. This is the type of information that would be used to calculate SAP ratings for Building Control approval. The concept of producing a very approximate average energy rating (Level 0) for a housing stock was introduced in the early 1990s to guide the selection of dwellings for improvements on the basis of low ratings. It has generally been assumed that the average of the SAP or NHER results would be much more accurate then individual ratings, which are not intended to be quoted.

Level 0 was originally intended as a short term solution, with data mainly being provided from existing information such as rent databases combined with heating, insulation and glazing contract information. However the cost of organising surveys of individual homes has led most social housing providers to 'stick' at this level, since current reporting requires only the average SAP. Worse, many stock condition survey companies have adopted the Level 0 methodology even though accurate data could be collected on site visits at little extra cost.

In order to understand the level and quality of information held currently, a questionnaire[16] was circulated via local authorities. Though not intended to

[16] See Appendices 1 and 2

provide a statistically robust sample, the 37 respondents included local authorities, large-scale voluntary stock transfers, Arms Length Management Companies, and Housing Associations. Stock sizes varied from under 900 to over 40,000, with 65% in the 1,000 to 10,000 range. Together with the results of a roughly contemporaneous survey by National Energy Services Ltd[17] the results confirmed that most social housing stock owners do not have very detailed information on their older housing[18]. All of the respondents who reported that they held higher level data said this was based on a sample survey rather than their whole stock[19].

The variety of assumptions (defaults) by different software and the range of differing levels of data collected have given rise to wide variations, even in results for average SAP. In response to this problem, the Reduced Data SAP (RDSAP) has been developed to ensure a common data collection and calculation method for SAP ratings on existing (rather than new) properties. This method will become the 'norm' for quoting SAP ratings and the RDSAP value is used here as a benchmark to assess the accuracy of existing SAP and NHER ratings.

The commercially available program NHER Surveyor, with over 4,000 surveyors and assessors trained, is widely used by social housing providers. The program and method are used here as a comparison with RDSAP and Level 0 as the only site survey tool with quality assured ratings, a data level fairly close to that of RDSAP and similar defaults.

The main assumptions in the different levels of data relate to heating and controls, heat loss areas, and ventilation. Here each is considered individually and conclusions drawn about likely degree of error. Then by way of illustration, individual SAP results are compared for two authorities where information at RDSAP level has been recalculated several times, each time with the data reduced to a lower level[20].

The main conclusions are:

- Level 0 with adjusted defaults plus accurate heating data is likely to give a reasonably accurate picture overall of which homes do not meet the SAP standard for social housing. Typically, the lower level data set underestimates the SAP. For a SAP target of 60, around 4% would be classed as failing by more than 5 SAP points when in fact they would be likely to meet the target if more accurate data were used.

- Level 0 without adjustments and with basic information about heating not only considerably underestimates SAP by around 5 points on average, but would classify many as failing when the more accurate SAP would not.

- Monitoring against SAP targets and annual reporting on progress can only be carried out meaningfully if heating data is accurate and defaults for minor items are not used. Measured surveys are not essential for the use of the SAP but should be used for all fuel poverty calculations.

[17]National Energy Services Ltd and Elmhurst Energy Ltd (2006), *Report on the results of the survey of RDSAP data held by Social Landlords*, for B.R.E., Defra and ODPM
[18] See Appendix 2
[19] See Appendix 1 for an explanation of the different levels of data
[20] See Appendix 4

a) *Improving accuracy – overall conclusions*

In the longer term all social housing in England and Wales will have an Energy Performance Certificate, either when the property is let or as part of some other survey such as a Decent Homes inspection. At present the majority of housing providers have information on the entire housing stock but at a lower level. Even for average SAP ratings, there is likely to be considerable error due to the systematic bias towards a lower rating in most of the defaults. For affordable warmth target setting the accuracy of the calculation needs to be improved by using additional data items.

In the short term the accuracy of Level 0 can be substantially improved in the following ways:

- Minor items should be altered from existing knowledge – extract fans, floor types, wall types, chimneys, rather than being defaulted

- Good central heating information is absolutely essential – controls as well as boiler efficiencies for newer boilers

Dimensional information for houses is not essential to give a reasonably accurate assessment. For flats the main source of error is the number of walls exposed. This can often be deduced from floor plans, but may need a site visit.

Accurate gas central heating information can be collected within a year since all properties with gas must be serviced annually. Details of the boiler are normally recorded on a servicing database and can be used to provide the actual SEDBUK efficiency. The detail of the controls and information about water heating takes only a few minutes to collect and can be carried out at little extra cost by the servicing engineer.

10. Fuel price increases and SAP targets

In SAP 2001, the costs of non space and water heating (apart from electricity for pumps and fans) is not included in the SAP calculation. Increasing the price of electricity has only a slight effect on the SAP even in SAP 2005, since only the energy used for lighting, pumps and fans is used in the calculation.

The SAP needed for affordability in 2006 compared to a year earlier illustrates the effect of recent price rises (see table 7).

Table 7 Recommended SAP by year

	Location Band			
	1	2	3	4
	Recommended SAP			
2005	54	58	60	66
2006	66	71	74	78

The effect of the price increases in 2005 and early 2006 had the effect of increasing the SAP target by 12 to 14 points. A SAP increase of 13 points is similar in effect to installing cavity wall insulation in this house type. Average SAP increases in local authority housing are generally no more than 2 to 3 points annually – so that it could be said that the effect of fuel price increases on affordability in social housing has been to reverse at least 5 years of energy efficiency improvements.

The recent rapid rise in prices for the domestic sector does not seem to have been foreseen by DTI. The fuel poverty ready reckoner produced by DTI in 2003 only considered price rises by 2010 of up to 20%. In March 2006 Energywatch suggested that average gas bills had increased by 63%, and electricity bills by 44% since 2003. Since the publication of our article in Energy Action in July 2005, gas prices for most of the large suppliers have risen by over 40%.

The price increases for gas are a result of shortages in capacity and also the rapid increase in the world price of oil, to which many gas contracts are linked. The percentage rise in electricity prices has been less than that for gas as electricity is generated mainly from other fuels (about 38% from gas).

DTI (EEPH, conference July 2006) consider that domestic gas and electricity prices are likely to stabilise in the near future, resulting in a continued fall in the numbers of households in fuel poverty to 2010. However, the very recently announced round of increases from British Gas, Scottish Power and EDF Energy makes this seem less likely in the short term.

We have considered the effect on SAP targets of a 10% / 6% (gas / electricity) and 20% / 12% (gas / electricity) increase in fuel prices relative to the incomes of those on benefits, by recalculation of running costs using the increased fuel prices.

As an approximate guide analogous to the DTI ready reckoner on fuel poverty numbers, we suggest that the target SAP rating should be increased by 6% for each 10% rise in gas prices *relative to benefits*. This assumes that electricity prices will follow the gas price rise but only at ⅔ of the rate of increase.

The SAP targets are then as follows: -

Table 8 SAP Targets – effect of fuel price increase

	Location Band			
	1	**2**	**3**	**4**
	June 2006			
Recommended SAP	66	71	74	78
Minimum SAP	51	56	59	64
	Fuel Price Increase 10%			
Recommended SAP	70	75	78	83
Minimum SAP	54	59	63	68

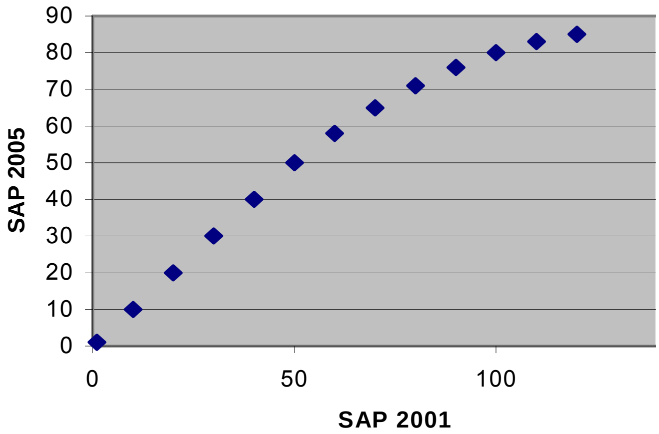
11. Change from SAP 2001 to SAP 2005

All of the previous discussion has centred on the SAP rating as calculated using SAP 2001. The next round of reporting for social housing relates to 2006-2007, and will take place from April 2007. Guidance has already been issued by DCLG and the Housing Corporation that this must be based on the 2005 methodology.

SAP 2005 uses a scale of 1 to 100, instead of 1 to 120 scale as in SAP 2001. A SAP of 100 will be very difficult to achieve.

For existing homes BRE has produced a table to show the approximate value of the new SAP 2005 compared to the 'old'. This is shown in graph form in figure 3 for gas heating.

Figure 3 Comparison: SAP 2001 and SAP 2005



There are several factors in the conversion: the new scaling, the relative change in fuel prices, and the inclusion of thermal bridging in SAP 2005 but not SAP 2001. Our recalculation of the standard house type under SAP 2005 with the inclusion of thermal bridging for existing homes fits very closely to the BRE figures in the chart.

Under SAP 2005, the suggested SAP targets would be as follows:

Table 9 Suggested SAP targets under SAP 2005

	Location Band			
	1	2	3	4
	June 2006			
Recommended SAP	62	66	68	70
Minimum SAP	51	55	56	61
	Fuel Price increase 10%			
Recommended SAP	65	68	70	73
Minimum SAP	53	57	60	64

The compressing of the scale in the 60 to 90 range of SAP 2001 (to a range of 58 to 75 in SAP 2005) has a number of implications for target setting.

Each SAP point in the range from 50 to 80 now corresponds to a greater running cost differential compared to 2001 where typically a SAP was equivalent to about £15 to £20. For SAP 2005, in the middle range the difference of 1 SAP point is nearer £40.

The difference between RDSAP and the SAP calculated without using dimensions for SAP 2005 is also reduced. For the examples used in the appendix, 99% are now within +/- 5 SAP points of the RDSAP answer.

12. Discussion and overall conclusions

In our article a year ago we suggested that improving the energy performance of the social housing stock would be likely to outweigh the effects of rising fuel prices over the next few years, in terms of numbers in fuel poverty. Gas prices have risen over 40% in the last year, and are reported to be about to increase again in the coming months. The recommended SAP needed to make dwellings affordable for a one person household is now considerably higher than the *average* reported SAP (DCLG), (although this is likely to be an underestimate given the previous discussion) of local authority housing.

The recommended SAP target needed to ensure affordability in social housing is now very difficult to achieve where either walls cannot be insulated or heating is not mains gas. It is likely that all suitable cavity walls in social housing will have been insulated through EEC by 2008 since this is essentially a no cost option. Higher efficiency gas heating will ensure that all homes with insulated walls will meet the target. High cost improvements such as external cladding or insulated dry lining will normally only be carried out at the appropriate time – for instance when the property is having a new kitchen or bathroom in the case of dry lining.

Implications for policy

It is clear that in terms of progress towards reducing fuel poverty, the price rises over the last year have more than offset all of the progress made in several years of efficiency improvements.

The SAP targets for affordability are now unlikely to be achieved in the short term, and if fuel prices increase by another 20%, would be difficult to achieve economically in many cases, even with a longer timescale.

An option in the short term is to financially compensate low income tenants who have to live in a house below the defined SAP target.

There has been some discussion recently about financial compensation measures[21] including fuel vouchers to pay part of the fuel bill, and also wider use of social tariffs - in effect a subsidised rate for those on lower incomes or in certain circumstances.

[21] Fuel Poverty Advisory Group

Fuel vouchers

Until 1988, those claiming Supplementary Benefit (now Income Support) were able to apply for additional payments, known as heating additions, if their home was categorised as “difficult to heat” or even “exceptionally difficult to heat”. Estates of certain house types were also eligible for estate rate heating additions. The payments were quite generous – up to £800 a year valued on 2006 prices. A modern version of this could be based on SAP rating as the criterion of difficult to heat.

A voucher towards fuel costs from the landlord, based on the SAP difference, could be available for those on Housing Benefit. It would be property based (on SAP) rather than required spend for a particular family.

A sliding scale based on the difference between the target and actual SAP can be developed. For instance if the SAP target were 80, the difference in running cost would be around £300 a year if the actual rating were 55. The landlord would continue to pay this amount towards the fuel bill until the necessary improvements had been carried out to the property. This would ensure that the household was not disadvantaged compared to those living in upgraded properties.

Low SAP rated properties would be less likely to be let to those on Housing Benefit, and would therefore have a lower value to the landlord.

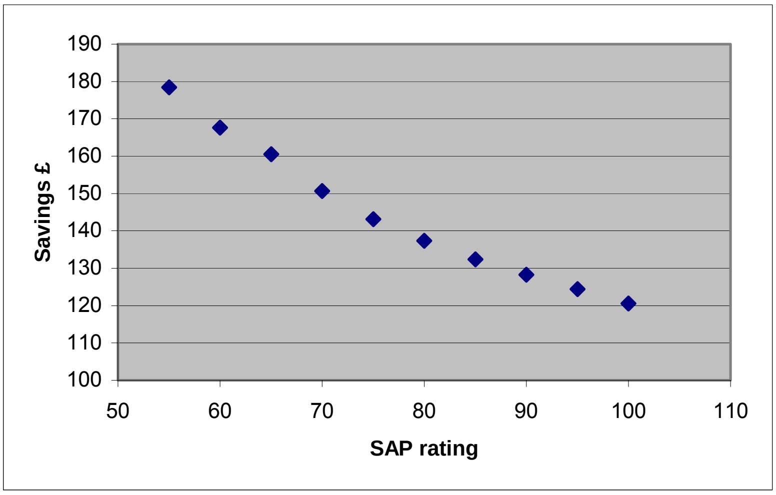
Social tariffs

There are a number of special tariffs developed by fuel suppliers that aim to offer discounts to certain household categories. A recent report by the Centre for Sustainable Energy[22] is critical of this approach and points out that in some cases the discount is less than the household would receive by changing to a different supplier on the standard rate. Another difficulty with any social tariff from the main suppliers is deciding which households qualify for the reduced rate.

In contrast, the Equipower tariff[23] is available to all consumers, not just those judged to be vulnerable or fuel poor. The absence of a standing charge and low unit rate for gas mean that almost all households in social housing would save on this tariff. Several of the web site comparison services exclude Equipower as they do not pay commission.

[22] Centre for Sustainable Energy (2006) *Social Tariffs: A Solution to Fuel Poverty?* available from http//:www.cse.org.uk
[23] Appendix 5

Figure 4 Annual savings on switching to Equipower from Scottish Power



As a result the recommended SAP 2005 targets are much more achievable if the Equipower tariff were to be used in all social housing.

Table 10 Suggested SAP targets assuming Equipower tariff

	Location Band			
	1	**2**	**3**	**4**
2005	54	58	60	66
2006	67	71	73	78
2006 Equipower	53	57	60	66

Appendix 1 The Questionnaire

The following questionnaire and guidance were circulated by email to HECA officers in every local authority.

Questionnaire

1. Data level

Please indicate where you consider your information to be in relation to the different levels of data – see guidance.

Level 0 *Basic data only*	***Level 0 +***	***Enhanced Level 0*** *Floor areas and boiler efficiencies*	***Enhanced +***	***Level 1*** *Full surveys*

2. SAP results for 2005

On your current (2005) stock profile please state your average SAP.

Average SAP	

Please indicate the % of your housing stock with SAP ratings in each band.

SAP band	*<10*	*10-19*	*20-29*	*30-49*	*50-59*	*60-69*	*70-79*	*80-89*	*90-99*	*100+*
%										

3. Secondary heating

What proportion of your housing stock has a wall mounted boiler with a fixed secondary heating system such as a gas fire or fixed electric fire. (Please estimate if not known exactly).

Roughly what proportion of the housing stock have a gas back boiler, with a gas fire that can be operated independently. (Please estimate if not known exactly).

Is the information on secondary heating included in the SAP calculation for the performance indicator?

YES		*NO*	

4. Age of boilers

Approximately what number of gas boilers have been fitted since April 2002.

How many of the new boilers have been condensing or condensing combi boilers?

How many non condensing boilers are currently in the housing stock.

5. Further contact

Are you willing to be contacted by email or telephone for a short (less than 10 minutes) interview to expand on the above?

YES		*NO*	

6. Seminars

Is your organisation likely to attend one of the seminars

YES		*NO*	

If you know the identity of the person likely to attend, please give their name and contact details.

Name
Tel
E mail

Would a morning or afternoon seminar be preferred?

am		*pm*		*No preference*	

Locations for the seminars are not yet finalised. If you have indicated that you would like to send at least one delegate, please state your preferred location for the seminars

York	*Nottingham*	*London*	*Manchester*	*Bristol*	*Other* *Please state*

Form completed by:

Name ....
Position ....
Tel ....
E mail ....
Postal address ....
....
....
....

Please return this form to Bill Wilkinson at bwilkinson@energyaudit.co.uk

Guidance on completing the questionnaire

Most local authority and housing associations are likely to have data somewhere between the levels, since some items, but not all, are above the basic data level. For instance If you use good information about boilers such as make and model, and SEDBUK efficiencies, but do not have measured floor areas, tick the **Level 0 +** box between **Level 0** and **Enhanced Level 0**. If the information is better than Enhanced level 0 (good heating information and floor areas) but not at Level 1 i.e. you have measured perimeters and floor areas, but not room heights, tick the **Enhanced +** box between **Enhanced Level 0** and **Level 1**.

Data levels

SAP calculations and lower level data

The ' full' SAP calculation was designed for Building Regulations approval and uses wall, floor and roof areas taken from plans, sections, and elevations taken from architect's drawings. U-values are normally calculated from a knowledge of the layer structure within each wall, roof and floor type. Information on heating and controls is available from the building specification.

For existing buildings the full SAP dimensional data set is time consuming to collect and the wall and floor information needed to accurately calculate the U-value may require extensive disruption of the building fabric. As a consequence a variety of different data collection methods have been used over the last 15 years. For stock profiles (not very accurate for individual homes) information is often obtained from existing records.

The majority of housing stock analyses for local authorities and for stock condition surveys have been performed using NHER Autoevaluator and similar software produced by Elmhurst and MVM Starpoint. The NHER program also links to stock condition software such as Codeman.

These programs take a minimum data set and produce all the dimensional data from a geometric model using correlations between the age, number of rooms, and property type. The geometric model is much more accurate if floor areas are measured. Heating and controls can be a reduced data set with defaults – for instance gas central heating rather than knowing the boiler type and whether a room thermostat is fitted.

Typical Level 0/QuickSAP information used

This is similar to that used in the EST advice system, where the householder is asked to complete the form and return to receive energy advice.

Built Form	**Age band**	**Storeys**	**No. of rooms**
Glazing Type	**Glazing Frame**	**Loft Insulation**	**Wall Insulation added**
Heating Fuel	**Heating System**	**Hot Water Fuel**	**Hot Water System**

Primary Heating Reference (boiler or heater type)

For flats additional information is needed

Flat Type	**Floor Exposure**	**Roof Exposure**	**No. of external Walls**

Enhanced Level 0 information

This is level 0, but with additional information on the floor areas and more accurate information on heating and controls. This would normally require a visit, but in some cases the floor areas are known for letting purposes, and the heating information can be obtained from heating maintenance records.

Level 1 information

In addition to the enhanced level 0, items such as exposed wall perimeters, room heights, perimeters and floor areas at each level are noted. Glazing areas are not measured, and the different glazing types such as double single etc, are apportioned between the main wall type and any extension wall type.
NHER Surveyor (or Elmhurst Streamline SAP) are often used for measured site surveys.

Appendix 2 Questionnaire responses and discussion

The main aim of the questionnaire was to find out how accurately social housing providers calculated the average SAP required each year for performance indicators (BVPI 63 for local authorities) and the Regulatory Statistical Return for housing associations, and to look for examples where more accurate data was being used. Optional questions included the number of gas boilers fitted since 2002, and the number of condensing boilers. The proportion of newer more efficient boilers has a significant effect on the SAP rating.

The questionnaire was sent to all HECA officers in England and Wales via the national HECA network. HECA officers were asked to forward the e mail to relevant members of staff in the local authority or to the ALMO/LSVT contact. It was also sent to housing associations in their area by many of the contacts.

Responses

The response was disappointing, with information on only 37 social housing providers being analysed. We attribute this poor response to a number of other similar requests for information made around the same time. These included an ODPM/BRE survey in December that asked for detailed information on insulation and heating, and the FAERO survey sent out only a week or so later than this one. The FAERO survey covered some of the same issues of level of data, and the results have been published recently.

Page 6 of the FAERO report gives the percentages of respondents who collect various data items. This is broadly in agreement with our findings on data levels, with high percentages of those collecting basic information such as property type, age, and heating fuel, but low percentages of those with information on floor area or SEDBUK efficiencies.

The response was not intended to provide a statistically robust sample, although it does cover local authorities, large scale voluntary stock transfers, Arms Length Management Companies, and Housing Associations. Stock sizes vary from under 900 to over 40,000, with 65% in the 1,000 to 10,000 range.

All of the respondents that reported higher level data used a sample survey, rather than having information about individual homes.

Table A1 Data levels reported

	Level 0	*Level 0 +*	*Enhanced Level 0*	*Enhanced Level 0+*	*Level 1*
% respondents	***5***	***57***	***5***	***5***	***8****

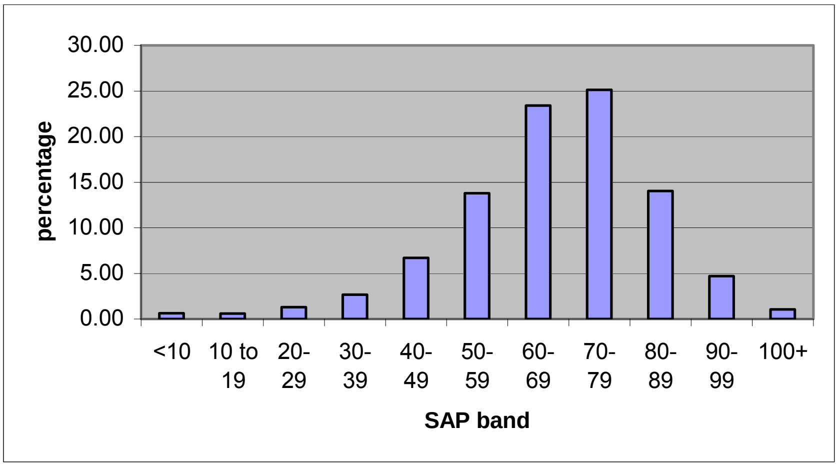
Stock profiles and averages

The mean reported average SAP rating was 67.2 overall, and 73 and 65 for housing associations and non housing associations respectively. These are slightly higher than the nationally reported figures for 2004 - 2005 of 64 for local authorities and 67 for housing associations. The lowest average SAP reported was 40 (local authority) and the highest 77 (Housing Association).

Respondents were asked to give a breakdown of the distribution of SAP ratings in the housing stock as well as the average SAP. This is a standard output for those with energy databases and was provided by all but 4 respondents.

Figure A1 gives a summary of overall summary of the percentages in each band. These are not weighted by size of housing stock.

Figure A1



Boilers

The proportion of new boilers fitted since 2002 that are condensing models varies widely, from 100% to as low as 2%. In 27% of cases, more than 90% of new boilers are condensing, while in 42% of cases, the proportion is lower than 30%.

Appendix 3 Geometric Model for Enhanced Level 0 and 2001 EHCS information

In social housing, the shapes of dwellings are normally simple rectangles or L shapes. The Maxim 3 energy database system (MVM) estimates the perimeter from the floor area and degree of detachment assuming that all dwellings have a square shape. For a semi or end terrace for example, with a $40m^2$ ground floor area:

$$Perimeter = 3 \times (floor\ area)^{1/2} = 3 \times (40)^{1/2} = 3 \times 6.32 = 18.87m$$

The NHER model assumes a 1:1.4 ratio between width and depth for all houses. For the house in the example above this produces a different result:

$$Perimeter = 3 \times (floor\ area)^{1/2} = 3.4 \times (40/1.4)^{1/2} = 3.4 \times 6.32 = 18.17m$$

The EHCS 2001 data set for local authority housing was used to check the accuracy of the perimeter estimation. For semi detached houses, using the above MVM relationship, the mean error in the perimeter is 0.09m, or less than 0.5%. 83% of the predicted perimeters are within 1m of the measured perimeter for semi detached houses. The NHER model, although apparently more sophisticated, is less accurate with a mean error of 0.87m.

For mid terraced houses the agreement between the Level 0 and actual perimeter is less good for both MVM and the NHER. Only 54% are within 2m of the predicted perimeter although the median difference for MVM is only –0.35m. For an uninsulated wall, a 2m error in the perimeter of a mid terraced house will give a SAP error of about 4 points. With an insulated wall the error is around 1-2 SAP points. In social housing the majority of walls have now been insulated so the error overall is likely to be small.

In terms of Enhanced Level 0 it is possible to estimate the perimeters from the floor area reasonably accurately for houses. The main error for flats is likely to be the number of exposed walls. For an insulated wall the change from 2 walls to 3 walls gives a SAP change of 2 points, but for uninsulated walls this can give a SAP error of up to 4 points.

Since SAP is relatively insensitive to changes in floor area (providing the area and perimeter are consistent) the error in the SAP result compared to RDSAP, using a Level 0 approach to predict floor areas, perimeters, and wall areas, is likely to be quite small especially where the wall is insulated.

Running costs, however, are a function of the floor area, so the error is likely to be much larger if the actual floor area is not used. The prediction of floor areas in the NHER Level 0 and the MVM Maxim does not take account of the tenure, and is a function of rooms, age, and property type.

However, fuel poverty calculations which are not based on at least floor area are likely to be subject to considerable error. There are implications here for quick assessments of fuel poverty such as those carried out on the doorstep in Warm Zone or other area based systems. The error in the classification of fuel poverty may well be compounded by the combination of underestimated income and overestimated running costs as a result of 'low' SAP ratings.

Appendix 4 Accuracy of data collection and calculation methods

The main assumptions in the different levels of data relate to heating and controls, heat loss areas and ventilation. Each is discussed individually here, with some conclusions about likely error. Finally, two data sets with information at RDSAP level have been recalculated several times, with the data reduced to the different lower levels and the individual SAP results compared for each property.

Heating, boiler efficiencies and controls

The biggest variation in SAP is related to heating efficiencies and controls rather than heat loss areas or exact thickness of insulation. In the absence of information, decisions about assumed efficiencies are crucial. If we are looking for an accurate average SAP for a housing stock then using average efficiencies and controls for a particular boiler type will give an answer that is approximately correct. In practice most default values for heating are biased towards a worst case.

The adoption of the SEDBUK in 1997 together with minimum efficiencies for both new and replacement boilers has resulted in modern boilers being much more efficient. In the SAP calculation if the actual boiler efficiency is not known, one of a set of default values can be used. These are set to be the lowest for the particular type of boiler and are not intended to be correct “on average”.

For the lowest data level, gas boiler efficiencies are defaulted to only three types - old (65%), new (73%), and condensing (83%).

When the efficiency of boilers recorded in the SEDBUK database was analysed to compare default and actual efficiencies, for those boilers categorised as new but non condensing (default value 73%), of the 770 boilers listed only 21 had an efficiency lower than 76%, and the mean was 79.1%. For condensing boilers (default value 83%) 82% of the 549 boilers in this category had an efficiency of 90% or higher, with the overall mean being 90.2%.

Since crucial information on controls is lacking, the default in NHER Level 0 and others is usually a room thermostat and programmer, but no boiler interlock (an efficiency measure which causes the boiler to turn off when there is no demand for heat). In the SAP calculation, not having an interlock results in a reduction of 5% in the boiler’s seasonal efficiency. The interlock assumption (if in error) will typically give a Level 0 answer that is too low by 3-4 SAP points compared to the ‘correct’ value in NHER Surveyor or RDSAP. Modern boilers in social housing fitted as part of a planned upgrade would normally have had the controls improved to give an interlock. Since 2002, Building Regulations have required boiler replacements in all sectors to have the controls required for an interlock.

Conclusion - the SAP is likely to be under estimated by 3 – 4 points if the boiler has an interlock and under estimated by 6 – 7 points if the boiler has an interlock and the default efficiency for modern (post 1998) boilers is used.

Heat loss areas

Table A2 Heat loss areas - dimensional data comparison

	Level 0	NHER Surveyor	RDSAP
Wall, floor, roof, and glazing types	Only 1 of each can be used in the calculation	Two of each if in extensions, + multiple options for glazing and frame	Three wall types for both main house and extensions.
Floor area	From property type, age, rooms, storeys	Measured	Measured
Room heights	Defaulted from age	Measured for each storey	Measured for each storey (and any extension)
Gross wall area (including windows)	Estimated from floor area and property type	Estimated from ground floor perimeter, room heights, property type and individual floor areas	Calculated from perimeters at each level and room heights.
Window areas	Estimated from property type, age, and floor area	Estimated from property type and floor area	Estimated from age and floor area
Zone 1 area *	= 25% of ground floor area	Approx = 2 /(room total +1)	Function of habitable rooms and floor area from Table

** The definition of habitable rooms in RDSAP only includes bedrooms and living rooms (lounge, dining etc). Thus a two storey, 3 bedroom house with a living room, dining room, bathroom, kitchen, and hallway but no dining room has 5 habitable rooms, and 8 rooms in total. This gives different zone 1 fractions, but has only a slight effect (no more than 1) on the SAP, with the Level 0 being too high.*

Conclusions

The main problem with Level 0 estimated heat loss areas is related to flats and mid terraced houses. The heat loss through house walls is very largely a function of the house type: detached - 4 walls, semi - 3 walls etc. Flats have a heat loss through an often unspecified number of walls, and this can result in larger errors if averages are used.

Older (pre 1930) mid terraced houses may have SAP ratings that are perhaps 4 SAP points too high at Level 0, since the wall area prediction is quite critical in the accuracy of the calculation. There are relatively few of these in local authority housing.

Overall comparison of Level 0 and RDSAP

The data from two local authorities with data at RDSAP level were used as the basis for analysis of the accuracy of the SAP calculation. Both authorities are good performers in terms of insulation and heating improvements, and in both cases the average SAP reported is over 70. The results are shown in the table below.

Authority 1 has carried out 3,500 surveys at RDSAP level in the last year using a group of trained and qualified NHER surveyors who have received additional training on RDSAP. The heating information on boilers was also derived from gas servicing records in order to obtain the actual SEDBUK efficiency.

Authority 2 has house type drawings for almost all of its housing stock. The property database records the house type for each individual property address. The drawings were used to calculate the heat loss areas and perimeters for each type and individual address. Heating, glazing and insulation records have been recorded and updated for over 15 years.

Table A3

	Level of Data	Average SAP	
		Authority 1	Authority 2
Stage			
1	RDSAP	74.6	74.3
2	No dimensions used	74.5	74.4
3	As 2 with basic heating only	71.5	71.2
4	Level 0 only	69.8	69.1

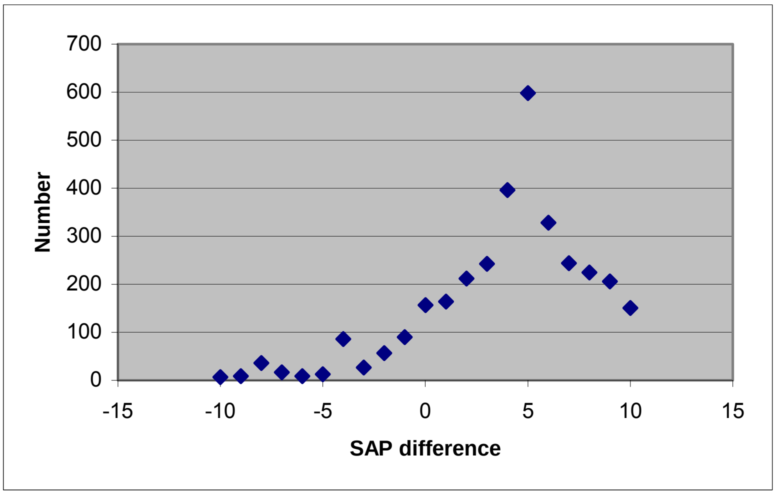
The calculations were carried out initially using data at RDSAP level (Stage1), and then again with dimensional data removed (Stage 2). The geometric model was used to derive all heat loss areas, but all other information was retained.

The SEDBUK information was then removed, so that the boiler efficiency was defaulted from the boiler type, and the RDSAP and NHER assumptions about presence of interlock were also removed and replaced by defaults (Stage 3).

Finally (Stage 4), all heating controls, fans, flues, chimneys, floor types, draughtstripping, water heating controls, cylinder insulation and size were defaulted by the NHER Autoevaluator program instead of being set (Level 0).

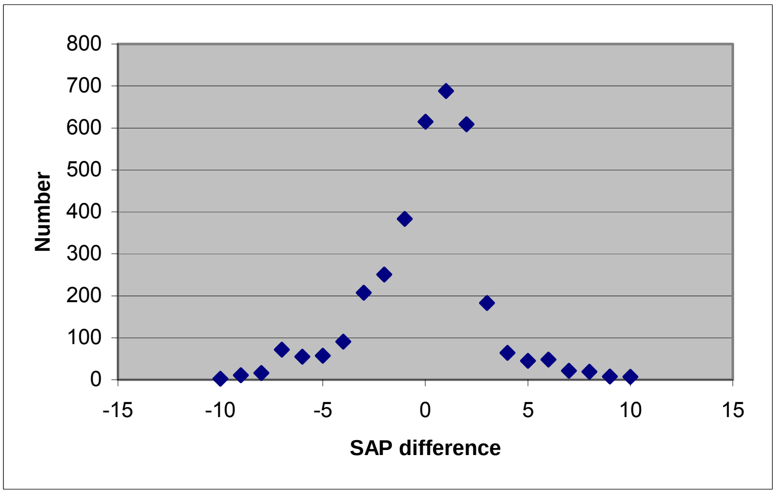
The difference in average SAP between the Level 0 and the accurate RDSAP is around 5 points in each case. The majority of the difference arises from the heating defaults for boiler efficiencies and controls as can be seen by comparing stages 2 and 3. In both authorities the proportion of high efficiency boilers is relatively small but increasing rapidly as older back boilers are replaced by condensing boilers as required by Building Regulations. As the proportion of high efficiency boilers increases, the SAP difference is likely to be greater.

Figure A2 Distribution of differences in SAP (Stages 1 and 4): Authority 1



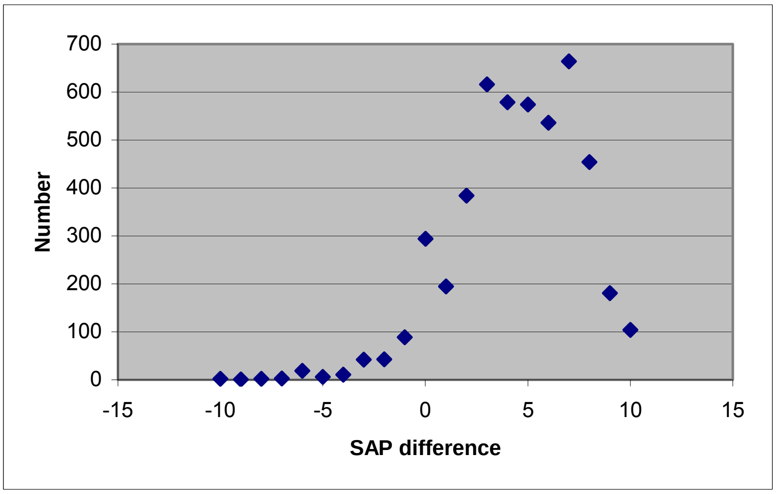
14 results differ by more than –10, and 38 by more than +10 (not shown on graph due to long tail). This includes those that are obvious survey or data entry errors – perimeters of over 100m etc. The obvious bias is clear from the distribution with the differences clustered around the +5 mark.

Figure A3 Distribution of differences in SAP (Stages 1 and 2): Authority 1



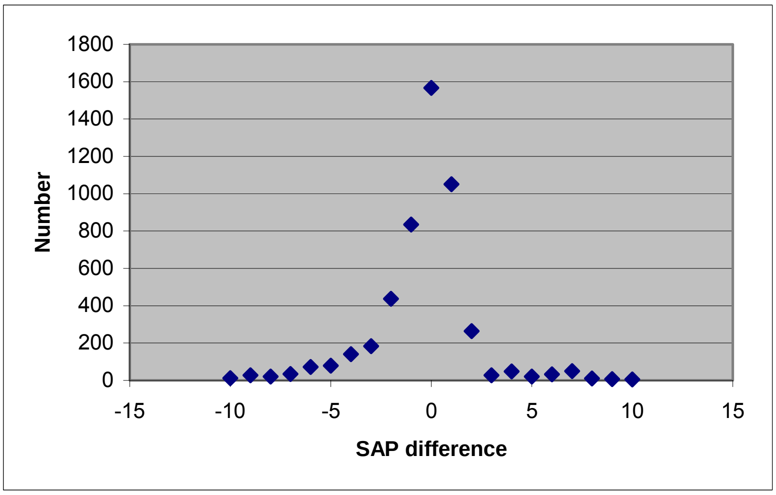
This distribution shows a very slight bias overall (non dimensional SAP is slightly too low) but is much more evenly distributed about the zero position. As a result, the mean is very close to the RDSAP value.

Figure A4 Distribution of differences in SAP (Stages 1 and 4): Authority 2



For Level 0, the systematic bias towards lower ratings is evident with the differences clustered around the 5 SAP point.

Figure A5 Distribution of differences in SAP (Stages 1 and 2): Authority 2



This shows a similar result to Authority 1, with most of the results clustered around the zero, and the mean being very close to the RDSAP value.

Accuracy of identifying homes with lower SAP ratings

The issue for target setting is how well the Level 0 or other method correctly identifies properties that fail to meet the target figure of say 60 or 74. Tables A4 and A5 show the percentage of properties ***incorrectly*** identified as being ***lower than*** the target for Level 0, and also for the 'no dimensional data' method where a visit may not be needed.

Table A4 Authority 1:
% properties incorrectly identified as not achieving target

Authority 1 (site visits)	SAP 60	SAP 60 +/- 5	SAP 73	SAP 73 +/- 5
No dimensional data	18.5%	4%	14%	2.2%
Level 0	44%	15%	37%	15.0%

Table A5 Authority 2:
% properties incorrectly identified as not achieving target

Authority 2 (from drawings)	SAP 60	SAP 60 +/- 5	SAP 73	SAP 73 +/- 5
No dimensional data	13%	3%	14%	2.2%
Level 0	49%	15%	37%	15.0%

The results are very similar for the two authorities, and indicate that the option of deriving a SAP without a site visit has a reasonable level of accuracy, especially if a margin of error of 5 SAP is allowed. The quality standard for RDSAP is likely to be that 95% of SAP ratings should be within 5 SAP points. In this housing stock this could be achieved without visiting to collect dimensions, providing the heating, insulation and other crucial data are correct.

Appendix 5 House type calculations and fuel prices

A semi detached house of 80m^2 floor area has been used as the model for the SAP target setting and is based on the values from the data in the EHCS. It is similar in size and characteristics to the semi detached house used in the Fuel Prophet Tool scenarios published in March 2006.

The house has a perimeter of 18.7m, room heights of 2.4m and a gross (solid) wall area of 95m^2. Window areas have been estimated from the RDSAP document as 16.63m^2 with 20% of the total window area being in the better heated living area. An uninsulated solid floor is assumed for all versions. Windows are single glazed and draughtstripped, and there are 2 solid doors. Loft insulation is 200mm (U-value of 0.2). With a new 90% condensing combi gas boiler, this house has a SAP of 65 on the SAP 2001 scale.

This house can achieve a SAP of 100 with wall insulation, low E argon filled double glazing, and insulated doors.

The calculations for running costs, SAP and NHER were carried out using NHER Evaluator (version 4.1) with one person occupancy for 16 hours a day, 7 days a week with a demand temperature of 21C in the main living area. A three person occupancy was used for the ‘minimum SAP’. Cooking was assumed to be from a gas hob and electric oven, and 20% of the fixed lighting outlets were assumed to have CFLs.

The heat loss U-values and boiler efficiencies were varied to give a range of SAP ratings and corresponding running costs for each location using the fuel prices given in Table 6.

Fuel prices

Historically fuel suppliers have varied their prices with lower prices offered to consumers outside their traditional regional base. Surprisingly prices still vary throughout the UK even between areas where the supplier was not formerly the “home supplier”.

The prices in Table A6 are those of Scottish Power for a standard direct debit tariff at various locations from the Energylinx website using appropriate postcodes on 31st May 2006. They are not ‘best buys’, but are around the mid range in terms of value for a dual fuel tariff.

Table 6

	Gas		Electricity	
	p/kWh	Standing Charge £	p/kWh	Standing Charge £
Wales	2.318	8.65	8.437	14.5
Scotland	2.218	9.65	8.976	9.5
East Midlands	2.177	12.59	7.16	13.13
M Keynes	2.177	12.59	7.16	13.13
Cornwall	2.138	9.57	8.535	12.7
North East	2.251	11.02	7.102	14.51

The best tariff, Equipower, would save about £140 a year for a SAP of 75 in the East Midlands, and nearly £250 compared to British Gas.

Equipower is a not for profit company and has no standing charges. There is no additional charge for prepayment meters, and no discounts are given for internet, standing orders or direct debits.

In the Equipower tariff gas is 1.94 p/kWh and electricity is 7.4 p/kWh

Oil is now 3.5 p/kWh, (based on 36p per litre), 66% higher than the SAP 2005 price.

Appendix 6 Under occupancy

Calculations carried out for the fuel poverty report of the EHCS have traditionally used a heating pattern where only half of the house outside the living room is heated if the house is classified as under occupied.

We have assumed a more generous heating regime with all of the area outside the living room (known as Zone 2, and taken as 75% of the total floor area) assumed to be heated for the 80m^2 house.

For the 90m^2 and 100m^2 variations the perimeters and wall areas were increased in proportion as were the main living area dimensions. Window areas were estimated by the use of the RDSAP formula. The area of Zone 2 actually heated for the larger houses was reduced in order to give a total heated area, including the living room, of 80m^2. The lights and appliances figure (which is based on floor area and number of occupants in the BREDEM 12 algorithm) was adjusted to be the same as the 80m^2 house, since the most obvious consequence of a one person household occupying a house that is too large for them is that one of the bedrooms is not used – no additional lighting or appliance use would result in this case.

Table A7 Running costs for under occupancy of larger houses for SAP 65 - East Pennines region

Floor Area	% Zone 2 heated	Unheated area m^2	MIT[24] outside living area	Space heating cost £	Total running cost £
80m^2	100.0	0	17.27	421	727
90m^2	85.1	10	16.67	423	729
100m^2	73.3	20	15.81	435	741

The difference in running cost of £14 a year for the 100m^2 house compared to the 80 m^2 one would only represent about 1 SAP point. The effect of under occupancy can therefore be disregarded for social housing using this approach.

[24] Mean internal temperature

Appendix 7 Technological change - domestic scale renewables and micro-generation

As homes become better insulated and with more efficient heating the space and water heating cost (almost all of the SAP running cost) is a smaller proportion of overall fuel costs. The lights and appliance figure is growing over time but for the single occupancy assumed here is less likely to be a major area of expenditure. Larger households have much higher electrical appliance usage and a house with a SAP of 80 occupied by 2 adults and 3 children would spend nearly 40% of their fuel bill on lights and appliances. Larger households are less likely to be in fuel poverty as their incomes are higher, but they may have problems in paying for fuel.

The SAP rating is intended to reflect the ‘fixed’ features of the house such as heating, insulation and glazing. The electricity consumption is largely dependent on appliances that are not ‘fixed’ such as washing machines, freezers and televisions that would be removed when the tenancy changes. However the SAP 2005 calculation now includes the energy for lighting, so that fitting CFLs may increase the SAP by up 2 points.

Table A8 SAP (2001) and running costs of 80m^2 house with 1 person occupancy

SAP	55	60	65	70	75	80	85	90	95
	Running Cost £								
Space & water heating	575	517	460	388	340	292	255	225	200
Cooking	31	31	31	31	31	31	31	31	31
Lights and appliances	134	134	134	134	134	134	133	132	132
Standing charges	102	102	102	102	102	102	102	102	102
TOTAL	843	784	727	655	607	559	521	490	465
% lights/appliances	15.9	17.1	18.4	20.5	22.1	24.0	25.5	26.9	28.4

Reducing the cost of running lights and appliances can be achieved by more efficient appliances, and/or some on site generation of electricity. Given the relatively short timescale of 2010 for eradicating fuel poverty in vulnerable households, it seems unlikely that electricity from renewables or micro chp could have a significant short term impact on the numbers in fuel poverty, but may well have a longer term role.

The technologies currently available for electricity generation include:

Photovoltaics

Light falling on the PV cell is converted to electricity that can be used within the home or exported via a special meter. The PV cells can be retrofitted on the roof as a panel, or can be integrated into a new or replacement roof. The DTI has given grants for domestic installations for a number of years, and around 1,300 homes have been fitted at an average (including grant) cost of £15,000.

Micro C.H.P.

These are small units that provide electricity as well as heat from a small gas engine. Whisper tech(Powergen) and Microgen (British Gas) are expected to be commercially available in 2008 following extensive trials. A recent report[25] on the initial small scale trial of the units has suggested that savings may be lower than originally thought. The additional cost compared to fitting a condensing gas boiler has been estimated to be around £500 (Fuel Prophet). Maintenance costs are likely to be much higher than boiler servicing, but will fall significantly as the market expands.

Domestic wind turbines

Small wind turbines can now be designed to be fixed onto the structure of a house rather than having a separate tower. In urban areas planning constraints and low wind speeds may be significant barriers. Several new manufacturers (e.g. Windsave, Swift) have claimed that a roof mounted turbine could supply half of the electricity demand of a typical house, about 2,200 kWh. Others[26] estimate that around 4-500 kWh is likely to be more typical in an urban site. In this case, even with all of the electricity consumed on site, the cost saving would only be around £40 a year on current prices.

Other non (electric) technologies to improve SAP ratings

Biomass (wood) boilers

These normally refer to high efficiency wood boilers that can run central heating systems. Most incorporate a thermal store that allows the boiler to operate semi automatically. Typical costs are about £5,000 (not including radiators etc). It is most likely to be suitable for larger houses off the gas mains, since adequate storage for fuel needs to be provided. It is likely to be less appropriate for most existing social housing although linked systems for new home developments are more promising, and replacement of existing solid fuel community heating boilers has proved to be successful[27].

Solar water heating

The ‘normal’ flat plate technology has been used for well over 100 years and is a well established technology in many parts of the world. For instance, in the United States around 30% of homes in Pasadena had solar water heating in 1897. In Miami alone, over 60,000 homes had solar water heaters fitted between 1935 and 1941[28]. There were around 78,000 solar water heaters in Britain in 2005.

A report by the Energy Saving Trust[29] suggests that solar water heating is unlikely to be cost effective (even in 2050), compared with other technologies, as major cost reductions are unlikely to occur. In hot countries homes do not need space heating

[25] Carbon Trust (2005), *The Carbon Trust’s Small-Scale CHP Field Trial Update*, available from www.carbontrust.co.uk

[26] Martin, N. (2005), *Can we harvest useful wind energy from the roofs of our buildings?* Building for a Future, Winter Issue, 2005/06

[27] Barnsley Metropolitan Council, Ashden Award Winners 2006 see http//:www.ashdenawards.org.uk

[28] Butti, K. and Perlin, J. (1980); *A Golden Thread, 2500 Years of Solar Architecture and Technology*, Marion Boyars

[29] Energy Saving Trust (2005), *Potential for Microgeneration: Study and Analysis,* EST

systems, so the comparison on cost effectiveness is usually with expensive on peak electric heating or bottled gas. In social housing in England and Wales the preferred option for heating is now the condensing combi boiler, providing relatively cheap instantaneous hot water. Using solar panels with a combi boiler is more expensive as a pre-heat cylinder has to be fitted.

Heat pumps (ground source and air to water)

Ground source heat pumps use electricity to take heat from coils buried in a trench or via a bore hole, and provide low temperature heat, normally to underfloor heating. One unit of electricity can provide 3 to 4 units of heat, but since electricity is more expensive than other fuels such as gas, the savings are not as large as some newspaper reports suggest. Typical costs for the heat pump but not including radiators or underfloor heating are around £3,000 - £5,000 depending on type[30].

In relation to domestic scale renewables, a recent report[31] looks at what point the technology might become 'economic', taking account of fuel prices and the effects of increased demand, lower production costs etc. For heating, two comparisons are used – gas and electric heating. The prediction of fuel costs by the DTI is that prices are relatively static to 2030 in real terms – this is already looking implausible given the enormous rises in gas and electricity prices in the last year. Domestic fuel prices in the UK are still amongst the lowest in Europe, and act as a barrier to both new technologies and investment in energy efficiency.

All of the above are relevant irrespective of location, but most are likely to be of greater interest in off gas areas. For instance, heat pumps in areas away from mains gas may be close to being commercially attractive at the present time.

Improving appliance efficiencies

Compact Fluorescent Lamps (CFLs) now average just under one per home[32], although installation into *all of* the light fittings including table lamps etc could reduce the electricity use of a typical house by over 600 kWh a year. Consumer resistance has been mainly on grounds of cost, size, and colour compared to tungsten lamps. Costs are now greatly reduced for the common sizes and candle bulbs and spotlights are also coming onto the market as an everyday purchase. In the longer term, LED lighting may overcome most of the perceived disadvantages of CFLs.

Improvements in the energy efficiency of **white goods** have been such that the savings for separate A** freezer and larder fridge for example, compared to the same appliances with an A rating are 169 kWh a year. EEC funding is available to schemes that promote upgrades.

Home entertainment systems in the form of replacement of conventional televisions by large screen plasma TVs represent a problem in terms of their high energy consumption. A 42inch plasma screen in use for 10 hours a day instead of a smaller television could increase consumption by 300 watts or 3kWh a day, costing about £90 a year extra. LCD TVs use about a third of the energy of a plasma screen TV, although the difference is less for larger screens.

---

[30] see www.ukace.org/research/fuelprophet
[31] Energy Saving Trust (2005), *Potential for Microgeneration: Study and Analysis,* EST Potential for Microgeneration, EST, 2005
[32] Boardman, B. et al (2005), *40% House*, Environmental Change Institute, University of Oxford

It is often stated that reducing demand is almost always more cost effective than increasing supply and this is clearly illustrated in this table of SAP improvements.

Table A9 SAP 2005 changes and running costs for standard house

	PV	Solar thermal	CFLs
SAP increase	7	1	2
kWh saved	1563	(See below)	See below)
£ saved	£65	£15.90	£19
Cost (no grant)	£12,500	£2475	£60
Cost per SAP point	£1780	£2475	£30

The house has a SAP of 65 in SAP 2001. kWh savings are for average occupancy rather than the one person household and are taken from the SAP 2005 calculation. Cost savings use the May 2006 gas and electricity prices in Appendix 5.

Solar thermal: – the assumption in RDSAP is a 3m^2 panel with an electrically powered pump. Gas savings of 940kWh are partially offset by the electricity used, although PV pumped systems are available at higher costs. The price of the system is from Fuel Prophet.

Lights: – the calculation allows for the heat replacement effect where the reduced heat from the lights results in an increased amount of gas being burned to maintain desired temperatures. The price of £60 allows for a more costly mix of candle and spot bulbs as well as 'normal' CFLs.

PV: – the 2.5 kWp system is priced at £5,000 per kWp. This has much larger savings if the price paid for export of electricity is the same as the import price. Good Energy, a supplier of 'green electricity', now run a scheme which pays the householder 4.5p/kWh for all of the output from the PV. This is not allowed for in the SAP rating, but would result in much larger cost saving.

Appendix 8 SAP and running cost tables

The graphs for SAP and running costs have been fitted to a series of equations to produce a running cost for each individual SAP value. The running cost figures, corresponding to minimum SAP (3 person) and recommended SAP (1 person), are highlighted.

	1 person					3 person			
SAP	Band 1	Band 2	Band 3	Band 4		Band 1	Band 2	Band 3	Band 4
50						868	942	988	1086
51						855	928	972	1068
52						842	913	957	1049
53						830	899	941	1032
54						817	885	926	1014
55	749	812	857	948		805	872	912	997
56	736	798	842	931		793	859	897	980
57	724	785	827	914		781	846	883	963
58	711	772	813	897		770	833	869	947
59	699	759	799	881		759	820	855	931
60	688	746	785	865		747	808	842	915
61	676	734	771	849		737	796	829	900
62	665	722	758	833		726	784	816	885
63	654	710	745	818		716	772	803	870
64	643	698	732	803		705	761	791	855
65	632	687	719	788		695	750	779	841
66	622	675	707	774		686	739	767	827
67	611	664	695	760		676	728	755	814
68	602	653	683	746		667	718	744	800
69	592	643	671	732		658	708	733	787
70	582	633	660	719		649	698	722	774
71	573	622	649	706		640	688	712	762
72	564	613	638	693		632	679	701	750
73	555	603	627	681		623	670	691	738
74	547	593	617	669		615	661	682	726
75	538	584	607	657		607	652	672	715
76	530	575	597	646		600	644	663	704
77	523	567	588	635		592	636	654	693
78	515	558	579	624		585	628	646	683
79	508	550	570	613		578	620	637	673
80	500	542	561	603		572	612	629	663