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ANNEX 1 – NATIONAL REGULATORY FRAMEWORK

Standard Assessment Procedure (SAP)

The Standard Assessment Procedure is a government approved energy rating scheme for dwellings and uses calculations derived from the Building Research Establishment's Domestic Energy Model (BREDEM). SAP has been revised several times since its introduction alongside the building regulations in 1995. The version used in the modelling in section 3 is the SAP 2001. This is the version that is used with the 2003 English House Condition Survey which forms the primary data source for the modelling.

SAP 2001 operates over a scale up to 120 with 120 being the most energy efficient. SAP 2005 operates over a scale up to 100, though due to the logarithmic nature of the scale the difference between the two only becomes significant at the higher end of the scale, as demonstrated in the table below.

Table 1: Relationship between SAP 2001 ratings and SAP 2005 ratings

SAP 2001	SAP 2005 for main heating fuel as:				
	Mains Gas	**LPG**	**Oil**	**Solid Fuel**	**Electricity**
1	1	-5	-5	3	3
10	10	5	5	13	13
20	20	16	16	23	22
30	30	26	26	33	32
40	40	36	36	43	41
50	50	45	45	52	50
60	58	54	54	59	58
70	65	61	61	66	64
80	71	67	67	71	69
90	76	72	72	75	72
100	80	75	76	78	75
110	83	77	78	80	77
120	85	79	80	82	78

Source: BRE

Whilst SAP 2001 has been used within the modelling, the measures of success outlined within section 4 should utilise SAP 2005 as this will now be in common usage, particularly following the introduction of the European Energy Performance in Buildings Directive and the Home Information Report that will utilise an A-G rating based on the SAP 2005 scale.

For more information from BRE on SAP 2005 see http://projects.bre.co.uk/sap2005/ and SAP 2001 see http://projects.bre.co.uk/sap2001/

Building Regulations (Part L) 2006

Building Regulations exist principally to ensure the health and safety of people in and around buildings, and are governed by the Office of the Deputy Prime Minister. The regulations apply to most new buildings and many alterations of existing buildings in England and Wales, whether domestic, commercial or industrial.

On April 6th 2006, important revisions came into affect to the Building Regulations Part L1 (and approved documents) which govern the energy performance of a building.

The previous (2002) regulations allowed three methods of compliance, the Elemental Method, the Target U-value Method and the Carbon-Index Method. In the new revisions, these three methods are abandoned and replaced by an approach that introduces the Target CO_2 Carbon Emission Rate and the Dwelling CO_2 Carbon Emission Rate. This method includes a whole building energy calculation which is sensitive to fuel type. The Target CO_2 Emission Rate is calculated based on a notional dwelling of the same size and shape. The Dwelling CO_2 Emission Rate, calculated on the actual dwelling, must then be less than the Target CO_2 Emission Rate.

How these standards are achieved is left open, and for the first time renewable energy sources will be able to count towards compliance.

The amendments raise the energy performance of new dwellings by 20 per cent. In terms of SAP this corresponds to a SAP rating of between 90-110, as compared to between 80-100 under the previous (2002) regulations, depending on fuel source.

Over time we can expect to see the Target Carbon Emissions Rate be ratcheted upwards towards the standard of a building that is ‘carbon neutral’ in heating, ventilation and lighting demands.

The greater flexibility offered by the new Part L revision presents an opportunity to designers to consider potentially radical new approaches to construction. This, combined with the progressive tightening of standards, is likely to provide a strong incentive to adopt more modern methods of construction (such as off-site manufacture). These can deliver substantially improved energy performance, as well as potential cost efficiencies over traditional techniques.

For further information from ODPM see
www.odpm.gov.uk/index.asp?id=1130474

EcoHomes

EcoHomes is an environmental assessment method for homes, launched and run by the Building Research Establisment (BRE) in 2000. It is the domestic version of BREEAM. Ecohomes addresses a range of environmental impacts. These are grouped together under the following elements:

- Energy
- Transport
- Pollution
- Materials
- Water

- Landuse and ecology
- Health and well being

Assessments are carried out by qualified assessors under license from BRE, who carry out assessor training and quality assurance for the assessment.

EcoHomes is a flexible standard. Scores achieved in each section are summated, and an overall rating can be awarded ranging from pass to excellent. Only 22.5% of the scores of the current version of EcoHomes are directly related to energy. It is therefore theoretically possible to score excellence without doing anything about energy.

The EcoHomes standard applies purely to new build. A version focused on existing stock has just been launched, called EcoHomes XB. Its aim is to allow housing associations to develop, measure and monitor stock profiles in terms of the current environmental performance of their housing, and target improvements.

The impact of EcoHomes on reducing domestic energy demand is limited by the fact that you can achieve an 'Excellent' score whilst taking no action on energy (above the regulatory minimum).

For further information from BRE see
http://www.breeam.org/ecohomes.html

Code for Sustainable Homes

The Code for Sustainable Homes was proposed by the Sustainable Buildings Task Group, which was established following the Government's Better Buildings Summit in 2003. The purpose of the Code is the establishment of a single national code for sustainable buildings. A proposal for the Code is currently out for pubic consultation.

As of February 2006, no firm decision has been made as to when and if the code will be introduced, nor have the scoring criteria been finalized. The Code for Sustainable Homes covers similar criteria to EcoHomes, but deals principally with the sustainability of the building, independent of its location. The Tranpsort and Ecology credits of EcoHomes are not represented. Instead these are proposed to be dealt with through region-specific Sustainability Checklists for Developments, currently under development. On energy, the minimum standard requires compliance with the 2006 Building Regulations (Part L), while the highest score ('Level 5') is likely to require a zero-carbon approach (although detail on this is not included in the draft proposals).

The Code has received criticism from many sources for lacking teeth and rigour, and WWF resigned from the steering group in protest, arguing that the Code represents less than existing commitments for publicly funded housing to go beyond minimum building regulations for energy efficiency.[1] It remains to be seen how ODPM will take the Code forward, though recent announcements suggest that the final version may well have more teeth from an energy perspective.

For further information from ODPM see
http://www.communities.gov.uk/index.asp?id=1162094

[1] http://www.publications.parliament.uk/pa/cm200506/cmselect/cmenvaud/uc779-i/uc77902.htm

Energy Performance in Buildings Directive

The EU Directive on the Energy Performance of Buildings (EU Directive 2002/91/EC) entered into force in January 2003. The principal objectives of the Directive are:

- To promote the improvement of the energy performance of buildings within the EU through cost effective measures;
- To promote the convergence of building standards towards those of Member States which already have ambitious levels.

The EU Directive requires that a valid 'energy performance certificate' be generated for all dwellings at the time of sale or rental. This certificate should provide information on the overall energy performance characteristics of the property and ways in which its energy efficiency could be improved.

The form and design of the energy certificate has been driven by the introduction of the Home Information Pack, a requirement of the Housing Act 2004, which will be required as part of every home purchase process. This Home Information Pack will contain a Home Energy Report, which in turn will contain an energy certificate. The certificate will 'grade' the energy performance of the property on a scale from A-G, much like the energy labels displayed on fridges and other electrical appliances. It will also contain recommendations for energy improvements to the home, together with indicative costs and energy savings. The Home Information Pack will become a requirement in England and Wales in January 2007.

A similar 'energy certificate' will be required to be made available to tenants in the social and private rented sectors, whenever a property is rented out. The timeline for this, and legal mechanism for enforcing it, have not yet been defined, although this part of the Directive must be implemented by Member States at the latest by January 2009. The Office of the Deputy Prime Minister (ODPM) will take the lead for implementing the measures contained within the Directive.

The introduction of the report could help to raise consumer awareness of sustainable energy issues in the home and represents an opportunity for organisations operating in the South West to link awareness raising campaigns to the introduction of the energy certificate.

There will clearly be a need for qualified home energy inspectors, capable of generating energy certificates, for both the Home Condition Report market and in due course the social and private rented sectors.

The latest draft version of the Energy Certificate can be seen here:
http://portal.est.org.uk/uploads/documents/partnership/Current%20version%20of%20the%20EPC.pdf

Further info from DEFRA:
http://www.defra.gov.uk/environment/energy/internat/ecbuildings.htm

Decent Homes

The Government wants all social housing to be brought up to the Decent Homes standard by 2010.

Following its 2000 Spending Review, the Government established a target to 'ensure that all social housing meets set standards of decency by 2010, by reducing the number of households living in social housing that does not meet these standards by a third between 2001 and 2004, with most of the improvement taking place in the most deprived local authority areas'. In 2002 the target was expanded to also include vulnerable housing in the private sector.

Delivering decent homes is now one of the key investment drivers for the social housing sector, and is a key commitment in the national strategy for neighbourhood renewal.

The definition of a 'decent home' is set out in a guidance document issued by ODPM[2]. In essence it is one which is wind and weather tight, warm and has modern facilities. It reflects what social landlords spend their money on. A decent home meets the following four criteria:

- It meets the current statutory minimum standard for housing.
- It is in a 'reasonable' state of repair.
- It has 'reasonably modern' facilities and services (this includes features such as a kitchen less than 20 years old, and a bathroom less than 30 years old).
- It provides a 'reasonable degree' of thermal comfort.

The thermal component of the DHS states that:

- Every home should provide a reasonable degree of thermal comfort, defined as having both efficient heating and effective insulation
- Efficient heating is defined as programmable, central heating
- Effective insulation is defined according to the heating fuel used

The following table summarises that standards required:

Heating system	Insulation requirements
Mains gas or oil fired programmable central heating	Cavity wall insulation (if feasible) OR At least 50mm loft insulation (if there is a loft space
LPB or solid fuel fired programmable central heating, or electric storage heaters	Cavity wall insulation (if feasible) AND At least 200mm loft insulation (if there is a loft space)

There is no specification for wall insulation in solid wall properties. Whilst insulation requirements are low, the standards are meant to act as a trigger for insulation up to a lot higher levels, rather than as a maximum level in themselves.

For further information from ODPM see
http://www.odpm.gov.uk/index.asp?id=1152136

[2] 'A Decent Home - The definition and guidance for implementation', ODPM, February 2004.

Housing Health and Safety Rating System (HHSRS)

The Housing Health & Safety Rating System was introduced by the Housing Act 2004 and comes into effect April 6th 2006. HHSRS also replaces the fitness standard as an element of the Decent Home Standard and introduces an evidence-based risk assessment procedure.

The HHSRS assessment is based on the risk to the potential occupant who is most vulnerable to that hazard. For example, stairs constitute a greater risk to the elderly, so for assessing hazards relating to stairs they are considered the most vulnerable. The very young as well as the elderly are susceptible to low temperatures. A dwelling that is safe for those most vulnerable to a hazard is safe for all.

The principle of HHSRS is that any residential premises (including the structure, means of access, and any associated outbuilding, garden or yard) should provide a safe and healthy environment for any potential occupier or visitor.

The Housing Health and Safety Rating System (HHSRS) considers a range of hazard which includes the risk of excess cold and damp and mould growth. As such it provides an additional mechanism for engaging housing providers on key issues relating to the incidence of fuel poverty.

National average risk assessment scores suggest that an average pre 1945 dwelling may be assessed as a category 1 hazard and fail the Decent Homes Standard requiring local authorities to take enforcement action, thereby potentially having significant impact on energy efficiency within existing dwellings.

For further information from ODPM see
http://www.odpm.gov.uk/index.asp?id=1152820

Renewables Obligation & Microgeneration

The Renewables Obligation was introduced in April 2002 and in the Government's main mechanism for supporting renewable energy. The Obligation is a legal requirement placed on electricity supply companies to source an increasing proportion of their supply from renewable resources up to 10% by 2010, and increasing to 15% by 2015. For each unit (megawatt hour) of renewable energy generated, a tradable certificate called a Renewable Obligation Certificate (ROC) is issued. Suppliers can meet their obligation through the purchase of the appropriate number of ROCs, or through paying a 'buy-out' price, currently set at £30 per megawatt hour. This creates a market value for renewable electricity which in turn provides an important financial incentive for renewable electricity sources.

In 2004, generators smaller than 50kW were included in the Renewables Obligation, with the minimum power output being 0.5 megawatt hours per annum. This was an important development for microgenerators, such as domestic solar PV, small hydro and domestic wind turbines. For the first time domestic scale generators could access the market for ROCs. A typical value for a ROC might be between 3-3.5p/kWh, although the actual market value of a ROC can vary.

A further source of income from microgeneration is the value of the electrical power exported to the grid. However it can be difficult for domestic customers to obtain adequate reward for this income stream. This is largely because of the institutional framework that is geared primarily towards larger generators.

Changes are currently being discussed as part of the Government's developing Microgeneration Strategy, and ongoing review of the RO, that could further help microgenerators by enabling agents to act on their behalf through the process of accreditation and claiming of ROCs. This should help microgenerators who do not wish to handle the administrative burden of the RO.

For further information from DTI see
http://www.dti.gov.uk/energy/sources/renewables/policy/index.html

Landlords Energy Saving Allowance

The Landlords Energy Saving Allowance was introduced in April 2004 and updated again in April 2005 and 2006. It provides tax allowances for capital expenditure up to a maximum of £1,500 on cavity wall insulation, solid wall insulation, loft insulation, draught proofing and insulation of hot water systems within rented accommodation. It is available to landlords who pay income tax.

The Energy Efficiency Commitment

The Energy Efficiency Commitment (EEC) took over in 2002 from the Energy Efficiency Standards of Performance as the obligation on all energy suppliers with over 50,000 customers to fund the delivery of energy efficiency measures within the domestic sector to targets set by government. The scheme is overseen by the regulator Ofgem. Energy suppliers with an EEC obligation are required to secure 50% of the benefits within the homes of priority customers. The funding for the measures comes from consumer bills and within the first phase of EEC running from 2002-2005 represented an increase in annual bills of £3.20 ex VAT per fuel per consumer.

Energy suppliers exceeded their targets for the first phase of EEC and were allowed to carry over savings into the second phase running from 2005-2008. Government hopes to see EEC 2 (2005-2008) deliver roughly twice the level of activity as EEC 1 at a cost of approximately £9 per fuel per consumer, or roughly 2% of the average bill for electricity of gas. Initial forecast of savings within the third EEC (2008-2011) contained within the recently revised Climate Change Programme suggest that by 2010 annual carbon savings could be as much as three times greater than the annual carbon savings delivered by the end of EEC 1 in 2005.

Priority group customers are defined as those where one or more occupants is in receipt of one or more of the qualifying benefits which are:

- Attendance allowance
- Council Tax Benefit (excluding single occupancy discount)
- Disability living allowance
- Housing benefit
- Income based job seeker's allowance
- Income support
- Industrial injuries disablement benefit
- Child tax credit
- Working tax credit
- Pension credit
- War disablement benefit

For further information from DEFRA see
http://www.defra.gov.uk/environment/energy/eec/index.htm

Warm Front

Warm Front is a national grant scheme managed in the South West by EAGA Ltd. Warm Front provides grants of up to £2700 for insulation and heating improvements. The scheme applies to householders who own their home (or are buying on a mortgage) or who rent from a private landlord.

Householders can claim if they received one or more of the following:

- Working tax credit (with an income of less than £15050 and which must include a disability element)
- Child tax credit
- Attendance allowance
- Disability living allowance
- Income support (which must include disability premium)
- Housing benefit (which must include disability premium)
- Council tax benefit (which must include disability premium)
- War disablement pension (which must include a mobility supplement or Constant Attendance Allowance)
- Industrial Injuries Disablement Benefit (which must include constant attendance allowance).

Parents with a child under 16 and pregnant women can claim if they receive:

- Income support
- Housing benefit
- Council tax benefit
- Income based Jobseeker’s Allowance
- Pension Credit

Those over 60 can also claim if they receive one or more of the following:

- Income support
- Council tax benefit
- Housing benefit
- Income based Jobseeker’s Allowance
- Pension credit

Homes that need oil central heating may receive a grant of up to £4000.

For further information from DEFRA see
http://www.defra.gov.uk/environment/energy/hees/index.htm

Low Carbon Buildings Programme

The Low Carbon Buildings Programme is the replacement for the previous government grant scheme for small scale renewable energy technologies, Clear Skies. It will provide £30 million over three years within two streams, one aimed at householders and smaller community organisations and the other aimed at larger schemes. The scheme is managed on behalf of the DTI by the Energy Saving Trust. In order to be eligible for a grant, basic energy efficiency measures must have been undertaken.

An additional £50 million, announced by government, will be allocated differently and support bulk orders for microgeneration technologies by public sector organisations and possibly private sector groups with a view to driving down the capital cost for key technologies.

For more information on the main open grant scheme see
http://www.est.org.uk/housingbuildings/funding/lowcarbonbuildings/

ANNEX 2 – BASELINE ENERGY EFFICIENCY DATA[3]

Headline Indicators

EHCS sample < 35

Data for England	Average SAP	% in fuel poverty*	% all vulnerable	% hard-to-treat**	% failing DHS-TC	Number of households	2003 EHCS sample*
GO Regions							
North East	**54.8**	8.7	76.6	21.8	15.5	1,091,972	962
Yorks & Humber	51.5	8.6	73.5	29.8	23.7	2,089,786	1657
North West	52.5	6.3	73.2	26.7	24.0	2,827,661	2245
East Midlands	51.1	6.3	70.7	37.6	18.1	1,777,207	1310
West Midlands	49.6	6.7	71.6	40.1	23.4	2,163,226	1553
South West	**49.3**	**6.5**	**69.7**	**37.6**	**27.7**	**2,136,132**	**1757**
East England	51.1	5.1	68.8	38.7	19.5	2,267,996	1643
South East	52.4	4.4	71.1	30.0	21.6	3,359,097	2525
London	52.4	**3.6**	68.0	66.3	21.8	3,011,077	2298
England Total	**51.6**	**5.9**	**71.1**	**37.8**	**22.1**	**20,724,154**	**15950**

* Excludes survey sample not grossed to regional populations (66 cases in SW)

** All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

All Households	Average SAP	% in fuel poverty	% all vulnerable	% hard-to-treat**	% failing DHS-TC	Number of households	2003 EHCS sample*
Own with mortgage	49.9	3.1	58.0	38.2	22.1	946,197	564
Own outright	47.7	11.0	83.1	30.7	28.9	677,024	392
Private Rented	42.3	12.2	51.0	55.4	42.8	227,356	280
Local Authority	54.9	3.6	**92.1**	40.5	32.4	140,525	247
Registered Social Landlord (RSL)	58.6	1.8	90.8	35.0	31.2	145,030	274
Urban - Tenure							
Own with mortgage	52.4	2.5	56.8	27.4	19.5	670,036	395
Own outright	51.4	8.6	84.3	18.7	27.6	450,861	255
Private Rented	46.1	8.9	48.7	45.9	40.9	163,033	191
Local Authority	56.8	3.3	93.1	34.6	28.6	118,973	209

[3] Within the final document data will be rounded to the nearest 1,000 in order to avoid a sense of absolute accuracy given the statistically representative but still relatively small sample utilised by the English House Condition Survey

RSL	61.5	2.6	90.1	26.3	23.3	103,460	194
Rural - Tenure							
Own with mortgage	43.9	4.1	60.7	64.4	28.3	276,161	169
Own outright	40.4	16.1	80.9	54.6	31.4	226,163	137
Private Rented	**32.6**	**21.3**	57.0	79.4	47.7	64,323	89
LA	44.7	5.3	86.7	73.3	53.2	21,552	38
RSL	51.2	1.3	92.5	56.6	50.8	41,570	80
Built form							
Detached	48.2	4.3	64.8	31.2	15.4	446,796	268
Semi-detached	48.8	5.6	77.8	35.0	24.2	470,604	385
Mid Terrace	53.6	5.3	62.5	50.2	32.9	376,308	318
End Terrace	47.6	8.1	62.8	39.3	25.9	241,209	216
Bungalow	43.8	12.3	83.6	28.2	25.1	294,343	229
Converted flat	38.1	12.1	37.0	73.6	45.3	101,526	100
Purpose-built flat	60.6	2.7	79.2	28.0	50.5	205,346	241
Urban - Built form							
Detached	53.2	3.6	64.4	8.2	10.6	246,371	140
Semi-detached	51.5	4.0	77.6	19.6	20.8	329,578	262
Mid Terrace	54.9	4.7	60.9	49.0	30.1	307,846	265
End Terrace	52.0	6.5	68.8	26.4	19.6	180,967	156
Bungalow	47.7	7.9	82.9	9.1	15.8	171,487	128
Converted flat	38.0	11.1	37.1	70.4	44.9	89,013	87
Purpose-built flat	60.5	2.6	78.6	27.3	49.9	181,101	206
Rural - Built form							
Detached	42.1	5.3	65.3	59.6	21.4	200,425	128
Semi-detached	42.2	9.4	78.2	71.0	32.1	141,026	123
Mid Terrace	47.6	7.8	69.5	55.4	45.8	68,462	53
End Terrace	34.6	12.8	44.7	78.0	44.8	60,242	60
Bungalow	38.4	18.4	84.6	54.9	38.0	122,856	101
Converted flat	38.5	18.8	36.1	95.8	47.8	12,513	13
Purpose-built flat	61.1	3.0	83.6	32.7	55.4	24,245	35

* Fuel poverty on the full income definition

Headline Indicators by Tenure and Built Form

Average SAP	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	51.1	46.5	33.4	no sample	26.3
Semi-detached	50.3	46.8	39.6	51.0	52.6
Mid Terrace	53.1	48.8	54.3	60.3	65.4
End Terrace	46.9	46.4	40.4	50.9	59.2
Bungalow	42.0	44.6	38.4	48.9	44.5
Converted flat	41.7	49.4	**32.1**	59.2	51.5
Purpose-built flat	59.0	63.1	54.4	58.2	**65.0**

FP%	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	1.1	7.6	11.3	no sample	0.0
Semi-detached	3.4	10.2	11.1	3.4	0.0
Mid Terrace	1.7	18.1	1.5	5.7	4.7
End Terrace	9.3	10.2	10.9	0.0	0.0
Bungalow	4.9	15.8	28.6	6.8	4.2
Converted flat	0.0	0.0	**22.1**	0.0	27.8
Purpose-built flat	0.0	3.5	6.8	3.3	0.0

Vul%	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	57.5	73.3	70.3	no sample	100.0
Semi-detached	72.9	84.5	66.8	93.2	87.3
Mid Terrace	56.3	73.7	44.3	94.3	93.9
End Terrace	45.6	79.6	47.6	93.1	94.4
Bungalow	57.3	93.1	80.4	97.0	**98.1**
Converted flat	31.4	83.2	27.1	100.0	100.0
Purpose-built flat	21.6	100.0	61.4	88.5	85.4

HTT%	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	33.1	25.3	59.9	no sample	0.0
Semi-detached	31.2	33.8	49.9	46.8	45.0
Mid Terrace	52.1	52.7	55.3	33.8	28.9
End Terrace	42.4	36.3	50.7	42.2	18.4
Bungalow	22.8	26.9	47.4	37.7	37.0
Converted flat	73.2	81.7	**74.2**	38.3	76.0
Purpose-built flat	20.5	9.6	29.6	39.9	39.0

Thousands	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	237,293	186,057	22,898	no sample	548
Semi-detached	251,053	129,268	33,181	30,098	27,004
Mid Terrace	206,617	73,136	52,096	19,180	25,279
End Terrace	113,221	61,606	24,928	17,064	24,390
Bungalow	77,481	163,740	15,783	17,183	20,156
Converted flat	35,093	8,768	52,678	2,805	2,182
Purpose-built flat	25,439	54,449	25,792	54,195	45,471

DHS-TC%	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	11.2	18.8	29.4	no sample	100.0
Semi-detached	18.7	28.2	41.3	27.0	32.1
Mid Terrace	31.8	48.9	28.9	16.6	17.1
End Terrace	26.1	21.0	45.2	22.4	20.0
Bungalow	20.6	22.4	35.6	41.7	41.4
Converted flat	34.5	52.1	51.2	43.7	49.0
Purpose-built flat	48.1	62.5	70.3	40.5	38.3

2003 EHCS sample	Tenure				
Built form	Own mortgage	Own outright	Private Rented	LA	RSL
Detached	128	109	30	0	1
Semi-detached	154	78	46	54	53
Mid Terrace	127	45	64	36	46
End Terrace	73	35	33	29	46
Bungalow	46	92	19	30	42
Converted flat	23	6	62	5	4
Purpose-built flat	13	27	26	93	82

Current Energy Efficiency Standards - Loft Insulation

Row percentages	Has loft	No loft	% of lofts with loft insulation thickness* of:- None	< 100 mm	100 mm	125/150	200 mm+	Number with loft	EHCS loft sample	Total households
Total SW region	**91.5**	**8.5**	**2.9**	**29.4**	**39.1**	**18.2**	**10.3**	**1,953,725**	**1566**	**2,136,132**
Tenure										
Own with mortgage	96.1	3.9	2.2	29.2	40.6	18.7	9.3	909,523	543	946,197
Own outright	93.1	6.9	3.1	30.0	40.0	17.3	9.6	630,480	369	677,024
Private Rented	82.1	17.9	**8.9**	**40.1**	31.7	7.6	11.6	186,685	235	227,356
LA	73.6	26.4	0.5	23.3	37.6	23.8	14.7	103,461	184	140,525
RSL	85.2	14.8	0.4	15.9	36.7	30.6	**16.4**	123,576	235	145,030
Built form										
Detached	100.0	(no flat	2.0	29.1	37.9	18.5	12.5	446,796	268	446,796
Semi-detached	100.0	roof types	3.3	28.9	45.9	14.1	7.8	470,604	385	470,604
Mid Terrace	100.0	in SW	3.6	30.0	36.5	19.2	10.8	376,308	318	376,308
End Terrace	100.0	sample)	4.8	28.7	38.7	19.4	8.4	241,209	216	241,209
Bungalow	100.0		1.1	28.6	34.8	24.0	11.6	294,343	229	294,343
Converted flat	42.3	57.7	**8.0**	**72.1**	7.4	5.5	7.0	42,904	42	101,526
Purpose-built flat	39.7	60.3	1.1	13.1	53.3	18.1	**14.5**	81,561	108	205,346
Fuel poverty										
Not in fuel poverty	91.1	8.9	2.4	28.6	39.4	19.1	10.5	1,819,890	1461	1,997,042
In fuel poverty	96.2	3.8	**10.2**	**40.0**	36.0	5.8	8.0	133,835	105	139,090
Vulnerable group										
Not vulnerable	91.0	9.0	3.1	34.6	38.1	13.7	10.5	589,244	442	647,814
In vulnerable group	91.7	8.3	2.8	27.1	39.6	20.2	10.3	1,364,481	1124	1,488,318
DHS-TC										
Not fail on TC	94.3	5.7	0.2	27.1	41.5	19.5	11.7	1,455,425	1123	1,543,413
Fails on thermal C.	84.1	15.9	**11.0**	**36.1**	32.2	14.5	6.3	498,300	443	592,719
Hard-to-Treat**										
Not hard-to-treat	91.6	8.4	1.8	28.2	41.6	19.5	8.8	1,221,182	909	1,333,265
On gas, solid wall	88.9	11.1	6.6	39.2	33.4	11.8	9.0	326,670	275	367,580
On gas, non-trad	85.5	14.5	1.0	25.0	47.4	14.0	12.7	56,852	74	66,480
Off gas, cavity wall	92.2	7.8	1.9	21.8	35.6	23.4	17.3	215,684	190	233,905
Off gas, solid/n-trad	98.8	1.2	6.9	29.9	32.4	15.2	15.6	133,337	118	134,902

* To allow for measurement variation, 100mm taken as 91 to 114mm, 125mm - 119 to 134 & 150mm - 139 to 150 mm

** All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Predominent Wall Type and Insulation

Row percentages	Masonry cavity walls			Solid masonry		Non-traditional		Total households	2003 EHCS sample
	All cavity filled	Some walls filled*	None filled	All/some insulated	None insulated	All/some insulated	None insulated		
Total SW region	**27.9**	**2.0**	**42.6**	**3.7**	**19.4**	**2.4**	**1.9**	**2,136,132**	**1757**
Tenure									
Own with mortgage	26.5	2.0	42.5	4.3	22.1	1.9	0.8	946,197	564
Own outright	30.2	2.2	**46.3**	3.4	15.7	0.9	1.4	677,024	392
Private Rented	12.6	0.0	39.6	5.7	**39.0**	1.4	1.7	227,356	280
LA	28.7	4.6	36.4	1.6	3.7	14.5	**10.5**	140,525	247
RSL	50.2	2.2	36.4	0.3	3.9	3.3	3.7	145,030	274
Built form									
Detached	36.7	1.0	43.4	1.7	16.1	1.1	0.0	446,796	268
Semi-detached	24.7	4.2	44.6	2.8	18.3	2.4	3.1	470,604	385
Mid Terrace	19.6	2.1	30.8	8.6	33.6	3.3	2.0	376,308	318
End Terrace	28.0	0.6	40.7	6.2	21.5	2.5	0.4	241,209	216
Bungalow	36.0	2.6	**51.7**	0.0	4.3	2.4	3.0	294,343	229
Converted flat	0.9	0.0	26.4	10.7	**60.6**	1.3	0.0	101,526	100
Purpose-built flat	33.1	1.0	**54.6**	0.3	2.0	4.6	4.4	205,346	241
Fuel poverty									
Not in fuel poverty	29.5	2.0	42.1	3.4	18.9	2.4	1.7	1,997,042	1645
In fuel poverty	**5.7**	2.6	49.0	7.6	**27.3**	3.0	4.9	139,090	112
Vulnerable group									
Not vulnerable	24.7	0.8	39.9	3.8	28.7	1.3	0.8	647,814	497
In vulnerable group	29.4	2.6	43.7	3.7	15.4	2.9	2.4	1,488,318	1260
DHS-TC									
Not fail on TC	33.8	2.4	37.8	3.0	18.7	2.5	1.8	1,543,413	1217
Fails on thermal C.	12.6	1.1	**55.1**	5.4	21.2	2.3	2.3	592,719	540
Hard-to-Treat**									
Not hard-to-treat	37.5	2.3	59.7			0.3	0.2	1,333,265	1020
On gas, solid wall				17.1	82.9			367,580	314
On gas, non-trad						52.8	47.2	66,480	91
Off gas, cavity wall	41.3	5.6	48.5			3.8	0.8	233,905	212
Off gas, solid/n-trad				12.2	81.5	2.7	3.6	134,902	120

* Typically where walls filled in a later extension

** All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Extent of Double Glazing

Row percentages	**Proportion of windows double glazed** None	Less than half	More than half	Entire home	**Total households**	**2003 EHCS sample**
Total SW region	**19.2**	**7.1**	**13.2**	**60.5**	**2,136,132**	**1757**
Tenure						
Own with mortgage	17.5	6.9	17.0	58.7	946,197	564
Own outright	14.2	8.4	17.7	59.8	677,024	392
Private Rented	**34.1**	12.4	10.1	43.4	227,356	280
LA	17.1	2.1	6.9	**73.8**	140,525	247
RSL	11.1	2.2	5.1	81.5	145,030	274
Built form						
Detached	12.2	8.0	17.5	62.2	446,796	268
Semi-detached	14.2	7.4	19.4	59.0	470,604	385
Mid Terrace	23.2	6.8	16.3	53.7	376,308	318
End Terrace	16.6	5.4	13.2	64.8	241,209	216
Bungalow	11.6	8.5	16.6	63.2	294,343	229
Converted flat	**54.3**	15.4	6.4	23.9	101,526	100
Purpose-built flat	19.9	3.0	0.9	**76.1**	205,346	241
Fuel poverty						
Not in fuel poverty	16.7	6.8	14.8	**61.7**	1,997,042	1645
In fuel poverty	**32.3**	14.4	18.2	35.1	139,090	112
Vulnerable group						
Not vulnerable	20.1	8.6	16.6	54.6	647,814	497
In vulnerable group	16.7	6.7	14.3	62.3	1,488,318	1260
DHS-TC						
Not fail on TC	16.0	5.9	15.3	62.8	1,543,413	1217
Fails on thermal C.	**22.3**	10.9	14.2	52.5	592,719	540
Hard-to-Treat*						
Not hard-to-treat	11.9	5.7	12.9	69.5	1,333,265	1020
On gas, solid wall	36.6	11.8	17.8	33.8	367,580	314
On gas, non-trad	19.8	2.2	11.0	67.0	66,480	91
Off gas, cavity wall	13.2	7.1	9.4	70.3	233,905	212
Off gas, solid/n-trad	46.7	10.0	11.7	31.7	134,902	120

* All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Hot Water Tank Presence and Insulation

Row percentages	Has HW tank	No HW tank	Foam insulation			Jacket Insulation			Other insul.	No Insul.	Insulation NK	Total with HWT	EHCS HWT sample
			12.5mm	38mm	50mm +	12.5mm	38mm	50mm +					
Total SW region	**71.5**	**28.4**	**26.1**	**35.3**	**5.7**	**18.3**	**8.5**	**1.9**	**2.2**	**1.7**	**0.3**	**1,528,341**	**1247**
Tenure													
Own with mortgage	69.2	30.7	27.4	37.7	4.2	19.1	7.1	1.6	1.0	1.3	0.4	654,633	387
Own outright	76.5	23.5	24.6	31.8	8.5	18.3	10.7	1.8	2.2	1.8	0.4	517,731	295
Private Rented	65.1	34.9	29.4	33.5	1.6	19.8	7.2	3.5	1.3	**3.7**		148,028	184
LA	72.0	28.0	22.6	30.1	2.7	**21.3**	9.9	1.5	8.7	3.3		101,138	180
RSL	73.6	26.4	24.8	44.4	9.4	8.6	6.4	2.0	4.1	0.4		106,811	201
Built form													
Detached	84.9	14.8	33.7	33.5	7.6	12.3	6.8	2.2	0.9	2.0	1.0	379,450	226
Semi-detached	72.2	27.8	23.7	41.3	4.0	17.7	9.9	0.6	1.8	0.7	0.4	339,760	286
Mid Terrace	63.0	37.0	22.4	31.2	7.7	22.6	7.8	2.7	3.8	2.0		237,101	203
End Terrace	71.3	28.7	19.6	38.5	4.1	**25.1**	8.6	2.9	0.4	0.8		171,916	153
Bungalow	73.3	26.7	31.0	32.2	2.5	20.9	9.2	1.9	1.1	1.2		215,658	171
Converted flat	43.2	56.8	16.1	38.4	7.4	21.6	7.3		5.5	**3.7**		43,823	45
Purpose-built flat	68.5	31.5	21.5	32.2	7.6	15.5	9.9	2.1	6.7	4.4		140,633	163
Fuel poverty													
Not in fuel poverty	70.5	29.4	26.7	35.7	5.6	17.8	8.6	1.9	2.0	1.5	0.4	1,407,761	1151
In fuel poverty	86.7	13.3	20.0	30.7	6.8	**24.2**	7.3	1.9	4.6	**4.5**		120,580	96
Vulnerable group													
Not vulnerable	66.5	33.3	28.1	36.6	4.2	18.7	6.5	2.4	0.6	2.8		430,477	322
In vulnerable group	73.8	26.2	25.4	34.7	6.2	18.1	9.2	1.7	2.8	1.3	0.5	1,097,864	925
DHS-TC													
Not fail on TC	69.4	30.5	28.2	36.5	5.7	17.5	7.6	1.6	1.9	0.8	0.1	1,071,874	826
Fails on thermal C.	77.0	23.0	21.2	32.4	5.6	20.1	10.6	2.6	2.8	**3.8**	0.8	456,467	421
Hard-to-Treat*													
Not hard-to-treat	72.3	27.7	26.9	36.6	4.9	18.0	8.0	2.1	2.3	1.0	0.1	964,262	717
On gas, solid wall	51.9	48.1	16.7	28.7	4.0	32.5	12.8	1.0	1.7	1.9	0.7	190,634	163
On gas, non-trad	80.5	19.5	18.6	27.3	4.7	21.2	22.2	1.9	1.8	2.1		53,504	73
Off gas, cavity wall	85.1	14.9	31.6	34.1	9.4	11.1	3.8	2.4	2.9	3.6	1.2	199,069	187
Off gas, solid/n-trad	89.6	10.4	29.0	40.0	9.1	9.0	7.0	1.1	1.0	3.9		120,872	107

* All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Type and Age of Main Heating

Row	**Central heating system**				**Storage & other room heaters**				**Total**	**2003 EHCS**
percentages	< 3 years	3-12 yrs	> 12 yrs	Age NK	< 3 years	3-12 yrs	> 12 yrs	Age NK	**households**	**sample**
Total SW region	**15.9**	**33.6**	**29.7**	**1.0**	**1.0**	**3.0**	**15.0**	**0.7**	**2,136,132**	**1757**
Tenure										
Own with mortgage	17.9	36.9	28.7	1.8	0.7	2.1	11.3	0.7	946,197	564
Own outright	16.4	31.8	**35.0**	0.0	1.0	3.2	12.0	0.6	677,024	392
Private Rented	9.5	28.4	24.8	1.3	1.8	4.0	**29.4**	0.9	227,356	280
LA	**18.1**	26.1	31.8	0.4	0.7	3.0	19.1	0.9	140,525	247
RSL	9.5	36.4	17.5	1.1	2.1	5.8	26.9	0.7	145,030	274
Built form										
Detached	13.5	41.0	41.4	0.3	0.0	0.0	3.4	0.3	446,796	268
Semi-detached	20.6	36.0	28.1	1.6	1.2	2.0	9.9	0.6	470,604	385
Mid Terrace	12.7	33.7	24.8	0.5	0.5	4.9	21.9	1.0	376,308	318
End Terrace	13.1	33.8	28.3	1.1	2.8	4.8	15.2	0.9	241,209	216
Bungalow	17.9	34.3	**31.3**	0.7	0.4	1.0	13.7	0.7	294,343	229
Converted flat	22.4	20.0	14.0	3.9	2.3	5.9	31.6		101,526	100
Purpose-built flat	13.6	17.6	24.2	1.2	1.7	7.1	**33.2**	1.4	205,346	241
Fuel poverty										
Not in fuel poverty	16.6	34.8	30.2	1.1	1.0	2.7	13.0	0.7	1,997,042	1645
In fuel poverty	6.5	15.9	23.1	0.0	0.9	7.1	**45.4**	1.1	139,090	112
Vulnerable group										
Not vulnerable	16.6	33.6	28.6	1.8	1.1	3.2	14.2	1.0	647,814	497
In vulnerable group	15.7	**33.6**	30.2	0.7	1.0	2.8	15.4	0.6	1,488,318	1260
DHS-TC										
Not fail on TC	18.2	41.6	34.0	1.2	0.2	1.6	3.1	0.0	1,543,413	1217
Fails on thermal C.	10.0	12.7	18.5	0.6	3.0	6.5	**46.3**	2.4	592,719	540
Hard-to-Treat*										
Not hard-to-treat	15.5	37.3	32.1	0.9	1.1	2.2	10.4	0.4	1,333,265	1020
On gas, solid wall	20.5	27.8	27.9	1.5	0.4	4.2	17.7		367,580	314
On gas, non-trad	17.6	23.9	35.4			0.7	21.6	0.8	66,480	91
Off gas, cavity wall	10.8	32.2	18.0	1.3	0.8	4.5	29.3	3.1	233,905	212
Off gas, solid/n-trad	15.6	20.2	28.4	1.1	2.9	5.4	25.6	0.9	134,902	120

* All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Heating Controls for Central Heating

Row	Time control		Time/temp	Temperature control					Time/temp	Total	2003 EHCS
	Central	No time	Zone	Room	No room thermostat, but			No temp	control	relevant	relevant
percentages	timer	control	control	stat/s	All TRVs	Some Trvs	Manual	control	not known	systems	sample
Total SW region	**89.3**	**7.9**	**1.8**	**49.8**	**19.4**	**9.2**	**14.1**	**4.9**	**0.9**	**1,799,870**	**1423**
Tenure											
Own with mortgage	89.4	7.3	1.8	50.5	17.9	10.6	12.9	5.2	1.2	848,538	504
Own outright	92.3	5.4	2.3	53.5	19.1	7.8	14.0	3.3	0.0	578,558	335
Private Rented	86.0	13.0	0.3	34.1	21.7	9.8	25.0	**8.6**	0.4	160,240	201
LA	85.5	12.7	0.9	49.3	27.0	6.3	10.6	5.5	0.5	112,176	195
RSL	80.6	**14.5**	1.3	49.0	20.8	8.1	10.2	6.2	4.4	100,358	188
Built form											
Detached	93.8	3.1	2.7	64.0	14.3	7.2	10.8	0.3	0.7	430,887	257
Semi-detached	91.3	6.2	1.5	44.4	23.2	13.2	13.5	3.6	0.7	421,635	334
Mid Terrace	83.5	14.5	0.5	40.5	19.6	7.4	18.1	12.9	1.0	301,847	263
End Terrace	91.1	8.5	0.2	46.5	19.2	11.3	16.7	5.9	0.2	196,568	173
Bungalow	91.1	5.6	3.2	56.7	19.3	7.6	11.3	1.9	0.0	249,198	176
Converted flat	80.9	**15.8**	0.0	29.1	26.9	8.5	24.5	11.1	0.0	70,999	67
Purpose-built flat	79.3	14.0	2.6	45.1	19.8	7.1	13.0	7.7	4.7	128,736	153
Fuel poverty											
Not in fuel poverty	90.6	6.7	1.7	50.5	19.7	9.3	13.9	4.0	0.9	1,719,122	1361
In fuel poverty	61.3	**35.2**	3.5	35.0	11.8	7.1	17.0	**25.7**	0.0	80,748	62
Vulnerable group											
Not vulnerable	88.1	9.3	1.6	47.3	20.5	8.6	15.9	5.2	0.9	550,873	413
In vulnerable group	89.8	7.3	1.8	51.0	18.9	9.5	13.2	4.8	0.8	1,248,997	1010
DHS-TC											
Not fail on TC	95.2	2.7	1.3	53.1	20.4	9.8	13.6	1.3	0.6	1,476,292	1147
Fails on thermal C.	62.5	**31.9**	3.8	34.9	14.8	6.6	16.2	**21.7**	2.0	323,578	276
Hard-to-Treat*											
Not hard-to-treat	92.9	4.3	1.8	56.3	17.4	9.5	10.8	3.2	1.0	1,181,667	884
On gas, solid wall	85.0	13.8	0.3	31.1	24.9	9.2	24.4	10.0	0.2	314,630	261
On gas, non-trad	78.5	**20.6**		35.4	28.2	6.2	9.9	**19.4**	0.9	62,030	82
Off gas, cavity wall	82.2	11.6	4.8	51.6	17.2	10.2	12.4	2.7	1.0	151,127	115
Off gas, solid/n-trad	76.3	20.4	1.8	37.7	23.6	5.5	26.1	4.0	1.3	90,416	81

* All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Water Heating & Programmable Heater Controls

Row percentages	H.W. tank has thermostat (%) Yes stat.	No stat.	Stat. not known	Homes with HWT	2003 EHCS HWT sample	Programmable heater controls (%) Celect system	Charge control Auto	Charge control Manual only	Controls not known	Total prog. heaters	2003 EHCS prog. ht sample
Total SW region	**64.6**	**34.3**	**1.1**	**1,528,341**	**1247**	**3.5**	**53.1**	**42.7**	**0.7**	**255,910**	**261**
Tenure											
Own with mortgage	65.1	33.8	1.1	654,633	387	4.3	40.5	55.2	0.0	70,685	41
Own outright	68.0	31.7	0.3	517,731	295	4.1	56.7	39.2	0.0	71,096	41
Private Rented	50.3	46.7	3.0	148,028	184	1.4	54.7	41.4	2.5	49,318	57
LA	62.5	36.3	1.2	101,138	180	0.0	64.4	35.6	0.0	24,533	45
RSL	67.0	31.2	1.8	106,811	201	5.7	60.1	32.9	1.3	40,278	77
Built form											
Detached	77.7	22.3	0.0	379,450	226	0.0	46.6	53.4	0.0	15,909	11
Semi-detached	63.2	36.0	0.8	339,760	286	3.3	45.8	49.1	1.9	35,814	38
Mid Terrace	57.9	40.8	1.4	237,101	203	3.2	45.2	51.6	0.0	45,782	33
End Terrace	65.5	33.1	1.5	171,916	153	0.0	61.8	38.2	0.0	26,498	26
Bungalow	63.4	35.0	1.6	215,658	171	6.7	63.9	27.8	1.5	37,638	48
Converted flat	46.0	48.3	5.7	43,823	45	6.8	48.5	44.7	0.0	22,755	24
Purpose-built flat	50.8	47.8	1.5	140,633	163	3.1	55.8	40.3	0.7	71,514	81
Fuel poverty											
Not in fuel poverty	66.9	32.1	1.0	1,407,761	1151	4.1	51.7	43.6	0.5	218,994	230
In fuel poverty	38.2	60.2	1.6	120,580	96	0.0	61.1	37.3	1.6	36,916	31
Vulnerable group											
Not vulnerable	61.6	37.1	1.4	430,477	322	2.1	47.7	47.8	2.5	70,914	62
In vulnerable group	65.8	33.2	1.0	1,097,864	925	4.0	55.2	40.8	0.0	184,996	199
DHS-TC											
Not fail on TC	72.4	26.5	1.1	1,071,874	826	3.0	59.4	37.6	0.0	63,991	67
Fails on thermal C.	46.3	52.7	1.0	456,467	421	3.7	51.0	44.4	0.9	191,919	194
Hard-to-Treat*											
Not hard-to-treat	69.5	29.4	1.1	964,262	717	0.8	56.6	42.1	0.5	111,036	101
On gas, solid wall	54.4	44.1	1.5	190,634	163	5.1	51.4	43.5		30,445	33
On gas, non-trad	61.1	37.8	1.1	53,504	73		34.9	65.1		3,986	8
Off gas, cavity wall	55.4	43.3	1.3	199,069	187	6.0	61.2	32.0	0.8	72,415	88
Off gas, solid/n-trad	58.0	42.0		120,872	107	5.7	30.8	61.8	1.7	38,028	31

* All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

Current Energy Efficiency Standards - Extent of Low Energy Lighting

Row percentages	Percentage of main rooms with low energy lighting* None	20 to <40%	40% to <60%	60% or more	Total households	2003 EHCS sample
Total SW region	**58.3**	**30.9**	**7.3**	**3.4**	**2,136,132**	**1757**
Tenure						
Own with mortgage	**65.8**	26.9	5.3	2.1	946,197	564
Own outright	50.5	34.8	9.7	5.0	677,024	392
Private Rented	54.9	36.0	5.5	3.6	227,356	280
LA	59.8	26.9	9.2	4.1	140,525	247
RSL	50.4	35.5	10.7	3.3	145,030	274
Built form						
Detached	59.4	33.4	5.2	2.0	446,796	268
Semi-detached	56.2	30.9	10.1	2.8	470,604	385
Mid Terrace	64.5	26.7	5.7	3.0	376,308	318
End Terrace	57.6	33.5	7.6	1.3	241,209	216
Bungalow	51.7	33.6	8.1	6.5	294,343	229
Converted flat	**66.2**	24.7	5.0	4.1	101,526	100
Purpose-built flat	55.9	29.5	8.3	6.3	205,346	241
Fuel poverty						
Not in fuel poverty	58.9	30.0	7.5	3.6	1,997,042	1645
In fuel poverty	49.8	44.3	5.0	1.0	139,090	112
Vulnerable group						
Not vulnerable	61.7	29.2	5.7	3.4	647,814	497
In vulnerable group	56.8	31.7	8.1	3.4	1,488,318	1260
DHS-TC						
Not fail on TC	58.8	30.2	7.9	3.2	1,543,413	1217
Fails on thermal C.	57.1	33.0	5.9	4.0	592,719	540
Hard-to-Treat**						
Not hard-to-treat	55.2	32.7	8.4	3.7	1,333,265	1020
On gas, solid wall	**67.4**	24.1	5.9	2.6	367,580	314
On gas, non-trad	52.1	34.0	11.9	1.9	66,480	91
Off gas, cavity wall	60.9	30.9	3.5	4.8	233,905	212
Off gas, solid/n-trad	63.0	31.0	4.8	1.1	134,902	120

* Based on maximum of five inspected rooms

** All dwellings with solid walls, of pre 1981 non-traditional construction or in a postcode with no gas supply.

ANNEX 3 – CURRENT ACTIVITY: INSTALLATIONS, ADVICE & ECONOMIC IMPACTS

Energy efficiency measures

There is no central register of energy efficiency measures installed regionally or nationally. Limited data is available for individual grant schemes, particularly for the Energy Efficiency Commitment. Current installation rates have been estimated from published installation data, cost data, and national replacement rates for measures such as boilers.

The following data sources have been used:

- Installation rates for Warm Front (2004 to 2005) in the West as supplied by EAGA.
- Yearly average installation rates for measures under EEC have been derived from published national data for EEC 1 i.e. 2002 to 2005.
- Fenestration Self-Assessment Scheme (FENSA) supplied national statistics for double glazing installations which have been applied pro-rata to obtain installation rates in the South West.
- Revision 2020. This report gave an annual turnover rate for domestic boilers of 6.7%[4]. This has been applied to the total number of boilers in the South West to calculate annual installation rates in the South West. The number of boiler installations that result from Warm Front and EEC have been removed from the total to avoid double counting.
- AFP (the Ace Fuel Prophet) tool has been used for cost data to quantify current investment in the energy efficiency sector, with the exception of central heating controls, CFLs and fridges which are based on a survey of large and small contractors undertaken for this project.

The table below shows the estimated annual level of energy efficiency installations in the South West, and the total installed cost of measures

Table 2: Current Annual Installation Rates for Energy Efficiency Measures in the South West

Measure	Total Measures	Installed Cost
Cavity Wall Insulation	28,229	£5,670,626
Loft insulation top up	23,164	£5,919,763
Loft insulation virgin fill	6,820	£1,583,850
DIY loft insulation	5,667	£240,828
Draught proofing	6,002	£600,153
Hot water tank Insulation	7,640	£152,797
Foam Insulated hot water tank	59	£11,800
Radiator panels	1,172	£2,344
External wall insulation	715	£6,285,911
Double glazing	89,534	£201,593,355

[4] Figure of 6.7% was based on an assumption that boilers are replaced once every 15 years.

Energy efficient cold appliances	89,103	£22,275,865
Energy efficient wet appliances	107,058	£26,764,468
A & B rated boilers	13,154	£13,153,827
None EEC & WF Boilers A & B rated boilers	100,234	£200,468,476
Central heating controls upgrade	71,321	£10,943,178
Night storage heaters	300	£450,000
Compact fluorescent lightbulbs	1,209,016	£12,090,157
Total	**1,780,788**	**£513,652,324**

Note:
Following the April 2005 revision to the Building Regulations all replacement boilers (with a few very limited exceptions) must now be high efficiency SEDBUK A or B rated appliances.

Renewable energy measures

Between the launch of Clear Skies in 2003 and the effective conclusion of the scheme at the end of February 2006, £934,110.00 of grant funding was approved for the installation of 1512 renewable energy measures for households in the South West.

As with energy efficiency measures there is no central register recording the number of renewable energy installations in the South West. It is probably reasonable to assume that for most of the building integrated renewable energy measures, few installations would have taken place without the intervention of grant funding.

Solar water heating (solar thermal) is the likely exception here as it is a more mature technology and a significant number of installations were already taking place annually prior to the introduction of Clear Skies. The Solar Trade Association (STA) estimate that the overall level of installations is twice the number being installed under the Clear Skies programme. To be conservative this analysis assumes a mid way point between these two figures

Photovoltaic panels were not covered under Clear Skies but under the Small Scale PV Demonstration Programme, administered by the Energy Saving Trust.

Between April 2002 and March 2006, 259 grants were awarded for PV systems in the South West with a total value of £1,916,250, a total installed capacity of 640kWp and an average grant value of £7400. (These figures apply only to stream 1 which is for systems between 0.5 and 5kWp. It is assumed that Stream 2 for installations between 5 and 100kWp will be exclusively taken up by non-domestic community scale applications).

The average installed capacity under Stream 1 is 2.47kWp. The average annual installation rate for PV systems is 65 installations per annum[5].
Applying the ratios for the number of measures installed nationally[6] to the total number of measures installed in the South West gives the following breakdown by technology and annual installation rates[7].

[5] Annual installation rates are an average of the number of measures installed over the 48 month duration of the project.
[6] Based on the percentage number of measures installed for each technology.
[7] Annual installation rates are an average of the number of measures installed over the 37 month duration of the programme.

Table 3: Current Annual Installation Rates for Building Integrated Renewables in the South West

Technology	Estimated number of measures installed in South West as a result of Clear Skies and PV grant scheme	Estimated average number of installations per annum
Solar Thermal	1295	630
Wind Turbines	57	18
Small Scale Hydro Turbines	4	1
Ground Source Heat Pumps	121	39
Biomass - Wood Fuelled Boilers	24	8
Biomass - Pellet Stoves	11	4
PV	259	65
Total	**1771**	**765**

Conservation areas and listed buildings

The criteria for the improvement model for the South West housing stock, assumes that where buildings are listed or in conservation areas, certain energy efficiency for example external wall insulation and renewable energy measures may not be installed.

For this reason it is necessary to estimate the number of dwellings that are listed, in conservation areas, or fall into one or both categories.

A detailed methodology of how this has been done is provided in Annex 3.

Within the model, key house types, based on age and built form have been assumed to have been individually listed.

In all, these account for 56,030 dwellings in the South West. This compares favourably with the actual number of listed dwellings in the region which is 56,461. A large proportion of these dwellings are in rural areas.

Estimating the number of dwellings likely to be in conservation areas has been undertaken by combining postal sectors covering the relevant parts of areas of obvious historic or architectural heritage, and postcode sector maps for the following places:

Bath, Blandford Forum, Bristol, Brixham, Castle Cary, Cheltenham, Dorchester, Exeter, Falmouth, Helston, Looe, Lyme Regis, Penzance, Salcombe, Salisbury, Shaftesbury, Sherborne, St Ives, Taunton, Totnes, Truro, Wells, Weymouth, Wimborne Minster.

An allowance was also made for areas which had 25 or more properties which the EHCS assessed of being the highest visual appearance.

After accounting for some overlap, these EHCS sub-samples account for a total of some 93,700 homes in conservation areas. As would be expected, there is some overlap between listed buildings and those in conservation areas. Across all urban areas in the South West, some 47% of listed buildings fall in conservation areas (which is compatible with the 46% estimated by Bristol City Council). However, in rural areas only 18% of the listed buildings are in conservation areas.

Overall, it is assumed that a little over 137,600 homes or some 25.6% of the total of 533,100 pre 1919 homes in the South West are either listed or located in conservation areas. These account for some 6.4% of the total housing stock in the region.

The figure of 137,600 of pre 1919 homes determined as either listed or falling in Conservation areas is compatible with the estimates in the 40% House Report (see Annex 3).

Baseline employment levels and GVA with the South West

Whilst employment data is easily obtainable for the South West region, the employment categories used by the government's statistical office do not easily match the energy efficiency and renewable energy measures being considered in this project.

Figures for building integrated renewables are taken from analysis undertaken by DTZ Pieda Consulting on behalf of Regen SW[8] within a wider study examining the impact of the renewable energy sector in the South West.

Their research estimates the GVA for all renewable energy measures to be just under £34million. The GVA of micro-renewables is estimated to be £3.5million with 150 people employed within the region. GVA represents the economic value of activity to the region and is defined as turnover minus the cost of bought in materials, components and services.

The table below shows the breakdown by renewable technology.

Table 4: Employment and GVA from the South West Renewable Energy Sector

Technology	Employment (FTE)	GVA (£ million)
Wind	390	£9.60
Biomass	330	£10.80
Marine Energy	110	£4.90
Hydro	80	£3.50
Micro-Renewables	150	£3.50
Other	70	£1.50
Total	1,140	£33.80

Source: Regen SW

[8] The Economic Contribution of the Renewable Energy Sector to the South West - Regen SW November 2005

Ecotech are currently carrying out a study for the Regional Development Agency assessing the region's approach to business resource efficiency. As part of this work they will be considering levels of employment and GVA contribution to the region's economy. Whilst their primary focus is on business, due to the overlap of sectors they will also identify the value and contribution from servicing the domestic sector as well.

However, in lieu of the more detailed work being undertaken across both business and domestic sector, the analysis in table 11 provides an assessment of current employment levels based on assumptions of labour required to deliver a range of individual measures[9].

Table 5: GVA and employment based on current installation levels

Measure	Total Measures	Labour/job (days)[10]	Installer (FTE)[11]	Plus ancillary staff[12]	Installed cost/ measure[13]	Total costs	GVA[14]	GVA/FTE
Cavity Wall Insulation	28,000	0.6	95	159	350	£9,800,000	£3,920,000	£24,500
Loft insulation top up	30,000	0.4	68	114	340	£10,200,000	£4,080,000	£36,000
Hot water tank Insulation	7,500	0.1	4	7	60	£450,000	£180,000	£25,500
Draught proofing	6,000	0.3	10	17	170	£1,020,000	£408,000	£24,000
External wall insulation	600	15	51	85	11,800	£7,080,000	£2,832,000	£33,500
Internal wall insulation	100	6	3	6	1,300	£130,000	£52,000	£9,000
Ground Source Heat Pumps	40	13	3	5	6,300	£252,000	£76,000	£15,500
Biomass boilers	10	8	0	1	6,000	£60,000	£18,000	£24,000
Solar water heating	630	6	21	36	2,300	£1,449,000	£435,000	£12,000
Solar PV	65	4	1	2	12,000	£780,000	£234,000	£95,000
Micro wind	20	2	0.2	0.3	2,000	£40,000	£12,000	£39,500
Total			**259**	**432**		**£31,261,000**	**£12,246,000**	**£28,500**

Some important issues of note include:

- The energy efficiency measures listed in table 11 provide a smaller sub set than those listed in table 8. Measures not included include glazing, appliances and boilers. These measures are delivered through mainstream supply chains e.g the supply of double glazing and energy efficient boilers are now

[9] Labour requirements per job derived from discussions with South West installers
[10] Labour requirements per job derived from discussions with South West installers
[11] Assumes 220 days in working year and a productivity rate of 80%
[12] Assumes within companies installing measures, 60% of staff are actually installers, the other 40% include administration, management, technical support/monitoring etc
[13] Installed costs based on average costs generated for installations within the South West from the modelling summarised in annexes 4 and 5
[14] Assumes GVA represents approximately 40 or 30% of total installed costs depending on the measure - based on a review of selected annual accounts and discussions with the sector

standard, and as such they could be considered to be not strictly part of the energy efficiency sector. Whilst it could be argued that high efficiency glazing should still be included, data on take up is not available. Other small scale measures such as radiator panels are also not included

- The employment figures in the micro renewables sector in table 10 suggest a total 150 employees in the region, far more than that suggested within table 11. However the DTZ study highlighted that just over 40% of companies were installers. In addition only a percentage of these company employees will be actually doing the installation work. Given that the companies will also be installing building integrated or micro renewables technologies in non domestic sectors, the figures in table 11 provide a reasonable comparison

This analysis relates to those companies involved in the installation of measures. It doesn't include companies involved in manufacture, supply of equipment, consultancy, advice or R&D. Within the DTZ study over 50% of employment within the region's renewable energy sector was in consultancy, R&D, manufacture and supply of equipment.

The following section provides an indication of the employment levels within another key part of the sector as part of a wider review of the provision of energy advice through the Energy Efficiency Advice Centre network.

Current provision of domestic energy advice

The primary source of energy efficiency advice for householders within the South West comes via the network of Energy Efficiency Advice Centres. Other sources of energy advice include the energy suppliers, local authorities and other housing providers. Increasingly the Energy Efficiency Advice Centres are working with a range of front line staff and mainstream advice agencies in order to encourage and support them in the provision of basic energy advice and signposting as appropriate, when working with householders.

All suppliers of gas and electricity within the domestic market are required to provide information and guidance on energy efficiency measures as a condition of their supply licence. Whilst the number of clients actually advised is not available regionally, enquiries suggest that in total, the three of the six major suppliers most active in the South West together advised less than 10,000 clients per year within the region. By way of comparison, the EEAC network within the region advised in excess of 80,000 clients in 2004/2005 via telephone and the provision of Home Energy Reports on completion of a Home Energy Check.

Energy Efficiency Advice Centres (EEACs) are a UK wide network part-funded by the Energy Saving Trust to provide free, impartial and expert advice to UK householders to help them to reduce energy use and save money in their homes. Most EEACs have developed service level agreements with local authorities in the areas they cover, in support of Home Energy Conservation and wider sustainability objectives.

EEACs provide freephone advice, press, media and marketing activities, and a wide range of energy awareness-raising work.

Energy Savings Trust (EST) have contracts with five independent organisations to provide EEAC services in the South West region. In the Dorset and Wiltshire territory, a sixth independent body acts as a sub-contractor to provide the EEAC service in Wiltshire.

EST is currently reviewing the network with a view to replacing it with a new network of Sustainable Energy Centres, with a wider subject and geographical coverage. These are currently being piloted in 3 areas of the UK.

The review of energy advice provision carried out on behalf of GOSW during October/November 2005 has provided the following information about EEACs in the South West:

Table 6: SW EEAC provider organisational details

Organisation	EEAC territory	Staff (fte) whole org.	Staff (fte) on sustainable energy	Domestic energy advice staff (fte) ***
Centre for Sustainable Energy	Bristol, Somerset, S. Glos	26	21	10
Community Energy Plus	Cornwall and Isles of Scilly	18.5	15	7
Dorset Energy Advice Centre	Dorset and Wiltshire *	5	3	3
Wiltshire Wildlife Trust	Wiltshire **	64.4	6.5	5
Severn Wye Energy Agency	Gloucestershire	15	13.4	10
West Country Energy Action Trust	Devon	9	8	8
Totals			**66.9**	**43**

* *data included by DEAC for Dorset only, to allow WWT to input Wiltshire data separately*
** *sub-contractor to Dorset Energy Advice Centre*
*** *estimated total for staff providing core EEAC service, Local Energy Support Team and outreach projects*

Table 7: EEAC one year activity levels 2004-5

EEAC	Phone enquiries to advice line	HEC reports delivered	Home advice visits	Presentations/ outreach events	Training sessions	Radio/t.v. appearances
Bristol, S. Glos Somerset,	2,894	15,984	28	77	11	9
Cornwall & Isles of Scilly	1,960	9,380	15	94	13	6
Dorset	*2,686*	*9,217*	*19*	*34*	*9*	*4*
& Wiltshire	*1,632*	*6,173*	*39*	*47*	*14*	*42*
Total	4318	15,390	58	81	23	46
Gloucestershire	4,689	15,642	105	95	28	46
Devon	4,334	9,734	108	83	30	2
Totals	**18,195**	**66,130**	**314**	**430**	**78**	**105**

Table 8: Funding for the delivery of EEAC service and outreach projects

	Estimated funding 2004-2005
Core funding for EEAC (EST)	£128,615
EEAC activity funding (EST)	£322,501
Local Energy Support Teams (EST)	£275,000
Local Authority service level agreements	£174,638
Total EEAC service	*£900,754*
Outreach projects - not including measure funding	
Private sector funding	£221,000
EST funding	£240,000
Other public sector funding	£645,000
Total Outreach projects- not including measure funding	*£1,106,000*
Total funding for EEAC service and outreach	**£2,006,754**
Total EST funding	£966,116
Total other public sector funding	£819,638
Total private sector funding	£221,000

The above funding levels are for 5 EEACs only as funding for the Dorset and Wiltshire EEAC is split between Wiltshire Wildlife Trust and the Dorset Energy Advice Centre

All the EEAC providers are non-profit organisations, and five of the six are registered charities. Most of the EEAC providers offer a range of other sustainable energy services beyond the core EEAC service, including advice services to social housing providers, research and consultancy, education, training, advice and project development in renewables and sustainable transport, strategy development, work with SMEs.

Four of the six EEAC providers (covering four of the five EEAC areas, excluding Dorset and Wiltshire) run a Local Energy Support Team with core funding from the EST. Local Energy Support Teams provide strategic support to stakeholders in the delivery of sustainable energy at a local level.

The organisations delivering the EEACs have added value to the core service by developing a range of outreach projects. All 6 have projects linked to health, and several have initiated schemes targeting the private rented sector and owner occupiers.

As well as promoting behavioural change, the EEACs typically make referrals to three types of grant/subsidy programmes for energy efficiency measures:

* Warm Front: government scheme for energy efficiency measures for vulnerable households. Some EEACs make as many as 1,000 referrals to Warm Front in a year with one reporting 2,500 referrals in 02-03
* EEC: Energy Efficiency Commitment, domestic sector energy saving targets to be achieved by fuel suppliers, set by OFGEM
* Local Authority private sector grants.

Some EEAC providers manage schemes to achieve a level of integration of these grant schemes at local level. Some projects exceed £1 million in value (including the capital cost of energy efficiency measures) and install thousands of energy efficiency measures on an annual basis.

Sustainable Energy Networks within the South West

The EST is currently piloting an approach that builds upon the work of the Energy Efficiency Advice Centre network to develop a number of Sustainable Energy Centres, operating as part of a Sustainable Energy Network. The pilots are taking place in the North East, Northern Ireland and East Anglia.

Under the Sustainable Energy Network (SEN) model the provision of an advice service (currently delivered through the Energy Efficiency Advice Centres) will be part of an integrated approach to changing consumer behaviour on a much larger scale, where each Sustainable Energy Centre will:

- Be tasked with the delivery of strategically defined regional carbon saving targets for the domestic sector in their territory. Such a role will involve supporting and co-ordinating the range of existing delivery agencies and filling any gaps in delivery as necessary.
- Provide an advice service that covers the use of renewable energy in homes and road transport as well as energy efficiency. This will operate as a high profile ‘one-stop-shop’ service that can directly link consumers to the range of delivery mechanisms for domestic scale sustainable energy, thereby making it easy and convenient for them to take action.
- Instigate effective local awareness raising activity that links seamlessly with national marketing activity, is integrated with local delivery mechanisms and thereby encourages the provision of a cohesive and compelling message to consumers on sustainable energy.

The ultimate aim of the SEN approach is to achieve a step change in consumers taking action to reduce carbon emissions through a more joined up and strategic approach to local delivery, providing an effective infrastructure for the integration of Government policy at the local level.

The pilots will be operating over the next year or so prior to a full roll out within England during 2007/2008. The EST are currently carrying out a consultation with the English regions around developing the SEN concept so that it will meet the needs of each region. Within the South West one regional consultation event has been held in partnership with the Government Office of the South West. Future discussions around how the SEN approach will be developed within the region will take place between the EST and the Housing Energy Steering Group. The Housing Energy Group was set up to oversee the development of this strategy, see section 5.9 for more details.

ANNEX 4 – MODELLING METHODOLOGY: INSTALLATION FORECASTS AND FUEL POVERTY ASSESSMENT

Summary

The energy improvement model determines the measures required to improve the housing stock in the South West Government Office Region. The model has been designed to produce outputs for the following four different improvement programmes, but can be readily set to examine any SAP average or target:-

1. Average SAP 65: this raises the average SAP of the stock to 65 by improving sufficient of the least efficient homes to a minimum SAP of 65, where economically feasible.
2. Target SAP 65: this improves all homes with SAP ratings of less than 65 to a minimum SAP of 65, where feasible.
3. Target SAP 80: this improves all homes with SAP ratings of less than 80 to a minimum SAP of 80, where feasible.
4. Fuel Poverty: this improves the homes of the fuel poor to target SAP 65 or target SAP 80 and determines the consequent reduction in fuel poverty numbers in 2003 and 2005.

For each improvement programmes, the model provides the following main outputs:-

- The type and number of improvement packages and individual measures required;
- The average and total programme costs of the required packages and individual measures.
- The savings in the energy requirements by fuel (in kWh/year).
- The consequent theoretical savings in carbon emissions (but not the actual kWh and carbon savings, taking account of the comfort factor).
- The distribution of the SAP ratings, before and after improvement.
- The breakdown of the above outputs by any EHCS variable e.g. by tenure, vulnerable group and fuel poverty status.

Main data sources

The model has three main data sources as follows:-

- ACE's Fuel Prophet (AFP): This provides improvement data for 21 generic dwelling types. These covers 6 built-forms (detached, semi-detached or end terraced, mid-terrace, flat, detached bungalow, and semi-detached bungalow), 2 construction types (cavity wall and solid wall) and 3 heating fuels (gas, electricity and coal). For each generic type, it generates for up to some 21 energy measures and packages of measures, the kWh saving for each fuel, the cost savings, the pay-back periods and the installation costs. Importantly, it determines the extent to which combining measures reduced the sum of the individual savings from each measure.

- The EEC savings Matrices: These provide savings for many more generic types. These cover 7 built forms (detached, semi-detached, end-terrace, mid-terrace, flat, detached bungalow and semi-detached bungalow), 2 to 3 different dwelling sizes per built-form, 2 construction types (cavity wall and solid wall); 5 heating fuels (gas, electricity, coal, oil and LPG) and different standards of existing insulation (e.g. 5 levels of existing loft insulation). For each generic type, the matrices give kWh savings for each fuel, but only for each individual measure. However, importantly they indicate the savings relative to dwelling size, for different levels of existing insulation and additionally for existing oil and LPG heated homes. The EEC_2 (2005–2008) matrices have been used in preference to EEC_1 (of Feb 2002), except where the latter provides more comprehensive data on the relationship between savings and dwelling size etc.

- The Latest (2003) EHCS: While the above two sources provide vital inputs, the core of the model is the latest English House Condition Survey. The 2003 EHCS provides comprehensive information on the dwellings and households at some 1,760 addresses in the South West, which are representative of and can be grossed to the region's housing stock. For the model, this SW sample has been categorised into 26 generic types. A separate primary generic type was used for every dwelling type which accounted for significantly more than 1% of the regions housing stock, the remaining types being grouped with the primary type which was closest to it in terms of its heating fuel, construction and built form.

In addition to the three main data sources described above some other data, for example, related to the Standard Assessment Procedure, BRE documentation on the EHCS fuel poverty methodology and savings data from Energy Saving Trust (EST) have also been used.

- Standard Assessment Procedure 2001 documentation: This provides the algorithms and fuel prices which enable the energy savings required in each of the 2003 EHCS sample dwellings to be determined from their SAP ratings.

Using SPSS, a computer programme (of over 8,000 lines) has been written to link the required data from each of the data sources and to determine the energy measures, energy savings and installation costs required in each of the 1,760 EHCS sample dwellings and thereby in the South West regional housing stock as a whole.

Details of Generic Types

For compatibility with the energy savings data provided by both ACE's Fuel Prophet and the EEC savings matrices, the housing stock in the South West is categorised into six basic dwelling types - detached houses, semi-detached or end terraced houses, mid-terraced houses, detached bungalows, semi or other attached bungalows, and flats. For the same reason, these types are further subdivided by their form of construction, into those built with cavity walls or modern timber frames and those with solid wall or of older non-traditional construction.

To be compatible with Fuel Prophet, the dwelling types are also subdivided by whether their main heating fuel is mains gas, electricity or coal (or other solid fuels). However, because the EEC matrices additionally give savings for oil and LPG, these fuel categories are extended in the SW model to five fuel types. (Although the number of dwellings in the South West using LPG is small, these are not combined with oil-fired dwellings, due to the much higher price of LPG used in the SAP calculations.) Each dwelling category is given an acronym according to it basic type, construction and heating fuel as shown in the key below.

Table 9: Key to dwelling types

1st part of acronym	Bd	Detached bungalow
	Bs	Semi-detached (or end terrace) bungalow
	D	Detached house
	F	Flat (all types)
	S	Semi-detached (or end terrace) house

	T	Mid-terrace house
2nd part of acronym	C	Cavity wall or modern timber frame
	S	Solid wall or older non-traditional construction
3rd part of acronym	C	Coal or other solid fuel heating
	E	Electric heating
	G	Gas fired heating
	O	Heating oil
	P	LPG
e.g.	DCG	Detached house with cavity walls and gas-fired heating

The 2003 EHCS sample for the South West includes a total of 53 dwelling categories, not all of the sixty possible combinations of 6 dwelling types, 2 constructions and 5 heating fuels being present in the sample. However, the grossed number of dwellings in each category in the region varies considerably, ranging from over 421,700 or 19.7% of the total stock for semi-detached or end terraced dwellings with cavity walls and gas-fired heating to only 501 dwellings or 0.02 % for flats with cavity walls heated by solid fuel.

The energy savings, fuel cost savings and improvement costs for each of the relevant energy measures and packages of measures are separately computed for each of the dwelling categories that include more than 28,000 dwellings or 1.3% of the South West stock. The same detailed analysis is undertaken for all categories accounting for more than 1% of the stock that cannot be easily combined with another category, such as flats with solid walls and electric heating. Twenty two ‘primary’ dwelling categories are treated in this most detailed and accurate of ways, these accounting for a total of over 1.9 million dwellings or 90% of the regions housing stock.

In the remaining 31 dwelling categories, each of which includes no more than 28,000 dwellings or 1.3% of the stock, energy and fuel cost savings per square metre and improvement costs per square metre are assumed to be the same as those in a similar dwelling type. However, in these categories, the total savings and improvement costs are still adjusted for the particular floor area of each sample dwelling, as in the 22 primary dwelling types. How these less frequent dwelling categories are combined with the primary dwelling types is shown in Table 2. In total these account for just under 216,000 dwellings or some 10% of the South West’s housing stock.

Table 10: Generic types used in SW Energy Improvement Model

	Primary types		**Less frequent types (< 28,000 or <= 1.3% of SW stock)**								**Total Hholds**	
	Type	Hholds	Type	Hholds	Type	Hholds	Type	Hholds	Type	Hholds	Hholds	%
1	SCG*	421,773									421,773	19.7
2	DCG*	302,949									302,949	14.2
3	TCG*	161,265									161,265	7.5
4	TSG*	139,843									139,843	6.5
5	BdCG*	133,714									133,714	6.3
6	BsCG*	43,969									43,969	2.1
7	SSG*	130,856	BsSG	2,777							133,633	6.3
8	DSG*	27,718	BdSG	10,014							37,732	1.8
9	FCG	119,269									119,269	5.6

10	FSG*	68,370									68,370	3.2
11	FCE	90,211									90,211	4.2
12	SCE*	50,012	BsCE*	24,840	BdCE*	13,833	DCE*	7,532			96,217	4.5
13	TCE*	28,421									28,421	1.3
14	SSE*	30,101	TSE*	25,821	DSE*	10,454	BsSE	1,589	BdSE	742	68,707	3.2
15	FSE*	26,498									26,498	1.2
16	SSC*	16,043	TSC*	11,552	DSC*	6,978	BdSC	3,655	FSC	725	38,953	1.8
17	SCC	11,818	Bd/sCC	11,297	TCC	4,962	DCC	2,789	FCC	501	31,367	1.5
18	DCO	44,041	SCO	27,833	TCO	2,068					73,942	3.5
19	BdCO	28,998	BsCO	1,241							30,239	1.4
20	DSO	33,217	SSO	21,755	BdSO	3,542	BsSO	1,964	FSO	1,298	61,776	2.9
21	DCP	5,290	BdCP	5,299	BsCP	2,701	SCP	1,622	TCP	1,130	16,042	0.8
22	DSP	5,828	BdSP	4,168	TSP	1,246					11,242	0.5
	Totals	**1,920,204**								**215,928**	**2,136,132**	**100.0**

* Generic types uses in Fuel Prophet

Energy savings and installation costs are computed separately for each of the 14 primary generic dwelling types used in ACE's Fuel Prophet (AFP) – i.e. those with an asterisk in the second column of Table 2. Despite combining similar types such as semi-detached and end terraced dwellings and non-traditional walls with solid walls, some 21% of the housing in the South West is not covered by the AFP generic types. These include all cavity wall houses heated by solid fuel, all flats with cavity walls and all dwellings with LPG and oil fired heating. However, as already mentioned, the EEC Matrices do provide energy savings for these types and this data are used to modify the AFP energy savings in these cases.

Determining the required cost savings

<u>BREDEM based floor area</u>

As the energy savings are related to the floor area, the first task is to determine the floor area for the dwelling as specified in the Building Research Establishment's Domestic Energy Model (BREDEM). The 2003 EHCS dataset only gives the "useable floor area" for the dwelling, excluding stairwells etc, but this is not the same as the floor area as required by BREDEM, which is concerned with the total volume of the dwelling. However, the BREDEM area can be calculated from the following 2001 BREDEM-12 algorithms for the energy requirement for lights and appliances, as these only depend on the floor area (TFA) and the number of occupants (Occ).

Algorithm 1: Lights and Appliances

Ela(GJ/yr) = 4.47+(0.0232*TFA*Occ) for TFA*Occ<710
Ela = 11.98+(0.0146*TFA*Occ)-2.78*10**-6*(TFA*Occ) for 710<TFA*Occ<2400
Ela = 31.01 for TFA*Occ>2400

The lights and appliance costs are given by the 2003 EHCS fuel poverty dataset and the number of occupants in 2003 is also known, as is the price of electricity for each dwelling.
Thus, using the above algorithms, the BREDEM area is calculated for each dwelling in the 2003 EHCS sample.

Existing and required cost savings

The SAP rating of a dwelling is an index of the unit cost of heating that dwelling to a set standard and assuming a standard location. The current standardised heating costs for each particular EHCS dwelling is given from the existing SAP rating and the BREDEM based floor area (TFA), using the BREDEM-9 (SAP) algorithms below:-

Algorithm 2: Heating costs from SAP rating

Energy cost factor (ECF) = 10**((97 - SAP)/100).
Heating costs = (ECF*(TFA+45)+30)/1.05.

The minimum energy and cost savings required to increase the SAP rating of the dwelling to 65 or above or 80 or above can be determined by simply substituting the existing SAP rating with 65 and 80 in the above algorithms. This provides the new heating cost and subtracting the existing heating cost therefore gives the required cost saving (in £/year).

Fuel poverty

Determining the required cost savings to lift a household out of fuel poverty is more complex, as unlike SAP these relate to total fuel costs for different heating regimes, which are climatically corrected, and based on different fuel prices to those used in either SAP or AFP. However, the fuel poverty related heating costs can be determined for each household from the 2003 EHCS fuel poverty dataset. It is also reasonable to assume that the relationship between fuel poverty and SAP related heating costs will remain the same both before and after improvement.

It is therefore possible to determine the fuel poverty related heating costs after improvement and, with improvements currently limited to heating measures, to also determine the total fuel costs after works. For a household to have been lifted out of fuel poverty, this will need to be no more than a tenth of the households full income, as also determined from the 2003 EHCS.

Existing fuel poverty after improvement

The average and target SAP 65 and target SAP 80 programmes all generate just the heating (space + water heating) cost for each sample dwelling after improvement. As mentioned above, these are the standardised SAP heating costs and are not those used to calculate fuel poverty. However, assuming that the relationship between fuel poverty and SAP related heating costs remains the same both before and after improvement, the fuel poverty related heating costs after improvement can be calculated from the algorithm:-

Algorithm 3: Relationship between SAP and fuel poverty fuel costs

$$\text{New FP heating costs} = \text{New SAP heating costs} \times \frac{\text{existing FP heating costs}}{\text{existing SAP heating costs}}$$

As all improvements are heating related, the total fuel poverty fuel cost after improvement can be determined by simply adding the existing cooking and lights and appliances cost to the new heating cost produced by this algorithm. The new total fuel cost can then be related to the household income to determine whether the household is still in fuel poverty after the improvements have been applied.

Fuel poverty at Q4 2005

Since 2003, the number of households in fuel poverty has increased significantly due to fuel price rises, and in the current model these numbers are determined by simply inflating the fuel poverty related fuel costs for each fuel to the 4th quarter of 2005 using DTI's quarterly fuel price index, corrected for inflation. Thus, the incomes of those in or near fuel poverty, being largely dependant on index linked benefits, are assumed to have remained generally level in real terms.

The DTI *Retail price index: fuel components, relative to GDP deflator*, was first used to determine the average % increase in fuel prices in real terms for mains gas, electricity, solid fuels and oil/LPG:-
1) from Q4 2001 to Q3 2002, to Q4 2005; and
2) from Q4 2002 to Q3 2003, to Q4 2005, the latter being the latest available available for the price index.
For every sample address in the 2003 EHCS, the main fuel used was also determined for (a) space heating, (b) water heating, (c) cooking and (d) lights and appliances.

The 2003 EHCS Fuel Poverty dataset was then used and, depending on whether the sample dwelling came from the 2002-03 or 2003-04 sample and the type of fuel, the results from the above were used to update the existing fuel poverty related costs for space heating, water heating, cooking and lights and appliances to Q4 2005. The four fuel cost components were summed to give a new total fuel cost (at 2003 prices) for each household at Q4 2005.

Finally, the total new fuel costs for each dwelling, as determined above, was then related to the existing 2003 full income of the household to determine whether the household was in fuel poverty at Q4 2005 before any improvement work.

To determine whether the various improvement programmes were sufficient to lift a household who was fuel poor at Q4 2005 out of fuel poverty, the same procedure was used as for the existing fuel poor in 2003. The new fuel poverty related heating cost was determined from the new SAP heating cost using Algorithm 3 above. The total new SAP related fuel cost was then calculated by again adding the cooking and lights and appliance costs, but only after these had now been inflated to account for the increased fuel prices since 2003. This new total fuel cost (at 2003 prices) was finally related to the household income to determine whether the household was still in fuel poverty after the improvement programme.

Determining the energy savings and costs from each measure

The next main stage is to determine, the savings provided by each measure, where such measures are appropriate, and the cost of each measure for each sample EHCS dwelling. For each of the 26 primary generic types in the 2003 EHCS, all the potentially relevant measures and packages of measures provided by AFP are determined. The energy measures and packages of measures used are based on those used in Fuel Prophet. However, as SAP is only concerned with heating costs, AFP measures that provide electricity savings for lights and appliances such as micro wind turbines and solar photovoltaic panels, including those that provide both types of saving, such as micro CHP, are not considered. (With CHP, AFP does not distinguish between the savings on heating and on power).

For the most common generic type, semi-detached and end-terraced houses with cavity walls and gas fired heating, a total of 13 target measures or target packages are used. For the generic types having solid walls and/or without gas heating the list of potential measures and packages, which the model chooses from, is much greater than 13. However, as the model omits the individual measures in any particular package where the sample dwelling is already satisfactory in that respect, for all generic types, the actual number of measures and combination of measures used in practice is far greater still. In short, the measures used are tailored to the particularly needs of each individual dwelling, taking account of its existing heating and insulation standards.

The gas and electricity prices used in Fuel Prophet are different from those used in calculating the SAP rating in the 2003 EHCS. Consequently, all savings resulting from each measure and each combination of measures are initially determined in terms of required energy savings (kWH/year).

For each insulation measure, how the energy savings varied with the level of any existing insulation was determined from the appropriate EEC-2 matrix. The standard savings provided by AFP was then adjusted accordingly to the particular existing insulation present in each EHCS sample dwelling, relative to that specified by AFP for the same generic type. For all measures, how the fuel savings related to the floor area was similarly determined from EEC-2. The energy savings provided by AFP for each fuel was then also adjusted to the particular floor area of each sample dwelling, relative to that of the standard AFP generic type. Also with reference to the data provided by EEC-2, the energy savings from AFP were adjusted for each measure where the EHCS showed the dwellings existing main heating fuel to be oil or LPG. Using the savings data provided by AFP, further adjustments were made to account for any reduction in savings caused by the measures being applied in combination rather than individually.

In this way, for every relevant heating and insulation measure and every package of measures, the potential saving for each fuel was determined for each individual dwelling in the EHCS sample, depending on its generic type, its specific floor area and type and level of existing insulation. As the energy requirement for gas heating includes a significant proportion of electricity (for the circulation pump etc), the cost saving is determined by multiplying the proportion of the total kWh saving for gas and electricity by the relevant fuel prices for gas and electricity used in the SAP calculations. Having determined the potential kWh saving for each fuel for each measure or package, these were converted into total cost savings per package by applying the standardised fuel prices (converted to £/kWh) used in the 2001 Standard Assessment Procedure. (This is the version of SAP used in the 2001 EHCS.)

Like the energy savings, the installation costs of the measures and packages were also based on the cost data in AFP. Depending on the type of measures applied, a proportion of the standard AFP costs was adjusted to account for the size and any existing insulation in each EHCS sample dwelling, after allowing for an appropriate set charge to cover the installer's overheads etc.

Detailed determination of the savings and costs for each measure

As previously mentioned, the savings are computed separately for each generic dwelling type. However, the methodology is detailed below for the most common AFP generic type found in the South West stock – Semi-detached and End Terraced houses with cavity walls and gas fired heating (SCG) – these accounting for nearly 20% of the regional stock.

Draught proofing (DS)

Draught proofing is assumed to be required only for single glazed windows and doors. The 2003 EHCS window based file is aggregated to household level and the proportion of single glazed windows in each dwelling determined. The 2005-08 EEC matrix shows the saving from draught proofing to be directly proportional to the total floor area. AFP gives a total saving of 1000 kWh/year in the standard SCG dwelling type and this is, therefore, adjusted according to the actual floor area in each sample dwelling. The saving is also adjusted for the proportion of single glazed windows, but with reference to the assumption in AFP that 50% of the windows are already double-glazed.

In the standard AFP dwelling, 97.2% of the energy saving from draught proofing is from gas and the remaining 2.8% from electricity. The cost saving in each sample dwelling is determined by applying these proportions to the adjusted total kWh saving and applying the relevant gas and electricity prices used in the 2003 EHCS SAP calculation.

Like the energy saving, the installation cost of draught proofing is assumed to relate to the proportion of windows draught proofed and the total floor area, the latter affecting the size of the windows. However, only 80% of the standard cost provided by AFP is adjusted for these factors, 20% being assumed to be the fixed cost of such work.

Loft insulation (LI)

Loft insulation, including top-up insulation, is limited to dwellings having existing loft insulation of below 125 mm. In the standard AFP dwelling of 85 m^2, the energy saving is based on topping up the existing 100 mm of loft insulation to 270 mm. The EEC matrix shows the saving from loft insulation to be directly proportional to the total floor area and also provides the factor by which the saving needs to be increased where there are existing insulation levels below 100 mm (i.e. no insulation, 25 mm, 50 mm and 75 mm). The saving rapidly declines as the existing insulation gets thicker, topping up insulation of 125 mm or more being not particularly cost effective. Using this information, the saving of 805.55 kWh/year provided by AFP is adjusted according to the actual floor area and level of existing loft insulation for each EHCS sample dwelling in the South West Region.

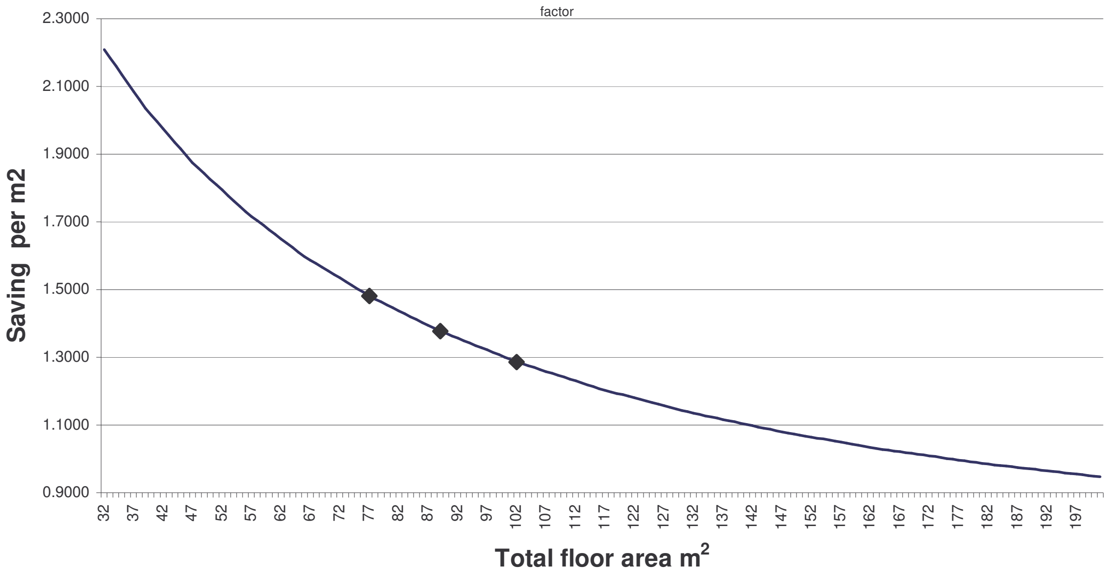
For loft insulation, the AFP shows 96.6% of the total energy saving to be from gas and 3.4% from electricity and these proportions are applied to the total saving determined as above. This breakdown is then related to the SAP gas and electricity prices to give the cost savings from loft insulation in each sample dwelling.

For topping up the insulation from 100 mm to 270 mm, 20% of the cost of £235 is assumed to be fixed and the remainder is adjusted according to the floor area of the dwelling relative to that of the AFP standard type. However, where the dwelling has no loft insulation or less than 100 mm, the cost is also inflated in proportion to the additional thickness of insulation required.

Cavity wall insulation (CWI)

All totally un-insulated cavity walls are assumed to be suitable for cavity insulation, unless the house is in a severely exposed location. Unlike draught proofing and loft insulation, the EEC matrix shows that for semi-detached dwellings the relationship between the savings from cavity wall insulation and floor area is not linear, the saving per m^2 falling progressively with increasing dwelling size. However, an extrapolation/interpolation curve has been constructed from the known three points (Figure 1 below) and from this the energy savings determined for each of the 2003 EHCS sample dwellings. However, the EEC matrix also indicates that for all sizes of property the savings from CWI in post 1976 dwellings is only some 59% of the savings in earlier dwellings. The nearest EHCS age category gives post 1974 dwellings and the savings based on AFP (which assumes a U value of 1.5 typical of pre 1976 wall construction) is therefore reduced by the equivalent percentage in these later dwellings.

Figure 1: Extrapolation/Interpolation curve of CWI savings per m² by total floor area



Fuel Prophet indicates that 96.8% of the energy saving from cavity wall insulation is from gas and the remaining 3.2% from electricity. The cost saving is determined by applying these proportions to the adjusted total kWh saving for each sample dwelling and applying the relevant gas and electricity prices used in the 2003 EHCS SAP calculation.

To determine the cost of cavity wall insulation in each sample dwelling, the cost of £300 for insulating a 85 m^2 semi-detached house, as given by AFP, is adjusted relative to the actual floor area of each dwelling, after first deducting 20% of the cost to cover fixed overheads etc.

Hot water tank insulation (HWI)

In Fuel Prophet, the energy saving from hot water cylinder insulation is not recorded separately. However, this can be determined by comparing the total saving from the main AFP insulation package, which comprises cavity wall insulation, loft insulation, draught proofing, compact fluorescent lights and hot water cylinder insulation, with the separate savings from the first four items. However, in AFP no net energy (kWh) saving is recorded for CFLs.

When combined, however, the total saving from insulation measures is slightly lower than the sum of each separate saving. For the AFP packages of CWI with LI, the actual savings is 99.2% of the sum of the separate savings, and this reduction is assumed wherever just insulation measures are combined. (A reduction of a similar order is recorded where CWI, LI and DG are combined). This reduction is applied to CWI, LI and DS in the main insulation package, giving a combined and separate saving for hot water cylinder insulation of 90.22 and 90.95 kWh/year respectively. (Table 3) This AFP derived saving is for a hot water cylinder of only 80 litres with 120mm of existing jacket insulation in a 85 m^2 semi-detached house.

Where dwellings have a hot water cylinder, the EHCS records three cylinder sizes, 450x900mm (120 l), 450x1050mm (140 l) and 450x1500mm (210 l), whether the existing insulation is foam or a jacket and bands the insulation thickness into 7 levels, including no insulation. The saving is assumed to be proportional to the surface area and the type and thickness of the existing insulation. It is assumed to increase with lower levels of existing insulation to the same extent as shown by the EEC Matrix for loft insulation, but with the savings being less in the case of foam insulation than for the same jacket thickness. Using this data, the energy saving for hot water cylinder insulation is calculated for each sample dwelling.

Table 11: Reduction in savings arising from combining insulation measures

Savings kWh/year	**CWI**	**LI**	**DS**	**CFLs**	**HWTI**	**Sum**	**Actual**
Separate savings	6000.00	805.55	1000.00	0	?		
CWI and LI	6000.00	805.55				6805.55	6750.00
CWI, LI, DS & HWTI	5952.00	799.11	992.00	0	90.22	7833.33	7833.33
Separate savings	6000.00	805.55	1000.00	0	90.95	7896.50	7833.33
Reduction factor	for all insulation combined – 0.8%						

As AFP does not give any separate data for hot water cylinder insulation, the breakdown of the savings between gas and electricity is assumed to be the same as for loft insulation. On this assumption, the cost savings are again calculated by applying the fuel prices used to calculate the SAP ratings in the 2003 EHCS.

The cost for an insulation jacket for the standard AFP dwelling is assumed to be £54, this being the cost given by EST for calculating savings and payback periods. In the EHCS sample 60% of the cost is adjusted for the actual size of each hot water cylinder, the remaining 40% being the fixed sum of installing this single item.

Double glazed windows (DG)

As with draught proofing, double-glazing is applied only to the windows in the dwelling that are still single glazed. The EEC matrix shows the saving from double-glazing to be directly proportional to the total floor area. AFP gives a total saving of 2035.55 kWh/year in the standard dwelling type and this is, therefore, adjusted according to the actual floor area and proportion of single glazed windows in each sample dwelling, again allowing for the AFP assumption that 50% of the windows are already double-glazed.

In the standard AFP dwelling, 96.4% of the energy saving from double-glazing is from gas and the remaining 3.6% from electricity. The cost saving in each sample dwelling is determined by applying these proportions to the adjusted total kWh saving and applying the relevant gas and electricity prices used in the 2003 EHCS SAP calculation.

Like the energy saving, the cost of double-glazing is assumed to relate to the proportion of windows double glazed and the total floor area, the latter affecting the size of the windows. However, only 80% of the standard cost provided by AFP is adjusted for these factors, 20% being assumed to be the fixed cost of such work.

The actual modelling did not in the end assume any double glazing due to its low cost effectiveness, double glazing is unlikely to be installed on energy grounds alone. The modelling did however substitute draught proofing wherever there was single glazing, generating less than half the savings of double glazing. Whilst this has the affect of underestimating the overall potential savings, the affect is minor and does not affect the overall conclusions outlined within sections 3 and 4.

Condensing boilers (CB)

Condensing boilers are assumed not to be required where the existing boiler is no more than 5 years old or is already a condensing boiler or CHP system. As for most insulation measures, the EEC Matrix shows the savings from new heating appliances to be directly proportional to the floor area. The total energy saving of 5,555 kWhs is therefore adjusted to account for the difference in total floor area between the 2003 EHCS dwelling and that of AFP's generic dwelling type.

For condensing boilers, 10% of the total energy saving is from electricity and 90% from gas. The total cost saving is again determined, using these proportions with the adjusted total energy saving and the relevant electricity and gas prices.

For condensing boilers, AFP provides a discounted installation cost of £1000. As the cost of installing a single new boiler is likely to less dependent on the size of the dwelling than installing insulation, 40% of this cost is assumed to be constant, with just 60% varying with the floor area and covering the cost of the larger boiler size etc.

Ground source heat pumps (GSHP)

Determining the energy savings for ground source heat pumps is somewhat more complex than for most other energy measures. With the installation of a GSHP, the energy from gas and standard tariff electricity required by the existing heating system is totally replaced by a new requirement for on and off peak electricity. For this measure, AFP shows the gas saving to comprise the whole of the existing gas consumption (22,000 kWh), adjusted to account for the actual floor area of the sample dwelling. The electrical saving comprises the saving on standard tariff electricity (3,722 kWh) less the new requirement for on peak (3,278 kWh) and off-peak electricity (5,806 kWh), after again adjusting these figures for the different floor area of the EHCS sample dwelling. In short, the net saving on electricity is negative in this case.

The total cost saving is determined by applying the standardised fuel prices for gas, standard tariff, on-peak and off-peak electricity used in the SAP calculation to the above consumptions and also allowing for the differences in the (SAP defined) heating related standing charges between the old and new fuels.

As with condensing boilers, 40% of the AFP installation cost of £5,075 is assumed to be fixed with the remaining 60% depending on the size of the dwelling, and being adjusted to the particular floor area of each sample dwelling.

Solar Hot Water (SHW)

Although not covered by the EEC matrix, the savings from solar hot water installations are assumed to be directly proportional to the floor area, as for other heating appliances. Thus, the standard saving for the generic type of 1,694 kWh/year is adjusted to reflect the size of each particular dwelling. The cost savings is determined by multiplying this adjusted saving by 0.013464, Fuel Prophet showing the savings gained by installing solar water heating to come from gas alone. As with other heating measures, just 60% of the base installation cost of £2,475 is assumed to vary with the size of the dwelling.

Detailed determination of the savings and costs for each package of measures

To achieve the required savings, the above measures frequently need to be applied in combination in a package of measures. However, as already shown in Table 2 above, when measures are combined, the total energy saving is not necessarily the sum of the individual savings. While combining insulation measures results in little if any reduction in the total energy saving, this is not the case when heating and insulation measures are combined. This is because a new boiler or heat pump, being more efficient, will produce the same amount of heat for less cost and, thus, the savings to be had from insulating the dwelling against heat loss will be less. When combined with insulation, the saving from a new boiler or heat pump will remain the same, but the saving to be had from the insulation or insulation package will fall significantly.

Cavity wall with loft insulation (CWI + LI)

For each sample dwelling, the total saving from this package is determined by simply adding the saving from each measure and applying the marginal reduction factor shown by AFP (of 0.8%). However, the split between gas and electricity savings (96.7% and 3.3% respectively) and consequent cost saving is determined as shown by AFP for the particular package. As with Fuel Prophet, the cost of the package is determined by summing the cost of the two measures.

AFP insulation package (INSC)

For this particular generic type, the other insulation only package used is the AFP insulation package (INSC) of cavity wall and loft insulation, draught proofing and hot water tank insulation. Again, the total energy saving from this package is determined by adding the savings from each measure and applying the small reduction factor; omitting the savings from any measures where the dwelling already reaches a satisfactory standard. For the package, the division between gas and electricity savings and consequent cost saving is also determined from the AFP data. The total installation costs are determined in a similar way to the energy savings.

Condensing boiler with insulation package (CB + INSC)

Fuel Prophet shows the combined energy saving from a condensing boiler and the insulation package (INSC) to be 11,916.67 kWh/year. However, as the saving from the condensing boiler alone is 5555.56 kWh/year, the saving from the insulation package when combined with the new boiler must be 6,361.11 kWh/year. This compares with a total saving of 7,833.33 kWh when only the installation package is used (Table 4), indicating a savings reduction factor for this combination of some 19%. Consequently, the energy saving for the total package can be calculated by adding the savings from a condensing boiler to those for the insulation package as already determined, but as now reduced by some 19%. The model so adds up and reduces the savings as already determined rather than using the total combined saving as shown by AFP, as the former, being built up from the individual measures, already accounts for any nil savings resulting from measures already in place.

Table 12: Reduction in savings arising from combining measures (CB + INSC)

Savings kWh/year	**CB**	**CWI**	**LI**	**DS**	**CFLs**	**HWT**	**Insul.**	**Total**
Separate savings	5555.56	6000.00	805.55	1000.00	0	90.95	7896.65	
Insul. combined	5555.56	5952.00	799.11	992.00	0	90.22	7833.33	
All combined	5555.56	4833.36	648.92	805.56	0	73.27	6361.11	11916.67
Reduction factors	for insulation combined – 0.8%				for CB + insulation combined – 18.8%			

The distribution between gas and electricity savings for this particular package is shown by AFP to be 92.3% and 7.7% respectively. These percentages are applied to the total combined saving and multiplied by the relevant SAP based gas and electricity prices to give the total cost saving.

As with the energy savings, the installation cost for the package is also determined by adding together the cost for a condensing boiler and for the insulation package (INSC) as already determined. Being based on the cost of each individual measure, this again ensures that the cost of any measure (generally included in the package), where the particular dwelling already meets a satisfactory standard, is omitted from the total cost.

Condensing boiler with cavity wall insulation (CB + CWI)

A further advantage of basing the total savings and installation costs on the sum of the individual measures, is that it allows some combinations of measures to be used that are not covered by Fuel Prophet, such as CB and CWI. In these cases, the distribution between the savings in gas and electricity are assumed to be the same as similar combinations in AFP – for example, for CB + CWI being taken to be the same as for CB and INSC.

Condensing boiler with cavity wall and loft insulation (CB + CWI + LI)

The same distribution of gas and electricity savings is assumed for CB combined with both cavity wall and loft insulation. Otherwise, the energy savings, cost savings and installation costs for this and the previous package are determined in the same way as for all other packages, as already described.

Ground source heat pump with insulation package (GSHP + INSC)

As with a ground source heat pump alone, determining the energy saving for a GSHP combined with the standard insulation package is more complex than usual. The savings on gas and standard tariff electricity are the same as for a GSHP alone, these fuels being totally replaced. However, AFP shows that the addition of the insulation package now decreases the required new consumption on on-peak and off-peak electricity to 3000 kWH/year and 4083.33 kWH/year respectively.

The total cost saving is again determined by applying the relevant fuel prices used in the SAP calculation to the above consumptions, after adjustment for the size of the dwelling, and also allowing for the differences in the heating related standing charges between the old and new fuels.

The installation cost is calculated simply by adding the cost of a GHSP to the cost of the insulation package, as already determined for the particular dwelling.

GSHP with insulation package and solar hot water (GSHP + INSC + SHW)

The final, most expensive package used with this generic type comprises the previous combination of measures with the addition of a solar hot water system. The energy savings for this package is determined by simply adding the saving provided by a solar hot water insulation, as already computed, to the savings from the previous package, after first reducing the former to account for the much more efficient GSHP. The total installation costs are similarly determined by adding the cost of solar water heating to the previous package costs.

Detailed methodology for other generic types

In principle, the methodology for the other generic types is the same as that described above for semi-detached and end terraced houses with cavity walls and gas fired heating. However, the detail is significantly different in a number of ways.

Firstly, a number of different measures need to be considered, such as internal and external wall insulation for solid wall dwellings and switching to gas heating where the heating is not gas-fired but the area has a gas supply. Where there is no gas supply or the supply is likely to be remote (as indicated by the location and plot data in the EHCS), the installation of oil fired condensing boilers or biomass heating is considered. An LPG fired condensing boiler is also considered, but only where the dwelling already has an LPG boiler and bulk storage tank.

Even for the same measures and packages, however, each different AFP generic type produces:-

- different energy (kWh) savings for each measure or package;
- different distributions between savings in gas and electricity; and
- different reductions in savings due to the same combination of measures;
- In AFP, detached, mid terraced and flatted dwellings all have different floor areas, necessitating a different adjustment in the savings to account for the actual floor areas of each sample EHCS dwelling;
- They also have different existing insulation standards, hot water cylinder sizes etc, also requiring the adjustments for the existing standards in the EHCS sample dwellings to be modified for each type;
- As with the energy savings, the installation costs of energy measures and packages of measures provided by AFP also varies with each generic type. Consequently, the computer programme is also modified for each type to cover the different base costs used.

Similarly, the ECC Matrix also shows important differences between different generic dwellings types:-

- The factors by which the energy saving increases with reducing levels of loft insulation varies with the built form;
- The factor by which the energy saving from cavity wall insulation decreases in post 1976 dwellings also varies by dwelling type;
- The built form of the dwelling also occasionally changes the relationship between dwelling size and savings from particular measures. For example, for detached dwellings, the EEC matrix shows the savings from cavity wall insulation to be directly proportional to the floor areas, unlike the situation in semi-detached dwellings.

Protected buildings

To ensure that the energy improvement model allows for the preservation of historic buildings, and does not propose, for example, external wall insulation for dwellings in Georgian Bath, all dwellings that are likely to be listed or in conservation areas are first determined.

<u>Listed buildings</u>

The following dwellings in the 2003 EHCS sample are assumed to be individually listed:-

1. Pre 1850 dwellings with thatched roofs.
2. Pre 1850 dwellings with cobb walls.

3. Pre 1900 traditional timber framed dwellings
4. Pre 1900 dwellings with original shiplap boarding or wall tiling.
5. Pre 1850 converted flats with pointed masonry walls and above average room sizes.
6. Pre 1850 houses with pointed masonry walls and above average floor areas and room sizes.

The first four categories are designed to capture the traditional 'chocolate box' cottages and houses located mainly in villages and other rural areas in Dorset and Devon etc. The latter two categories are designed to encompass the originally better quality, stone and brick built pre 1850 dwellings that are now likely to be listed, including large houses, many of which have been converted into flats, in places like Bath, Cheltenham and the Clifton Area of Bristol.

When grossed to the national stock, the six categories account for a total of 56,030 dwellings in the South West. This can be compared to the actual number of listed dwellings in the region, as provided by English Heritage, of 56,461. All of the sample for the first four 'listed' categories are found to be located in rural areas, two thirds being in villages and the remainder in more isolated rural locations. Of the larger masonry houses, many are also rural, again including a high proportion in isolated locations, such as Georgian farmhouses.

Conservation areas

Estimating the number of dwellings likely to be in conservation areas has been undertaken in two ways. The EHCS sample of pre 1900 and pre 1919 homes has been determined that are located in:-

1. postal sectors covering the relevant parts of the most obvious historic or architecturally important cities, towns or large villages in the South West; and
2. older housing areas of more than 25 like houses that the EHCS surveyors recorded as ranking 1 or 2 on a 7 point scale of visual quality.

Using postcode sector maps for the South West produced by Map Marketing Ltd in association with the Royal Mail and also, for confirmation, "postcode finder" on the Royal Mail's website, the relevant postcode sectors (e.g. BA1 1) were determined for the following places:-

Bath, Blandford Forum, Bristol, Brixham, Castle Cary, Cheltenham, Dorchester, Exeter, Falmouth, Helston, Looe, Lyme Regis, Penzance, Salcombe, Salisbury, Shaftesbury, Sherborne, St Ives, Taunton, Totnes, Truro, Wells, Weymouth, Wimborne Minster.

The historic centres of these towns and villages was normally covered by just one postal sector and in only a few places such as Bath and Cheltenham were more than two postal sectors required. Using a 2003 EHCS postal sector file provided by ODPM, all the pre 1900 sample dwellings falling in these sectors were then determined and assumed to be in conservation areas.

To capture any other likely conservation areas, sample dwellings which the EHCS surveyor had identified as being in a housing area of the highest visual quality (if 1900 to 1919 housing) or, at least, next highest visual quality (if pre 1900 housing) were also selected, provided this area contained, at least 25 such dwellings.

Total preserved buildings

After accounting for some overlap, these two EHCS sub-samples account for a total of some 93,700 homes in conservation areas. As would be expected, there is some overlap between listed buildings and those in conservation areas. Across all urban areas in the South West, some 47% of listed buildings fall in conservation areas (which is compatible with the 46% estimated by Bristol City Council). However, in rural areas only 18% of the listed buildings are in conservation areas.

Overall, it is assumed that a little over 137,600 homes or some 25.6% of the total of 533,100 pre 1919 homes in the South West are either listed or located in conservation areas. These account for some 6.4% of the total housing stock in the region.

The University of Oxford's 40% House report estimates that of the 23,900,000 domestic properties in the UK 1,200,000 are in conservation areas and that about 300,000 are individually listed. In the UK, this represents, in total, about a quarter of all pre 1919 housing, where both listed buildings and conservation areas are heavily concentrated. As the South West has the highest proportion of pre 1919 housing outside London (25% compared with 20% for England generally), we should therefore assume that some 25% of pre 1919 dwellings (and not 5% of all properties) in the South West are either listed or fall within conservation areas.

The 137,600 of pre 1919 homes determined as either listed or falling in Conservation areas is therefore fully compatible with the estimates in the 40% House report and other published estimates.

Criteria for selecting potential measures

As well as for historic buildings, many other criteria were applied to realistically limit the improvement measures and packages allowed in certain dwellings. Some of the main criteria that determine the selection of a particular measure or package are as follows:-

General criteria

- Where they can be fitted, draught-proofing, loft insulation, cavity wall insulation and hot-water tank insulation are fitted in preference to all other measures.
- Where property is in a gas supply area, a gas condensing boiler is next selected if the above insulation measures fail to provide the required saving.
- Where the property is off-gas, an oil condensing boiler is generally selected as the next most appropriate measure.
- An LPG condensing boiler may be next selected where there is already an existing LPG boiler and bulk storage tank and the property is off-gas.
- Renewable energy measures are applied only where the above heating and insulation measures fail to provide the required saving.
- Heating measures are only selected without insulation measures, where the dwelling already has a satisfactory existing level of draught-proofing, loft insulation, cavity wall insulation and hot water tank insulation.
- In solid wall dwellings, heating appliances alone can be installed if no external or internal insulation, provided the other elements are insulated to a satisfactory standard.

Specific criteria for insulation measures

- Draught stripping and double glazing are confined to single glazed windows and doors.
- Existing draught-proofed and double glazed windows are considered to be already satisfactorily draught-proofed.
- Loft insulation, including top-up insulation, is limited to dwellings having existing loft insulation of below 125 mm.
- Existing loft insulation greater than 100 mm is considered to be already satisfactorily.
- All totally un-insulated cavity walls are assumed to be suitable for cavity insulation, unless in a severely exposed location.
- External wall insulation is not selected for listed buildings with solid walls or homes in a conservation area.
- Internal wall insulation is not selected for listed buildings with solid walls and/or where the habitable rooms are already small.
- Hot water tank insulation is limited to homes having existing insulation below 150 mm.
- Existing HWT insulation greater than 100 mm is considered to be already satisfactorily.

Specific criteria for heating measures

- A condensing boiler is not selected where the existing boiler is less than 5 years old or where there is already a condensing boiler or CHP system.
- Oil and LPG fired heating is only upgraded using the same fuel in off gas areas.
- Ground source heat pumps are not selected where the area has gas or where the garden is smaller than 10 metres in depth.
- Biomass boilers are not selected where the area has gas, for flats or where the youngest occupant is aged 60 years or over.
- Solar hot water installations are not selected for flats or any dwellings that are listed or in a conservation area.

AFP does not record the separate savings or installation cost of improved heating controls, but allows for modern heating controls in the savings and installation costs given for new heating appliances. The latter are thereby included in the model wherever a new heating boiler/system is installed.

Determining the most appropriate measure or package

To determine the most appropriate target measure or package for each particular dwelling, all the measures that satisfy all of the criteria and produce savings that are sufficiently high to reach the target SAP or lift the household out of fuel poverty are first determined, together with their equivalent installation cost.

For the most common generic type, semi-detached and end terraced houses with cavity walls and gas fired heating, this amounts to a total of 13 target measures or target packages, as listed in Table 5. However, as the model omits the measures in any particular package where the sample dwelling is already satisfactory in that respect, the actual number of measures and combination of measures used is actually far greater than 13.

Table 13: Target measures and packages (for SCG)

Insulation only measures	1	Draught proofing single glazing
	2	Top-up loft insulation only
	3	Cavity wall insulation only
Insulation only packages	4	Cavity wall and loft insulation
	5	Insulation package
Condensing boiler	6	Condensing boiler installed
Condensing boiler with insulation	7	Boiler & cavity insulation
	8	Boiler, cavity & loft insulation
	9	Boiler & insulation package
	10	As above, including double glazing
Ground source heat pump	11	Ground source heat pump
GHSP with other measures	12	GSHP & insulation package
	13	GHSP, insulation + solar HW

The measure or package is then chosen that generates the required saving for the minimum installation cost in each sample dwelling. Where more than one package achieves this, the one with the fewest measures is selected. This ensures that where, for example, a condensing boiler with cavity wall insulation is sufficient to reach SAP 65 or SAP 80, that the boiler with CWI alone rather than with CWI and loft insulation is chosen as the required package, where the sample dwelling already has adequate loft insulation generating a nil additional cost.

The cheapest measure or package is not necessarily the one that gets closest to the saving required. Generally, the savings achieved by the measures or package of measures will frequently exceed the required saving by a significant margin. Given reasonable existing insulation, this is particularly the case for the installation of new condensing boilers and heat pumps, where the saving may be considerably greater than that for the previous package in the list. Consequently, for these measures and to a lesser extent for cavity wall insulation, the chances of over-shooting the required saving is high.

That said, there are a significant number of dwellings that are unable to reach the required savings, particularly where the measures or packages are limited by the selection criteria. Where this is the case, these dwellings are provided with the measure or package that provides the largest energy savings for a reasonable cost. For these cases, the consequent energy savings and new SAP ratings are determined, albeit below the target. .

New SAP rating after improvement

The new SAP rating after improvement can be simply calculating by feeding in the new heating costs into essentially the same algorithms as those used for determining the existing and required heating costs i.e.

Algorithm 4: SAP rating from heating cost

Energy cost factor (ECF) = ((heating costs*1.05) -30.0)/(TFA+45).
New SAP rating = 97 - 100*Log10(ECF).

Target SAP and average SAP programmes

Once the appropriate measures and installation costs have been determined for each sample dwelling, three improvement programmes are computed and analysed:-

- Target SAP 65 programme: This targets all dwellings that have an existing SAP rating of under 65 and brings as many of these as possible up to SAP 65 or above.
- Average SAP 65 programme: This targets only dwellings of below SAP 48, such that the average energy rating for the stock after improvement is SAP 65 or just above.
- Target SAP 80 programme: This targets all dwellings that have an existing SAP rating of under 80 and brings as many of these as possible up to SAP 65 or above.
- Fuel Poverty: This improves the homes of the fuel poor to target SAP 65 or target SAP 80 and determines the consequent reduction in fuel poverty numbers in 2003 and 2005.

As a target SAP 80 programme produces an average SAP rating for the total stock of only just over 80 (83.0), a separate “average SAP 80 programme” has not been undertaken. Similar final SAP averages for the target and average programmes is not the case for the first two programmes. Because of the large proportion of dwellings (nearly 20%) that already exceed SAP 65, the fewer dwellings that cannot achieve 65 after improvement and the inevitable over-shooting of the required savings, mentioned above, the first programme produces an average SAP rating for the stock of over 72 - well above the target of 65.

Not all the packages are selected as part of every programme. For example, packages including double glazing generally tend not to be chosen under the criteria of achieving the required saving for the minimum cost, due to the high cost of this measure. Also in programmes that limit improvement work to dwellings with a lower SAP rating, some of the single measures, such as draught proofing alone, may not be sufficient to bring any dwelling up to the target SAP.

Main Outputs of Model

For each of the programmes, as well as determining the number and distribution of packages required, the model also computes the total number of individual measures regardless of whether they are used separately or as part of a package of measures. For each measure, the number is determined by calculating the number of measures and packages that generally include that measure and omitting the particular sample dwellings that do not require that measure.

The gas and electricity savings for each measure vary according to the way they are combined. with other measures. These savings are largely indeterminate where measures are combined with a ground source heat pump, where the use of gas and standard electricity is replaced with that of on and off-peak electricity. Consequently, statistics for gas and electricity savings are confined to those of individual measures used alone, together with those for each package of measures.

As previously described, all the package costs are based on the sum of the individual costs of each measure. Consequently, determining the total cost of any particular measure is relatively simple. However, unlike the packages, which are mutually exclusive, each measure has to be computed separately as many households are provided with more than one measure.

To summarise, the model provides the following key outputs for each improvement package:-

- The type and number of improvement packages and individual measures required;
- The average and total programme costs of the required packages and individual measures.
- The savings in the energy requirements by fuel (in kWh/year).
- The consequent theoretical savings in carbon emissions (but not the actual kWh and carbon savings, taking account of the comfort factor).
- The distribution of the SAP ratings, before and after improvement.
- The breakdown of the above outputs by any EHCS variable e.g. by tenure, vulnerable group and fuel poverty status.

When combined with the mass of housing and social data collected by the 2003 EHCS, the model allows many detailed analysis to be undertaken and recorded. For example, as well as outputs for all households, comparable outputs can also be produced broken down by tenure, vulnerable households and those in fuel poverty. When used at regional level, the main constraints on the model outputs lie in the sometimes small sample sizes produced, but the model can be equally applied to the national housing stock.

ANNEX 5 – IMPACT OF DELIVERING SAP BENCHMARKS[15][16]

AVERAGE SAP 65	All Households				Vulnerable Households				Fuel Poor Households			
IMPROVEMENT PACKAGES	Average cost	Total cost	Dwellings with each package		Average cost	Total cost	Dwellings with each package		Average cost	Total cost	Dwellings with each package	
	£	£x1000	Number	%	£	£x1000	Number	%	£	£x1000	Number	%
Draught proofing single glazing	239	2,151	9,010	0.4	290	1,471	5,074	0.3	712	1,617	2,269	1.6
Loft insulation (LI)	554	5,174	9,347	0.4	576	4,040	7,010	0.5	616	4,119	6,691	4.8
Insulation package (excl. wall insul.)*	597	17,131	28,719	1.3	623	9,473	15,198	1.0				
Cavity wall insulation (CWI)	1,341	9,172	6,837	0.3	659	2,356	3,578	0.2				
External wall insulation (EWI)	15,060	1,404,059	93,234	4.4	14,820	832,649	56,183	3.8	12,536	37,757	3,012	2.2
Internal wall insulation (IWI)	1,975	16,100	8,153	0.4	2,295	5,961	2,598	0.2				
Cavity wall and loft insulation (CWI+LI)	1,084	25,249	23,299	1.1	1,069	17,545	16,410	1.1	1,273	3,743	2,939	2.1
External wall and loft insulation (EWI+LI)	16,497	288,914	17,513	0.8	19,080	179,030	9,383	0.6	12,364	16,815	1,360	1.0
Insulation package (incl. CWI.)	1,020	148,702	145,719	6.8	861	84,502	98,154	6.6	1,193	15,270	12,799	9.2
Insulation package (incl. EWI.)	11,906	148,318	12,457	0.6	12,965	57,008	4,397	0.3	15,134	20,915	1,382	1.0
Insulation package (incl. IWI.)	2,076	12,599	6,070	0.3	2,173	8,409	3,870	0.3				
Gas condensing boiler (GCB) installed**	2,806	165,288	58,905	2.8	3,066	106,550	34,748	2.3	3,181	9,018	2,835	2.0
Oil condensing boiler (OCB)**	4,064	22,257	5,477	0.3	4,064	22,257	5,477	0.4	4,842	11,761	2,429	1.7
GCB + insul package (excl. wall insul)*	4,644	38,540	8,298	0.4	4,251	30,312	7,130	0.5	5,062	2,981	589	0.4
OCB + insul package (excl. wall insul)*	4,186	8,163	1,950	0.1	4,186	8,163	1,950	0.1				
GCB + insul package (incl. wall insul)	3,404	1,282,982	376,878	17.6	3,293	896,700	272,336	18.3	4,162	301,893	72,540	52.2
LPGCB + insul package (incl. wall insul)	15,435	133,685	8,661	0.4	13,656	101,670	7,445	0.5	13,102	37,250	2,843	2.0
OCB + insul package (incl. wall insul)	9,186	202,664	22,063	1.0	9,068	184,180	20,312	1.4	4,896	18,149	3,707	2.7
Ground source heat pump (GSHP)**	6,649	44,723	6,726	0.3	6,649	44,723	6,726	0.5	4,585	7,771	1,695	1.2
Biomass boiler (BMB)**	6,165	28,580	4,636	0.2	6,297	26,779	4,253	0.3				
GSHP + insul package (incl. wall insul)	6,560	165,176	25,178	1.2	6,112	80,688	13,202	0.9	6,712	14,182	2,113	1.5
BMB + insul package (incl. wall insul)	6,970	310,358	44,530	2.1	7,057	128,728	18,242	1.2	8,995	71,932	7,997	5.7
GSHP + insul package + solar HW	10,248	13,035	1,272	0.1	10,248	13,035	1,272	0.1	10,248	13,035	1,272	0.9
No action SAP >= 48 already	0	0	1,209,075	56.6	*0*	*0*	*873,370*	*58.7*	*0*	*0*	*10,618*	*7.6*
Totals		**4,493,018**	**2,136,132**	**100.0**		**2,846,233**	**1,488,318**	**100.0**		**588,208**	**139,090**	**100.0**

[15] Within the final document data will be rounded to the nearest 1,000 in order to avoid a sense of absolute accuracy given the statistically representative but still relatively small sample utilised by the English House Condition Survey

[16] The modeling did not assume any double glazing due to its low cost effectiveness, double glazing is unlikely to be installed on energy grounds alone. However it did recommend draught proofing wherever there was single glazing, generating less than half the savings of double glazing. This underestimation is minor and does not affect the overall conclusions.

AVERAGE SAP 65	**All Households**				**Vulnerable Households**				**Fuel Poor Households**			
INDIVIDUAL MEASURES	**Average cost £**	**Total cost £x1000**	**Dwelling with each measure Number**	**% homes**	**Average cost £**	**Total cost £x1000**	**Dwelling with each measure Number**	**% homes**	**Average cost £**	**Total cost £x1000**	**Dwelling with each measure Number**	**% homes**
Draught proofing single glazing	186	73,854	396,206	18.5	180	48,454	268,616	18.0	225	17,549	78,045	1,048.3
Loft insulation	364	191,585	526,520	24.6	375	132,984	354,650	23.8	369	35,629	96,637	1,298.0
Cavity wall insulation	364	153,898	422,546	19.8	361	107,046	296,466	19.9	345	19,718	57,215	768.5
Solid wall insulation - external	12,934	2,349,804	181,683	8.5	13,451	1,403,285	104,325	7.0	9,802	167,090	17,047	229.0
Solid wall insulation - internal	1,390	42,072	30,265	1.4	1,525	16,810	11,020	0.7				
Hot water tank insulation	57	30,126	530,932	24.9	57	21,046	369,319	24.8	56	5,532	98,805	1,327.1
Gas condensing boiler	2,290	1,015,346	443,313	20.8	2,318	726,452	313,446	21.1	2,857	217,031	75,964	1,020.3
LPG condensing boiler	1,109	9,608	8,661	0.4	1,057	7,868	7,445	0.5	953	2,711	2,843	38.2
Oil condensing boiler	3,858	113,785	29,490	1.4	3,914	108,579	27,739	1.9	4,387	26,919	6,136	82.4
Ground source heat pump	5,976	198,268	33,176	1.6	5,850	124,019	21,200	1.4	5,474	27,810	5,080	68.2
Biomass boiler	6,380	313,680	49,166	2.3	6,489	145,965	22,495	1.5	8,065	64,494	7,997	107.4
Solar hot water system	2,929	3,725	1,272	0.1	2,929	3,725	1,272	0.1	2,929	3,725	1,272	17.1
No action SAP >= 48 already	*0*	*0*	*1,209,075*	*56.6*	*0*	*0*	*873,370*	*58.7*	*0*	*0*	*10,618*	*142.6*
Totals		**4,495,751**	**2,653,230**	**2,136,132**		**2,846,233**	**1,797,993**	**1,488,318**		**588,208**	**447,041**	**139,090**

TARGET SAP 65	**All Households**				**Vulnerable Households**				**Fuel Poor Households**			
IMPROVEMENT PACKAGES	**Average cost**	**Total cost**	**Dwellings with each package**		**Average cost**	**Total cost**	**Dwellings with each package**		**Average cost**	**Total cost**	**Dwellings with each package**	
	£	**£x1000**	**Number**	**% homes**	**£**	**£x1000**	**Number**	**% homes**	**£**	**£x1000**	**Number**	**% homes**
Draught proofing single glazing	186	6,760	36,391	1.7	192	4,707	24,479	1.6				
Loft insulation (LI)	424	29,797	70,284	3.3	456	20,729	45,428	3.1	712	1,617	2,269	1.6
Insulation package (excl. wall insul.)*	468	29,603	63,239	3.0	457	17,586	38,515	2.6	570	4,608	8,088	5.8
Cavity wall insulation (CWI)	450	88,073	195,603	9.2	453	62,473	137,810	9.3	495	2,920	5,902	4.2
External wall insulation (EWI)	12,885	2,301,275	178,602	8.4	12,846	1,501,908	116,919	7.9	11,305	63,240	5,594	4.0
Internal wall insulation (IWI)	1,693	21,611	12,766	0.6	1,685	8,729	5,180	0.3				
Cavity wall and loft insulation (CWI+LI)	822	62,946	76,559	3.6	837	48,552	57,981	3.9	1,273	3,743	2,939	2.1
External wall and loft insulation (EWI+LI)	16,046	293,396	18,285	0.9	19,080	179,030	9,383	0.6	12,364	16,815	1,360	1.0
Internal wall and loft insulation (IWI+LI)	1,286	2,734	2,125	0.1								
Insulation package (incl. CWI.)	800	217,552	272,069	12.7	692	134,051	193,718	13.0	1,193	15,270	12,799	9.2
Insulation package (incl. EWI.)	11,906	148,318	12,457	0.6	12,965	57,008	4,397	0.3	15,134	20,915	1,382	1.0
Insulation package (incl. IWI.)	1,860	14,013	7,534	0.4	1,842	9,824	5,334	0.4				
Gas condensing boiler (GCB) installed**	1,939	276,929	142,824	6.7	2,046	188,309	92,051	6.2	3,181	9,018	2,835	2.0
Oil condensing boiler (OCB)**	3,629	63,437	17,479	0.8	3,803	62,044	16,314	1.1	4,842	11,761	2,429	1.7
GCB + insul package (excl. wall insul)*	4,644	38,540	8,298	0.4	4,251	30,312	7,130	0.5	5,062	2,981	589	0.4
OCB + insul package (excl. wall insul)*	4,186	8,163	1,950	0.1	4,186	8,163	1,950	0.1				
GCB + insul package (incl. wall insul)	3,103	1,454,771	468,893	22.0	3,021	1,028,916	340,587	22.9	4,129	302,590	73,277	52.7
LPGCB + insul package (incl. wall insul)	15,435	133,685	8,661	0.4	13,656	101,670	7,445	0.5	13,102	37,250	2,843	2.0
OCB + insul package (incl. wall insul)	7,873	213,098	27,067	1.3	7,974	192,574	24,151	1.6	4,896	18,149	3,707	2.7
Ground source heat pump (GSHP)**	6,299	51,072	8,108	0.4	6,299	51,072	8,108	0.5	4,585	7,771	1,695	1.2
Biomass boiler (BMB)**	5,729	76,216	13,304	0.6	5,718	57,267	10,016	0.7				
GSHP + insul package (incl. wall insul)	6,529	171,996	26,343	1.2	6,112	80,688	13,202	0.9	6,712	14,182	2,113	1.5
BMB + insul package (incl. wall insul)	6,984	337,433	48,315	2.3	7,073	155,802	22,027	1.5	8,995	71,932	7,997	5.7
GSHP + insul package + solar HW	10,248	13,035	1,272	0.1	10,248	13,035	1,272	0.1	10,248	13,035	1,272	0.9
No action SAP >= 65 already	*0*	*0*	*417,704*	*19.6*	*0*	*0*	*304,921*	*20.5*				
Totals		**6,054,452**	**2,136,132**	**100.0**		**4,014,452**	**1,488,318**	**100**		**617,799**	**139,090**	**100**

TARGET SAP 65	All Households				Vulnerable Households				Fuel Poor Households			
INDIVIDUAL MEASURES	Average cost £	Total cost £x1000	Dwelling with each measure Number	% homes	Average cost £	Total cost £x1000	Dwelling with each measure Number	% homes	Average cost £	Total cost £x1000	Dwelling with each measure Number	% homes
Draught proofing single glazing	180	97,669	542,855	25.4	175	64,481	369,334	24.8	225	17,549	78,045	56.1
Loft insulation	361	285,382	791,558	37.1	370	201,665	545,088	36.6	368	36,043	98,034	70.5
Cavity wall insulation	358	272,245	760,069	35.6	361	194,535	538,573	36.2	356	22,733	63,854	45.9
Solid wall insulation - external	12,037	3,284,665	272,890	12.8	12,404	2,101,777	169,441	11.4	9,811	192,573	19,629	14.1
Solid wall insulation - internal	1,327	49,196	37,071	1.7	1,367	20,601	15,066	1.0				
Hot water tank insulation	57	41,914	737,028	34.5	57	29,867	522,818	35.1	56	5,608	100,202	72.0
Gas condensing boiler	2,018	1,249,915	619,247	29.0	2,058	903,578	439,000	29.5	2,837	217,634	76,701	55.1
LPG condensing boiler	1,109	9,608	8,661	0.4	1,057	7,868	7,445	0.5	953	2,711	2,843	2.0
Oil condensing boiler	3,481	161,858	46,496	2.2	3,630	153,950	42,415	2.8	4,387	26,919	6,136	4.4
Ground source heat pump	5,917	211,373	35,723	1.7	5,773	130,368	22,582	1.5	5,474	27,810	5,080	3.7
Biomass boiler	6,279	386,901	61,619	2.9	6,305	202,038	32,043	2.2	8,065	64,494	7,997	5.7
Solar hot water system	2,929	3,725	1,272	0.1	2,929	3,725	1,272	0.1	2,929	3,725	1,272	0.9
No action SAP >= 65 already	0	0	417,704	19.6	*0*	*0*	*304,921*	*20.5*				
Totals		**6,054,452**	**3,914,489**	**2,136,132**		**4,014,452**	**2,705,077**	**1,488,318**		**617,799**	**459,793**	**139,090**

TARGET SAP 65

INDIVIDUAL MEASURES	All Households by Tenure: Average cost £	Total cost £x1000	Dwelling with each measure: Number	% homes
Owner Occupied				
Draught proofing single glazing	180	73,700	409,456	25.2
Loft insulation	372	246,355	662,727	40.8
Cavity wall insulation	379	233,808	617,601	38.0
Solid wall insulation - external	13,146	2,672,409	203,284	12.5
Solid wall insulation - internal	1,409	40,724	28,894	1.8
Hot water tank insulation	57	31,161	548,143	33.8
Gas condensing boiler	1,967	919,044	467,175	28.8
LPG condensing boiler	1,139	9,087	7,975	3.5
Oil condensing boiler	3,535	119,295	33,743	14.8
Ground source heat pump	5,931	208,089	35,084	2.2
Biomass boiler	6,687	274,574	41,060	18.1
Solar hot water system	2,929	3,725	1,272	0.6
No action SAP >= 65 already	*0*	*0*	*278,034*	*17.1*
Total Owner Occupied		**4,831,971**	**3,056,414**	**1,623,221**
Private Rented				
Draught proofing single glazing	188	17,660	93,885	5.8
Loft insulation	320	26,731	83,584	36.8
Cavity wall insulation	288	20,304	70,568	31.0
Solid wall insulation - external	8,946	435,004	48,623	3.0
Solid wall insulation - internal	976	6,941	7,112	3.1
Hot water tank insulation	56	5,188	92,363	40.6
Gas condensing boiler	2,279	179,927	78,960	34.7
LPG condensing boiler	758	520	686	0.3
Oil condensing boiler	3,474	19,572	5,634	2.5
Ground source heat pump	5,139	3,284	639	0.3
Biomass boiler	5,388	24,406	4,530	2.0
No action SAP >= 65 already	0	0	37,270	*16.4*
Total Private Rented		**739,537**	**486,584**	**227,356**

	All Households by Tenure: Average cost £	Total cost £x1000	Dwelling with each measure: Number	% homes
Local Authority				
Draught proofing single glazing	169	4,303	25,471	18.1
Loft insulation	278	7,006	25,177	17.9
Cavity wall insulation	245	8,675	35,408	25.2
Solid wall insulation - external	8,555	127,170	14,865	10.6
Solid wall insulation - internal	2,044	1,067	522	0.4
Hot water tank insulation	58	3,295	57,253	40.7
Gas condensing boiler	1,883	81,540	43,296	30.8
Oil condensing boiler	3,126	14,913	4,771	3.4
Biomass boiler	5,707	25,281	4,430	3.2
No action SAP >= 65 already	*0*	*0*	*38,879*	*27.7*
Total Local Authority		**273,251**	**211,193**	**140,525**
Registered Social Landlord				
Draught proofing single glazing	143	2,005	14,043	9.7
Loft insulation	264	5,290	20,070	13.8
Cavity wall insulation	259	9,458	36,492	25.2
Solid wall insulation - external	8,186	50,082	6,118	4.2
Solid wall insulation - internal	855	464	543	0.4
Hot water tank insulation	58	2,269	39,269	27.1
Gas condensing boiler	2,328	69,404	29,816	20.6
Oil condensing boiler	3,440	8,078	2,348	1.6
Biomass boiler	5,401	62,640	11,599	8.0
No action SAP >= 65 already	*0*	*0*	*63,521*	*43.8*
Total RSL		**209,693**	**160,298**	**145,030**

Total All Tenures	**6,054,452**	**3,914,489**	**100.0**	**2,136,132**

TARGET SAP 80	All Households			
IMPROVEMENT PACKAGES	Average cost	Total cost	Dwellings with each package	
	£	£ x 1000	Number	% homes
Draught proofing (DS)	112	2,936	26,282	1.2
Loft insulation (LI)	460	14,307	31,078	1.5
Insulation package (excl. wall insul.)*	452	24,909	55,090	2.6
Cavity wall insulation (CWI)	864	78,648	90,994	4.3
External wall insulation (EWI)	13,781	1,573,588	114,186	5.3
Internal wall insulation (IWI)	1,651	7,016	4,249	0.2
Cavity wall and loft insulation (CWI+LI)	841	15,301	18,188	0.9
External wall and loft insulation (EWI+LI)	12,018	263,819	21,952	1.0
Internal wall and loft insulation (IWI+LI)	2,505	7,899	3,153	0.1
Insulation package (incl. CWI.)	863	267,972	310,632	14.5
Insulation package (incl. EWI.)	13,366	677,363	50,677	2.4
Insulation package (incl. IWI.)	1,831	13,123	7,169	0.3
Gas condensing boiler (GCB) installed**	1,601	445,256	278,179	13.0
Oil condensing boiler (OCB)**	2,799	60,870	21,749	1.0
GCB + insul package (excl. wall insul)*	4,007	24,485	6,110	0.3
OCB + insul package (excl. wall insul)*	4,186	8,163	1,950	0.1
GCB + insul package (incl. wall insul)	2,964	2,607,921	879,840	41.2
LPGCB + insul package (incl. wall insul)	15,085	84,369	5,593	0.3
OCB + insul package (incl. wall insul)	10,840	317,730	29,311	1.4
Ground source heat pump (GSHP)**	6,511	88,860	13,647	0.6
Biomass boiler (BMB)**	6,091	110,736	18,179	0.9
GSHP + insul package (incl. wall insul)	8,506	351,555	41,328	1.9
BMB + insul package (incl. wall insul)	6,472	328,001	50,679	2.4
GSHP + insul package + solar HW	7,797	21,059	2,701	0.1
No action SAP >= 80 already	*0*	*0*	*53,216*	*2.5*
Totals		**7,395,888**	**2,136,132**	**100.0**

TARGET SAP 80	All Households			
INDIVIDUAL MEASURES	Average cost	Total cost	Dwelling with each measure	
	£	£x1000	Number	% homes
Draught proofing single glazing	172	121,661	706,221	33.1
Loft insulation	339	358,411	1,056,567	49.5
Cavity wall insulation	347	304,148	876,226	41.0
Solid wall insulation - external	11,812	3,561,967	301,554	14.1
Solid wall insulation - internal	1,310	50,119	38,260	1.8
Hot water tank insulation	57	60,775	1,069,689	50.1
Gas condensing boiler	1,681	1,956,042	1,163,361	54.5
LPG condensing boiler	1,136	6,354	5,593	0.3
Oil condensing boiler	3,668	189,385	51,628	2.4
Ground source heat pump	6,358	366,712	57,676	2.7
Biomass boiler	6,013	414,072	68,858	3.2
Solar hot water system	2,311	6,243	2,701	0.1
No action SAP >= 80 already	*0*	*0*	*53,216*	*2.5*
Totals		**7,395,888**	**5,398,334**	**2,136,132**

ANNEX 6 – DETAILED FUEL POVERTY ANALYSIS

Background

The modelling and analysis of fuel poverty within the South West has been carried out in order to answer two key questions central to the development of the regional strategy and targets set within a context of the governments targets for fuel poverty.

1. **To what extent do rising fuel prices increase the numbers of households in fuel poverty within the South West?**

   The data set that this modelling has been based on has been drawn from the 2003 English House Condition Survey. There have been significant price rises between then and now, that will have significantly altered the profile of fuel poverty within the region.

2. **Do rising fuel prices require the raising of SAP targets above SAP 65 in order to mitigate the increase in fuel poverty within the region?**

   SAP 65 has been considered to be the point above which thermal improvements have limited impact on fuel poverty. This is not the same as saying that there will be no fuel poverty in properties above SAP 65. It does imply however that where fuel poverty does exist in properties above SAP 65, it is non energy factors, such as low incomes and large properties, that become the key determinants of fuel poverty rather than the property's SAP rating. SAP 65 therefore seems a reasonable energy based target when seeking to address the incidence of fuel poverty.

   However, it is important to understand the degree to which this assumption may also be affected by fuel price rises.

The impact of rising fuel prices has been assessed using the fuel component of the DTI's retail price index and assessing the number of households in fuel poverty in 2003 and then the number of households in fuel poverty by the end of 2005. The characteristics of these two samples of the wider 2003 EHCS sample for the SW can then be analysed and compared. Based on the most recently published figures (December 2005), there has been a 19% increase in fuel bills between Q1 2003 and Q4 2005 in real terms (based on 2003 prices) and across all fuels. Whilst there have been further fuel bill increases in 2006 they have not been able to be taken into account.

The modelling assumes two programmes of energy efficiency and building integrated renewables measures designed to deliver a target of SAP 65 and a target of SAP 80 across all households in the region.

Due to the relatively short timescales to 2010 and 2016 a number of constraints have been placed on some of the measures in order to simulate the constraints imposed on the market by industry capacity and technological development. However, even allowing for these assumptions the programmes assume a massive increase in the installation rate for renewable technologies and solid wall insulation. See the full report for more details and a full breakdown of the measures installed within each programme.

The English House Condition Survey is based on a representative sample of properties that includes 1757 properties in the South West. The conclusions drawn from the modelling are then applied to the full housing stock within the region. The fuel poverty analysis has been carried out on the appropriate sub set of properties. Whilst this is adequate for drawing overall conclusions, the small sample sizes inherent within the fuel poverty analysis limits the analysis of smaller sub sets and needs to be born in mind when considering the implications of the analysis.

Key findings

- **Impact of rising fuel prices -** When comparing the 2003 and 2005 fuel poor households, before energy efficiency improvement, the 2005 fuel poor sample has:
    - Grown by 63% (figure 2)
    - Higher average SAP ratings with 1% of properties over SAP 65 as opposed to all properties under SAP 65 in 2003 (figure 3)
    - Higher average incomes and higher average fuel bills (figure 4)
- **Impact of rising fuel prices and energy efficiency -** When comparing the 2003 and 2005 fuel poor households, after improvement, the 2005 fuel poor sample has:
    - Grown by only 7% (4% growth after target SAP 80 programme) as opposed to the 63% growth in fuel poverty before improvements (figure 2)
    - Been reduced from 10.6% of households in the SW to 1.8% of all households (figure 2). The 2003 sample was reduced from 6.5% to 1.7%.
    - Similar average SAP ratings for those households still in fuel poverty after energy efficiency improvements as in 2003 (figure 5)
    - A marginal reduction in the gap between average SAP ratings for those properties with households lifted out of fuel poverty and those still in fuel poverty as compared to the 2003 sample (figure 5)
- There is some suggestion of a relationship between properties with households still in fuel poverty and a SAP of over 65 and large properties, but at this level of analysis sample sizes are very small, with variations caused by one or two properties. Definite conclusions will need to wait on an analysis of larger samples.
- Those properties that fail to reach SAP 65 following the target SAP 65 programme (18% of all properties) have a markedly higher than average proportion of hard to treat properties, properties with no lofts, converted flats, private rented properties, fuel poor households, listed properties or properties in conservation areas and small (<75m2) properties (figure 6).
- There are a very similar number of properties (approximately 376,000) that fail to reach SAP 65 within both target SAP 65 and target SAP 80 programmes (figure 1)

Summary

- Increasing fuel prices pulls significant numbers of households into fuel poverty that in general have higher average incomes and are in properties with on average higher SAP ratings
- Implementing a programme of energy efficiency aimed at raising all households to SAP 65:
    - lifts a significant majority of households out of fuel poverty
    - leaves a significant proportion of households still in fuel poverty, the majority of whom are in properties unable to reach SAP 65
    - has a similar impact on fuel poverty regardless of increased fuel prices

- Implementing a programme of energy efficiency aimed at raising all households to SAP 80:
  - has a similar impact on fuel poverty as the target SAP 65 programme
  - this can in part be explained by the similar number of properties left below SAP 65, following the target SAP 65 and target SAP 80 programmes
  - this suggests that failing SAP 65 is a more significant barrier to lifting households out of fuel poverty than insufficient energy efficiency levels above SAP 65
- There is no single cause of properties failing to reach SAP 65, though the majority of factors do in someway each limit the ability to increase the energy efficiency of the property, particularly when considered along side some of the measure constraints imposed on the modelling, for example limiting renewable heat technologies to off gas areas.

Conclusions

- In response to the two key questions outlined above, rising fuel prices has undoubtedly had a significant impact of the incidence of fuel poverty within the SW. However, the response to the second question as to whether SAP targets should be raised above SAP 65 in response to rising fuel prices is more complex.
- Evidence for raising SAP targets, though not demonstrated in this analysis, might have included:
  - a significant increase in fuel poverty after improvements, between the 2003 and 2005 samples - *suggesting that higher fuel prices significantly reduces the impact on fuel poverty of raising properties to SAP 65*
  - a growing gap in SAP ratings between those lifted out of fuel poverty and those still in fuel poverty between the 2003 and 2005 samples, after improvements - *suggesting that with higher fuel prices, higher SAP ratings are required to lift households out of fuel poverty*
  - A significantly increased impact on fuel poverty following the target SAP 80 programme as opposed to the target SAP 65 programme – *suggesting that increasing energy efficiency levels above SAP 65 was at least as important to reducing fuel poverty as addressing those properties unable to reach SAP 65*
- Whilst the target SAP 80 programme did limit slightly the increase in fuel poverty resulting from fuel price rises, the increased impact was marginal (particularly considering the error inherent with the small sample sizes) when compared to the significant barrier to reducing fuel poverty posed by the number of properties unable to reach SAP 65 in either programme.
- There is therefore little evidence in this analysis that suggests that raising SAP targets above 65 should be a priority response to rising fuel prices. This is not to say that increasing SAP ratings beyond 65 will not be beneficial or necessary in individual cases, but that in policy terms, emphasis needs to be placed on the priority issues in order to create the appropriate focus for action at a strategic level
- The key strategic goals in addressing fuel poverty within the region should therefore include:
  - Raising all households to a minimum of SAP 65 by 2016 wherever possible
  - Understanding and addressing the reasons for properties failing to reach SAP 65
  - Integrating approaches to income maximisation, in particular benefit take up, into mainstream energy efficiency programmes and highlighting and addressing where possible the problems caused by under occupancy

Figure 2: Impact of rising fuel prices and energy efficiency improvements on SW fuel poverty Q1 2003 – Q4 2005

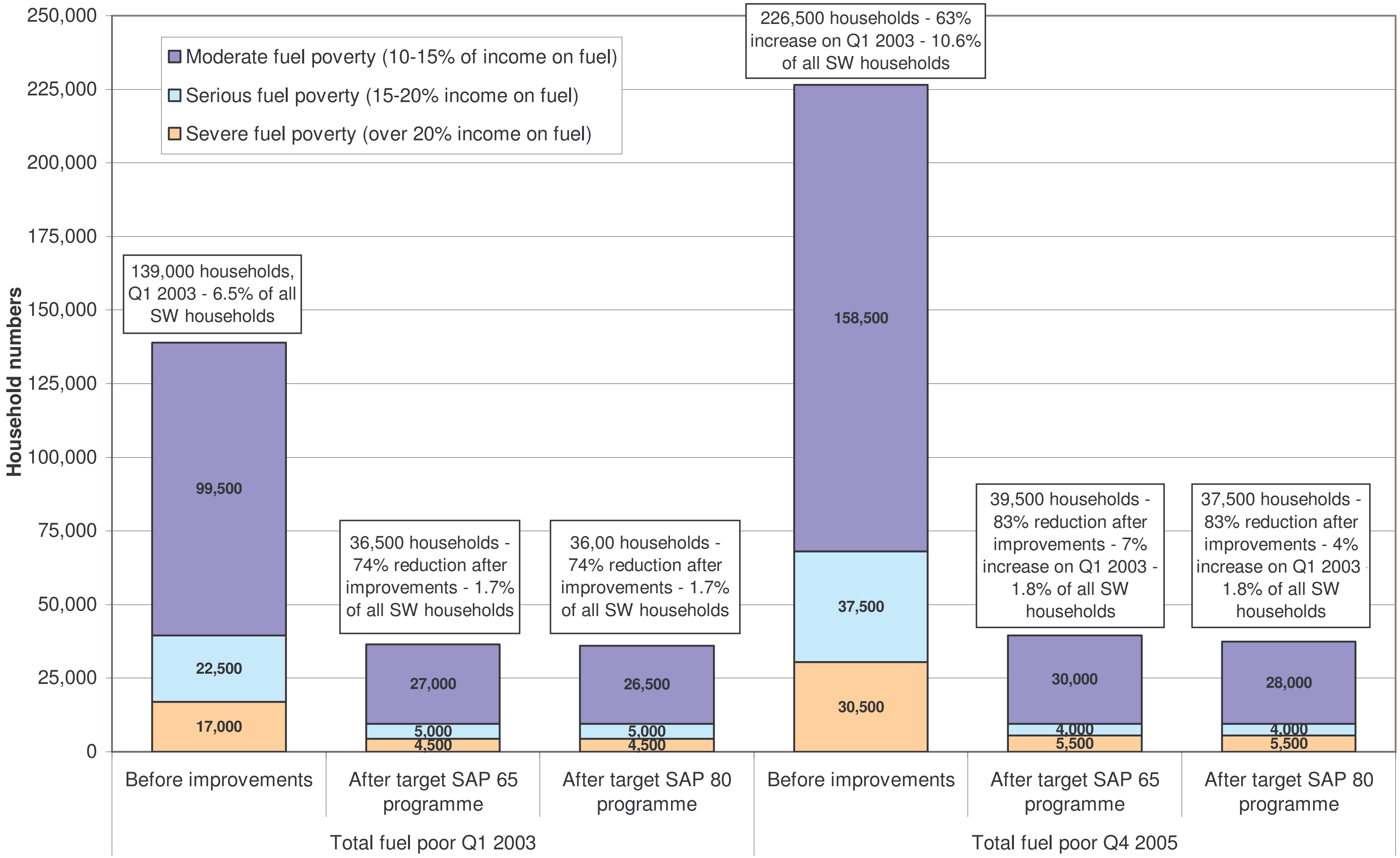


Figure 3: SAP profiles for fuel poor households 2003 and 2005

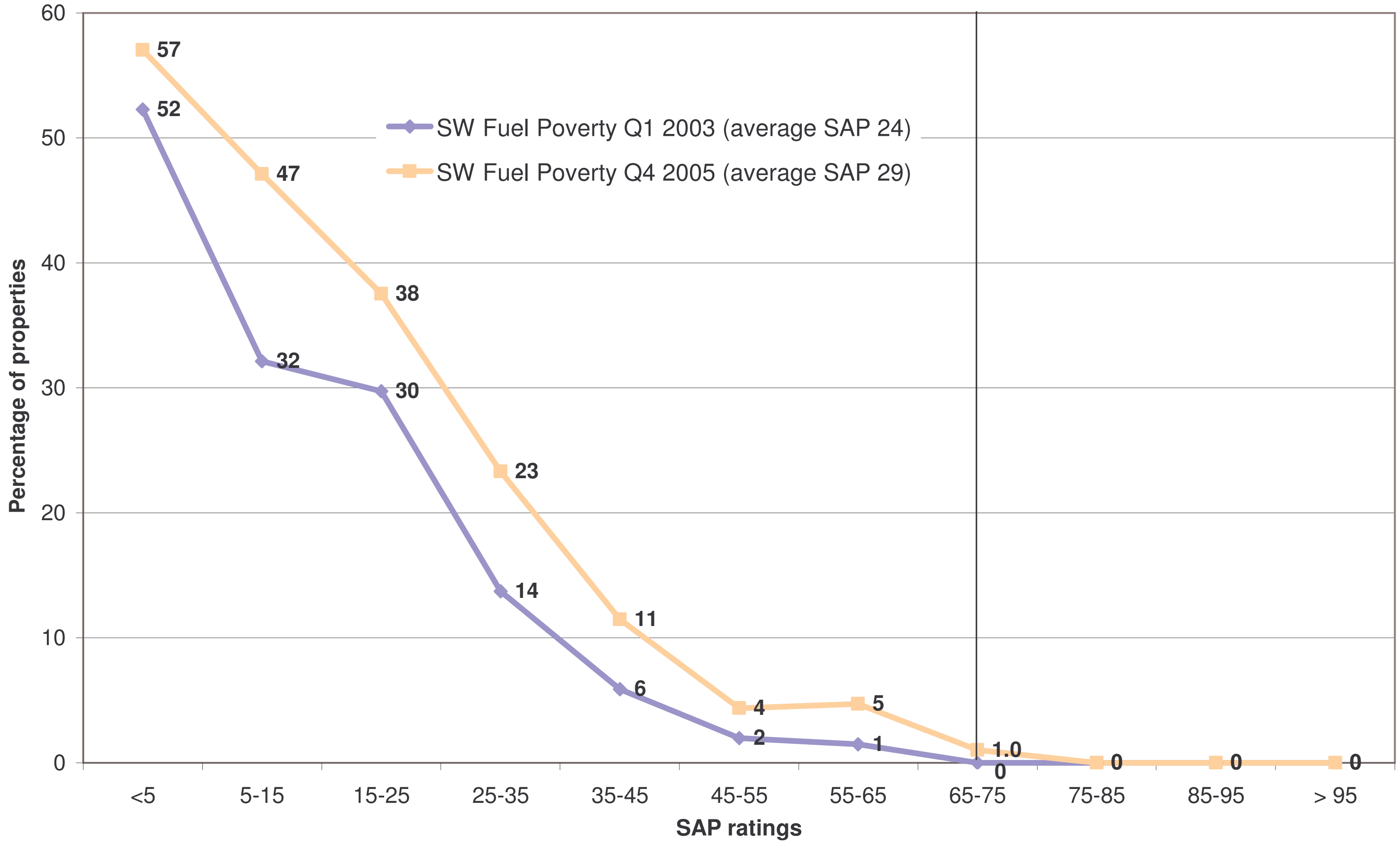


Figure 4: Variations in annual income and fuel costs amongst fuel poor households in 2003 and 2005

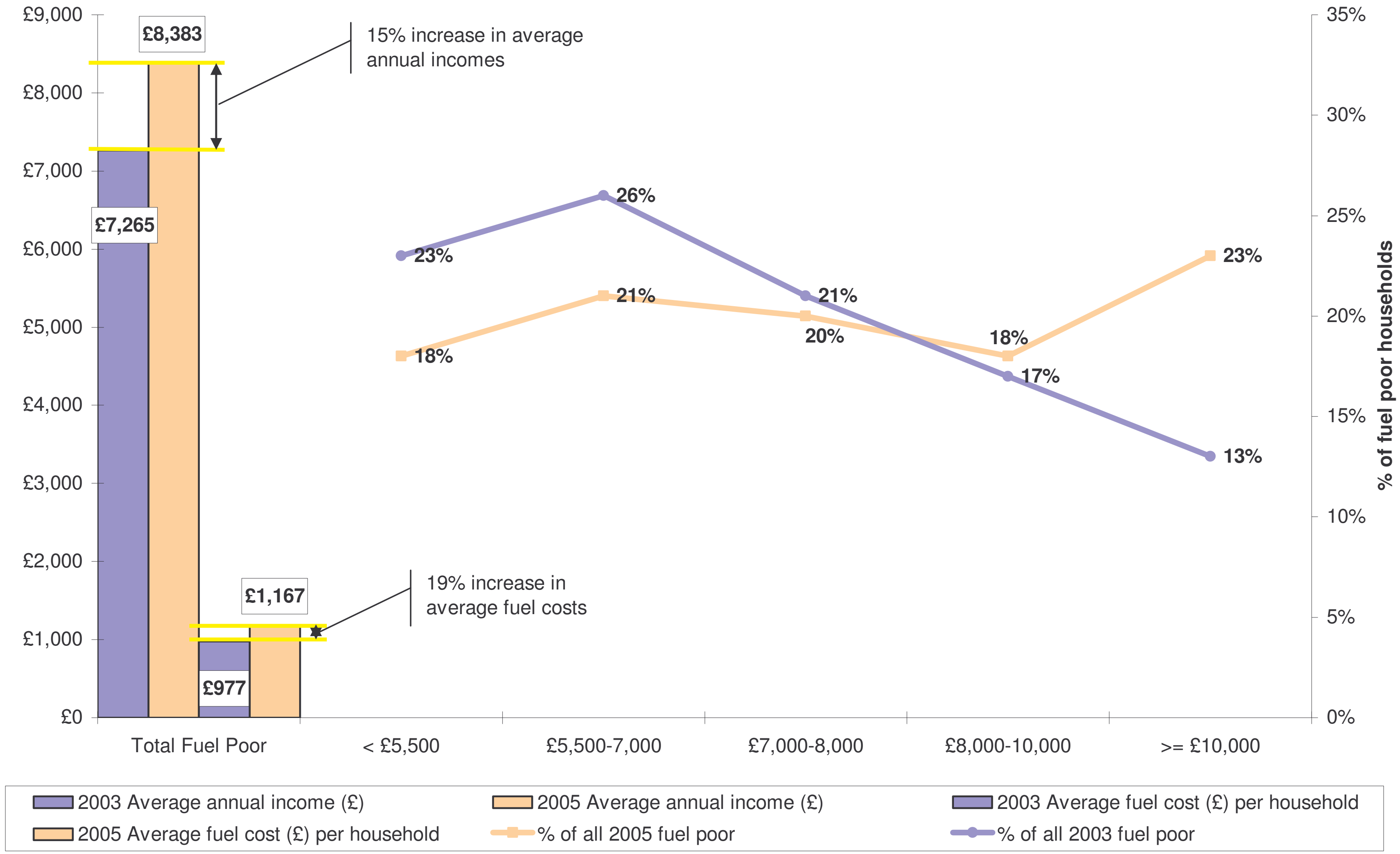
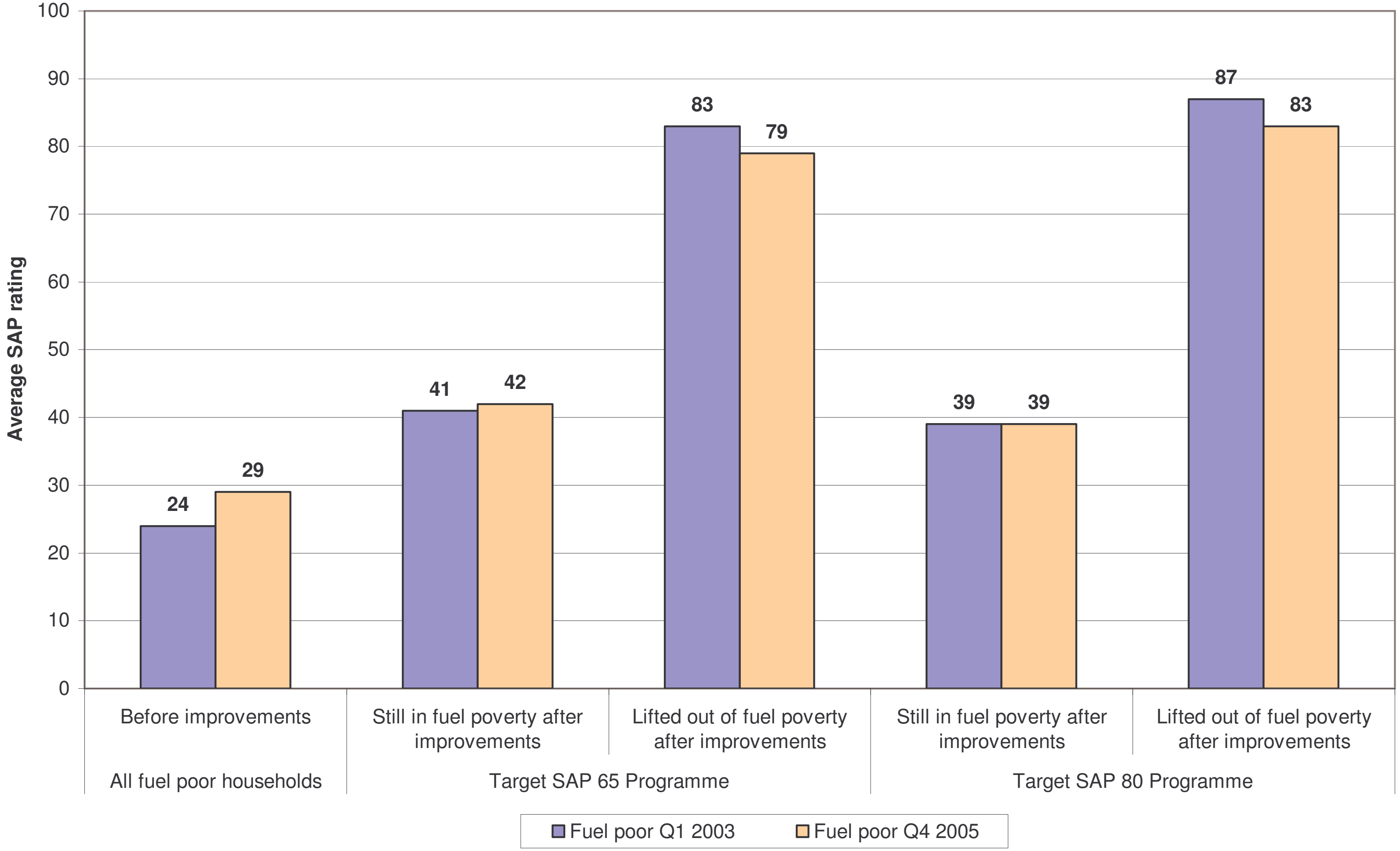


Figure 5: Impact of energy efficiency on average SAP ratings for properties with households in fuel poverty in 2003 and 2005



ANNEX 7 – MODELLING METHODOLOGY: CARBON DIOXIDE EMISSION SCENARIOS

Methodology used to model the carbon emissions from existing and new housing stock

Objective

To develop a model for emissions of carbon dioxide from existing and new housing stock in the South West.

Overview

In summary the modelling undertaken by CSE has taken the results of the separate model for the South West housing stock, developed by Dr Richard Moore, (referred to as the EHCS model) and used the outputs as follows:

- The EHCS model has been used to calculate the percentage reduction in carbon emissions in the existing South West housing stock following the introduction of packages of energy efficiency and renewable energy measures. These packages have been used to raise the average and minimum SAP for the stock as a whole to 65, and to a minimum SAP of 80.

- The percentage reductions in emissions of carbon dioxide achieved in the EHCS model, have then been applied to the actual (rather than modelled[17]) consumption figures for the South West housing stock allowing for projected changes in consumption patterns for lights and appliances.

- The number of new properties expected to be constructed annually has been based on figures provided in the Regional Housing and Regional Spatial Strategy. The carbon emissions as a result of the new housing have been calculated in three scenarios

- The carbon model has also taken into account the impact of emissions of micro-renewables (PV and micro-wind) which were not included in Dr Moore's model for the existing stock. Projections for the take up of these have been based on analysis presented in *Potential for Microgeneration – Study and Analysis* by Element Energy on behalf of EST (2005).

- The modelling has further considered what the impact would be if renewable energy suppliers and installers are unable to achieve the target number of installations necessary to achieve the SAP targets. This has been presented as three separate scenarios, low – business as usual based on current installation rates, high – the fastest rate of growth which appears feasible at the present time, and medium – an interim scenario. The scenarios have been based on interviews with suppliers and installers.

- In each case the reduction in emissions of carbon dioxide has been calculated relative to a 1990 baseline.

[17] Modeled energy consumption is significantly higher than the actual recorded levels due the necessity to assume standard occupancy patterns within the modeling

Detailed methodology

Estimated actual emissions for the South West region

Estimated actual emissions for the South West housing stock have been taken from the Netcen/Defra data on local and regional carbon emissions[18], which in turn have been derived from local and regional energy consumption data published by the DTI in Energy Trends[19].

Table 15: Annual CO2 emissions arising from the domestic sector within the South West for 2003 baseline

Carbon dioxide emissions in the South West, domestic sector	GWhs	Percentage	Million tonnes	Percentage
	45,915	100%	13.44	100%
Gas	27,806	60.6%	5.62	41.8%
Electricity	11,413	24.8%	6.14	45.7%
Oil, Coal, and LPG	6,696	14.6%	1.68	12.5%

Source: DTI Energy Trends and Netcen/DEFRA

Table 14: Carbon Emission Factors

Fuel Type	Carbon factor kg CO2/kWh
Gas	0.19
Electricity	0.54
Oil	0.25
Coal	0.3
LPG	0.21
Biomass	0.025

Source: DEFRA 2005

Netcen/DEFRA assume 0.54 kgCO_2/kWh rather than the standard 0.43 when calculating carbon emissions for electricity. This represents the actual value calculated for emissions from electricity generation in 2003. This is the figure that is then used through the modelling outlined within this report. If the carbon footprint of electricity generation was to reduce, this carbon factor would also reduce. This would have the effect of increasing the percentage savings achieved by the measures outlined within this document. The savings outlined here are therefore conservative. However given the likelihood that targets will increase as society more fully understands the demands of avoiding catastrophic climate change, this seems an appropriate approach to take.

Assumptions made about existing housing stock (see annex 4 for assumptions around installation within existing properties)

Proportion of electricity consumption from lights and appliances

The modelled baseline data used in the EHCS model are based on the 2003 English House Condition survey. This has been used to estimate the proportion of electricity consumption for the existing housing stock which results from the use of lights and appliances.

This fraction has then been applied to the *actual* electricity consumption figures in the South West to obtain the proportion of the total electricity consumption which results from the use of lights and appliances. This has then been used to calculate the actual CO_2 emissions in the South West which result from lights and appliances.

[18] Local and Regional CO2 Emissions Estimates for 2003, DEFRA August 2005 http://www.defra.gov.uk/environment/statistics/globatmos/galocalghg.htm
[19] Regional and Local Energy Consumption 2003, DTI http://www.dti.gov.uk/energy/statistics/regional/index.html

Table 16: Assumptions and baseline data used for electricity consumption

Assumptions used for estimates of electricity consumption attributable to lights and appliances		Notes
Modelled annual electricity demand for the South West stock GWh[1]	14124	1 Taken from EHCS model baseline data
Modelled annual consumption for lights and appliances in existing South West stock GWh[2]	6225	2 Taken from EHCS baseline model
Percentage of electricity consumption in existing South West stock which is from lights and appliances based on modelled data	44.1	
Actual electricity consumption for the existing stock in the South West GWh	11413	
Estimated actual annual electricity consumption excluding lights and appliances GWh	6383	
Estimated annual consumption for lights and appliances based on modelled ratios above for whole of the South West Stock GWh	5030	
Carbon factor for electricty kg CO2/kWh	0.54	

Annual decrease in energy consumption from lights and appliances in existing housing stock

The annual decrease in energy consumption from lights and appliances has been derived from data published in the 40% House (Boardman et al, 2005). This report assumes that consumption due to lights and appliances falls year on year. An annual reduction factor[20] of 0.986 has been calculated assuming that consumption stabilises at 2192 kWh in 2003 to 2010 and then falls to 1680 kWh per annum in 2050. The consumption figure for 2003 has been provided by the Energy Saving Trust. The target figure for 2050 is taken from the 40% House Report.

This annual reduction factor has been applied to both the existing housing stock and new housing where constructed to the standard set by 2006 Building Regulations.

The underlying assumption behind year on year reduction in consumption due to lights and appliances is that the use of more efficient white goods offsets the use of more appliances per household.

The table below shows the assumptions made in the 40% House report for the number of appliances used per household and the energy use per appliance.

[20] Multiple by which consumption reduces year on year from 2010 to 2050

The table shows that whilst the ownership of appliances per household is set to rise, appliances are also assumed to become more efficient, offsetting the increased use and enabling the average consumption for lights and appliances to fall to 1680kWh per annum by 2050.

Table 17: Electricity consumption and ownership, residential lights and appliances 1998 & 2050[21]

	Current - 1998			**40% House - 2050**		
	TWh	**Ownership per household**	**kWh per appliance per year**	**TWh**	**Ownership per household**	**kWh per appliance per year**
Cold	**17.5**			**3.5**		
Refrigerator	3.1	0.43	300	0.8	0.43	58
Fridge-freezer	9.5	0.6	650	1.8	0.6	94
Upright freezer	2.9	0.24	500	0.7	0.32	64
Chest freezer	2.0	0.18	460	0.2	0.12	54
Consumer Electronics	**10.4**			**21.0**		
TV CRT	5.3	1.7	128	4.4	0.5	277
TV Plasma				6.6	0.3	693
TV LCD				4.2	1.2	111
VCR	1.9	0.94	84			
DVD			15	0.6	1.3	15
IRD (digital box)	0.6	0.28	95	0.8	2	13
Computer	0.5	0.3	75	1.1	1	36
Games Console				3.3	1	105
Miscellaneous	2.1					
Cooking	**11.9**			**11.5**		
Hob - electric	3.0	0.46	270	2.8	0.43	203
Oven - electric	3.4	0.57	245	1.8	0.69	80
Kettle	3.9	0.95	170	4.5	1	140
Microwave	1.6	0.77	85	2.4	0.85	90
Lighting	**17.4**			**4.1**		

[21] Source: 40% House, Boardman et al 2005, chapter 6, taken from Fawcett et al 2000, and UKDCM.

Indoor	17.4	1	715	3.9	1	122
Security				0.2	1	5
Miscellaneous	4.0			4.0		
Wet	11.8			9.3		
Dishwasher	2.2	0.22	410	1.6	0.6	83
Tumble Dryer	3.1	0.35	365	1.0	0.25	128
Washing machine	5.1	0.77	270	1.1	0.5	72
Washer dryer	1.4	0.15	380	5.6	0.5	352
Total	**73.0**			**53.4**		
Total kWh per household	**3000**			**1680**		

Assumptions relating to new housing in the South West

Estimating growth in new housing stock in the South West

New housing for 2003-2006 has been based on data supplied by the Regional Development Agency for the South West region.

The annual increase in housing between 2006 and 2026 has been taken from the Regional Spatial Strategy which projects a requirement for 23,060 new properties annually up to 2026.

Scenarios for new housing

New housing has been modelled using three scenarios:

Scenario 1: Assuming that all new housing is built to Part L Building Regulations for 2006

Scenario 2: Assuming that all new housing is constructed to the standard set out in Code for Sustainable Homes Level 3.

Scenario 3: Assume a phase transition from Sustainable Buildings Code Level 3 to zero carbon

Scenario 1: New dwellings built to Part L Building Regulations

Under this scenario calculations have been based on a representative property constructed to 2002 building regulations, which have then been amended to reflect the higher energy efficiency standards under the revision to Part L of the building regulations in 2006. It has been assumed that the same property built to 2006 building regulations will have approximately a 20% reduction in CO_2 emissions resulting from energy use for space and water heating.

For each property the consumption resulting from space heating, water heating, lights and appliances and cooking has been itemised, based on information provided by the Energy Saving Trust.

Assumptions	
SW Housing stock in 2003[1]	21,360,00
No of dwellings constructed between 2003 and 2006[2]	44,899
No of dwellings scheduled to be built annually between 2006 and 2026	23,060
Estimated average delivered energy for **space heating** in new dwelling kWh per annum[3]	3,373
Estimated delivered energy requirement kWh per annum for hot water[4]	4,212
Estimated electricity demand for new dwellings for lights and appliances[6] assuming no growth kWh per annum	2,912
Proportion of new dwellings assumed to be on gas network	70%

Notes:

1 Derived from English House Condition Survey 2003.

2 As supplied by the RDA

3-6: Data supplied by the Energy Saving Trust for representative dwelling.

Using the data supplied by the Energy Saving Trust for a representative dwelling, the energy consumption for all new properties on a year on year basis has been calculated, and from this the resulting CO_2 emissions, based on 2006 Building Regulations.

Estimates of the likely distribution of new dwellings by built form have not been made. It is assumed that all new dwellings have the same energy consumption characteristics.

For new properties on the gas network it has been assumed that 64% of cooking is done using gas with the remainder done using electricity.

A slightly higher annual reduction factor of 0.989 for consumption due to lights and appliances was applied to new housing under this scenario assuming that the reduction started from now as opposed to 2010.

Under this scenario it has been assumed that 70% of the new dwellings constructed in the South West between 2006 and 2016 will be constructed on the gas network and will use gas for space heating and hot water.

It has been assumed that 70% of homes constructed off the gas network will use electricity for space heating and hot water, and 30% will use oil for space heating and hot water, up to 2020. Beyond 2020 it has been assumed that biomass replaces oil in new properties for space and water heating.

Scenario 2: New build dwellings constructed to Code for Sustainable Homes Level 3.

At the time of writing what is meant by the Code for Sustainable Homes Level 3 has yet to be defined in terms of carbon emissions. It has therefore been necessary to make assumptions about what this might mean, for the purposes of the carbon model.

It has been assumed that dwellings constructed to this standard will have a CO_2 'output' of 20kg/CO_2/m_2/yr, including cooking and appliances[22]. Dwellings built to this standard have been assumed to have a total floor area of 79m^2. This results in CO_2 emissions per dwelling of approximately half those under Scenario 1.

Emissions arising from lights and appliances have not been itemised under this scenario as it is assumed that in order to achieve the target CO_2 emissions from lights and appliances will be at, or close to, the consumption figure for 2050 as proposed in the 40% House report. For this reason, year on year reductions are assumed not to be feasible. (A higher figure has been used for lights and appliances in the table below to illustrate that there is some leeway in achieving the target).

This target of 20kg per m^2 per annum may be regarded as challenging but technically feasible. It may also be considered as higher than may be achieved through Eco Homes 'Very Good', though this is difficult to say definitely due to the way credits are awarded under Eco Homes. Eco Homes Very Good has been linked to level 3 of the Code for Sustainable Homes, and is referred to within the Regional Spatial Strategy. However, given the significant boost to standards given by the 2006 building regulations and the stated aim of Eco Homes to be requiring standards above building regulations, this may need some review. If level 1 is equivalent to building regulations (in the region of 35kg/CO_2/m_2/yr) and level 5 is carbon neutral, then having level three at anything higher than 20kg/CO_2/m_2/yr would leave a disproportionate gap between levels 3 and 5.

Constructing dwellings which reach this level of emissions could be achieved in a number ways, using a combination of demand reduction measures and renewable energy.

The target implies that the building will be constructed to a 'zero (or near zero) carbon heating and cooling' standard, and the use of some building integrated renewable energy.

[22] The latest indications from ongoing discussions around the code for sustainable homes suggest that this report's assumptions may be too stringent. However reducing standards to 35kgCO_2/m_2/yr from 20 for level 3 for all household emissions (not just emissions covered by the building regulations) will cause a reduction of around 2-3% in the savings achieved at the regional level by 2020. In order to compensate for this reduction, the region would need to fully implement the Regional Spatial Strategy policy by 2020 rather than secure only 50% compliance as currently assumed.

Zero carbon heating and cooling is usually achieved by increasing the level of insulation in the building envelope and making use of thermal mass (within the insulated envelope) to a level where the building no longer requires a boiler for space heating in the winter or air conditioning for cooling during the summer temperature.

In this case the bulk of the space heating is provided by incidental gains from the occupants themselves, heat gains from lights and appliances and from the sun (solar gain). However, a property of this type is usually constructed with some form of secondary heating for use during cold snaps or after the building has been unoccupied for a long period. This is frequently provided by a small biomass stove which may or may not have a back boiler.

The key to achieving this level of performance is the combination of very high levels of insulation and thermal mass within the insulated envelope which acts a sink retaining heat in the winter and coolth in the summer. The table below provides two examples of how emissions of 20kg per m^2 could be achieved.

Table 18: Achieving emissions of 20kg per m^2 using zero heating standard:

Assumed total floor area m^2	*79*	*Emissions CO2 kg/CO_2/m_2/yr*	*20*	*Total annual emissions CO2 kg*	*1580*
Scenario A	**Based on energy demand for Zero Heating dwelling as defined in GIR 53.**				
	Required energy	**Fuel**	**Carbon factor kg CO_2 per kWh**	**Annual emissions**	
Space heating requirement kWh	240	Biomass	0.025	6	
Water heating	1660	50% solar thermal 25% biomass 25% electricity	0.025 biomass 0.43 electricity	21 biomass 357 electricity	
Pump & Fan	330	Electricity	0.43	142	
Cooking	330	Gas	0.19	63	
Lights and appliances	2100	Electricity	0.43	903	
Total				**1492**	
Scenario B	**Assumes higher requirement for hot water and 500Wpeak PV system**				
Annual requirement for hot water	5000	50% solar thermal 25% biomass 25% electricity	0.025 biomass 0.43 electricity	32 biomass 538 electricity	
Annual contribution from 500Wpeak PV system kWh	400 contribution from PV system	Electricity (fuel off set)	0.43	172 carbon offset as a result of the PV system	
Total emissions kg				**1512**	

Notes:

- Energy demand figures taken from GIR 53 – Building A Sustainable Future, Energy Saving Trust, table 5, page 17, for a zero heating dwelling, unless otherwise specified.

- Space heating requirement is for secondary heating for use during periods of extreme cold.

- Solar thermal system assumed to provide 50% of the energy required for hot water per annum, and that circulating pump is powered by integral PV panel.

- PV panel assumed to produce 400kWh electricity per annum. System assumed to be monocrystalline and approximately $4m^2$

- The assumed demand for lights and appliances is higher than the figure used in the 40% House report for 2050. This is to illustrate that there is some leeway in achieving the overall target of 1580kg CO_2 per annum.

The target suggests that the energy demand for cooking and hot water will need to be considerably lower than those for property constructed to 2006 Building Regulations.

Scenario B shows how a higher demand for hot water could be offset by the use of a small PV system.

In all cases a higher demand in one area will need to be met by a lower demand in others or the greater use of renewable energy.

Where gas is not available for cooking the standard can still be met, provided the targets for hot water, lights and appliances can be met as shown in scenario A.

Within the carbon model no assumption has been made as to how the emissions target of 20kg per m^2 per annum of CO2 will be met.

Scenario 3: A phased transition to zero carbon developments

Under this scenario an increasing proportion of new dwellings are assumed to achieve zero carbon emissions, with the remainder being constructed to the Code for Sustainable Homes Level 3 standard as outlined within scenario 2.

In 2010 10% of all new developments constructed that year are assumed to be zero carbon. This increases on a linear basis to 36% by 2016, and then to 54% by 2020. By 2036 the upper limit is reached with 90% of new dwellings assumed to be constructed as zero carbon developments.

Modelling the impact of micro renewables – PV and small scale wind

The impact of emissions off set as a result of the adoption of PV and small scale wind has been modelled. The installation rates for both technologies have been based on analysis undertaken by Element Energy and the Energy Saving Trust in their report - *Potential for Microgeneration – Study and Analysis*. The rate of adoption assumes a full package of Government Funding, which approximately doubles the base rate of take up.

For each technology the number of installations by 2010, 2016, 2020 and 2050 have been plotted and the resulting offset in CO_2 emissions calculated.

Assumed outputs follow those in the Element Energy report, that is 2.5kW peak for the PV system and 800kWh per kW peak, and 1.5kW for micro wind, assuming a capacity factor of 17%.

The carbon offset factor for building integrated renewables (0.568kg CO_2 per kWh) has been derived from Building Regulations – Draft Approved Document L (2006 edition)[23]

Assessing the overall reduction in CO_2 emissions for existing and new housing in the South West

The different elements of the model described above are brought together in a spreadsheet to calculate the reduction in annual CO_2 emissions for the stock as a whole as a result of the package of measures required to achieve a given SAP rating.

The approach may be broken down into the following steps:

a. Modelled energy consumption figures by fuel type are taken from the baseline EHCS model prepared by Dr Moore and converted into emissions of carbon dioxide using the published carbon factors.
b. Modelled annual energy savings for each fuel type as a result of the package of energy efficiency measures are taken from the EHCS model and converted into carbon dioxide emission reduction figures
c. Actual energy savings and carbon dioxide emission reductions are calculated by applying the percentage savings calculated above to actual energy consumption and carbon dioxide figures for 2003
d. The savings generated by each of the SAP benchmarks is assumed to be achieved over time as follows, average SAP 65 and target SAP 65 in vulnerable households by 2010 and in all households by 2016 and target SAP 80 in all households by 2020
e. Final carbon dioxide emissions are calculated by summing emissions for the existing stock including estimates of future electricity demand and for new build on an annual basis.
f. Further reductions in carbon dioxide emissions from electricity as a result of micro renewables are then subtracted from the total.
g. The 1990 baseline has been set by calculating the difference between 2003 and 1990 carbon dioxide emissions in the UK and applying this factor to carbon dioxide emissions within the South West in 2003.
h. Each scenario as outlined in section 3 can then be modelled in terms of potential savings against the 1990 baseline used within government targets

[23] Report states that *'Grid displaced electricity comprises all electricity generated by building integrated power generation systems (PV, CHP etc)'* (page 6)

Modelling the impact of industry capacity

Reductions in CO2 emissions as a result of limitations in industry capacity have been modelled as follows:

a. Based on interviews with suppliers and installers of Ground Source Heat Pumps, Biomass boilers, Solid Wall Insulation and Solar Water Heating projections for the maximum number of measures which could be installed by 2016 and 2020 have been prepared under three scenarios, Low, Medium and High as outlined in table below.

b. For each of the listed measures a standard saving (kWh) has been calculated dependent on the displaced fuel and replacement measure (that is the measure that would be installed were the renewable energy measure not installed).

c. By calculating the total change in saving which would result from fewer of the listed measures being installed (or more in the case of solar thermal), revised savings by fuel are calculated for the low, medium and high scenario.

d. These revised saving figures are then fed into the carbon reduction model at step C above.

Table 19: Summarising the industry capacity scenarios modelled

Measure	Low scenario	Medium scenario	High Scenario
External wall insulation	Assumes that the current rate at which EWI is installed remains unchanged	Mid point between low and high scenarios	Assumes that the current installation rate doubles every five years (equivalent to 15% annual growth)
Ground source heat pumps	Assumes that current installation rate remains unchanged	Assumes that current installation rate doubles every five years (equivalent to 15% annual growth)	Assumes that the installation rate doubles every year
Biomass boilers	Assumes that current installation rate remains unchanged	Assumes 60% annual growth	Assumes that the installation rate doubles every year
Solar water heating	Assumes that the current installation rate remains unchanged	Assumes 25% annual growth	Assumes 50% annual growth