Energy Efficiency Commitment 2005-08

Background Information on the Illustrative Mix

Department for Environment, Food and Rural Affairs

February 2005 (replaces version of 6 December 2004)

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Background Information on the Illustrative Mix

Introduction

1. The Government consulted on the Energy Efficiency Commitment (EEC) 2005-08 from May to August 2004. The consultation document included an Illustrative Mix of measures, which explains how we derived the overall proposed target. As the name suggests, this mix is simply to illustrate that the target can be achieved by what is considered to be a plausible scenario. The Illustrative Mix in the consultation document proposed an overall target of 127 fuel-standardised lifetime-discounted TWh of energy efficiency improvements, which was subsequently corrected to 122.

2. As part of the consultation process, several changes were made to the Illustrative Mix,

    (i) in response to the consultation,

    (ii) because of new and updated information, and

    (iii) correcting or updating the model.

    The main changes are listed below.

3. These changes have resulted in an overall target of 130, but this is not directly comparable to the figure in the consultation document because of the variety of detailed corrections/refinements to the EEC model mentioned below.

4. This explanatory note should be read in conjunction with the final Illustrative Mix (Tables 1-3) below.

Changes to the Illustrative Mix comprise:

5. A correction to incorporate the increased energy savings and benefits resulting from projected higher internal temperatures in 2010. Previously only applied to the carbon savings, this increase in heating demand raises insulation savings by approximately 18% on average.

    See BRE paper for more details (Annex).

6. Updated energy improvement figures for insulation measures for 2010 from BRE, including the following changes:

    (i) Loft topup: thermal coefficient of existing insulation changed to be consistent with new CE marking

    (ii) Professional loft insulation: hatch insulation now included

(iii) Cavity wall insulation (CWI): 10% deducted for over-prediction by the model, as some building construction details resulting in unfillable areas are not included (based on EHCS data and BREDEM analysis).

(iv) Fuel mix updated[1] for 2010, based on new BRE projections.

See BRE paper for more details (Annex).

7. 'Comfort factor' differential between Priority and non-Priority Group removed, equalising it to 30% (used to be 45% and 15% respectively), because several studies[2,3] show no significant difference between the two groups. Studies[4] also suggest that real comfort taking in the long term is less than 30%, so this factor implicitly includes some allowance for potential underperformance of measures. The 10% over-prediction for CWI is separately (and additionally) applied to the energy improvement (see above).

8. Comfort factor for compact fluorescent lights (CFLs), boilers and heating controls reduced to zero, based on recent monitoring studies.

9. Lighting model revised, resulting in slightly different energy improvement for CFLs, as new information became available from a recent study.

   Assumptions for CFLs are based on the NES report[5]:

Assuming one bulb has already been replaced, Average of the next 4 bulbs chosen to be replaced				
	Stick	Lookalike/ Decorative	**Average**	**Comments**
Lifetime [hours]	15000	8000	10333	Ratio of Sticks to Lookalike/Decoratives: 1/3
Usage [hours/year]			648	NES report: average of bulbs 2-5 chosen to be replaced
Lifetime of measure [years]			15.96	
Electricity savings per unit [kWh pa]			33.5	NES report: average of bulbs 2-5 chosen to be replaced
Discounted lifetime electricity savings [kWh]			405	
Fuel-standardised lifetime-discounted energy savings, including the heat replacement effect [kWh]			208	If the heat replacement effect didn't exist, the score would be 324. In other words, it reduces the score by 35.7%.

[1] The projected fuel mix differences between the EEC period (when the scores are accredited to suppliers by Ofgem) and 2010 (for which the savings are estimated) are small enough for 2010 values to be used throughout the EEC model (error <1% of overall TWh score).

[2] *Monitoring Energy Savings achieved from Insulation Measures installed in Gas Heated Homes in SoP3 and EEC Schemes*, Paper by EST for Defra

[3] *Measurement of heating standards and temperatures in gas heated houses*, Chris Martin and Martin Watson, Energy Monitoring Company Ltd (August 2004)

[4] For example *Using historical monitoring data to examine the relationship between mean internal temperatures and dwelling heat losses*, Les Shorrock, BRE (May 2004)

[5] *Energy Monitoring Project for Lighting*, National Energy Services Ltd (June 2004)

The heat replacement factor is 56.8%, using 60% as in the BRE modelling report[6] but adjusting for 10% outside lighting (compared with 5% in the report).

10. The number of retail CFLs has been much reduced to 9.7m, while the number of direct CFLs has been increased to 32.6m, with the total remaining the same at 42.3m.

11. Heat replacement factors for CFLs and appliances updated on the basis of recent detailed modelling study.

    See above for CFLs, below for appliances, and MTP website for modelling report[6].

12. Appliance energy savings revised, based on new market data.

    The baseline is sales weighted (including A-rated). The average electricity savings for cold appliances assumes 2/3 A+ and 1/3 A++.

	Electricity savings (raw) [kWh/y]	**EEC score [MWh], incl. HRE**	**Reduction of EEC score due to HRE**	**Heat replacement factor**
Fridgesavers-type schemes	345	1.877	29.8%	47.4%
Appliances - Cold	154	0.836	29.8%	47.4%
Appliances - Wet	23.9	0.181	1.6%	2.5%
Appliances - Set Top Boxes	41.9	0.154	33.1%	52.6%

HRE: Heat replacement effect.

The heat replacement factor is based on using 50% (except for wet appliances). For cold and wet appliances it is adjusted for 10% outside (instead of 5%), while all set top boxes are expected to be in heated areas.

The savings for set top boxes are based on the following assumptions (based on MTP):

		Units	**Reference**	**Best Practice**
Power	Standby	W	6.61	1
	On		8.56	6
Usage	Standby	Hours per Day	17.5	17.5
	On		6.5	6.5
Annual Unit Consumption		kWh/y	62.5	20.6
Annual Unit Savings		kWh/y		**41.9**

[6] MTP Briefing Note BNXS29; for further details on the heat replacement effect see MTP website http://www.mtprog.com/ApprovedBriefingNotes/OverviewoftheHeatReplacementEffect.aspx.

13. Fuel switching assumptions updated using new information, including the fraction of fuels being replaced and their efficiencies.

    Switching from non-central heating to central heating:

Old system	Efficiency	Fraction by fuel of old system		
		Priority Group	Non-PG	Weighted average
Solid fuel	40%	40%	60%	44%
Electric	90%	40%	20%	36%
Gas	60%	20%	20%	20%
		100%	100%	100%

    The new system is assumed to be a gas central heating system with a condensing boiler efficiency of 90%.

14. Glazing included as a new measure: upgrading from E to C-rated, taking advantage of the newly introduced energy labelling.

    See BRE paper for more details (Annex).

15. DIY loft insulation cost estimate increased by 12.5%, in line with the amount of material used for non-qualifying purposes.

16. Fuel price projections revised, based on new data from DTI.

    These are shown below. However, in the final illustrative mix, dated 29 October 2004 (see below) and published on 6 December 2004, a mistake had been made in the conversion of DTI data from *therms* into *kWh*. This meant that the fuel prices, and hence the energy benefits were underestimated by 16.4%. The average annual benefits per household from EEC 2005-08, at the end of the programme and in 2010, are therefore about £18 instead of £15.50 as indicated in Table 1. The value of continuing benefits beyond 2010 will depend on future prices, the lifetimes of the measures, and the underlying upward trend in demand for heating and other energy services. The correct fuel price projections are as follows:

    Fuel prices in p/kWh including VAT (Oct-04 DTI projections in 2004 prices):

Year	Electricity (standard)	Electricity (heating)	Gas	Solid fuel	Oil
2004	7.64	5.46	1.93	2.45	1.43
2005	7.79	5.56	2.03	2.55	1.48
2006	7.84	5.60	2.00	2.49	1.44
2007	7.90	5.64	1.97	2.43	1.40
2008	7.96	5.69	1.94	2.37	1.36
2009	8.02	5.73	1.91	2.31	1.32
2010	8.08	5.77	1.88	2.25	1.28
2011	8.09	5.78	1.89	2.25	1.29

DTI estimates. Estimates may not be directly comparable with official published data on energy prices, as there may be differences in coverage and definition.

17. Average seasonal heating efficiency in 2010 increased from 77% to 78%, based on updated BRE model.

Defra

February 2005

(Replaces version of 6 December 2004)

TABLE 1: EEC 2005-08. ILLUSTRATIVE MIX OF POSSIBLE ENERGY EFFICIENCY MEASURES; COSTS AND BENEFITS ANALYSIS

1	2			3	4		5		6			7	8	9					10	11
Illustrative mix of possible EEC measures	Number of installations by 31 March 2008			Unit cost per measure	Supplier contribution to cost of measure		One-off consumer or landlord financial contribution		Non-ongoing impact on annual energy prices, average over EEC period - £M / £ per gas and electricity bill, and per household (excluding VAT)			Over-head costs (incl. in column 6), average annual £M	Ongoing annual energy benefit to house-holds in 2010	Ongoing annual energy benefits by 2010 - £M aggregate / £ per household p.a. (including VAT)					Adjustment for "comfort taking" allowance in EEC	Annual Carbon Saving in 2010
	Business As Usual subsidised by EEC (1)	Additional due to EEC programme (2)	Total		Priority Group (see Table 1A)	Other h'holds (see Table 1B)	Priority Group (see Table 1A)	Other h'holds (see Table 1B)						Priority Group		Other households		Total benefits	All GB house-holds	
	M	M	M	£	£	£	£	£	£M	£/bill (3)	£/hh (3)	£M	GWh	£M	£/hh	£M	£/hh	£M	£/hh	%	MtC/y
Cavity wall insulation - private	0.12	0.88	1.00	314	304	195	0	130	108	2.33	4.24	24.96	5,146	45	5.10	51	3.03	95	3.74	30	0.18
Cavity wall insulation - social	0.12	0.58	0.70	310	152	163	152	163	44	0.96	1.74	8.18	3,504	45	5.10	20	1.21	65	2.55	30	0.12
Loft ins - professional - private (4)	0.07	0.64	0.70	259	252	162	0	108	58	1.26	2.28	9.39	1,908	18	2.01	18	1.06	35	1.39	30	0.06
Loft ins - professional - social (4)	0.02	0.40	0.42	261	126	135	126	135	21	0.46	0.84	3.49	785	10	1.14	5	0.27	15	0.57	30	0.03
Loft insulation DIY (4)	0.23	0.23	0.46	132	75	80	50	53	14	0.30	0.54	1.53	1,535	3	0.36	25	1.52	28	1.12	30	0.03
Glazing E to C rated (in m^2)	0.00	4.50	4.50	10	7	6	2	4	10	0.22	0.20	0.60	122	1	0.14	1	0.06	2	0.09	30	0.00
B to A-rated boilers	0.08	0.93	1.00	50	50	50	0	0	20	0.43	0.78	3.33	1,154	10	1.19	8	0.50	19	0.74	0	0.06
A/B rated boilers (exceptions)	0.00	0.20	0.20	193	154	117	33	83	11	0.24	0.44	1.86	634	5	0.61	5	0.30	10	0.40	0	0.03
Fuel Switching (5)	0.00	0.06	0.06	1798	1595	728	177	1172	30	0.65	1.18	0.93	485	10	1.13	5	0.29	15	0.58	30	0.05
Heating controls - upgrade with boiler replacement	0.00	0.45	0.45	82	67	50	12	35	11	0.23	0.43	1.94	306	3	0.31	2	0.13	5	0.20	0	0.02
Heating controls - extra	0.00	0.09	0.09	134	111	82	20	58	4	0.08	0.15	0.67	173	2	0.20	1	0.09	3	0.13	0	0.01
CFLs - retail	5.92	3.83	9.7	3.70	1.11	1.11	2.59	2.59	4	0.09	0.17	0.65	89	1	0.13	17	1.03	18	0.72	0	0.01
CFLs - direct	12.00	20.64	32.6	3.90	3.90	1.95	0.00	1.95	33	0.71	1.29	5.44	297	18	2.03	43	2.60	61	2.40	0	0.05
Fridgesavers-type schemes	0.00	0.10	0.10	120	90	0	30	0	3	0.07	0.13	0.37	14	2	0.23	0	0.00	2	0.08	0	0.00
Appliances - Cold	0.00	0.88	0.88	20	20	20	0	0	7	0.14	0.26	0.88	53	1	0.11	7	0.41	8	0.31	0	0.01
Appliances - Wet	0.00	1.17	1.17	10	10	10	0	0	5	0.11	0.20	1.17	27	0	0.03	2	0.10	2	0.08	0	0.00
Appliances - Set Top Boxes	0.00	0.50	0.50	1.40	1.40	1.40	0	0	0	0.01	0.01	0.03	7	0	0.05	1	0.05	1	0.05	0	0.00
Tank insulation - top-up	0.28	0.18	0.46	13	11	8	2	5	2	0.04	0.08	0.55	206	2	0.26	2	0.09	4	0.15	0	0.00
Draughtproofing	0.00	0.31	0.31	95	81	55	14	40	9	0.20	0.37	2.25	227	2	0.28	2	0.10	4	0.17	30	0.01
Total EEC									**396**	**£8.54**	**£15.33**	**68**	**16,670**	**180**	**£20.42**	**214**	**£12.82**	**394**	**£15.45**		**0.68**

NOTES

Number of households: Electricity: 25.5m; gas: 20.9m
Priority group estimate for 2005-2008 comprises all households in receipt of income-related benefits and tax credits, including Pension Credit and thresholded Child Tax Credit: total 8.8 million out of 25.5 million
Assumed energy prices: Electricity (daytime) 6.79p/kWh; Electricity (night) 4.85p/kWh; gas 1.69p/kWh average over 2005-2008
Annual energy benefits are calculated on the basis of total installations, but Business As Usual 'deadweight' is excluded from carbon savings (and from target energy savings in Table 2)
Costs and prices are quoted in today's money (2004)

(1) Component of Business as Usual (BAU) 'deadweight' assumed to be taken up and subsidised by EEC. May be less than total BAU if EEC installations total does not meet BAU.
(2) Additionality depends on the distribution of BAU between tenure groups, as well as total BAU and EEC installation numbers
(3) Programme costs equate to *£8.97/bill* or *£16.09/household* including 5% VAT
(4) Loft Insulation: professional installation assumed to be about 9% full, 91% top-up to 270mm. DIY schemes are assumed to average 20% full and 80% top-up.
(5) Fuel switching: switching to central heating with condensing boiler from non-central heating with gas (20%), electricity (36%) and solid fuel (44%).

	Priority Group	Other households
Proportion of households	35%	65%
Target (standardised TWh)	50%	50%
Programme cost	61%	39%
Energy cost benefits	46%	54%

29-Oct-2004

TABLE 1A: EEC 2005-08. SUPPLIER AND CONSUMER OR LANDLORD CONTRIBUTION BY TENURE GROUP PRIORITY GROUP

Illustrative EEC measures	Supplier contribution to cost of measure - Priority Group			One-off consumer or landlord financial contribution - Priority Group		
	Owner Occupiers	Private Tenants	Social Housing Tenants	Owner Occupiers	Private Tenants	Social Housing Tenants
	£	£	£	£	£	£
Cavity wall insulation - private	304	304		0	0	
Cavity wall insulation - social			152			152
Loft ins - professional - private	252	252		0	0	
Loft ins - professional - social			126			126
Loft insulation DIY	75	75	75	50	50	50
Glazing E to C rated (in m2)	9	9	5	0	0	5
B to A-rated boilers	50	50	50	0	0	0
A/B rated boilers (exceptions)	187	187	93	0	0	93
Fuel Switching	1773	1773	886	0	0	886
Heating controls - upgrade with boiler replacement	79	79	40	0	0	40
Heating controls - extra	131	131	65	0	0	65
CFLs - retail	1.11	1.11	1.11	2.59	2.59	2.59
CFLs - direct	3.90	3.90	3.90	0.00	0.00	0.00
Fridgesavers-type schemes	90	90	90	30	30	30
Appliances - Cold	20	20	20	0	0	0
Appliances - Wet	10	10	10	0	0	0
Appliances - Set Top Boxes	1.40	1.40	1.40	0.00	0.00	0.00
Tank insulation - top-up	13	13	7	0	0	7
Draughtproofing	95	95	48	0	0	48

TABLE 1B: EEC 2005-08. SUPPLIER AND CONSUMER OR LANDLORD CONTRIBUTION BY TENURE GROUP
OTHER HOUSEHOLDS

Illustrative EEC measures	Supplier contribution to cost of measure - Other households			One-off consumer or landlord financial contribution - Other households		
	Owner Occupiers	Private Tenants	Social Housing Tenants	Owner Occupiers	Private Tenants	Social Housing Tenants
	£	£	£	£	£	£
Cavity wall insulation - private	195	195		130	130	
Cavity wall insulation - social			163			163
Loft ins - professional - private	162	162		108	108	
Loft ins - professional - social			135			135
Loft insulation DIY	80	80	80	53	53	53
Glazing E to C rated (in m2)	6	6	5	4	4	5
B to A-rated boilers	50	50	50	0	0	0
A/B rated boilers (exceptions)	120	120	100	80	80	100
Fuel Switching	627	627	950	1273	1273	950
Heating controls - upgrade with boiler replacement	51	51	43	34	34	43
Heating controls - extra	84	84	70	56	56	70
CFLs - retail	1.11	1.11	1.11	2.59	2.59	2.59
CFLs - direct	1.95	1.95	1.95	1.95	1.95	1.95
Fridgesavers-type schemes						
Appliances - Cold	20	20	20	0	0	0
Appliances - Wet	10	10	10	0	0	0
Appliances - Set Top Boxes	1.40	1.40	1.40	0.00	0.00	0.00
Tank insulation - top-up	8	8	7	5	5	7
Draughtproofing	57	57	48	38	38	48

TABLE 2: EEC 2005-08. BASIS OF TARGET

Possible EEC Measure	Total installations via EEC programmes (including 'deadweight')	Lifetime of measure	Net Energy Improvement (1)		Discounted aggregate energy improvement for lifetime of measure				Discounted aggregate energy improvement for lifetime - fuel standardised GWh				**Total EEC target, lifetime-discounted and fuel-standardised**
			Per year	Discounted aggregate (3.5%) over lifetime	Electricity	Gas	Coal	Oil	Electricity	Gas	Coal	Oil	
	M	Years	MWh/Unit/yr	MWh/unit	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	**TWh**
Cavity wall insulation - private	1.00	40	5.15	110.1	7,139	93,641	1,827	7,276	5,719	33,069	1,018	3,373	**43.2**
Cavity wall insulation - social	0.70	40	5.00	106.7	4,862	63,770	1,244	4,955	3,894	22,520	693	2,297	**29.4**
Loft ins - professional - private	0.70	30	2.71	49.8	2,280	29,901	583	2,323	1,826	10,559	325	1,077	**13.8**
Loft ins - professional - social	0.42	30	1.87	34.5	938	12,300	240	956	751	4,344	134	443	**5.7**
Loft insulation DIY	0.46	30	3.34	61.4	1,834	24,058	469	1,869	1,469	8,496	261	867	**11.1**
Glazing E to C rated (in m2)	4.50	20	0.03	0.4	112	1,474	29	115	90	521	16	53	**0.7**
B to A-rated boilers	1.00	15	1.15	13.3	0	13,293	0	0	0	4,694	0	0	**4.7**
A/B rated boilers (exceptions)	0.20	15	3.10	35.7	0	7,302	0	0	0	2,579	0	0	**2.6**
Fuel Switching	0.06	15	7.91	91.1	3,239	-6,128	8,470	0	2,595	-2,164	4,718	0	**5.1**
Heating controls - upgrade with boiler replacement	0.45	15	0.68	7.9	0	3,523	0	0	0	1,244	0	0	**1.2**
Heating controls - extra	0.09	15	1.88	21.7	129	1,698	33	132	104	600	18	61	**0.8**
CFLs - retail	9.75	16.0	0.01	0.1	3,758	-2,448	-48	-190	3,010	-864	-27	-88	**2.0**
CFLs - direct	32.64	16.0	0.01	0.1	12,583	-8,196	-160	-637	10,080	-2,895	-89	-295	**6.8**
Fridgesavers-type schemes	0.10	12	0.14	1.3	327	-176	-3	-14	262	-62	-2	-6	**0.2**
Appliances - Cold	0.88	12	0.06	0.6	1,251	-674	-13	-52	1,002	-238	-7	-24	**0.7**
Appliances - Wet	1.17	12	0.02	0.2	268	-7	0	-1	215	-3	0	0	**0.2**
Appliances - Set Top Boxes	0.50	8	0.01	0.1	138	-83	-2	-6	110	-29	-1	-3	**0.1**
Tank insulation - top-up	0.46	10	0.45	3.7	111	1,459	28	113	89	515	16	53	**0.7**
Draughtproofing	0.31	20	0.74	10.5	210	2,750	54	214	168	971	30	99	**1.3**
TOTAL					**39,180**	**237,454**	**12,752**	**17,052**	**31,385**	**83,855**	**7,103**	**7,905**	**130.2**

(1) including the heat replacement effect for CFLs and appliances

TABLE 3: EEC 2005-08. ASSUMED COSTS AND DISTRIBUTION

Possible EEC Measure	Unit Cost of Measure for 3 Bed Semi (Year 2004 Prices)	Estimated Indirect Costs for 3 Bed Semi			Priority Group fraction of installations	Social Housing fraction of total installations	Social Housing fraction of PG installations	Owner Occupier fraction of PG installations	Private Rented fraction of PG installations	Social Housing fraction of Other HH installations	Owner Occupier fraction of Other HH installations	Private Rented fraction of Other HH installations
		Owner Occupier	Social Housing	Private Rented								
	£	£	£	£	%	%	%	%	%	%	%	%
Cavity wall insulation	326	75	35	75	59%	41%	50%	48%	2%	28%	70%	2%
Loft insulation - professional	270	40	25	40	59%	37%	45%	52%	3%	26%	73%	2%
Loft insulation DIY	134	10	10	10	13%	0%	0%	100%	0%	0%	100%	0%
Glazing E to C rated (in m2)	10	1.00	0.60	1.00	56%	39%	50%	48%	2%	24%	74%	2%
B to A-rated boilers	50	10	10	10	59%	33%	44%	53%	3%	17%	81%	2%
A/B rated boilers (exceptions)	200	30	20	30	56%	27%	35%	62%	3%	17%	81%	2%
Fuel Switching	1900	50	30	50	80%	22%	20%	76%	4%	31%	67%	2%
Heating controls - upgrade with boiler replacement	85	13	13	13	59%	25%	30%	67%	3%	17%	81%	2%
Heating controls - extra	140	22	22	22	59%	25%	30%	67%	3%	17%	81%	2%
CFLs - retail	3.70	0.20	0.20	0.20	6%	19%	44%	53%	3%	17%	81%	2%
CFLs - direct	3.90	0.50	0.50	0.50	29%	25%	44%	53%	3%	17%	81%	2%
Fridgesavers-type schemes	120	11	11	11	100%	44%	44%	53%	3%	0%	0%	0%
Appliances - Cold	20	3	3	3	13%	21%	44%	53%	3%	17%	81%	2%
Appliances - Wet	10	3	3	3	13%	21%	44%	53%	3%	17%	81%	2%
Appliances - Set Top Boxes	1.40	0.20	0.20	0.20	35%	26%	44%	53%	3%	17%	81%	2%
Tank insulation - top-up	13	4	4	4	59%	25%	30%	67%	3%	17%	81%	2%
Draughtproofing	95	22	22	22	59%	25%	30%	67%	3%	17%	81%	2%
		Equal no. of installations per household:			35%	22%	41%	49%	10%	11%	79%	10%

Note: 72% of Social Housing tenants are assumed to be in the Priority Group

Annex

BREDEM CALCULATIONS FOR EEC2 ILLUSTRATIVE MIX

This note describes the key parameters and BREDEM modelling undertaken by BRE that contributed to the calculation by DEFRA of the 'Illustrative Mix' for the Energy Efficiency Commitment 2005-2008 (EEC2). These key parameters are, of course, also the basis for the subsequent calculations of energy credits which Ofgem is planning to attribute to energy suppliers for individual energy efficiency measures in EEC2.

Brief overview of BREDEM

BREDEM was developed in the early 1980s as a relatively simple but reliable calculation procedure for estimating the energy use of dwellings. It has been, and continues to be, subjected to testing and development, and has become very widely used as a calculation tool. BREDEM has been extensively tested against the monitored energy consumption of real houses, and against more detailed complex simulation models. The results show good agreement, and indicate that predictions of annual energy consumption from BREDEM are as good as those from the detailed simulation models used[1].

'Typical' 2010 parameters for existing housing stock

The BREDEM calculations for the EEC2 Illustrative Mix were based on a semi-detached house, with a total floor area of 89m^2, which matches the average floor area for dwellings in the country. Calculated savings for this semi-detached are used to represent the wide range of sizes and shapes of dwellings in the housing stock. For these calculations, the following estimates for a 'typical dwelling' of the building stock in 2010 were developed, as follows.

	Value	Source of estimate for 2010
Loft U-value	0.322	150mm depth insulation. Estimated from the Domestic Energy Factfile (DEFF)
Wall U-value	1.1	Estimate of weighted U-value average in 2010. (This value is close to an uninsulated post'76 cavity and is between extremes of solid wall and insulated cavity wall)
Glazing U-value	2.8	Double glazed 12mm wood/uPVC frame – estimated as typical from DEFF, and is between extremes of single glazing and current regulations U-value 2.0
Tank insulation	55 mm jacket	Derived from Market Transformation Programme work
% of low energy lamps	20%	Estimate for 2010 using EHCS 1998 Follow Up Survey data, with SoP and EEC1 & 2 estimates
Heating efficiency	Gas 79% Oil 83%	BRE UK Boiler Energy Model, taking account of anticipated changes to regulations. (note: in BREDEM these values are reduced by 1 % point to account for boilers without an interlock)
Heating controls	50% TRVs	Estimate for 2010, using EHCS 1996 and 2001 data.

[1] CIBSE A: Building Serv. Eng. Res. Technol. 17(3) 135-140(1996). BREDEM: Testing monthly and seasonal versions against measurements and against detailed simulation models. C.M.Dickson, J.E.Dunster, S.Z.Lafferty, and L.D.Shorrock.

It is estimated that the difference between average internal and external temperatures, averaged over the stock, will increase by 1.5°C in the decade 2001 to 2010. This is consistent with the projected temperature increase used for scenarios developed using BREHOMES. The heating standard in BREDEM was therefore adjusted to give this increase in 24hr average internal temperature (the average external temperature was not altered), as compared with a 2001 'typical dwelling'.

Heating regime for central heating

The 2001 'typical dwelling' for gas central heating (which dominates the stock) was established. Parameters were then adjusted to estimates for 2010 (as described above). To achieve an average internal temperature increase of 1.5°C, the heating regime was modified to the following.

- Zone 1 demand temperature 21.3°C (previously 21°C)
- Zone 1 as 50% of dwelling (previously 25%)
- Zone 1 and 2 (nominal) temperature difference of 1°C (previously 3°C)

A standard heating on/off pattern, of morning and evening during weekdays and all day at the weekend, is retained - there is no indication that this will not remain the most common heating pattern, and is considered to be representative of the average.

Heating regime for non-central heating

For dwellings with heating other than central heating, past surveys have indicated an internal average temperature around 2.5°C lower. This was achieved in BREDEM with a non-centrally heated house with the following heating regime.

- Zone 1 demand temperature 21°C
- Zone 1 as 25% of dwelling
- Zone 1 and 2 (nominal) temperature difference of 5.4°C

It is considered that in general, zone 1 will tend to be kept well heated, while zone 2 will have lower temperatures, which are likely to vary significantly between individual rooms depending on their use and occupancy. The higher temperature difference between zone 1 and 2 is used to represent the overall lower heating standard in zone 2.

Parameters used to calculate savings for individual measures

LOFT INSULATION
Conductivity of 0.044 W/mK used for existing and installed insulation.
Loft hatch considered to be not insulated or draught-proofed before installation.

Professionally installed
– loft hatch insulated and draught-proofed after installation, insulation cross laid over joists.

DIY installed
– loft hatch not insulated or draught-proofed after installation, no cross laying.

U-values for a typical pitched roof

Thickness of insulation (mm)	U-value of roof (W/m^2K)	Comments
0	**2.3**	
25	**1.123**	Insulation between joists; Loft hatch not insulated before (Professional & DIY)
50	**0.735**	
75	**0.551**	
100	**0.443**	
270	**0.265**	Insulation between joists; Loft hatch not insulated (DIY)
270	**0.159**	Insulation between & over joists; Loft hatch insulated (Professional)
Lambda value 0.044 W/mK		

1. Uninsulated loft calculated to allow resistance of the rafter level components to be taken account of (this is only significant when no insulation is present).
2. Note: U-value of 0.25 for 270mm laid between joists, increased to 0.265 for uninsulated loft hatch. These values for 270mm between joists are best estimates..

CAVITY WALL INSULATION

An analysis of the extent and effect of unfillable areas of wall was undertaken. This included the effect of areas of tile hanging, solid walls, and conservatories, where insulation would not be possible. As a result of this analysis, the BREDEM calculated energy savings were reduced by 10%.

To calculate cavity wall insulation savings, a pre-1976 wall is taken to be a brick outer leaf, 65mm cavity, and brick inner leaf finished with a dense plaster. A post-1976 wall is assumed to have a U-value consistent with the Building Regulations of that time. Insulated walls assume injection of a material with a lambda of 0.04 W/mK.

Wall	**U-value of wall (W/m^2K)**
Pre 1976 uninsulated	1.44
Pre 1976 insulated	0.48
Post 1976 uninsulated	1.00
Post 1976 insulated	0.42

DRAUGHT-PROOFING

This was calculated on the same basis as for EEC1.

GLAZING
The BFRC Windows Energy Rating bands were used, and savings calculated for upgrading glazing from E-rated to C, B, and A-rated, for a 2010 typical dwelling. The savings were calculated using BREDEM with glazing parameters from the Windows Energy Rating Method. (Other parameters for the dwelling were as described earlier).

Fuel mix weighting of savings

Energy savings were thus calculated using BREDEM and the parameters above, for the measures in the illustrative mix. Values were obtained for each of the seven heating system types:
- Gas, oil, solid fuel central heating, and electric storage heating
- Gas, electric and oil non-central heating

Scenarios developed by BRE were used to obtain a 2010 fuel consumption split by fuel consumption in terms of delivered energy for the above seven heating system types.
This was transformed to a fuel consumption split in terms of useful energy (i.e. the useful heating output from a heating system)[2]. This split was then used by DEFRA to weight the savings calculated for each measure to obtain an average saving..

[2] It would be incorrect to weight the savings from each measure by the split in terms of delivered energy to obtain the EEC2 target, as the energy savings depend on the useful heating energy output. For example, solid fuel heated dwellings consume more delivered energy in general than dwellings heated by other fuels, and this will increase their weighting. However, the energy savings calculated for solid fuel are already high because they have taken account of the heating system efficiency. It would also be incorrect to weight the savings from each measure by the split in terms of number of dwellings with each heating system. This is because, for example, the savings for oil heated homes are on average greater per dwelling than for other fuels, due to the larger size of homes heated by oil, whereas the energy savings have been calculated for dwellings of a fixed size.