Energy Efficiency Commitment 2005-2008

Technical Guidance Manual Issue 1

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Summary

This is the first edition of the Technical Guidance Manual produced for the purposes of the Electricity and Gas (Energy Efficiency Obligations) Order 2004 ("the Order"). Specifically, the role of the manual is to provide information on:

- the factors taken into account in quantifying the improvement in energy efficiency to be attributed to the installation or provision of a type of action (eg, loft or cavity wall insulation, a low energy light bulb), and
- best practice guidelines which Ofgem encourages suppliers to comply with in relation to each action.

Chapter 1 outlines the rationale for this document. Chapters 2 to 7 relate to the four main types of energy efficiency action (insulation, lighting, heating and appliances) and two more specific types of action; Combined Heat and Power (CHP) and fuel switching. For each action included in these chapters, information is provided on the attribution of the improvement in energy efficiency in terms of:

- the basis of the annual energy saving applied,
- the lifetime of the action, and
- the technical standards or specific requirements for the delivery or installation of the action which must be adhered to in order for the attributed improvement in energy efficiency to be awarded.

The manual includes the most common energy efficiency actions which Ofgem may be satisfied will lead to an improvement in energy efficiency for the purposes of a supplier meeting its energy efficiency obligation under the Order. The manual is not intended as an exhaustive list of actions that may be qualifying actions under the Order.

Energy saving values for insulation and heating measures have been calculated using the Building Research Establishment's Domestic Energy Model (BREDEM). These savings are displayed in the EEC Scheme Spreadsheet which is provided to EEC obligated suppliers separately to this document. The Building Research Establishment's (BRE) assumptions for these energy saving values are detailed in full in the report contained in Appendix 1 of this document.

The Technical Guidance Manual should be used in conjunction with the ‘Energy Efficiency Commitment 2005-2008: Administration Procedures’ and the EEC Scheme Spreadsheet. The Administration Procedures document can be viewed at www.ofgem.gov.uk by selecting Energy Efficiency from the ‘Ofgem’s work’ section. The EEC Scheme Spreadsheet is disseminated to EEC obligated suppliers.

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1. Rationale

1.1. The Electricity and Gas (Energy Efficiency Obligations) Order 2004 ('the Order') came into force on 22 December 2005. It is the statutory basis for the Energy Efficiency Commitment 2005 – 2008 ("the EEC"). The procedures by which Ofgem carries out its functions under the Order are set out in the Ofgem publication Energy Efficiency Commitment 2005 – 2008 Administration Procedures, December 20041.

1.2. The Order relates to obligations on certain suppliers in the period from 1 April 2005 until 31 March 2008 and forms part of the Government's Climate Change Programme and Fuel Poverty Strategy. It follows on from the Electricity and Gas (Energy Efficiency Obligations) Order 2001 which was preceded by the Energy Efficiency Standards of Performance (EESoP) programmes (1994 – 2002).

Administration of the EEC

1.3. The Order sets an overall target for improvements in energy efficiency of 130 fuel-standardised, lifetime-discounted terawatt hours (TWh). Ofgem is required to apportion this overall target to certain gas and electricity supply licensees. A supplier meets its target by achieving improvements in energy efficiency attributable to qualifying actions and ensuring that at least 50% of the total improvement it achieves is in relation to the 'Priority Group' - domestic consumers receiving certain benefits or tax credits.

1.4. In setting the overall target of 130 fuel-standardised, lifetime-discounted TWh, Defra developed a model to derive an illustrative mix of possible energy efficiency actions which suppliers might deliver during the three years of the EEC ("the Target Setting Model").

1.5. The Order requires each obligated supplier to notify Ofgem of the actions which it intends to count towards its energy efficiency target. Ofgem will approve a scheme of action if it is satisfied that it will lead to an improvement in energy efficiency. Once a scheme has been completed, suppliers are required to notify Ofgem so it can quantify the amount of any improvement in energy efficiency in

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[1] EEC 2005 – 2008 Administration Procedures, December 2004 is available on Ofgem's website www.ofgem.gov.uk

relation to domestic consumers, estimate the lifetime of that improvement and the amount of the improvement in relation to domestic consumers in the Priority Group.

Quantifying improvements in energy efficiency

1.6. Ofgem will use a three step process, in accordance with Defra's Target Setting Model, to determine the improvement in energy efficiency to be attributed to an action. Firstly, the annual energy saving will be calculated. Secondly that amount will be fuel-standardised. Thirdly, the resulting amount will be lifetime-discounted.

Annual energy saving

1.7. The annual energy saving (kWh/a) represents the improvement in energy efficiency achieved by the action[2] in a year. For the majority of insulation and lighting actions, this will be a comparison of the before and after scenarios (with all other relevant circumstances remaining the same). One example is comparing the energy required to be consumed to heat a home to the same level before and after insulation has been installed.

1.8. For actions that require installation into the physical fabric of a consumer's property eg, insulation and heating actions, Ofgem will accredit the energy savings based upon the type of property and the number of bedrooms the property has (on the basis of average property sizes in Great Britain).

1.9. For actions in relation to which existing legal requirements apply, improvements in energy efficiency for the purposes of the Order are those that exceed the existing legal requirements. The energy saving will be determined by comparing the energy consumption of the dwelling after the installation of the action with the energy consumption of the property compliant with the legal standards required.

1.10. For example, the Building Regulations 2000 require reasonable provision for the conservation of fuel and power in domestic premises. As there is already a legal requirement to meet the Building Regulations 2000, a supplier's action must lead to improvements in energy efficiency above what would be achieved to meet those requirements.

1.11. The Building Regulations 2000 apply to England and Wales. Part L relates to requirements in respect of conservation of fuel and power in dwellings. Approved Document L1[3] provides guidance on compliance. It is due to be revised by the Office of the Deputy Prime Minister, with the changes coming into force on 1 April 2005. The expected changes to Approved Document L1 were included in the Target Setting Model. References in this document to the guidelines to the Building Regulations 2000 are to Approved Document L1 as amended.

1.12. The Building (Scotland) Act 2003[4] is due to be amended on 1 May 2005. Ofgem will approve actions that will result in improvements in energy efficiency above those required by that Act.

1.13. Further amendments to the Building (Scotland) Act 2003 may come into effect in 2007 and, if so, Ofgem will reconsider this issue at that time.

Fuel standardisation

1.14. Fuel-standardisation multipliers have been included in the Order and are applied to the annual energy saving for an action. The multipliers reflect the different carbon content of the fuels. Therefore, different energy savings are applicable to actions depending on the associated fuel. For example, when installing insulation the supplier must determine the fuel used to heat the property to ensure that the appropriate improvement in energy efficiency is claimed.

Lifetime–discounting

1.15. To calculate the lifetime-discounted, fuel-standardised energy savings (GWh), the annual fuel-standardised energy saving is discounted at 3.5% over the estimated lifetime of the action. The 3.5% discount factor is the standard HM Treasury discount rate and was used in the Target Setting Model.

1.16. A spreadsheet has been developed by Ofgem to detail the annual energy savings (kWh/a) associated with the common energy efficiency measures ("the EEC

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[2] This term relates to categories of technology eg lighting measures, insulation measures

[3] "Approved Document L1, Conservation of fuel and power in dwellings" 2002 edition, Office of the Deputy Prime Minister

[4] References to the Building Regulations in this document are to be read as referring to the provisions of the corresponding legislation in Scotland, the Building (Scotland) Act 2003 unless indicated otherwise.

Scheme Spreadsheet"). The spreadsheet has the functionality to automatically calculate the lifetime-discounted, fuel-standardised energy saving attributable to an action and is available to those suppliers with an energy efficiency target.

The role of the Technical Guidance Manual

1.17. The Technical Guidance Manual should be read in conjunction with Ofgem's Administration Procedures. It provides information on the actions that Ofgem expects suppliers will most commonly promote. Chapters 2, 3, 4, 5 and 6 divide the common energy efficiency actions into insulation, lighting, heating, appliances and CHP. For each type of action, the Technical Guidance Manual provides details information on:

- the factors taken into account in quantifying the improvement in energy efficiency to be attributed to an action, specifically:
    - details of the basis of the annual energy saving figures in the EEC Scheme Spreadsheet;
    - the estimate of the lifetime of the measure, and
    - the technical standards or specific requirements to be met when delivering or installing an action to ensure that the improvement in energy efficiency that may be attributed is realised.
- Best practice guidelines which Ofgem encourages suppliers to comply with in relation to the installation of actions.

1.18. Chapter 7 provides some specific guidelines on how to demonstrate improvements in energy efficiency when delivering fuel switching schemes.

1.19. It should be noted that the manual is not an exhaustive list of the actions that Ofgem may be satisfied will lead to an improvement in energy efficiency. If a supplier wishes to promote an action which is not listed in this document, it must provide sufficient information, including information as to the lifetime of the action, to enable Ofgem to determine the improvement in energy efficiency attributable to the action.

1.20. The Energy Saving Trust's 'New Product Procedures' are detailed in Appendix 3 to ensure that sufficient information is collected on an action to enable Ofgem to be satisfied whether it would lead to an improvement in energy efficiency.

1.21. Qualifying actions considered 'innovative' under the Order qualify for a 50% increase in energy savings. Chapter 8 provides additional information on innovative action.

1.22. The Order provides that, where a supplier completes qualifying action that is energy service action, Ofgem will increase the energy savings attributable to that action by 50%. Chapter 9 provides additional information on energy service action.

1.23. This Technical Guidance Manual is designed to be a working document and will be updated as necessary throughout the course of the obligation period under the Order.

2. Insulation Actions

Loft insulation

Attribution of improvement in energy efficiency

Annual energy savings

2.1. Energy savings for loft insulation actions have been calculated on a property type basis using the Building Research Establishment Domestic Energy Model (BREDEM). Savings have been quantified for properties heated by gas, electricity, oil and coal. Properties heated by LPG are assumed to have the same energy savings as those heated by gas. Table 1 lists the installations for which energy savings can be claimed from loft insulation.

Table 1: Virgin and top-up loft insulation measures

Virgin	0mm to 200mm	0mm to 250mm	0mm to 270mm
Top-up	25mm to 200mm	25mm to 250mm	25mm to 270mm
	50mm to 200mm	50mm to 250mm	50mm to 270mm
	75mm to 200mm	75mm to 250mm	75mm to 270mm
	100mm to 200mm	100mm to 250mm	100mm to 270mm

2.2. Energy savings for installations of, or up to, 200mm, 250mm or 270mm of loft insulation are included in the EEC Scheme Spreadsheet.

2.3. In addition, a spreadsheet calculator is available from Ofgem to quantify the energy savings for installations of 200mm, 250mm or 270mm in properties that have more bedrooms than those stated in the EEC Scheme Spreadsheet. In order to calculate increased savings, the floor area of the property must be accurately measured. These measures should be entered into the 'Other Insulation' sections of the EEC Scheme Spreadsheet.

Lifetime

2.4. The lifetime of loft insulation is estimated to be 30 years.

Technical Standards or specific requirements

2.5. Loft insulation should be installed to a depth of 270mm[5]. Suppliers will be accredited for depths of less than 270mm in circumstances where it is physically impossible or unsafe to install 270mm or if the householder requests a lesser amount.

2.6. When insulating lofts, the loft hatches must be insulated and draught sealed.

2.7. There are two British Standards relevant to the installation of loft insulation. These are:

BS 5803 Part 1: 1985 "Thermal insulation for use in pitched roof spaces in dwellings. Specification for man made mineral fibre thermal insulation mats." This specifies the standard loft insulation materials must meet to be eligible for improvements under the Order.

BS 5803 Part 5: 1985 "Thermal insulation for use in pitched roof dwellings. Specification for installation of man-made mineral fibre and cellulose fibre insulation". This standard specifies the requirements when installing loft insulation in pitched roof dwellings.

Best Practice Guidelines

2.8. There are two Good Practice Guides relating to best practice when installing loft insulation. These are "Energy efficiency refurbishment of existing housing" (Good Practice Guide 155, January 2003) and "Refurbishment site guidance for solid walled houses – roofs" (Good Practice Guide 296, November 2002). Both publications state that insulation above the height of the joists should be laid across the joists where appropriate.

2.9. The two Good Practice Guides also refer to best practice methods to avoid problems of damp and condensation. Cases of condensation in newly insulated lofts have been identified in previous monitoring exercises. There are several factors that can lead to condensation in lofts, such as failing to draught seal the loft

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[5]The depth quoted is to ensure that the loft has a U-value of $0.16W/m^2K$, based on the product installed having a lambda of 0.044W/mK. Suppliers can be accredited for installing other insulants, although the lambda will need to be verified and the thickness of the material recorded.

hatch or the blocking of loft vents with insulation. Energy suppliers should encourage their installers to take care to minimise the risk of condensation when installing loft insulation.

2.10. Good practice suggests that all improvements resulting from loft insulation claimed under the Order should, where appropriate, include loft boarding in order to provide safe access to the cold water tank.

2.11. In addition, good practice when insulating roof spaces is to insulate the cold water tank and associated pipe work. The relevant British Standard is:

BS 5422: 2001 "Method for specifying thermal insulation materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".

DIY loft insulation

Attribution of improvement in energy efficiency

Annual energy savings

2.12. Energy savings for DIY loft insulation schemes have been calculated on a 'per square metre' installed basis. For any particular increase in insulation (eg, the installation of 100mm insulation in a virgin loft, or the installation of top-up loft insulation from 100mm to 200mm), the energy saving per square metre is similar for different dwelling types. For this reason, energy savings have only been calculated on a per-fuel basis.

2.13. The energy savings are average figures which are weighted by the assumed proportion of householders installing the specified thickness of insulation on top of various depths of existing insulation. This reflects the fact that the householder may or may not already have some insulation within their loft.

2.14. Four different energy savings have been calculated for each fuel type for loft insulation according to the thickness of the insulation, specifically: 100mm, 150mm, 170mm or 200mm. These values have been included in the EEC Scheme Spreadsheet.

2.15. In relation to insulation in the Target Setting Model, account was taken of material used for compliance with the Building Regulations 2000 and material likely to be left over after installation. The same factors are incorporated into the energy savings in the EEC Scheme Spreadsheet.

Lifetime

2.16. The lifetime of DIY loft insulation is estimated to be 30 years.

Technical standards or specific requirements

2.17. All loft insulation materials promoted or delivered as part of suppliers' DIY loft insulation schemes must be manufactured to British Standard **BS 5803 Part 1: 1985** "Thermal insulation for use in pitched roof spaces in dwellings. Specification for man made mineral fibre thermal insulation mats".

2.18. The energy savings calculated for DIY loft insulation assume that it will be installed to the same standard as professionally installed insulation (detailed in paragraphs 2.5, 2.6 and 2.7). Whilst Ofgem appreciates that a supplier cannot ensure that these standards are adhered to in the case of DIY installation, best endeavours must be made to inform the householder of these installation standards.

2.19. If the DIY loft insulation is sourced by mail order, the supplier must inform the householder of these installation standards. If the DIY loft insulation is delivered through a retail outlet, the supplier should ensure that installation guidelines detailing the standards are available to all consumers at the place of purchase and, if not supplied with the product, the consumer is informed of where they are located.

Best Practice Guidelines

2.20. Aside from being installed to the required technical standards, it is also of primary concern that the insulation is installed safely. While a supplier may not be able to enforce safe installation, best endeavours should be made to encourage this.

2.21. If the DIY loft insulation is sourced by mail order, the supplier should provide appropriate safety guidance to all customers ordering loft insulation. As the customer has not visited a DIY store to purchase the loft insulation and has not had access to safety equipment, the supplier should provide a face-mask, gloves and goggles at no cost to the customer. It would be preferable to include the safety equipment with each order, but if the supplier can show that the purchase is a repeat purchase and the customer has already been supplied with safety equipment, it will not be necessary to provide the safety equipment again.

2.22. If the DIY loft insulation scheme is delivered through a retail outlet, the supplier should provide the appropriate safety guidance to all customers purchasing loft insulation along with the appropriate installation guidelines. Suppliers are not required to provide safety equipment because the insulation might be a repeat purchase; it is also likely to be available in store. However, it should be emphasised that safety is an important issue when installing loft insulation and this should be reflected in the written guidance. It is strongly recommended that the written guidance is suitably close to the product and that there is clear signposting to where the safety equipment can be purchased in store. Ideally, it should be stocked next to the insulation.

2.23. The two Good Practice Guides which relate to best practice for professionally installed loft insulation also apply to DIY schemes. These are "Energy efficiency refurbishment of existing housing" (Good Practice Guide 155, January 2003) and "Refurbishment site guidance for solid walled houses – roofs" (Good Practice Guide 296, November 2002). Good Practice Guide 171 "Domestic Energy Efficiency Primer" (2003 edition) may also be helpful. Accordingly, insulation above the height of joists should be laid across the joists where appropriate and care should be taken to avoid future problems of damp and condensation. Suppliers are strongly encouraged to alert householders to these issues.

2.24. Good practice suggests that all loft insulation should include, where appropriate, loft boarding in order to provide safe access to the cold water tank. This point should be included in the installation guidelines.

2.25. In addition, good practice when insulating roof spaces is to insulate of the cold water tank and associated pipe work. The relevant British Standard is:

BS 5422: 2001 "Method for specifying thermal insulation materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C".

Cavity wall insulation

Attribution of improvement in energy efficiency

Annual energy savings

2.26. Energy savings for cavity wall insulation have been calculated on a property type basis using the BREDEM. Savings have been quantified for each property type heated by gas, electricity, oil and coal. Properties heated by LPG are assumed to have the same energy savings as those heated by gas.

2.27. Different energy savings apply to properties constructed pre 1976 and those constructed post 1976; the energy savings achieved in properties constructed after this year are less due to their higher thermal insulation standard. Installers must, therefore, determine when the property was built, to enable suppliers to report accurately.

2.28. The energy savings attributable to cavity wall insulation are included in the EEC Scheme Spreadsheet. The energy savings assume the average installation of insulation improves the U-value of the wall to 0.48 W/m^2K and 0.42 W/m^2K for pre 1976 and post 1976 properties respectively. Suitable cavity wall insulation products include mineral wool insulation, polystyrene beads or urea-formaldehyde (UF) foam.

2.29. In addition, a spreadsheet calculator is available from Ofgem to quantify the energy savings for installations in properties that have more bedrooms than those stated in the EEC Scheme Spreadsheet. In order to calculate increased savings, the floor area of the property must be accurately measured. These measures should be entered into the 'Other Insulation' sections of the EEC Scheme Spreadsheet.

2.30. In relation to cavity wall insulation in the Target Setting Model, account was taken of the likely incomplete fill of the cavity. The same factor is incorporated into the energy savings in the EEC Scheme Spreadsheet.

Lifetime

2.31. The lifetime of cavity wall insulation is estimated to be 40 years.

Technical standards or specific requirements

2.32. Insulation materials used must be certified by the British Board of Agrément (BBA) and must conform to the following British Standards:

For mineral wool insulation, the relevant British Standard is **BS EN 13162: 2001** **"**Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification."

For UF foam insulation, the relevant British Standards are **BS 5617:1985** "Specification for urea-formaldehyde (UF) foam systems suitable for thermal insulation of cavity walls with masonry or concrete inner and outer leaves" and **BS 5618:1985** "Code of practice for thermal insulation of cavity walls (with masonry or concrete inner and outer leaves) by filling with urea-formaldehyde (UF) foam systems"

2.33. A 25-year guarantee must be provided to the customer when the insulation work has been completed as the energy savings calculated are based on installation to the technical requirements of such a guarantee. The technical requirements are outlined in the following three documents published by CIGA (Cavity Insulation Guarantee Agency), which can be obtained by e-mailing Peter Dicks (peter.dicks@ciga.co.uk):

"Assessor's Guide: Suitability of external walls for filling with cavity wall insulation. Part 1 existing buildings" Version 1.0, October 2003

"Technician's guide to best practice – Installing cavity wall insulation" Version 2, July 2002

"Technician's guide to best practice – Flues, chimneys and combustion air ventilators" Version 2.0, March 2002

Best Practice Guidelines

2.34. The Health and Safety Executive (HSE) has prepared a briefing note for installers to follow to ensure adequate precautions are taken for the safe installation of cavity wall insulation in gas-heated properties. This is included as Appendix 2 to this document.

Draught-proofing

Attribution of improvement in energy efficiency

Annual energy savings

2.35. Energy savings for draught-proofing actions have been modelled on a property type basis using the BREDEM. Savings have been quantified for properties heated by gas, electricity, oil and coal. Properties heated by LPG are assumed to have the same energy savings as those heated by gas.

2.36. The energy savings attributable to draught-proofing are appropriate for strip and brush-type systems applied to operable windows and external doors and are based on a high air infiltration rate. The savings are included in the EEC Scheme Spreadsheet.

Lifetime

2.37. The lifetime for draught-proofing measures is estimated to be 20 years where a 20 year guarantee is provided by the manufacturer. Where only a 10 year guarantee is provided, the supplier should only claim a 10 year lifetime and these measures should be included in the Other Insulation sections of the EEC Scheme Spreadsheet.

Technical standards or specific requirements

2.38. As the energy savings accredited for draught-proofing are based on a high air infiltration rate, the action should be targeted at homes where windows and doors have a poor fit or seal to the frame, and where the property is particularly exposed.

2.39. The draught-proofing products installed must conform to two British Standards: **BS 7386: 1997** "Specification for draught strips for the draught control of existing doors and windows in housing" and **BS 7880: 1997** "Code of practice for draught control of existing doors and windows in housing using draught strips".

Best Practice Guidelines

2.40. When installing draught-proofing measures, it is important to ensure that open flue combustion appliances, such as gas fires, have an adequate direct fresh air supply for the safe operation of the appliance. Separate provision for such a supply should be made, and a combustion spillage test undertaken when air-tightening work is being carried out.

2.41. Draught-proofing should not be installed where condensation and mould is present as it will reduce ventilation and exacerbate these problems. Good Practice Guide 224 "Improving air-tightness in existing homes" is a useful reference for general draught-proofing advice and specific information on ventilation.

External and internal solid wall insulation

Attribution of improvement in energy efficiency

Annual energy savings

2.42. Energy savings attributed for solid wall insulation (external and internal) have been calculated on a property type basis using the BREDEM. Savings have been quantified for properties heated by gas, electricity, oil and coal. Properties heated by LPG are assumed to have the same energy savings as those heated by gas.

2.43. Two different sets of savings have been calculated for solid wall insulation. They are both based upon a specific improvement in the thermal performance of the wall.

2.44. The following can achieve U-values of 0.35 W/m^2K and 0.45 W/m^2K when installed on a wall with a U-value of 2.1 W/m^2K or higher (e.g. 220mm solid brick wall).

2.45. If the installation differs from that specified below, these U-values may not be achieved, in which case specific U-value calculations should be carried out. In particular, bridging by other materials will degrade the thermal properties.

2.46. Depths and conductivities stated here are of the insulation, and do not include the facing or finish.

Internal or external insulation with no timber studs bridging the insulation

Examples of insulating material	Conductivity (W/mK) as stated, or better than	U-value 0.35 W/m²K Minimum insulation depth	U-value 0.45 W/m²K Minimum insulation depth
Mineral wool or expanded polystyrene	0.040	100mm	75mm
Mineral wool, expanded polystyrene or extruded polystyrene with CO_2	0.036	90mm	65mm
Mineral wool, expanded polystyrene or extruded polystyrene with CO_2	0.032	80mm	60mm
Extruded polystyrene with CO_2 or polyurethane with pentane	0.028	70mm	50mm
Extruded polystyrene with CO_2, polyurethane with pentane, phenolic foam, polyisocyanurate	0.024	60mm	45mm

For external insulation the finish should be 25mm render and for internal insulation the finish should be with plasterboard facing mineral wool.

Internal insulation with timber studs bridging the insulation

	U-value 0.35 W/m²K	U-value 0.45 W/m²K
Minimum insulation depth	100mm	75mm
Conductivity (W/mK) as stated, or better than	0.036	0.038

(50mm wide studs at 600mm centres to support 1200mm wide plasterboard)

2.47. The materials listed above are for illustrative purposes only. It will be possible to reach the required energy saving with materials with the same thermal characteristics. The exact energy saving will vary according to the specific product, the nature of the wall it is put on and the proportion of timber-work study. However, for the energy saving to be realised, an improvement in U-value from 2.1 W/m^2 K is required.

2.48. The energy savings attributable to solid wall insulation are available from Ofgem. The values are not included in the EEC Scheme Spreadsheet and should be entered manually into the 'Other Insulation' sections on the relevant fuel worksheet. Several solid wall insulation manufacturers have had the energy savings from their products independently quantified through the EST's New Product Procedure. For a current list of those products, please contact James Russill at the EST. Relevant contact details can be found in Appendix 3 of the manual.

Lifetime

2.49. The lifetime of solid wall insulation is estimated to be 30 years.

Technical standards or specific requirements

2.50. The guidelines to the Building Regulations suggest that, when work includes the substantial replacement of an exposed wall or its external rendering or internal finishes, it should include the provision of reasonable insulation. General Information Leaflet 70 "The effect of the Building Regulations (Part L1 2002) on existing dwellings" (November 2002) summarises the guidance for the insulation of solid walls.

2.51. Compliance with the following British Standards is necessary to ensure the estimated improvement in energy efficiency from solid wall insulation is realised:

BS 5262: 1991 "Code of Practice for External Renderings". This Standard specifies the materials, aspects of design, mixes and methods of application of cement-based renderings to all common types of new and old backgrounds. It also includes advice on the inspection and repair of defective renderings.

BS 8212: 1995 "Code of practice for dry lining and partitioning using gypsum plasterboard". This Standard contains recommendations for materials, design backgrounds and insulation of dry lining to walls, ceilings and partitioning.

Best Practice Guidelines

2.52. For the purposes of the Order, energy savings are attributed to solid wall insulation with an R-value of 1.75 m^2K/W or an R-value of 2.38 m^2K/W applied to a wall with a U-value of 2.1 $W/m^2 K$. However, Best Practice guidelines for external wall insulation state a U-value of 0.35$W/m^2 K$ should be achieved and Ofgem strongly encourages suppliers to install to this level. Good Practice Guide 155 "Energy Efficient refurbishment of existing housing" (2003) and Good Practice Guide 293 "External insulation systems for walls of dwellings" (August 2000) provide further detail on products that can be used to attain the Best Practice improvement.

2.53. In addition, two other Good Practice Guides, Ofgem encourages reference to:

Good Practice Guide 297 "Refurbishment site guidance for solid-wall houses – walls" (May 2000), and

Good Practice Guide 138 "Internal wall insulation in existing housing – a guide for specifiers and contractors" (July 2003).

Hot water tank insulation

Attribution of improvement in energy efficiency

Annual energy savings

2.54. Energy savings for hot water tank insulation have been calculated as average savings on a fuel type basis as the dwelling type has little effect on the calculated value. The energy savings have been weighted by the relative thickness of existing hot water tank insulation across the housing stock. The energy savings are included in the EEC Scheme Spreadsheet.

2.55. Suppliers can be attributed an energy saving for fitting insulation to a bare tank or topping up existing insulation. Suppliers cannot be accredited with an energy saving for replacing a tank jacket.

Lifetime

2.56. The lifetime for tank insulation is estimated to be 10 years.

Technical standards or specific requirements

2.57. All hot water tank jackets should be manufactured to **BS 5615: 1985** "Specification for insulating jackets for domestic hot water storage cylinders". This Standard specifies the performance, in terms of the maximum permitted heat loss, the materials, design and marking of jackets for cylinders to BS1566-2: 1984 and BS1566-1: 2002.

High efficiency hot water cylinders

Attribution of improvement in energy efficiency

Annual energy savings

2.58. The energy savings for high efficiency hot water cylinders have been calculated for existing and new build properties that heat water using gas or electricity. These data cannot be derived directly from BREDEM so a modified version has been used which takes cylinder standing losses, primary pipe-work losses and boiler losses into consideration.

2.59. Primary pipe-work losses and boiler losses will not be relevant in the case of electric immersion heaters. However, they will apply to properties heating water using a gas boiler. Consequently, there are separate gas savings for instances where the primary pipe-work is and is not insulated.

2.60. For existing properties, the Building Regulations 2000 require replacement cylinders to be the same standard as for new build properties. The energy savings that can be claimed for high efficiency hot water cylinders in both existing dwellings and new build properties are as follows:

Where water is heated by a gas-fired boiler in a property with no primary pipe-work insulation, the energy saved by replacing a stock average cylinder with a high performance cylinder is **83 kWh/annum,**

Where water is heated by a gas-fired boiler in a property with insulated primary pipe-work, the saving from replacing a stock average cylinder with a high performance cylinder is **58 kWh/annum,**

Where water is heated by an electric immersion heater, the saving from replacing a stock average cylinder with a high performance cylinder is **38 kWh/annum.**

2.61. These energy savings should be entered into the 'Other Insulation' section of the EEC Scheme Spreadsheet. The cylinders are classed as insulation actions because the energy savings result, in the main, from the high levels of insulation in their design.

Lifetime

2.62. A lifetime of 20 years is estimated for this action.

Technical Standards or specific requirements

2.63. Installations of hot water cylinders should meet the basic level of specification set out in General Information Leaflet 59 “Central Heating System Specifications – CheSS” (July 2002).

Radiator panels

Attribution of improvement in energy efficiency

Annual energy savings

2.64. Energy savings can only be awarded for the installation of radiator panels when they are fitted to external walls. Further, research by the BRE indicates that energy savings from radiator panels are minimal if the radiator is fitted on a wall with a filled cavity. Therefore, radiator panels should be installed on either solid walls or walls with unfilled cavities.

2.65. Two types of radiator panel may result in energy savings. The savings claimed depend on the type of panel used. The first, quantified by modelling carried out by the BRE, covers all radiator panels constructed in a louvered or saw toothed fashion (with raised ridges) with a reflective surface. The energy saving attributable is 93 kWh/m^2 per annum. If a panel is used which does not have a reflective surface, the energy saving should be taken as **a half** of the above value.

2.66. A second type of panel has been tested through field trials. The results from this work are still being verified, but once finalised will be released to suppliers and provided in the next issue of this manual. This saving can only be claimed for certain manufacturers’ radiator panels which have undergone field trials. To obtain a list of the panels for which this saving may be claimed, please e-mail eec@ofgem.gov.uk.

2.67. Where radiator panels are sold as part of a DIY scheme, suppliers cannot guarantee that the panels will be installed to external walls or that the property would have unfilled cavity walls or solid walls. Consequently, the energy savings from DIY sales need to be corrected by 30% for those panels that do not realise the attributed energy saving.

2.68. Radiator panel energy savings are calculated on a 'per panel' basis. This calculation requires the assessment of the area of the radiator panel, which should then be multiplied by the relevant value above. When submitting radiator panel schemes, suppliers should indicate the numbers of panels installed to allow the overall savings to be calculated. Suppliers should also include a breakdown of their calculations in their notification. The energy saving values and total area of panel installed should be entered into the 'Other Insulation' section on the relevant worksheet of the EEC Scheme Spreadsheet.

Example calculation

Professionally installed radiator panels

2.69. The panel is louvered with a reflective surface. Its surface area is 0.3 m^2. The energy savings that can be claimed for this type of panel are 93 kWh/m^2 per annum on a 'per square metre' installed basis.

Total energy savings for the panel (**kWh per annum** = 93 x 0.3

Total energy savings for the panel = 27.9 **kWh/m^2 per annum**

DIY installed radiator panels

Energy saving to be claimed per DIY panel = 93 x 0.3 x (1-0.3)

Energy saving to be claimed per DIY panel = 19.5

Lifetime

2.70. A lifetime of 10 years is estimated for radiator panels.

Window glazing

2.71. The Building Regulations 2000 require reasonable provision to be made for the conservation of fuel and power in dwellings by limiting the heat loss through the fabric of the building. The guidelines to these Regulations[6] suggest that compliance can be achieved by a minimum specification of double glazed low-emissivity glass for all new glazing installations, windows that are E-rated under the Domestic Window Energy Rating (DWER) system. Energy savings can be attributed to glazing with a rating above 'E'.

2.72. Suppliers should discuss with Ofgem any proposed action and energy saving values prior to submitting a scheme.

2.73. Further information on the UK DWER system is available on the British Fenestration Rating Council's website www.bfrc.org.

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[6] "Approved Document L1, Conservation of fuel and power in dwellings", Office of the Deputy Prime Minister.

3. Lighting Actions

Attribution of improvement in energy efficiency

Annual energy savings

3.1. The energy savings for Compact Fluorescent Lamps (CFLs) and luminaires are calculated on a wattage comparison basis of the market average CFL installed against the average General Lighting Service (GLS) bulb that it is assumed to be replaced. These figures were derived from monitoring research undertaken as part of the EESoP 3 programme.

3.2. The EEC Scheme Spreadsheet provides a separate annual energy saving for luminaires, CFLs that have been installed in medium to high use fittings and CFLs that have been installed in low use fittings. The usage patterns for each have also been derived from the EESoP 3 monitoring research.

3.3. The energy savings for luminaires are based on the assumption that the consumer will install the fitting in specific high use locations in the home because of the investment needed to install the ballast.

3.4. As set out in Ofgem's administration procedures relating to the Order, there are limits on the number of lamps suppliers can distribute to consumers to ensure that the energy saving attributed is realised. Where the consumer purchases lamps the energy savings for the first six CFLs supplied to each household are based on the consumer's choice of what will be the high to medium use fittings in the home. The energy savings for the seventh to tenth CFL supplied to each household are based on the usage pattern of low use fittings. CFLs that are distributed for free are capped to four per household and are assumed to be installed in high to medium use fittings.

3.5. In the Target Setting Model, account was taken of the heat replacement effect for lighting actions. This same factor is automatically incorporated into the calculations for CFLs and luminaires in the EEC Scheme Spreadsheet.

Lifetime

3.6. In the Target Setting Model, it was assumed that two-thirds of the CFLs installed would have an 8,000 hour lifetime and one-third would have a 15,000 hour lifetime. This suggests the lifetime for a CFL in a high to medium use fitting is 16 years while the lifetime for a low use CFL is 28 years.

3.7. The lifetime for luminaires is considered to be 30 years, which assumes that the consumer will replace the lamp at least once during the lifetime of the ballast.

Technical standards or specific requirements

3.8. For energy savings from CFLs and luminaires to be counted towards a supplier's target, the CFLs and luminaries must be included on the EST's approved list and must have achieved Energy Efficiency Recommended (EER) status, awarded by the EST's Endorsement Programme. The approved CFL and luminaire list is revised as necessary. For confirmation of the current version, contact James Russill at the EST. Relevant contact details are included in Appendix 3 of this document.

4. Heating Actions

Boilers

Attribution of improvement in energy efficiency

Annual energy savings

4.1. In the guidance to the Building Regulations 2000, minimum combustion efficiencies for boilers are outlined which would demonstrate compliance with the requirement to conserve fuel and power[7]. The Regulations apply to both new-build properties and existing dwellings when a new boiler is installed. When attributing energy savings to boiler replacements Ofgem needs to consider whether it is:

- a standard boiler replacement
- an exception to the Building Regulations 2000
- an exception to the Building Regulations 2000 where the boiler being replaced is a back boiler, and
- an installation in Scotland

4.2. For the purposes of the EEC, energy savings are calculated on the basis of a comparison between the combustion efficiency of the new condensing boiler and the minimum combustion efficiency outlined in the guidance to the Building Regulations 2000. Table 2 lists the minimum combustion efficiencies, expressed as SEDBUK (Seasonal Efficiency of Domestic Boilers in the UK) values, which are included in the guidance.

4.3. Table 2 also includes the minimum SEDBUK efficiencies for exceptions to the Building Regulations 2000 where the previous boiler was either a standard boiler or a back boiler. The required efficiency for a back boiler is 3 percentage points lower than the minimum SEDBUK value for a standard boiler exception for each fuel type. For example, the minimum SEDBUK value required for a natural gas back boiler exception is 75%. Consequently, the energy saving for replacing a back boiler exempt from the Building Regulations 2000 is based on the SEDBUK

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[7] "Approved Document L1, Conservation of fuel and power in dwellings", Office of the Deputy Prime Minister

combustion efficiency of the new condensing boiler compared with the minimum required combustion efficiency for the back boiler for the relevant fuel type.

4.4. The Building (Scotland) Act 2003 is due to be amended by April 2005. The minimum standard for new build installations and replacement installations is expected to change to bring it into line with the exceptions to the Building Regulations 2000 in England and Wales from April 2005 until 2007. The minimum efficiency for back boiler installations in Scotland is 3 percentage points lower than the standard installation.

Table 2: Minimum SEDBUK values outlined in the guidelines to the Building Regulations 2000

Fuel type	Minimum SEDBUK value in England and Wales	Exceptions to the Building Regulations 2000 in England and Wales and minimum standard in Scotland (until 2007)	Exceptions to the Building Regulations 2000 in England and Wales where the previous boiler was a back boiler and minimum back boiler efficiency in Scotland (until 2007)
Natural Gas	86%	78%	75%
LPG	86%	80%	77%
Oil	86%[8]	85%	82%
Oil – combi boiler	82%	82%	79%

4.5. The energy savings for the installation of a condensing boiler, either with or without heating control upgrades, are calculated automatically on the heating worksheets in the EEC Scheme Spreadsheet. The number of boilers installed should be entered into the relevant worksheet. There is a different heating worksheet for gas, LPG and oil and each has three separate sections:

- one for conventional boilers in England and Wales,
- a second for exceptions to the Building Regulations 2000 and installations in Scotland, and

[8] This requirement is expected to come into force in April 2007. Supplier schemes will therefore be accredited on a comparison to a 85% efficient boiler, the current standard.

- third for exceptions to the Building Regulations 2000 and for installations in Scotland where a back boiler was previously installed.

4.6. The worksheets are set to a default combustion efficiency of 91% for condensing boilers. If the combustion efficiency of the boilers provided differs from 91%, the supplier should enter the actual value. If the scheme is based on the installation of boilers with different SEDBUK efficiencies, a weighted average combustion efficiency should be calculated based on the relative number of boilers of each efficiency.

4.7. In addition, a spreadsheet calculator is available from Ofgem to quantify the energy savings for installations of condensing boilers in properties that have more bedrooms than those stated in the EEC Scheme Spreadsheet. In order to calculate increased savings, the floor area of the property must be accurately measured. These measures should be entered into the 'Other Heating' sections of the EEC Scheme Spreadsheet.

Lifetime

4.8. The lifetime estimated for boilers is 15 years.

Technical standards or specific requirements

4.9. Boilers installed as part of suppliers' qualifying action must be SEDBUK 'A' rated. The SEDBUK database has been set up as part of the Government's Energy Efficiency Best Practice Programme and can be viewed at http://www.sedbuk.com/. It indicates the combustion efficiency of all boilers currently available.

4.10. Installations of boilers must meet the best practice guidance set out in General Information Leaflet 59 "Central Heating System Specifications – CheSS" (July 2002). Such installations will meet the standards outlined in the guidance to the Building Regulations 2000. Suppliers should note sections 1.47 through to 1.51 of the document which relate to the commissioning of the system and the provision of operation instructions. A guidance note can be obtained by calling the EST's Energy Efficiency Publication Hotline on 0845 727 7200.

4.11. Several British Standards also apply:

BS 5440 Part 1: 2000 "Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70kW net (1st, 2nd and 3rd family gases). Specification for installation and maintenance of flues".

BS 5440 Part 2: 2000 "Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70kW net (1st, 2nd and 3rd family gases). Specification for installation and maintenance of ventilation for gas appliances".

BS 6798: 2000 "Specification for installation of gas-fired boilers of rated input not exceeding 70kW net".

BS 5449: 1990 "Specification for forced circulation hot water central heating systems for domestic premises".

BS 7671: 2001 "Requirements for electrical installations, Institution of Electrical Engineers (IEE) wiring regulations, 16th Edition".

Best Practice Guidelines

4.12. Ofgem refers suppliers to Good Practice Guide 284 "Domestic central heating and hot water: systems with gas and oil-fired boilers" (2000) for gas and oil systems.

Heating controls

Attribution of improvement in energy efficiency

4.13. In addition to outlining minimum combustion efficiencies for boilers, the Guidelines to the Building Regulations 2000 refer to space heating and hot water system controls. The current England and Wales guidance and the expected guidance in Scotland states that zone controls, time controls and a boiler interlock should be installed whenever a new boiler or hot water cylinder is installed in a new-build property or an existing dwelling. Heating control measures installed to comply with the Building Regulations 2000 cannot be attributed with an energy saving under the Order. Ofgem will continue to apply the guidelines to determine whether an action will lead to an improvement in energy efficiency.

4.14. When heating controls are being installed or upgraded as part of a boiler replacement scheme, energy savings can be attributed where the supplier installs heating controls with delayed start, weather or load compensation, or independent time and temperature zone control functionality and for each TRV installed in existing dwellings. The improvement in energy efficiency will be assessed on the average efficiency of the boilers that have been installed by the supplier.

4.15. If the heating controls are being upgraded without a boiler or hot water cylinder replacement, energy savings will be attributed (based on a stock average boiler efficiency of 78% for gas, 82% for oil and 78% for LPG) for all of the heating controls installed.

Annual energy savings

4.16. The annual energy saving is based on a comparison between the efficiency of a heating system that is compliant with the Buildings Regulations and the efficiency of the replacement system.

4.17. The energy savings for the installation of heating controls are calculated automatically on the heating worksheets (gas, oil and LPG) in the EEC Scheme Spreadsheet on a property type basis. The spreadsheet contains options for installing heating controls in tandem with a new boiler or installing heating controls alone.

4.18. The energy savings listed in the EEC Scheme Spreadsheet have been calculated according to different types of heating control and suppliers will be attributed energy savings on the basis of the different types of control installed. The heating control functionalities outlined in the EEC Scheme Spreadsheet are:

- room thermostat
- boiler interlock
- delayed start functionality
- weather or load compensation
- time and temperature zone control, and
- TRVs.

Lifetime

4.19. A lifetime of 15 years is estimated for heating controls.

Technical standards or specific requirements

4.20. Installations of heating controls must meet the requirements described as "Basic" in General Information Leaflet 59 "Central Heating System Specifications – CheSS" (July 2002). Such installations will meet the standards outlined in the guidelines to the Building Regulations 2000 (or the technical standards in Scotland). A guidance note, "The Domestic Heating and Hot Water Guide to the Building Regulations 2001 – Part L1", can obtained by calling the EST's Energy Efficiency Publication Hotline on 0845 727 7200.

4.21. It is important to note that, to demonstrate compliance with the Building Regulations 2000, a boiler control interlock must be included when upgrading the heating controls regardless of whether a new boiler is installed or not.

4.22. In addition, heating controls must all be installed in line with **BS 7671: 2001 "**Requirements for electrical installations, IEE wiring regulations, 16th Edition" and BS **5449: 1990 "**Specification for forced circulation hot water central heating systems for domestic purposes".

Best Practice Guidelines

4.23. Ofgem recommends that suppliers refer to **Good Practice Guide 302** "Controls for domestic central heating and hot water – guidance for specifiers and installers" (September 2001) is for information on the different types of controls available, including descriptions of advanced functions.

Electric heating controls

Attribution of improvement in energy efficiency

Annual energy savings

4.24. Energy savings for six different types of storage heater controls have been calculated on a property type basis using the BREDEM with independent laboratory tests. There are different energy savings for solid wall and cavity wall properties due to different space heating consumption in such properties. When providing or installing electric heating controls, suppliers must take note of the construction type of the property's walls.

4.25. The energy savings for storage heater controls are available from Ofgem. The relevant values should be inserted into the 'Heating Controls' section of the electricity worksheet on the EEC Scheme Spreadsheet.

Lifetime

4.26. A lifetime of 15 years is estimated for electric heating controls.

Technical Standards or specific requirements

4.27. All electric storage heater controls should be installed in line with British Standard **BS 7671: 2001 "**Requirements for electrical installations, IEE wiring regulations, 16th Edition".

Best practice guidelines

4.28. Good Practice Guide 345 "Domestic heating by electricity" (March 2003) outlines the general issues relating to the use of electricity for heating and also broadly defines the different functionality of storage heater controls. Good Practice Guide 302 "Controls for domestic central heating and hot water – guidance for specifiers and installers" (September 2001) refers to control functions in greater technical detail.

Heat Recovery Ventilation

Attribution of improvement in energy efficiency

Annual energy savings

4.29. With respect to energy savings for heat recovery ventilation units, please contact James Russill at the EST. For specific details of the models accredited and the associated energy savings and lifetimes, relevant contact details can be found in Appendix 3 of the manual.

4.30. The relevant energy saving should be entered in the 'Other Heating' section of the relevant fuel worksheet on the EEC Scheme Spreadsheet.

Technical standards or specific requirements

4.31. All installations of heat recovery ventilation units must comply with British Standard **7671: 2001** "Requirements for electrical installations, IEE wiring regulations, 16th Edition."

Best practice guidelines

4.32. Good Practice Guide 268 "Energy-efficient ventilation in housing – a guide for specifiers on the requirements and options for ventilation" (February 2002) provides background information on wider ventilation issues together with more specific advice about heat recovery room ventilators.

Solar Water Heating

Attribution of improvement in energy efficiency

Annual energy savings

4.33. Energy savings may be attributed to two types of solar panel – flat plate and evacuated tube. The savings have been quantified using BREDEM and independent field tests.

4.34. Table 3 summarises the calculation factors for two types of solar panel. The main sections of the table relate to energy savings for a typical installation on a property type basis for gas, electricity, LPG, oil and coal. Savings can also be calculated on an average 'per square metre' of installed panel basis for each of the different heating fuels. Suppliers should enter details of completed solar panel actions in the 'Other Heating' sections of the EEC Scheme Spreadsheet.

4.35. Suppliers may find it easier to submit schemes using the typical installation savings for the different property types. Once the solar panels have been installed, the supplier should report the savings based on the total area of solar panels installed by property type. The 'per square metre' data should be used in these calculations.

Table 3: Annual energy savings for flat plate collector and evacuated tube solar water heating

Flat plate collectors			Fuel used to heat water				
Average kWh/yr saving per square metre of panel			Gas	Electricity	Oil	LPG	Solid
			396	309	376	396	514
Household type and occupancy level		Hot water requirements (Litre/day)	Energy saving (KWh/yr)				
Flat	2.1	90.5	1,589	1,240	1,512	1,589	2,066
Mid terrace	2.6	103	1,583	1,235	1,506	1,583	2,058
End terrace	2.6	103	1,583	1,235	1,506	1,583	2,058
Semi detached bungalow	2.2	93	1,589	1,239	1,511	1,589	2,066
Detached bungalow	2.3	95.5	1,588	1,239	1,510	1,588	2,064
Semi detached house	2.9	110.5	1,577	1,230	1,500	1,577	2,050
Detached house	3.3	120.5	1,567	1,222	1,490	1,567	2,037

Evacuated tube collectors			Fuel used to heat water				
Average kWh/yr saving per square metre of panel			Gas	Electricity	Oil	LPG	Solid
			520	406	495	520	676
Household type and occupancy level		Hot water requirements (Litre/day)	Energy saving (KWh/yr)				
Flat	2.1	90.5	2,007	1,566	1,909	2,007	2,609
Mid terrace	2.6	103	2,113	1,648	2,009	2,113	2,746
End terrace	2.6	103	2,113	1,648	2,009	2,113	2,746
Semi detached bungalow	2.2	93	2,023	1,578	1,924	2,023	2,630
Detached bungalow	2.3	95.5	2,045	1,595	1,945	2,045	2,658
Semi detached house	2.9	110.5	2,125	1,658	2,022	2,125	2,763
Detached house	3.3	120.5	2,135	1,666	2,031	2,135	2,776

Lifetime

4.36. The lifetime of solar water heating is estimated to be 20 years.

Technical standards or specific requirements

4.37. The following British Standards are relevant to the installation of solar water heating.

BS 5918: 1989 "Code of practice for solar heating systems for domestic hot water."

This standard contains recommendations for the design, construction, installation and commissioning of components and systems for domestic hot water preheating for single family dwellings.

This standard describes the test methods for proving the performance of solar panels.

BS EN 12976-1: 2001 "Thermal solar systems and components. Factory made systems. General requirements."

Heat Pumps

Attribution of improvement in energy efficiency

Annual energy savings

4.38. When calculating the energy savings for heat pumps, it is important to reflect whether the heat pump will replace all of a household's heating demand or just the majority of the heating demand from conventional electric or fossil-fuelled heating systems.

4.39. The energy savings are calculated on the assumption that a dwelling needs a replacement heating system. If the heat pump was not installed, the homeowner would replace its system with the same type as before eg, if gas was used, a new gas boiler would be purchased.

4.40. The energy required to heat standard dwelling types to a suitable level is illustrated in the spreadsheet entitled 'energy demand data final' available from Ofgem. The data is shown in terms of the heat requirement of the dwellings, the amount of delivered energy needed to meet this requirement (taking into account heating system efficiency) and the delivered energy shown in fuel-standardised terms. The data is based on the standard property types listed in the EEC Scheme Spreadsheet.

4.41. While the heat pump will replace most, if not all, of the energy used by the conventional heating system, it will itself use a quantity of electricity in order to operate. This electricity must be subtracted from the energy savings claimed. The efficiency of a heat pump is referred to as the 'Coefficient of Performance' abbreviated as the 'CoP'. The CoP refers to the amount of useful heat, in kWh, that the pump can generate for each kWh of electricity it consumes while operating.

4.42. As a heat pump will usually have different efficiencies for space and water heating, an average CoP is calculated and used in the calculation. For example, a CoP of 3 for space heating and 2.4 for water heating indicates that for each kWh of electricity consumed the heat pump will generate 3kWh of space heating and 2.4 kWh of water heating. When calculating the average CoP, it is assumed that 80% of the delivered energy is for space heating and 20% is for hot water heating. The average CoP that should be used to calculate the energy savings will be:

Space heating CoP (3) multiplied by the percentage of delivered energy required for space heating (80%), which gives **2.4**

Water heating CoP (2.4) multiplied by the percentage of delivered energy required for water heating (20%), which gives **0.48**

The average CoP is therefore 2.4 + 0.48 = **2.88**

4.43. Where a supplier seeks attribution of energy savings for a heat pump, it must submit the seasonal CoP of the unit to be used to Ofgem at the time of notification.

Example calculations

4.44. The following examples show how the energy savings would be calculated in the case of a heat pump being installed in a gas heated home and in the case of installation in an electrically heated home. In each case the dwelling type is assumed to be a three bedroom semi-detached house. The first example is for a unit that is capable of providing 100% of the energy demand. The second example is for a unit that is not capable of providing 100% of the energy demand and requires supplementary heating. A CoP of 2.88 is used in the examples.

A heat pump capable of providing 100% of a household’s heat and hot water demand

4.45. This example is based on the assumption that the heat pump will be able to replace all of the dwelling's conventional space and hot water heating demand. In this particular example, the heat pump replaces electric storage heating.

Annual heat requirement with electric storage heaters: **16,391 kWh**

Delivered energy to meet heat requirement (@100% efficiency): **16,391 kWh**

Fuel standardised delivered energy (multiplied by the electricity fuel standardisation factor of 0.801): **13,129 kWh**

The heat pump needs to meet 16,391 kWh heat requirement. To calculate the energy consumption of the heat pump this heat requirement should be divided by the CoP of 2.88.

Heat requirement (16,391) divided by CoP (2.88): **5,691 kWh**

Fuel standardised energy consumption of the heat pump (multiplied by the electricity fuel standardisation factor of 0.801): **4,559 kWh**

The energy savings are calculated by comparing the amount of energy that would be consumed by an electric heating system to the energy consumed by the heat pump.

The difference in this example, and therefore the energy saving is:

13,129 kWh – 4,559 kWh: **8,570 kWh per annum**

A heat pump that requires supplementary heating

4.46. Some heat pumps may only replace 70 - 80% of the total demand. If this is the case, then it must be assumed that the conventional system will fulfil the remainder. In this example, the heat pump can provide 80% of the space and hot water requirements. Supplementary heating will be provided by a gas boiler with the minimum combustion efficiency required by the Building Regulations 2000 (or the standard set in Scotland).

Annual heat requirement: **15,252 kWh**

In this example, the heat pump would only be meeting 80% of the demand (**12,201 kWh)** and the remaining 20% (**3,051 kWh)** would be met by the gas boiler.

The energy savings would therefore be calculated as follows:

Delivered energy to meet requirement (@ 86% efficiency): **17,735 kWh**

Fuel standardised delivered energy (multiplied by the gas fuel standardisation factor of 0.353): **6,260 kWh**

To calculate the electrical energy consumption of the heat pump, the proportion of the heat requirement which is being met by the heat pump should be divided by the CoP of 2.88.

Heat requirement (12,201 kWh) divided by CoP (2.88): **4,236 kWh**

Fuel standardised energy consumption by heat pump (multiplied by the electricity fuel standardisation factor of 0.801): **3,393 kWh**

Twenty percent of the demand, 3,051 kWh will still need to be met by the gas boiler. When this is divided by the efficiency of the boiler (86%), this equates to 3,548 kWh. In fuel standardised terms (multiplied by the gas fuel standardisation factor of 0.353) this equates to **1,252 kWh**.

The total energy consumption will be the energy consumption of the heat pump (3,393 kWh) plus the energy consumed by the gas boiler (1,252 kWh) **4,645 kWh**

The energy savings in this example are calculated by comparing the amount of energy that would be consumed by a gas boiler (6,260 kWh) to the energy consumed by the combination of heat pump and gas boiler (4,645 kWh).

The difference in this example, and therefore the energy saving is:

6,260 kWh – 4,645 kWh: **1,615 kWh per annum**

Lifetime

4.47. Relevant evidence should be provided by the manufacturer to Ofgem to allow Ofgem to estimate the lifetime of the product.

Best practice guidelines

4.48. There are three publications which provide good background information to the installation of ground source heat pumps:

Technical Note TN 18/99 Ground source heat pumps - a technology review, R H D Rawlings, BSRIA, July 1999 (ISBN 0 86022 506 2) can be obtained from http://www.bsria.co.uk/bsriabshop/system/index.html

Good Practice Guide 339 "Domestic Ground Source Heat Pumps: Design and installation of closed-loop systems", January 2003.

General Information Leaflet 72 "Heat pumps in the UK - a monitoring report", March 2000.

5. Energy Efficient Appliances

Cold and wet appliances

Attribution of improvement in energy efficiency

5.1. This section covers the energy savings, lifetimes, specific requirements and best practice guidelines associated with the promotion of cold appliances (ie, fridges, freezers and fridge freezers) and wet appliances (ie, dishwashers and washing machines).

5.2. There are several different ways in which suppliers can deliver appliances. The related energy savings are dependant on the type of appliance as well as the way in which it is delivered to the consumer.

5.3. The Target Setting Model included a factor for the heat replacement effect of A-rated cold and wet appliances. This factor is automatically incorporated into the calculations in the EEC Scheme Spreadsheet.

Cold and wet appliance incentive and trade-in schemes

5.4. There are two principal delivery routes relevant to cold and wet appliances:

- an incentive to purchase a more efficient appliance, and
- a trade-in of a working appliance.

5.5. In incentive schemes, the supplier incentivises the consumer to purchase a more efficient appliance than it would have otherwise purchased. Savings for incentive schemes are the difference between the sales-weighted average energy consumption for the particular type of appliance eg a fridge, and the energy consumption of the promoted appliance.

5.6. Under trade-in schemes, consumers are able to trade in a working appliance for a more efficient replacement. To qualify, the consumer's existing appliance is assumed to be working and the trade involves the appliance being removed from the consumer's home and being destroyed (in a manner that is compliant with EU legislation governing emissions of ozone depleting gases) to avoid entry into the second-hand market.

5.7. In trade-in schemes, there is a two-fold saving. Firstly, by removing the existing, inefficient appliance from the market, the higher consumption over the remainder of the product life is avoided. Secondly, a more efficient appliance is purchased than would normally be the case.

5.8. The energy saving accredited to a traded-in appliance is the difference between the existing stock-weighted average energy consumption of the product and the energy consumption of the promoted appliance applied for two thirds of the appliance lifetime. This is to reflect the fact that the supplier has persuaded the consumer to purchase a new appliance prematurely, after two thirds of the lifetime of the old appliance.

Lifetime

5.9. The estimated lifetime is dependant on the type of appliance (eg fridge or freezer), the type of promotion (incentive or trade-in) and whether the householder is in the Priority Group. Table 4 shows the lifetimes for each type of appliance.

Table 4: Measure lifetime (years) by scheme and customer type

	Appliance Type		
	Freezers and Fridge Freezers	Refrigerators and Larders	Washing Machines and Dishwashers
Incentive Scheme			
Non-priority lifetime	15	12	15
Priority Lifetime	15	15	15
Trade-in scheme			
Non-priority lifetime	10	8	10
Priority Lifetime	10	10	10
Fridgesaver scheme			
Priority Lifetime	15	15	-

Technical standards or specific requirements for incentive or trade-in schemes

5.10. All cold appliances and washing machines delivered must be at least A-rated in terms of energy consumption. Dishwashers should be at least A-rated and have achieved Energy Efficiency Recommended (EER) status, awarded by the EST's endorsement programme. A list of EER appliances can be viewed on the EST's website at www.saveenergy.co.uk. Energy suppliers should contact the EST if further details of the endorsement programme are required or if an appliance they wish to use in a scheme does not appear on the EST's website. The EER application process for new appliances is straightforward and quick.

5.11. Suppliers wanting to claim energy savings for fridge freezers that are of a top/bottom design and are greater than 70cm wide or are of a side by side design and greater than 160cm tall should do so under the 'US style' rows in the EEC Scheme Spreadsheet.

5.12. To claim trade-in savings for a cold or wet appliance, the supplier should ensure that the old appliance is removed from the consumer's property and destroyed.

Fridgesaver schemes

5.13. Fridgesaver schemes operate in a similar way to trade-in schemes but are limited to Priority Group consumers trading an inefficient cold appliance for at least an A-rated model. The energy savings that can be claimed for Fridgesaver measures are considerably higher than those for standard trade-in schemes.

5.14. The householder's existing cold appliance must be in use and also in a suitably bad condition to be eligible for the scheme. The condition of the appliance is assessed by a standard scoring system, which is illustrated in Table 7. The fridge or fridge- freezer being traded in must score three points or more on the protocol.

5.15. Table 5 sets out the combination of appliances that can be traded under a Fridgesavers scheme.

Table 5: Appliances that can be traded under a Fridgesavers scheme

New appliance / Existing appliance	Fridge	Fridge Freezer	Fridge and a Freezer
Fridge	✓	✓[1]	X
Fridge Freezer	✓[1]	✓	✓
Fridge and a Freezer	X	✓	✓

Note: 1 Suppliers can only claim the savings for a fridge to a fridge.

Annual energy savings

5.16. Fridgesaver energy savings can be claimed for A, A+ or A++ -rated refrigerators and fridge-freezers only. Energy savings are calculated on the basis of the difference between the energy consumption of the specific model provided to the consumer to which a factor (of 0.71875) has been applied, and the energy consumption of either a fridge or fridge-freezer which would meet the scoring protocol requirements.

5.17. The 0.71875 adjustment factor is based on the results of EESoP 1 and 2 monitoring, which showed that eligible consumers used their fridges or fridge-freezers less (in terms of opening and closing the appliance door, etc.). This adjustment factor is applied to reduce the energy consumption of the replacement appliance in line with the research. The monitoring also concluded that:

- the energy consumption of a standard fridge-freezer which would meet the Fridgesavers protocol is **983 kWh/a**, and

- the energy consumption of a fridge which would meet the Fridgesavers protocol is **603 kWh/a.**

5.18. In Fridgesaver schemes in which both a fridge and a freezer are traded in for a new fridge-freezer, both the fridge and the freezer should be working. However, only one appliance has to be scored and attain 3 on the protocol.

5.19. Table 6 provides the energy savings for cold appliances.

Table 6: Average energy consumption (kWh/a) of cold appliances by energy label

	A++	A+	A
Fridge-freezer (standard)	136	204	275
Fridge-freezer (frost free)	149	223	301
US style fridge-freezer (side by side)	220	330	445
US style fridge-freezer (above and below)	177	265	358
Refrigerator (ice box)	74	112	151
Refrigerator (larder)	68	101	137
Chest freezer	77	115	155
Upright freezer (standard)	98	146	197
Upright freezer (frost free)	113	170	228

Lifetime

5.20. The estimated lifetimes for new appliances are shown in Table 4.

Technical standards or specific requirements for Fridgesaver schemes

5.21. To claim Fridgesaver appliance savings, a supplier must ensure that the old appliance scores 3 or more on the Fridgesaver protocol illustrated in Table 7.

5.22. The fridge and fridge-freezer models provided as part of a Fridgesaver scheme must be at least A-rated.

5.23. The appliances must also be removed from the consumer's home and destroyed in accordance with trade-in schemes as outlined in paragraph 5.10.

Table 7: Fridgesavers scoring protocol system

Fridge Freezers	Score
Fridge compartment	
Door	
Minor damage to seal	1
Major damage to seal	2
Door not closing properly	2
Internal damage	1
External damage	1
Body (walls excluding door)	
External damage	1
Internal damage	1
Thermostat not working/missing/damaged	1
Fittings damaged/missing (e.g. shelves/vegetable box)	1
Icing up	1
Freezer compartment	
Door	
Minor damage to seal	1
Major damage to seal	2
Door not closing properly	2
Internal damage	1
External damage	1
Body	
External damage	1
Internal damage	1
Refrigerators	Score
Door	
Minor damage to seal	1
Major damage to seal	2
Door not closing properly	2
Internal damage	1
External damage	1
Body (walls excluding door)	
External damage	1
Internal damage	1
Thermostat not working/missing/damaged	1
Fittings damaged/missing (e.g. shelves / vegetable box)	1
Icing up	1
Icebox	
Icebox door missing	3
Icebox door does not close	2
Icebox door has crack / hole	2

6. Combined heat and power (CHP)

6.1. The attribution of an improvement in energy efficiency to a community based combined heat and power scheme will be carried out on a case by case basis because each installation will have different before and after characteristics.

6.2. For the improvement in energy efficiency to be calculated, a supplier must provide the relevant information with its notification, including the energy required from the existing boiler plant per annum, the electricity demand of the site, and the electricity and fuel demand of the site after the CHP unit has been installed. When submitting a community CHP scheme, a supplier should submit a feasibility report with its submission giving full supporting evidence for the energy consumption data.

6.3. Ofgem will produce a separate spreadsheet for the calculation of the energy savings arising from the installation of CHP systems, which will include an explanation of the relevant methodology. Relevant information should then be entered onto the EEC Scheme Spreadsheet.

6.4. Suppliers can deliver CHP schemes with the Community Energy Programme. Where a supplier is providing EEC funding for a CHP scheme that will also be funded by the Community Energy Programme, the energy saving attributable under the Order will be determined in relation to the contribution made by the supplier towards the cost of the installed unit.

6.5. Further details on the Community Energy Programme can be found at http://www.est.co.uk/communityenergy/index.cfm.

7. Fuel switching

Attribution of improvement in energy efficiency

7.1. This chapter sets out how suppliers can demonstrate that fuel switching has led to an improvement in energy efficiency.

7.2. A supplier can be attributed energy savings if domestic consumers switch the fuel type of their heating systems to a more efficient fuel as a result of funding by it. Fuel switching relates to the switching of the primary heating fuel in the property.

7.3. Some properties have multiple sources of heating and it may be more difficult to identify the primary heating fuel in such cases. For the purposes of attributing improvements in energy efficiency under the Order, the primary fuel is the fuel used to heat zone 1 of the property, which is considered to be the lounge or living room. For example, if a house had a gas focal point fire in the living room and electric panel heating in the bedrooms, it would be considered to be a gas heated home. However, if a house had both a focal point fire (using any fuel) and an electric storage heater in zone 1, it would be considered to be an electrically heated home.

7.4. In the majority of cases, fuel switching will involve switching from coal or electricity to gas although switching to LPG may also occur. Coal and electric heating systems can be covered in three broad categories:

- electric storage heating,
- other electric systems, and
- coal wet systems.

7.5. For all electric heating systems it is assumed that the whole system needs replacing. While there are examples of wet based electrical systems, these are very rare. If a supplier is fuel switching from a wet electric system, it will need to specify whether the whole system requires replacing.

7.6. Coal-fired systems are based on a wet system and are likely to be old and consequently contain too much water for a new gas-fired boiler. It is therefore likely that the whole system would need replacing. In addition, most coal-fired systems are gravity fed and may pose problems in terms of compliance with the Building Regulations 2000. If a supplier intends to carry out a fuel switching scheme where the whole coal system does not need replacing it must inform Ofgem and give full reasoning.

Types of fuel switching scheme

7.7. There are four scenarios in which energy savings could arise as a result of fuel switching.

Preventing like-for-like replacements (Scenario 1)

7.8. When replacing heating systems many social housing providers (SHPs) operate a system of replacing like-for-like. The ongoing cost associated with such programmes is high, but not as high as replacing, for instance, an electric system with a gas-fired system. If a supplier ties in with a SHP who is operating a like-for-like replacement system and provides financial assistance to allow the social landlord to replace electric heating with gas-fired heating, the supplier can be awarded energy savings for actions installed.

7.9. When notifying Ofgem of such a scheme, the supplier should indicate the percentage cost contribution to the marginal cost of the fuel switch. If a scheme covers activity with multiple SHPs, all with different cost contributions, the minimum percentage cost contribution to the marginal cost of the fuel switch should be given. This information should be detailed on the EEC Scheme Spreadsheet. The SHP declaration in Ofgem's Administration Procedures should be signed by all SHPs and they should confirm that they had operated a like-for-like replacement of electric (or coal-fired) systems.

Partnership with SHPs in a fuel switching only scheme (Scenario 2)

7.10. Some SHPs are undertaking fuel switching programmes, without the help of the suppliers, to provide new gas-fired central heating to their residents. If a supplier works with a SHP on such a scheme it is difficult to demonstrate how its action leads to an improvement in energy efficiency as the supplier would require the housing provider to pay the majority of the cost of the installation.

7.11. If suppliers wish to tie in with a SHP fuel switching scheme they must demonstrate that their action has led to an improvement in energy efficiency within each partnership. Separate notifications must be provided for each SHP and the supplier is required to indicate the full financial cost of the project and the contribution it will be making to the work. In addition, the SHP should provide full written details of the proposed work including a breakdown of the additional work that the supplier funding will lead to. This information would need to be verified at scheme completion.

Fuel switching as part of larger energy efficiency schemes with SHPs (Scenario 3)

7.12. This scenario involves fuel switching work being carried out as part of a larger energy efficiency programme that might, for instance, include insulation as well fuel switching with one or several SHPs. For this scenario, the energy savings arising from the fuel switching measures should not account for more than 20% of the overall energy savings of the scheme.

7.13. If a scheme will involve multiple SHPs, the 20% fuel switching applies to each SHP and not just the scheme overall. If a supplier does wish to undertake work with SHPs where fuel switching measures will account for more than 20% of the total energy savings achieved with that partner, there are two options available:

- if the fuel switching savings are likely to account for the minority of the savings from work with a SHP, but this proportion is higher than 20%, it may be appropriate to increase the threshold. The supplier should demonstrate why in this case. It might, for instance, have a programme of work with a local authority that could include like-for-like replacement systems and insulation, and

- if the fuel switching savings are likely to account for a considerably higher proportion, the actions can be split between two different schemes. Effectively, a separate scheme should be submitted for the fuel switching actions and the additional insulation, heating and/or lighting actions should be claimed under an existing SHP scheme.

7.14. Suppliers must keep clear records of their activity with each SHP so that the level of fuel switching activity with each SHP could be verified if the scheme was audited. The SHP declaration should be signed by all partners.

Fuel switching in private households (Scenario 4)

7.15. This scenario involves suppliers installing fuel switching actions in private households. To demonstrate how its action will lead to an improvement in energy efficiency the supplier should detail its marketing and promotional activity. The supplier's consumer satisfaction monitoring should ask whether the household would have installed the fuel switching activity without the supplier's input.

Annual energy savings

7.16. The energy savings for fuel switching are based on the comparison between the energy consumption of the existing heating system and the replacement system, in fuel-standardised terms. The EEC Scheme Spreadsheet should be used to calculate the energy savings for a scheme. The number of measures for each type of fuel switch should be entered on the fuel switching worksheet. These values then automatically link to the appropriate fuel worksheet, where the supplier should enter information on the supplier, consumer and other party percentage cost contribution.

7.17. The energy savings in the spreadsheet are based on a B-rated replacement boiler. If a supplier wishes to install an A-rated boiler or intelligent heating controls, these should be claimed as separate actions using the relevant heating worksheet.

Focal point heating

7.18. In situations where the property is heated using focal point fires, different energy savings should be claimed. These savings are also included in the EEC Scheme Spreadsheet, in the focal-point sections on the fuel switching worksheet. Partial heating that involves heating in the living area, the kitchen and the downstairs hall could potentially use almost as much energy as a full heating system. Therefore, where there is a central heating system (including storage heater systems) even if it does not heat the whole house the supplier will be accredited with the full energy saving. Focal point savings should be claimed only for properties that either have no formal heating system or are reliant on focal point fires.

7.19. The energy savings for fuel switching in a house heated by focal point fires are based on the comparison of the energy consumption of the existing heating system and the energy consumption of the replacement system used to heat the property to the same standard as the existing system, in fuel-standardised terms.

7.20. Data presented in 'UK Energy Sector Indicators 2001' (DTI) suggests that roughly 80% of households have gas central heating, 10% of the remainder have coal, oil, or electric central heating and the remaining 10% are unclassified. Ofgem is concerned about the fuel use in this third category and it is highly possible that some of the remainder will be using focal point fires. It is likely that the fuel consumption in these properties will be less than the full BREDEM figures. Therefore, reduced energy savings will be attributed to fuel switching carried out in a property that relies on focal point fires for heating.

7.21. Suppliers must, therefore, maintain a record of the survey carried out on each house so that it can be checked if the scheme is audited.

Lifetime

7.22. A lifetime of 15 years is estimated for fuel switching.

Technical standards or specific requirements

7.23. All heating actions installed as part of fuel switching schemes must be compliant with the Building Regulations 2000 (and the technical standards in Scotland). Boilers and heating control actions should fulfil the technical standards or specific requirements outlined in points 4.9 to 4.11 and 4.21 to 4.23.

7.24. Several British Standards also apply:

BS 5440 Part 1: 2000 "Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70kW net (1st, 2nd and 3rd family gases). Specification for installation and maintenance of flues".

BS 5440 Part 2: 2000 "Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70kW net (1st, 2nd and 3rd family gases). Specification for installation and maintenance of ventilation for gas appliances".

BS 6798: 2000 "Specification for installation of gas-fired boilers of rated input not exceeding 70kW net".

BS 5449: 1990 "Specification for forced circulation hot water central heating systems for domestic premises".

BS 7671: 2001 “Requirements for electrical installations, IEE wiring regulations, 16th Edition”.

7.25. In addition, any heating control measures must be installed in line with **BS 7671: 2001** “Requirements for electrical installations, IEE wiring regulations, 16th Edition” and **BS 5449: 1990** “Specification for forced circulation hot water central heating systems for domestic purposes”.

Best Practice Guidelines

Suppliers should be aware of the following Best Practice Guidelines.

Good Practice Guide 284 “Domestic central heating and hot water: systems with gas and oil-fired boilers” (2000) is a good overall reference for gas and oil systems.

Good Practice Guide 302 “Controls for domestic central heating and hot water – guidance for specifiers and installers” (September 2001) is a useful reference point for information of the different types of controls available, including descriptions of more-advanced functions.

8. Innovative Action

8.1. Suppliers are incentivised in the Order to promote innovative action, including CHP units with an installed electrical capacity of less than 50 kWe.

8.2. Where a supplier considers that its proposed action falls within the definition of innovative action in the Order, it should provide Ofgem with independent verification of the energy savings that will result from the action if taken. The energy saving evaluation procedure should be discussed with Ofgem at the time of scheme notification. Appendix 3 lists approved laboratories and test houses.

9. Energy service action

9.1. The Order provides for attribution of improvements in energy efficiency on a different basis in the case of "energy service action". Further information about energy services actions can be found in the 'Energy Efficiency Commitment 2005-2008 Administration Procedures' which can be viewed on the Ofgem website – www.ofgem.gov.uk – by selecting Energy Efficiency from the 'Ofgem's work' section.

9.2. To demonstrate that action is energy service action, suppliers are required to contract with a domestic consumer to achieve, amongst other things, improvements in energy efficiency at the domestic premises concerned by at least 13%. Appendix 4 provides the percentage improvements that are attributable for the main energy efficiency products.

9.3. The contract with the domestic customer must require the supplier to undertake an assessment of the energy efficiency of the consumer's property and the provision of advice based upon this assessment. An example of the kind of questionnaire that could be used to fulfil this requirement is shown in Appendix 5 of this document.

Appendix 1 BRE Report - ' Energy Efficiency Commitment 2005-2008, and BREDEM calculation of energy savings'

Executive Summary

Energy Efficiency Commitment 2005-2008 (EEC 2005-2008) will be introduced in April 2005 and run to March 2008. EEC 2005-2008 is a continuation of Energy Efficiency Commitment 2002-2005 (EEC 2002-2005), and will build on the achievements of this scheme, and the earlier 'Energy Efficiency Standards of Performance' (SoP) schemes, for promoting and funding energy efficiency in dwellings. As was the case for EEC 2002-2005, the EEC 2005-2008 allows energy efficiency improvements not only to dwellings heated with electricity and gas , but also to dwellings heated by oil, LPG and coal.

- For the purposes of setting the EEC 2005-2008 energy savings target, BRE provided information to DEFRA about the energy savings resulting from common energy efficiency measures. Ofgem required a more detailed 'matrix' of energy savings, which is consistent with the information used to set the EEC 2005-2008 target, but including further measures and a variety of dwelling types.
- BRE provided and updated this information for EEC 2002-2005, and for the earlier SoP schemes, using the BRE Domestic Energy Model (BREDEM), which is uniquely suited to this type of application. The energy savings for the various measures and house types have been tabulated.
- This report describes background information about the parameters used in these calculations. The energy savings are given for eight typical dwelling types, each with two or three different floor areas which are notionally related to the number of bedrooms. The 'base parameters' for the calculations (e.g. level of insulation, heating system efficiency and controls, etc.) are for a typical dwelling in 2010, and are derived from extensive survey data.
- Many factors affect energy savings, so the parameters selected are, in general, those which have the most significant effect on the energy saved.
- The various parameters (i.e. dwelling type, size, level of insulation, heating type) used in the BREDEM calculation, and the underlying assumptions, must be kept in mind when using the calculated values. The calculated energy savings are

typical for the situations described, but may be very different for situations which differ from the parameters used.

1 Introduction

The Energy Efficiency Commitment (EEC) requires Energy Suppliers to comply with an obligation to improve domestic energy efficiency. EEC 2005-2008 will run from April 2005 to March 2008, and is a continuation of EEC 2002-2005, which in turn followed the earlier Energy Efficiency Standards of Performance (SoP) schemes. To enable targets to be set, and individual projects to be evaluated, information about typical energy savings from a range of energy efficiency measures, for a variety of dwelling types and constructions is required.

BRE has provided and updated this information for EEC 2002-2005, and the earlier Energy Efficiency Standards of Performance schemes. The BRE Domestic Energy Model, BREDEM (1), was used to calculate the energy consumption, and hence savings. The savings resulting from a range of energy efficiency measures were tabulated, for a variety of typical domestic dwellings, for the different fuels.

BREDEM is an established and verified model which has been developed and tested by BRE over the past 20 years, and is uniquely suited to this type of requirement. As for EEC 2002-2005, EEC 2005-2008 obligations will allow energy efficiency measures to be implemented in dwellings heated by electricity and gas (including LPG), and also in dwellings heated by oil and solid fuel . As a result, savings are calculated for energy efficiency measures related to electric, gas, oil, LPG and solid fuel heated dwellings.

This report describes the parameters and methodology used for these calculations, and underlying information.

2 Description of the project

2.1 Aim

The aim of this work was to indicate the delivered energy savings associated with a range of energy efficiency measures, for various typical dwelling types and sizes, and for heating systems using different fuels.

The energy savings for the various measures, dwelling types and sizes, have been tabulated for each heating system and fuel, taking account of factors which have a significant effect on the energy saved.

2.2 Dwelling Types

The energy savings are calculated for eight dwelling types, which are the main types found in Great Britain (the area relevant to EEC). BRE has developed drawings for typical dwellings of these types. The dimensions of the external walls, roof, floor, windows and doors have been input in BREDEM, to give calculations of energy savings. These dwellings are listed in bold type in the table below, and are referred to as 'base case' dwellings.

Energy savings for other sizes of each dwelling type are derived for different floor areas which are notionally related to the number of bedrooms. These are listed in ordinary type in the table below. For wall insulation (because the wall is a fixed height) the area of the wall is related to the square root of the floor area, and the savings are approximately related in the same way. So for wall insulation, the 'base case' savings are adjusted by the square root of the ratio of the floor areas. For most other measures, such as loft insulation, the savings are approximately related to floor area, and the 'base case' savings are adjusted by simply using the ratio of the floor areas. This gives the savings for other sizes of each dwelling type. The effect of op, mid and ground-floor flats has also been considered, and this is discussed in Annex 1.

Dwelling type	Number of bedrooms	Floor area m2
Flat with 3 ext. walls	**1** **2** **3**	**42** **61** **89**
Flat with 2 ext. walls	**1** **2** **3**	**42** **61** **89**
Mid-terrace house	**2** **3**	**63** **79**
End-terrace house	**2** **3**	**63** **79**
Semi-det. bungalow	**2** **3**	**64** **74**
Detached bungalow	**2** **3** **4**	**67** **78** **90**
Semi- det. house	**2** **3** **4**	**77** **89** **102**
Detached house	**2** **3** **4**	**90** **104** **120**
'Base case' dwellings in bold		

2.3 Base parameters – heating systems and insulation

Calculations have been undertaken for the following heating systems

- Gas central heating
- LPG central heating (delivered energy savings are as for gas central heating)
- Oil central heating
- Electric storage heating

For fuel switching, calculations have also been undertaken for 'focal point' heating (also known as 'room heating' or 'non central heating'):

- Gas heating (room heaters)
- Electric heating (direct, not storage, room heaters)
- Solid fuel heating (room fires)

The base parameters for the calculations are estimates for a typical existing dwelling in 2010, and are the same as those used in the DEFRA target setting calculations. These are used in all calculations, except where otherwise stated or required by the calculation.

The parameters were derived from various sources, including extensive survey data, for example, the English House Condition Survey, and BREHOMES data (2). Where appropriate, this was combined with estimates of trends in, for example, insulation, heating systems, and numbers of households.

The following table gives the estimates, with a brief description of its source, for a 'typical dwelling' of the building stock in 2010.

Parameter	**Value**	**Source of estimate for 2010**
Loft U-value	0.322 $W/m^2/K$	150mm depth insulation. Estimated from the Domestic Energy Factfile (DEFF)
Wall U-value	1.1 $W/m^2/K$	Estimate of weighted U-value average in 2010. (This value is between extremes of solid wall and insulated cavity wall and is close to the value for an uninsulated post'76 cavity)
Glazing U-value	2.8 $W/m^2/K$	Double glazed 12mm wood/uPVC frame – estimated as typical from DEFF, and is between extremes of single glazing and current regulations which require a U-value 2.0
Tank insulation	55 mm jacket	Derived from Market Transformation Programme work
Heating seasonal efficiency	Gas 79% Oil 83%	BRE UK Boiler Energy Model, taking account of anticipated changes to regulations. In BREDEM these values are reduced by 1% point to account for boilers without an interlock. See Annex 2
Controls for gas and oil	Roomstat & 50% TRVs	Estimate for 2010, using EHCS 1996 and 2001 data.
Controls for elect. storage	Automatic	Estimate for 2010, using EHCS 1996 and 2001 data.

2.4 Heating regime

2.4.1 Central heating

It is estimated that the difference between average internal and external temperatures, averaged over the stock, will increase by about 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'.

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 it is considered to be representative of the average.

2.4.2 Focal point (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 was 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.

2.5 *Insulation measures*

2.5.1 Loft insulation

Analysis in EEC 2002-2005 showed that: the effect of the different wall types (solid or cavity) is small, less than 2%; and the effect of the number of external walls, e.g. a flat with 2 external walls compared with 3 external walls, a mid-terrace compared with end-terrace is also small, less than 5%.

A conductivity of 0.044 W/mK is used for both existing and installed insulation. This is a change from EEC 2002-2005 and is consequence of the introduction of CE marking for 'formed' insulation products such as insulation rolls.

Before installation the loft hatch is considered to be not insulated or draught-proofed .

The assumed standard for professionally installed loft insulation:

- Loft hatch is insulated and draught-proofed after installation, and the insulation cross laid over joists.

The assumed standard for DIY installed loft insulation:

- Loft hatch is not insulated or draught-proofed after installation, and the insulation is not cross laid.
- The energy saving is calculated in terms of kWh per square metre of insulation sold. See Annex 3 for details of the method for this calculation
- Savings were reduced by 12.5% in line with estimates of DIY insulation used for Building Regulations purposes (and hence not eligible in EEC) and the amount of material that was left over after installation.

U-values for a typical pitched roof

<table>
<tr><th>Thickness of insulation (mm)</th><th>U-value of roof (W/m²K)</th><th>Comments</th></tr>
<tr><td>0</td><td>2.3</td><td>Uninsulated loft</td></tr>
<tr><td>25</td><td>1.123</td><td rowspan="4">Insulation between joists;
Loft hatch not insulated before
(Professional & DIY)</td></tr>
<tr><td>50</td><td>0.735</td></tr>
<tr><td>75</td><td>0.551</td></tr>
<tr><td>100</td><td>0.443</td></tr>
<tr><td>270</td><td>0.265</td><td>Insulation between joists;
Loft hatch not insulated (DIY)</td></tr>
<tr><td>270</td><td>0.159</td><td>Insulation between & over joists;
Loft hatch insulated (Professional)</td></tr>
</table>

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.

2.5.2 Cavity wall insulation

Cavity wall savings are clearly affected by both the U-value of the cavity wall before it is insulated, and by the number of external walls.

- Savings are calculated for the different dwelling types and sizes. The results for flats may be applied to top-floor, mid-floor, and ground-floor flats. (Analysis in EEC 2002-2005 showed that the difference in results is less than 1% - see Annexe 1).

For EEC 2005-2008, 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 are 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 (W/m^2K)**
Pre 1976 uninsulated	1.44
Pre 1976 insulated	0.48
Post 1976 uninsulated	1.00
Post 1976 insulated	0.42

2.5.3 Draught-proofing

BREDEM takes account of draught-stripping of windows and doors by modifying the amount of air infiltration, by an amount based on work carried out in the 1980's. This work found that there are a large range of other air infiltration routes (such as dry lining on dabs or battens, cracks, gaps and joints in the structure, joist penetrations of external walls, timber floors, internal stud walls, electrical components and service ducts, and areas of unplastered masonry).

Openable doors and windows are therefore only one of many causes of heat loss through air infiltration. As a consequence of this work, results were obtained for good quality draught-stripping of openable doors and windows (excluding the kitchen and bathroom, as is normal practice), for a representative range of dwellings. The BREDEM calculated results are consistent with these results.

Because of the nature of air infiltration measurements, it is impossible to be precise about what should be taken as a baseline, that is, the air infiltration before draught-stripping. For this work the savings have been based on initial ventilation rates at the higher end of the range, consistent with the data available. This reflects the principle that Energy Efficiency Commitment should be targeting draught-stripping at such properties. In addition, the BREDEM ventilation algorithm assumes that if air infiltration is low, occupants will open windows. Because of this, draught-stripping savings become small if too low an air infiltration baseline is used.

A higher baseline is readily achieved by the selection of a number of options in the ‘ventilation’ and ‘location’ BREDEM inputs. Under the 'ventilation' inputs, two extract fans and one unrestricted chimney were assumed for all cases. For the ‘location’ inputs, ‘sheltered on 1 side’, and 'above average site exposure' was selected in all cases; although it may not be realistic for a mid-terrace house or a flat with two outside walls, it may be taken as a proxy for a number of other contributing factors, such as a leakier-than-average structure.

- Savings are calculated for the different dwelling types and sizes. The results for flats may be applied to top-floor, mid-floor, and ground-floor flats.

2.5.4 Glazing

The BFRC Windows Energy Rating bands were used (www.bfrc.org). Savings were 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).

- Savings per square metre of window are calculated for upgrading glazing from E-rated to D, C, B, and A-rated, for the different dwelling types. An average was then calculated, weighted by the number of each dwelling type in the stock, giving an average saving per square metre of window.

2.5.5 Solid wall insulation

Savings are affected by the before and after U-value and by the number of external walls.

A solid wall is assumed to have a U-value of 2.1 W/m^2K before it is insulated. Internal or external insulation can be applied to decrease the U-value. Two values were used for insulated walls, 0.45 and 0.35 W/m^2K. A U-value of 0.35 is recommended as a ‘Good Practice’ specification, but this is not always practical, particularly for internal insulation if the room size is significantly reduced.

- Savings are calculated for the different dwelling types and sizes. The results for flats may be applied to top-floor, mid-floor, and ground-floor flats (analysis in EEC 2002-2005 showed the difference in results to be less than 1%).

2.5.6 Hot water tank insulation

An average energy saving weighted by the number of dwellings of each type was calculated. The results are as follows.

(a) Gas and LPG central heated dwellings

None to 75mm jacket	1876 kWh/yr.
25mm to 75mm jacket	774 kWh/yr.
50mm to 75mm jacket	191 kWh/yr.

Taking account of the relative numbers of dwellings in the building stock with 50mm, 25mm, and no tank jacket (Domestic Energy Fact File, 2003) gives a weighted average of

- 715 kWh/yr

(b) Electric storage heated dwellings:

None to 75mm jacket	1355 kWh/yr.
25mm to 75mm jacket	147 kWh/yr.
50mm to 75mm jacket	36 kWh/yr.

Taking account of the relative numbers of dwellings in the building stock with 50mm, 25mm, and no tank jacket (Domestic Energy Fact File, 1998) gives a weighted average of

- 376 kWh/yr

(c) Oil central heated dwellings:

None to 75mm jacket	1784 kWh/yr.
25mm to 75mm jacket	736 kWh/yr.

50mm to 75mm jacket 182 kWh/yr.

Taking account of the relative numbers of dwellings in the building stock with 50mm, 25mm, and no tank jacket (Domestic Energy Fact File, 1998) gives a weighted average of

- 680 kWh/yr

(d) Solid fuel central heated dwellings:

For an open fire with back boiler when heating water with an efficiency of 55%, the following results were obtained

None to 75mm jacket	1939 kWh/yr.
25mm to 75mm jacket	805 kWh/yr.
50mm to 75mm jacket	197 kWh/yr.

Taking account of the relative numbers of dwellings in the building stock with 50mm, 25mm, and no tank jacket (Domestic Energy Fact File, 1998) gives a weighted average of

- 740 kWh/yr

2.5.7 Floor insulation

Calculations are for 100mm depth for insulation of conductivity 0.044 W/m^{2}C (see loft insulation re CE marking). This is often the maximum practicable depth, and insulating to this depth is considered worthwhile considering the disruption and labour cost associated with installing this measure. Analysis in EEC 2002-2005 showed that different wall types have a small effect, less than 7%. However, house size and type have a significant effect.

- Savings are calculated for the different dwelling types and sizes.

2.6 *Gas, LPG, oil, solid fuel, heating measures*

2.6.1 Boiler replacement

A generalised calculation method is given for flexibility, which enables estimated savings to be calculated using appropriate seasonal boiler efficiencies, with reference to SEDBUK (Seasonal Efficiency of Domestic Boilers in the UK), which is described in Annexe 2.

- The 'heat required' is calculated for each dwelling type and size, for each fuel. The 'heat required' divided by the boiler efficiency gives the delivered fuel consumption. (Note that the 'heat required' includes energy for hot water as well as heating, since this is also affected by the boiler efficiency).

For an initial boiler efficiency value E1, and a new boiler efficiency value E2, the energy saving is then.

(*heat required* / E1) - (*heat required* / E2)

For example, the saving for installing a boiler with seasonal efficiency (SEDBUK value) 91% compared with the minimum requirement in AD Part L1 of the Building Regulations for a gas centrally heated detached house is

(19,681 / 86%) – (19,681 / 91%) = 1257 kWh/yr

2.6.2 Boiler controls

A detailed description of the following controls is given in the 'Heating controls' section of SAP (3)

- **Room thermostat**
- **Delayed start thermostat**
- **Time and temperature zone control**

For these controls, the saving in terms of 'heat required' for each dwelling type and size, was derived using BREDEM for each fuel. The delivered energy saving can then be derived by dividing by boiler seasonal efficiency. (The presence of other controls affected the calculated savings, but only by less than 5%; this was therefore neglected).

For example, the saving for installing a delayed start thermostat in a gas centrally heated mid-terrace in terms of 'heat required' is 136 kWh/yr. The saving for a boiler with seasonal efficiency of 78% is then:

744 / 78% = 159 kWh/yr

- TRVs

The same method was used to calculate energy savings for installation of TRVs in a dwelling (on all radiators except in the room where a thermostat is sited). In addition, using an estimate of the number of radiators in each dwelling type, and a weighting from the relative number of each dwelling type, an average energy saving per TRV was derived (for each fuel).

- **Boiler interlock**
- **Weather or load compensator (only for condensing boilers, see SAP (3))**

For these controls, an adjustment is applied to the seasonal boiler efficiency. The 'heat required' value from BREDEM for each dwelling type and size, for each fuel was therefore used, and an appropriate formula applied.

For example, lack of boiler interlock results in a 5% point penalty to the seasonal boiler efficiency. The gas centrally heated mid-terrace 'heat required' value is 10,033 kWh/yr. The saving from installing a boiler interlock removes this 5% point penalty. Thus, for a stock average efficiency boiler (see Annex 2) the saving is:

10,033 / 74% - 10,033 / 79% = 858 kWh/yr

2.6.3 Radiator panels

An analysis by BRE based on test data was undertaken, the results being consistent with two other reports of tests undertaken by independent laboratories. This gives results which are dependent on the thermal properties of the wall to which it is applied.

The energy saving is applicable to

- silvered reflective radiator panels
- applied to external walls
- applied to uninsulated solid or cavity walls

Wall U-value W/m2K	Reduction in delivered energy kWh/m^2/yr	
	Gas or LPG central heating	Oil central heating
1.0	37	35
1.5	75	71
2.1	131	124

An average saving, weighted by the relative number of dwellings with walls of each U-value is as follows.

Gas/LPG central heating – 93 kWh/yr per square metre of panel

Oil central heating – 88 kWh/yr per square metre of panel

2.7 Fuel switching

Energy savings were calculated for switching the following central heating systems.

From electric storage heating to

- new gas central heating
- new oil central heating
- new LPG central heating

From solid fuel central heating to

- new gas central heating
- new oil central heating
- new LPG central heating

From oil central heating to

- new gas central heating
- new LPG central heating

Energy savings were also calculated for switching the following focal point (non-central heating) systems.

From 'focal point' electric heating to

- new gas central heating
- new oil central heating
- new LPG central heating

From 'focal point' solid fuel heating to

- new gas central heating
- new oil central heating
- new LPG central heating

From 'focal point' gas heating to

- new gas central heating

The difference in fuel consumption for space heating, water heating, lights and appliances, was calculated, for each dwelling type and size. (Lights and appliances includes the heating system pumps energy consumption and so the comparison eliminates the demand for lights and appliances, leaving the demand for heating system pumps).

Sections 2.4 and 2.5 describe the differing heating regimes for 'focal point' heating and central heating. In calculating the energy savings for switching between these heating systems, the effect of the changed heating regime was removed. This was done by using the same 'focal point' heating regime for calculating both the 'before' focal point heating, and the 'after' central heating energy consumption.

3 *Conclusion and recommendations*

Estimated energy savings have been calculated for a large range of energy measures, and typical dwelling types and sizes. In an exercise of this kind, values must be chosen about various parameters, the most important of which have been stated at the start of this report.

These chosen parameters must be kept in mind when using these results. The savings are typical for the situations described, but may be very different for situations which differ from the assumptions made.

4 References

(1) BREDEM-12: model description, 2001 update. B R Anderson, P F Chapman, N G Cutland, C M Dickson, G Henderson, J H Henderson, P J Iles, L Kosmina, L D Shorrock

(2) Domestic Energy Fact File, 2003. L D Shorrock and J I Utley. BRE Report 457. Downloadable from http://projects.bre.co.uk/factfile/index.html

or available from www.BREbookshop.com

(3) The Government's Standard Assessment Procedure for Energy Rating of Dwellings. SAP 2001. Downloadable from http://projects.bre.co.uk/sap2001

Annexe 1 - Effect of flat type on savings

A flat of a given size and shape can be top-floor, mid-floor, or ground-floor, with different numbers of external walls. Each combination of these parameters will result in a different energy consumption.

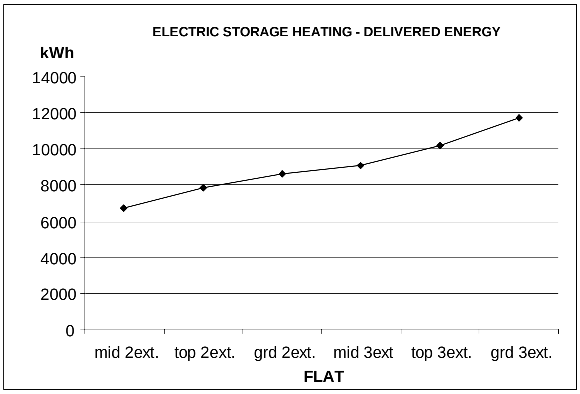
Moreover the savings from different energy saving measures are affected by different parameters. For example, the number of walls affects the savings resulting from cavity wall insulation, floor insulation and draught-stripping, but does not significantly affect savings resulting from the other insulation measures considered.

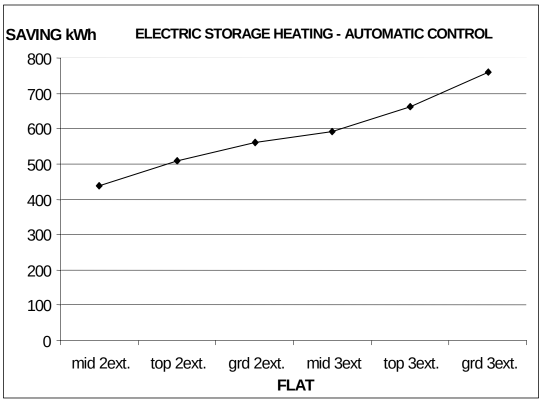
<u>Effect of different types of flat on energy efficiency savings</u>

Energy Efficiency Measure	**Top/Mid/Ground Floor Flat**	**Number of External Walls**
Loft insulation	Top-floor flats only	Insignificant effect
Floor insulation	Ground-floor flats only	Significant effect
Cavity wall insulation	Insignificant effect	Significant effect
Draught stripping	Insignificant effect	Significant effect
Double glazing	Insignificant effect	Insignificant effect
Boiler replacement & controls	See below	

EEC 2002-2005 calculations demonstrated that the energy savings resulting from boiler replacement and controls are dependent on the space heating energy consumption of the flat. The savings will therefore be affected both by the number of external walls, and whether it is a top, mid, or ground floor flat.

The following graphs show, for an electric storage heating system, the effect of both of these factors on (a) the space heating energy consumption, and (b) the saving achieved by automatic controls.





- It can be seen that the number of external walls has a significant effect on energy consumption and savings. The effect of whether it is top, mid or ground floor is less significant. Therefore, separate results have been calculated for flats with two, and three external walls.
- It can also be seen that the top-floor flat is intermediate in energy consumption between the ground-floor and mid-floor flat, and the difference is relatively small (especially in relation to the effect of the amount of loft and wall insulation). Calculations have therefore been undertaken for top-floor flats only. Savings for mid-floor and ground-floor flats will be similar.

(It could be argued that mid-floor flats should be used on the basis that these are the most common type, however, while this is true in high rise buildings, there are a large number of blocks which are three or fewer storeys high, for which this is not true.)

Graphs of energy consumption and savings relating to the replacement of boilers, boiler controls, and gas room heaters show the same behaviour, and the same conclusions can be drawn.

It should be appreciated that the savings resulting from these measures are significantly dependent on the heat required and therefore the level of insulation in the dwelling (as well as other factors such as the heating pattern). This contrasts with insulation measures (for example, loft insulation) where savings are not strongly dependent on the level of insulation in the rest of the dwelling, except for very poor, or very good, insulation levels.

Annexe 2 - Boiler efficiencies and SEDBUK

Gas and Oil boilers

A method for estimating a realistic 'seasonal' domestic boiler efficiency, representing an average efficiency in domestic conditions over a seasonal cycle in the UK, has been incorporated into the calculation of SAP energy ratings (Appendix D of SAP 2001). The method involves a number of equations that use the measured full load and part load efficiency of a boiler to estimate its seasonal efficiency in typical UK conditions.

The method results from a research project supported by DETR, BRECSU, British Gas Research & Technology, and manufacturers of boilers and other products for the heating industry. The method has been agreed by all those involved, and is referred to as 'SEDBUK' (Seasonal Efficiency of Domestic Boilers in the UK).

SEDBUK values for many boilers currently available have been published on an internet web site www.sedbuk.com. In addition, from real product data that BRECSU holds, it has been possible to use SEDBUK to estimate typical UK seasonal efficiency values of different types of boilers.

The energy savings calculated for EEC 2005-2008 use estimates of the average seasonal efficiency of gas and oil boilers in the existing UK stock. BRE's UK National Boiler Energy Model estimates for 2010 the average boiler efficiency to be 79% for gas and 83% for oil. For BREDEM calculations, a penalty of 5 percentage points is deducted where there is no boiler interlock. From information on the proportion of boiler systems that do not have a room thermostat, and allowing for growth in interlock as new regulations take effect, only a small proportion of boilers will not have an interlock in 2010. A 1 percentage point penalty is therefore used for the proportion of the stock that is expected not to have boiler interlock, for both gas and oil.

Values used in these calculations are therefore

- Gas central heating 79%, reduced by 1% to 78% as a BREDEM input
- LPG central heating is estimated to have a similar efficiency
- Oil central heating 83%, reduced by 1% to 82% as a BREDEM input

Solid fuel heating

There are many different configurations for solid fuel heating. For example, an open or closed fire may have a back boiler, in which case this may supply radiators, or alternatively an independent solid fuel boiler may supply a central heating system. Estimated efficiency values are approximate and vary depending on the configuration, from 32% for an open fire with no throat restrictor and no back boiler, to 65% for a closed fire with a back boiler, or an independent boiler with an autofeed system.

In addition BREDEM calculations take account of 'responsiveness' on a scale of 0 (unresponsive) to 1 (responsive). Open and closed solid fuel fires are attributed a responsiveness of 0.5, while independent boilers are attributed a responsiveness of 0.75.

Note that this variability in evaluating energy for solid fuel systems is exacerbated when considering cost of energy and CO_2 emissions (these are not calculated in this report). Open fires may use house coal, or smokeless fuel if required, which have different costs and CO_2 emission values (£4.62/GJ and £7.46/GJ, and 81 kg CO_2/GJ and 109 kg CO_2/GJ respectively; SAP 2001 values).

The most common solid fuel heating system is an open fire with a back boiler and radiators, though closed fires with back boiler and radiators are also common, and also open and closed fires of all other configurations. There are a smaller, but still significant, number of independent boilers supplying central heating systems.

The parameters for the different systems, and numbers of households with each, have been assessed. The typical values of efficiency and responsiveness which have been used in the EEC 2005-2008 calculations as follows.

Solid fuel central heating

(boiler with manual or autofeed, open or closed fire with back boiler to radiators)

- Responsiveness 0.5 and seasonal efficiency 60%,

Solid fuel 'focal point' (room fires without central heating)
(open or closed fire with or without back boiler)

- Responsiveness 0.5 and seasonal efficiency 50%,

Annexe 3 – Calculation of DIY insulation savings

Since the dwelling into which DIY loft insulation is installed is not known, an energy saving per square metre sold is required. This is calculated using a weighted average of the savings over different dwellings, and different starting depths, as follows.
Consider the dwellings in the housing stock - for each starting depth of loft insulation, two weighting factors are considered in the calculations

1) The percentage of dwellings in the stock with that existing depth.
If there is a small percentage of dwellings with a particular starting depth, there will be a smaller potential for installing from that depth than if there are a large percentage of dwellings with that starting depth. These 'existing depth' percentages are derived from numbers in the Domestic Energy Fact File.

2) An estimated likelihood of buying and installing insulation, for each existing depth.
If there is no, rather than some, existing insulation in a dwelling, a householder is more likely to purchase and install some. The householder will be progressively less motivated (likely) to install insulation the greater the depth of existing insulation. Sensible estimates are made for this 'likelihood', and, for 100mm insulation, the possibility of being laid double is also considered. Sensitivity analysis shows that the final result is not greatly affected within a sensible range of this estimate.

These two weighting factors are multiplied and then normalised to give, for householders who purchase a given thickness of insulation, the estimated percentage which will buy that thickness to install from (and to) a given depth. The weighted saving per square metre for that thickness of insulation may then be calculated.

This estimated percentage is also used to indicate the implied proportion of insulation which is used for first time insulation, as compared with top-up, to ensure that it agrees reasonably with other estimates of this value from survey sources.

Appendix 2 HSE advice on potential risks to safety of combustion appliances from the installation of cavity wall insulation (May 2000)

What is the purpose of this advice?

This advice:

- highlights the potential hazard of cavity wall insulation work adversely affecting the safety of combustion appliances and the importance of ensuring air supply vents and flues are always checked by a competent person after this work

- gives general guidance on the action required, further details of which are given in the Cavity Insulation Guarantee Agency (CIGA) guide 'Flues, Chimneys and Combustion Air Ventilators'

- is addressed to all concerned with the management, control and installation of cavity wall insulation under energy efficiency schemes

- is targeted both at those involved with the installation of cavity wall insulation and the running of specific schemes such as DEFRA's Home Energy Efficiency Scheme (HEES), those run by Energy Suppliers and Transco (Affordable Warmth)), as well as initiatives run by local authorities

- updates and replaces an earlier HSE advice sheet on this subject.

What is the hazard?

This guidance is about the way in which incorrect installation of cavity wall Insulation can adversely affect the safety of gas, oil and solid fuel appliances. The main concerns are:

(a) possible blockage of air supply vents with insulation material if the vents are not ducted across the cavity, and

(b) possible flue damage (eg by accidental drilling) or blockage (ie by insulating material entering a flue through the damaged area).

Either, or both of these could cause appliances to operate unsafely, and produce amounts of carbon monoxide (CO) that could cause death of occupants.

These are not just theoretical risks. Although the industry safety record is accepted to be generally very good, a few residents recently had their ventilation/flues completely blocked by insulation material, as a result of cavity wall insulation work, and this was not detected in the normal way by the installer because the established industry safety procedures were not followed. This presented a major potential risk of CO poisoning to these tenants, and it was fortunate that the problem was otherwise noticed, as death or serious injury might have resulted.

What action is required?

In view of the above, there is an urgent need for all parties involved to give early consideration to the possible effects that the insulation work might have for the safety of appliances in the houses they are working on, however they are fuelled. Any guidance and contract conditions should call for safety management systems that include thorough checks before work starts, eg on whether air vents are sleeved through the cavity wall, and the type/location of appliances and run of flues provided for them. This is essential to identify appliances and flues 'at risk' and for planning work to minimise the risk of damage or blockage.

It is particularly important that landlords such as local authorities are forewarned of any work to be carried out, so that they are given the opportunity to carry out their own checks on work to discharge their own legal responsibilities to their tenants.

What precautions are necessary?

The following is a summary of the main areas to be addressed. Detailed guidance is given in the Cavity Installation Guarantee Agency (CIGA) Best Practice Guidance document and relevant British Standards on cavity wall insulation. Further information regarding safety checks on gas appliances may be obtained from the Council for Registered Gas Installers (CORGI).

(*a*) *safety management.*

All cavity wall insulation work must be properly managed and controlled to ensure safe systems of work are used, which effectively address the risks involved. Suitable guidance and training should be given to all concerned that stresses the possible effects of the work for the safety of occupants from interference with ventilation and flueing, and the action required to address these risks (see below).

(b) safety checks after installation of cavity wall insulation.

Before combustion appliances are recommissioned/retaken into use, the following checks for safety should be carried out:

(i) Air supply vents

A visual examination should be carried out of all air vent openings, whether for supply of combustion air to appliances or for cooling air of compartments housing appliances, to ensure there is no blockage or interference by insulating material. This applies to air vents serving all types of combustion appliance, whether flueless, open-flued or room sealed. Further information on air supply requirements is given in Approved Document J 'Heat Producing Appliances' under the Building Regulations 2000 (and Technical Standards in Scotland). Further information in respect of air supply requirements for gas appliances is contained in British Standard 5440 Part 2: 2000.

(ii) Flue examination/testing

The following examinations and tests should be carried after installation of cavity wall insulation, except for those flues **known** not to be at risk of damage or blockage from cavity wall insulation work (eg where no part of a flue is run along or adjacent to a cavity wall). A decision on this should be made by a competent person after inspecting the flue run. In **any** case of doubt, it should be assumed that flue damage/blockage is possible, and that examinations/tests need to be carried out. These are identified below.

Appliances other than room sealed appliances

The flue should be visually examined for any damage or blockage caused by the cavity wall insulation work, which would prevent safe transfer of combustion products to the open air. This will involve external visual examination of the flue along its whole length, including loft spaces.

After the visual examination, further assessment should be made to establish whether there is any indication of possible flue damage or blockage. This will involve a smoke spillage test (to check that combustion products are being safely removed with the appliance connected) and visual inspection for any signs of incomplete combustion (eg yellowing of burner flame and soot deposits). Further investigation, including a flue flow test (to establish whether combustion products are capable of being safely transferred to the open air) **must** be carried out if there is **any** doubt or suggestion of flue damage or interference.

Further information on flue requirements, including examination/testing, is given in Approved Document J 'Heat Producing Appliances' under the Building Regulations 2000 (and Technical Standards in Scotland). Further information on flues for gas appliances is contained in British Standard 5440 Part 1: 1990[9].

Room sealed appliances

No flue flow or spillage test is required for room sealed appliances, however, a visual external examination of the flue path (eg to ensure there is no flue damage) and checks as in (i) earlier, on air vents providing cooling air for any compartment housing such an appliance are still required. Further information is given in the CIGA guide.

(iii) Examination of appliance safe functioning.

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[9]Under revision when this advice was prepared. Revised standard expected to be published later this year (2000).

After any 'work' on an appliance, including 'disconnection' and 'reconnection', it should be checked that the appliance functions safely. Examinations for gas appliances are specified in regulation 26(9) of the Gas Safety (Installation and Use) Regulations 1998 (GSIUR).

Action in case of a 'dangerous appliance'

Where there is any doubt about safety, arrangements should be made for the appliance to be disconnected (with the owner's consent, as necessary) and a warning notice attached, pending further investigation and remedial work. If the owner does not agree to disconnection of a dangerous gas appliance, Gas Emergency Freephone 0800 111 999, or in the case of LPG the gas supplier, should be contacted for further action to make safe.

Who may carry out safety examinations?

The examinations described earlier must only be carried out by a person who has been adequately trained and possesses the required competence, eg for proper conduct and interpretation of safety checks. The smoke spillage test is appliance specific and specialist training is essential to perform this correctly, in accordance with manufacturers instructions.

In the case of gas, any disconnection of appliances (eg as normally required for the flue flow test) constitutes 'work on a gas fitting'[10] and may <u>only</u> be carried out by a CORGI registered installer, holding a current certificate under the 'ACoPS' or Accredited Certification Scheme (ACS), covering the work involved. Further advice may be obtained from CORGI (tel: 01256 372200).

May carbon monoxide detectors be used?

[10]'work in relation to a gas fitting' as defined in GSIUR covers a wide range of activities including (but not limited to) installing; disconnecting; removing; re-connecting; or (where a fitting is not readily movable), changing its position. However, it does not cover separate activities which might affect gas safety but are not directly associated with a gas fitting/appliance, such as installation of cavity wall insulation.

If carbon monoxide detectors/alarms are used, they must **never** be regarded as a substitute for primary safeguards, eg safe installation and maintenance of gas appliances. Similarly, use of CO detectors must **not** be regarded as a substitute for flue/combustion air checks by a competent person, after completion of cavity wall insulation (as earlier). If detectors are used as part of a safety check regime, they must only be used to **indicate or confirm a hazardous situation**; they must **never** be relied upon to prove safety or to contradict evidence of a possible problem, where a flue spillage test is inconclusive or suggests flue blockage.

What are the relevant legal requirements?

The main legal requirements for protection of the general public and employees in these situations are the general provisions of the Health and Safety at Work etc 1974 (HSWA), and related legislation, including the Management of Health and Safety at Work Regulations 1999, which require a 'risk assessment' and plan of protective measures to be drawn up, as well as appointment of competent persons to ensure that safety requirements are effectively met.

In the case of gas, specific requirements also apply under the Gas Safety (Installation and Use) Regulations 1998. In particular, regulation 8(1) effectively prohibits any person from making an alteration to premises[11] (including cavity wall insulation) which would adversely effect the safety of a gas fitting installed at those premises and cause it no longer to comply with the Regulations, eg because combustion air supply or fluing is no longer adequate.

These duties for ensuring safety of combustion appliances extend beyond installers themselves to include managing contractors and others involved in planning heat efficiency schemes. Further information on controls and responsibilities under GSIUR is given in the Health and Safety Commission (HSC) Approved Code of Practice 'Safety in the installation and use of gas fittings and appliances', (ISBN: 0-7176-1635-5) available from HSE Books (tel 01787 881165)

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[11]The prohibition extends to a wide range of activities which might affect the safety of a gas appliance (or gas storage vessel) on the premises, including installation of double glazing, building extension, modifications to chimneys etc.

Appendix 3 Approved laboratories and Test Houses

This list contains details of UKAS and other recognised laboratories and test houses. The listing is not exhaustive, and does not preclude the ability of test houses listed under one category to conduct testing in other areas. For updated information on UKAS accredited laboratories please visit www.ukas.org

Testing for Electrical Energy Consumption

ITS Testing & Certification

Davy Avenue, Knowlhill, Milton Keynes, MK5 8NL
+44 (0)20 7770 7759

EA Technology Ltd.

Capenhurst, Chester, CH1 6ES
+44 (0)151 339 4181

Testing of Insulation/Construction Materials

CERAM

(CERAM Research Limited), Queens Road, Penkhull, Stoke-on-Trent, Staffordshire, ST47LQ
+44 (0) 1782 764444

British Board of Agrement

PO Box 195, Bucknalls Lane, Garston, Watford, Hertforshire, WD259BA
+44 (0)1923 665300

Building Investigation and Testing Services (Redhill) Ltd

Trowers Way, Holmethorpe Industrial Estate, Quarryside Business Park, Redhill, Surrey, RH12LH
+44 (0)1737 765432

BSI Product Services

Maylands Avenue, Hemel Hempstead, Hertfordshire, HP24SQ
+44 (0) 1442 230442/278535

Pattinson & Stead

Westside House, Marton, Middlesborough, Cleveland, TS78BG
+44 (0) 1642 317034

BRE

Bucknalls Lane, Garston, Watford, WD259XX

44+ (0)1923 664334

Thermal testing of construction materials

CERAM

(CERAM Research Limited), Queens Road, Penkhull, Stoke-on-Trent, Staffordshire, ST47LQ

+44 (0) 1782 764444

Stanger Testing Services Ltd

Cambuslang Laboratory, Bogeshole Road, Cambulang, Glasgow, G727DD

+44 (0) 141 641 3623

British Board of Agrement

PO Box 195, Bucknalls Lane, Garston, Watford, Hertforshire, WD259BA

+44 (0)1923 665300

Building Investigation and Testing Services (Redhill) Ltd

Trowers Way, Holmethorpe Industrial Estate, Quarryside Business Park, Redhill, Surrey, RH12LH

+44 (0)1737 765432

Marley Building Materials

Birmingham Laboratory, Canton Lane, Hams Hall Distribution Park, Coleshill, Birmingham, B461AQ

+44 (0) 1675 468 038

University of Salford

Thermal Measurement Laboratory, School of Acoustics and Electronic Engineering , Salford, M54WT

+44 (0) 161 295 5172/3114

National Physical Laboratory

Queens Road, Teddington, Middlesex, TW110LW

+44 (0)20-8943 6880

IRTU

17 Antrim Road, Lisburn, BT28 3AL

+44 (0)28 9262 3000

Heating and Fossil fuel burning appliances

Advantica Technologies Ltd

Certification Services, Ashby Road, Loughborough, Leicestershire, LE113GR

+44 (0)1509 282066

BSI Product Services

Maylands Avenue, Hemel Hempstead, Hertfordshire, HP24SQ

+44 (0) 1442 230442/278535

GASTEC at CRE LIMITED

PO Box 279, Cheltenham, Gloucestershire, GL524ZJ

+44 (0)1242 677877

ITS Testing & Certification Ltd

Unit D, Imperial Park, Randalls Way, Leatherhead, Surrey,

+44 (0)1372 370900

BSRIA Limited

Old Bracknell Lane West, Bracknell, Berkshire, RG127AH

+44 (0)1344 426511

ITS Testing & Certification Ltd

ITS House, Cleeve Road, Leatherhead, Surrey, KT227SB

+44 (0)1372 370900

ITS Testing & Certification Ltd

Blackwood EMC Facility, Unit 8, Woodfield Business Park, Pontlanfraith, Blackwood, Gwent, NP12 2DG

Appendix 4 Percentage improvements for the main energy efficiency measures

GAS		Energy savings as proportion of household energy demand													
Property Type	Number of bedrooms	0-270mm Loft Insulation	25-270mm Loft Insulation	50-270mm Loft Insulation	100-270mm Loft Insulation	Cavity Wall Insulation (pre 1976)	Cavity Wall Insulation (post 1976)	Replacement boiler (91%)		Draught-stripping	Tank jacket	4 CFLs	A-Rated Fridge Freezer (standard)	A++-rated Fridge Freezer (standard)	A+++-rated Fridge Freezer (standard)
Flat	1	38.0%	21.1%	13.9%	7.7%	14.3%	9.4%	3.0%		2.4%	5.6%	1.3%	1.5%	2.7%	3.9%
Flat	2	41.8%	23.9%	15.9%	8.9%	13.6%	9.1%	3.3%		2.7%	4.5%	1.0%	1.2%	2.2%	3.1%
Flat	3	44.2%	25.7%	17.3%	9.8%	12.3%	8.3%	3.4%		3.0%	3.4%	0.8%	0.9%	1.6%	2.4%
Mid-Terrace	2	24.3%	12.4%	7.9%	4.2%	16.5%	11.3%	3.3%		2.9%	4.2%	0.9%	1.1%	2.0%	2.9%
Mid-Terrace	3	25.5%	13.0%	8.3%	4.4%	15.6%	10.7%	3.4%		3.1%	3.5%	0.8%	0.9%	1.7%	2.5%
End-Terrace	2	22.2%	11.5%	7.2%	3.8%	23.7%	15.8%	3.6%		2.7%	3.5%	0.8%	0.9%	1.7%	2.5%
End-Terrace	3	23.1%	12.0%	7.5%	3.9%	22.1%	14.8%	3.7%		2.8%	3.0%	0.7%	0.8%	1.4%	2.1%
Semi-bungalow	2	35.2%	20.3%	13.3%	7.0%	17.4%	11.3%	3.8%		2.4%	3.3%	0.8%	0.9%	1.6%	2.3%
Semi-bungalow	3	35.9%	20.9%	13.7%	7.3%	16.6%	10.8%	3.8%		2.5%	2.9%	0.7%	0.8%	1.4%	2.1%
Det-bungalow	2	33.6%	19.4%	12.7%	6.8%	19.3%	12.7%	3.9%		2.3%	3.0%	0.7%	0.8%	1.5%	2.1%
Det-bungalow	3	34.3%	19.9%	13.1%	7.0%	18.4%	12.2%	3.9%		2.3%	2.7%	0.6%	0.7%	1.3%	1.9%
Det-bungalow	4	34.8%	20.2%	13.3%	7.1%	17.4%	11.6%	3.9%		2.4%	2.4%	0.5%	0.6%	1.1%	1.7%
Semi-house	2	22.7%	11.8%	7.4%	3.9%	22.0%	14.6%	3.7%		2.7%	3.0%	0.7%	0.8%	1.5%	2.1%
Semi-house	3	23.2%	12.0%	7.6%	4.0%	21.0%	13.9%	3.7%		2.8%	2.7%	0.6%	0.7%	1.3%	1.9%
Semi-house	4	23.5%	12.2%	7.7%	4.0%	19.9%	13.2%	3.7%		2.8%	2.3%	0.5%	0.6%	1.1%	1.6%
Det-house	2	21.3%	11.2%	7.2%	3.8%	27.7%	19.0%	3.9%		2.4%	2.3%	0.5%	0.6%	1.1%	1.6%
Det-house	3	21.6%	11.4%	7.3%	3.9%	26.1%	18.0%	3.9%		2.5%	2.1%	0.5%	0.5%	1.0%	1.4%
Det-house	4	21.8%	11.5%	7.3%	3.9%	24.5%	16.9%	3.9%		2.5%	1.8%	0.4%	0.5%	0.9%	1.3%

ELECTRICITY

Property Type	Number of bedrooms	Energy savings as proportion of household energy demand													
		0-270mm Loft Insulation	25-270mm Loft Insulation	50-270mm Loft Insulation	100-270mm Loft Insulation	Cavity Wall Insulation (pre 1976)	Cavity Wall Insulation (post 1976)	Fuel Switching (full elec to full gas)	Fuel Switching (focal ptl elec to full gas)	Draught-stripping	Tank jacket	4 CFLs	A-Rated Fridge Freezer (standard)	A+-rated Fridge Freezer (standard)	A++-rated Fridge Freezer (standard)
Flat	1	49.0%	29.4%	19.4%	10.4%	19.4%	13.0%	33.8%	28.5%	3.6%	4.6%	0.9%	1.0%	1.9%	2.7%
Flat	2	51.7%	31.7%	21.1%	11.5%	17.6%	11.9%	37.3%	32.3%	4.0%	3.5%	0.7%	0.8%	1.4%	2.1%
Flat	3	53.3%	33.1%	22.2%	12.2%	15.5%	10.5%	39.7%	34.9%	4.3%	2.5%	0.5%	0.6%	1.0%	1.5%
Mid-Terrace	2	32.2%	17.2%	10.9%	5.8%	21.8%	14.8%	37.9%	31.6%	4.3%	3.2%	0.6%	0.7%	1.3%	1.9%
Mid-Terrace	3	33.1%	17.7%	11.3%	6.0%	20.2%	13.7%	39.4%	33.2%	4.5%	2.7%	0.5%	0.6%	1.1%	1.6%
End-Terrace	2	28.0%	15.1%	9.7%	5.2%	31.5%	21.7%	42.5%	34.9%	3.7%	2.6%	0.5%	0.6%	1.0%	1.5%
End-Terrace	3	28.7%	15.5%	10.0%	5.3%	28.9%	20.0%	43.8%	36.4%	3.8%	2.1%	0.4%	0.5%	0.9%	1.2%
Semi-bungalow	2	43.0%	25.4%	17.0%	9.3%	22.9%	15.6%	44.4%	36.5%	3.2%	2.3%	0.4%	0.5%	0.9%	1.4%
Semi-bungalow	3	43.5%	25.8%	17.3%	9.5%	21.6%	14.8%	45.2%	37.6%	3.2%	2.0%	0.4%	0.4%	0.8%	1.2%
Det-bungalow	2	41.1%	24.0%	16.0%	8.7%	24.8%	17.1%	45.4%	37.3%	2.9%	2.1%	0.4%	0.5%	0.8%	1.2%
Det-bungalow	3	41.6%	24.4%	16.2%	8.9%	23.3%	16.2%	46.2%	38.2%	3.0%	1.8%	0.3%	0.4%	0.7%	1.1%
Det-bungalow	4	41.9%	24.6%	16.4%	9.0%	22.0%	15.2%	46.8%	38.9%	3.0%	1.6%	0.3%	0.3%	0.6%	0.9%
Semi-house	2	28.3%	15.2%	9.8%	5.2%	28.9%	19.8%	43.4%	35.7%	3.6%	2.1%	0.4%	0.5%	0.9%	1.3%
Semi-house	3	28.6%	15.4%	9.9%	5.3%	27.2%	18.7%	44.0%	36.4%	3.6%	1.9%	0.4%	0.4%	0.8%	1.1%
Semi-house	4	28.8%	15.6%	10.0%	5.3%	25.6%	17.6%	44.5%	36.9%	3.7%	1.7%	0.3%	0.4%	0.7%	1.0%
Det-house	2	26.1%	13.9%	8.9%	4.8%	34.5%	24.8%	45.7%	37.2%	3.1%	1.6%	0.3%	0.4%	0.7%	1.0%
Det-house	3	26.3%	14.0%	9.0%	4.8%	32.4%	23.3%	46.1%	37.7%	3.1%	1.4%	0.3%	0.3%	0.6%	0.8%
Det-house	4	26.4%	14.0%	9.0%	4.8%	30.3%	21.8%	46.3%	38.0%	3.1%	1.2%	0.2%	0.3%	0.5%	0.7%

COAL

Property Type	Number of bedrooms	0-270mm Loft Insulation	25-270mm Loft Insulation	50-270mm Loft Insulation	100-270mm Loft Insulation	Cavity Wall Insulation (pre 1976)	Cavity Wall Insulation (post 1976)	Fuel Switching (full coal to full gas)	Fuel Switching (focal pt coal to full gas)	Draught-stripping	Tank jacket	4 CFLs	A-Rated Fridge Freezer (standard)	A+-rated Fridge Freezer (standard)	A++-rated Fridge Freezer (standard)
		Energy savings as proportion of household energy demand													
Flat	1	46.8%	27.3%	18.0%	10.0%	19.0%	13.3%	45.6%	41.4%	3.2%	4.8%	0.7%	0.8%	1.4%	2.1%
Flat	2	50.0%	29.9%	20.0%	11.2%	17.7%	12.4%	51.4%	46.7%	3.6%	3.8%	0.5%	0.6%	1.1%	1.6%
Flat	3	52.2%	31.8%	21.4%	12.1%	15.8%	11.2%	55.7%	50.6%	3.9%	2.8%	0.4%	0.4%	0.8%	1.2%
Mid-Terrace	2	30.7%	16.0%	10.2%	5.5%	21.1%	14.7%	49.7%	47.7%	3.8%	3.5%	0.5%	0.6%	1.0%	1.5%
Mid-Terrace	3	31.8%	16.7%	10.7%	5.8%	19.7%	13.8%	52.2%	50.2%	4.0%	2.9%	0.4%	0.5%	0.9%	1.3%
End-Terrace	2	27.4%	14.7%	9.4%	5.0%	30.0%	20.4%	53.0%	53.0%	3.5%	2.8%	0.4%	0.4%	0.8%	1.2%
End-Terrace	3	28.2%	15.2%	9.8%	5.2%	27.7%	18.9%	55.1%	55.2%	3.6%	2.3%	0.3%	0.4%	0.7%	1.0%
Semi-bungalow	2	41.9%	24.9%	16.7%	9.1%	22.1%	14.8%	55.6%	54.2%	3.1%	2.6%	0.4%	0.4%	0.8%	1.1%
Semi-bungalow	3	42.6%	25.4%	17.1%	9.3%	20.9%	14.0%	57.0%	55.6%	3.2%	2.3%	0.3%	0.4%	0.7%	1.0%
Det-bungalow	2	40.1%	23.6%	15.7%	8.6%	24.1%	16.4%	56.5%	55.7%	2.8%	2.3%	0.3%	0.4%	0.7%	1.0%
Det-bungalow	3	40.6%	24.0%	16.1%	8.8%	22.8%	15.6%	57.8%	57.0%	2.9%	2.0%	0.3%	0.3%	0.6%	0.9%
Det-bungalow	4	41.1%	24.3%	16.3%	8.9%	21.5%	14.7%	58.7%	58.0%	3.0%	1.8%	0.2%	0.3%	0.5%	0.8%
Semi-house	2	27.9%	15.0%	9.6%	5.1%	27.8%	18.8%	53.8%	54.3%	3.5%	2.4%	0.3%	0.4%	0.7%	1.0%
Semi-house	3	28.4%	15.3%	9.8%	5.2%	26.3%	17.9%	55.0%	55.5%	3.5%	2.1%	0.3%	0.3%	0.6%	0.9%
Semi-house	4	28.7%	15.5%	9.9%	5.3%	24.9%	16.9%	55.8%	56.3%	3.6%	1.9%	0.3%	0.3%	0.6%	0.8%
Det-house	2	25.8%	13.8%	8.9%	4.8%	33.9%	24.1%	55.5%	57.2%	3.0%	1.8%	0.3%	0.3%	0.5%	0.8%
Det-house	3	26.1%	14.0%	9.0%	4.9%	31.9%	22.8%	56.3%	58.0%	3.1%	1.6%	0.2%	0.3%	0.5%	0.7%
Det-house	4	26.3%	14.1%	9.1%	4.9%	30.0%	21.4%	56.9%	58.6%	3.1%	1.4%	0.2%	0.2%	0.4%	0.6%

Oil

Property Type	Number of bedrooms	Energy savings as proportion of household energy demand													
		0-270mm Loft Insulation	25-270mm Loft Insulation	50-270mm Loft Insulation	100-270mm Loft Insulation	Cavity Wall Insulation (pre 1976)	Cavity Wall Insulation (post 1976)	Replacement boiler (91%)	Fuel Switching (full oil to full gas)	Draught-stripping	Tank jacket	4 CFLs	A-Rated Fridge Freezer (standard)	A+-rated Fridge Freezer (standard)	A++-rated Fridge Freezer (standard)
Flat	1	40.0%	22.5%	14.7%	8.1%	15.2%	10.3%	4.1%	17.9%	2.5%	6.0%	1.1%	1.2%	2.3%	3.4%
Flat	2	43.7%	25.2%	16.7%	9.3%	14.5%	9.8%	4.4%	20.6%	2.9%	4.8%	0.9%	1.0%	1.9%	2.7%
Flat	3	46.1%	27.2%	18.1%	10.2%	13.1%	9.0%	4.5%	22.6%	3.2%	3.6%	0.7%	0.7%	1.4%	2.0%
Mid-Terrace	2	25.9%	13.2%	8.4%	4.4%	17.5%	12.0%	4.4%	19.5%	3.1%	4.4%	0.8%	0.9%	1.7%	2.5%
Mid-Terrace	3	27.0%	13.9%	8.8%	4.7%	16.5%	11.3%	4.5%	20.7%	3.3%	3.8%	0.7%	0.8%	1.5%	2.1%
End-Terrace	2	23.3%	12.2%	7.7%	4.1%	25.2%	16.8%	4.8%	21.0%	2.9%	3.7%	0.7%	0.8%	1.4%	2.1%
End-Terrace	3	24.2%	12.8%	8.1%	4.3%	23.5%	15.8%	4.8%	22.0%	3.0%	3.1%	0.6%	0.6%	1.2%	1.7%
Semi-bungalow	2	36.5%	21.3%	14.1%	7.5%	18.5%	12.1%	4.9%	22.5%	2.6%	3.5%	0.6%	0.7%	1.4%	2.0%
Semi-bungalow	3	37.3%	21.9%	14.5%	7.8%	17.7%	11.6%	5.0%	23.2%	2.7%	3.1%	0.6%	0.6%	1.2%	1.7%
Det-bungalow	2	34.8%	20.2%	13.3%	7.2%	20.4%	13.6%	5.0%	22.8%	2.4%	3.1%	0.6%	0.7%	1.2%	1.8%
Det-bungalow	3	35.5%	20.7%	13.7%	7.4%	19.4%	13.0%	5.1%	23.4%	2.4%	2.8%	0.5%	0.6%	1.1%	1.6%
Det-bungalow	4	36.0%	21.0%	13.9%	7.5%	18.4%	12.4%	5.1%	23.9%	2.5%	2.5%	0.4%	0.5%	1.0%	1.4%
Semi-house	2	23.8%	12.5%	7.9%	4.2%	23.4%	15.6%	4.8%	21.4%	2.9%	3.2%	0.6%	0.7%	1.2%	1.8%
Semi-house	3	24.3%	12.8%	8.1%	4.3%	22.3%	14.9%	4.9%	21.9%	2.9%	2.8%	0.5%	0.6%	1.1%	1.6%
Semi-house	4	24.6%	13.0%	8.2%	4.3%	21.1%	14.1%	4.9%	22.3%	3.0%	2.5%	0.5%	0.5%	1.0%	1.4%
Det-house	2	22.2%	11.7%	7.5%	4.0%	29.2%	20.3%	5.0%	22.1%	2.5%	2.5%	0.4%	0.5%	1.0%	1.4%
Det-house	3	22.5%	11.9%	7.6%	4.0%	27.5%	19.2%	5.0%	22.5%	2.6%	2.2%	0.4%	0.4%	0.8%	1.2%
Det-house	4	22.6%	12.0%	7.7%	4.1%	25.9%	18.1%	5.0%	22.7%	2.6%	1.9%	0.3%	0.4%	0.7%	1.1%

lpg

		Energy savings as proportion of household energy demand													
Property Type	Number of bedrooms	0-270mm Loft Insulation	25-270mm Loft Insulation	50-270mm Loft Insulation	100-270mm Loft Insulation	Cavity Wall Insulation (pre 1976)	Cavity Wall Insulation (post 1976)	Replacement boiler (91%)		Draught-stripping	Tank jacket	4 CFLs	A-Rated Fridge Freezer (standard)	A+-rated Fridge Freezer (standard)	A++-rated Fridge Freezer (standard)
Flat	1	39.2%	21.9%	14.5%	8.1%	14.9%	9.8%	3.2%		2.5%	5.8%	1.2%	1.3%	2.5%	3.6%
Flat	2	42.9%	24.7%	16.5%	9.3%	14.2%	9.5%	3.4%		2.9%	4.7%	0.9%	1.1%	2.0%	2.9%
Flat	3	45.4%	26.7%	18.0%	10.2%	12.9%	8.6%	3.5%		3.1%	3.5%	0.7%	0.8%	1.5%	2.2%
Mid-Terrace	2	25.1%	12.8%	8.2%	4.4%	17.2%	11.8%	3.4%		3.0%	4.3%	0.9%	1.0%	1.9%	2.7%
Mid-Terrace	3	26.3%	13.5%	8.6%	4.6%	16.3%	11.2%	3.5%		3.2%	3.7%	0.7%	0.8%	1.6%	2.3%
End-Terrace	2	22.9%	11.8%	7.4%	3.9%	24.5%	16.4%	3.8%		2.8%	3.7%	0.7%	0.8%	1.6%	2.3%
End-Terrace	3	23.8%	12.4%	7.8%	4.1%	22.9%	15.4%	3.8%		2.9%	3.1%	0.6%	0.7%	1.3%	1.9%
Semi-bungalow	2	36.0%	20.9%	13.7%	7.3%	17.9%	11.7%	3.9%		2.5%	3.4%	0.7%	0.8%	1.5%	2.1%
Semi-bungalow	3	36.8%	21.4%	14.1%	7.5%	17.1%	11.2%	4.0%		2.6%	3.0%	0.6%	0.7%	1.3%	1.9%
Det-bungalow	2	34.4%	19.9%	13.1%	7.0%	19.9%	13.1%	4.0%		2.3%	3.1%	0.6%	0.7%	1.3%	1.9%
Det-bungalow	3	35.1%	20.4%	13.4%	7.2%	18.9%	12.6%	4.0%		2.4%	2.7%	0.6%	0.6%	1.2%	1.7%
Det-bungalow	4	35.5%	20.7%	13.7%	7.3%	17.9%	11.9%	4.1%		2.4%	2.4%	0.5%	0.6%	1.0%	1.5%
Semi-house	2	23.4%	12.1%	7.6%	4.0%	22.7%	15.1%	3.8%		2.8%	3.1%	0.6%	0.7%	1.3%	1.9%
Semi-house	3	23.8%	12.4%	7.8%	4.1%	21.6%	14.4%	3.8%		2.9%	2.7%	0.6%	0.6%	1.2%	1.7%
Semi-house	4	24.1%	12.6%	7.9%	4.2%	20.5%	13.7%	3.9%		2.9%	2.4%	0.5%	0.6%	1.0%	1.5%
Det-house	2	21.9%	11.5%	7.4%	3.9%	28.5%	19.7%	4.0%		2.5%	2.4%	0.5%	0.6%	1.0%	1.5%
Det-house	3	22.2%	11.7%	7.5%	4.0%	26.9%	18.6%	4.0%		2.5%	2.1%	0.4%	0.5%	0.9%	1.3%
Det-house	4	22.3%	11.8%	7.6%	4.0%	25.3%	17.5%	4.0%		2.6%	1.9%	0.4%	0.4%	0.8%	1.2%

Appendix 5 Energy Efficiency Assessment Questionnaire

A. CUSTOMER DETAILS

A1. Title: Mr ☐ Mrs ☐ Ms ☐ Miss ☐

Other ☐

A2. First Name / Initial: ☐

A3. Surname: ☐

A4. Address: ☐ ☐ ☐

A5. Postcode: ☐☐☐☐ ☐☐☐☐

A6. Contact tel. no: ☐

● **A7. In what year was your house built?** (Mark one.)

Before 1900	☐	1966 – 1975	☐
1900 – 1918	☐	1976	☐
1919 – 1929	☐	1977 – 1980	☐
1930 – 1944	☐	1981	☐
1945 – 1949	☐	1982 – 1990	☐
1950 – 1964	☐	1991 – 1995	☐
1965	☐	1996 or later	☐

● **A8. Property type?** (Mark one.)

Detached	☐	Mid terrace with passage	☐
Semi-detached	☐	Top floor flat	☐
End terrace	☐	Middle floor flat	☐
Mid terrace	☐	Ground floor flat	☐

● **A9. Do you own your home or do you rent?**

- Own / buying on mortgage ☐
- Renting from council ☐
- Renting from housing association ☐
- Renting privately ☐
- Tied house / other ☐

B. PROPERTY DETAILS

IF YOU LIVE IN A FLAT

B1a. What type of building is it in?

- Tower block (six or more storeys) ☐
- Custom block (five or less storeys) ☐
- Above shop or office ☐
- Divided house ☐

B1b. Is there a roof directly above your flat?

- Yes, sloping (pitched) ☐
- Yes, flat ☐
- Yes, part sloping (pitched) and part flat ☐
- Only part of the flat has a roof ☐
- No ☐

FOR ALL TYPES OF HOME

● **B2. Does your home have a loft?**

Yes ☐ No ☐

B3. If yes, is there a heated room that's in regular use within the loft?

Yes ☐ No ☐

B4. How many floors does your home / flat have? (Excluding loft rooms or cellars.)

One (e.g. bungalow)	☐	Four	☐
Two	☐	Five	☐
Three	☐	More	☐

B5. How many bedrooms do you have?

One	☐	Three	☐	Five	☐
Two	☐	Four	☐	Six	☐
				More	☐

B6. How many living or dining rooms do you have? (Include study / playrooms etc.)

None	☐	Two	☐	Four	☐
One	☐	Three	☐	More	☐

B7. Is your building listed or in a conservation area?*

Yes, listed ☐ Yes, conservation area ☐

No ☐

C. INSULATION DETAILS

● **C1. How much loft insulation do you have?***

(If this is going to prove difficult, please take an educated guess. You can use the ruler provided to help you visualise the depth of insulation.)

None	☐	150mm (6 inches)	☐
25mm (1 inch)	☐	200mm (8 inches)	☐
50mm (2 inches)	☐	No Loft	☐
75mm (3 inches)	☐	Don't know	☐
100mm (4 inches)	☐		

C2. Does your loft have any flooring?*

Yes ☐ No ☐

● **C3. What type of outside walls do you have?***

- Solid brick ☐
- Solid concrete ☐
- Solid stone ☐
- Cavity – insulated ☐
- Cavity – uninsulated ☐
- Mixed ☐
- Modern timber framed ☐
- Don't know ☐

C4. Which type of windows do you have?

- All single glazed ☐
- Some double or secondary glazed ☐
- Most double or secondary glazed ☐
- All double or secondary glazed ☐

● **C5. Is there any draught proofing on windows and external doors? (Assume sealed double glazed windows to be draught proofed.)**

- None draught proofed ☐
- Some draught proofed ☐
- Most draught proofed ☐
- All draught proofed ☐

D. HEATING AND HOT WATER

● **D1. What is your main heating system?**

- Boiler and radiators ☐
- Electric storage heaters ☐
- Warm air system ☐
- Room heaters or fires ☐
- Other ☐

● **D2. What is your main heating fuel?**

- Mains gas ☐
- Electricity ☐
- Oil ☐
- Solid fuel ☐
- Bottled gas ☐
- L.P.G. (bulk) ☐

D3. Do you have a separate fire that you use regularly?

- Yes, electric ☐
- Yes, solid fuel ☐
- No ☐
- Yes, gas ☐

● **D4. What heating controls do you have?***
(Mark all that apply.)

- None ☐
- Programmer / timer ☐
- Room thermostat ☐
- Thermostatic radiator valves ☐
- Storage heater dials ☐

● **D5. If you have a boiler, how old is it?**

- Less than five years old ☐
- Five to ten years old ☐
- Eleven to fifteen years old ☐
- Over fifteen years old ☐

D6. Which of your radiators have foil behind them?*

None ☐ All ☐ Some ☐

D7. Do you have a condensing boiler?*
(If you are not sure, please mark 'no'.)

Yes ☐ No ☐

● **D8. How is your hot water usually provided?***

- From central heating system ☐
- Gas instantaneous / combi boiler ☐
- Electric instantaneous ☐
- Electric immersion (on peak) ☐
- Electric immersion (off peak) ☐
- Dual electric immersion ☐
- Gas, oil or coal range (e.g. AGA-Rayburn) ☐
- Back boiler ☐
- Other ☐

D9. How would you describe your hot water tank insulation?

- No tank ☐
- Solid foam insulation ☐
- Jacket (no gaps around jacket) ☐
- Jacket (with gaps around jacket) ☐
- No insulation ☐

D10. If you have a hot water tank, is there insulation on the pipes between the boiler and the tank?

- Yes ☐
- No ☐
- Can't see pipes ☐
- Don't know ☐