Carbon Emissions Reduction Target (CERT) 2008-2011 Technical Guidance Manual

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Target audience: CERT obligated energy suppliers, energy efficiency stakeholders, project partners working on CERT schemes

Overview:

This document provides information on actions that Ofgem expects suppliers will promote to comply with the Carbon Emissions Reduction Target. It details the basis of the annual reduction in carbon emissions and lifetimes and sets out technical standards or specific requirements that need to be met when delivering or installing the actions. It also includes specific Best Practice guidelines, which suppliers are encouraged to comply with when installing measures.

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Context

The Carbon Emissions Reductions Target 2008-2011 (CERT), previously Energy Efficiency Commitment (EEC), is the government's main policy instrument for reducing carbon emissions from existing households. It requires certain gas and electricity suppliers to meet a carbon emissions reduction obligation between 1 April 2008 and 31 March 2011. Suppliers meet this obligation by delivering and installing carbon emissions reduction actions in domestic premises.

This document sets out technical standards or specific requirements that need to be met when delivering or installing the actions to ensure that the reduction in carbon emissions that may be attributed is realised. It also includes specific Best Practice guidelines, which suppliers are encouraged to comply with when installing measures.

Associated Documents

- The Electricity and Gas (Carbon Emissions Reduction) Order 2008 http://www.opsi.gov.uk
- The explanatory memorandum to the Order http://www.opsi.gov.uk
- The CERT Supplier Guidance http://www.ofgem.gov.uk
- The CERT Market Transformation Guidance http://www.ofgem.gov.uk
- The Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 2005) http://projects.bre.co.uk/sap2005/pdf/SAP2005.pdf
- The Building and Approved Inspectors (Amendment) Regulations 2006 (SI 2006/652)
- The Building (Scotland) Amendment Regulations 2006 (SSI 2006/534)
- Microgeneration Certification Scheme http://www.greenbooklive.com/page.jsp?id=4

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Summary

The Electricity and Gas (Carbon Emissions Reduction) Order 2008 (the Order) came into force on 31 January 2008. It provides the statutory basis for the Carbon Emissions Reduction Target 2008-2011 (CERT), which imposes an obligation upon licenced gas and electricity suppliers that have at least 50,000 customers to meet a carbon reduction target (CER Target). The Order also sets out the broad framework for how this obligation is to be achieved by promoting actions which:

a. achieve an improvement in energy efficiency
b. increase the amount of electricity generated or heat produced by microgeneration
c. increase the heat produced by any plant which relies wholly or mainly on wood
d. reduce energy consumption

and therefore lead a reduction in carbon emissions.

In order to comply with their obligations, suppliers are required to notify Ofgem of their actions. Ofgem will approve these notifications if it is satisfied that the measures suppliers are proposing to deliver would result in a reduction in carbon emissions. Before 30 April 2011, the suppliers must notify Ofgem of all measures installed. Ofgem will then determine the actual reduction in carbon emissions from each notification and whether each supplier has met its CER Target.

This document is one of a number of tools Ofgem has developed to administer the CERT programme. The CERT Supplier Guidance sets out how we approve suppliers' proposed activity, determine the reduction in carbon emissions in relation to their completed actions, and monitor suppliers' compliance with the obligation. The CERT Scheme Spreadsheet has been developed by Ofgem to detail annual reductions in carbon emissions ($kgCO_2$) and lifetimes associated with the most common measures. This spreadsheet has the functionality to automatically calculate the reduction in carbon emissions over the lifetime of each measure to determine the reduction in carbon emissions from each completed activity.

This document, the CERT Technical Guidance Manual, sets out technical standards or specific requirements that need to be met when delivering or installing the actions to ensure that the reduction in carbon emissions attributed to each measure is realised. It also includes specific Best Practice guidelines, which suppliers are encouraged to comply with when installing measures. All of the tools used to administer the CERT programme are available from our website www.ofgem.gov.uk.

It should be noted that this manual is not an exhaustive list of the actions that may lead to a reduction in carbon emissions. If a supplier wishes to promote an action that is not listed in this document, it must provide sufficient information to enable Ofgem to determine a reduction in carbon emissions attributable to the action.

1. Insulation actions

This chapter provides information on factors taken into account when quantifying a reduction in carbon emissions for insulation measures. It also sets out technical standards to be met when installing insulation and includes specific Best Practice guidelines.

Loft insulation

Annual reduction in carbon emissions

1.1. A reduction in carbon emissions for loft insulation has been calculated on a property type basis using the Building Research Establishment Domestic Energy Model (BREDEM). The reduction in carbon emissions, which has been aggregated by fuel type based on the fuel mix in the Target Setting Model, is available for installations covering two ranges of depths:

a. 60mm and less, i.e. a starting depth from 0 to 60mm, and
b. Over 60mm, i.e. a starting depth of over 60mm to 160mm.

1.2. We are not planning to accredit the reduction in carbon emissions from a starting depth of 200mm.

1.3. The reduction in carbon emissions for installations of, or up to 200mm, 250mm and 270mm is available in the CERT Scheme Spreadsheet.

1.4. A spreadsheet calculator is available from Ofgem to quantify the reduction in carbon emissions for installations to 200mm, 250mm or 270mm in properties where the floor area is larger than average, or in properties which have more bedrooms that those listed in the CERT Scheme Spreadsheet. For the floor areas of average property types see paragraph 2.2, Appendix 1.

1.5. The U-values of the insulation have been adjusted to reflect recent research into the disturbances to the loft insulation during its lifetime. This is taken into account in the savings in the CERT Scheme Spreadsheet.

1.6. In addition, a reduction factor has been applied to the BREDEM savings which takes into account a number of different research reports. This factor, which includes the 'comfort factor', is accounted for in the reduction in carbon emissions in the CERT Scheme Spreadsheet.

1.7. If a supplier insulates at least two thirds of the loft area, the full reduction in carbon emissions for such an installation should be claimed. However, this will only apply to cases where some of the loft cannot be insulated for good reasons. To evaluate the reduction in carbon emissions for a part installation, which is less than two thirds of the loft area, the following relationship should be used:

(percentage of area insulated / (2/3)) x reduction in carbon emissions

Lifetime

1.8. The lifetime of loft insulation is 40 years. This has been increased from the 30 years used in EEC2 now that the savings take account of disturbances over the lifetime of the insulation.

Technical standards or specific requirements

1.9. Loft insulation should be installed to a depth of 270mm. 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.

1.10. Insulation installed to 270mm ensures 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 recorded to ensure that the loft has the U-value of $0.16W/m^2K$.

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

1.12. Loft insulation products must be compliant with the following British or European Standards:

BS EN 13162:2001 - "Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification." This document details the standards loft insulation materials must meet to be eligible as a qualifying action under the Order.

BS EN 5803 Part 5:1985 - "Thermal insulation for use in pitched roof spaces in 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.

1.13. When loft insulation is composed of material for which no British or European Standard exists, the material must by certified by the British Board of Agrément (BBA), or another UKAS Accredited Technical Approval Body for its thermal performance.

Best Practice guidelines

1.14. There are two guides relating to best practice when installing loft insulation:

Energy-efficient refurbishment of existing housing (GPG155/CE83, November 2007)

Practical refurbishment of solid-walled houses (CE184, March 2006)

1.15. Both publications state that insulation above the height of the joists should be laid across the joists where appropriate.

1.16. These 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 hatch or 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.

1.17. Best 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.

1.18. In addition, BS 5422:2001 - "Method for specifying thermal insulation materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range - 40^{o}C to +700^{o}C" specifies that when insulating roof spaces, the cold water tank and associated pipe work should be insulated.

DIY loft insulation

Annual reduction in carbon emissions

1.19. A reduction in carbon emissions for DIY loft insulation has been calculated on a per square metre installed basis. For any particular increase in insulation (e.g. the installation of 100mm insulation in a virgin loft or the installation of top-up loft insulation from 100mm to 200mm), the reduction in carbon emissions per square metre is similar for different dwellings. For this reason four different reductions in carbon emissions have been calculated according to the thickness of the insulation purchased. The reduction in carbon emissions for each of the thicknesses of 100mm, 150mm, 170mm or 200mm, has been aggregated by the mix of fuel types in the Target Setting Model and included in the CERT Scheme Spreadsheet.

1.20. The reduction in carbon emissions is an average figure which is 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.

1.21. The U-values of the insulation have been adjusted to reflect recent research into the disturbances to the loft insulation during its lifetime, and less thorough installation than professionally installed loft insulation. A factor has also been applied to make an allowance for wasted and unused material. These issues are accounted for in the reduction in carbon emissions in the CERT Scheme Spreadsheet.

1.22. In addition, a reduction factor has been applied to the BREDEM savings which takes into account a number of different research reports. This factor, which includes the 'comfort factor', is accounted for in the reduction in carbon emissions in the CERT Scheme Spreadsheet.

Lifetime

1.23. The lifetime of DIY loft insulation is 40 years. This has been increased from the 30 years used in EEC2 now that the savings take account of disturbances over the lifetime of the insulation.

Technical standards or specific requirements

1.24. Loft insulation products for DIY installations must be manufactured to the following British or European Standards:

BS EN 13162:2001 - "Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification." This document details the standards loft insulation materials must meet to be eligible as a qualifying action under the Order.

1.25. When loft insulation is composed of material for which no British or European Standard exists, the material must by certified by the British Board of Agrément (BBA), or another UKAS Accredited Technical Approval Body for its thermal performance.

1.26. Installation guidelines should be available to consumers at the place of purchase, and if not supplied with the product, the consumer should be informed where they are located.

Best Practice guidelines

1.27. 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.

1.28. 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.

1.29. The two guides which relate to best practice for professionally installed loft insulation also apply to DIY schemes. There is also a guide relating to best practice when installing DIY loft insulation. These are:

Energy-efficient refurbishment of existing housing (GPG155/CE83, November 2007)

Practical refurbishment of solid-walled houses (CE184, March 2006)

Domestic Energy Efficiency Primer guide (GDP171/CE101, June 2006)

1.30. 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.

1.31. Best 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.

1.32. In addition, BS 5422:2001 - "Method for specifying thermal insulation materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range - 40^{o}C to +700^{o}C" specifies that when insulating roof spaces, the cold water tank and associated pipe work should be insulated.

Cavity wall insulation

Annual reduction in carbon emissions

1.33. A reduction in carbon emissions for cavity wall insulation has been calculated on a property type basis using BREDEM. The reduction has been aggregated by fuel type, based on the fuel mix in the Target Setting Model.

1.34. These reductions in carbon emissions are tabulated in the CERT Scheme Spreadsheet and represent a weighted average of the improvements to the U-value of a cavity wall in pre ’76, ’76-’82 and post ’83 age bands according to the number of cavity wall households in each of these age bands. For the improvement to the U-value see paragraph 2.5.1, Appendix 1.

1.35. A spreadsheet calculator is available from Ofgem to quantify the reduction in carbon emissions for installations in properties where the floor area is larger than average, or in properties which have more bedrooms than those listed in the CERT Scheme Spreadsheet. For the floor areas of average properties see paragraph 2.2, Appendix 1.

1.36. A reduction factor has been applied to the BREDEM savings which takes into account a number of different research reports. This factor, which includes the ‘comfort factor’, is accounted for in the reduction in carbon emissions in the CERT Scheme Spreadsheet.

1.37. If a supplier insulates at least two thirds of the cavity area, the full reduction in carbon emissions for such an installation should be claimed. However, this will only apply to cases where some of the cavity in the wall cannot be insulated for good reasons. To evaluate the reduction in carbon emissions for a part installation, which is less than two thirds of the cavity area, the following relationship should be used:

(percentage of area insulated / (2/3)) x reduction in carbon emissions

Lifetime

1.38. The lifetime of cavity wall insulation is 40 years.

Technical standards and specific requirements

1.39. Cavity wall insulation products must be compliant with the following British or European Standards:

For mineral wool insulation, BS EN 13162:2001 - "Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification."

For UF foam insulation, 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."

1.40. These documents detail the standard cavity wall insulation materials must meet to be eligible as a qualifying action under the Order.

1.41. When cavity wall insulation is composed of material for which no British or European Standard exists, the material must by certified by the British Board of

Agrément (BBA), or another UKAS Accredited Technical Approval Body for their thermal performance.

1.42. A 25-year guarantee must be provided to the customer when the insulation work has been completed as the reduction in carbon emissions calculated are based on installation to the technical requirements of such a guarantee.

1.43. The technical requirements are outlined in the following documents published by Cavity Insulation Guarantee Agency (CIGA) and 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, December 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 3.0, May 2006

Conservatories, Technical guidance note, Version 1.0, July 2007, and

Ventilators, Technical guidance note, Version 1.0, September 2007.

Best Practice guidelines

1.44. 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 (Appendix 2).

Draught-proofing

Annual reduction in carbon emissions

1.45. A reduction in carbon emissions for draught-proofing has been modelled on a property type basis using BREDEM. The reduction has been aggregated by fuel type, based on the fuel mix in the Target Setting Model.

1.46. The reduction in carbon emissions attributable to draught-proofing is appropriate for strip and brush-type systems applied to openable windows and external doors. The reduction in carbon emissions is based on a higher than average initial infiltration rate and is included in the CERT Scheme Spreadsheet.

1.47. A spreadsheet calculator is available from Ofgem to quantify the reduction in carbon emissions for installations in properties where the floor area is larger than average, or in properties which have more bedrooms that those listed in the CERT Scheme Spreadsheet. For the floor areas of average properties see paragraph 2.2, Appendix 1.

Lifetime

1.48. The lifetime of draught-proofing is 10 years unless accompanied by a longer guarantee.

Technical standards or specific requirements

1.49. As the reduction in carbon emissions accredited for draught-proofing is based on a higher than average initial infiltration rate, the action should target homes where windows and doors have a poor fit or seal to the frame, and where the property is particularly exposed.

1.50. The draught-proofing products installed must conform to the following British or European Standards:

BS 7386:1997 - "Specification for draught strips for the draught control of existing doors and windows in housing." This document details the standard draught-proofing materials must meet to be eligible as a qualifying action under the Order.

BS 7880:1997 - "Code of practice for draught control of existing doors and windows in housing using draught strips." This standard specifies the requirements when installing draught-proofing.

Best Practice guidelines

1.51. 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.

1.52. Draught-proofing should not be installed where condensation and mould is present as it will reduce ventilation and exacerbate these problems. "Improving airtightness in existing homes" (GPG 224/CE137, October 2005) is a useful reference for general draught-proofing advice and specific information on ventilation.

External and internal solid wall insulation

Annual reduction in carbon emissions

1.53. A reduction in carbon emissions for solid wall insulation (internal and external) has been modelled on a property type basis using BREDEM. The reduction in carbon emissions has been aggregated by fuel type, based on the fuel mix in the Target Setting Model.

1.54. Three different sets of reduction in carbon emissions have been calculated for solid wall insulation. They are based upon a specific improvement to the thermal performance of the wall.

1.55. Solid wall installation (internal or external) can achieve U-values of $0.35W/m^2K$, $0.37W/m^2K$ and $0.45W/m^2K$ when installed on a wall with a U-value of $2.1W/m^2K$ or higher (eg 220mm solid brick wall). The reduction in carbon emissions for these installations is available in the CERT Scheme Spreadsheet.

1.56. 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 thermal properties.

Table 1. 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 $0.35W/m^2K$ Minimum insulation depth	U-value $0.45W/m^2K$ 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

1.57. Depths and conductivities stated here are for the insulation, and don't include facing or finish. External insulation should be finished with 25mm render, and internal insulation with plasterboard facing mineral wool.

Table 2. Internal insulation with timber studs bridging the insulation (50mm wide studs at 600mm centres to support 1200mm wide plasterboard)

	U-value 0.35 W/m^2K	U-value 0.45 W/m^2K
Minimum insulation depth	100mm	75mm
Conductivity (W/mK) as stated, or better than	0.036	0.038

1.58. The solid wall insulation materials listed above are for illustrative purposes only. An improvement to constructions with equivalent U-values of the wall can be achieved using other materials with the same thermal characteristics.

1.59. Suppliers can be accredited with installing other materials, although the lambda will need to be verified and the thickness of insulation recorded to calculate the improvement in the U-value.

1.60. Several solid wall manufacturers have had a reduction in carbon emissions from their products independently quantified. A current list of these products is available from our website at www.ofgem.gov.uk.

Lifetime

1.61. The lifetime of solid wall insulation is 30 years.

Technical standards and specific requirements

1.62. The effect of the Building Regulations (Part L1 2002) on existing dwellings (GIL70, November 2002) summarises the guidance for the insulation of solid walls.

1.63. Solid wall insulation materials must conform to the following British or European Standards:

BS EN 13914-1:2005 - "Design, preparation and application of external rendering and internal plastering – Part 1: External rendering." 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.

1.64. When solid wall insulation is composed of material for which no British or European Standard exists, the material must by certified by the British Board of Agrément (BBA), or another UKAS Accredited Technical Approval Body for their thermal performance.

Best Practice guidelines

1.65. Best Practice guidelines for solid wall insulation recommend an improvement to the U-value of 0.35W/m^{2}K. Ofgem strongly encourages suppliers to install to this level, where practical. Further detail on products that can be used to attain the Best Practice improvement are provided in the following publications:

Energy-efficient refurbishment of existing housing (GPG155/CE83, November 2007)

External insulation systems for walls of dwellings (GPG293/CE118, March 2006)

1.66. The following guides provide advice on solid wall installations:

Practical refurbishment of solid-walled houses (CE184, March 2006)

Internal wall insulation in existing housing – a guide for specifiers and contractors (GPG138/CE17, January 2008)

Hot water tank insulation

Annual reduction in carbon emissions

1.67. A reduction in carbon emissions for hot water tank insulation has been calculated on a per installation basis, as the dwelling type has little effect on the calculated value. The reduction in carbon emissions has been weighted by the relative thickness of existing hot water tank insulation across the housing stock aggregated by fuel type, based on the fuel mix in the Target Setting Model. The reduction in carbon emissions is included in the CERT Scheme Spreadsheet.

1.68. Suppliers can be attributed the reduction in carbon emissions for fitting insulation to a bare tank or topping up existing insulation. Suppliers cannot be accredited with a reduction in carbon emissions for replacing a tank jacket.

Lifetime

1.69. The lifetime of tank insulation is 10 years.

Technical standards or specific requirements

1.70. 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 BS 1566-2:1984 and BS 1566-1:2002.

High efficiency water cylinders

Annual reduction in carbon emissions

1.71. A reduction in carbon emissions for high efficiency hot water cylinders has been calculated for existing and new build properties that heat water using gas or electricity. The reduction in carbon emissions has been calculated for each type of water heating taking cylinder standing losses, primary pipe-work losses and boiler losses into consideration.

1.72. 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, for these cases there are separate gas savings for instances where the primary pipe-work is and is not insulated.

1.73. The reduction in carbon emissions that can be claimed for high efficiency hot water cylinders in both existing dwellings and new build properties is as follows:

a. where water is heated by a gas-fired boiler in a property with no primary pipe-work insulation, the reduction in carbon emissions resulting from replacing a stock average cylinder with a high performance cylinder is 15.8 $kgCO_2$/annum

b. where water is heated by a gas-fired boiler in a property with insulated primary pipe-work, the reduction in carbon emissions from replacing a stock average cylinder with a high performance cylinder is 11.0 $kgCO_2$/annum, and

c. where water is heated by an electric immersion heater, the reduction in carbon emissions from replacing a stock average cylinder with a high performance cylinder is 17.7 $kgCO_2$/annum.

1.74. These reductions in carbon emissions should be entered into the 'Other Insulation' section on the Insulation worksheet of the CERT 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

1.75. The lifetime of high efficiency water cylinders is 20 years.

Technical standards or specific requirements

1.76. Replacement cylinders in existing properties are required to be installed to the same standard as for new build properties

1.77. Installations of hot water cylinders should meet the basic level of specification set out in Central Heating System Specifications – CheSS (CE51, June 2008).

Radiator panels

Annual reduction in carbon emissions

1.78. A reduction in carbon emissions can only be awarded for the installation of radiator panels when they are fitted to external walls. Furthermore, research by the BRE indicates that an improvement in energy efficiency from an installation of radiator panels is 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.

1.79. 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. Suppliers can be accredited with installing other types of radiator panels, in which case a reduction in carbon emissions will need to be verified by an independent field trial.

1.80. The reduction in carbon emissions for professionally installed radiator panels has been calculated on a per square meter basis. The reduction in carbon emissions has been aggregated by fuel type, based on the fuel mix in the Target Setting Model. The reduction in carbon emissions attributable to professionally installed reflective radiator panels is 17 $kgCO_2/m^2$/annum.

1.81. 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 reduction in carbon emissions from DIY sales needs to be adjusted to account for those panels that are fitted on a wall with a filled cavity. The reduction in carbon emissions attributable to DIY reflective radiator panels is 10 $kgCO_2/m^2$/annum.

1.82. As the reduction in carbon emissions for radiator panels is calculated on a per square metre basis, when submitting radiator panel schemes, suppliers should indicate the total area of panel installed to allow the overall reduction in carbon emissions to be calculated. The carbon reduction values and total area of panel installed should be entered into the 'Other Insulation' section on the Insulation worksheet of the CERT Scheme Spreadsheet.

Lifetime

1.83. A lifetime of radiator panels is 10 years.

Window glazing

Annual reduction in carbon emissions

1.84. 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. As stated in AD Part L of the Building Regulation, 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. A reduction in carbon emissions can be attributed to glazing with a rating above ‘E’.

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

1.86. Four different sets of reduction in carbon emissions on a per square meter installed basis have been calculated for window glazing. They are based upon an improvement in the rating and have been aggregated by the mix of fuel types in the Target Setting Model. The reduction in carbon emissions for these installations is available in the CERT Scheme Spreadsheet.

Lifetime

1.87. The lifetime of window glazing is 20 years.

Technical standards and specific requirements

1.88. Installation of window glazing should meet the basic level of specification set out in Windows for new and existing housing (CE66, March 2006).

2. Heating action

This chapter provides information on factors taken into account when quantifying a reduction in carbon emissions for heating measures. It also sets out technical standards to be met when delivering heating and includes specific Best Practice guidelines.

Boilers

Annual reduction in carbon emissions

2.1. In the guidance to the Building Regulations 2000 (Scotland 2004) as amended, minimum combustion efficiencies for boilers are outlined which would demonstrate compliance with the requirement to conserve fuel and power. These apply to both new-build properties and existing dwellings when a new boiler is installed. As most non-exceptions boiler installations are now A-rated, Ofgem will only consider action in relation to replacing an exception to the Building Regulations, where a D-rated exception is replaced by A- or B-rated boiler.

2.2. For the purposes of the CERT, a reduction in carbon emissions is calculated on the basis of a comparison between the weighted seasonal combustion efficiency of the new A- and B-rated condensing boiler and the minimum weighted combustion efficiency of exceptions. Table 3 lists the minimum combustion efficiencies for exceptions to the Building Regulations, expressed as Seasonal Efficiency of Domestic Boilers in the UK (SEDBUK) values.

Table 3. Minimum SEDBUK values outlined in the guidelines to the Building Regulations 2000 (Scotland 2004) as amended

	Minimum SEDBUK	
Fuel type	Normal	Exceptions
Natural Gas	86%	78%
LPG	86%	80%
Oil regular	86%	85%
Oil combi	86%	82%

2.3. The reduction in carbon emissions has been quantified for each property type and fuel type on the Heating worksheet in the CERT Scheme Spreadsheet.

2.4. A spreadsheet calculator is available from Ofgem to quantify the reduction in carbon emissions for boiler installations in properties where the floor area is larger than average, or in properties which have more bedrooms that those listed in the CERT Scheme Spreadsheet. For the floor areas of average property types see paragraph 2.2, Appendix 1.

Lifetime

2.5. The lifetime of boilers is 12 years.

Technical standards or specific requirements

2.6. Replacement boilers installed as part of suppliers' qualifying action must be SEDBUK A- or B-rated. The SEDBUK database has been set up as part of the Government's Energy Efficiency Best Practice Programme and indicates the combustion seasonal average efficiency of all boilers currently available. It can be viewed at www.sedbuk.com .

2.7. Installations of boilers must meet the basic level (HR7 for regular boilers and HC7 for combi boilers), which is set out in Central Heating System Specifications – CHeSS (CE51, June 2008). Such installations will meet the standards outlined in the guidance to the Building Regulations 2000 (Scotland 2004) as amended. The guidance note can be obtained by calling the EST's Energy Efficiency Publication Hotline on 0845 120 7799 or by visiting www.energysavingtrust.org.uk/housingbuildings.

2.8. Boiler installations must be compliant with the following British or European Standards:

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 7671:2008 - Requirements for electrical installations, Institution of Electrical Engineers (IEE) wiring regulations, 17th Edition

Best Practice guidelines

2.9. Ofgem refers suppliers to the following guides for a good overall reference on gas and oil systems:

Energy Efficiency Best Practice in Housing Domestic heating by oil: boiler systems (CE29, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating by gas: boiler systems (CE30, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating: solid fuel systems (CE47, March 2005)

Heating controls

Annual reduction in carbon emissions

2.10. In addition to outlining minimum combustion efficiencies for boilers, the guidance documents for the Building Regulations 2000 (Scotland 2004) as amended refer to space heating and hot water system controls.

2.11. The current England and Wales guidance and the 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.

2.12. It is important to include boiler interlock where possible, to prevent the boiler firing when there is no demand for heat (see SAP2005 9.3.9). Where boiler interlock is not a replacement, a reduction in carbon emissions may be attributed to this control, otherwise Building Regulations guidance standards apply.

2.13. When heating controls are being installed or upgraded as part of a boiler replacement scheme a reduction in carbon emissions 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.

2.14. If the heating controls are being upgraded without a replacement boiler or hot water cylinder replacement, a reduction in carbon emissions will be attributed (based on a stock average boiler efficiency of 78 per cent for gas, 82 per cent for oil and 78 per cent for LPG) for all of the heating controls installed.

2.15. The reduction in carbon emissions for the installation of heating controls installed without a replacement boiler are calculated automatically on the heating worksheet in the CERT Scheme Spreadsheet on a property type basis. The heating control functionalities outlined in the CERT Scheme Spreadsheet are:

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

Descriptions of each of these can be found in SAP2005 section 9.3.

Lifetime

2.16. The lifetime of heating controls is 12 years.

Technical standards or specific requirements

2.17. Installations of heating controls must meet the basic level, which is set out in Central Heating System Specifications – CHeSS (CE51, June 2008). Such installations will meet the standards outlined in the guidelines to the Building Regulations 2000 (Scotland 2004) as amended. The guidance note can obtained by calling the EST's Energy Efficiency Publication Hotline on 0845 120 7799 by visiting www.energysavingtrust.org.uk/housingbuildings.

2.18. In addition, heating controls must all be installed in line with BS 7671:2008 - "Requirements for electrical installations, IEE wiring regulations, 17th Edition" and BS 5449:1990 - "Specification for forced circulation hot water central heating systems for domestic purposes."

Best Practice guidelines

2.19. Ofgem refers suppliers to the following guides for information on the different types of controls available, including descriptions of advanced functions:

Energy Efficiency Best Practice in Housing Domestic heating by oil: boiler systems (CE29, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating by gas: boiler systems (CE30, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating: solid fuel systems (CE47, March 2005)

Fuel switching

2.20. Fuel switching action relates to the switching of carbon intensive primary heating fuel of the property to a fuel with lower carbon content.

2.21. Some properties have multiple sources of heating and it may be more difficult to identify the primary heating fuel in such cases. Where one heating system is clearly dominant in terms of the heating it provides (taking account of the greater heating provided in rooms such as the living room, compared to e.g. bedrooms, and also the provision of water heating), this should be taken as the heating system in attributing a reduction in carbon emissions.

2.22. 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 funding fuel switching from a wet electric system, it will need to specify whether the whole system requires replacing.

2.23. 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 (Scotland 2004) as amended. 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.

Annual reduction in carbon emissions

2.24. A reduction in carbon emissions can be attributed to fuel switching activity if domestic consumers switch the fuel type of their heating systems to a less carbon intensive fuel as a result of suppliers' funding.

2.25. 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 reduction in carbon emissions for full fuel switching will be accredited in those cases.

2.26. Focal point savings should be claimed only for properties that either have no formal heating system or are reliant on focal point fires.

2.27. The reduction in carbon emissions for full and partial fuel switching is included in the CERT Scheme Spreadsheet. The reduction in carbon emissions for fuel switching in a house heated by central heating is based on the comparison between the energy consumption of the existing heating system and the replacement system. The reduction in carbon emissions for fuel switching in a house heated by focal point fires is 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.

2.28. If a supplier wishes to install intelligent heating controls, these should be claimed as separate actions using options in the Heating worksheet of the CERT Scheme Spreadsheet.

Lifetime

2.29. A lifetime of fuel switching is 20 years.

Technical standards or specific requirements

2.30. Boilers and heating control installations should fulfil the technical standards or specific requirements outlined in 2.6 to 2.8 and 2.17 to 2.18.

Best Practice guidelines

2.31. Ofgem refers suppliers to the following guides for a good overall reference on gas and oil systems and for information on the different types of controls available, including descriptions of advanced functions:

Energy Efficiency Best Practice in Housing Domestic heating by oil: boiler systems (CE29, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating by gas: boiler systems (CE30, January 2008)

Energy Efficiency Best Practice in Housing Domestic heating: solid fuel systems (CE47, March 2005)

Flue Gas Heat Recovery Systems

Annual reduction in carbon emissions

2.32. A reduction in carbon emissions for flue gas heat recovery systems (FGHRS), including passive flue gas heat recovery devices (PFGHRD), should be verified through Appendix Q of SAP. For specific details of the models accredited, associated reductions in carbon emissions, and lifetimes, please contact Ofgem.

2.33. The relevant reduction in carbon emissions should be entered in the Other Heating section of the Heating worksheet in the CERT Scheme Spreadsheet.

Lifetime

2.34. The lifetime of FGHRS is 12 years.

Technical standards or specific requirements

2.35. As FGHRS are regarded as part of the boiler, boilers and heating control installations should fulfil the technical standards or specific requirements outlined in 2.6 to 2.8 and 2.17 to 2.18.

Heat recovery ventilation

Annual reduction in carbon emissions

2.36. A reduction in carbon emissions for heat recovery ventilation units should be verified through Appendix Q of SAP. For specific details of the models accredited, associated reductions in carbon emissions and lifetimes, please contact Ofgem.

2.37. The relevant reduction in carbon emissions should be entered in the Other Heating section of the Heating worksheet in the CERT Scheme Spreadsheet.

Lifetime

2.38. The lifetime of heat recovery ventilation is 10 years.

Technical standards or specific requirements

2.39. All installations of heat recovery ventilation units must comply with BS 7671: 2008 - Requirements for electrical installations, IEE wiring regulations, 17th Edition.

Best Practice guidelines

2.40. "Energy-efficient ventilation in housing – a guide for specifiers on the requirements and options for ventilation" (GPG 268, March 2006) provides background information on wider ventilation issues together with more specific advice about heat recovery room ventilators.

3. Lighting actions

This chapter provides information on factors taken into account when quantifying a reduction in carbon emissions for lighting measures. It also sets out technical standards to be met when delivering lighting.

Compact fluorescent lamps and luminaires

Annual reduction in carbon emissions

3.1. An improvement in energy efficiency 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 replacing. These figures were derived from monitoring research undertaken as part of the EESoP3 programme.

3.2. The CERT Scheme Spreadsheet provides a reduction in carbon emissions for luminaires and CFLs that have been installed.

3.3. The reduction in carbon emissions 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. 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 CERT Scheme Spreadsheet.

Lifetime

3.5. The lifetime of CFLs is 17.7 years.

3.6. The lifetime of luminaires is 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

3.7. CFLs and luminaires can be considered qualifying action in CERT provided that they have been awarded Energy Saving Recommended (ESR) status. The approved CFL and luminaire list is revised as necessary. For confirmation of the current version, contact James Russill (james.russill@est.org.uk) at the EST.

Halogens

Annual reduction in carbon emissions

3.8. An improvement in energy efficiency for halogens is calculated on a wattage comparison basis of the energy efficient halogen installed against the average halogen that it is assumed to be replacing.

3.9. The CERT Scheme Spreadsheet provides a reduction in carbon emissions for halogens.

3.10. 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 halogens in the CERT Scheme Spreadsheet.

Lifetime

3.11. The lifetime of halogens is 6.5 years.

Technical standards or specific requirements

3.12. Halogens can be considered qualifying action in CERT provided that they have been awarded Energy Saving Recommended (ESR) status. The approved halogen list is revised as necessary. For confirmation of the current version, contact James Russill (james.russill@est.org.uk) at the EST.

4. Energy efficient appliances

This chapter provides information on factors taken into account when quantifying a reduction in carbon emissions for appliances. It also sets out technical standards to be met when delivering appliances.

Incentive appliances

4.1. There are several ways in which suppliers can deliver appliances. In incentive schemes, the supplier incentivises more efficient appliances to the consumer.

Annual reduction in carbon emissions

4.2. A reduction in carbon emissions for incentive appliances is based on an improvement in energy efficiency between the sales weighted average consumption of the particular type of appliance and the consumption of the promoted appliance. The reduction in carbon emissions is included in the CERT Scheme Spreadsheet.

4.3. The reduction in carbon emissions for incentive 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 be claimed under the 'US style' category in the CERT Scheme Spreadsheet.

4.4. The Target Setting Model included a factor for the heat replacement effect for cold appliances. This factor is automatically incorporated into the calculations in the CERT Scheme Spreadsheet.

Lifetime

4.5. The lifetime of incentive appliances, tabulated below, is dependant on the type of appliance and whether the householder is in the Priority Group.

Table 4: Incentive measure lifetime (years) by customer type

	Freezers and Fridge Freezers	Refrigerators and Larders
Non-Priority measure lifetime	15	12
Priority measure lifetime	15	15

Technical standards or specific requirements

4.6. All eligible cold appliances must be at least A+ rated in terms of energy consumption. Chest freezers are an exception to this rule where A-rated models are also eligible.

Trade-in appliances

4.7. Under trade-in schemes, consumers are able to trade-in a working appliance for a more energy efficient replacement.

Annual reduction in carbon emissions

4.8. There is a two-fold benefit to be gained from trade-in action; first removing the existing inefficient appliance from the market and second replacing it with a more efficient appliance than would normally be the case.

4.9. A reduction in carbon emissions accredited to trade-in appliances represents an improvement in energy efficiency between the existing stock weighted average consumption of the products and the consumption of the promoted appliance applied for two thirds of the appliance lifetime. This reflects the fact that consumer was persuaded to purchase the new appliance prematurely, after two thirds of the lifetime of the old appliance. The reduction in carbon emissions is available from the CERT Scheme Spreadsheet.

4.10. The Target Setting Model included a factor for the heat replacement effect for cold appliances. This factor is automatically incorporated into the calculations in the CERT Scheme Spreadsheet.

Lifetime

4.11. The lifetime of trade-in appliances, tabulated below, is dependant on the type of appliance and whether the householder is in the Priority Group.

Table 5: Trade-in measure lifetime (years) by customer type

	Freezers and Fridge Freezers	Refrigerators and Larders
Non-Priority measure lifetime	10	8
Priority measure lifetime	10	10

Technical standards or specific requirements

4.12. All eligible cold appliances must be at least A+ rated in terms of energy consumption. Chest freezers are an exception to this rule, where A-rated models are also eligible.

4.13. To qualify for a trade-in scheme, the consumer's existing appliance should be in a working condition.

4.14. The existing cold appliance must be removed from consumer's home and destroyed in a manner that is compliant with EU legislation governing emissions of ozone depleting gases to avoid entry into the second-hand market (Regulation (EC) No 2037/2000, 29 June 2000). This EU legislation has been transposed in to UK legislation (SI 1510, 2006) and is available from http://www.opsi.gov.uk/si/si2006/20061510.htm.

Fridgesaver appliances

4.15. Fridgesaver schemes operate in a similar way to trade-in schemes, but are limited to Priority Group consumers trading an inefficient cold appliance for a more efficient model.

Annual reduction in carbon emissions

4.16. A reduction in carbon emissions for fridgesavers is calculated on the basis of the difference between the energy consumption of the specific model provided to the consumer to which a reduction factor has been applied, and the energy consumption of either a fridge or fridge-freezer which would meet the scoring protocol requirements.

4.17. The combination of appliances that can be traded in under a fridgesaver scheme and the reduction in carbon emissions attributed for each combination is listed in the CERT Scheme Spreadsheet

4.18. The 0.71875 factor is applied to reduce the energy consumption of the replacement appliance based on the results of EESoP 1 and 2 monitoring, which took place between 1994 and 2000. The research shows that eligible consumers used their new fridges or fridge-freezers less (in terms of opening and closing the appliance door, etc.). The monitoring also concludes that:

a. the energy consumption of a standard fridge-freezer which would meet the Fridgesaver Protocol is 983 kWh/a

b. the energy consumption of a fridge which would meet the Fridgesaver Protocol is 603 kWh/a, and

c. the energy consumption of a freezer which would meet the Fridgesaver Protocol is 594 kWh/a.

4.19. The Target Setting Model included a factor for the heat replacement effect for cold appliances. This factor is automatically incorporated into the calculations in the CERT Scheme Spreadsheet.

Lifetime

4.20. The lifetime of fridgesaver appliances is 15 years.

Technical standards or specific requirements

4.21. All eligible cold appliances must be at least A+ rated in terms of energy consumption. Chest freezers are an exception to this rule, where A-rated models are also eligible.

4.22. 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 (Fridgesaver Protocol), which is illustrated in Appendix 4. The fridge or fridge-freezer being traded in must score 3 points or more on the protocol.

4.23. Where 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 scoring protocol.

4.24. The existing cold appliance must be removed from consumer's home and destroyed in a manner that is compliant with EU legislation governing emissions of ozone depleting gases to avoid entry into the second-hand market (Regulation (EC) No 2037/2000, 29 June 2000). This EU legislation has been transposed in to UK legislation (SI 1510, 2006) and is available from http://www.opsi.gov.uk/si/si2006/20061510.htm.

5. Microgeneration and combined heat and power actions

This chapter provides information on factors taken into account when quantifying a reduction in carbon emissions for microgeneration and combined heat and power. It also sets out technical standards to be met when delivering these measures and includes specific Best Practice guidelines.

Combined heat and power

Annual reduction in carbon emissions

5.1. Attributing a reduction in carbon emissions to a community based or mini combined heat and power (CHP) scheme will be carried out on a case by case basis, because each installation will have different before and after characteristics.

5.2. For the reduction in carbon emissions 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.

5.3. A separate spreadsheet for the calculation of the reduction in carbon emissions arising from the installation of CHP systems is available from Ofgem. Relevant information from the Communal Heating Spreadsheet should then be entered into the Microgen&CHP worksheet of the CERT Scheme Spreadsheet.

5.4. Ofgem will consider the accreditation of domestic scale (micro) CHP systems when the appropriate data becomes available.

Lifetime

5.5. The lifetime of a CHP system is 15 years.

Technical standards and specific requirements

5.6. When submitting a community CHP scheme, a supplier should provide a feasibility report with its submission giving full supporting evidence for the energy consumption data.

5.7. Large scale CHP installations need to be certified by CHP Quality Assurance.

Heat generation

Solar Water Heating

Annual reduction in carbon emissions

5.8. A reduction in carbon emissions for solar water heating has been calculated on an installation basis. A $4m^2$ flat plate panel or $3m^2$ evacuated tube panel is assumed a suitable size for a semi-detached dwelling, and the panel area is scaled according to hot water load for other dwellings. The reduction in carbon emissions by dwelling type is found to be very similar. Therefore, the reduction in carbon emissions tabulated in the CERT Scheme spreadsheet is for an appropriately sized indirect system[1] irrespective of a property type. The savings reduction in carbon emissions has been quantified for each fuel type and is available in the Microgen & CHP section of the CERT Scheme Spreadsheet.

Lifetime

5.9. The lifetime of solar water heating is 25 years.

Technical standards or specific requirements

5.10. Solar water heating must be compliant with the following British or European Standards, as specified by the Microgeneration Certification Scheme (MCS):

EN 12975-1:2006 - Thermal solar system and components. Solar collectors. General requirements

EN 12976-1:2006 - Thermal solar systems and components. Factory made systems

BS 5918:1989 - Code of practice for solar heating systems for domestic hot water; these standards contain recommendations for the design, construction, installation and commissioning of components and systems for domestic hot water preheating for single family dwellings.

5.11. "Solar water heating systems – guidance for professionals, conventional indirect systems" (CE131, 2006) provides advice on installing solar thermal systems that transfer heat to an indirect cylinder.

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[1] Indirect systems may either have a separate cylinder for solar heated water, or a single cylinder with two coils, one for solar heating and the other from the boiler

Heat Pumps

Annual reduction in carbon emissions

5.12. When calculating a reduction in carbon emissions from 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.

5.13. 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. To evaluate the reduction in carbon emissions from these systems the CO_2 emissions associated with this electricity consumption is subtracted from the CO_2 emissions of the original system.

5.14. 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. It represents the average annual performance of the heat pump. 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 3 kWh of space heating and 2.4 kWh of water heating.

5.15. Seasonal CoP (SCoP) in an equivalent measure to CoP, but calculated or measured over a whole year's operation. A European standard procedure defining a range of part-load laboratory tests together with rules for combining these to produce a value of SCoP has been recently approved, but not yet published. Therefore, where a supplier seeks attribution of a reduction in carbon emissions for a ground source heat pump, it must submit the measured SCoP of the unit to Ofgem at the time of notification.

5.16. As a heat pump will usually have different efficiencies for space and water heating, both SCoPs should be provided. When the supplier is provided with the average SCoP, it should be assumed that 80 per cent of the delivered energy is for space heating and 20 per cent of is for water heating when calculating individual SCoPs.

5.17. Some heat pumps may only meet a proportion of the total heating or/and hot water demand. If this is the case, the supplier must specify the system that will fulfil the remainder.

5.18. A spreadsheet calculator is available from Ofgem to quantify the reduction in carbon emissions from heat pumps. The spreadsheet calculator has been adapted to quantify the reduction in carbon emissions in properties where the floor area is larger than average, or in properties which have more bedrooms than those listed in the CERT Scheme Spreadsheet.

Air source heat pumps

5.19. A methodology was developed to evaluate the performance of air source heat pumps. The suppliers wishing to promote air source heat pumps should undertake a field trial to verify the SCoP. Details of the trial are provided in Appendix 5. Once this data is available we will consider accreditation.

Lifetime

5.20. The lifetime of ground source heat pumps is 40 years.

Technical standards or specific requirements

5.21. As specified by the Microgeneration Certification Scheme (MCS), heat pumps must be compliant with EN 14511:2004 Parts 1-4 – "Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling."

5.22. The CoP of ground source heat pumps needs to be tested to in accordance with EN 14511-3:2004 to the rating conditions specified at EN 14511-2:2004.

5.23. Good background information to the installation of ground source heat pumps is provided in Technical Note TN 18/99 "Ground source heat pumps - a technology review", R H D Rawlings, BSRIA, July 1999 (ISBN 0 86022 506 2). The publication can be obtained from http://www.bsria.co.uk/bsriabshop/system/index.html.

5.24. "Domestic Ground Source Heat Pumps: Design and installation of closed-loop systems" (GPG339/CE82, June 2007) and "Heat Pumps in the UK" (GIL72/CE186, November 2005) are a useful reference for specific information on installation and general heat pump advice.

Biomass heating

Annual reduction in carbon emissions

5.25. Domestic biomass heating must comply with the guidance to the Building Regulations 2000 (Scotland 2004) as amended, including the minimum efficiencies specified. A reduction in carbon emissions for domestic biomass boiler installation (less than 45kWhth) has been tabulated in the Carbon Reduction Matrix, which is available from Ofgem. The reduction in carbon emissions has been calculated for:

a. wood burning stoves, providing primary space heating and hot water heating, and
b. wood burning stoves, providing secondary space heating; water heating is supplied by the existing conventional system.

5.26. Details of individual installations should be entered in the Biomass boilers section of the Microgen&CHP worksheet.

5.27. The reduction in carbon emissions attributed to an installation of a communal based biomass boiler, which is the main source of space and hot water heating, will be evaluated on a case by case basis, because each installation will have different before and after characteristics. For the reduction in carbon emissions to be calculated, the supplier must provide the relevant information with its notification, including the energy required from the existing system per annum, type of wood feeding the biomass boiler, annual fuel demand of the site after the biomass boiler has been installed and efficiency of the new biomass boiler. The suppliers should also confirm whether an alternative source of heat will be provided to meet hot water energy demand in the summer and whether there will be a backup system in case of a shortage of biomass fuel.

5.28. A separate spreadsheet for the calculation of the reduction in carbon emissions arising from the installation of communal biomass boilers is available from Ofgem. Relevant information from the Communal Heating Spreadsheet should then be entered onto the CERT Scheme Spreadsheet. Information on communal installations should be entered into the Other Heating section of the Heating worksheet.

Lifetime

5.29. The lifetime of biomass boilers depends on their size. Community heating biomass boilers have a lifetime of 30 years, whereas the lifetime of domestic biomass boilers is 20 years.

Technical standards and specific requirements

5.30. Installations of biomass appliances must meet the standards outlined in the guidance to the Building Regulations 2000 (Scotland 2004) as amended.

5.31. Biomass boilers must be compliant with the following standards:

BS EN 303-5:1999 - Heating boilers. Heating boilers with forced draught burners. Heating boilers for solid fuels, hand and automatically fired, nominal heat output of up to 300 kW. Terminology, requirements, testing and marking.

BS EN 13240:2001 - Roomheaters fired by solid fuel. Requirements and test methods.

5.32. When submitting a biomass boiler scheme, the supplier should provide a feasibility report with its submission giving full supporting evidence for the energy consumption data. Suppliers should also ensure that there is sufficient space for storing the fuel. The Low and Zero Carbon guidance associated with Part L shows whether it would be worthwhile installing a biomass boiler in any given circumstance.

5.33. Under the Clean Air Act 1993 local authorities may declare the whole or part of the district of the authority to be a smoke control area, in which only exempted appliances may be used. The list of exempted appliances in England, Scotland and Wales is available from http://www.uksmokecontrolareas.co.uk/appliances.php.

Electricity generation

Wind

Annual reduction in carbon emissions

5.34. A reduction in carbon emissions from wind generation is dependent on the size of the unit and the load factor. The load factor is site specific and it will be important for Ofgem to have confidence in it to attribute a reduction in carbon emissions to wind generation.

5.35. For each installation, annual energy performance data should be calculated as specified by the Microgeneration Certification Scheme (MCS). The manufacturer's annual energy performance curve should be then corrected to take into account the altitude and mean wind speed for the location. Where necessary, wind speed should be reduced to take account of obstructions.

Lifetime

5.36. The lifetime of wind turbines depends on the size of the measure and is 10 years for micro wind (roof mounted up to 1kWp) and 22.5 years for mini wind (pole mounted up to 5kWp).

Technical standards and specific requirements

5.37. Performance of wind turbines needs to be measured in accordance with:

BS EN 61400-12-1:2006 - Wind turbines. Power performance measurements of electricity producing wind turbines.

BS EN 61400-11:2003 - Wind turbine generator systems. Acoustic noise measurement techniques.

BS EN 61400-2:2006 - Design requirements provides gives guidance on additional requirements and standards regarding the installation of wind turbines.

5.38. "Installing small wind-powered electricity generating systems" (CE72, November 2004) outlines general issues relating to the installation of wind turbines.

Photovoltaics

Annual reduction in carbon emissions

5.39. Product performance varies with their crystal structure:

a. Amorphous (thin film) - system efficiency between 3 and 6 per cent

b. Polycrystalline - system efficiency between 10 and 13 per cent

c. Monocrystalline - system efficiency between 12 and 15 per cent.

5.40. Therefore, attributing a reduction in carbon emissions to a photovoltaic (PV) installation will be carried out on a product type basis.

5.41. For the reduction in carbon emissions to be calculated, the supplier must provide the relevant information with its notification, including type of product and its efficiency, size of the panel installed and power rating in KWp per m^2.

Lifetime

5.42. The lifetime of PV varies with their crystal structure and is 20 years for amorphous (thin film), 25 years for polycrystalline, and 30 years for monocrystalline panels.

Technical standards and specific requirements

5.43. PV installation must be compliant with the following standards:

BS EN 61215:2005 – Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval

BS EN 61646:1977 – Thin film terrestrial photovoltaic (PV) modules – Design qualification and type approval

5.44. The following guides provide advice on installing frame mounted photovoltaics:

Photovoltaics in Buildings, Guide to the installation of PV systems (DTI/Pub URN 06/1972)

Wind loads on roof-based photovoltaic systems (BRE Digest 489, 2004)

Mechanical installation of roof-mounted photovoltaic systems (BRE Digest 495, 2005)

Best Practice guidelines

5.45. "Photovoltaics Field Trial Good Practice Guide: Parts 1 Project Management and Installation Issues" and "Photovoltaics Field Trial Good Practice Guide: Part 2 System Performance Issues" provide a good overall reference on PV installations including building integration issues and specific details on the design and performance. Part 1 is available from http://www.bre.co.uk/filelibrary/rpts/pvdt/PVDFT_Good_Practice_Guide_Part_1_a.pdf and Part 2 from http://www.bre.co.uk/filelibrary/rpts/pvdt/GoodPracticeGuidePart2_FINAL.pdf.

Micro hydro

Annual reduction in carbon emissions

5.46. A reduction in carbon emissions from a micro hydro installation will be verified on a case by case basis. Where a supplier is looking to install micro hydro it should contact Ofgem first.

Lifetime

5.47. The lifetime of micro hydro is 20 years.

6. New products

This chapter provides guidance on the type of information that is required to be submitted to Ofgem if manufacturers wish to have a new product assessed for use in CERT.

Introduction

6.1. Technologies accredited in CERT vary, and include heating systems, insulation materials, lighting measures, a range of appliances, and less conventional measures. Consequently, each technology has to be considered individually and it is not possible to develop a standard assessment protocol that would be suitable for all products.

6.2. In this chapter, we give an indication of what information we will require to assess a new product for the use in CERT and to evaluate a reduction in carbon emissions attributed to this product.

Procedure for each product type

6.3. An applicant should contact Ofgem with the following information about the product:

a. description of the product, its installation instructions and usage

b. details of any requirement for specific skills/equipment for professional installation or DIY installation

c. information on any potential problems associated with the installation or use that would affect the operation of the unit

d. any performance related issues that would affect energy consumption

e. details of any standards (BS, EN, industry) to which the product and its installation conform to or must conform to. This should include any safety standards and legislation, and

f. lifetime of the product

6.4. Ofgem will assess the information and propose methodology to verify savings for the product and outline testing requirements.

6.5. Before undertaking any work, a testing methodology must be agreed with Ofgem. This is to ensure that the methodology is based on the underlying assumptions used for the accreditation of measures in CERT and prevent any dispute at a later stage. This will ensure that the results are suitable and where appropriate can be modelled in BREDEM-12 to provide a reduction in carbon emissions for all standard dwellings and fuel types used in CERT.

6.6. An applicant will be required to arrange for suitable testing as agreed with Ofgem. A list of UKAS approved test houses and laboratories are provided in Appendix 3.

6.7. Results from product testing should be submitted to Ofgem for review. Should a product be suitable, Ofgem will notify energy suppliers of the reduction in carbon emissions attributable to the product and where appropriate these will be included in the Carbon Reduction Matrix.

Specific information for individual product types

Insulation measures

6.8. Verification of the thermal conductivity (lambda value) of the product will be required. This must be in a form of a test certificate from a UKAS accredited testing laboratory (Appendix 3) or the British Board of Agrément (BBA).

Appliances

6.9. Product testing should be done on a finished product, and not on a prototype. The tests must ascertain that the product is safe for domestic use.

Appendices

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Appendix 1[2] – Energy Efficiency Commitment 2008-2011, and BREDEM Calculation of Energy Savings

Executive Summary

1.1. The Energy Efficiency Commitment 2008-2011 (EEC 2008-2011)[3] is to be introduced in April 2008 and will run to March 2011. This is a continuation of the Energy Efficiency Commitment 2005-2008 and 2002-2005 schemes, and will build on their significant achievements, and the earlier 'Energy Efficiency Standards of Performance' (SoP) schemes, for promoting and funding energy efficiency in dwellings. The current EEC 2005-2008 and the earlier EEC 2002-2005 allowed energy efficiency improvements not only to dwellings heated with electricity and gas, but also to dwellings heated by oil, LPG and coal. The scope will be further broadened in the EEC 2008-2011 scheme, and allows any measures which reduce carbon emissions.

- For the purposes of setting the EEC 2008-2011 target, BRE has developed an 'illustrative mix' of measures with DEFRA. This incorporates the calculated energy savings resulting from a wide range of energy efficiency measures. Ofgem requires a more detailed 'matrix' of energy savings for the more common of these measures. The results must be consistent with the savings used to set the EEC 2005-2008 target, but include additional measures and dwelling types.
- BRE has provided and updated savings for the current and previous EEC schemes, and for the earlier SoP schemes, incorporating the latest developments and research results, using the BRE Domestic Energy Model (BREDEM), which is uniquely suited to this type of application. The energy savings for a variety of measures and house types have thereby 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, 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 (primarily information relating to the Domestic Energy Fact File, and the English House Condition Survey).
- Many factors affect energy savings, so the parameters selected for tabulation are, in general, those which have the most significant effect on the energy saved. This provides an effective, yet relatively simple method for energy suppliers to aggregate the savings to be credited to them from individual measures.
- The underlying assumptions, e.g. heating and hot water usage, location of dwelling, level of insulation, heating type, used in the BREDEM calculation, must

[2] BRE report prepared for Ofgem
[3] Now Carbon Emissions Reduction Target 2008-2011 (CERT 2008-2011)

be kept in mind when using these calculated values. The calculated savings are typical for the situations described, but may be very different for situations where the parameters differ.

Introduction

1.2. The Energy Efficiency Commitment (EEC) requires Energy Suppliers to comply with an obligation to improve domestic energy efficiency. EEC 2008-2011 will run from April 2008 to March 2011, and is a continuation of the current EEC 2005-2008 and the previous EEC 2002-2005, which both 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.

1.3. BRE has developed an 'Illustrative Mix' of measures with DEFRA for EEC 2008-2011, which includes calculated energy savings. BRE has provided and updated this information for the current and previous EEC schemes, and the earlier Energy Efficiency Standards of Performance schemes, incorporating the latest developments and research results. The BRE Domestic Energy Model, BREDEM (1), is 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, and for different fuels and heating systems.

1.4. 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. The two previous EEC schemes allowed energy efficiency measures to be implemented in dwellings heated by electricity and gas (including LPG), and also in dwellings heated by oil and coal. The scope has been further broadened for the EEC 2008-2011 obligations, and allows any measures which reduce carbon emissions. Savings are therefore calculated for energy efficiency measures related to a range of fuels.

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

Description of the project

Aim

1.6. The aim of this work is 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.

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

Dwelling Types

1.8. The energy savings are calculated for eight main dwelling types found in Great Britain (the area relevant to EEC). Drawings for these typical dwellings which have been developed by BRE are used (as they have been for previous EEC and SoP schemes), and the dimensions of the external walls, roof, floor, windows and doors provide basic inputs in BREDEM. These dwellings are listed in bold type in the table below, and are referred to as the ‘base case’ dwellings.

1.9. Energy savings for other sizes of each dwelling type are derived for different floor areas, which are related to the number of bedrooms. These ‘variant’ dwellings, and their floor areas, are shown in ordinary type in the table below. The methods for calculating the energy savings for the ‘variant’ dwellings are described in Annexe 1. The effect of top, mid and ground-floor flats has also been considered, and this is discussed in Annexe 2.

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

Base parameters – heating systems and insulation

1.10. Calculations have been undertaken for the following central heating systems:

- Gas and LPG central heating (energy savings are the same for both)
- Oil central heating
- Electric storage heating
- Solid fuel central heating

1.11. 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)

1.12. 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.

1.13. The base 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 Annexe 3
Controls for gas and oil	Roomstat & 50% TRVs	Estimate for 2010, using EHCS data.
Controls for elect. storage	Automatic	Estimate for 2010, using EHCS data.

Heating regime

Central heating

1.14. 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'.

1.15. 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
- Zone 1 as 50% of dwelling
- Zone 1 and 2 (nominal) temperature difference of 1°C

1.16. 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.

Focal point (non-central) heating

1.17. 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.

1.18. 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.

Insulation measures

Cavity wall insulation

1.19. 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 previous work for EEC showed that the difference in results is less than 1% - see Annexe 1).

1.20. For cavity wall insulation, the housing stock is split into three periods; pre 1976, 1976-83 and post 1983, each period being associated with significantly differing wall U-values, caused by the introduction of successive new Building Regulations. The U-values attributed to these periods, before and after insulation are as follows:

U-values for cavity wall insulation

Year of construction	Uninsulated U-value (W/m^{2}K)	Insulated U-value (W/m^{2}K)
Pre 1976	1.440	0.480
1976 - 83	1.000	0.420
post 1983	0.694	0.343

1.21. The pre 1976 uninsulated U-value is based on a typical brick/cavity/brick construction type, and is unlikely to vary much, since cavity width has little effect on the U-value. The 1976 - 83 uninsulated U-value of 1.0 results from Building Regulations, and is usually a brick/cavity/block construction. Further tightening of the Building Regulations resulted in the post 1983 uninsulated U-value of 0.6 using calculation methods of the time which ignored thermal bridging. Taking account of thermal bridging gives the value tabulated above. (Note that after 2003, most walls are insulated to meet further tightening of the Building Regulations, and are unsuited to retrofit cavity wall insulation). For insulated cavity walls, it is assumed that all three time periods have an average cavity width of 65mm (from survey data), and standard insulation with conductivity 0.04 W/mK.

1.22. A further adjustment is then made to take account of factors not considered in this BREDEM calculation. A recent study (3) has shown that the net savings of loft and cavity wall insulation achieved in practice is likely to be 50% lower than that calculated using BREDEM. This includes a 'comfort factor', a reduction due to part of the saving being taken in improved comfort (i.e. increased internal temperatures), which has been found to be of the order of 15% for all insulation measures. The rest of the factor is thought to be due to areas of wall that cannot, or tend not to be, filled with insulation in practice (e.g. lintels, tiled areas of wall, areas above conservatories, areas of solid wall), as well as any underperformance of insulated areas of wall (for example due to imperfect fill). The detailed reasons for the considerably lower savings achieved in practice are still under investigation, but the overall reduction has been demonstrated and is therefore taken account of.

Loft insulation

1.23. Analysis in previous work for EEC 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%.

1.24. A conductivity of 0.044 W/mK is used for both existing and installed insulation, following the characterisation given by CE marking for 'formed' insulation products such as insulation rolls.

1.25. The U-values used for calculating loft insulation energy savings takes account of a report which considered the effect of 'disturbances' to loft insulation (4). These 'disturbances', such as missing or compressed insulation, mostly degrade the performance of the insulation, but may be corrected when insulation is topped up. This increases the energy savings of a 'top-up'. 193 lofts were surveyed, and a variety of disturbances were quantified. In addition, information on the size of joists resulted in a revision to the fraction of wood in the U-value calculation. Information on the insulation of the loft hatch, and water tanks, was also used to refine the U-values used.

1.26. The loft hatch is considered to be not draught-proofed before installation (only a minority were draught-proofed in the survey). It is considered draught-proofed after professional, but not after DIY installation. The insulation on the hatch before installation is as found on average in the survey, while after installation it is always insulated after professional, and insulated if absent in half the cases after DIY installat The water tank insulation and boarding for access is as found on average in the survey, while after installation it is assumed insulated with boarding over 100mm depth of insulation of an area derived from the findings of the survey.

1.27. After topping up it was considered that there would be some missing insulation from later disturbance, such as work undertaken in the loft. Estimates of this are given in Appendix D of the report of the loft surveys (4).

1.28. For DIY installed loft insulation:

- The energy saving is calculated in terms of kWh per square metre of insulation sold. See Annexe 4 for details of the method for this calculation
- Savings were reduced by 10% to account for material which is wasted or not used for thermal insulation - based on EEC1 data (5).

1.29. A reduction factor of 50% is also applied to both DIY and professionally installed insulation, in the same way as for cavity wall insulation (see previous section). As for cavity wall insulation, this overall reduction factor includes a factor of 15% for comfort taking.

Insulation thickness (mm)	U-value of roof (W/m²K)		
	Existing insulation	Topped-up, professional	Topped-up, DIY
0	2.3	-	-
50	0.787	-	-
100	0.494	-	0.426
150	0.387	-	0.301
200	-	0.228	0.248
250	-	0.195	0.216
270	-	0.185	0.206

Lambda value 0.044 W/mK, timber fraction 11%

Draught-proofing

1.30. BREDEM takes account of draught-stripping of windows and doors by modifying the amount of air infiltration, by an amount based on research carried out in the 1980's. The results demonstrated that there are a large range of other air infiltration routes, e.g. 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.

1.31. Openable doors and windows are therefore only one of many causes of heat loss through air infiltration. As a consequence of this research, 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 savings are consistent with these results. Further work in recent years supports the magnitude of these results.

1.32. Because of the nature of air infiltration measurements, it is not possible to be precise about what should be taken as a baseline, that is, the air infiltration before draught-stripping. For EEC 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.

1.33. 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.

1.34. 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.

Glazing

1.35. 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 base parameters for the dwelling were as described earlier).

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

Solid wall insulation

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

1.37. 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.

1.38. 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 previous work for EEC showed the difference in results to be less than 1%).

Hot water tank insulation

1.39. Cylinder insulation is assumed to be improved to a 75mm nominal depth jacket, from three 'before' cases of: no insulation, 25mm, and 50mm depth. A weighted average is calculated with equal weighting for each starting depth. (Though there are fewer cylinders with no insulation than with 50mm, these are also more likely to be improved, so these two effects are assumed to approximately cancel, giving equal weighting for each starting depth). These results are then weighted by the number of dwellings of each type, giving an overall average value for each fuel.

High efficiency hot water cylinders

1.40. High efficiency hot water cylinders are defined in CHeSS Year 2002 (6), and savings are derived compared with a British Standard cylinder. They have a higher efficiency heat exchanger, but most of the savings are due to the better insulation standard. Savings are calculated for each heating type, with insulated, and uninsulated primary pipework.

Radiator panels

1.41. The savings for radiator panels are based on an analysis by BRE which is based on test data. The results are consistent with two other reports of tests undertaken by independent laboratories. This provides savings which are dependent on the thermal properties of the wall to which it is applied.

1.42. The energy saving is applicable to silvered reflective radiator panels applied to external, uninsulated solid or cavity walls.

Wall types	$kgC/m^2/yr$
Solid and uninsulated cavity walls	4.66
(All wall types, including insulated)	(2.80)

Heating measures

Boiler replacement

1.43. 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).

1.44. For 'heat required' HR, initial boiler efficiency value E1, and new boiler efficiency value E2, the energy saving is then:

(HR / E1) - (HR / E2)

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

(19,681 / 78%) – (19,681 / 91%) = 3605 kWh/yr

Following this calculation, the savings are reduced by 10% to allow for the presence of secondary heating. This follows the methodology of the Illustrative Mix.

Boiler controls

1.45. A detailed description of the following controls is given in the 'Heating controls' section of SAP (7)

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

1.46. 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).

1.47. For example, the saving for installing a delayed start thermostat in a gas centrally heated mid-terrace in terms of 'heat required' is 124 kWh/yr. The saving for a boiler with seasonal efficiency of 91% is then:

124 / 91% = 136 kWh/yr

TRVs

1.48. 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 (7))

1.49. For these controls, the BREDEM specification requires an adjustment 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 seasonal efficiency penalty, so installing the interlock removes this penalty. The gas centrally heated mid-terrace 'heat required' value is 10,033 kWh/yr. Thus, for a stock average efficiency boiler (see Annexe 2) the saving is:

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

Solar water heating

1.50. Savings are calculated using the most recent calculation method. A $4m^2$ panel is assumed for the semi-detached, and the area was scaled for other dwelling sizes, relative to the hot water 'load'. Savings do not vary greatly by dwelling type, but vary significantly with heating system. Highest savings are realised where the water heating is otherwise by electricity (i.e. electric storage heating and non central heating in these calculations).

Fuel switching

1.51. 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

1.52. 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

1.53. The 'before' cases for oil central heating were based on the Building Regulations minimum SEDBUK 82% efficiency, on the basis that this would be required for the alternative of a replacement oil boiler. 'Typical' seasonal efficiencies were used for the 'before' case of other heating systems.

1.54. The seasonal efficiencies of the 'after' cases may be input to give the saving.

1.55. The difference in carbon emissions for space heating, water heating, lights and appliances, was calculated, for each dwelling type and size. (Lights and appliances includes energy consumption of any central heating pumps and so is included).

1.56. 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.

1.57. Energy savings were also derived for switching to new wood chip central heating. These have been calculated in a similar way for switching to a new wood chip/pellet central heating:

- from electric, gas, LPG, oil, coal central heating
- from electric, gas, coal 'focal point' heating (to wood chip central heating with a 'focal point' heating regime, as described above).

Conclusion and recommendations

1.58. Estimated energy savings have been calculated for a wide range of energy measures, and typical dwelling types and sizes. In work of this nature, values must be chosen for a variety of parameters, the most important of which have been stated in this report.

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

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Annexe 1 - Calculation of results for 'variants' from 'base case' dwellings

1.60. In these calculations of energy savings for EEC, BREDEM is normally used as the calculation tool for the 'base case' size of each dwelling type (e.g. semi-detached, flat, detached bungalow). The following describes how the results for the 'variant' dwellings of the same type, with greater and smaller floor areas, are calculated from the 'base case results. (The 'variant' calculations could be calculated using BREDEM for each dwelling size, but the following methodology is used in EEC3 to reduce the number of individual BREDEM model calculations).

1.61. Care must be taken in applying the following relationships, which are approximations to a greater or lesser extent, and may only apply for a limited range of floor areas and the particular cases (e.g. levels of insulation, etc.) which have been investigated for these EEC calculations. This is particularly true for 'Heating measures' and 'Fuel switching'.

1.62. The following notation is used:

Sb	&	Sv	energy saving for base case dwelling	&	for variant
Ab	&	Av	total floor area for base case dwelling	&	for variant

Loft insulation

1.63. The calculated energy saving is proportional to the area of the loft. Thus the base case energy saving can be modified in proportion to the dwelling total floor area. (This method was used in EEC2).

Sv = Sb x (Av / Ab)

Cavity wall insulation

1.64. The calculated energy saving is proportional to the area of the walls. The wall area is related to the square root of the floor area of a dwelling. (This is because as the size of a dwelling is increased, the length and breadth increase, but the height stays the same). The base case saving can therefore be modified in proportion to the square root of the dwelling total floor area. (This method was used in EEC2).

$Sv = Sb \times (Av / Ab)^{0.5}$

Heating measures

1.65. As the size of a dwelling is increased, the calculated space heating energy is affected by energy losses through the roof, floor, walls, and air infiltration. The space heating energy is therefore related to something between the floor area (as is the case for the roof and floor) and the square root of the floor area (as is the case for the walls).

1.66. Investigation of BREDEM results for the EEC base cases was undertaken over a limited range of floor areas, from 0.5 to 1.5 times the 'base case' floor area. The space heating energy, and also energy savings from heating measures (improved boiler efficiency, controls) is found to be quite well related to the floor area to the power of 0.754. (This is a refinement to EEC2 where heating measure savings were considered proportional to area, similar to loft insulation).

$$Sv = Sb \times (Av / Ab)^{0.75}$$

Draughtproofing

1.67. Draughtproofing savings are affected by energy losses through air infiltration. Investigation of BREDEM results for the EEC base cases was again undertaken over a limited range of floor areas, from 0.5 to 1.5 times the 'base case' floor area. The draughtproofing savings are found to be reasonably well related to the floor area to the power of 0.8. (This is a refinement to EEC2 where draughtproofing savings were considered proportional to the floor area, similar to loft insulation).

$$Sv = Sb \times (Av / Ab)^{0.8}$$

Fuel switching

1.68. Fuel switching involves subtracting the carbon related value for the 'after change' heating system from the 'before change' heating system. Thus the energy consumptions for the variant dwelling types are required for the various end uses and for all the heating types.

Space heating

1.69. As already mentioned, investigation has shown that over a limited range of floor area, the space heating energy is approximately related to the floor area to the power of 0.751. It is therefore calculated from the base case as follows.

4 It is believed that the value of this power will change depending on the relative insulation of roof and floor compared to the insulation of the walls. Considering the extreme cases, if almost all heat loss were through the roof and floor, the power would tend to the value 1.0, and if through the wall, the power would tend to the value 0.5.

$Hv = Hb \times (Av / Ab)^{0.75}$

where Hv, Hb is the space heating energy for the variant and base case respectively.

Water heating

1.70. In BREDEM, the calculation of water heating energy consumption is related to the number of occupants, which is in turn related to the floor area. The calculation also takes account of any water tank and pipework heat losses, before it is divided by the heating efficiency to give the delivered energy.

1.71. For EEC, the 'required energy' consumption (before efficiency of the heating system is accounted for) can therefore be directly related to floor area using one of three cases, used for both the 'base case' dwellings, and the variant floor areas.

- Gas CH, Oil CH, Coal CH (tank with jacket insulation and pipework to boiler)
- Electric Storage (electric immersion in tank with foam insulation)
- Gas/Electric/Coal room heating (electric immersion in tank with jacket)

Lights and appliances

1.72. Similarly, the calculation of lights & appliances 'delivered energy' consumption is related to the number of occupants, which is in turn related to the floor area. The calculation also takes account of the effect of low energy lights, extract fans, and any central heating pump, and oil pump.

1.73. As in the case of water heating, for EEC, the energy consumption can be directly related to floor area, using one of three cases, used for both the 'base case' dwellings, and the variant floor areas.

- Gas CH, Coal CH (central heating pump)
- Oil CH (central heating pump and oil pump)
- Electric Storage, Gas/Electric/Coal room heating (no pumps)

(This does involve a small approximation for gas, coal, and oil CH, because the central heating pump energy consumption in BREDEM is related to the specific heat loss of the dwelling. To avoid complication, for EEC the pump consumption is considered constant at the value for the typical semi-detached. The difference to the Lights and Appliances consumption for other dwellings is very small, 1.1% or less).

Cooking

1.74. The calculation of cooking is also related to the number of occupants, which is in turn related to the floor area. For EEC, the energy consumption can be directly related to floor area, using two cases, one for gas cooking, one for electric cooking. Gas cooking is assumed with a gas heating system, and electric cooking with all other heating systems. These equations are used for both the 'base case' dwellings, and the variant floor areas.

Note that the cooking energy consumption is not included in the fuel switching energy saving calculation, since a change in cooking fuel would not be considered as one of the benefits of fuel switching.

Annexe 2 - Effect of flat type on savings

1.75. 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.

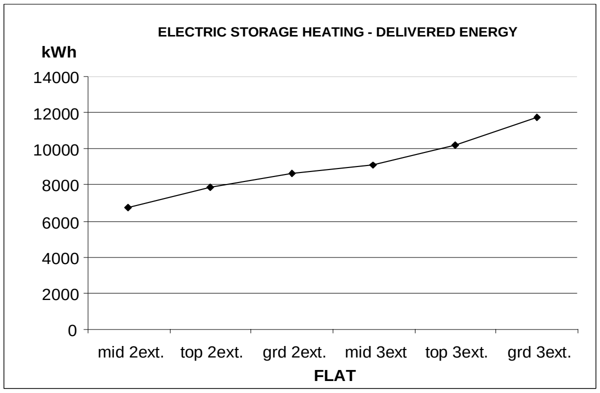
1.76. Moreover the savings from different energy saving measures are affected by different parameters. For example, the number of walls affects the savings resulting from cavity wall insulation, floor insulation and draught-stripping, but does not significantly affect savings resulting from the other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

Effect of different types of flat on energy efficiency savings

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	

1.77. Previous calculations for EEC 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.

1.78. 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.



1.79. 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.

1.80. 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.

1.81. (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.)

1.82. 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.

1.83. 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 3 - Boiler efficiencies and SEDBUK

Gas and Oil boilers

1.84. 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 2005). 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.

1.85. 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).

1.86. 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.

1.87. The energy savings calculated for EEC 2008-2011 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.

1.88. 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

1.89. 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.

1.90. 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.

1.91. 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 1.91p/kWh and 2.67p/kWh, and 0.291 kg CO_2/kWh and 0.392 kg CO_2/kWh respectively; SAP 2005 values).

1.92. 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.

1.93. 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 2008-2011 calculations are 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 4 - Calculation of DIY insulation savings

1.94. 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.

1.95. 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.

1.96. 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.

1.97. 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.

1.98. 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.

1.99. 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?

1.1. This advice:

a. 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
b. 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
c. is addressed to all concerned with the management, control and installation of cavity wall insulation under energy efficiency schemes
d. 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, and
e. updates and replaces an earlier HSE advice sheet on this subject.

What is the hazard?

1.2. 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).

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

1.4. 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?

1.5. 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.

1.6. 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?

1.7. 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).

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).

Safety checks after installation of cavity wall insulation.

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

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.

Flue examination/testing

1.9. 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

1.10. 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.

1.11. 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.

1.12. 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[5].

Room sealed appliances

1.13. 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

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

housing such an appliance are still required. Further information is given in the CIGA guide.

Examination of appliance safe functioning.

1.14. 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'

1.15. 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?

1.16. 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 manufacturer's instructions.

1.17. In the case of gas, any disconnection of appliances (eg as normally required for the flue flow test) constitutes 'work on a gas fitting'6 and may only 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?

1.18. 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

[6] '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.

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?

1.19. 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.

1.20. 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 premises7 (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).

[7]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 – Fridgesavers scoring protocol

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

Appendix 5 - Monitoring trial for air source heat pumps

1.1. A field trial should be carried out on at least 10 dwellings initially, in a variety of common dwelling types, and preferably in different locations.

1.2. The trial should be for a particular configuration of the heat pump (e.g. either supplying or not supplying hot water, distribution by radiators or other means). Depending on the results, further testing may be necessary.

1.3. The field trial would need to be monitored by an independent organisation.

1.4. The field trials would need to monitor:

- electricity consumption weekly, or preferably daily; this must include all electricity, including that for defrosting (it would be useful to meter this separately if possible)
- heat output from the heat pump weekly, or preferably daily
- any significant use of secondary heating
- internal temperatures e.g. lounge, hall, bedrooms, to ensure adequate temperatures are being achieved
- humidity
- external temperature, to test the sensitivity of the CoP to this parameter
- level of insulation to the wall
- wall construction type
- level of loft insulation
- glazing type
- size of house
- property type
- previous heating system and fuel

1.5. Monitoring would be required over at least half, and preferably a whole heating season.

Appendix 6 – The Authority's Powers and Duties

1.1. Ofgem is the Office of Gas and Electricity Markets which supports the Gas and Electricity Markets Authority ("the Authority"), the regulator of the gas and electricity industries in Great Britain. This Appendix summarises the primary powers and duties of the Authority. It is not comprehensive and is not a substitute to reference to the relevant legal instruments (including, but not limited to, those referred to below).

1.2. The Authority's powers and duties are largely provided for in statute, principally the Gas Act 1986, the Electricity Act 1989, the Utilities Act 2000, the Competition Act 1998, the Enterprise Act 2002 and the Energy Act 2004, as well as arising from directly effective European Community legislation. References to the Gas Act and the Electricity Act in this Appendix are to Part 1 of each of those Acts.[8]

1.3. Duties and functions relating to gas are set out in the Gas Act and those relating to electricity are set out in the Electricity Act. This Appendix must be read accordingly[9].

1.4. The Authority's principal objective when carrying out certain of its functions under each of the Gas Act and the Electricity Act is to protect the interests of consumers, present and future, wherever appropriate by promoting effective competition between persons engaged in, or in commercial activities connected with, the shipping, transportation or supply of gas conveyed through pipes, and the generation, transmission, distribution or supply of electricity or the provision or use of electricity interconnectors.

1.5. The Authority must when carrying out those functions have regard to:

- The need to secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met;
- The need to secure that all reasonable demands for electricity are met;
- The need to secure that licence holders are able to finance the activities which are the subject of obligations on them[10]; and

[8] entitled "Gas Supply" and "Electricity Supply" respectively.
[9] However, in exercising a function under the Electricity Act the Authority may have regard to the interests of consumers in relation to gas conveyed through pipes and vice versa in the case of it exercising a function under the Gas Act.
[10] under the Gas Act and the Utilities Act, in the case of Gas Act functions, or the Electricity Act, the Utilities Act and certain parts of the Energy Act in the case of Electricity Act functions.

- The interests of individuals who are disabled or chronically sick, of pensionable age, with low incomes, or residing in rural areas.[11]

1.6. Subject to the above, the Authority is required to carry out the functions referred to in the manner which it considers is best calculated to:

- Promote efficiency and economy on the part of those licensed[12] under the relevant Act and the efficient use of gas conveyed through pipes and electricity conveyed by distribution systems or transmission systems;
- Protect the public from dangers arising from the conveyance of gas through pipes or the use of gas conveyed through pipes and from the generation, transmission, distribution or supply of electricity;
- Contribute to the achievement of sustainable development; and
- Secure a diverse and viable long-term energy supply.

1.7. In carrying out the functions referred to, the Authority must also have regard, to:

- The effect on the environment of activities connected with the conveyance of gas through pipes or with the generation, transmission, distribution or supply of electricity;
- The principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed and any other principles that appear to it to represent the best regulatory practice; and
- Certain statutory guidance on social and environmental matters issued by the Secretary of State.

1.8. The Authority has powers under the Competition Act to investigate suspected anti-competitive activity and take action for breaches of the prohibitions in the legislation in respect of the gas and electricity sectors in Great Britain and is a designated National Competition Authority under the EC Modernisation Regulation[13] and therefore part of the European Competition Network. The Authority also has concurrent powers with the Office of Fair Trading in respect of market investigation references to the Competition Commission.

[11] The Authority may have regard to other descriptions of consumers.
[12] or persons authorised by exemptions to carry on any activity.
[13] Council Regulation (EC) 1/2003