CE290

Energy efficiency and the Code for Sustainable Homes

Level 3

Also available:

Energy efficiency guidance for level 4

Energy efficiency guidance for levels 5 and 6

energy saving trust®

Contents

1. Introduction 3
   - 1.1 The Energy Saving Trust guidance 3
   - 1.2 Who the guides are for 3
   - 1.3 Outline of the guidance 4
   - 1.4 Key features 4

2. How the Energy Saving Trust 25% guidance works 5

3. Criteria for achieving the Energy Saving Trust 25% guidance 6
   - Criterion 1 Predicted CO_2 emissions from the dwelling 6
   - Criterion 2 Design backstops 7
   - Criterion 3 Provisions to limit the effects of solar gains 8
   - Criterion 4 Quality of construction and commissioning 9
   - Criterion 5 Provision of information and future proofing 9

4. Scenarios for achieving the Energy Saving Trust 25% solutions 10
   - 4.1 Achieving robust CO_2 savings 10
   - 4.2 Correct use of MVHR 10
   - 4.3 Regional variations 10
   - 4.4 Data source 10
   - 4.5 Flats 10

   - Detached house (104m^2) scenarios 11
   - Semi-detached house (89m^2) scenarios 12
   - Mid-terrace house (79m^2) scenarios 13
   - Four-storey flats (61m^2) scenarios 14

5. Further information 15

Acknowledgement

Cover photo: Peter White, BRE

The Osborne Demonstration House, built at BRE in 2006. The Osborne Demonstration House exceeds the Energy Saving Trust best practice standard for energy efficiency. It is this best practice standard that forms the basis of the mandatory energy requirement for the Code for Sustainable Homes level 3.

1. Introduction

1.1 The Energy Saving Trust guidance

Home energy use is responsible for over a quarter of the UK's carbon dioxide (CO_2) emissions which contribute to climate change. To help mitigate the effects of climate change, the Energy Saving Trust has developed a range of guidance to help housing professionals meet the energy performance requirements of the Code for Sustainable Homes[1].

This guide[2] outlines recommendations for housing professionals to meet, and in some cases, exceed the energy efficiency requirements of level 3 of the Code for Sustainable Homes.

In 2005 the Energy Saving Trust commissioned BRE to work in collaboration with an industry consultation group. The aim was to carry out research that would underpin solutions to achieve a 25% reduction in carbon emissions. This standard became known as the Energy Saving Trust best practice standard. The specifications were arrived at using a combination of energy modelling and analysis of existing low carbon dwellings, as well as practical experience provided by the developer design teams. The solutions were assessed against the seven most common built forms, and refined in line with comments from industry consultees before being finalised for launch in 2006.

In December 2006 Communities and Local Government (CLG) adopted the best practice standard to form the basis of the mandatory energy requirement for the Code for Sustainable Homes level 3.

This publication is the first in a suite of Energy Saving Trust guides, designed to achieve step-change energy efficiency improvements over national building regulations[3]. It provides technical guidance on designing and building new homes that have 25% lower CO_2 emissions than the minimum levels in the regulations, and meet the energy requirements of the Code for Sustainable Homes level 3.

Other guides in this series cover 44%, 100% and true zero carbon and will help housing professionals to meet levels 4, 5 and 6 of the Code for Sustainable Homes respectively.

For more information on the other Energy Saving Trust guides go to www.energysavingtrust.org.uk/housing or contact the free helpline on 0845 120 77 99.

1.2 Who the guides are for

Energy Saving Trust guides will help:

- Anyone wanting to build a low carbon dwelling (whether developer, designer or builder, etc).
- Developers and specifiers needing to formulate robust energy specifications to demonstrate performance beyond the requirements of current building regulations.
- Policy makers in local government wanting to refer to recognised standards in local development frameworks.
- Builders required to meet an energy efficiency standard – referring to Energy Saving Trust guidance reduces technical risks whilst maintaining a good level of flexibility.
- Housing professionals required to meet a percentage target for the use of renewable energy –the fabric-first measures recommended in the guidance make hitting this target percentage easier, because overall dwelling energy demand is reduced.

1. The Code for Sustainable Homes has only been adopted for use in England and Wales. See www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf
2. This guide relates to the April 2008 Code for Sustainable Homes Technical guide.
3. England and Wales: The Building Regulations 2000, Conservation and power, are detailed in Approved Document L1A (2006 Edition). See www.planningportal.gov.uk
   Northern Ireland: Building Regulations (Northern Ireland) 2000, are detailed in Technical booklet F1 2006, Conservation of fuel and power in dwellings. See www.dfpni.gov.uk
   Scotland: Section 6: Energy, of the Domestic Technical Handbook outlines possible ways of complying with the Building (Scotland) Regulations 2007. See www.sbsa.gov.uk

Introduction

1.3 Outline of the guidance

This guide presents the required criteria and a set of scenarios for applying the Energy Saving Trust 25% guidance.

The guidance is based on energy efficient products and technologies that combine to give very well insulated, airtight dwellings with appropriate and efficient building services. It emphasises the importance of maximising long-lasting energy efficiency improvements to the fabric of a dwelling, before adding the optimum renewables solution if required.

Due to the multitude of potential configurations it has not been possible to present every combination of fabric and renewables strategy. The scenarios have been modelled using four standard housing types:

- Detached house – 104m^2 (page 11)
- Semi-detached house – 89m^2 (page 12)
- Mid-terrace house – 79m^2 (page 13)
- Four storey flats – 61m^2 (page 14)

1.4 Key features

Key features of the Energy Saving Trust guidance include:

An integrated design-led approach

The guidance provides an integrated design-led approach so that insulation, heating and ventilation systems work together to maximise cost-effectiveness in construction, and minimise occupant fuel costs. Carbon reduction targets are combined with minimum 'backstop' design performance requirements based on practical insulation levels and appropriate dwelling airtightness.

Flexibility

Beyond these backstop requirements, the method of achieving the desired CO_2 reduction is flexible – insulation can be increased, renewables can be added, and thermal bridging or airtightness can be improved. Builders are free to innovate and use newly available products, or to minimise technical risks by using only tried and tested solutions.

Proven solutions

All of the aspects, strategies and components required by the guidance have been successfully built on developments in the UK. The solutions bring these together to form a rounded approach that is achievable using proven and available products and technologies. If product availability or skills are limited, industry should consider taking the lead in developing stronger manufacturing capability via their supply chains, and increasing on-site skills through training.

Compatibility across the UK

This guidance has been structured to ensure alignment with the building regulations in England and Wales, and has been reviewed to ensure continuing compatibility with subsequent changes in Scotland and Northern Ireland, as well as the Code for Sustainable Homes.

A familiar format

This guidance has been specifically designed to adopt the existing building regulations compliance methodology, ensuring a familiar format for builders and designers that will help to speed up the design process.

More help available

The Energy Saving Trust provides a specifiers' technical helpline and a range of publications for support and assistance (see back page 15 for details).

Achieving level 3 of the Code for Sustainable Homes

As well as showing housing professionals how to achieve CO_2 emissions that are 25% lower than the requirements of current building regulations, the guidance describes how to meet the energy efficiency requirement of level 3 of the Code for Sustainable Homes. This level of efficiency is mandatory for all publicly funded housing in England and is likely to be incorporated into the new national Building Regulations in England and Wales by 2010. It is possible that Scotland, Wales and Northern Ireland may adopt a similar rating scheme in the future.

In addition to the energy efficiency benefits, this guidance also describes how to achieve additional credits for internal lighting, external lighting and drying space under the Code for Sustainable Homes (and EcoHomes, where applicable). Further credits for the heat loss parameter and the use of renewables are available, and depend on the specifics of the design.

2. How the Energy Saving Trust 25% guidance works

The process is summarised in figure 1, and consists of two key stages to achieve 25% less CO_2 emissions than the legal maximum CO_2 emissions required by the building regulations:

1. Establishing minimum backstop design performance requirements on practical insulation levels (see page 7) and appropriate dwelling airtightness (see page 9). It is up to the design teams to determine how best to meet the specified U-values, airtightness and other parameters, and the exact specifications may vary depending on individual dwelling design.

2. Once the backstop values have been adopted, fabric, service or renewable options (pages 11–14) are then used to gain the 25% reduction. This gives the guidance user flexibility in choosing whether to increase insulation, improve thermal bridging or airtightness, or add renewables.

How the Energy Saving Trust 25% guidance works

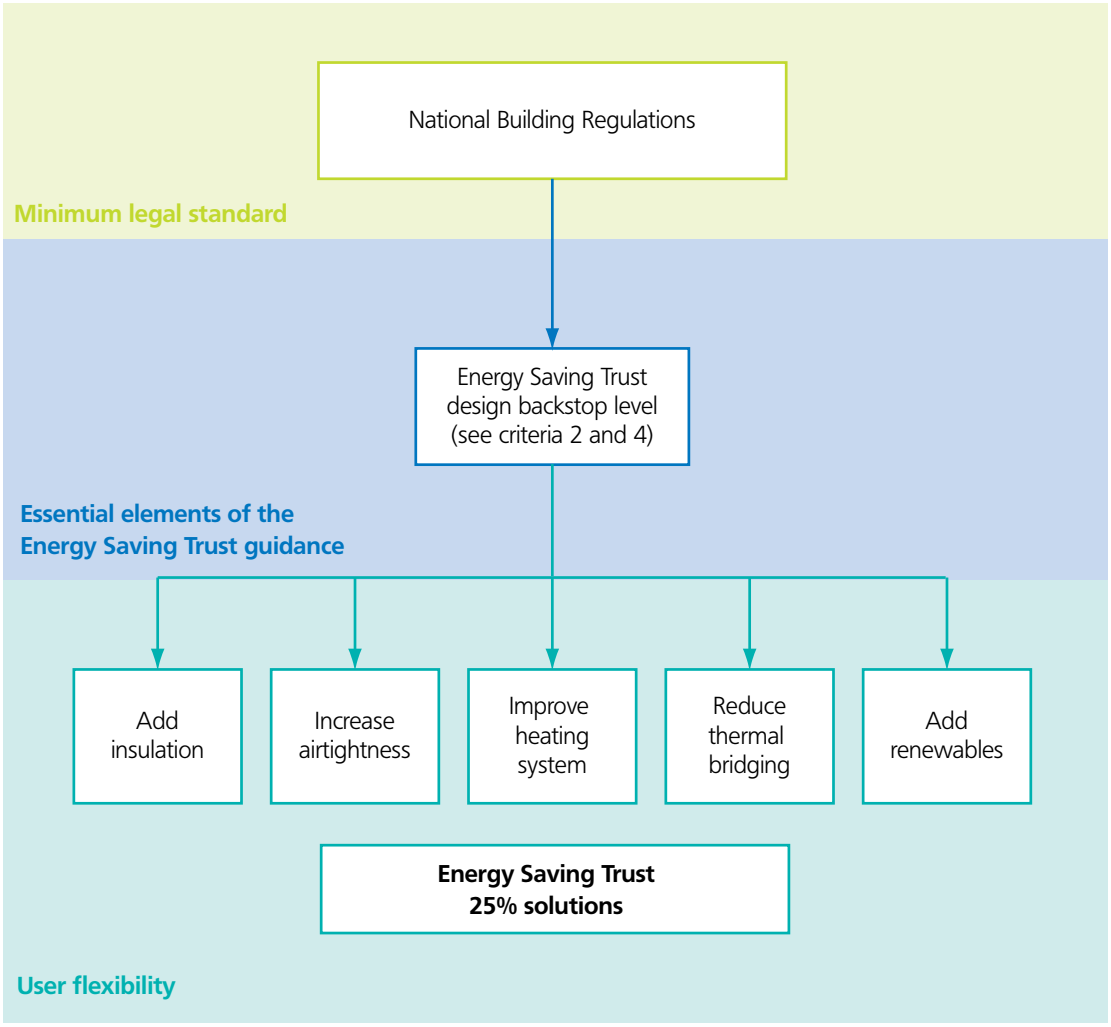

Figure 1: Summary of how the Energy Saving Trust 25% guidance works

3. Criteria for achieving the Energy Saving Trust 25% guidance

Achieving a 25% improvement using the Energy Saving Trust guidance can be demonstrated by complying with all of the five criteria listed below, and detailed on the following pages.

Criterion 1
The predicted CO_2 emissions from the dwelling (the Dwelling Emission Rate, DER) should be no worse than the Energy Saving Trust Target Emission Rate (TER $_{\text{(Energy Saving Trust 25\% guidance)}}$) – see below.

Criterion 2
All relevant areas of the dwelling should comply with the design backstops as set out in the table on pages 7 to 8.

Criterion 3
Provision should be made to limit the effects of internal temperature rises in the summer due to excessive solar gains, as set out on page 8.

Criterion 4
The quality of construction and commissioning should meet the requirements as set out in the table on page 9.

Criterion 5
Requirements for provision of information and future proofing should be adhered to, as set out on page 9.

Criterion 1: Predicted CO_2 emissions from the dwelling

To assess whether a dwelling design achieves the 25% CO_2 reduction, the target carbon dioxide emission rate (TER) methodology should be used (as defined in national building regulations).

The TER is expressed in terms of the annual CO_2 emissions, in kg per m^2 of floor area.

Different dwellings will have different emissions targets, because the TER is based on floor area, dwelling shape and other factors, such as the heating fuel used. Under national building regulations, the dwelling's DER (dwelling emissions as designed) should be equal or less than its TER to pass.

A similar method is adopted for assessing compliance with the Energy Saving Trust 25% guidance, but in order to give the desired CO_2 savings the TER is reduced by 25% by multiplying it by 0.75.

TER (national building regulations) **x 0.75 = TER** (Energy Saving Trust 25% guidance)

Beyond this the method is unchanged from standard national building regulations compliance, i.e. the DER is required to be equal or less than the TER (Energy Saving Trust 25% guidance) to pass.

The following equation clarifies this:

DER (proposed dwelling) $\leqslant$ **TER** (Energy Saving Trust 25% guidance)

This is usually easiest to achieve using an approved SAP software package.

Criteria for achieving the Energy Saving Trust 25% guidance

Criterion 2: Design backstops

Aspect		National building regulations[1]	Energy Saving Trust 25% solutions
Opaque elements $W/m^2.K$	roof	0.25	0.13
	walls	0.35	0.25
	exposed floors	0.25	0.20
Windows and doors $W/m^2.K$ For further guidance see 'Windows for new and existing housing' (CE66)[2].		2.2 (area weighted average).	Windows must achieve a BFRC (British Fenestration Rating Council) rating in band C or better. Doors should achieve U-values better than 1.5 if glazed, or 1.0 if solid.
Space and hot water heating For further guidance see 'Central heating system specifications (CHeSS)' (CE51/GIL59).		Services must comply with the limits set out in the 'Domestic Heating Compliance Guide'[3].	Where gas, LPG or oil central heating systems are specified they should conform to CHeSS HR5 or HC5.
Ventilation For further guidance see 'Energy efficient ventilation in dwellings – a guide for specifiers' (GPG268).		Purpose provided ventilation should be provided by way of methods accepted in national building regulations.	Mechanical extract ventilation (MEV) • The whole system must have a specific fan power (SFP) of 0.6 Watts per litre per second or less; or • Whole house mechanical ventilation with heat recovery (MVHR). • The whole system must have a specific fan power (SFP) of 1 Watt per litre or less; and • The heat recovery efficiency must be 85% or better. To claim full credit under SAP 2005, the performance of an MEV or MVHR unit should be assessed using SAP Appendix Q test methodologies[4].
Lighting (internal) Percentage of all fixed lighting to be dedicated low energy (i.e. only accept low energy lamps with luminous efficacy of greater than 40 lumens per circuit Watt). For further guidance see 'Energy efficient lighting – guidance for installers and specifiers' (CE61).		1.. One per $25m^2$ of dwelling floor area (excluding garages) or part thereof; or 2. One per four fixed lighting fittings.	75%. The lamp fitting may contain one or more lamps and should include the ballast, appropriate housing, reflector, shade or diffuser or other appropriate device for controlling the output of light. If tubular fluorescent lamps are used, T8 (26mm tube diameter) lamps, or preferably T5 (16mm diameter) lamps should be specified.
Lighting (external)		Maximum lamp capacity of 150 Watts per fitting with controls that automatically switch off: 1. When there is enough daylight; and 2. When it is not required at night, or only energy efficient light fittings greater than 40 lumens per circuit Watt.	Maximum lamp capacity of 150 Watts per fitting with controls that automatically switch off: 1. When there is enough daylight; and 2. When it is not required at night, or only energy efficient light fittings greater than 40 lumens per circuit Watt and compatible photocell or timer.

Criteria for achieving the Energy Saving Trust 25% guidance

Aspect	National building regulations[1]	Energy Saving Trust 25% solutions
White goods (where specified)  For guidance, see www.energysavingtrust.org.uk/compare	n/a	All major electrical appliances (i.e. refrigerators, freezers, washing machines, tumble dryers, washer-dryers and dishwashers) supplied with the dwelling must be Energy Saving Recommended.
Air permeability	See Criterion 4	
Drying space	n/a	A ventilated space for drying clothes should be provided within the house. This could be either an unheated space with good ventilation, or a heated space with adequate, controlled ventilation.

Notes

1. This column gives a summary of the national building regulations in England and Wales and Northern Ireland, but the official documents should be referred to for detailed guidance.
2. Please note that all documents referenced beginning with CE, GIL and GPG can be downloaded from the Energy Saving Trust's website – please visit http://www.energysavingtrust.org.uk/housing
3. Please see http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_DOMHEAT.pdf
4. Please see http://www.sap-appendixq.org.uk

Criterion 3: Provisions to limit the effects of solar gains

In order to comply with the Energy Saving Trust 25% guidance, care must be taken to use appropriate steps to avoid summer overheating. 'Reducing overheating – a designers guide' (CE129) gives information on avoiding overheating by reducing heat gains, solar shading, incorporating thermal mass and providing secure night ventilation.

SAP2005 Appendix P contains a procedure that enables designers to check whether solar gains are excessive. Reasonable provision would be achieved if the SAP assessment indicates that the dwelling will not have a high risk of high internal temperatures.

In order to comply with the Energy Saving Trust 25% guidance, the use of mechanical cooling (air conditioning) is not permitted.

Criteria for achieving the Energy Saving Trust 25% guidance

Criterion 4: Quality of construction and commissioning

Aspect	National building regulations	Energy Saving Trust 25% solutions
Maximum permissible air permeability $m^3/(hr.m^2)$@50Pa Confirmed after construction (but prior to completion) by a pressure test carried out in accordance with the procedure set out in the ATTMA publication 'Measuring air permeability of building envelopes'.[1] For further guidance see 'Improving airtightness in dwellings' (CE137/GPG224) and 'Achieving airtightness in new dwellings: case studies' (CE248).	10[2]	3
Limiting of thermal bridging Repeating thermal bridges within the planes of the construction will be accounted for within the U-value calculations, however junctions between elements (non-repeating thermal bridges) need special consideration. For further guidance see 'Accredited construction details'[3] and BRE information paper IP1/06 'Assessing the effect of thermal bridging at junctions and around openings'.[4]	It is acceptable to use the Energy Saving Trust's Enhanced Construction Details, or alternatively the assessment of bespoke constructions to a similar or better standard using IP1/06. For further information on Enhanced Construction Details, please see the Energy Saving Trust website.	

1. Please see http://www.attma.org/ATTMA_TS1_Issue2_July07.pdf
2. Different requirements apply across the UK with regard to testing
3. Please see http://www.planningportal.gov.uk/england/professionals/en/1115314255826.html
4. Please see http://www.brebookshop.com

Criterion 5: Provision of information and future proofing

Householders should be provided with clear and simple operating and maintenance instructions for both fixed building services and the dwelling as a whole, to help achieve energy efficient operation. Examples of the kind of information to include are:

- How to adjust the time and temperature settings of heating controls.
- How to maintain services and any equipment included with the home at optimum energy efficiency.
- The energy rating of the home.

The Energy Saving Trust produces a number of technical publications on energy efficiency and renewable energy which may be of assistance. These can be found at www.energysavingtrust.org.uk/housing

If renewable energy technologies are not installed, dwellings should be designed and constructed to facilitate the installation of renewable energy technologies at some point in the future. This requirement will depend on the renewable energy technologies appropriate to the particular dwelling, for example:

- Roof structure with identified fixing locations for PV or solar hot water panels.
- Space for enlarged hot water cylinder (solar hot water).
- Roof orientated to face between south-east and south-west with minimal overshading, to maximise PV and solar hot water panel efficiency.
- Provision of identified and accessible electrical cable ductwork between the electrical consumer unit and proposed location of generating equipment (small scale wind and PV).

4. Scenarios for achieving the Energy Saving Trust 25% solutions

The following scenarios show various ways that the Energy Saving Trust guidance can help achieve a 25% reduction in CO_2 emissions over national building regulations, in line with level 3 of the Code for Sustainable Homes.

4.1 Achieving robust CO_2 savings

Certain options may show improvements that are significantly in excess of the required 25%, but it is still important to ensure that the fundamental thermal performance of the building fabric is of a suitably high standard. This is because the lifespan of the dwelling may be up to 100 years, and heating and renewables systems may be changed during this time. Therefore, even with the inclusion of low or zero-carbon heating technology, best practice backstop U-values, airtightness, etc. should be adhered to.

4.2 Correct use of MVHR

When installed correctly, mechanical ventilation heat recovery (MVHR) systems will maintain healthy, fresh air. Studies have shown that they can provide further health benefits through the reduction of dust mite growth (a potential cause of asthma, etc). MVHR is most effective in highly airtight dwellings, and when planning to incorporate an MVHR system it is essential to design the airtightness and ventilation strategies to work in harmony.

MVHR is a low maintenance technology which typically requires little user intervention, but as it may not be familiar to all householders, it is important that occupants receive an information sheet detailing maintenance regimes and other checks (in addition to the full manufacturer's instructions). This should be posted next to the MVHR unit itself, with a duplicate copy included in the home buyer's pack. Manual switches, automatic humidity or other sensors, should be clearly marked and located in accessible locations in or near the wet rooms.

4.3 Regional variations

Please note that due to minor regional variations the scenarios shown are for England and Wales only, but suitable specifications for Scotland and Northern Ireland will in most cases be very similar. In all cases, the relevant requirements of current building regulations should always be checked to ensure that they are satisfied.

4.4 Data source

All of the fuel costs and carbon intensities are taken from SAP 2005. Please note, due to SAP compliance methodology, the CO_2 emissions shown below do not reflect low energy lighting savings beyond building regulations' levels (30%).

4.5 Flats

Figures for the flats are the aggregate of ground, middle and top-floor dwellings in a four-storey building. Note that the Code for Sustainable Homes does not deal with hallways, but for the purposes of modelling thermal performance, hallways have been treated as unheated.

Scenarios for achieving the Energy Saving Trust 25% solutions

Detached house (104m^2) scenarios

		Typical building regulations scenario	Energy Saving Trust 25% solutions				
			Improvements to fabric only	Gas boiler		Biomass boiler	Heat pump
				Solar water heating	PV panels		
Fabric U-values W/m^2.K	Roof	0.25	0.13	0.13		0.13	0.13
	Walls	0.30	0.25	0.25		0.25	0.25
	Ground floor	0.20	0.20	0.20		0.20	0.20
	Windows	2.10, g=0.72	1.20, g=0.50	1.50, g=0.57		1.50, g=0.57	1.50, g=0.57
	Doors	2.20	1.00	1.00		1.00	1.00
	y-value	0.08 (accredited construction details)	0.04	0.04		0.04	0.04
Ventilation	Airtightness m^3/(hr.m^2)	7.0	3.0	3.0		3.0	3.0
	Mechanical Ventilation	Extractor fans	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power		MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power
Heating	Boiler	Gas condensing 90%, boiler interlock	Gas condensing 90%, boiler interlock, weather or load compensator	Gas condensing 90%, boiler interlock		Wood pellet independent boiler, 86%	Electric ground to water heat pump
	Controls	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves		Programmer, room thermostat, thermostatic radiator valves	Programmer and at least 2 room thermostats
	Water heating	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	210 lit re dual coil cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation
	10% secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters	Electric heaters		Electric heaters	Electric heaters
Renewables		n/a	n/a	Solar water heating 2m^2	0.2 kWp PV	n/a	n/a
Low energy lighting		30%	75%	75%		75%	75%
CO_2	TER	23.76	23.76	23.76		23.76	33.73*
	DER	23.22	17.59	17.00	17.28	11.90	19.70
	Improvement	**2.3%**	**26.0%**	**28.4%**	**27.6%**	**49.9%**	**41.6%**
Energy efficiency rating		80 (C)	84 (B)	85 (B)	85 (B)	75 (C)	75 (C)
Environmental impact rating		79 (C)	85 (B)	85 (B)	84 (B)	91 (B)	83 (B)
Running costs (£/yr)		**263**	**216**	**214**	**210**	**331**	**323**

*Here the TER has changed because the heating fuel for this option has different CO_2 emissions

Scenarios for achieving the Energy Saving Trust 25% solutions

Semi-detached house (89m²) scenarios

		Typical building regulations scenario	Energy Saving Trust 25% solutions				
			Improvements to fabric only	Gas boiler		Biomass boiler	Heat pump
				Solar water heating	PV panels		
Fabric U-values W/m².K	Roof	0.25	0.13	0.13		0.13	0.13
	Walls	0.30	0.25	0.25		0.25	0.25
	Ground floor	0.20	0.15	0.20		0.20	0.20
	Windows	2.10, g=0.72	1.20, g=0.50	1.50, g=0.57		1.50, g=0.57	1.50, g=0.57
	Doors	2.20	1.00	1.00		1.00	1.00
	y-value	0.08 (accredited construction details)	0.04	0.04		0.04	0.04
Ventilation	Airtightness m³/(hr.m²)	7.0	3.0	3.0		3.0	3.0
	Mechanical ventilation	Extractor fans	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power		MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power
Heating	Boiler	Gas condensing 90%, boiler interlock	Gas condensing 90%, boiler interlock, weather or load compensator	Gas condensing 90%, boiler interlock		Wood pellet independent boiler, 86%	Electric ground to water heat pump
	Controls	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves		Programmer, room thermostat, thermostatic radiator valves	Programmer and at least 2 room thermostats
	Water heating	160 litre cylinder 50mm insulation	160 litre cylinder 50mm insulation	210 litre dual coil cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation
	10% secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters	Electric heaters		Electric heaters	Electric heaters
Renewables		n/a	n/a	Solar water heating 2m²	0.25kWp PV	n/a	n/a
Low energy lighting		30%	75%	75%		75%	75%
CO_2	TER	23.00	23.00	23.00		23.00	32.60*
	DER	22.78	17.18	16.65	17.09	12.33	19.76
	Improvement	**1.0%**	**25.3%**	**27.6%**	**25.7%**	**47.6%**	**39.4%**
Energy efficiency rating		82 (B)	85 (B)	86 (B)	86 (B)	76 (C)	77 (C)
Environmental impact rating		81 (B)	86 (B)	86 (B)	86 (B)	91 (B)	84 (B)
Running costs (£/yr)		**227**	**188**	**185**	**185**	**283**	**278**

*Here the TER has changed because the heating fuel for this option has different CO_2 emissions

Scenarios for achieving the Energy Saving Trust 25% solutions

Mid-terrace house (79m²) scenarios

		Typical building regulations scenario	Energy Saving Trust 25% solutions				
			Improvements to fabric only	Gas boiler		Biomass boiler	Heat pump
				Solar water heating	PV panels		
Fabric U-values W/m².K	Roof	0.25	0.13	0.13		0.13	0.13
	Walls	0.30	0.25	0.25		0.25	0.25
	Ground floor	0.20	0.15	0.20		0.20	0.20
	Windows	2.10, g=0.72	1.20, g=0.50	1.50, g=0.57		1.50, g=0.57	1.50, g=0.57
	Doors	2.20	1.00	1.00		1.00	1.00
	y-value	0.08 (accredited construction details)	0.04	0.04		0.04	0.04
Ventilation	Airtightness m³/(hr.m²)	7.0	3.0	3.0		3.0	3.0
	Mechanical ventilation	Extractor fans	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power		MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power
Heating	Boiler	Gas condensing 90%, boiler interlock	Gas condensing 90%, boiler interlock, weather or load compensator and delayed start	Gas condensing 90%, boiler interlock		Wood pellet independent boiler, 86%	Electric ground to water heat pump
	Controls	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves	Programmer, room thermostat, thermostatic radiator valves		Programmer, room thermostat, thermostatic radiator valves	Programmer and at least 2 room thermostats
	Water heating	140 litre cylinder 50mm insulation	140 litre cylinder 85mm insulation	190 litre dual coil cylinder, 50mm insulation	140 litre cylinder, 50mm insulation	140 litre cylinder, 50mm insulation	140 litre cylinder, 50mm insulation
	10% secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters	Electric heaters		Electric heaters	Electric heaters
Renewables		n/a	n/a	Solar water heating 2m²	0.25kWp PV	n/a	n/a
Low energy lighting		30%	75%	75%		75%	75%
CO_2	TER	21.32	21.32	21.32		21.32	30.13*
	DER	21.06	15.97	15.56	15.72	12.04	19.19
	Improvement	**1.2%**	**25.1%**	**27.0%**	**26.3%**	**43.5%**	**36.6%**
Energy efficiency rating		83 (B)	86 (B)	87 (B)	87 (B)	79 (C)	79 (C)
Environmental impact rating		83 (B)	87 (B)	88 (B)	88 (B)	91 (B)	85 (B)
Running costs (£/yr)		**197**	**166**	**164**	**159**	**241**	**240**

*Here the TER has changed because the heating fuel for this option has different CO_2 emissions

Scenarios for achieving the Energy Saving Trust 25% solutions

Four-storey flats (61m^2) scenarios

		Typical building regulations scenario	Energy Saving Trust 25% solutions			
			Improvements to fabric only	Communal heat pump	Communal biomass boiler	Communal gas CHP
Fabric U-values W/m^2.K	Roof	0.20	0.13	0.10	0.13	0.13
	Walls	0.25	0.25	0.25	0.25	0.25
	Ground floor	0.15	0.10	0.20	0.20	0.20
	Windows	1.80, g=0.63	0.80, g=0.50	1.50, g=0.57	1.50, g=0.57	1.50, g=0.57
	Doors	1.00	0.80	1.00	1.00	1.00
	y-value	0.08 (accredited construction details)	0.04	0.04	0.04	0.04
Ventilation	Airtightness m^3/(hr.m^2)	7.0	3.0	3.0	3.0	3.0
	Mechanical ventilation	Extractor fans	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power	MVHR 85% efficiency, 1W /(l.s) specific fan power
Heating	System	Electric panel heaters	Electric storage heaters, integrated storage/direct acting	Communal heat pump	Biomass communal boiler, 86% efficiency	Gas combined heat and power, 75% overall efficiency
	Controls	Programmer, room thermostat	Automatic charge control	Programmer and TRVs	Programmer and TRVs	Programmer and TRVs
	Water heating	Electric immersion	Immersion heater, 120 litre cylinder, 80mm insulation	From community scheme	From community scheme	From community scheme
	10% secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters	Electric heaters	n/a	n/a
Renewables		n/a	n/a	n/a	n/a	n/a
Low energy lighting		30%	75%	75%	75%	75%
CO_2	Aggregate TER	31.75	31.75	31.75	22.42*	22.42*
	Aggregate DER	31.44	23.79	13.66	9.81	8.30
	Improvement	**0.98%**	**25.1%**	**57.0%**	**56.3%**	**63.0%**
Energy efficiency rating		65 (D)	82 (B)	86 (B)	86 (B)	89 (B)
Environmental impact rating		76 (C)	83 (B)	90 (B)	93 (A)	95 (A)
Running costs (£/yr)		**323**	**191**	**156**	**151**	**129**

*Here the TER has changed because the heating fuel for this option has different CO_2 emissions

5. Further information

The Energy Saving Trust provides free technical guidance and solutions to help UK housing professionals design, build and refurbish to high levels of energy efficiency. These cover all aspects of energy efficiency in domestic new build and renovation. They are made available through the provision of training seminars, downloadable guides, online tools and a dedicated helpline.

A complete list of guidance categorised by subject area can be found in Energy Efficiency is best practice (CE279). To download this, and to browse all available Energy Saving Trust publications, please visit www.energysavingtrust.org.uk/housing

The following publications may also be of interest:

General

- Domestic energy efficiency primer (CE101)
- Energy efficiency frequently asked questions (CE126)

For a variety of shorter introductory guides, visit: www.energysavingtrust.org.uk/resources/publications

Insulation

- Insulation materials chart – thermal properties and environmental ratings (CE71)

Lighting

- Low energy domestic lighting (GIL20)
- Cost benefit of lighting (CE56)

Community Heating

- Community heating serves luxury private apartments (CE103)

Windows

- Windows for new and existing housing (CE66)

To view a list of BFRC rated windows, please visit www.bfrc.org

To view a list of the most efficient windows currently available, please visit www.passivhaus.org.uk

Heating system

- Domestic heating by electricity (CE185)
- Domestic heating by solid fuel (CE47)
- Domestic heating by gas (inc. LPG) (CE30)
- Domestic heating by oil (CE29)

To view a list of the most efficient boilers currently available, please visit www.boilers.org.uk

Airtightness and efficient ventilation

- Improving airtightness in dwellings (CE137)
- Energy efficient ventilation in housing (GPG268)
- Achieving airtightness in new dwellings: case studies (CE248)

Renewables

- Renewable energy sources for homes in urban environments (CE69)
- Renewable energy sources for homes in rural environments (CE70)
- Domestic ground source heat pumps (CE82)
- Solar water heating systems (CE131)

To obtain these publications or for more information, call 0845 120 7799,
email bestpractice@est.org.uk
or visit www.energysavingtrust.org.uk/housing

energy saving trust®

Energy Saving Trust 21 Dartmouth Street London SW1H 9BP
Tel 0845 120 7799 Fax 0845 120 7789
bestpractice@est.org.uk www.energysavingtrust.org.uk/housing