CE291

Energy efficiency and the Code for Sustainable Homes

Level 4

Also available:

Energy efficiency guidance for level 3

Energy efficiency guidance for levels 5 and 6

energy saving trust®

Contents

Acknowledgement

Cover: The Hanson House 2, BRE Innovation Park. Photograph: Peter White, BRE

1. Introduction

1.1 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 energy efficiency requirements of level 4 of the Code for Sustainable Homes.

This publication is the second in a suite of Energy Saving Trust guidance, designed to achieve step-change energy performance improvements over national building regulations[3]. It provides technical guidance on designing and building new homes that have 44% lower CO_2 emissions than the minimum levels in the regulations, and meet the mandatory (ENE1) energy requirements of the Code for Sustainable Homes level 4.

Constructing dwellings that achieve these heightened levels of energy performance currently presents a significant challenge to industry, and research on compliance is still at a pioneering stage. Cost-effective alternative solutions and strategies to meet the required energy performance may emerge in the short to medium term. Therefore, please note that the scenarios suggested in this guide are offered for demonstration and learning purposes only, and should not be regarded as definitive.

Other guides in this series cover 25%, 100% and true zero carbon solutions, and will help housing professionals to meet levels 3, 5 and 6 of the Code for Sustainable Homes respectively.

For more information on the other Energy Saving Trust guidance 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 performance 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 of fuel 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 44% 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 performance 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 includes:

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 solutions 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 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 have 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 page 15 for details).

Achieving Level 4 of the Code for Sustainable Homes

As with previous versions of Energy Saving Trust guidance, this document focuses on achieving CO_2 emissions that are significantly lower than national building regulations. The guidance and solutions described in this guide are illustrative only, and are offered to help designers achieve ENE1 at level 4 of the Code for Sustainable Homes.

This level of performance is likely to be incorporated into the new national building regulations in England and Wales by 2013. Code level 4 is also likely to become a mandatory requirement for publicly funded housing in England from 2012.

Please note that this document is specifically targeted at meeting ENE1 and is not intended to provide a complete guide to meeting the whole of Code level 4.

2. How the Energy Saving Trust 44% guidance works

The process is summarised in figure 1, and consists of two key stages:

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 44% 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 44% guidance works

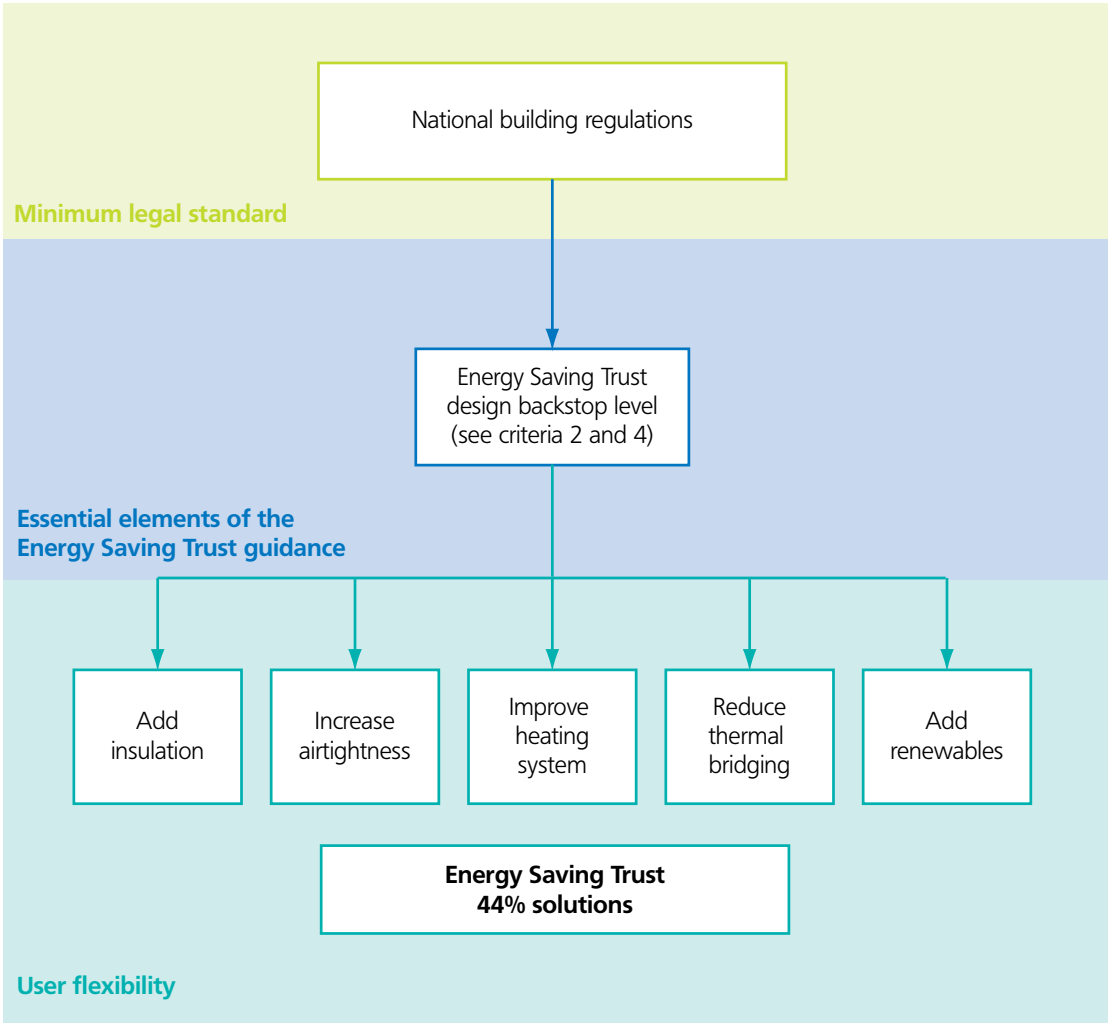

Figure 1: Summary of how the Energy Saving Trust 44% guidance works

3. Criteria for achieving the Energy Saving Trust 44% solutions

Achieving a 44% 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 Target Emission Rate ($TER_{(Energy\ Saving\ Trust\ 44\%\ guidance)}$) – see below for explanation.

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

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
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 44% 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 44% guidance, but in order to give the desired CO_2 savings the TER is reduced by 44% by multiplying it by 0.56.

TER (national building regulations) **x 0.56 = TER** (Energy Saving Trust 44% 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 44% guidance) to pass.

The following equation clarifies this:

DER (proposed dwelling) $\leqslant$ **TER** (Energy Saving Trust 44% guidance)

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

Criteria for achieving the Energy Saving Trust 44% solutions

Criterion 2: Design backstops

Aspect		National building regulations[1]	Energy Saving Trust 44% solutions
Opaque elements W/m^2.K (area weighted average)	roof	0.25	0.13
	walls	0.35	0.20
	exposed floors	0.25	0.20
Windows and doors W/m^2.K (area weighted average) For further guidance see 'Windows for new and existing housing' (CE66)[2].		2.2	Windows must achieve a BFRC (British Fenestration Rating Council) rating in band B 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 of 1 Watt per litre or less; **and** • The heat recovery efficiency must be 85% or better. 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. fittings will 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.	100%. 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** 3. Only energy efficient light fittings greater than 40 lumens per circuit Watt and compatible photocell or timer.

Criteria for achieving the Energy Saving Trust 44% solutions

Aspect	National building regulations[1]	Energy Saving Trust 44% 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 44% 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 to enable designers to check to see 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 44% guidance, the use of mechanical cooling (air conditioning) is not permitted.

Criteria for achieving the Energy Saving Trust 44% solutions

Criterion 4: Quality of construction and commissioning

Aspect	National building regulations	Energy Saving Trust 44% 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 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 ensure the energy efficient running of the dwelling. 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 initially 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 suitable 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 44% solutions

The following scenarios show various ways that the Energy Saving Trust guidance can help achieve a 44% reduction in CO_2 emissions over national building regulations, in line with level 4 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 44%, 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.

As previously stated, constructing dwellings that achieve these heightened levels of energy performance currently presents a significant challenge to industry, and research on compliance is still at a pioneering stage. Cost-effective alternative solutions and strategies to meet the required energy performance may emerge in the short to medium term. Therefore, please note that the scenarios suggested in this guide are offered for demonstration and learning purposes only, and should not be regarded as definitive.

Scenarios for achieving the Energy Saving Trust 44% solutions

Detached house (104m^2) scenarios

		Typical building regulations scenario	Energy Saving Trust 44% solutions				
			Gas boiler (with either SWH or PV)		Biomass boiler	Heat pump	Communal gas CHP
			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	0.20		0.20	0.20	0.20
	Ground floor	0.20	0.20		0.20	0.20	0.20
	Windows	2.10, g=0.72	0.80, 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)	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		Wood pellet, closed heater 86%	Electric ground to water heat pump	Gas CHP, overall efficiency 75%
	Controls	Programmer, room thermostat, thermostatic radiator valves	Time and temperature zone control		Programmer, room thermostat, thermostatic radiator valves	Programmer and at least 2 room thermostats	Unit charging, programmer and thermostatic radiator valves
	Water heating	160 litre cylinder, 50mm insulation	160 litre cylinder, 80mm insulation		160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation
	Secondary heating (as required under building regulations methodology)	Electric heaters	Gas heater, closed fronted, fan assisted		Electric heaters	Electric heaters	Electric heaters
Renewables		n/a	Solar water heating 4m^2	0.64kWp PV	n/a	n/a	Solar water heating 4m^2
Low energy lighting		30%	100%		100%	100%	100%
CO_2	TER	23.76	23.76		23.76	33.73*	23.76
	DER	23.22	13.18	13.07	11.71	18.11	12.77
	Improvement	**2.3%**	**45.5%**	**45.0%**	**50.7%**	**46.3%**	**46.3%**
Energy efficiency rating		80 (C)	88 (B)	89 (B)	77 (C)	83 (B)	87 (B)
Environmental impact rating		79 (C)	89 (B)	89 (B)	91 (B)	85 (B)	89 (B)
Running costs (£/yr)		**263**	**177**	**164**	**307**	**227**	**180**

*Here the TER has changed because the heating fuel for this option has different fuel factor in the building regulations

Scenarios for achieving the Energy Saving Trust 44% solutions

Semi-detached house (89m²) scenarios

		Typical building regulations scenario	Energy Saving Trust 44% solutions				
			Gas boiler (with either SWH or PV)		Biomass boiler	Heat pump	Communal gas CHP
			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	0.20		0.20	0.20	0.20
	Ground floor	0.20	0.20		0.20	0.20	0.20
	Windows	2.10, g=0.72	0.80, 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)	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		Wood pellet, closed heater 86%	Electric ground to water heat pump	Gas CHP, overall efficiency 75%
	Controls	Programmer, room thermostat, thermostatic radiator valves	Time and temperature zone control, delayed start		Programmer, room thermostat, thermostatic radiator valves	Programmer and at least 2 room thermostats	Flat rate charging, programmer, room thermostat and thermostatic radiator valves
	Water heating	160 litre cylinder, 50mm insulation	160 litre cylinder, 80mm insulation		160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation	160 litre cylinder, 50mm insulation
	Secondary heating (as required under building regulations methodology)	Electric heaters	Gas heater, closed fronted, fan assisted		Electric heaters	Electric heaters	Electric heaters
Renewables		n/a	Solar water heating 4m²	0.64kWp PV	n/a	n/a	Solar water heating 4m²
Low energy lighting		30%	100%		100%	100%	100%
CO_2	TER	23.00	23.00		23.00	32.60*	23.00
	DER	22.78	12.77	12.82	11.89	18.05	12.65
	Improvement	**1.0%**	**44.5%**	**44.3%**	**48.3%**	**44.6%**	**45.0%**
Energy efficiency rating		82 (B)	89 (B)	90 (B)	78 (C)	85 (B)	88 (B)
Environmental impact rating		81 (B)	90 (B)	90 (B)	91 (B)	86 (B)	90 (B)
Running costs (£/yr)		**227**	**154**	**144**	**264**	**194**	**157**

*Here the TER has changed because the heating fuel for this option has different fuel factor in the building regulations

Scenarios for achieving the Energy Saving Trust 44% solutions

Mid-terrace house (79m²) scenarios

		Typical building regulations scenario	Energy Saving Trust 44% solutions				
			Gas boiler (with either SWH or PV)		Biomass boiler	Heat pump	Communal gas CHP
			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	0.20		0.20	0.20	0.20
	Ground floor	0.20	0.20		0.20	0.20	0.20
	Windows	2.10, g=0.72	0.80, g=0.50		1.30, g=0.64	1.50, g=0.64	1.50, g=0.64
	Doors	2.20	1.00		1.00	1.00	1.00
	y-value	0.08 (accredited)	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		Wood pellet, closed heater 86%	Electric ground to water heat pump	Gas CHP, overall efficiency 75%
	Controls	Programmer, room thermostat, thermostatic radiator valves	Time and temperature zone control, weather or load compensator		Programmer, room thermostat, thermostatic radiator valves	Programmer and room thermostat	Flat rate charging, programmer and thermostatic radiator valves
	Water heating	140 litre cylinder, 50mm insulation	140 litre cylinder, 80mm insulation		140 litre cylinder, 80mm insulation	140 litre cylinder, 50mm insulation	140 litre cylinder, 50mm insulation
	Secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters		Electric heaters	Electric heaters	Electric heaters
Renewables		n/a	Solar water heating 4m² + 0.16kWp PV	0.80kWp PV	n/a	n/a	Solar water heating 4m²
Low energy lighting		30%	100%		100%	100%	100%
CO_2	TER	21.32	21.32		21.32	30.13*	21.32
	DER	21.06	11.79	11.69	11.73	15.09	11.76
	Improvement	**1.2%**	**44.7%**	**45.2%**	**45.0%**	**49.9%**	**44.8%**
Energy efficiency rating		83 (B)	90 (B)	91 (B)	81 (B)	84 (B)	90 (B)
Environmental impact rating		83 (B)	91 (B)	91 (B)	92 (A)	89 (B)	91 (B)
Running costs (£/yr)		**197**	**131**	**120**	**221**	**185**	**135**

*Here the TER has changed because the heating fuel for this option has different fuel factor in the building regulations

Scenarios for achieving the Energy Saving Trust 44% solutions

Four-storey flats (61m^2) scenarios

		Typical building regulations scenario	Energy Saving Trust 44% solutions			
			Electric	Communal biomass boiler	Communal heat pump	Communal biomass CHP with gas backup
Fabric U-values W/m^2.K	Roof	0.20	0.13	0.13	0.13	0.13
	Walls	0.25	0.20	0.20	0.20	0.20
	Ground floor	0.15	0.20	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	1.00	1.00	1.00	1.00
	y-value	0.08 (accredited)	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	Panel heaters	Panel heaters	Wood pellet independent boiler 86%	Electric ground to water heat pump	Biomass CHP, gas backup, overall efficiency 75%
	Controls	Programmer, room thermostat	Programmer, room thermostat	Programmer, room thermostat, thermostatic radiator valves	Flat rate charging, programmer and thermostatic radiator valves	Flat rate charging, programmer and thermostatic radiator valves
	Water heating	Immersion heater, 140 litre cylinder, 50mm insulation	Immersion heater, 140 litre cylinder, 80mm insulation	From community scheme	From community scheme	From community scheme
	Secondary heating (as required under building regulations methodology)	Electric heaters	Electric heaters	Electric heaters	Electric heaters	Electric heaters
Renewables		n/a	n/a	n/a	n/a	n/a
Low energy lighting		30%	100%	100%	100%	100%
CO_2 (aggregate)	TER	31.75	31.75	22.42	31.75	22.42
	DER	31.44	16.85	9.23	13.75	7.57
	Improvement	**0.98%**	**46.94%**	**58.85%**	**56.88%**	**66.25%**
Energy efficiency rating		65 (D)	81 (B)	86 (B)	86 (B)	87 (B)
Environmental impact rating		76 (C)	88 (B)	94 (A)	91 (B)	95 (A)
Running costs (£/yr)		**323**	**189**	**151**	**151**	**144**
*Here the TER has changed because the heating fuel for this option has different fuel factor in the building regulations						

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

- Energy efficiency frequently asked questions (CE126)

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

Insulation

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

Lighting

- Cost benefit of lighting (CE56)
- Daylighting in urban areas: a guide for designers (CE257)
- Low energy domestic lighting (GIL20)

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 systems

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

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

Community Heating

- Community heating serves luxury private apartments (CE103)

Airtightness and efficient ventilation

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

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

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