Building Typology Brochure England
September 2014

Co-funded by the Intelligent Energy Europe Programme of the European Union

TABULA

EPISCOPE

Disclaimer

BRE output: 296-024 (23rd September 2014)

Introduction

As part of the Typology Approach for the EPISCOPE project, dwellings in England have been subdivided into types characterised by age and dwelling type. This document provides base data on the English housing stock, split into typologies consistent with the approach used by the other EU nations involved in this project. It also provides a reference to accompany the results of the English energy calculations for this project.

The basis of the data used for the English typologies is the English Housing Survey. The English Housing Survey is carried annually to collect information about householders, their housing condition and energy efficiency. The key aspects of information collected include dimensions/dwelling size, energy, disrepair and hazards and other household information. The Survey is split into 2 parts,

- A household interview – around 13,300 householders per year
- Physical inspection by a qualified surveyor of a sample of properties – around 6,200 properties per year

Analysis of the data is typically conducted on two years combined data.

Dwelling age

For the purposes of the defining TABULA consistent typologies, the dwelling age in England was split into to the following bands,

- Pre 1919
- 1919 – 1944
- 1945 – 1964
- 1965 –1980
- 1981 – 1990
- 1991 – 2003
- 2004-2009
- Post 2010 (which includes examples of NZEB)

Built form

English dwelling types are usually classified into

- End terrace
- Mid terrace
- Semi detached

- Detached
- Flats (purpose built or converted)

For the purposes of the project, however, the classification needs to be modified to match existing structures. The English dwelling types have therefore been classified into four main groups,

- Single Family House (detached)
- Terraced House (mid or end terrace – n.b. this includes semi-detached houses considered a two-dwelling terrace)
- Multifamily house (converted or low rise flats)
- Apartment (purpose built or high rise flat)

Combining these types with the age bands above the following age/type typologies consistent with TABULA are produced:

- Single family house pre 1919
- Single family house 1919-44
- Single family house 1945-64
- Single family house 1965-80
- Single family house 1981-90
- Single family house 1991- 2003
- Single family house 2004-2009
- Single family house post 2010
- Terraced house pre 1919
- Terraced house 1919-44
- Terraced house 1945-64
- Terraced house 1965-80
- Terraced house 1981-90
- Terraced house 1991- 2003
- Terraced house 1991- 2003
- Terraced house 2004-2009
- Terraced house post 2010

- Multifamily house pre 1919
- Multifamily house 1919-44
- Multifamily house 1945-64
- Multifamily house 1965-80
- * Multifamily house 1981-90
- Multifamily house 1991-2003
- Multifamily house 2004-2009
- Multifamily house post 2010
- *Apartment pre 1919
- *Apartment 1919-44
- Apartment 1945-64
- Apartment 1965-80
- *Apartment 1981-90
- *Apartment 1991- 2003
- Apartment post 2004

*small sample size – no data for this typology recorded

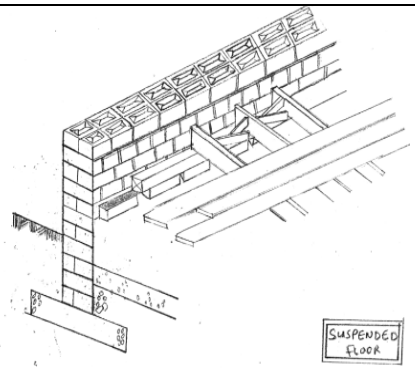
Energy efficiency characteristics

Energy efficiency characteristics of these typologies have been defined for an un-modernised example of each of these typologies. The thermal performance of building elements is based upon the age of the dwelling. For example the type of wall, windows and doors, roof elements, floors etc. that were available at the time of construction. The heating systems in this base position reflect typically unimproved inefficient systems as would be found in relatively un-modernised dwellings of this type today (it is not appropriate to assume as-built systems for the base position, as for the oldest stock this would be solid fuel fires, which have almost all been replaced today with more modern systems).

Building Elements

The building elements employed in the construction contribute to determining several factors relating to the energy performance of the building. As mentioned previously, assumptions can be made about building elements based on their age however once improvements have been made, this may not be the case. For the reference of readers less familiar with the building elements found in English dwellings, a few of the most common building elements are explained in the following table.

Building element	Brief description	Example image
Cavity wall (and cavity wall insulation)	Cavity wall construction (where the external walls are constructed of two leaves, separated by a narrow cavity) is the most common form of construction in English dwellings and has been a common domestic building techniques since the 1930s. These walls can be insulated through the application of insulatuing materials between the two leaves of the wall. Insulation could have been fitted during construction or retrospectively injected between the masonry leaves of the wall.	
Non-cavity wall	These are dwellings without a cavity within their external wall structure – principally of solid wall masonry construction. Also included in this category are dwellings of timber, metal or concrete frame construction. These may have additional insulation applied either externally (e.g. insulated board attached to the external face with a render finish) or internally (e.g. insulated plasterboard fitted to the external walls inside each room, with a plaster finish).	
Loft insulation	Loft insulation was not routinely added in English dwellings until the second half of the 20th century. Insulation can be found between joists above the ceiling of the top floor of the dwelling or between the rafters of the roof	

	(especially where the loft has been converted to a habitable space).	
Double glazing	Double glazed windows are those made up of two panes of glass separated by a narrow air gap (or in some cases another gas). The definition of double glazing used here does not include windows with secondary glazing. Older dwellings which have not undergone a refit/refurbishment are more likely to have single glazed windows. Double glazed windows can have a wooden, metal, or pvc frame.	
Roof types	Roofs are classified as being either pitched or flat. Roofs can also come in the mansard or chalet design, where some of the living space of the dwelling is contained underneath the sloping surface of the roof.	
Floor types	Floors are typically solid or suspended timber. The image on the right is that of a suspended floor. Floor insulation is very rare in England, except in the most recently constructed dwellings.	

Door	Doors are usually wooden, metal or pvc with frames of similar materials.	

Table 1: Building Elements

TABULA dwelling type	pitched roof with gables	Pitched roof (1967 to1975)	Flat roof (1983 to 90)- also include pitched	flat roof (post 2004) also includes pitched roofs	Pitched roof post 2010	Masonry cavity Wall	Solid wall	Cavity wall with insulation	Cavity wall post 2010	Floor 1 (single family house)	floor 2 (terraced house)	floor 3 (flat)	floor 4(post 1990)	floor 5 (post 2002)	floor 6 (post 2010)	wood framed window	PVCU window (pre 2002)	PVCU window (post 2002)	softwood door	PVCU door
u values	2.3	1.5	0.4	0.25	0.18	1.6	2.1	0.35	0.28	0.72	0.59	0.45	0.5	0.25	0.22	4.8	3.1	1.85	3	2
g values																0.85	0.76	0.72		
SFH pre 1919	x						x			x						x			x	
SFH 1919-1944	x						x			x						x			x	
SFH 1945-1964	x					x				x						x			x	
SFH 1965-80		x				x				x							x			x
SFH 1981-1990			x			x				x							x			x
SFH 1991- 2003			x			x							x				x			x
SFH 2004-2009				x				x						x				x		x
SFH post 2010					x				x						x			x		x
Terraced house pre 1919	x						x				x					x			x	
Terraced house 1919-1944	x						x				x					x			x	
Terraced house 1945-1964	x					x					x					x			x	
Terraced house 1965-1980		x				x					x						x			x
Terraced house 1981-1990			x			x					x						x			x
Terraced house 1991- 2003			x			x							x				x			x
Terraced house 2004-2009				x				x						x				x		x
Terraced house post 2010					x				x						x			x		x
MFH pre 1919	x						x					x				x			x	
MFH 1919-1944	x						x					x				x			x	
MFH 1945-1964	x					x						x				x			x	
MFH 1965-1980		x				x						x					x			x
MFH 1981-1990			x			x						x					x			x
MFH 1991- 2003			x			x							x				x			x
MFH 2004-2009				x				x						x				x		x
MFH post 2010					x				x						x			x		x
Apartment pre 1919	**Small sample size**																			
Apartment 1919-1944	**Small sample size**																			
Apartment 1945-1964	x						x					x				x			x	
Apartment 1965-1980		x				x						x					x			x
Apartment 1981-1990	**Small sample size**																			
Apartment 1991-2003	**Small sample size**																			
Apartment post 2004				x				x							x			x		x

Table 2: Assumptions made for TABULA

Heating Systems

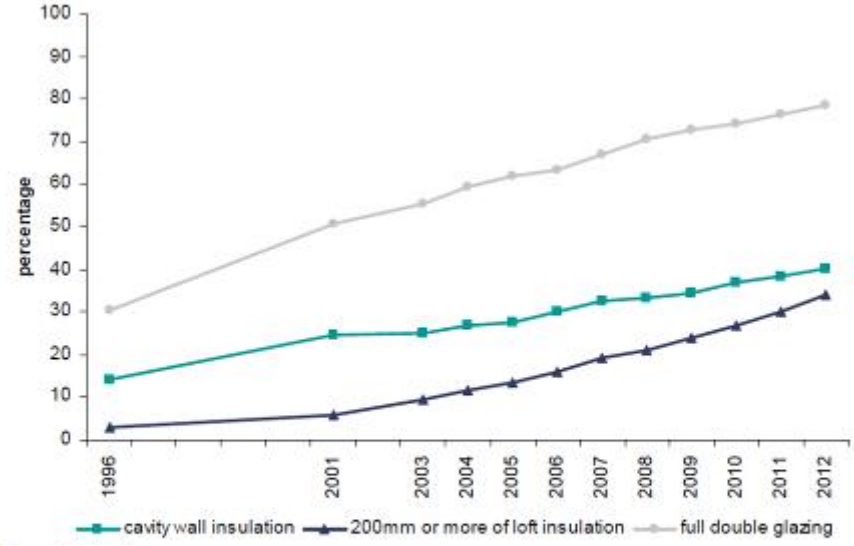
There are various space heating systems and corresponding fuels used in England however space heating systems are dominated by boilers. These include, standard boilers, back boilers, combination boilers, condensing boilers or condensing-combination boilers. Water heating systems are typically combined with the central heating system. However there are also systems specifically for water heating, these include dedicated boilers, electric immersion heaters and instantaneous heaters. For the purposes of TABULA, the most common systems were included in the typologies; these are shown in table 3.

Heating type	Fuel	System type
Space	o Gas o Electricity	o Condensing boiler o Condensing-combi boiler o Electrical storage heaters o Combined heat and power* o Heat pump* o Electrical Underfloor heating*
Water	o Gas o Electricity	o Water heating with central heating system (i.e. with systems identified above) o Electric Immersion
*for refurbishment scenarios		

Table 3: Heating assumptions

Energy Efficiency Trends

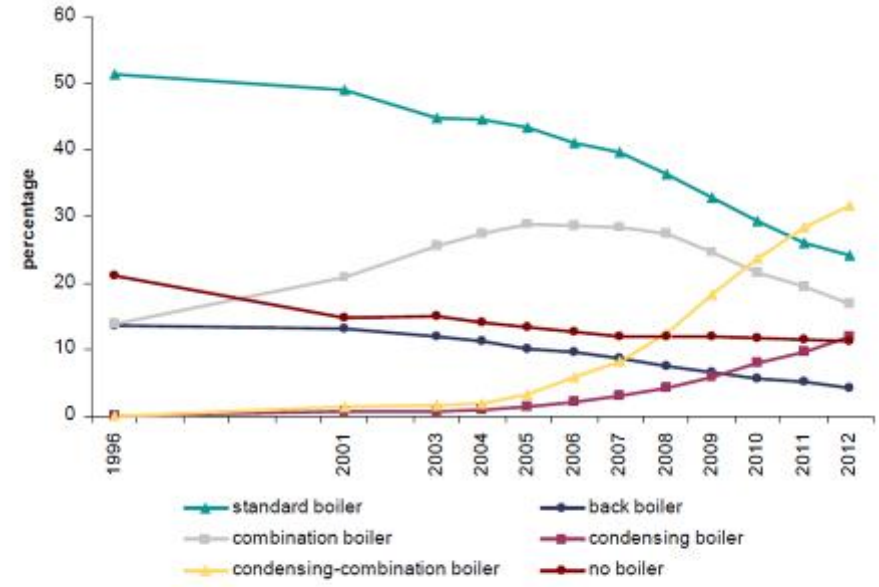
The energy efficiency of the English housing stock has improved over time. Existing dwellings have been improved by adding energy efficient measures and better heating systems while new buildings are built to the latest building regulations. Figure 1 below from the *English Housing Survey: Headline Report, 2012-2013* demonstrates that the uptake of insulation measures follows an upward trend. From 1996 to 2012, there has been a continuous growth in the uptake of insulation measures. For example in 1996 only 3% of dwellings had 200mm or more of loft insulation however by 2012, it had become 34% of dwellings (DCLG 2014).



Base: all dwellings
Notes:
1) percentages are based on all dwellings, including those with no loft or no cavity walls. Only 87% of all dwellings have lofts, and 69% have cavity walls
Sources:
1996 to 2007: English House Condition Survey;
2008 onwards: English Housing Survey, dwelling sample

Figure 1: Insulation Measures 1996 to 2012 (DCLG 2013)

Similarly, heating systems can be improved by installing more efficient systems. Condensing boilers are considered to be more efficient than older equivalents. Figure 2 below shows that from around 2006 when new building regulations emerged, there has been an increase in condensing boilers (including condensing-combination) while other boiler types show a decline.

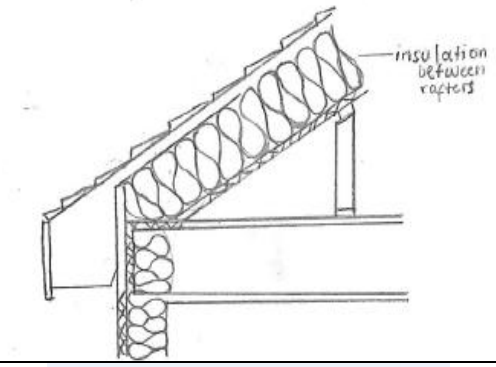
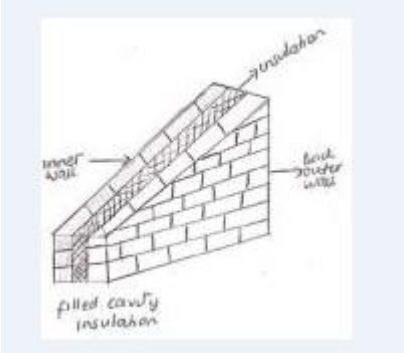
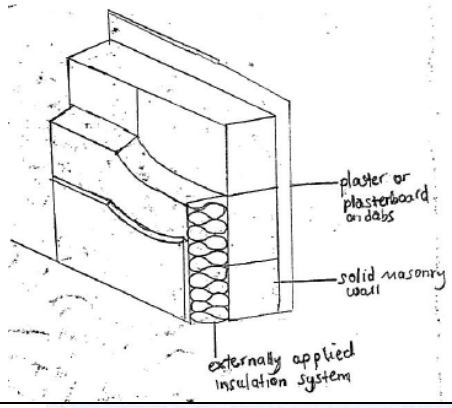


Base: all dwellings
Sources:
1996 to 2007: English House Condition Survey;
2008 onwards: English Housing Survey, dwelling sample

Figure 2: Boiler Types 1996 to 2012 (DCLG 2013)

Refurbishment

For the purposes of TABULA, combinations of the following measures are used for the refurbishment scenarios.

Building Element	Measure	u-values	g-value	
Roof	Loft insulation between rafters	0.13		
Wall	Cavity filled wall insulation	0.6		
Wall	solid wall insulation	0.3		
Window	UPVC double glazing	2.2	0.72	
Window	UPVC double glazing	1.6	0.7	

Door	pvc door	1.8		

Table 3: Refurbishment measure assumed for TABULA

NZEB variations

For the purposes of the NZEB variations (for those dwellings post 2010) U values of elements were applied which are in line with example buildings built to meet the Code for Sustainable Homes level 6 (i.e. zero carbon) in the UK, specifically the Barratt Green House on the BRE innovation park[1]. The U values of the building fabric and heating systems used for the elements are given below. The building form (floor areas etc) was cloned from the previous age band (2004-2009).

Higher level building fabric for NZEB examples	u-value
Highly insulated roof	0.11
Concrete construction wall with 180mm external wall insulation	0.11
High specification triple glazing, argon filled.	0.68
High specification door	1.40
Highly insulated floor	0.11

Heating & Energy Generation measures for NZEB examples
Electric air source heat pump
Solar water heating
Mechanical Ventilation Heat Recovery
Photovoltaics

[1] http://www.bre.co.uk/filelibrary/Innovation_Park/Brochure_sections/BRE_Innovation__Barrat_Green_House.pdf

Display Sheets

Single Family House pre 1919

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Solid wall		none	2.1
Floor		none	0.72
single glazed windows, wood frames		n/a	4.8
Door		n/a	3
Energy needed for heating kWh/(m²a)	247.3		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	87.5		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	77.6		

Single Family House 1919-1944

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		None	2.3
Solid wall		None	2.1
Floor		None	0.72
single glazed windows, wood frames		n/a	4.8
Door		n/a	3
Energy needed for heating kWh/(m²a)	266.5		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	94.7		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	83.8		

Single Family House 1945-1964

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		None	2.3
Masonry (Unfilled) Cavity wall		None	1.6
Floor		None	0.72
single glazed windows, wood frames		n/a	4.8
Door		n/a	3
Energy needed for heating kWh/(m²a)	259.8		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	103.0		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	92.0		

Single Family House 1965-80

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	1.5 (0.01m)
Masonry (Unfilled) Cavity wall		none	1.6
Floor		none	0.72
single glazed windows, wood frames		n/a	4.8
Door		n/a	2
Energy needed for heating kWh/(m²a)	228.0		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	138.5		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	93.7		

Single Family House 1981-1990

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	0.4 (0.01m)
Masonry (Unfilled) Cavity wall		none	1.6
Floor		none	0.72
double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	166.3		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	110.5		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	90.2		

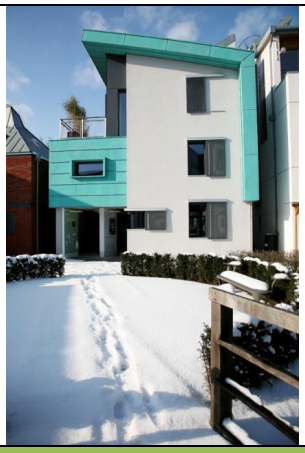
Single Family House 1991- 2003

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.4 (0.01m)
Masonry (Unfilled) Cavity wall		none	1.6
Floor		none	0.5
Double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	143.2		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Cavity wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	103.6		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Cavity wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	82.9		

Single Family House 2004-2009

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.25 (0.25m)
Filled cavity wall		yes	0.35 (0.05m)
Floor		yes	0.25
Double glazed windows		n/a	1.85
Door		n/a	2
Energy needed for heating kWh/(m²a)	69.6		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
None			
Energy needed for heating kWh/(m²a)	69.6		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	66.3		

Single Family House post 2010



AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.18
Filled cavity wall		yes	0.28
Floor		yes	0.22
Double glazed windows		n/a	1.85
Door (pvcu)		n/a	2.0
Energy needed for heating kWh/(m²a)	63.7		
STANDARD VARIATION INPUTS AND TABULA RESULTS			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Energy needed for heating kWh/(m²a)	47.1		
AMBITIOUS VARIATION INPUTS AND TABULA RESULTS (NZEB)			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Heating & Energy Generation specification			
Electric air source heat pump			
Solar water heating			
Mechanical Ventilation Heat Recovery			
Photovoltaics			
Energy needed for heating kWh/(m²a)	43.9		

Terraced house pre 1919

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Solid wall		none	2.1
Floor		none	0.59
single glazed windows, softwood frames		n/a	4.8
Door (softwood panel)		n/a	3
Energy needed for heating kWh/(m²a)	281.1		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	89.9		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	79.2		

Terraced house 1919-1944

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Solid wall		none	2.1
Floor		none	0.59
single glazed windows, softwood frames		n/a	4.8
Door (softwood panel)		n/a	3
Energy needed for heating kWh/(m²a)	310.0		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	98.2		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	85.8		

Terraced house 1945-1964

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Masonry (Unfilled) cavity wall		none	1.6
Floor		none	0.59
single glazed windows, softwood frames		n/a	4.8
Door		n/a	3
Energy needed for heating kWh/(m²a)	281.2		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		Yes	2.2
Energy needed for heating kWh/(m²a)	107.9		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	95.9		

Terraced house 1965-1980

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	1.5 (0.01m)
Masonry (Unfilled) cavity wall		none	1.6
Floor		none	0.59
double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	221.4		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	114.5		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	94.0		

Terraced house 1981-1990

-AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		Yes	0.4 (0.01m)
Masonry (Unfilled) cavity wall		None	1.6
Floor		None	0.59
double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	193.0		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	114.2		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	95.2		

Terraced house 1991-2003

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		Yes	0.4 (0.01m)
Masonry (Unfilled) cavity wall		None	1.6
Floor		None	0.5
Double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	176.4		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Cavity wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	110.7		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Cavity wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	92.2		

Terraced house 2004 - 2009

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.25 (0.25m)
filled cavity wall		yes	0.35 (0.05m)
Floor		yes	0.25
Double glazed windows		n/a	1.85
Door		n/a	2
Energy needed for heating kWh/(m²a)	71.3		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
None			
Energy needed for heating kWh/(m²a)	71.3		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	68.6		

Terraced house post 2010

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.18
Filled cavity wall		yes	0.28
Floor		yes	0.22
Double glazed windows		n/a	1.85
Door (pvcu)		n/a	2.0
Energy needed for heating kWh/(m²a)	64.9		
STANDARD VARIATION INPUTS AND TABULA RESULTS			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external wall		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Energy needed for heating kWh/(m²a)	46.8		
AMBITIOUS VARIATION INPUTS AND TABULA RESULTS (NZEB)			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external wall		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Heating & Energy Generation specification			
Electric air source heat pump			
Solar water heating			
Mechanical Ventilation Heat Recovery			
Photovoltaics			
Energy needed for heating kWh/(m²a)	43.6		

Multi Family House pre 1919

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Solid wall		none	2.1
Floor		none	0.45
single glazed windows, softwood frames		n/a	4.8
Door (softwood panel)		n/a	3
Energy needed for heating kWh/(m²a)	205.5		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating Wh/(m²a)	64.2		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	58.0		

Multi Family House 1919-1944

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		none	2.3
Solid wall		none	2.1
Floor		none	0.45
single glazed windows, softwood frames		n/a	4.8
Door (softwood panel)		n/a	3
Energy needed for heating kWh/(m²a)	222.4		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	69.5		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	61.8		

Multi Family House 1945-1964

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Flat Roof		none	2.3
Masonry (Unfilled) cavity wall		none	1.6
Floor		none	0.45
single glazed windows, softwood frames		n/a	4.8
Door		n/a	3
Energy needed for heating kWh/(m²a)	219.1		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	82.4		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	72.9		

Multi Family House 1965-1980

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Flat Roof		Yes	1.5 (0.1m)
Masonry (Unfilled) cavity wall		none	1.6
Floor		none	0.45
Double glazing		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	166.5		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	85.2		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	67.1		

Multi Family House 1981-1990

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		Yes	0.4 (0.1m)
Masonry (Unfilled) cavity wall		Yes	1.6
Floor		none	0.45
Double glazing		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	128.4		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	74.8		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	61.5		

Multi Family House 1991-2003

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.4 (0.1m)
Masonry (Unfilled) cavity wall		none	1.6
Floor		None	0.5
Double glazed windows		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	122.4		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
None			
Cavity wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	81.2		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Cavity wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	65.0		

Multi Family House 2004 - 2009

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.25 (0.1m)
Cavity wall		yes	0.35
Floor		yes	0.25
Double glazed windows		n/a	1.85
Door		n/a	2
Energy needed for heating kWh/(m²a)	55.0		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
None			
Energy needed for heating kWh/(m²a)	55.0		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	52.8		

Multi Family House post 2010

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Pitched Roof		yes	0.18
Filled cavity wall		yes	0.28
Floor		yes	0.22
Double glazed windows		n/a	1.85
Door (pvcu)		n/a	2.0
Energy needed for heating kWh/(m²a)	50.6		

STANDARD VARIATION INPUTS AND TABULA RESULTS			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external wall		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Energy needed for heating kWh/(m²a)	35.0		

AMBITIOUS VARIATION INPUTS AND TABULA RESULTS (NZEB)			
Variation specification		Insulation	u-value
Highly insulated roof		yes	0.11
Concrete construction wall with 180mm external wall		yes	0.11
High specification triple glazing, argon filled.		n/a	0.68
High specification door		n/a	1.40
Highly insulated floor		yes	0.11
Heating & Energy Generation specification			
Electric air source heat pump			
Solar water heating			
Mechanical Ventilation Heat Recovery			
Photovoltaics			
Energy needed for heating kWh/(m²a)	31.8		

Apartment Building 1945-1964

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Flat Roof		none	2.3
Masonry solid wall		None	2.1
Floor		none	0.45
single glazed windows, softwood frames		n/a	4.8
Door (softwood panel)		n/a	3
Energy needed for heating kWh/(m²a)	175.7		

STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	2.2
Energy needed for heating kWh/(m²a)	56.5		

AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.3
Window change		n/a	1.6
Door change		n/a	1.8
Energy needed for heating kWh/(m²a)	48.8		

Apartment Building 1965-1980

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Flat Roof		Yes	1.5 (0.1m)
Masonry (Unfilled) cavity wall		none	1.6
Floor		none	0.45
Double glazing		n/a	3.1
Door		n/a	2
Energy needed for heating kWh/(m²a)	121.9		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Energy needed for heating kWh/(m²a)	70.2		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Roof insulation		Yes	0.13
Wall insulation		Yes	0.6
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	51.8		

Apartment Building 2004 - 2010

AS BUILT INPUTS AND TABULA RESULTS			
Building details		Insulation	u-value
Flat Roof		Yes	0.25
Insulated wall		yes	0.28
Floor		yes	0.25
Double glazed windows		n/a	1.85
Door		n/a	2
Energy needed for heating kWh/(m²a)	44.3		
STANDARD REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
None			
Energy needed for heating kWh/(m²a)	44.3		
AMBITIOUS REFURBISHMENT INPUTS AND TABULA RESULTS			
Refurbishment measures		Insulation	u-value
Window change		n/a	1.6
Energy needed for heating kWh/(m²a)	41.5		

References

English Housing Survey: Headline Report 2012-13 (2013). *Department for Communities and Local Government*. London. [Online] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284648/English_Housing_Survey_Headline_Report_2012-13.pdf [Accessed 25 April, 2014]