EUFORIE
European Futures for Energy Efficiency

Consumers and energy efficiency

(Workpackage 5)

Country Report for the United Kingdom

An inventory of policies, business and civil society initiatives focusing on heating & hot water and the use of electricity

December, 2015

This project is supported by the European Commission
Horizon2020 Research and Innovation Programme

www.euforie-h2020.eu

Methodological notes:

This report has been compiled as a result of desktop search into:

i) data on energy consumption in the household sector in the United Kingdom, and

ii) policies, business and civil society initiatives mainly at the national level to promote energy efficiency in the household sector in Hungary.

The report focuses on the use of energy in the household sector for the purposes of heating and the use of hot water, as well as on the use of electricity. Transport-related use of energy is excluded.

The data analysis on energy consumption is based on the ODYSSEE database on energy efficiency indicators and data (http://www.odyssee-mure.eu), using the most recent data available.

The scope of information presented in the report in the case of policies at the national level is mainly on governmental measures in effect. In the case of business and civil society initiatives the main objective of the report is to illustrate diversity and not to provide a complete overview or an exhaustive list of all existing initiatives. An attempt was made to introduce the better-known campaigns and programmes as well as to indicate the variety of the actions.

The collection of information was concluded by end of November 2015.

Please cite as:

Trotta, Gianluca and Lorek, Sylvia (2015). Consumers and Energy Efficiency – Country Report United Kingdom. An inventory of policies, business and civil society initiatives, focusing on heating, hot water and the use of electricity. *EUFORIE – European Futures for Energy Efficiency*

Content

Abbreviations

ABS	Area Based Schemes
BIS	Department for Business Innovation and Skills
CERO	Carbon Emissions Reduction Obligation
CERT	Carbon Emissions Reduction Target
CESP	Community Energy Savings Programme
CHP	Micro Combined Heat and Power
CFR	Central FIT Register
CSCO	Carbon Saving Community Obligation
DBOOT	Design-Build-Own-Operate-Transfer
DEEC	Department of Energy & Climate Change
DHS	District Heating Systems
DBOOT	Design-Build-Own-Operate-Transfer
ECO	Energy Companies Obligation
EDRP	Energy Demand Research Project
EMA	Energy Manager Association
EMS	Environmental Management Systems
EPC	Energy Performance Contract
EPRSC	Engineering and Physical Sciences Research Council
EST	Energy Saving Trust
ESTA	Energy Services and Technology Association
ETI	Energy Technologies Institute
FIT	Feed in Tariff
GDHIF	Green Deal Home Improvement Fund
GIB	Green Investment Bank
GBS	Government Buying Standards
HEEPS	Home Energy Efficiency Programmes for Scotland
HHCRO	Home Heating Cost Reduction Obligation
IHD	In-Home Display
LCICG	Low Carbon Innovation Co-ordination Group
OFGEM	Office of Gas and Electricity Markets
PSWMR	Provisional Solid Wall Minimum Requirement
RHI	Renewable Heat Incentive
SMET	Smart Meters Equipment Technical Specification
TIC	Total Installed Capacity
TSB	Technology Strategy Board
TWh	Terawatt-hour
WHD	Warm Home Discount

List of tables

List of figures

1. Introduction

1.1 General socio-economic and energy data

United Kingdom is the world's fifth biggest economy and the second largest in Europe (IMF, 2015). The United Kingdom economy growth by 41.65% in the period 1995-2012; GDP and private consumption at 2005 PPP increased with annual average rate of 2.31% and 7.8%, respectively (Table 1).

The United Kingdom's economic structure is principally dominated by its tertiary sector, which accounted for more than 70% of its GDP in 2012, followed by industry (16.4%) and the agriculture sector (0.6%). Within the tertiary sector, the most important contributors are banking, insurance, and business services. Manufacturing of goods is particularly important for UK industries; within manufacturing, the production of automotive or aerospace equipment is a major contributor to UK industries. With regard to the agriculture sector, despite only contributing 0.6% to UK's GDP in 2012, it is still considered an important part of the UK's economy and society as it covers 60 percent of the UK's food needs. From 1995 to 2012 the tertiary sector increased by 61.5%, while the industry and the agriculture sector decreased by 5.3% and 36.4%, respectively.

The population of United Kingdom was estimated at 63.705,00 in 2012 (64.105,7 million in 2013, Odyssee database LE), equivalent to 12.5% of the total European Union population. The population from 1995 to 2012 increased by 9.7%.

Table 1. General socio-economic data

SOCIO-ECONOMIC				
Item	**Unit**	**1995**	**2005**	**2012**
GDP at exchange rate	M€2005	1.439.284,36	1.940.128,69	2.038.714,84
GDP at 2005 PPP	M€2005p	1.327.343,39	1.789.234,33	1.880.152,89
Population	k	58.024,80	60.413,30	63.705,00
Number of households	k	23.473,40	25.482,30	26.794,43
Private consumption of household at exchange rate	M€2005	512.576,33	1.423.057,91	1.232.624,03
Private consumption of household at 2005 PPP	M€2005p	472.710,48	1.312.378,96	1.136.756,15
Value added of agriculture at exchange rate	M€2005	19358,25	10824,8	12311,97
Value added of agriculture at 2005 PPP	M€2005p	17852,65	9982,9	11354,4
Value added of industry at exchange rate	M€2005	354773,81	361908,45	335733,54
Value added of industry at 2005 PPP	M€2005p	327181,12	333760,86	309621,72
Value added of tertiary at exchange rate	M€2005	887470,36	1327509,51	1433578,67
Value added of tertiary at 2005 PPP	M€2005p	818446,97	1224261,87	1322081,46

Source: Odyssee database

In 2012, the United Kingdom's final residential energy consumption amounted to 40.49 Mtoe – a 1.97% increase compared to 1995 – reaching its peak in 2004, with 45.52 Mtoe (Table 2).

The household sector accounted for 29.9% of the United Kingdom's total energy end-use in 2012, and the residential final energy consumption per capita was 0.63 Toe per inhabitant.

Table 2. Data related residential energy consumption

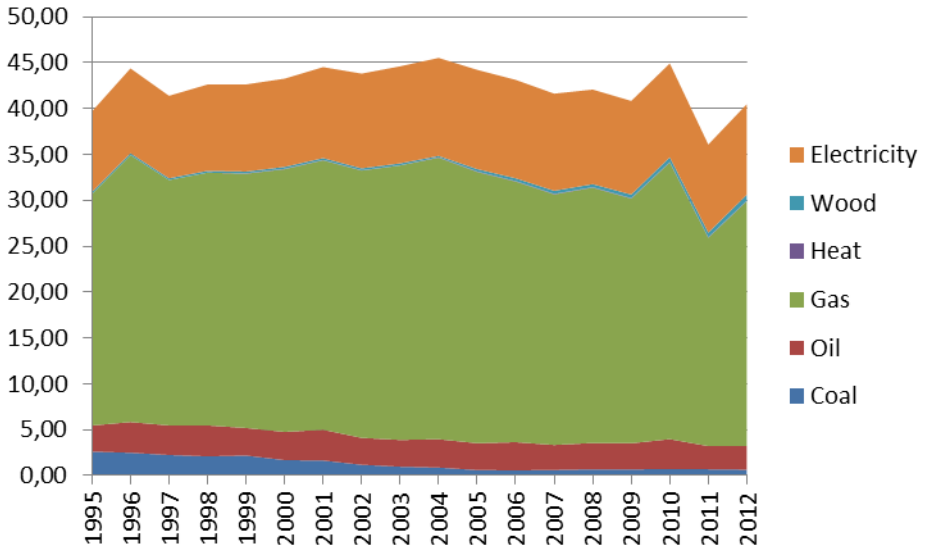
ENERGY				
Item	**Unit**	**1995**	**2005**	**2012**
Final consumption of residential (with climate correction)	Mtoe	46,40	46,83	40,43
Final consumption of residential	Mtoe	39,70	44,22	40,49
➢ Coal	Mtoe	2,63	0,62	0,66
➢ Oil	Mtoe	2,85	2,93	2,56
➢ Gas	Mtoe	25,23	29,55	26,70
➢ Heat	Mtoe	0,00	0,05	0,05
➢ Wood	Mtoe	0,21	0,27	0,65
➢ Electricity	Mtoe	8,79	10,81	9,87
Space heating	Mtoe	24,64	28,59	25,95
Water heating	Mtoe	7,92	7,25	6,50
Cooking	Mtoe	1,30	1,26	1,05
Air cooling	Mtoe	0,00	0,00	0,00
Electrical appliances and lighting	Mtoe	6,39	7,17	7,24
Electricity consumption of captive electricity	TWh	74,28	83,40	84,21
Total stock of dwellings	k	23.739,00	25.576,00	27.008,00
Stock of dwellings permanently occupied	k	23.315,00	24.729,89	26.184,87
Total construction of dwellings	k	199,12	209,58	143,93
Floor area of dwellings (average)	m^2	84,00	88,52	91,37
Stock of refrigerators	k	24.200,75	26.752,85	28.696,92
➢ Unit consumption	kWh/year	451,03	343,95	253,44
➢ Rate of equipment ownership	%	103,80	108,18	109,59
Stock of freezers	k	12.045,18	12.997,07	12.564,98
➢ Unit consumption	kWh/year	413,95	274,27	197,00
➢ Rate of equipment ownership	%	41,05	52,56	47,99
Stock of washing machines	k	17.921,64	19.873,30	21.577,01
➢ Unit consumption	kWh/year	275,04	198,07	201,97
➢ Rate of equipment ownership	%	90,90	95,20	97,00
Stock of dishwashers	k	4.531,20	8.153,25	10.112,25
➢ Unit consumption	kWh/year	435,27	327,52	299,51
➢ Rate of equipment ownership	%	20,00	34,70	42,00
Stock of TV	k	40.490,34	54.513,70	63.041,98
➢ Unit consumption	kWh/year	222,79	220,71	279,97
➢ Rate of equipment ownership	%	97,40	98,00	96,68

Source: Odyssee database

With respect to large appliances (refrigerators, freezers, washing machines, dishwasher, TV), the total electricity consumption (kWh/year) in the period 1995-2012 decreased 128.31%. Individually, refrigerators decreased of 43.81%, freezers 52.41%, washing machines 26.57%, dishwashers 31.19%, while TV increased 25.67%. On the other hand, the stock of refrigerators in the period under consideration grew of 18.58%, freezers 4.32%, washing machines 20.4%, dishwashers 123.17%, TV 55.70%.

The structure of final energy residential consumption did not substantially change in the period 1995-2012. Gas has been the predominant source of energy for the period under consideration with the 65.9% of the total final energy residential consumption in 2012. While the use of heat, coal and wood has been insignificant, the use of electricity represented the 24.3% in 2012, followed by oil (6.3%).

Figure 1. United Kingdom's final residential energy consumption by source 1995 – 2012 (Mtoe)

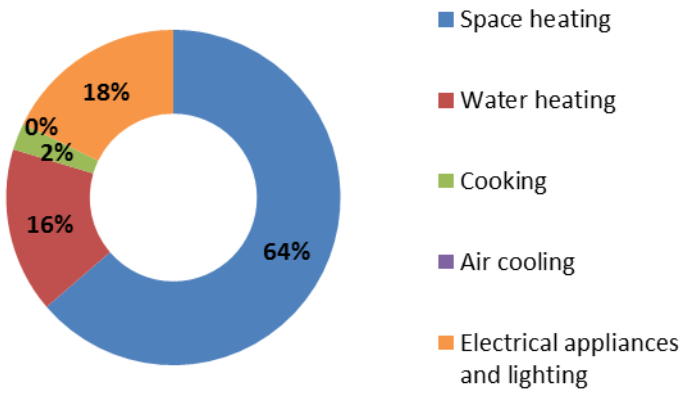


Source: Author's elaboration based on Odyssee database

Approximately 64% of energy in the residential sector was used for space heating, about 18% for electricity for appliances and lighting, roughly 16% for water heating, and a small part for air cooling and cooking (2%).

Figure 2 illustrates the composition of the energy end-use in the residential sector in 2012.

Figure 2. United Kingdom's final residential energy consumption by end-use 2012 (%)



Source: Author's elaboration based on Odyssee database

Total use of energy for space heating amounted to 25.95 Mtoe in 2012. Of this, gas was 20.29 Mtoe (78.1%), oil 2.17 Mtoe, electricity 2.1 Mtoe, wood 0.73 Mtoe, coal 0.67 Mtoe.

Also water heating, in the period 1995-2012, has been dominated by the consumption of gas; it represented the 83% of the total energy share of water heating in 2012, followed far enough by electricity (10%), and oil (6.1%).

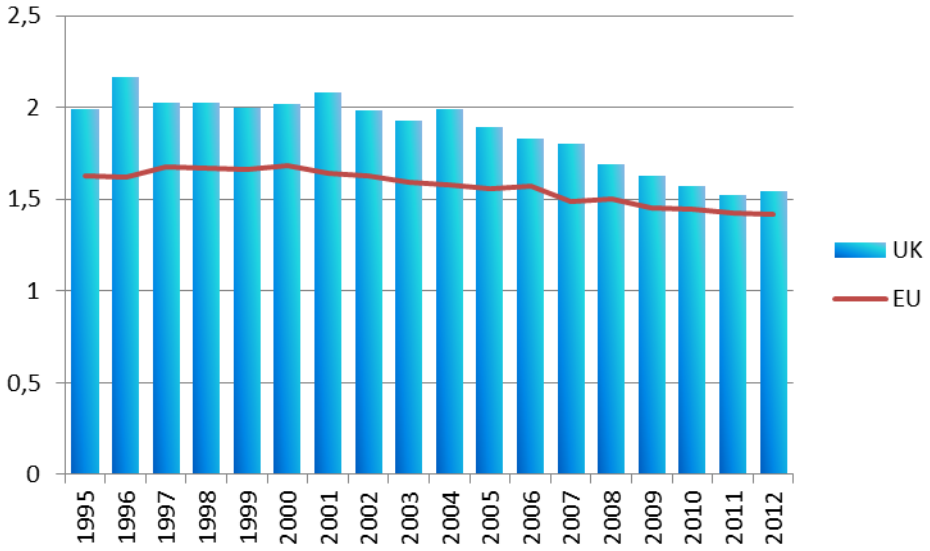
Electrical appliances were responsible of the 83.7% of the total electricity consumption in 2012; the remaining 16.3% was used for lighting.

The 52.3% of energy consumed for cooking in 2012 came from gas, and the 47.6% from electricity.

In 2012, the average floor area of dwellings was about 91.3 m^2, similar to the average of the European Member States (87.81 m^2). Energy consumption of households per permanently occupied dwellings (calculated at normal climate), was 1.54 toe/dw (the average of the European Member States was 1.41 toe/dw).

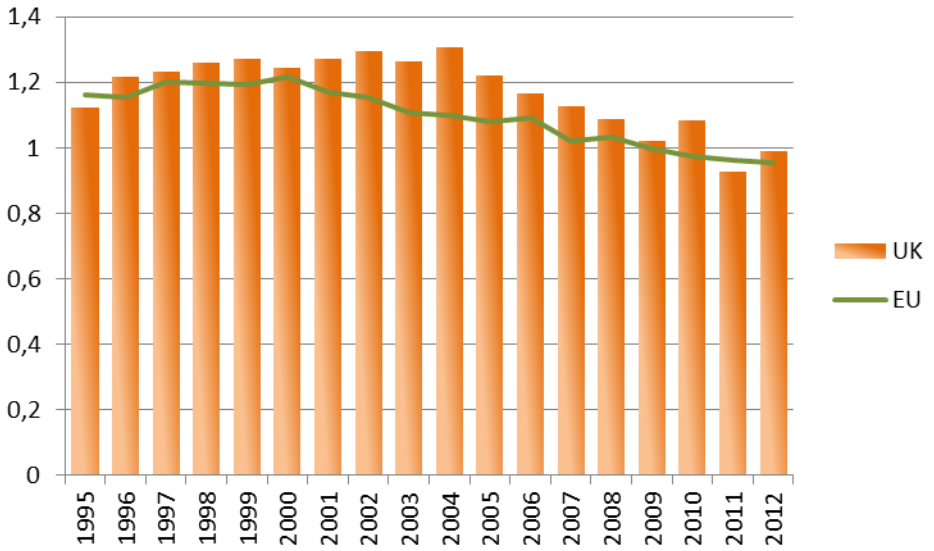
Figure 3 shows the household consumption per dwelling of the United Kingdom compared to the average of the European Member States over the period 1995-2012, while Figure 4 shows the household space heating consumption at normal climate per dwelling compared to the average of the European Member States.

Figure 3. United Kingdom's energy consumption per dwelling 1995-2012 (toe/dwelling)



Source: Author's elaboration based on Odyssee database

Figure 4. United Kingdom's space heating consumption per dwelling 1995-2012 (toe/dwellings)



Source: Author's elaboration based on Odyssee database

Regarding CO_2 emissions the residential sector's share of total emissions (133,55 Mt CO_2, Table 3) decreased of 5.45% from 1995 to 2012 and it was much bigger than the average of the European Union (27.9 Mt CO_2), decreased of 11.89% in the same period. In addition, the United Kingdom is ranked in the fourth position for the CO_2 emissions of the residential sector per capita among the European Member States in 2012 (where Estonia is in the first position being the less efficient).

Table 3. Environmental aspects of residential energy consumption

ENVIRONMENT				
Item	**Unit**	**1995**	**2005**	**2012**
CO_2 emissions of households (excluded electricity)	MtCO_2	79,15	82,40	72,98
Total CO_2 emissions of households (included electricity)	MtCO_2	141,25	149,99	133,55
CO_2 emissions per dwelling	tCO_2/dw	3,39	3,33	2,79
CO_2 emissions per dwelling (with climatic corrections)	tCO_2/dw	3,51	3,54	2,78
CO_2 emissions per dwelling with climatic corrections (included electricity)	tCO_2/dw	6,17	6,27	5,09
CO_2 emissions of space heating per dwelling	tCO_2/dw	2,57	2,67	2,16
CO_2 emissions of space heating (with climatic corrections)	tCO_2/dw	2,57	2,81	2,12
CO_2 emissions of space heating with climatic corrections (included electricity)	tCO_2/dw	2,97	3,3	2,61
Degree-days	degree	2.988,88	2.879,37	3.182,72

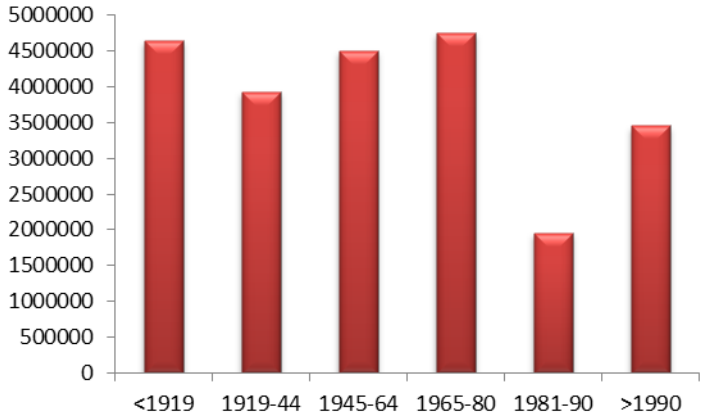
Source: Odyssee database

In 2012, CO_2 emissions per dwelling with climatic corrections (included electricity) were 5,09 (t CO_2 /dw), much higher than the European average (3,74). Also, CO_2 emissions of space heating with climatic corrections (included electricity) were the 30.5% higher than the European average (t CO_2 /dw 2).

1.2 Specific data on residential building stock and related energy use

The UK has around 27 million homes across a wide range of housing types, including a significant proportion of older buildings, as shown in Figure 4. The prevalence of older buildings in the national stock built to lower standards of energy efficiency leaves a considerable legacy of non-energy efficient features. Older homes typically have no, or lower quality insulation than more modern homes and if they have solid walls, they are more difficult to bring up to modern standards of insulation.

Figure 5. Dwelling stock by age



Source: Housing Survey (2013)

Dwellings are categorised as detached houses, semi-detached houses, terraced houses, flats or bungalows. Terraced house is the most common house type, representing 27.8% of UK homes, followed by semi-detached houses (24.9%), flats (20.6%), detached (17.5%), bungalows (9.1%).

Regarding the size of the dwellings, 9.3% are smaller than 50 m^2, 21.6% are between 50-69 m^2, 28.5% between 70-89 m^2, 15.6% between 90-109 m^2 and 24.7% are larger than 110 m^2.

In England, approximately half the homes have an Energy Performance Certificate (EPC) rating of D, further 25% are rated E, and 6% of homes are F or G rated. Scotland has a lower proportion of the least efficient housing with 4% rated F or G.

In 2011, around two-thirds (63%) of homes in the UK were owner occupied and recent years have seen a rapid growth in the private rented sector which accounts for 18% of homes in the UK. The level of owner occupation has implications for policy design. Owner occupiers benefit directly from energy efficiency upgrades, whereas landlords may pay for improvements while their tenants benefit from lower bills. In the last years, there has been a decline in the number of socially rented homes, which are provided by housing associations or local authorities. However at 18%, the UK still has some of the highest levels of social housing in Europe.

2. Politics affecting energy consumption in households

2.1 General policy framework

The UK Government is committed to improving the energy efficiency of the UK's building stock, to work towards cutting carbon emissions by 80% by 2050 relative to 1990 levels (Climate Change Act, 2008). This strategy for building renovation refers to the policies and analysis that influence building renovation contained in existing Government strategy documents; in particular the Energy Efficiency Strategy, the Carbon Plan, and The Future of Heating. The overarching approach to energy efficient renovation applies the same principles to both domestic and non-domestic buildings: making buildings more thermally efficient through better insulation and improved airtightness; improving the efficiency of heating systems through the use of more efficient boilers, and supporting the transition to lower carbon and renewable energy fuels and technologies; reducing electricity use through improved energy management systems and technologies, enabled by the introduction of smart meters and more efficient energy services within buildings.

The main policy instruments to improve energy efficiency in the residential sector with the aim of achieving the European energy savings target and as part of the United Kingdom's decarbonisation roadmap to 2050 are:

- Regulatory: Building Regulations (Part L), Code for Sustainable Homes, Technical Housing Standards Review.
- Economic - Financial: Energy Companies Obligation (ECO), Domestic Renewable Heat Incentive (Domestic RHI), Green Deal Home Improvement Fund (GDHIF), Warm Home Discount (WHD).
  Economic - Fiscal/Tariffs: Feed-in Tariff (FIT).
- Informational: Electricity and Gas smart meters.

2.2 Energy efficiency targets

On the 30th of April 2013 the UK notified the European Commission on its target under Article 3 of the Directive 2012/27/EU. The UK's target was set at the level of 129.2 Mtoe for final energy consumption on a net calorific value basis and 177.6 Mtoe for primary energy consumption. This represents an 18% reduction in final energy consumption (equivalent to a 20% reduction in primary energy consumption), relative to the 2007 business-as-usual projection, and reflects the UK's energy efficiency policy package.

Table 4 shows that the UK is projected to consume 126.6 million tonnes of oil equivalent (Mtoe) in 2020, 2% lower than the target set. The projected primary energy consumption of 175.0 Mtoe is also lower than the estimate made when the final consumption target was set.

Table 4. Estimates of key national energy production and consumption figures in 2020

Estimate of energy consumption in 2020	Million tonnes of oil equivalent (NCV basis)
Total primary energy consumption in 2020	**175.0**
Electricity transformation input (public thermal power plants)	51.0
Electricity generation output (public thermal power plants)	21.6
CHP transformation input	3.5
CHP transformation output – thermal	1.8
CHP transformation output – electrical	1.7
Energy distribution losses (all fuels)	3.3
Total final energy consumption	**126.6**
Final energy consumption – Industry	22.9
Final energy consumption – Transport	50.1
Final energy consumption – Households	38.2
Final energy consumption – Services	14.3
Final energy consumption – Agriculture	0.9

Source: NEEAP (2014)

Various policy measures have been identified to contribute towards the target including three Energy Efficiency Obligations: the Carbon Emissions Reduction Target (CERT); Community Energy Saving Programme (CESP); and Energy Company Obligation (ECO). In total, quantifiable savings equivalent to 467 TWh have been identified. The total energy savings which will be achieved by supplier obligations is 167 TWh.

Over the period 2010-2023, the residential sector will be the major contributor to energy saving with 312 TWh, corresponding to the 66.8% of the total energy savings.

Table 5 shows the projected energy savings by policy to be observed in each year covered by the target. All the savings presented are considered additional to how the UK has implemented minimum requirements of previous EU Directives.

Table 5. Final residential energy consumption savings by year from UK policies included for Article 7 policy plan, TWh

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018	2020	2021	2022	2023	TOT
Carbon Emissions Reduction Target (2010-2012)	2.7	5.7	9.1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	8.9	8.8	8.6	*116*
Community Energy Savings Programme (2010-2012)	0.0	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	*5*
Energy Company Obligation				0.7	1.4	2.1	2.8	3.6	4.4	5.1	5.7	6.4	7.1	7.1	*46*
Green Deal – domestic					0.2	0.4	0.5	0.7	0.8	0.9	1.1				*5*
Building Regulations					4.7	9.4	14.1	18.9	23.6	28.3	32.9				*132*
Home Energy Efficient Programmes (Scotland)					0.2	0.5	0.7	0.9	1.0	1.0	1.0				*5*
Private and Social Sector Regulation (Scotland)					0.0	0.1	0.1	0.2	0.3	0.4	0.4				*2*
Sustainable Energy Programme (Northern Ireland)					0.1	0.1	0.2	0.2	0.2	0.2	0.2				*1*
TOTAL	312 TWh														

Source: NEEAP (2014)

The energy saving potential for a range of energy efficiency measures is listed in Table 5, measured in terms of final energy consumption that could be achieved in a given year, through implementing energy efficiency measures between 2013 and 2020[1]. Of these measures, the highest energy saving potential comes from building fabric measures and heat pumps. However heat pumps are only efficient and cost effective when installed in homes with high levels of insulation that are relatively airtight.

[1] Energy Efficiency Strategy, 2013 update (DECC) (Annex E).

Table 6. Energy saving potential for measures

Measure	Energy Savings in 2020 TWh (rounded to nearest TWh)
Air Source Heat Pumps	15
Internal Solid Wall Insulation	10
Ground Source Heat Pumps	9
Smart Meters	8
Hard to Treat Cavity Insulation	5
External Solid Wall Insulation	3
Easy to Treat Cavity Insulation	3
Loft Insulation	1
Total	54

Source: DECC EE-MACC for 2020

2.3 Specific policies

2.3.1 Regulatory

Over time, there have been many changes to the legislation and the supporting guidance of the building regulation regime.

Building regulations set minimum energy efficiency standards whenever certain types of building work are carried out on new and existing buildings. Energy standards have been in place since the 1970s and have been steadily tightened, leading to increasingly better standards for insulation, glazing, airtightness and the efficiency of fixed building services such as heating, lighting and controls. Part L of the Building Regulations, introduced in April 2006 (amended in 2010 and 2013), addresses the conservation of fuel and power and sets out energy efficiency standards that apply to renovations. Technical Guidance is contained in two parts:

- Approved Document L1A: Conservation of fuel and power in new dwellings.
- Approved Document L1B: Conservation of fuel and power in existing dwellings.

These approved documents, set out what in ordinary circumstances, may be accepted as reasonable provision for compliance with the relevant energy efficiency requirements of the Building Regulation Part L.

Closely linked to the Building Regulations is the Code for Sustainable Homes.

The Code for Sustainable Homes was launched on 13 December 2006 with the publication of Code for Sustainable Homes: A step-change in sustainable home building practice (Communities and Local Government, 2006). It came into operation from April 2007. It is a national standard for the sustainable design and construction of new homes and it applies in England, Wales, Scotland and Northern Ireland. It was part of the package of measures that will ultimately contribute towards zero carbon development. The purpose of the Code is to promote higher sustainability performance across a range of criteria, especially energy, water and waste.

The assessment, which has to be carried out by a registered assessor, measures performance against nine criteria, then combines these scores into an overall sustainability rating measured from 1 to 6. One star is entry level above building regulations, with six stars being the highest performance, reflecting exemplary development in terms of sustainability.

The nine criteria assessed are Energy/ CO_2, Water, Materials, Surface Water Runoff (flooding and flood prevention), Waste, Pollution, Health and Well-being, Management and Ecology.

Initially, the Code was compulsory where public sector funding were involved, but voluntary in the private sector. However, since May 2008, there has been a mandatory requirement for all new homes including private sector to be rated against the Code so that new home owners know whether their home is built to higher standards than Building Regulations. Minimum standards for Code compliance have been set above the requirements of Building Regulations. It was intended that the Code would have signaled the future direction of Building Regulations in relation to carbon emissions from, and energy use in homes, providing greater regulatory certainty for the homebuilding industry.

However, on the 25th of March 2015, the Code for Sustainable Homes has been withdrawn and has been replaced by new national technical standards which comprise new additional optional Building Regulations regarding water and access as well as a new national space standard (this is in addition to the existing mandatory Building Regulations).

The new approach introduces optional building regulations requirements for access[2] and water efficiency[3] which provide a higher standard than the minimum national building regulations. Powers to introduce these optional requirements are now included in the Building Act 1984 as amended by the Deregulation Act 2015.

From the 25th of March 2015, Local Plans, Neighbourhood Plans, supplementary planning documents and local validation lists should not include any additional local technical standards or requirements relating to the construction, internal layout or performance of new dwellings. This includes any policy requiring any level of the Code for Sustainable Homes to be achieved by new development as the Government withdrew the code, aside from the management of legacy cases.

2.3.2 Economic

The ***Energy Companies Obligation (ECO)***, which started in 2013, was a Government scheme for Great Britain that placed legal obligations on larger energy companies to deliver energy efficiency measures to domestic premises. ECO was introduced as a successor to the Carbon Emissions Reduction Target (CERT) and Community Energy Savings Programme (CESP) schemes which ran from April 2008 to December 2012 and October 2009 to December 2012, respectively. As part of ECO, the UK Government estimated that £1.3 billion per year worth of energy efficiency and heating measures will be delivered across Great Britain.

ECO helps people install energy-efficiency measures to their home. Under this scheme the big energy suppliers are legally obliged to help the following with energy-efficiency measures:

- Low income and vulnerable households;
- Homes in low income areas.

In particular, ECO had three distinct obligations, which were initially conceived as:

- The Carbon Emissions Reduction Obligation (CERO) focused primarily on the installation of insulation measures in hard-to-treat properties with a target of 20.9 Mt CO_2 lifetime savings.

[2] Requirement M4: There are now three categories of sanitary conveniences in dwellings; M4(1), M4(2) and M4(3). M4(1) is the lowest level of standard and represents the mandatory requirements. Levels M4(2) and M4(3) represent increasingly higher levels of standards.

[3] Requirement G2: the potential water consumption by occupants of a new dwelling must not exceed 125 litres per person per day.

- The Carbon Saving Community Obligation (CSCO) focused on low income areas with a target of 6.8 Mt CO_2 lifetime savings, 15% of which was to be delivered in rural areas to consumers on certain types of benefits (the rural sub-obligation).
- The Home Heating Cost Reduction Obligation (HHCRO) – "Affordable Warmth Group" - focused on reducing heating costs for consumers on certain types of benefits as a way of targeting vulnerable households. The HHCRO target was £4.2bn lifetime savings.

Energy companies' obligations were determined for each phase of ECO. The obligations did not need to be met separately for each phase, but cumulatively for the overall obligation period.

The ECO Order established three phases for ECO:

- Phase 1: 1 January 2013 to 31 March 2013;
- Phase 2: 1 April 2013 to 31 March 2014;
- Phase 3: 1 April 2014 to 31 March 2015.

Over the course of ECO there were several legislative changes to reflect amendments to the overall intent of the scheme and which affected the eligibility criteria of measures.

Of the various legislative changes, the most significant was announced by DECC in December 2013, which included:

- A reduction of the CERO target by 33% from 20.9 Mt CO_2 to 14 Mt CO_2;
- Changes to the requirements for carrying over savings from CERT and CESP to ECO (excess actions a savings increase of 75% for CERO primary measures that energy companies delivered before 31 March 2014 (the levelisation process). This process was intended to reward early delivery under CERO;
- Extending the eligibility for CSCO from 15% to 25% of the lowest income areas on the Index of Multiple Deprivation, plus simplifying the qualifying criteria for the rural sub-obligation;
- The introduction of roof insulation, standard cavity wall insulation and connections to district heating systems (DHS) as primary measures in CERO.

These changes were largely the result of concerns around the cost to energy companies of delivering the scheme, which were passed on to consumer fuel bills. The changes reduced the cost of meeting the targets by reducing the overall carbon savings to be achieved, allowing for wider delivery of lower cost measures and simplification of some of the requirements.

In December 2014, a new obligation period was introduced starting on 1 April 2015 (referred to as ECO2). It included:

- Extending the scheme to 2017 allowing energy companies to carry forward the majority of savings that were not needed to achieve their obligations under ECO towards their ECO2 obligations (referred to as surplus actions);
- Introducing a provisional solid wall minimum requirement (PSWMR) of 4 $MtCO_2$ carbon savings to be achieved across all energy companies between January 2013 and March 2017, equivalent to approximately 100.000 solid wall insulation measures;
- Making changes to HHCRO including: the introduction of the uplifts in the cost savings for qualifying boiler replacements and measures delivered to non-gas premises; the repair and replacement of qualifying electric storage heaters as a new measure; minimum warranty requirements for replacement boilers and electric storage heaters.

The extension of the ECO scheme appeared to provide the energy companies with enough assurance to continue delivery, even after they had achieved their obligations.

Energy companies delivered savings significantly in excess of the ECO targets. The majority of energy companies chose to deliver their obligations via managing agents or direct contracts with installers

as opposed to via the brokerage mechanism. Overall, the most frequently installed measure type under ECO was cavity wall insulation (including hard-to-treat cavity wall insulation), followed by loft insulation and boiler replacements. A greater number of measures per household were delivered in Scotland for CERO and CSCO than England and Wales, while a significant number of measures per household were delivered in Wales for HHCRO.

The ***Domestic Renewable Heat Incentive (Domestic RHI)*** launched on 9th April 2014, is a Government financial incentive to promote the use of renewable heating system. The Domestic RHI is targeted at, but not limited to, homes off the gas grid. Those without mains gas have the most potential to save on fuel bills and decrease carbon emissions.

The scheme covers single domestic dwellings and it is open to homeowners, private landlords, social landlords and self-builders. It is not open to new build properties other than self-build.

The domestic RHI pays the following tariffs per unit of heat generated for seven years (Table 2).

Table 7. The domestic RHI tariffs per unit of heat generated

Technology	Tariff
Air-source heat pumps	7.3p/kWh
Ground and water-source heat pumps	18.8p/kWh
Biomass-only boilers and biomass pellet stoves with integrated boilers	12.2p/kWh
Solar thermal panels (flat plate and evacuated tube for hot water only)	19.2 p/kWh

Source: UK Government website

The tariffs have been set at a level that reflects the expected cost of renewable heat generation over 20 years. Payments are made on a quarterly basis.

All installations must be certified under the Microgeneration Certification Scheme and meet relevant required standards for each technology, including limits on harmful emissions for biomass systems.

The renewable heat generated will be estimated in most cases for payment purposes. For biomass and heat pumps, it will be based on an estimated figure of heat demand from an Energy Performance Certificate. For heat pumps, this will be combined with an estimate of the heat pump's efficiency to determine the renewable proportion of the heat. For solar thermal systems, the payments will be based on the estimate of system performance completed as part of an MCS installation. Those applying for a space heating system who have a backup heating system, such as an oil boiler, or people applying for a second home, will need to install metering equipment on which the RHI payments can be based.

To help improve performance of renewable heating systems, there will be an extra incentive for applicants who install metering and monitoring service packages, of £230 per year for heat pumps and £200 per year for biomass boilers. This scheme is administered by Ofgem (Office of Gas and Electricity Markets).

The ***Green Deal Home Improvement Fund (GDHIF)*** was hailed as "*transformational*" and the "*biggest home improvement programme since the second world war*" by ministers. With the Green Deal, the Government established a framework to enable private firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost, and recoup payments through a charge in instalments on the energy bill. In particular, consumers could see the Green Deal charge alongside the reductions in energy use which generated savings on their bill. It also means that if they had moved out and cease to be the bill-payer at that property, the financial obligation didn't move with them but moved to the next bill payer. In this way, the Green

Deal differed from existing lending – it was not a conventional loan since the bill-payer was not liable for the full capital cost of the measures, but only for the charges on the energy bill.

The original fund ran out in July 2014, and the scheme was relaunched in December 2014. The Government announced that money would have been released to the fund every quarter, with details of each release being announced periodically.

However, the Government stopped the Green Deal in July 2015.

The number of householders taking out the loans were much lower than had been hoped by the Government, with just over 15.000 issued or in progress according to statistics.

Although the Green Deal Home Fund was rapidly exhausted several times, the Energy and Climate Change Secretary, Amber Rudd, said it did not *"do what we wanted"* and created a boom-and-bust model. *"It's now time for the building industry and consumer groups to work with us to make new policy and build a system that works"* she said. *"Together we can achieve this Government's ambition to make homes warmer and drive down bills for 1 million more homes by 2020 – and to do so at the best value for money for taxpayers."*

This decision had no impact on existing Green Deal Finance Plans or existing Green Deal Home Improvement Fund applications and vouchers.

Mark Bayley, chief executive of the Green Deal Finance Company, said: *"The most important thing at the moment is for us and the Department to reassure those who currently have Green Deal finance plans in place and those with approved applications, that today's announcement does not change anything for them. We have taken this step to make sure we can meet all our expected liabilities and to have an orderly run-down of new business, while protecting existing plan holders and those whose applications are eligible and have been approved."*

The UK Government has recently committed to additional spending of £320m on the Warm Home Discount scheme in 2015/16. The Warm Home Discount scheme is a five-year scheme that was introduced in 2011. It involves the Government and electricity suppliers working together to offer extra support to people struggling to afford their energy. It is a one-off discount of £140 on the electricity bill, usually between September and March. Some people will automatically qualify for the Warm Home Discount and are in what is called the 'core group'. Those that don't fall into the core group, may still be able to get the Warm Home Discount, because some suppliers also offer the discount to a 'broader group' of customers who are vulnerable to falling into fuel poverty, such as low income households and those especially low income homes that contain a small child.

Case study: Home Energy Efficiency Programmes for Scotland (HEEPS)

HEEPS is the Scottish Government initiative to tackle fuel poverty and increase energy efficiency in homes (£103 million investment). It was launched in April 2013 to take over from the Energy Assistance Package, Universal Home Insulation Scheme and Boiler Scrappage Scheme. HEEPS is a cluster of programmes currently including:

- Area Based Schemes (ABS): Schemes, funded partly by the Scottish Government, are being run locally by the local authority to provide help to households experiencing fuel poverty. These schemes are partly funded through the Energy Companies Obligation (ECO). Measures available could include solid wall insulation, cavity wall insulation and heating systems.
- Warmer Homes Scotland: The Scottish Government Warmer Homes Scotland scheme opened for applications on 1 September 2015. The scheme is open to homeowners and private sector tenants who have lived in their property for at least six months, and who meet the qualifying conditions. Energy efficiency measures that may be offered include: wall insulation, loft insulation, draught-proofing, central heating, renewables.
- Cashback scheme: The Scottish Government is offering owner occupiers, private and social tenants and registered private sector landlords a rebate towards installing eligible energy efficiency measures for properties that are in council tax bands A to C. The measures must be recommended in a pre-install Green Deal Advice Report for the property.
- Loan scheme: An interest free loan of up to £10.000 is available to install measures such as solid wall insulation, double glazing or new boilers. The repayment period depends on the amount that the householder borrows.
- Gas Infill Loans Scheme: The Gas Infill Loans scheme provides interest free loan funding for gas connection costs and installation of a gas central heating system. It is available for individuals wishing to connect to the gas grid, or where the property is included in a gas infill project or gas grid extension project. Loans are available between £500 and £5.000.

To be eligible for most Scottish Government energy efficiency schemes, there must be a Green Deal Advice Report carried out at the property before installation starts. The Green Deal closed to new applications on 23 July 2015, but the Green Deal assessment and the Green Deal Advice Report are still in use.

The Energy Saving Trust manages calls for the Home Energy Efficiency Programmes for Scotland through the Home Energy Scotland hotline on behalf of the Scottish Government in partnership with a range of advice providers and the energy companies. They offer energy efficiency advice, information on low cost energy tariffs, and advice on income maximisation, as well as a wide range of energy efficiency measures.

With regard to fiscal/tariff policies, the Feed-in-Tariff scheme (FITs) is an environmental programme introduced by the Government on the 1st of April 2010 to promote widespread uptake of a range of small-scale renewable and low-carbon electricity generation technologies.

The name comes from the German system where generators were given a fixed price for every unit of electricity they exported to the grid. The scheme is different from the German scheme because in

the UK the generator is paid for every unit they generate, even if they use all the electricity themselves (the generation tariff). The rates vary depending on the size of the system, the technology installed and when the system was installed. If the generator does export electricity to the grid they will be paid an extra tariff on top of the FIT (export tariff - 4.77p per unit of electricity). The Energy Saving Trust calculators estimate how much households could earn using the FIT scheme and selling unused energy back.

The Feed-in Tariff has opened up low-carbon electricity generation beyond the traditional energy companies by making it more cost effective for communities and householders to buy the units.

The scheme is applicable to a number of technologies:

- Solar photovoltaic (usually called PV) with a total installed capacity (TIC) of 5MW or less;
- Wind with a TIC of 5MW or less;
- Hydro with a TIC of 5MW or less;
- Anaerobic digestion with a TIC of 5MW or less;
- Micro combined heat and power (CHP) installations with a TIC of 2kW or less.

Suppliers (FIT Licensees) play the main customer-facing role for this scheme: registering eligible installations, processing generation data, and making relevant payments; Ofgem is responsible for ensuring supplier compliance and maintaining the integrity of a Central FITs Register (CFR).

Applications for accreditation under the FIT go through one of two routes: the MCS or the ROO-FIT accreditation process.

1. MCS: The MCS route is for PV or wind installations with a declared net capacity (DNC) of 50kW or less and micro CHP installations with a TIC of 2kW or less. This will cover most applications.

2. ROO-FIT: All installations that are eligible and are between 50kW and 5MW in capacity (and any Anaerobic Digestion or Hydro plants up to 5MW) will need to apply to Ofgem directly for accreditation through Ofgem's Renewable and CHP Register www.renewablesandchp.ofgem.gov.uk.

2.3.3 Informational

Gas and electricity smart meters are part of the Government's plan for upgrading the UK's energy system. The aim is for all homes and small businesses to have smart meters by 2020. Energy suppliers will be required to install smart meters and take all reasonable steps to install them for everybody. Consumers with smart meters will be offered an in-home display (IHD) that lets them see how much energy they are using and what it will cost. This will let them have more control over their energy use and help them save energy and money. They will also receive energy efficiency advice as part of the installation process. Between 2015 and 2020 energy suppliers will be responsible for replacing over 53 million gas and electricity meters, but there will not be a legal obligation on individuals to have one. This will involve visits to 30 million homes and small businesses in the UK.

In line with art. 9(2) of the Directive 2012/27/EU, the Government put in place a Data Access and Privacy Framework that gives consumers control over who sees their energy consumption data, and implemented the second Smart Meters Equipment Technical Specification (SMETS 2) for ensuring meters are capable of providing customers with near real-time information on their energy usage and storing up to 24 months of consumption data as well as up to 3 months of half hourly export data. In addition, for the purposes of implementing Articles 9(2)(d) and 10(2)(b) of the Directive 2012/27/EU the Government introduced licence conditions in spring 2014 to ensure that if domestic customers request metering data on their electricity export and/ or electricity/ gas consumption, it will be made available to them by their supplier.

2.4 Side effects of politics

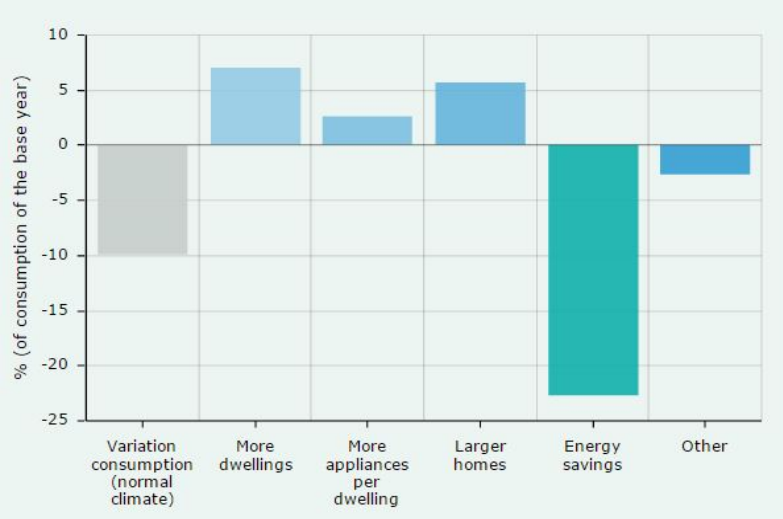
One of the strongest assumption behind improvements of energy efficiency indicates that increasing energy efficiency naturally and automatically leads to reductions in energy consumption or that efficiency is by far the dominant determinant. However, empirical studies consistently indicate that increases in energy efficiency do not regularly lead to one-to-one reductions in energy consumption (Galvin, 2014). In fact, policies designed to reduce energy consumption through energy efficiency measures in the residential sector are typically based upon engineering calculations, which differ significantly from outcomes observed in practice. A widely acknowledged explanation for this gap between expected and realized energy savings is household behavior, as energy efficiency gains alter the perceived cost of comfort and may thereby generate shifts in consumption patterns – a rebound effect (Aydin et al., 2015).

Over the period 2000-2012, even though energy efficiency in the residential sector increased by 22.7%, the final energy consumption of households at normal climate decreased of only the 9.9% in UK. According to Odyssee, the variation of the final energy consumption of households at normal climate is influenced by:

- Change in number of occupied dwelling (more dwellings);
- More appliances per dwelling (electrical appliances, central heating);
- Change in floor area of dwelling for space heating (larger homes);
- Energy savings, as measured from ODEX;
- Other effects (mainly change in heating behaviors).

Figure 6 shows the contribution of each variable to the overall variation of household energy consumption.

Figure 6. Variation households consumption - UK- % (2000-2012)



Source: Odyssee

In particular, 'more dwellings' means the demographic effect due to the increasing number of dwellings is calculated as the variation in the number of dwellings multiplied by the energy consumption per dwelling (with climatic corrections). From 2000 to 2012 it increased by 7.1% (in the EU it increased of 12.2%).

The demographic effect is: $\mathrm{DEH}_{t/t-1} = \Delta\mathrm{nbrlpr}_{t/t-1} * \mathrm{CU}_{t-1}$

Where, *nbrlpr* is the number of permantly occupied dwellings, and *CU* is the energy consumption per dwelling with climatic corrections.

Two lifestyle effects may also influence the energy consumption of households: the increase in the household equipment ownership (electrical appliances and central heating) and in the increasing size of dwellings (i.e. larger homes).

The increasing number of equipment per households is due on one hand to the increasing number of electrical appliances (ICT, small electrical appliances, air conditioning in Southern countries), larger homes which requires more energy and central heating which requires around 25% more energy compared to single room heating.

The increasing number of electrical appliances is approximated with the electricity consumption of large appliance (refrigerators, freezers, TV, washing machine, dish washers) per dwelling in relation with the overall index for electrical appliances (based on the evolution of the electricity consumption per appliances weighted by their energy share). The 'central heating' effect is calculated as a ratio between the unit consumption per $\mathbf{m^2}$ (with climatic corrections) and the unit consumption per equivalent dwelling (with climatic corrections).

In the period under investigation (2000-2012), the indicator 'more appliance per dwellings' showed an increase of 2.6%, in line with the EU average.

The indicator 'larger homes' that shows a change in floor area of dwelling for space heating, increased of 5.7% from 2000-2012 (in the EU it increased of 5%), while 'energy savings' increased of 22.7% (in the EU it increased of 19.5%).

Energy savings are based on ODEX, expressed in Mtoe.

$$ESI = Ct * \left(\left(\frac{ODEX\,t}{ODEX\,t-1} \right) - 1 \right)$$

For ODEX, the following indicators are considered to measure efficiency progress:

- Heating: unit consumption per $\mathbf{m^2}$ at normal climate (koe/$\mathbf{m^2}$)
- Water heating: unit consumption per dwelling with water heating
- Cooking: unit consumption per dwelling
- Large electrical appliances: specific electricity consumption, in kWh/year/appliance

In conclusion, the 22.7% of energy efficiency progress in the residential sector between 2000 and 2012, corresponding to 10.26 Mtoe, have been offset by more dwellings (demographic effect), more appliances per dwelling and larger homes.

3. Private sector support complementing public policies

3.1 Energy Performance Certificates (EPCs)

The Energy Performance of Buildings Directive (Directive 2002/91/EC) introduced energy labelling for both domestic and non-domestic properties when they are built, sold or rented. Energy Performance Certificates (EPCs) were introduced progressively for different types of buildings in the UK (1st of June 2007 for residential marketed sales). By requiring all homes put on the market to have an energy rating (from A to G), EPCs give all buyers and renters of homes transparent, accurate information on the energy running costs of their homes and practical advice on how to improve it. This helps them to cut their fuel bills and their carbon emissions. For domestic dwellings, EPCs apply to new buildings and the sale and rent of existing buildings.

Following the recast of the Energy Performance of Buildings Directive, the Energy Performance of Buildings (England and Wales) Regulations 2012 took effect on the 9th of January 2013 and the regulations revoke the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007 and all the many amending regulations from 2007 to 2012. A revised version of the domestic EPC was launched in April 2012; it has been redesigned and made more consumer-friendly.

By law, EPCs can only be produced by an accredited Energy Assessor. The accreditation schemes protect builders, owners, landlords and tenants by making sure Energy Assessors have the appropriate skills to carry out energy assessments, and that EPCs are always of the same high quality.

Providers of EPCs are often known as Energy Service Companies, or ESCOs.

The Carbon Trust has developed the following summary of the most common types of energy performance contracts:

- Guaranteed savings: This is the most common EPC structure in the UK, in which the ESCO guarantees to deliver the customer with a minimum level of savings. If the total savings are less, the ESCO pays the difference.
- Shared savings: The customer and the contractor agree to share the savings over the contract period according to an agreed formula.
- DBOOT (Design-Build-Own-Operate-Transfer) contracts: The ESCO designs, builds, funds, owns and operates the scheme for a defined period of time and then transfers this ownership across to the customer. Customers enter into long term supply contracts with the ESCO and are charged accordingly for the service delivered.
- Chauffage contracts: The ESCO takes complete responsibility for the provision of energy services and energy. Effectively the contractor takes responsibility for the operation of a customer's utility or production facilities as well as upgrading them, and often for paying the customer's utility bills. The fee paid by the client is calculated on the basis of its existing energy bill, minus an agreed percentage (e.g. 5-10%).
- First-out contracts: The ESCO pays for and installs an energy efficiency upgrade, then takes all the savings until it has recovered its costs. Once these costs are paid, the contract terminates and on-going savings revert to the customer.

3.2 Energy Service Companies (ESCOs)

The United Kingdom is one of the most developed ESCO markets in Europe. There are about 30-50 energy service companies active on the UK market: among these, Alpheon Energy, Cantium Energy, Cofely (GDF Suez - formerly Cofathec and Elyo), Cogenco, Dalkia (Mitie), EdF, E.ON Energy Services, ENER-G, Fontenergy, Galliford Try, Greenrock, GSH Group, Honeywell, Johnson Controls, Lorne Stewart, Maicon, MCL Energy, Norland, Schneider Electric, Scottish Power, Self Energy UK, Thameswey Energy, Utilicom (bought by Cofely / GDF, from Idex), Vital Energi.

The major players are large international manufacturers of building automation & control systems, as well as energy service and supply companies. Facility management companies are also part of the more dominant part of the market. A growing number of construction and property companies, smaller consultancies and dedicated ESCO firms started to populate the market in recent years.

There are various trade associations in the UK, some of which incorporate ESCOs. The Energy Services and Technology Association (ESTA) is the most known ESCO representative, which collects companies on the demand side energy efficiency of buildings, building services and process services, thus including ESCOs.

The Energy Managers Association (EMA) is also active in helping to cultivate a growing ESCO market. It represents individuals and companies of energy managers, provides trainings and conferences, raises awareness and knowledge and develops guidelines.

3.3 Banks

An important stimulus for ESCOs could be the Green Investment Bank (created in 2012).

The UK Green Investment Bank (GIB) is the world's first investment bank dedicated to greening the economy. With government funding of £3.8 billion, the GIB invests in innovative, environmentally-friendly areas for which there is a lack of support from private markets. This includes offshore wind power generation, waste-handling plants, energy efficiency measures, biofuels, biomass, carbon capture and storage, marine energy and renewable heat generation.

4. Initiatives targeting households behavior

The Energy Saving Trust (EST) is the UK's leading impartial organisation helping people save energy and reduce carbon emissions. It provides support for household energy efficiency activities; it promotes energy efficiency across the household sector in the UK though advertising programmes, advice centres and the endorsement of energy efficient products. EST has offices in England, Scotland, Northern Ireland and Wales and its aim is to cut emissions of carbon dioxide by promoting the sustainable and efficient use of energy and they act as a bridge between consumers, government, trade, businesses, third sector organisations, local authorities, and the energy market.

EST provides energy saving advice with the information householders need to make informed decisions about managing the energy efficiency of their homes:

- Renewables;
- Home Insulation;
- Heating and hot water;
- Home appliances;
- Utilities: information on switching;
- Saving water;
- Energy efficient lighting;
- Energy efficient windows
- Smart meters & controls.

From simple top tips to more detailed information, they offer impartial advice to over three and a half million people each year. They do this by:

- Delivering or managing government programmes;
- Testing low-carbon technology;
- Certification and assurance for businesses and consumer goods;
- Developing models and tools.

In the last years, the Energy Saving Trust has been involved in many initiatives concerning energy efficiency, renewable energy and clean fuels – such as Energy Saving Advice Service, Green Deal Certification Pilots, Energy Saving Trust Recommended product certification scheme, Home Insulation Scheme (Scotland), Energy Assistance Package (Scotland), etc. – and it has supported many different schemes and campaigns – such as Sustainable Energy Network (SEN), on-line Home Energy Checks, Save Your 20%, Energy Saving Recommended label, GoGreener, etc.

One of the major project in Great Britain testing how consumers react to improved information about their energy consumption over the long term, has been the Energy Demand Research Project (EDRP). EDRP was launched in July 2007 and finished towards the end of 2010. It has been managed by Ofgem on behalf of DECC.

The EDRP trailed a range of methods of providing customers with improved feedback on their energy consumption, including:

- Smart electricity and gas meters;
- Real-time display devices, which show energy use in pounds and pence;
- More accurate and more frequent bills;
- Energy saving information;
- Community engagement.

The trials were made up of different combinations of these actions and explored the responses of over 60.000 different households and the installation of 18.000 smart meters. Four energy suppliers ran the trials: EDF Energy Customers Plc, E.ON UK Plc, Scottish Power Energy Retail Ltd and SSE Energy Supply Ltd (EDF, E.ON, Scottish Power and SSE). The Government allocated £9.75 million to the trials, match-funded by the energy suppliers taking part.

The interventions were primarily directed at reducing domestic energy consumption, with a minority focused on shifting energy use away from periods of peak demand. The measures were generally applied at household level, but one supplier also tested action at community level. The findings are as follows:

- Interventions using smart meters were often successful and resulted in larger energy savings compared to other measures.
- Electricity savings can be promoted through provision of advice and historical feedback on consumption but they cannot be relied upon individually; a combination with a direct feedback measure is likely to have higher benefits.
- The delivery of information through the Web or customers' TVs was not successful.
- Community engagement can also be effective, but may require a higher initial investment and will not necessarily work in all localities.
- Financial incentives and commitment to reduce consumption had either no effect or a very short-term effect.
- The provision of a Real-Time Display (RTD) was particularly important in achieving savings in electricity consumption.
- The combination of smart meters and RTDs consistently resulted in energy savings of around 3% on average. Providing an RTD with a smart meter is important: savings were generally 2% to 4% higher than with a smart meter only.

The project also highlighted that support from the equipment installers may be particularly important for users to learn how to operate the devices in an optimal way. Furthermore, customer surveys on RTDs showed that cost information was used and valued more than unit (kW) information, and electricity information more than gas. Displays of CO_2 emissions were generally not widely noticed, used, or perceived as useful.

Programmes that could lead to long-term behaviour change through the introduction of new, pro-environmental social norms are the community-based initiatives. Within these programmes, participants benefit from a relevant frame of reference for their behaviour. They encourage households to participate toward community-level savings goals, or as part of a community through social marketing and social norms or encouragement.

The benefits of putting communities at the heart of energy policy are underlined by literature (Darby, 2006; Fischer, 2008; Fuller et al., 2010) and by the report ‘Community Energy Strategy’ (Department of Energy & Climate Change 2015) which set out how communities should change the way they think and act on energy. According to this report, the implementation of the strategy can help underpin the diversification of the current centralised energy system to a much more distributed approach, whereby local people have more control of and a stake in how energy is generated and supplied, and how their community’s energy demand can be managed and reduced.

Similar guidelines emerged from the report undertaken by RAND Europe in 2012, entitled “What Works in Changing Energy-Using Behaviours in the Home?", commissioned by the UK Department of Energy & Climate Change (2012) and aimed at understanding which interventions designed to change energy use behaviour in the home are the most successful. The report, which is drawn from 48 selected behaviour change programmes, examined the evidence from the published literature on the effectiveness of two different innovative approaches - such as the provision of Home Energy

Reports that compare households' consumption with their neighbours - and more traditional approaches (including advertising campaigns) to encourage behaviour change in the reduction of home energy use.

A number of dimensions were assessed in each programme analysed: the level of energy savings achieved through the interventions, the behaviour change underlying the energy savings, the responses by different groups, the persistence of the behaviour change, the contextual factors that contributed to the outcomes of the interventions and the evidence on the cost-effectiveness of the different types of interventions.

The interventions studied in the report are diverse, involving different combinations of mechanisms to encourage change and often implemented in very different contexts. This diversity means that there is no single model for the 'best' intervention to encourage behaviour change in energy-using behaviours in the home.

What is clear from the evidence is that two broad classes of interventions have been undertaken to date: broad universal initiatives, such as Home Energy Reports, which have been rolled out across large segments of the population and tend to save between 1% and 3% of energy consumption per household, and small-scale targeted community-based programmes. Interventions that operate at the community or neighbourhood level do seem to be effective in influencing domestic energy use. However, there are challenges concerning the extent to which these might be scaled, as by design, they assist households and neighbourhoods in a tailored manner.

It would seem that the key to maximizing returns could be to target the programmes better at the groups that have the scope to make the greatest savings. Although the evidence is limited, it suggests that among these target groups should be those that currently have the highest levels of energy.

However, from the evidence included in this review, it seems that large reductions in household energy use are unlikely to be achieved from interventions designed to change habitual behaviour alone. In fact, there is evidence that suggests that there is potential for larger energy savings if technical/infrastructural and behavioural interventions are applied in combination; this is an area where there may be a window of opportunity for aligning behaviour change interventions with programmes seeking to encourage investment in energy-saving infrastructure improvements.

References

Aydin, E., Kok, N., Brounen, D. (2015). Energy Efficiency and Household Behavior: The Rebound Effect in the Residential Sector.

Carbon Plan, DECC, originally published in December 2011 and most recently updated in April 2013.

Climate Change Act 2008. www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

Code for Sustainable Homes. A step-change in sustainable home building practice. December 2006, Department for Communities and Local Government: London.

Community Energy Strategy: Full Report. Department of Energy & Climate Change, January 2014.

Darby, S. (2006). The effectiveness of feedback on energy consumption. Environmental Change Institute, Oxford University.

Department of Energy & Climate Change (2012).What Works in Changing Energy-Using Behaviours in the Home? - A rapid evidence assessment. RAND Europe, final report.

Department of Energy & Climate Change (2015). Community Energy Strategy Update. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414446/CESU_FINAL.pdf

ECO final report 2015 – Ofgem.

Energy Demand Research Project: Final Analysis. Ofgem, June 2011.

Energy Efficiency Strategy, DECC, November 2012 and Energy Efficiency Strategy 2013 Update, DECC, December 2013.

Fisher, J., Irvine, K. (2010). Reducing household energy use and carbon emissions: the potential for promoting significant and durable changes through group participation, Paper presented at the IESD PhD Conference: Energy and Sustainable Development, Leicester, United Kingdom.

Fischer, C. (2008). Feedback on household electricity consumption: a tool for saving energy? Energy Efficiency 1:79–104.

Fuller, M., Kunkel, C., Zimring, M., Hoffman, I., Soroye, K.L., Goldman, C. (2010). Driving Demand for Home Energy Improvements. LBNL-3960E.

Galvin, R. (2014). Estimating broad-brush rebound effects for household energy consumption in the EU 28 countries and Norway: some policy implications of Odyssee data. Energy Policy, 73, 323-332.

Public funding for innovation in low carbon technologies in the UK. National Audit Office, October 2013.

The Future of Heating, DECC, March 2012.

United Kingdom housing energy fact file 2013. Authors: Jason Palmer (CAR), Ian Cooper (Eclipse).

UK Government website. www.gov.uk/government/publications/2010-to-2015-government-policy-household-energy/2010-to-2015-government-policy-household-energy

UK National Energy Efficiency Action Plan. April 2014.