1. Introduction

This report provides information about the implementation of the EPBD in England. It supersedes the previous reports published in 2010, 2012 and 2016. The implementation of the EPBD in the other three UK jurisdictions (Wales, Scotland and Northern Ireland) is addressed in separate reports.

In the UK, some powers of the UK Parliament have been transferred to the Scottish Parliament, the National Assembly for Wales, the Northern Ireland Assembly and to their executive bodies the Scottish Government, the Welsh Government, the Northern Ireland Executive. References to “Government” in this England report should be read as the “UK Government”. References to the Scottish Government, the Welsh Government, and the Northern Ireland Executive have been included in their respective country report as appropriate.

The implementation of the EPBD in England is the responsibility of the Department for Communities and Local Government (DCLG). This report introduces the most recent requirements. It also addresses performance standards, certification and inspection systems, including quality control mechanisms, the training of Energy Assessors, information campaigns, incentives and subsidies. For more details please visit the referenced websites or contact the responsible institutions.
2. Current Status of Implementation of the EPBD

2.1. Energy performance requirements: NEW BUILDINGS

2.1.i. Progress and current status

Figures 1 and 2 show the simplified historical Building Regulations improvements in England for new residential and new non-residential buildings. Since 2010, energy standards for new buildings have been strengthened by over 30%. Energy requirements are set as net CO$_2$ emissions targets (kg CO$_2$/m$^2$.year) and primary energy is also reported. Each new building must have emissions below those of a reference building, which has the same geometry as the actual building, but with standard levels of insulation, systems efficiency, etc. Each type of energy (e.g., gas, electricity) has a different carbon intensity, expressed as kg CO$_2$/kWh, which reflects the amount of CO$_2$ emitted to deliver 1 kWh of energy to the building.

The graphs in Figures 1 and 2 are based on the 2006 Building Regulations (the reference) and historical improvements for 2010 and 2013. Following the 2015 elections, the UK Government announced$^2$ that it would not be following the previous Government’s zero carbon policies. The UK Government will keep energy standards under review. An assessment of cost effectiveness/cost optimality has commenced and will inform whether any strengthening of standards is required.

The 2013 Building Regulations set energy performance requirements for new and existing buildings (residential and non‐residential) and came into effect in April 2014. The 2013 regulations were strengthened to deliver improved CO$_2$ savings over the previous 2010 Building Regulations of:

- 6% across new residential buildings;
- 9% across new non-residential buildings.

Minor changes to the requirements for existing buildings were also introduced in 2013. There are no specific requirements for public buildings.

![Figure 1: New residential Building Regulations (England), historical improvements.](chart)

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$2$ UK Government announcement.
2.1.ii. Format of national transposition and implementation of existing regulations

Part L of the Building Regulations addresses energy efficiency and transposes some of the EPBD requirements. To support the implementation of the Building Regulations, “Approved Documents” (ADs) have been published. These ADs are adopted for most projects to demonstrate compliance with Building Regulations. The ADs are:

- AD L1A and AD L1B for new and existing residential buildings; and
- AD L2A and AD L2B for new and existing non‐residential buildings.

The ADs include references to guides such as Eurocodes (EN) and set out five criteria for new buildings, as detailed in Table 1:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>For all buildings: achieve a Target CO\textsubscript{2} Emission Rate. In addition, for residential buildings: achieve a Target Fabric Energy Efficiency, which reflects space heating and cooling demand in kWh/m\textsuperscript{2} year.</td>
</tr>
<tr>
<td>2</td>
<td>Meet design flexibility limits, including minimum fabric standards and building services efficiencies.</td>
</tr>
<tr>
<td>3</td>
<td>Limit heat gains in summer including the effect of shading devices.</td>
</tr>
<tr>
<td>4</td>
<td>Ensure the building performance is consistent with design calculations. Focus on air permeability, commissioning of services and thermal bridges.</td>
</tr>
<tr>
<td>5</td>
<td>Provide information for energy‐efficient building operation.</td>
</tr>
</tbody>
</table>

*Table 1: New buildings requirements, England*
Note that internal air quality is addressed under Part F of the Building Regulations: “Ventilation”.

Compliance, particularly with the first three criteria, is assessed using the National Calculation Methodology (NCM)\textsuperscript{5}. For new residential units, the NCM is the Standard Assessment Procedure (SAP)\textsuperscript{6}. An updated version (SAP 2012) was released in 2013 and encoded in privately-owned software tools. For new non-residential buildings, the NCM Modelling Guide was updated in 2013 and is encoded in both a Government-approved software tool (SBEM)\textsuperscript{7} and privately-owned software tools. Both NCMs use an Asset Rating approach, i.e., predicted energy consumption based on standardised thermal condition. These software tools are also used to produce EPCs on construction, sale and rent.

To support construction quality, the UK Government produced Approved Construction Details (ACDs)\textsuperscript{7}. Alternatively, construction details calculated by qualified professionals may also be used. ACDs focus on improving thermal bridging and airtightness. Airtightness testing is required for most new residential and non-residential buildings with some exemptions.

Building Regulations outputs are submitted to Building Control Bodies (BCBs)\textsuperscript{8} for checking. Statistics on compliance, enforcement and penalties are not kept in England. “Competent Persons”, who are registered with a Government-approved Competent Person Scheme\textsuperscript{8}, are allowed to self-certify that their work complies with Building Regulations as an alternative to a BCBs submission.

**Cost-optimal assessment of energy performance requirements**

A UK-wide cost-optimal report was published in May 2013. The report compares Building Regulations\textsuperscript{10} (current at the time) in each UK jurisdiction to the calculated cost-optimal levels.

**Residential buildings**

For new residential buildings, two reference building types were considered representative of developments in the UK: semi-detached (single-family house) and mid-floor apartment. For existing buildings, the same two reference building types were adopted and modelled with the two most common wall construction types: uninsulated cavity wall and uninsulated solid wall. For new buildings, potential measures were grouped into packages representing three different components of a building design: fabric, heating and renewable energy (photovoltaics). A hundred and twenty (120) alternatives were considered for each reference building. For existing buildings, each measure was assessed individually. Primary energy was calculated for each package/measure using the NCM. Costs were calculated for each model to identify cost-optimal levels which were then compared to standards (current at the time) in each jurisdiction (Tables 2 and 3).

> **New residential buildings** – The results show that standards were on average 16 to 23% more energy efficient than the cost-optimal level.

Table 2: New residential buildings. Comparison of cost-optimal levels to current requirements for England and Northern Ireland.
**Table 2: New residential buildings. Comparison of cost-optimal levels to current requirements for England and Northern Ireland.**

<table>
<thead>
<tr>
<th>Reference building</th>
<th>Cost-optimal level (kWh/m².year)</th>
<th>Current requirements (kWh/m².year)</th>
<th>Gap (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-detached</td>
<td>141</td>
<td>117</td>
<td>+16%</td>
</tr>
<tr>
<td>Mid-floor apartment</td>
<td>116</td>
<td>99</td>
<td>better than cost-optimal</td>
</tr>
</tbody>
</table>

> **Existing residential buildings** – In all cases, the standards meet or improve upon cost-optimal levels.

**Table 3: Existing residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland**

<table>
<thead>
<tr>
<th>Reference building (averages)</th>
<th>Cost-optimal level</th>
<th>Current requirements</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavity walls</td>
<td>U=0.55 W/m².K</td>
<td>U=0.55 W/m².K</td>
<td>cost-optimal</td>
</tr>
<tr>
<td>Solid walls</td>
<td>U=0.4 W/m².K</td>
<td>U=0.30 W/m².K</td>
<td>+25% better than cost-optimal</td>
</tr>
<tr>
<td>Windows</td>
<td>U=1.6 W/m².K</td>
<td>U=1.6 W/m².K</td>
<td>cost-optimal</td>
</tr>
<tr>
<td>Roof</td>
<td>U=0.20 W/m².K</td>
<td>U=0.18 W/m².K</td>
<td>cost-optimal</td>
</tr>
<tr>
<td>Heating</td>
<td>88% (gas boiler)</td>
<td>88% (gas boiler)</td>
<td>cost-optimal</td>
</tr>
</tbody>
</table>

**Non-residential buildings**

For new non-residential buildings, seven reference buildings (representative of the building stock) were selected: office (natural ventilation and air-conditioning), education, hotel/restaurant, retail, distribution warehouse, and hospital/healthcare. A construction type (cavity wall or steel frames) was selected for each reference building. For existing buildings, two reference buildings were considered for each of the seven building types: a low and a high energy efficiency building based on benchmark data. A similar approach was adopted for measures and packages as for residential buildings. For new buildings, packages represent four different components of a building: fabric, services, heating and renewable energy (photovoltaics), therefore selecting one package from each component forms a complete building design. A total of 225 packages were considered for each reference building. For existing buildings, common renovation and replacement measures with significant impact on energy use were selected. As for residential buildings, primary energy was calculated using the NCM. Costs were calculated for each model to identify cost-optimal levels which were then compared to standards (current at the time) in each jurisdiction (Tables 4 and 5).
New non-residential buildings – In four building sectors, the reference standards were more energy efficient than the cost-optimal levels: air-conditioned office, naturally ventilated office, secondary school, and hospital. Reference standards in three sectors were below cost-optimal levels (air-conditioned hotel, distribution warehouse, air-conditioned retail warehouse). On average across all sectors, standards were 4 to 7% lower than cost-optimal levels. These standards have since been strengthened.

<table>
<thead>
<tr>
<th>Reference building</th>
<th>Cost-optimal Level (kWh/m².year)</th>
<th>Current requirements (kWh/m².year)</th>
<th>Gap (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office (air-conditioned)</td>
<td>163</td>
<td>155</td>
<td>-4% worse than cost-optimal</td>
</tr>
<tr>
<td>Office (naturally ventilated)</td>
<td>89</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Secondary school</td>
<td>143</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td>279</td>
<td>246</td>
<td></td>
</tr>
<tr>
<td>Hotel (air-conditioned)</td>
<td>419</td>
<td>487</td>
<td></td>
</tr>
<tr>
<td>Distribution warehouse</td>
<td>131</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Retail warehouse (air-conditioned)</td>
<td>193</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>202</td>
<td>211</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: New non-residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland.

Existing non-residential buildings – On average across all building sectors, the standards were below cost-optimal levels for walls, floors, windows, lighting, chillers, and air handling units. These standards have since been strengthened. The roof and heating standards met or improved upon cost-optimal levels.
### Implementation of the EPBD in the United Kingdom – England

#### Status in December 2016

<table>
<thead>
<tr>
<th>Reference building (averages)</th>
<th>Cost-optimal level</th>
<th>Current requirement</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavity walls</td>
<td>U=0.30 W/m².K</td>
<td>U=0.55 W/m².K</td>
<td>-83% worse than cost-optimal</td>
</tr>
<tr>
<td>Other walls</td>
<td>U=0.20 W/m².K</td>
<td>U=0.30 W/m².K</td>
<td>-50% worse than cost-optimal</td>
</tr>
<tr>
<td>Roof</td>
<td>U=0.24 W/m².K</td>
<td>U=0.18 W/m².K</td>
<td>+25% better than cost-optimal</td>
</tr>
<tr>
<td>Heating</td>
<td>84% (gas boiler)</td>
<td>84%</td>
<td>cost-optimal</td>
</tr>
<tr>
<td>Floor</td>
<td>U=0.22 W/m².K</td>
<td>U=0.25 W/m².K</td>
<td>-14% worse than cost-optimal</td>
</tr>
<tr>
<td>Windows</td>
<td>U=1.64 W/m².K</td>
<td>U=1.8 W/m².K</td>
<td>-10% worse than cost-optimal</td>
</tr>
<tr>
<td>Lighting</td>
<td>U=1.64 W/m².K</td>
<td>55 lm/W</td>
<td>-10% worse than cost-optimal</td>
</tr>
<tr>
<td>Chiller</td>
<td>3.9</td>
<td>3.5</td>
<td>-10% worse than cost-optimal</td>
</tr>
</tbody>
</table>

Table 5: Existing non-residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland.

### 2.I.iii. Action plan for progression to NZEB

The 2012 UK national plan “Increasing the number of Nearly Zero-Energy Buildings”\(^{11}\) covers all four UK jurisdictions. The plan was submitted to the European Commission and confirms the UK’s legally binding commitment (under the Climate Change Act 2008) to reduce greenhouse gas emissions by at least 34% by 2020 and 80% by 2050. To meet these targets, the emissions footprint of buildings will need to be almost zero, which will mainly be achieved through:

- reducing the energy demand in buildings;
- decarbonising the heating and cooling supply.

The UK has made successive improvements in new-build energy standards through changes to the Building Regulations in each jurisdiction (Figures 1 and 2).

England had a target for all new homes to be zero-carbon from 2016, and an ambition for all new non-residential buildings to be zero-carbon from 2019 (2018 for new public sector buildings). In 2015, the UK-Government announced that it would not be following the previous Government’s zero carbon policies. The Government will keep energy standards under review. A cost-effectiveness/cost-optimality assessment has commenced and will inform whether any strengthening of energy standards is required. The cost-optimal assessment calculated in accordance with Article 5 of the EPBD will also help define NZEB requirements for new buildings from 2021.

NZEB statistics are not maintained in England. Figure 3 shows historical EPC records for classes A and A+. The graph shows a steady increase for non-residential buildings, and a sharp drop in 2016 for residential buildings. Note that new building construction rates also affect these data.
2.1.iv. Requirements for systems and/or building components

Coverage of heating, domestic hot water, air-conditioning and large ventilation systems

The ADs reference the Domestic and Non-domestic Building Services Compliance Guides\textsuperscript{iv} which set out minimum energy efficiency standards for fixed building services systems, including:

- space heating;
- domestic hot water;
- mechanical ventilation;
- comfort cooling;
- internal and external lighting;
- low carbon generation of heat by heat-pumps, solar thermal panels, and combined heat & power.

Table 6 shows a summary of minimum standards for residential buildings as an example.
<table>
<thead>
<tr>
<th>Building Services Type</th>
<th>Recommended minimum energy efficiency standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas-fired wet central heating: condensing boiler</td>
<td>Seasonal Efficiency of Domestic Boilers in the UK (SEDBUK 2009): 88%</td>
</tr>
<tr>
<td>Solid fuel heating: independent boiler – wood/ pellets/ chips</td>
<td>75% nominal load 70% part load</td>
</tr>
<tr>
<td>Oil-fired wet central heating: condensing regular boiler</td>
<td>Seasonal efficiency (SEDBUK 2009): 88%</td>
</tr>
<tr>
<td>Heat pump – electrically driven (not air to air): space heating</td>
<td>For new buildings: coefficient of performance 2.5 at rating conditions in EN 14511</td>
</tr>
<tr>
<td>Heat pump – electrically driven (not air to air): domestic hot water</td>
<td>For new buildings: coefficient of performance 2.0 at rating conditions in EN 14511</td>
</tr>
<tr>
<td>Mechanical ventilation: continuous supply and extract with heat recovery</td>
<td>Specific fan power (W/(l.s)): 1.5</td>
</tr>
<tr>
<td>Heat recovery: balanced mechanical ventilation systems</td>
<td>Dry heat recovery efficiency: 70%</td>
</tr>
<tr>
<td>Fixed lighting: internal light fittings</td>
<td>Lighting efficacy: 45 lamp lumens per circuit-watt</td>
</tr>
<tr>
<td>Comfort cooling: water-cooled air-conditioners working in cooling mode</td>
<td>Energy efficiency ratio: 2.5</td>
</tr>
</tbody>
</table>


The ADs (for new buildings) include detailed specifications for the “reference building” from which the Target CO₂ Emission Rate is derived. The “reference building” provides typical specifications for the actual building design. Standards higher than the minimum (Table 6) may be required to satisfy Building Regulations for new buildings.

2.1.v. Regulation of system performance, distinct from product or whole building performance

The commissioning of fixed technical building systems is required by Building Regulations to ensure the actual building performance is as consistent as possible with design intentions. The ADs reference the Domestic and Non-domestic Building Services Compliance Guides, and industry guidance. Typically, the guides recommend following manufacturer’s instructions, and include information such as the qualifications/accreditation required for commissioning experts.

The non-residential ADs also reference Soft Landings, a voluntary approach to address the performance gap between design intentions and operational outcomes. The Government Soft Landings policy was to be mandated in 2016, and it is the responsibility of each Central Government Department to implement it.
Implementing the Energy Performance of Buildings Directive

2.I.vi. Encouragement of intelligent metering

Metering requirements are included in the ADs for new and existing non-residential buildings. The aim is to enable occupiers to meter at least 90% of the estimated annual energy consumption and to assign energy to the various end uses. The ADs reference industry best practice for meters installation. Automatic meter reading and data collection must be provided in new non-residential buildings greater than 1,000 m².

There are no metering provisions for new and existing residential units. Instead, the Government aims for all homes to be offered smart meters by the end of 2020. Energy suppliers are responsible for replacing over 53 million gas and electricity meters in the UK.

2.I.vii. Encouragement of active energy saving control (automation, control and monitoring)

Effective control of technical building systems are included in the Domestic and Non-Domestic Building Services Compliance Guides, the ADs, and the Building Regulations. The NCM also provides additional benefits for more effective controls.

The new ADs for non-residential buildings include benefits for installing automatic monitoring of the building’s energy performance and power factor correction equipment. E.g., the calculated Building Emission Rate (BER) may be reduced where management features are provided, which helps the new building to meet the maximum Target Emission Rate (TER). For “automatic monitoring and targeting with alarms for out of range values” the BER may be reduced by 5%.

2.II. Energy performance requirements: EXISTING BUILDINGS

The UK National Energy Efficiency Action Plan gives an overview of the UK building stock. Figures 14 and 15 illustrate data from the EPC register, therefore they are not fully representative of the building stock.

The UK has 27 million homes, of which 22.1 million are located in England. Figure 4 shows the distribution of about 14.5 million residential EPCs in England. Buildings with no EPCs are not represented.

There are >1.8 million non-residential premises in the UK. Figure 5 shows the distribution of >0.5 million non-residential EPCs in the UK. Buildings with no EPCs are not represented.
2.II.i. Progress and current status of existing buildings

Building regulations are supported by AD L1B and AD L2B for existing residential and existing non-residential buildings respectively\(^{17}\), which set out an elemental approach for existing buildings, and Domestic and Non-domestic Building Services Compliance Guides which include minimum energy efficiency standards for new and replacement of existing building systems.
Under certain circumstances (typically where the liveable building area is extended or where the capacity of building services is increased), additional energy efficiency measures (named “consequential improvements”) must be undertaken. These requirements only apply to large, existing residential and non-residential buildings (greater than 1,000 m\(^2\)) and can include improvements to the performance of the building fabric and/or services where technically, functionally or economically feasible.

2.II.ii. Plans to improve the existing building stock

The Department for Business, Energy & Industrial Strategy (BEIS) is responsible for the transposition of the EED, which is mostly implemented on a UK-wide basis with some jurisdiction-specific exceptions.

The UK National Energy Efficiency Action Plan\(^{xvi}\) includes a Building Renovation Strategy in compliance with EED Article 4. The strategy references existing measures, e.g., the Energy Company Obligation (helping households insulate homes), the Green Investment Bank (connecting private finance with demand for energy efficiency measures), Salix (improving energy efficiency in public sector organisations) and RE:FIT (financing modernisation of public sector buildings), smart meters for households and small businesses, and the residential Renewable Heat Incentive (transforming the way homes are heated).

The UK is implementing the alternative approach under Article 5(6) and notified the Commission of the alternative measures adopted to achieve an equivalent improvement in the energy performance of Government buildings. The National Energy Efficiency Action Plan confirms the main policies and measures used to meet the target: the Greening Government Commitments (GGC) for Central Government in England, and separate initiatives in Scotland, Wales and Northern Ireland. The measures include behavioural change, facilities management, estate management, and energy efficient technology. The GGC are expected to deliver 516.6 GWh savings by 2020, exceeding the 163.6 GWh target for equivalence.

2.II.iii. Regulation of system performance, distinct from whole building performance

As per new buildings. See details above.

2.II.iv. Encouragement of intelligent metering

As per new buildings. See details above.

2.II.v. Financial instruments and incentives for existing buildings


2.II.vi. Information campaigns / complementary policies

A communication campaign, across multiple media including television, to promote the installation of smart meters in residential buildings is ongoing, (Figure 6). More information at [www.smartenergygb.org](http://www.smartenergygb.org)


2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Overview and administration system
The systems in place are identical across all building sectors. The UK Government has licensed Accreditation Schemes which are permitted to accredit qualified/trained Energy Assessors for producing regulatory outputs in compliance with the Energy Performance of Buildings Regulations. Licenses are under regular review and may be revoked. In December 2016, seven Accreditation Schemes were licensed.

Accredited Energy Assessors must use Government-approved software tools to produce regulatory outputs such as EPCs, recommendations reports, AC inspection reports, etc. Regulatory outputs are recorded on a register (which covers England and Wales) and are publicly available.
Format and content of the EPC

Residential

The EPC provides a calculated energy rating (asset rating) of the current and potential energy efficiency of the building on an A to G scale (Figure 7). The current rating is based on the characteristics of the building, a standardised occupancy profile, and the energy consumption cost. The potential rating shows the effect of undertaking the EPC’s recommendations. The average EPC for a residential unit in England & Wales is D, rating 60. Typically, the lowest rating for a new building would be C.

In 2012, the format of the EPC was revised based on consumer research. The revised residential EPC is shorter, uses plain English and has an improved design. It focuses on potential costs and savings. The first page of a residential EPC is shown in Figure 8.
The EPC includes: an environmental impact rating in terms of CO₂ emissions and a list of cost-effective recommendations. It indicates the potential energy efficiency and environmental impact ratings if all cost-effective measures were installed. For new buildings, the current and potential ratings may be identical.

Non-residential
Energy performance is shown as a CO₂-based asset rating against an A to G scale (Figure 9). The EPC includes two benchmarks: the energy rating if the property were new, and the energy rating if it were typical of the existing stock (Figure 10). Standard cost-effective recommendations are generated by the EPC software. Appropriate recommendations are selected by the assessor for inclusion in the Recommendations Report. Bespoke recommendations may also be provided, based on the assessor’s knowledge.
Implementing the Energy Performance of Buildings Directive

Figure 9: First page of a non-residential EPC.

Figure 10: Non-residential EPC benchmarks.

EPC activity levels

Calculated EPCs are produced for buildings on construction, sale and rent, and are valid for 10 years. All EPCs become valid after they are recorded on the register. The register contains ~14.5 million EPCs (including cancelled, “not for issue” and multiple EPCs on a single property) and is growing by ~1 million/year, which represents a valuable source of information as they cover an increasingly larger proportion of the ~27 million UK homes.
Most EPCs on the register are publicly accessible through an address search, unless the building owner opted out. All EPCs on the register are accessible through a unique reference number search. EPCs statistics are also available on the register. Government provides statistics on EPC activity in England & Wales\textsuperscript{19}. Data from 2008 to December 2016 is included in Tables 7 and 8, Figures 11 and 12.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|c|c|c|c|}
\hline
 & Total EPCs & A & B & C & D & E & F & \textcolor{green}{G} & not recorded \\
\hline
Total & 14,453,300 & 18,870 & 1,341,588 & 3,658,620 & 5,679,040 & 2,618,580 & 725,009 & 210,705 & 388 \\
Percentage & 100\% & 0.1\% & 9.3\% & 26.7\% & 39.3\% & 18.1\% & 5.0\% & 1.5\% & 0.0\% \\
\hline
\end{tabular}
\caption{Residential EPCs, 2008 to December 2016, England.}
\label{tab:epcs_data}
\end{table}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{epcs_data.png}
\caption{Residential EPCs, 2008 to December 2016, England. Percentages by EPC band.}
\label{fig:epcs_data}
\end{figure}
### Table 8: Non-residential EPCs, 2008 to December 2016, England.

*“not recorded” = faulty EPC (cancelled, withdrawn, etc.)*

<table>
<thead>
<tr>
<th></th>
<th>Total EPCs</th>
<th>A+</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>not recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>643,475</td>
<td>365</td>
<td>7,167</td>
<td>50,013</td>
<td>171,427</td>
<td>194,882</td>
<td>106,671</td>
<td>51,093</td>
<td>61,627</td>
<td>230</td>
</tr>
<tr>
<td>Percentage</td>
<td>100%</td>
<td>0.1%</td>
<td>1.1%</td>
<td>7.8%</td>
<td>26.6%</td>
<td>30.3%</td>
<td>16.0%</td>
<td>7.9%</td>
<td>9.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

![Figure 12: Non-residential EPCs, 2008 to December 2016, England. Percentages by EPC band.](image)

Selected organisations have access to limited bulk data to protect consumers and there is a charge for this service. Benefits of allowing access to this data include supporting other Government energy efficiency programmes and facilitating research and analysis to inform policies.

### Typical EPC costs

EPC costs vary significantly. Indicative lowest costs based on internet search:

- for residential EPCs: £35 to £60 (~€41 to 70 €);
- for non-residential EPCs: £129 to £150 (~€150 to 174 €).

These costs include the registration fee payable each time an EPC is recorded on the register which range from £1.30 (~€2 €) to £9.73 (~€11 €).
Assessor corps

National Occupational Standards (NOS) specify the qualifications and skills, which Energy Assessors should meet to be accredited to produce regulatory outputs. Different accreditations are available (Table 9) depending on the building type, the complexity of the building software to be used, and the type of regulatory outputs to be produced. Accreditation Schemes ensure accredited assessors satisfy the NOS requirements through training and examination, or by demonstrating suitable experience.

<table>
<thead>
<tr>
<th>Assessor types</th>
<th>Assessor numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential EPCs (existing buildings) RdSAP</td>
<td>58,982</td>
</tr>
<tr>
<td>Residential EPCs (new buildings) SAP</td>
<td>4,427</td>
</tr>
<tr>
<td>Non-residential EPCs (level 3)</td>
<td>9,205</td>
</tr>
<tr>
<td>Non-residential EPCs (level 4)</td>
<td>5,987</td>
</tr>
<tr>
<td>Non-residential EPCs (level 5)</td>
<td>745</td>
</tr>
<tr>
<td>Display Energy Certificate (DEC)</td>
<td>3,331</td>
</tr>
<tr>
<td>AC inspection (level 3, simple)</td>
<td>1,941</td>
</tr>
<tr>
<td>AC Inspection (level 4, complex)</td>
<td>1,620</td>
</tr>
<tr>
<td><strong>Total Assessors</strong></td>
<td><strong>86,238</strong></td>
</tr>
</tbody>
</table>

**Notes**
- RdSAP: Reduced Standard Assessment Procedure
- SAP: Standard Assessment Procedure
- EPC: Energy Performance Certificate
- DEC: Display Energy Certificate
- AC: Air-Conditioning
- EPC level 3: simple non-residential buildings
- EPC level 4: medium complexity non-residential buildings
- EPC level 5: complex non-residential buildings
- AC level 3: simple packaged AC
- AC level 4: complex central AC

*Table 9: Energy assessor types and numbers notified to the England & Wales register.*

The NOS apply across England & Wales, therefore accredited Energy Assessors can operate in both jurisdictions. Minimum Continuous Professional Development (CPD) requirements apply, e.g., non-residential level 5 assessors must complete 7.5 hours/year. Penalties for not meeting the CPD requirement include temporary expulsion from the Accreditation Scheme, which prevents the assessor from producing EPCs.

**2.III.ii. Quality Assessment of EPCs**

**Quality assurance of EPCs**

The UK Government introduced Scheme Operating Requirements (SORs) in 2010 with an update in 2012 to ensure all Accreditation Schemes achieve common minimum quality standards.
SORs mandate Accreditation Schemes to undertake Quality Assurance of outputs produced by their accredited Energy Assessors. The Government carries out audits of the quality systems implemented by Accreditation Schemes and compliance with the SORs. These provisions ensure that a statistically significant percentage of certificates is checked.

In the most severe instances the Government may suspend or revoke an Accreditation Scheme’s license. To date, Government has made limited use of these powers. The number of EPCs controlled is recorded by Government but is not published. Similarly, Accreditation Schemes may revoke an Energy Assessor’s license to operate.

**Compliance levels by sector**
The Government does not monitor compliance. Compliance is verified by Local Authorities which are not required to publish compliance assessment outcomes. There is no central national body recording compliance.

**Enforcement with building owners and real estate actors**
Local Authorities Trading Standard Officers (TSOs) have the powers to require the “relevant person” (e.g., the seller, the prospective landlord or the constructor) to produce copies of the EPC for inspection. In 2012, these powers were extended to include persons acting on behalf of the “relevant person”, e.g., the Estate or Letting Agents.

Penalties for non-compliance vary depending on building types:

- for residential properties, the penalty is £200 (~232 €);
- for non-residential properties, the penalty is 12.5% of the rateable value of the building, subject to a minimum of £500 (~580 €) and a maximum of £5,000 (~5,800 €).

The Government does not collect data about the number of penalties issued by Local Authorities for non-compliance.

**2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public**

**Overview**
The approach depends on the type of occupier and the building’s floor area (Table 10). Display Energy Certificates (DECs) are issued and displayed in buildings > 250 m² that are occupied by a public authority and frequently visited by the public. EPCs are displayed in commercial premises > 500 m² that are frequently visited by the public, and where an EPC has previously been issued.
### Table 10: Energy performance display requirements

<table>
<thead>
<tr>
<th>Occupier</th>
<th>Floor area</th>
<th>Requirements</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public authority*</td>
<td>&gt;250 m²</td>
<td>Produce and display a DEC</td>
<td>10 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Produce a Recommendation Report</td>
<td>10 years</td>
</tr>
<tr>
<td></td>
<td>&gt;1,000 m²</td>
<td>Produce and display a DEC</td>
<td>1 year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Produce a Recommendation Report</td>
<td>7 years</td>
</tr>
<tr>
<td>Commercial premises*</td>
<td>&gt;500 m²</td>
<td>If an EPC has been produced (for construction, sale or rent), the EPC must be displayed**</td>
<td>10 years</td>
</tr>
</tbody>
</table>

(* The building must be frequently visited by the public.

(**) EPCs must be accompanied by a Recommendation Report.

EPCs are based on calculated energy consumption. DECs are based on measured energy, normalised to allow cross sector comparison. Annual DECs are only required for public authority buildings with a floor area > 1,000 m² (Table 10).

**Format and content of DECs**

DECs show the performance of a building based on actual energy consumption for the previous year in the form of an Operational Rating (OR), Figure 13. If available, the building’s performance over the previous three years is shown to illustrate the performance trend. The OR is a numerical indicator of a building’s CO₂ emissions on an A to G scale.
Implementing the Energy Performance of Buildings Directive

Figure 13: Display Energy Certificate (DEC).
The building’s performance is compared to a benchmark specific to its category. Benchmarks are reviewed periodically to ensure they are adequate. Buildings with zero CO\textsubscript{2} emissions or net energy generators achieve an OR of zero. Buildings, which perform at the benchmark level, achieve an OR of 100 at the D to E boundary. Buildings, which emit twice as much CO\textsubscript{2} as the benchmark, achieve an OR of 200. The approved benchmarks are set out in Energy Benchmarks (TM46)\textsuperscript{20}. DECs are accompanied by a Recommendation Report, which includes cost-effective recommendations and has a maximum validity of seven or 10 years (Table 10). DEC record data from 2008 to December 2016 is included in Table 11 and Figure 14.

Table 11: Display Energy Certificates (DECs), 2008 to December 2016, England.

<table>
<thead>
<tr>
<th>Total</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>not recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>269,281</td>
<td>1,939</td>
<td>14,476</td>
<td>55,357</td>
<td>92,942</td>
<td>59,016</td>
<td>22,960</td>
<td>22,585</td>
</tr>
<tr>
<td>Percentage</td>
<td>100%</td>
<td>0.7%</td>
<td>5.4%</td>
<td>20.6%</td>
<td>34.5%</td>
<td>21.9%</td>
<td>8.5%</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

"not recorded" = faulty EPC (cancelled, withdrawn, etc.).

Figure 14: Display Energy Certificates (DECs), 2008 to December 2016, England. Percentages by band.

DEC costs vary greatly. Indicative lowest market costs (based on internet search) range from £80 to £175 (~93 € to 203 €). These costs include the registration fee (£9.73 = ~11 €) payable each time a DEC is recorded on the non-residential register.
Implementing the Energy Performance of Buildings Directive

2.III.iv. Implementation of mandatory advertising requirement - status

Sellers and landlords are responsible for commissioning an EPC before the property is marketed. Estate or Letting Agents (acting on behalf of sellers or landlords) must be satisfied that an EPC is available or has been commissioned before the property is marketed.

Since 2013, for buildings on sale or rent that have a valid EPC, the Asset Rating of the building expressed in the EPC must be stated in any advertisement of the sale or rental in commercial media.

The enforcement and penalty regimes are as described for EPCs above.

2.IV Inspection requirements - heating systems, air conditioning

The UK adopted alternative measures for heating systems and inspections for AC systems. The UK-wide Energy Savings Opportunity Scheme (ESOS)\textsuperscript{21} transposes the requirements of EED Article 8 ESOS allows compliance with EED Article 8 through the use of DECs. The inspection of AC systems and the alternative measures adopted for heating systems are not recognised by ESOS but they would likely be considered when undertaking ESOS.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The UK decided to provide advice on boilers/heating systems, rather than implement an inspection regime. This is in continuation of the extensive programme of information, grant schemes and regulation which the UK has implemented historically. Equivalence reports were issued to the Commission in 2007, 2010 and 2013. The fourth report is being prepared and the information below is based on the 2013 report.

The 2013 report found that the UK’s alternative measures would produce a primary energy saving of 4.27 TWh during the period 2013 to 2015. In comparison, a boiler inspection regime would produce a saving of 1.14 TWh, thus justifying the UK’s preferred approach.

2.IV.ii. Progress and current status on heating systems

Activities to improve energy performance of heating systems

The alternative measures identified in the 2013 report are:

(1) The carbon emissions reduction target (early replacement of band G boilers).

(2) The community energy savings programme (energy suppliers/generators to deliver energy saving to residential consumers in low-income areas).

(3) Fuel poverty programmes in the UK (to improve identification and targeting of existing help to fuel poor customers).

(4) The energy company obligation – affordable warmth obligation (to obligate larger energy suppliers to deliver energy efficiency measures to residential premises).

(5) Green deal non-residential heating measures (to finance energy efficiency measures).
(6) Advice programmes and guidance encouraging boiler inspections leading to adjustments, installation of improved controls and early boiler replacements.

Building regulations requirements for heating systems – particularly the need to install condensing boilers – have not been included as an alternative measure, although the specific performance requirements are integral to all of the above alternative measures.

**Impact and equivalence assessment**

The impact of the alternative measures is detailed in Table 12.

<table>
<thead>
<tr>
<th>Alternative measure</th>
<th>Primary energy saving (2013-2015) (TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The carbon emissions reduction target</td>
<td>2.41</td>
</tr>
<tr>
<td>The community energy saving programme</td>
<td>0.40</td>
</tr>
<tr>
<td>UK fuel poverty programmes</td>
<td>0.68</td>
</tr>
<tr>
<td>Energy company obligation – affordable warmth obligation</td>
<td>0.65</td>
</tr>
<tr>
<td>Green deal – non-residential heating measures</td>
<td>0.13</td>
</tr>
<tr>
<td>Advice programmes</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4.27</strong></td>
</tr>
</tbody>
</table>

*Table 12: Primary energy savings attributable to alternative measures, UK 2013 Equivalence Report.*

The UK boiler stock model was updated to estimate the savings (Table 13) that would result from a hypothetical boiler inspection regime that extended the existing boiler inspection regime and met the requirements.
### Implementing the Energy Performance of Buildings Directive

#### Sector Measure

<table>
<thead>
<tr>
<th>Sector</th>
<th>Measure</th>
<th>Primary energy saving (2013-2015) (TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Boiler adjustment</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Implementation of controls guidance</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Early boiler replacement</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>0.57</strong></td>
</tr>
<tr>
<td>Non-residential</td>
<td>Boiler adjustment</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Early boiler replacement</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>0.57</strong></td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td></td>
<td><strong>1.14</strong></td>
</tr>
</tbody>
</table>

Table 13: Primary energy savings attributable to boiler inspection regime, UK 2013 Equivalence Report.

#### 2.IV.iii. Progress and current status on AC systems

**Overview, technical method and administration system**

AC inspections were phased in between 2009 (systems > 250 kW) and 2011 (systems > 12 kW). Installations must be inspected by an accredited Energy Assessor at least every five years.

From 2012, all new AC inspection reports must be registered on the EPC register for England & Wales which allows Quality Assurance. The report is publicly accessible from the Register using the building address or the report reference number.

**Arrangements for assurance, registration and promotion of competent persons**

Inspection of Air-conditioning Systems (TM 44) sets out good practice for AC inspections. The Chartered Institution of Building Service Engineers (CIBSE) is one of the main professional institutions for building services engineers.

NOS and SOR have been established for AC inspections. NOS provide two levels of accreditation for assessors: “Level 3” for simple packaged cooling systems, and “Level 4” for complex, centralised systems. SOR define minimum requirements for Accreditation Schemes and address the quality assurance of AC reports.

**Promotional activities**

Publicity campaigns were run in 2008 and 2009 to introduce a range of initiatives, including AC inspections. The Government has not run promotional activities focused solely on AC inspections.
2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties
Local Authorities Trading Standard Officers (TSOs) are responsible for ensuring that owners of AC systems (> 12 kW) possess a valid inspection report. The penalty for non-compliance is £300 (~348 €).

TSOs are required to record their enforcement action and publish a report annually.

Quality control of inspection reports
Over 62,000 AC reports are recorded on the England & Wales register. About 34,000 reports were registered between 2014 and 2016. It is difficult to estimate how many reports were produced before mandatory registration came into effect.

Impact assessment.
The impact assessment\(^{23}\) estimated a cost for AC inspection in England & Wales of ~£149 million (~173 M€) and benefits (improved performance, reduced operating costs, added stimulus for improvements) of ~£213 million (~247 M€). The net benefit is ~£64 million (~74 M€), with CO\(_2\) savings in the year 2020 at ~0.08 million tonnes.

3. A success story in EPBD implementation

Although not required by the EPBD, an EPC register was established in 2008, when EPBD requirements were first implemented. Regulatory outputs must be entered on the register before they are given to the person who requested them. All documents on the register are retained for 20 years minimum.

The register allows historic documents to be retrieved, Quality Assurance, and dissemination of certificates and reports. The register also supports enforcement activities, reduces fraud, and allows statistical analysis to inform policies and improve knowledge of the building stock.

In 2013, an analysis of DECs in England & Wales suggested that Operational Ratings (Figure 15) and energy consumption fell for public sector buildings with DECs. Comparing private sector offices to public sector offices with DECs provided tentative evidence to suggest that DECs had a slight impact on the energy performance (Figure 16).
Implementing the Energy Performance of Buildings Directive

Figure 15: Trend in median OR, based on performance of first DEC.

Figure 16: Comparing private sector offices with no DEC to public sector offices with a DEC (offices with DEC in 2008).
4. Conclusions, future plans

The UK is divided into four jurisdictions. In some instances, the mix of approaches transposing the requirements of the EPBD differs between jurisdictions. In other cases, similar approaches were adopted by two or more jurisdictions.

Overall, the 2013 Building Regulations in England were expected to improve the performance of new residential units by 6% and non-residential buildings by 9% over the previous (2010) standards. Government will keep energy standards under review, including assessing cost effectiveness/cost-optimality to determine whether any strengthening of standards is required.

The transposition of the EPBD and its benefits are being reviewed by each jurisdiction as part of their programmes to achieve national energy efficiency objectives and carbon emissions reduction.

In some instances, these reviews validated the current implementation approach. In other cases, the reviews resulted in changes, such as the 2012 updates of the residential EPC adopted in England, Wales and Scotland. Changes have and will continue to be made to the implementation instruments where deemed appropriate.

Endnotes

2. Fixing the foundations: Creating a more prosperous nation, HM Treasury, July 2015
3. The Approved Documents (ADs) are available at: [www.gov.uk/government/collections/approved-documents](http://www.gov.uk/government/collections/approved-documents)
5. [www.uk-ncm.org.uk](http://www.uk-ncm.org.uk)
6. [www.uk-ncm.org.uk/](http://www.uk-ncm.org.uk/) [www.bre.co.uk/sap2012/page.jsp?id=2759](http://www.bre.co.uk/sap2012/page.jsp?id=2759)
8. Building control bodies are, e.g., the building control department of the local authority, or an approved inspector.
9. [www.competentperson.co.uk](http://www.competentperson.co.uk)
10. In England, Building Regulations 2010 were used as the 2013 update was not finalised at the time of the cost-optimal study.
12. More information at [www.bsria.co.uk/services/design/softlandings](http://www.bsria.co.uk/services/design/softlandings)
Implementing the Energy Performance of Buildings Directive


14. Central Government Departments refer to the Departments of the UK Government. For more information visit: [www.gov.uk/government/organisations](http://www.gov.uk/government/organisations)


17. Approved Documents: AD L1B and AD L2B for existing residential and existing non-residential buildings respectively.

18. Residential register (England and Wales) [www.epcregister.com](http://www.epcregister.com); non-residential register (England and Wales for certificates and AC inspection reports) [www.ndepcregister.com](http://www.ndepcregister.com)


20. Energy Benchmarks, TM 46: 2008, Chartered Institution of Building Services Engineers (CIBSE)


24. Extracted from “Special Feature, What is the impact of DECs?” DECC, June 2013

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement Nº 692447.

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