

## **APPENDIX 7**

# **FUTURE HOMES STANDARD CONSULTATION**



Ministry of Housing,  
Communities &  
Local Government

## The Future Homes Standard

2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings: Impact Assessment

|   |   |  |                         |
|---|---|--|-------------------------|
| <b>Title:</b> Future Homes Standard Consultation IA<br><b>IA No:</b><br><b>RPC Reference No:</b><br><b>Lead department or agency:</b> MHCLG | <b>Impact Assessment (IA)</b>   |  |                         |
|   | <b>Date:</b> 1/10/2019  |  |                         |
|   | <b>Stage:</b> Development/Options   |  |                         |
|   | <b>Source of intervention:</b> Domestic   |  |                         |
|   | <b>Type of measure:</b> Secondary Legislation   |  |                         |
|   | <b>Contact for enquiries:</b><br><a href="mailto:FutureHomesStandardConsultation@communities.gov.uk">FutureHomesStandardConsultation@communities.gov.uk</a> |  |                         |
| <b>Summary: Intervention and Options</b>  |   |  | <b>RPC Opinion:</b> N/A |

| Cost of Preferred (or more likely) Option (in 2019 prices) |                           |                               |                               |
|--|---------------------------|-------------------------------|-------------------------------|
| Total Net Present Social Benefit                           | Business Net Present Cost | Net cost to business per year | Business Impact Target Status |
| £585m  | £6,452m                   | £750m                         | Qualifying provision          |

**What is the problem under consideration? Why is government intervention necessary?**  
 Homes, both new and existing, account for 20% of greenhouse gas emissions in the UK.<sup>1</sup> Reducing carbon emissions from new homes is essential to meeting the Government's net zero emissions target. The performance-based targets set through the Building Regulations are an important means of reducing the carbon emissions of new buildings, where the market would not meet these of its own accord. Market failures include the cost of climate change not being fully reflected in energy prices, lack of information about energy efficiency opportunities and limited incentives to make improvements. Constructing energy efficient buildings now reduces the need to retrofit these in future to meet our climate change targets.

**What are the policy objectives and the intended effects?**  
 To reduce carbon emissions of new buildings through changes to Part L of the Building Regulations, and to instigate the changes in specifications, skills and supply chains needed to stimulate innovation and learning in the sector, as the basis for introducing a world-leading performance standard incorporating low-carbon heat in new homes by 2025. To provide adequate ventilation provisions through changes to Part F of the Building Regulations to align with more airtight construction encouraged by Part L.

**What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)**  
**Policy Option 0: Do nothing.** Keep existing Part L 2013 standards, and Part F 2010 standards. This is the baseline option and does not result in any costs and benefit impact.  
**Policy Option 1: Central case.** New homes target that delivers circa 20% improvement on 2013 standards, aggregated across the build-mix, based on overall performance based carbon and primary energy targets, with mandatory energy efficiency requirements. Improvements to the ventilation and airtightness standards.  
**Policy Option 2: High case.** New homes target that delivers circa 30% improvement on 2013 standards, aggregated across the build-mix, based on overall performance based carbon and primary energy targets, with mandatory energy efficiency requirements. Improvements to the ventilation and airtightness standards. Policy Option 2 is our preferred option.

|  |                       |                     |                           |                     |
|--|-----------------------|---------------------|---------------------------|---------------------|
| Does implementation go beyond minimum EU requirements?   | Yes                   |                     |                           |                     |
| Is this measure likely to impact on international trade and investment?  |                       |                     |                           |                     |
| Are any of these organisations in scope?   | <b>Micro</b><br>Yes   | <b>Small</b><br>Yes | <b>Medium</b><br>Yes      | <b>Large</b><br>Yes |
| What is the CO <sub>2</sub> equivalent change in greenhouse gas emissions? (Million tonnes CO <sub>2</sub> equivalent) | <b>Traded:</b><br>-12 |                     | <b>Non-traded:</b><br>-24 |                     |

<sup>1</sup> UK housing: Fit for the future?, Committee on Climate Change (2019) <https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/>

# Summary: Analysis & Evidence

# Policy Option 1

Description: New homes target that delivers circa 20% improvement on 2013 standards

## FULL ECONOMIC ASSESSMENT

| Price Base | PV Base | Time Period | Net Benefit (Present Value (PV)) (£m) |                      |                               |
|------------|---------|-------------|---------------------------------------|----------------------|-------------------------------|
| 2019       | 2020    | 70          | Low: £1,440 million                   | High: £2,160 million | Best Estimate: £1,800 million |

| COSTS (£m)    | Total Transition (Constant Price) Years | Average Annual (excl. Transition) (Constant Price) | Total Cost (Present Value) |
|---------------|---|--|----------------------------|
| Low           | Optional                                | Optional   | Optional                   |
| High          | Optional                                | Optional   | Optional                   |
| Best Estimate | £3.2 million                            |  | <b>£5,577 million</b>      |

**Description and scale of key monetised costs by 'main affected groups'**  
 The increased costs (present value) for new homes are £5,574m plus transition costs of £3.2m. The initial capital costs will be borne by developers, but these costs may ultimately be passed to landowners. The costs would fall with moderate efficiency gain through learning over time. Maintenance and replacement costs will be borne by building owner/occupier.

**Other key non-monetised costs by 'main affected groups'**  
 These changes are unlikely to have a substantial impact on the demand for new homes, so this has not been monetised.

| BENEFITS (£m) | Total Transition (Constant Price) Years | Average Annual (excl. Transition) (Constant Price) | Total Benefit (Present Value) |
|---------------|---|--|-------------------------------|
| Low           | Optional                                | Optional   | Optional                      |
| High          | Optional                                | Optional   | Optional                      |
| Best Estimate | £0                                      |  | <b>£3,778 million</b>         |

**Description and scale of key monetised benefits by 'main affected groups'**  
 Energy savings: £1,414m. Non-financial benefits including carbon savings and air quality savings: £2,364m

**Other key non-monetised benefits by 'main affected groups'**  
 The savings to consumers will be greater than shown because of reduced payments for VAT which will be a cost to the exchequer. No allowance is made for fuel security benefits, employment opportunities from developing energy saving or low carbon/primary energy products or spill-over benefits of innovation.

| Key assumptions/sensitivities/risks  | Discount rate |
|--|---------------|
| The analysis has taken a common set of assumptions on fuel prices, traded and non-traded carbon values, emissions factors and air quality damage costs from 2019 Green Book Supplementary guidance. The low and high estimates are +/- 20% of the best estimate. |               |

### BUSINESS ASSESSMENT (Option 1)

|   |   |
|---|---|
| Direct impact on business (Equivalent Annual) £m: | Score for Business Impact Target (qualifying provisions only) £m: |
| Costs:   Benefits:   Net: £533m Cost              |   |

# Summary: Analysis & Evidence

# Policy Option 2

Description: New homes target that delivers circa 30% improvement on 2013 standards

## FULL ECONOMIC ASSESSMENT

| Price Base | PV Base | Time Period | Net Benefit (Present Value (PV)) (£m) |                    |                             |
|------------|---------|-------------|---------------------------------------|--------------------|-----------------------------|
| 2019       | 2020    | 70          | Low:<br>£468 million                  | High: £702 million | Best Estimate: £585 million |

| COSTS (£m)    | Total Transition<br>(Constant Price) Years | Average Annual<br>(excl. Transition) (Constant Price) | Total Cost<br>(Present Value) |
|---------------|--|---|-------------------------------|
| Low           | Optional                                   | Optional  | Optional                      |
| High          | Optional                                   | Optional  | Optional                      |
| Best Estimate | £3.2 million                               |   | £10,457 million               |

### Description and scale of key monetised costs by 'main affected groups'

The increased costs (present value) for new homes are £10,454m plus transition costs of £3.2m. The initial capital costs will be borne by developers, but these costs may ultimately be passed to landowners. The costs would fall with moderate efficiency gain through learning over time. Maintenance and replacement costs will be borne by building owner/occupier.

### Other key non-monetised costs by 'main affected groups'

These changes are unlikely to have a substantial impact on the demand for new homes, so this has not been monetised.

| BENEFITS (£m) | Total Transition<br>(Constant Price) Years | Average Annual<br>(excl. Transition) (Constant Price) | Total Benefit<br>(Present Value) |
|---------------|--|---|----------------------------------|
| Low           | Optional                                   | Optional  | Optional                         |
| High          | Optional                                   | Optional  | Optional                         |
| Best Estimate | £0   |   | £11,042 million                  |

### Description and scale of key monetised benefits by 'main affected groups'

Energy savings: £7,738m. Non-financial benefits including carbon savings and air quality savings: £3,304m

### Other key non-monetised benefits by 'main affected groups'

The savings to consumers will be greater than shown because of reduced payments for VAT which will be a cost to the exchequer. No allowance is made for fuel security benefits, employment opportunities from developing energy saving or low carbon/primary energy products or spill-over benefits of innovation.

### Key assumptions/sensitivities/risks

Discount rate

The analysis has taken a common set of assumptions on fuel prices, traded and non-traded carbon values, emissions factors and air quality damage costs from 2019 Green Book Supplementary guidance. The low and high estimates are +/- 20% of the best estimate.

## BUSINESS ASSESSMENT (Option 2)

|   |   |
|---|---|
| Direct impact on business (Equivalent Annual) £m: | Score for Business Impact Target (qualifying provisions only) £m: |
| Costs:   Benefits:   Net: £750m Cost              |   |

## Evidence Base (for summary sheets)

### Background and scope of the proposal

- 1.1. This impact assessment informs the consultation *The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings*. It considers two options to uplift the current Part L energy efficiency standards in 2020 for new homes. It also considers the wider impacts of Part L for new homes, including changes to Part F (Ventilation), airtightness, improving as built performance and changes to transitional arrangements in 2020.

### Future work (outside scope of the impact assessment)

- 1.2. This impact assessment only details the impacts of changes to new dwellings. A further consultation and impact assessment will be published in the coming months which will include changes to Part L and Part F for existing homes, Part L and F for new and existing non-domestic buildings and overheating in new homes.
- 1.3. This impact assessment does not consider the costs and benefits of the Future Homes Standard. Before the Future Homes Standard is introduced in 2025, the Government will consult on the full technical details and produce an associated impact assessment.

### Rationale for intervention

- 1.4. Reducing carbon emissions from the building stock is essential for the UK to meet its Climate Change Act targets.<sup>2</sup> Building Regulations should be used to achieve this only where it can be shown that the market would not make these changes of its own accord, or that other measures (regulatory or otherwise) are not already driving this change.
- 1.5. A number of market failures exist:
  - Climate change creates a huge externality: polluters (builders and building occupiers) do not incur the true cost of their emissions. Even if an appropriately high and sustained carbon price were applied, the mix of other market failures can act as a barrier to action.
  - Building buyers/tenants/mortgage providers do not have information on long term energy price rises, and most do not value better performing buildings at point of construction, sale or rent. In particular for most businesses, as opposed to households, energy costs are at present too small a percentage of their operating costs to make energy efficiency a material consideration in the choice of building they occupy.
  - Even where consumers, householders in particular, do have the information to act to take advantage of energy efficiency savings many fail to do so for a variety of reasons.
  - High fabric standards for buildings reduce the influence of such behaviour, as the occupants' actions have little impact on building performance.
  - Conversely, a failure to set standards at point of build can lock a building into higher energy consumption, giving those consumers who do want to act limited scope to make savings.
  - Split incentives mean that developers have little reason to build better performing buildings, as they do not enjoy the benefits of lower energy bills or income from energy generated by renewable technologies installed in the building.
  - Occupants have limited incentive to refurbish their buildings to higher energy standards, as the payback periods through lower fuel bills alone can be unattractive,

and there is limited evidence that higher performance results in a price premium when they come to sell or rent the building on.

- Lack of capital, lack of information and fear of hassle can act as barriers to households and businesses acting to renovate and improve existing buildings even if these would be cost effective in the medium or long term.

- 1.6. Building regulations and standards are widely recognised as an appropriate point of intervention to overcome these market failures in construction. Action at the point of build has the advantage of 'locking in' low carbon technologies and energy efficient design, reducing overall energy demand of the building.

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<sup>2</sup> <http://www.legislation.gov.uk/ukdsi/2019/9780111187654/contents>

## POLICY OBJECTIVES

- 2.1. The consultation document provides full details of the policy objectives. A summary of these policy objectives is provided here.

### Uplift to the energy efficiency requirements for 2020

- 2.2. The key consideration of the consultation and this impact assessment is what level of uplift should be made to the energy efficiency requirements of Part L of the Building Regulations for new homes in 2020.
- 2.3. As set out in Chapter 3 of the consultation, there are two options to uplift the energy efficiency requirements for 2020 proposed:
- a. **Option 1 - 'Future Homes Fabric'**. This would be a 20% reduction<sup>3</sup> in CO<sub>2</sub> from new dwellings, compared to the current standards. This performance standard is based on the energy and carbon performance of a home with:
    - i. Very high fabric standards to minimise heat loss from windows, walls, floors and roofs (typically with triple glazing). This would be the same fabric requirement as we currently anticipate for the Future Homes Standard
    - ii. A gas boiler
    - iii. A waste water heat recovery system.

This would add £2560 to the build-cost of a new home and would save households £60 a year on energy bills.

- b. **Option 2 - 'Fabric plus technology'**. This would be a 31% reduction<sup>3</sup> in CO<sub>2</sub> from new dwellings, compared to the current standards. This option is likely to encourage the use of low-carbon heating and/or renewables. The performance standard is based on the energy and carbon performance of a home with:
  - i. An increase in fabric standards (but not as high an increase as in Option 1, likely to have double rather than triple glazing)
  - ii. A gas boiler
  - iii. A waste water heat recovery system
  - iv. Photovoltaic (solar) panels

This would add £4850 to the build-cost of a new home and would save households £260 a year on energy bills.

- 2.4. In practice, we expect that some developers would choose less costly ways of meeting the standard, such as putting in low-carbon heating now. This would cost less than the full specification at £3130. It would give a carbon saving of only 22% for flats due to the standard including solar panels and flats having a smaller roof area per home. The additional cost per flat is also less at £2260.
- 2.5. Our preferred option is option 2.
- 2.6. The specifications for Part L 2020 options 1 and 2 are provided in Table 4 of the next chapter. For further detail to create the notional buildings see the consultation version of the Standard Assessment Procedure 10.1, called cSAP. This will be available shortly here: <https://www.isap.org.uk/>.

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<sup>3</sup> Based on a semi-detached home. As an aggregate across the build-mix, over a 60-year lifespan, this would be an estimated 20% CO<sub>2</sub> saving for option 1, and 30% CO<sub>2</sub> saving for option 2.

- 2.7. We expect the majority of the benefits and costs will come from the changes to the minimum energy efficiency standards. This forms the main basis of the cost-benefit analysis.

### **Performance metrics to assess the energy performance of new homes**

- 2.8. The consultation proposes four performance metrics for new buildings to be assessed against, these are:
- Primary energy target
  - CO<sub>2</sub> emission target
  - Householder affordability rating
  - Minimum standards for fabric and fixed building services
- 2.9. The rationale and policy intent for moving to the four performance metrics is set out in Chapter 3 of the consultation document.

### **Removing the fuel factors - phasing out high carbon fossil fuels**

- 2.10. As set out in Chapter 3 of the consultation, the intention is to remove fuel factors, so that any new building will need to meet primary energy and CO<sub>2</sub> emissions equivalent to that of option 1 or 2 above. This means that if oil, liquefied petroleum gas (LPG) or solid mineral fuel are to be used in new buildings, considerable mitigating measures would need to be installed to reach parity with a new gas-heated building.
- 2.11. Grid electricity now has a lower carbon emission factor than gas, as outlined in the tables in Appendix C. Therefore, grid electricity no longer needs a fuel factor to support its use.
- 2.12. Recognising heat networks as an important part of our energy future, we are proposing to introduce 'technology factors'. These would be applied to calculations for the target emission and primary energy rates for new dwellings where the design incorporates heat networks.

### **Future-proofing**

- 2.13. The full proposals for future-proofing policy are set out in Chapter 3 of the consultation document.
- 2.14. Our preferred approach to future-proofing is for developers to install larger emitters with lower flow temperatures. This has the benefits of increasing the efficiency of condensing boilers, giving an immediate energy saving to the consumer. It would also mean low cost and disruption to householders when low-carbon heat is installed in the future because they will not need to have new radiators installed.
- 2.15. We have provided two uplift options for the Part L primary energy and emission targets. Option 1, 'Future Homes Fabric', delivers the future-proofing element of improved fabric. Option 2, 'Fabric plus technology', will likely deliver some low-carbon heat now.

### **Statutory guidance**

- 2.16. Chapter 3 of the consultation document explains the rationale and policy intent for our proposed restructure the statutory guidance for Part L and Part F. Draft guidance is presented alongside this consultation and impact assessment.

## Energy Performance of Buildings Directive

- 2.17. The Building Regulations Part L is principally for domestic policy aims in reducing the energy impact of buildings. It is also used to transpose EU legislation, namely the Energy Performance of Buildings Directive (EU) 2018/844 (also known as EPBD).<sup>4</sup> The EPBD has recently been amended and member states are required to transpose these amendments by March 2020. Subject to the terms of the UK's exit from the EU, Part L may be used to transpose some of the requirements of the revised EPBD.
- 2.18. The EPBD affects new domestic buildings. We set out proposals in the consultation to align with the Directive requirements for new dwellings, in the following areas:
- Primary energy (see performance metrics section outlined earlier in this impact assessment).
  - Self-regulating devices
  - Information about building automation and control systems

## Part F

- 2.19. The full proposals for ventilation policy are set out in Chapter 4 of the consultation document. Changes to Part F are proposed principally to simplify and clarify the guidance. This will make it easier for installers to understand and comply with the requirements and for building control to check. Changes are also proposed to reflect the latest understanding of how ventilation systems operate. These changes are summarised as follows:
- We propose to provide guidance for different ventilation strategies to reflect how these strategies relate to the air tightness of the dwelling, and when specialist advice should be sought. For natural ventilation systems we propose to only provide guidance for less airtight homes. For continuous mechanical extract, we propose to only provide guidance for more airtight homes. We have also simplified the way that background ventilator sizes are determined in the Approved Document.
  - For balanced supply and extract systems, we propose to increase the minimum background ventilation rate to accommodate a likely occupancy level for bedrooms.
- 2.20. We propose that the minimum whole dwelling ventilation rates are amended. Further detail is provided in the draft Approved Document which accompanies this consultation package.
- 2.21. For continuous mechanical extract systems, we propose that the minimum level of background ventilators is increased from 2500 mm<sup>2</sup> to 5000 mm<sup>2</sup> per habitable room to make sure that air can be drawn through the background ventilators, accounting for the expected pressure differentials.

## Airtightness

- 2.22. The full proposals for airtightness testing policy are set out in Chapter 5 of the consultation document. We are proposing to:
- limit carbon savings associated with air-permeability levels below 3m<sup>3</sup>/m<sup>2</sup>h in naturally ventilated dwellings.
  - better account for the uncertainty of airtightness tests
  - require all new homes to be airtightness tested
  - introduce the Pulse test as an approved airtightness testing methodology
  - approve a new airtightness testing methodology

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<sup>4</sup> Directive (EU) 2018/844 amending Directive 2010/31/EU on the Energy Performance of Buildings. OJEU, 2018.

## **Performance gap**

2.23. The full proposals to reduce the performance gap are set out in Chapter 6 of the consultation document. We are proposing to:

- improve build quality by introducing guidance as part of the minimum standard of Part L
- improve the accuracy of as-built energy calculations by providing clearer information about the as-built specifications of new buildings to energy assessors
- improve information provided to Building Control Bodies and householders including a new style compliance report and photographic evidence
- improve information to householders by providing a Home User Guide

## **Transitional arrangements**

2.24. Transitional arrangements are used to smooth the transition to new standards in the implementation of building regulations; these arrangements allow some building works to be built to previous standards for a specified period.

2.25. We propose that transitional arrangements should only apply to individual buildings on which work has started within a reasonable period. Where work has not commenced on a specific building covered by the building notice, initial notice, or full plans within a reasonable period, that building should not benefit from the transitional provisions and so it would need to comply with the latest set of energy efficiency standards. The rationale and policy intent for this proposed change to transitional arrangements is set out in Chapter 7 of the consultation document.

# ESTIMATION OF COSTS AND BENEFITS

## Summary of impacts

- 3.1. A summary of the impacts considered under this Impact Assessment is provided below in Table 1, relative to the counterfactual (Option 0). All figures are Net Present Values (NPV) over 10 years of policy and a subsequent 60 year life of the buildings. The figures represent the aggregate impact across the building mix.
- 3.2. Overall, the additional costs and benefits are dominated by the uplift from the Part L 2013 performance targets – with the separate improvements to the ventilation and air tightness standards having a comparatively minor impact. Both the costs and benefits are greater for Option 2 which principally originates from the installation of on-site renewables and results in both greater upfront capital costs (and incurs replacement costs during the building life) as well as greater energy savings from the generated energy. Option 2 is estimated to result in an overall net benefit of £585 million compared to a net cost of £1,800 million for Option 1. The equivalent annual net cost to business of the preferred Option 2 is £750m in 2019 prices.

| <b>Table 1: Summary of costs and benefits</b>                                    |                 |                 |
|--|-----------------|-----------------|
|  | <b>Option 1</b> | <b>Option 2</b> |
| Transition costs   | (3.2)           | (3.2)           |
| Energy savings (£m)  | 1,414           | 7,738           |
| Incremental costs (£m)   | (5,574)         | (10,454)        |
| <b>Total financial benefit/(cost) (£m)</b>                                       | <b>(4,164)</b>  | <b>(2,719)</b>  |
| Carbon savings - non-traded (£M)   | 2,186           | 1,686           |
| Carbon savings - traded (£M)   | (2)             | 736             |
| <b>Total carbon savings (£m)</b>   | <b>2,185</b>    | <b>2,422</b>    |
| Air quality savings (£m)   | 179             | 882             |
| <b>Total carbon and air quality savings</b>                                      | <b>2,364</b>    | <b>3,304</b>    |
| <b>Net benefit/(cost) (£m)</b>   | <b>(1,800)</b>  | <b>585</b>      |
| Amount of gas saved (GWh)  | 168,447         | 93,932          |
| Amount of electricity saved (GWh)  | (476)           | 245,241         |
| Amount of CO <sub>2</sub> saved - non-traded (MtCO <sub>2</sub> (e))             | 31              | 24              |
| Amount of CO <sub>2</sub> saved - traded (MtCO <sub>2</sub> (e))                 | (0)             | 12              |
| Cost effectiveness – non-traded (£/tCO <sub>2</sub> )                            | 129             | 46              |
| Cost effectiveness – traded (£/tCO <sub>2</sub> )                                | (74,016)        | 13              |
| Present value net benefit/(cost) business (£m)                                   | (4,592)         | (6,452)         |
| Equivalent annual net benefit/(cost) to business (£m) [Annualised over 10 years] | (533)           | (750)           |

## Overview

- 3.3. The proposed policy changes will affect all new dwellings in England. The impact of the policy will be felt both at the point of new construction and over the life of the building during which energy savings will be achieved. As such, the policy will have an impact on manufacturers of construction products, the construction industry and the building owners and occupants. Given the long lives of the buildings affected there is considerable uncertainty about future values. So it is assumed that there is a ±20% uncertainty on the

central estimate and further sensitivity analysis of key assumptions is intended to be undertaken for the final Impact Assessment.

- 3.4. In order to estimate the overall costs and benefits of the proposed policy options we have modelled the changes in building costs, energy use and related CO<sub>2</sub> emissions using the building standards proposed for Part L and Part F compared with a baseline of costs and energy use implied by Part L 2013 and Part F 2010 standards which are now in place.
- 3.5. Not all of the policies above have been captured in the cost-benefit analysis.
- 3.6. The policies included in the cost-benefit analysis and the narrative below are:
  - The uplift to the energy performance requirements for 2020 - Costs and Benefits – Improved Part L standards for new homes
  - Performance gap - see Improved Compliance and Performance and Administrative burdens
  - Statutory guidance - see Improved Compliance and Performance
  - Calculation methods - Transition costs
  - Futureproofing - Costs and Benefits - Improved Part L standards for new homes
  - Airtightness - Modifications to Airtightness
  - Self-regulating devices - Mandating Self-Regulating Devices (SRDs)
  - Removing fuel factors - Rural impacts
  - Transitional arrangements - Transitional arrangements
- 3.7. The policies not included and why are:
  - Performance metrics to assess the energy performance of new homes, including primary energy, CO<sub>2</sub> and householder affordability – we expect there to be minimal familiarisation impacts of changing the performance metrics. Trained Energy Assessors calculate these metrics using a piece of software, the Standard Assessment Procedure (SAP). The new performance metrics are all already calculated by the Energy Assessors using SAP, they will simply have to report different metrics.
  - Uplift to minimum standards for fabric – these are backstop values to ensure good quality building fabric, the main standards are the performance metrics.
  - Uplift to minimum building services efficiencies – these are backstop values to ensure efficient building services, the main standards are the performance metrics.
  - Consideration of high efficiency alternative systems – this is a reduction in guidance, no assessment is required.
  - Approved construction details – costs have currently not been monetised and will be considered further in the final Impact Assessment.
  - Technology factors – this is to prevent the new uplift in standards and change in calculation methods from preventing the installation of heat networks. There is little change from the current standards.
  - Information about Building Automation and Control Systems (BACS) – would only affect homes with BACS, which would be very few new homes.
- 3.8. The figures in the following analysis are based on central estimates.

## **Assumptions applicable to all analysis**

- 3.9. This impact assessment is based on the Green Book and the accompanying supplementary guidance on the valuation of energy use.<sup>5</sup> This IA considers updated fuel prices, traded and non-traded carbon values and emission factors.
- 3.10. Energy savings are valued at the variable rate in macroeconomic calculations in accordance with the supplementary Green Book guidance. This is appropriate for social analysis and assumes that the retail energy savings enjoyed by the consumer occupying an energy efficient building does not fully reflect the social benefit.
- 3.11. A discount rate of 3.5 per cent has been used for the first 30 years of the building's life and 3 per cent for subsequent years. This is in line with guidance in HM Treasury's Green Book - Appraisal and Evaluation in Central Government.
- 3.12. Unless otherwise stated, prices and estimates shown below are in 2020 base year, 2019 prices.
- 3.13. The appraisal time period for estimating the impact of the policy is 10 years which is consistent with that used in the 2013 Part L Impact Assessment and in other Impact Assessments associated with the construction industry.
- 3.14. It is important to ensure there is a full appraisal of the 'lock in' impact of higher fabric standards. An example of this is the impact of higher wall standards, which will impact over a long period of time, potentially the entire lifetime of the building. For building fabric insulation (external walls, floors, roofs) we have assumed an asset life of 60 years, except for external windows which we have assigned an asset life of 30 years. This is comparable with indicative values provided in Annex E of BS EN 15459 Energy performance of buildings - Economic evaluation procedure for energy systems in buildings. For gas heating and ventilation equipment we have assumed asset lives of 15 and 20 years respectively, with hot water stores also having a lifespan of 20 years. This is comparable with indicative values provided in CIBSE Guide M – Maintenance engineering and management. The asset lives of waste water heat recovery systems were taken to be 20 years for horizontal systems and 60 years for vertical systems.
- 3.15. Only the elements of lifecycle cost that differentiated from the baseline cost were considered. For example, general repair and decoration costs were excluded from the analysis as these would be common to all homes irrespective of the energy performance options presented in this document.
- 3.16. Replacement costs were assigned to specific components within a specification and avoided replacements of components that would be expected to have a longer lifespan. For example, boiler replacements did not include replacement of a hot water tank or to the gas or water supplies. Replacement costs included an additional allowance for the costs of working in an existing property and for disposal of the end of life components; replacement is only costed if the boiler is more expensive than the counterfactual.
- 3.17. Consequently, we have estimated the ongoing costs associated with maintenance and replacement along with the benefits from energy, air quality and carbon savings over a 60 year period for each building, which provides a sufficiently long period to capture the benefits of fabric 'lock in'. For instance in the new homes' analysis, an external window is assumed to have a lifetime of 30 years. So a replacement after 30 years is assumed. This is important as Option 1 assumes more expensive triple glazing whereas Option 2 assumes double glazing, and this cost difference needs to be accounted for when the asset is replaced. Again, this is consistent with the 2013 Part L Impact Assessment. Given the

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<sup>5</sup> Valuation of energy use and greenhouse gas emissions for appraisal (April 2019)

10 year of policy being assumed, the total period for the IA is therefore 70 years so that the full 60 year impact of a building constructed in year 10 is assessed. Learning rates have been applied to account for reductions in costs for less mature technologies.

- 3.18. For the purposes of this analysis, we have used net completion projection as a proxy for annual rate of new buildings in our modelling. This has been broken down between detached, semi-detached/end-terraced, mid-terraced houses and four storey apartment blocks. For more details, please see Appendix A.
- 3.19. In addition, Table 2 shows the phasing assumptions that have been made about the numbers of new homes which will be built to the new 2020 standards in the first few years of the policy, to reflect the time lag between planning and building of new homes.

|  | 2020 | 2021 | 2022 | 2023 | 2024 onwards |
|--|------|------|------|------|--------------|
| Phase in (% dwellings captured by Part L and F 2020) | 20%  | 50%  | 75%  | 95%  | 100%         |

Source: MHCLG

- 3.20. The assessment of costs and benefits has been undertaken based on the 4 building types outlined in paragraph 3.18: detached, semi-detached, mid-terrace and a 4-storey block of flats (made up of 16 1-bed single aspect and 16 2-bed corner flats). To enable consistent target setting and comparison, we have used the same dwelling types employed in the Part L 2013 review, but with some updates to reflect the Nationally Described Space Standards – as implemented for MHCLG’s cost optimal analysis published in 2019.<sup>6</sup> The dwelling types are summarised in Table 3 below.

| Dwelling type                      | Small 1 Bed Single Aspect Apartment | Large 2 Bed Corner Apartment | Mid Terrace House | End Terrace/ Semi-detached House | Detached House |
|------------------------------------|-------------------------------------|------------------------------|-------------------|----------------------------------|----------------|
| Total Floor Area (m <sup>2</sup> ) | 50                                  | 70                           | 84                | 84                               | 117            |
|                                    | Total for apartment block: 1922     |                              |                   |                                  |                |

- 3.21. The modelling assumes that all new domestic buildings are presently constructed to current Part L and F standards. Some local authorities require construction to a higher standard which will reduce the impact of the policy change. Moreover, some new domestic buildings, where development started before the last Part L uplift, are constructed to old standards. These considerations will be examined further in the final Impact Assessment.

### **Costs and Benefits: Improved Part L standards for new homes**

- 3.22. For the uplift of Part L standards for new homes, two options are being proposed: options 1 and 2. The costs and benefits of these proposals have been assessed across the four building types detailed previously.

<sup>6</sup> DCLG, *Technical housing standards – nationally described space standard*, 2015. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/524531/160519\\_Nationally\\_Described\\_Space\\_Standard\\_Final\\_Web\\_version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/524531/160519_Nationally_Described_Space_Standard_Final_Web_version.pdf); and MHCLG, *Energy Performance of Buildings Directive: Second Cost Optimal Assessment for the United Kingdom (excluding Gibraltar)*, 2019. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/770783/2nd\\_UK\\_Cost\\_Optimal\\_Report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770783/2nd_UK_Cost_Optimal_Report.pdf)

3.23. Table 4 shows the specifications assessed for each building type - current Part L 2013 and the two consultation options. These are based on the notional (reference) building which is used to set the standard.

| <b>Table 4: Specification for each building type</b>          |  |  |   |
|---|--|--|---|
|   | <b>Part L 2013</b>   | <b>Part L 2020 Option 1</b>  | <b>Part L 2020 Option 2</b>   |
| External Wall U-value (W/m <sup>2</sup> K)                    | 0.18   | 0.15   | 0.18  |
| Corridor Wall U-value (W/m <sup>2</sup> K)                    | 0.18   | 0.18   | 0.18  |
| Party Wall U-value (W/m <sup>2</sup> K)                       | 0  | 0  | 0   |
| Roof U-value (W/m <sup>2</sup> K)                             | 0.13   | 0.11   | 0.11  |
| Floor U-value (W/m <sup>2</sup> K)                            | 0.13   | 0.11   | 0.13  |
| Window U-value (W/m <sup>2</sup> K)                           | 1.4  | 0.8  | 1.2   |
| Window g-value  | 0.63   | 0.57   | 0.63  |
| Door U-value (W/m <sup>2</sup> K)                             | 1.0  | 1.0  | 1.0   |
| y-value (W/m <sup>2</sup> K)                                  | Based on SAP Appendix R  | Based on the 'Option 1' psi values in Table R2 of SAP 10.1.                      | Based on the 'Option 2' psi values in Table R2 of SAP 10.1.   |
| Ventilation System Type                                       | Intermittent extract fans with trickle vents                   |  |   |
| Air permeability (m <sup>3</sup> /h·m <sup>2</sup> at 50 Pa)  | 5  |  |   |
| Space Heating Source  | Condensing gas boiler (regular for detached, combi for others) |  |   |
| Domestic Hot Water Source                                     | As for space heating   |  |   |
| Boiler Efficiency   | 89.5% (SEDBUK)   |  |   |
| Heat Emitters   | Standard radiators   | Large (low temp) radiators   | Large (low temp) radiators  |
| Shower flow rate  | 8 l/min  |  |   |
| Waste Water Heat Recovery (WWHR)                              | No   | Efficiency of 36%<br>Utilisation of 0.98<br>Connected to 2 showers where present |   |
| Fixed lighting capacity (lm)                                  | 185 x TFA  |  |   |
| Lighting efficacy (lm/W)                                      | 80   |  |   |
| PV installation area (percentage of building foundation area) | 0%   | 0%   | 40%   |
| PV assumptions  |  |  | SE/SW facing, 45-degree pitch, no/little overshadowing, 6.5m <sup>2</sup> /kWp, connected directly to dwelling. |

3.24. The increase in capital cost of achieving the consultation options, compared with the continuation of existing 2013 standards are shown in Table 5. Further breakdown of the costs of the different elements is provided in Appendix B. These results show a significantly higher capital cost for the option 2 which predominantly relates to the inclusion of photovoltaics (PV) in the notional building.

| <b>Table 5: Additional Capital Costs</b> |  |  |
|--|--|--|
|  | <b>Part L 2020 Option 1<br/>(20% uplift)</b> | <b>Part L 2020 Option 2 (30%<br/>uplift)</b> |
| Detached house                           | £4,200                                       | £6,520                                       |
| Semi-detached house                      | £2,560                                       | £4,850                                       |
| Mid-Terraced house                       | £2,200                                       | £4,740                                       |
| Flats                                    | £2,070                                       | £2,260                                       |
| Average (based on<br>build mix)          | £2,870                                       | £4,620                                       |

\* Option 1 includes heating distribution system cost savings (equivalent to 25% of heating distribution system costs) due to increased energy efficiency for the higher fabric specifications, at 2020 prices. However, it is expected that it will take time for designers to implement the changes to the heating system design to realise these savings, due to their experience in working on less energy efficient homes i.e. they will need time to adapt from current practice and/or overcome concerns of under-heating homes if a reduced heat distribution system is installed. These savings are assumed to be made from 2021 onwards with the following learning rates applied in the cost benefit assessment: 2021, 20% (of total cost saving realised); 2022, 40%; 2023, 60%; 2024, 80%; 2025 onwards, 100%.

- 3.25. The changes in energy use were assessed by using a consultation version of SAP (cSAP). Modified carbon emission and primary energy factors were used to rebase the Part L 2013 standard and used to calculate the proposed 2020 standards. These carbon emission and primary energy factors are in Appendix C.
- 3.26. The costs and benefits for options 1 and 2 compared with continuation of the existing 2013 standards are shown in Table 6. The results show that the Option 2 has a greater increase in costs but results in a net benefit. This principally arises from the additional costs of the PV and the significant energy savings arising from the electricity generation. Note that analysis suggests that it may well be possible to reduce the upfront capital costs in meeting the Option 2 target through the use of alternative low carbon/primary energy technologies such as the use of a heat pump or a mechanical ventilation system with heat recovery. As an example, further analysis has been undertaken by adopting the same design specification as for Option 2 but with the gas boiler and PV replaced by an air source heat pump (with efficiencies of around 250% for space heating and hot water as modelled in SAP). It shows, for example, the capital cost uplift as being £3130 for the semi-detached house and £2780 for flats which, in comparison with the results in Table 5, is a lower cost for the semi-detached house and is more expensive for flats. This solution is likely to over-comply (i.e. be better than the Part L targets) and there may be further upfront capital cost savings in reducing the building performance to just comply with the Part L targets.

| <b>Table 6: Summary of results from cost benefit analysis (improved Part L standards only) – total over the appraisal period</b> |                                 |                                 |
|--|---------------------------------|---------------------------------|
|  | <b>Part L 2020<br/>Option 1</b> | <b>Part L 2020<br/>Option 2</b> |
| Transition costs   | (3.2)                           | (3.2)                           |
| Energy savings (£M)  | 1,411                           | 7,735                           |
| Incremental costs (£M)   | (5,524)                         | (10,404)                        |

|  |                |                |
|--|----------------|----------------|
| Total financial benefit/(cost) (£M)                                  | <b>(4,116)</b> | <b>(2,672)</b> |
| Carbon savings - non-traded (£M)                                     | 2,182          | 1,682          |
| Carbon savings - traded (£M)   | (2)            | 736            |
| Total carbon savings (£m)  | 2,180          | 2,418          |
| Air quality savings (£m)   | 179            | 881            |
| Net benefit/(cost) (£m)  | <b>(1,757)</b> | <b>627</b>     |
| Amount of gas saved (GWh)  | 168,114        | 93,598         |
| Amount of electricity saved (GWh)                                    | (476)          | 245,241        |
| Amount of CO <sub>2</sub> saved - non-traded (MtCO <sub>2</sub> (e)) | 31             | 24             |
| Amount of CO <sub>2</sub> saved - traded (MtCO <sub>2</sub> (e))     | (0)            | 12             |
| Cost effectiveness – non-traded (£/tCO <sub>2</sub> )                | 127            | 44             |
| Cost effectiveness – traded (£/tCO <sub>2</sub> )                    | (72,266)       | 9              |

Source: Currie and Brown

### Mandating Self-Regulating Devices (SRDs)

- 3.27. Approved Document L1A and the associated Domestic Building Services Compliance Guide currently recommend installing SRDs in new homes to meet Part L. The policy change is to make this mandatory.
- 3.28. It is assumed that all new homes currently install SRDs in practice to meet Part L. As such, it is assumed that there are no significant costs and benefits of this policy change to make such installation mandatory.

### Futureproofing

- 3.29. Included within the section above *Costs and Benefits - Improved Part L standards for new homes* are the costs and benefits of installing larger emitters with lower flow temperatures now. The benefits for the future have not been fully captured. The CBA uses gas boilers as the replacement for gas boilers. It is however likely in the future that heat pumps will be installed as a replacement for gas boilers. The larger emitters will have the benefit to consumers in the future of not requiring replacement, therefore saving consumers money, reducing waste, reducing disruption and therefore making it more likely low carbon heat will be installed.

### Cost and Benefits: Modifications to Airtightness

- 3.30. There are two proposals for change: 100% sample testing and carbon capping. These are included in both policy options 1 and 2.

#### 100% sample testing

- 3.31. The counterfactual case is based on the current number of homes that have an airtightness test for Part L compliance purposes. This has been determined through the total number of airtightness tests undertaken on new homes,<sup>7</sup> corrected for (reduced by) additional testing based on unpublished data from BSRIA (e.g. due to testing during the construction process or additional testing when a home fails their initial test), divided by the number of new build dwellings.<sup>8</sup> This was analysed over the period from April 2016 to March 2018.

<sup>7</sup> DCLG, Airtightness testing Scheme Statistics: England and Wales, 2016. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/714057/180605\\_Air\\_Tightness\\_Testing\\_Master\\_Stats\\_April\\_2016\\_to\\_March\\_2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714057/180605_Air_Tightness_Testing_Master_Stats_April_2016_to_March_2018.pdf)

<sup>8</sup> MHCLG, Table 213 and 214: permanent dwellings started and completed by tenure England and Wales (quarterly), 2019. Available at: <https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building>.

This results in an average percentage of new build dwellings tested each year of 86% of all new build.

- 3.32. The counterfactual case is based on the current number of homes that have an airtightness test for Part L compliance purposes. This has been determined through the total number of airtightness tests undertaken on new homes,<sup>9</sup> corrected for (reduced by) additional testing based on unpublished data from BSRIA (e.g. due to testing during the construction process or additional testing when a home fails their initial test), divided by the number of new build dwellings.<sup>10</sup> This was analysed over the period from April 2016 to March 2018. This results in an average percentage of new build dwellings tested each year of 86% of all new build.
- 3.33. With 100% sample testing, the number of average new build dwellings to be tested each year in addition to those currently tested is based on the proportion of new build dwellings that are not currently tested, which is 14%. In practice, due to failures and subsequent retesting etc, based on published BSRIA data this increases the number of additional tests undertaken to around 16.6%.
- 3.34. Based on data by BSRIA, the cost of each test is on average £64.13 for volume housebuilders. Hence, the cost of extending air-permeability testing to 100% of new build UK properties will be therefore the number of homes constructed x 16.6% x £64.13.
- 3.35. The benefit is expected to be gained by the improvement of the air-permeability of those dwellings that are not currently tested. It is assumed for the purpose of this analysis that 100% testing could improve the air-permeability of the currently un-tested dwellings that would fail the initial test and require additional works to pass. It is assumed that airtightness testing will not impact on those homes that are currently un-tested but would be expected to pass the test first time. The benefit will be the fuel savings and reduced fuel bills that result from that improvement.
- 3.36. The number of dwellings that will benefit from a reduced air-permeability is therefore the number of homes constructed x 14% (number of homes not currently tested) x 10.08% (unpublished BSRIA estimate of the percentage of homes that currently fail the airtightness test i.e. the airtightness test result is poorer than their design air permeability).
- 3.37. The energy saving per benefitted dwelling was determined using the consultation version of SAP for the semi-detached house used elsewhere in the new domestic ADL1A modelling (the results from the semi-detached home were assumed on average to be representative of the building stock). Unpublished data from BSRIA shows that the typical design air permeability target is 5m<sup>3</sup>/m<sup>2</sup>h and on average failed tests (i.e. their first airtightness test) had an air-permeability that was 1.4m<sup>3</sup>/m<sup>2</sup>h poorer than the design air-permeability. Hence, we assumed the benefit from testing is associated with a reduction in air permeability from 6.4m<sup>3</sup>/m<sup>2</sup>h to 5m<sup>3</sup>/m<sup>2</sup>h. The results from SAP show a reduced energy consumption of 172kWh/year.
- 3.38. The overall costs and benefits for 100% sample testing, compared with continuation of the existing Part L 2013 standards, are shown in Table 7. This would apply under both option 1 and 2. As can be seen there is a net cost of this policy proposal.

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<sup>9</sup> DCLG, Air tightness testing Scheme Statistics: England and Wales, 2016. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/714057/180605\\_Air\\_Tightness\\_Testing\\_Master\\_Stats\\_April\\_2016\\_to\\_March\\_2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714057/180605_Air_Tightness_Testing_Master_Stats_April_2016_to_March_2018.pdf)

<sup>10</sup> MHCLG, Table 213 and 214: permanent dwellings started and completed by tenure England and Wales (quarterly), 2019. Available at: <https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building>.

| <b>Table 7: Summary of results from cost benefit analysis (100% sample testing)</b> |                     |
|---|---------------------|
|   | 100% sample testing |
| Energy savings (£M)   | 2.9                 |
| Incremental costs (£M)  | (20.5)              |
| <b>Total financial benefit/(cost) (£M)</b>  | <b>(18)</b>         |
| Carbon savings - non-traded (£M)  | 4.3                 |
| Carbon savings - traded (£M)  | -                   |
| <b>Total carbon savings (£m)</b>  | <b>4.3</b>          |
| Air quality savings (£m)  | 0.4                 |
| <b>Net benefit/(cost) (£m)</b>  | <b>(13)</b>         |
| Amount of gas saved (GWh)   | 333.5               |
| Amount of electricity saved (GWh)   | -                   |
| Amount of CO <sub>2</sub> saved - non-traded (MtCO <sub>2</sub> (e))                | 0.1                 |
| Amount of CO <sub>2</sub> saved - traded (MtCO <sub>2</sub> (e))                    | -                   |
| Cost effectiveness – non-traded (£/tCO <sub>2</sub> )                               | 282                 |
| Cost effectiveness – traded (£/tCO <sub>2</sub> )                                   | -                   |

### ***Carbon capping***

- 3.39. This proposed change involves capping carbon savings associated with an air-permeability below 3m<sup>3</sup>/m<sup>2</sup>h on naturally ventilated dwellings. The purpose of this would be to discourage the construction of overly tight naturally ventilated dwellings that could lead to poor ventilation and indoor air quality.
- 3.40. Data received from BSRIA confirms that this policy change has an impact on around 2% of naturally ventilated dwellings that have a design air permeability of below 3m<sup>3</sup>/m<sup>2</sup>h. In reality, around 5% of all new build naturally ventilated dwellings have a measured actual air-permeability of below 3m<sup>3</sup>/m<sup>2</sup>h @ 50 Pa, and hence it may be that a larger number of dwellings would be impacted by this proposed change.
- 3.41. It is assumed that the developer would still need to be compliant with the overall performance standards. Hence, the cost associated with this change would be the difference between the cost saving of construction to a reduced standard of air permeability and the additional costs of improvement elsewhere in the dwelling (e.g. to the building fabric or services) now necessary to comply.
- 3.42. The principle benefit would be expected to be achieving improved levels of ventilation in overly tight, naturally ventilated homes and the reduction of problems related to condensation and mould growth and decreased levels of respiratory illnesses associated with improved indoor air quality.
- 3.43. The cost and benefit of this policy change will be assessed more fully in the final stage impact assessment.

### **Part F**

- 3.44. There are a number of proposed changes to Part F. Many of the changes are intended to simplify the guidance and the associated costs and benefits are discussed later in this section. The analysis here focusses on changes where additional ventilation provisions are required. The combined impacts are presented at the end.

### ***Increased background ventilator sizing for naturally ventilated systems***

- 3.45. The proposed policy change is to simplify the guidance for naturally ventilated systems. As a consequence of this, it will result in an increase in the size of background ventilators for each naturally ventilated property with an air permeability leakier than 5 m<sup>3</sup>/hr/m<sup>2</sup>.
- 3.46. The percentage of new homes impacted per year is estimated based on the number of new homes that currently have a naturally ventilated system with an air permeability leakier than 5 m<sup>3</sup>/hr/m<sup>2</sup>. Data for new homes made available from EPCs lodged on the Energy Performance of Buildings Register suggests that 59% of new homes are naturally ventilated. Furthermore, unpublished BSRIA data estimates that 65% of these are leakier than 5 m<sup>3</sup>/hr/m<sup>2</sup>. Hence, it is assumed that this policy applies to 38% of new homes.
- 3.47. For simplicity, it is assumed the increased trickle ventilator area on average can be based on the semi-detached home. This results in the requirement of two additional background ventilators – one of 5000mm<sup>2</sup> and one of 10000mm<sup>2</sup> equivalent area. The total capital cost of these trickle ventilators per home is £17.
- 3.48. The benefit of this policy change is simplification and improved compliance. As previous Part F revisions assumed 100% compliance, no additional benefit has been accounted for here.

***Increased background ventilator sizing for MEV systems***

- 3.49. The proposed policy change is for the size of background ventilators to be increased from 2500mm<sup>2</sup> to 5000mm<sup>2</sup> equivalent area in habitable rooms for mechanical extract ventilation (MEV) systems.
- 3.50. The percentage of new homes impacted per year is estimated based on the number of new homes that currently have an MEV system. Data for new homes made available from EPCs lodged on the Energy Performance of Buildings Register suggests that this comprises 24% of new homes.
- 3.51. The total cost per home is estimated as £6. This is based on approximately 4 background ventilators per home on average.
- 3.52. The benefit of this policy change is improved air distribution in the home. This should lead to improved ventilation and indoor air quality, with associated health benefits. These benefits have not been monetised here and are intended to be included for the final Impact Assessment.

***Combined Part F impacts***

- 3.53. The overall costs and benefits for the proposed changes to Part F, compared with continuation of the existing Part F 2010 standards, are shown in Table 8. As discussed above, these only include net costs with around 80% arising from the amendments for naturally ventilated systems. As noted earlier, the currently non-monetised health benefit from the changes for MEV systems will be considered further for the final Impact Assessment.

| <b>Table 8: Summary of results from cost benefit analysis (Part F changes)</b> |        |
|--|--------|
|  | Part F |

|  |               |
|--|---------------|
| Energy savings (£M)                        | -             |
| Incremental costs (£M)                     | (29.6)        |
| <b>Total financial benefit/(cost) (£M)</b> | <b>(29.6)</b> |
| Carbon savings - non-traded (£M)           | -             |
| Carbon savings - traded (£M)               | -             |
| Total carbon savings (£m)                  | -             |
| Air quality savings (£m)                   | -             |
| <b>Net benefit/(cost) (£m)</b>             | <b>(29.6)</b> |

### Improved Compliance and Performance

- 3.54. In some new homes there is a gap between the designed and as-built performance of new buildings. The cause is poor build quality leading to non-compliance with the Part L and F standards.
- 3.55. The consultation is putting forward proposals for guidance for typical performance gap issues, a new-style compliance report, more information to building control, more information to householders to encourage housebuilders to improve the performance of new buildings. The consultation is also putting forward proposals for home user guides which will better inform new householders on how to use their home. Costs have currently not been monetised and will be considered further in the final Impact Assessment.
- 3.56. The consultation is also putting forward proposals to simplify the guidance in the Approved Documents. Whilst simplification, in principle, should lead to reduced time in understanding and following the guidance, it is assumed that there is no reduced time compared to continuing to follow the current standards with which the housebuilding industry is already familiar.

### Impact of Ban on Combustible Materials

- 3.57. The government banned the use of combustible materials in the external walls of on new residential buildings with a storey 18m or more in height. This impacts on the choice of external wall systems, including the type of insulation adopted. The costs and benefits of this ban under current Part L has been assessed in another Impact Assessment.<sup>11</sup>
- 3.58. This consultation is proposing to raise the target emission factor and introduce a target primary energy in the Part L standards which may result in additional costs for residential buildings with a storey 18m or more in height. In particular, the current notional building external wall U-value is 0.18 W/m<sup>2</sup>K. This consultation is proposing to keep this U-value for the option 2 (which adopts Fabric 1 specification) but is proposing to adopt a U-value of 0.15 W/m<sup>2</sup>K in the notional building for the option 1 (which adopts for Fabric 2 specification). There is also an uplift to the limiting fabric standards to 0.26 W/m<sup>2</sup>K.
- 3.59. Neither the target emission factor or the target primary energy requires a developer to adopt a higher standard of external wall insulation. Part L sets performance-based targets that can be achieved through a combination of fabric and building service efficiency measures as well as the adoption of low carbon/primary energy sources. Hence, there is significant flexibility in how the Part L targets are complied with. Furthermore, the cost-benefit of improving the standard of external wall insulation is less attractive for high rise apartments compared to most other dwelling types due to their relatively low external wall area to indoor volume ratio and thus relatively low space heating loads – hence making alternative means of complying with Part L more attractive. The uplift to limiting fabric standards could require a developer to adopt a higher standard of external wall insulation;

<sup>11</sup> <https://www.gov.uk/guidance/ban-on-combustible-materials>

however, it is expected that most developers are already building to this standard in order to meet the existing target emission rate and fabric energy efficiency in ADL1A 2013.

- 3.60. This Impact Assessment has monetised costs and benefits for dwellings not captured by the ban. In particular, it has only considered lower-rise apartment buildings. The additional costs for high-rise homes associated with the ban will be considered further in the final Impact Assessment.

## Training

- 3.61. There are transition costs incurred by businesses to familiarise their employees with the new technical requirements. We note that the overarching methodology has not changed (e.g. businesses will continue to use SAP to assess Part L compliance for new homes). Furthermore, the higher standards that will come into force are progressive i.e. should be able to be met in the main through straight forward amendments to current practices rather than radical changes in the way new buildings are constructed.
- 3.62. We assume that training is necessary for developers and associated professional services to design the buildings to the new Regulations and procure the appropriate building components, for the supply chain to be ready to meet this demand and for building control to assess the building applications and work.
- 3.63. Our estimated costs for training and dissemination is based on the previous change to Part L regulations (2013) when applied to new homes only, which assumes that there will be external training courses and that information from the external course would then be disseminated further internally. In addition, we assume that there will be indirect familiarisation costs associated with employees learning how the changes would affect their work; and also for small builders, we assume an initial cost associated with rejected building applications due to error in not updating to new standards.

| <b>Table 9: Transitional training cost to business (£mil)</b> |   |
|---|---|
|   | <b>Cost (£millions)</b>                 |
|   | <i>2011 base year, 2012 prices year</i> |
| External Training Cost  | 0.32                                    |
| Internal Training Cost  | 0.49                                    |
| Total Training Cost   | 0.81                                    |
| Familiarisation Cost  | 0.92                                    |
| Application Cost to Small Builders                            | 0.60                                    |
| <b>Total</b>  | <b>£3.14 million</b>                    |

- 3.64. Using the HMT GDP deflator, this means that the estimated transitional costs in 2019 base year and 2020 price year is **£3.15 million**.
- 3.65. Please note however that this estimate needs to be treated with caution as the scale and process for training and dissemination may be different for this set of regulations; we will need to use information gathered during consultation to produce a more robust analysis, and this will inform the final IA.

## **Transitional arrangements**

- 3.66. The more stringent transitional arrangements will mean that the Part L standard that developers need to build to will no longer apply indefinitely across whole development sites. This should mean that more homes are built to the new Part L standards sooner; this will result in greater energy and carbon savings but may be more expensive to developers. Anecdotally, the transitional arrangements could also lead to faster build-out on sites as developers may prefer the certainty of building to the same standards for the whole site.
- 3.67. However, it has not been possible to monetise in detail this impact. This will be reviewed in more detail for the final stage impact assessment.

## **Comfort taking**

- 3.68. Comfort taking is when reduction in heating bills leads to some householders choosing to heat their homes to higher temperatures. Consideration was made as to whether comfort taking should be taken into account in the new homes model.
- 3.69. With reference to the approach taken in the Green Deal IA; the most appropriate approach to take for comfort taking in new homes was unclear. The Green Deal IA's calculation of 15 per cent comfort taking for existing dwellings was based mostly on existing social housing rather than owner-occupiers. A further and larger extrapolation would be required to take the same conclusions to new-build homes, which is most relevant in this case. Since people in different situations are unlikely to perceive the same value of comfort, it is not reasonable to assume the same level of comfort taking for existing and new homes. The counterfactual for the new homes analysis is a Part L 2010 standard which is already a much more energy efficient standard than for a typical existing home. It is much less likely that there would be substantial further comfort taking from this uplift because consumers are unlikely to perceive this relatively small difference in standards. Furthermore, given the lack of empirical data available, applying any other assumption other than no comfort taking would effectively involve the imposition of an arbitrary assumption. We have therefore applied no comfort taking to new dwellings.

## **WIDER IMPACTS**

### **Economic and financial impacts**

#### ***Competition***

- 4.1. The principal markets affected by the 2020 policy are the markets for the development of new domestic buildings along with the supply chains for the production of construction materials used in those developments.
- 4.2. As a result of higher standards for new buildings from 2020, building developers would have to comply with the more stringent targets and as a result would see costs rise. As the increase in costs will affect all developers equally, any competitive effects in the market for building development are likely to be negligible.
- 4.3. Both Part L uplift options for 2020 assume some improvement in fabric and services specifications. If fabric energy efficiency had been improved in isolation, this could have given manufacturers of products which impact on fabric performance (insulation, windows) an advantage over those involved in manufacturing and supplying building services (e.g. boilers, lighting); however, this is not the case. Furthermore, flexibility is provided in a way that developers can meet the higher performance standards, which should ensure that no one product or manufacturer can dominate any part of the market.

#### ***Innovation***

- 4.4. Particularly with respect to raising the Part L standards for new homes, there should be the potential for new firms to enter the market due to the setting of higher standards and the flexibility for developers to choose building technologies to meet these standards. This should encourage innovation among manufacturers.
- 4.5. The options for more ambitious improvements in standards would likely result in an increased use of low and zero carbon generation technologies. There is competition in the supply of such technologies with a mix of large and small suppliers. As the cumulative production of such technologies rises, learning effects coupled with competition should bring down the unit cost. This learning effect has been built into our modelling of costs.

#### ***Small businesses***

- 4.6. Small businesses in the housing sector principally comprise developers, constructors, architects, engineers and other technical specialists. The impacts of a change in building standards are likely to be most significant for developers as any change in costs will affect their cost of business. For other parties, impacts are most likely to comprise a short term need to understand and revise practices to reflect the new requirements, however this is unlikely to be above the level that would be typically expected as part of ongoing professional development.
- 4.7. Small developers typically operate in a different segment of the housing market to larger businesses and will undertake projects that are not well suited to a larger developer's business model such as smaller sites or those requiring a more bespoke design solution. Therefore, while the impact of new standards on absolute build costs for a smaller developer may be higher than those for a larger business, this does not necessarily mean they will be affected more significantly. This is because their starting cost base is likely to be higher and other elements of their business model will differ.

- 4.8. Further, smaller developers are less likely to hold land for extended periods prior to development. This means that the implications of new standards on small development companies may be more easily accommodated by altering their land offers whereas for larger businesses developing sites that they have owned for several years, any additional costs of new meeting standards are more difficult to pass back to the landowner.<sup>12</sup>
- 4.9. As discussed above in the section on transition costs, for Option 1 the increase in fabric specification may be more difficult to adjust to for smaller businesses who employ their own workforce and will therefore need to retrain. For option 2 both larger and smaller businesses will likely subcontract the installation of solar panels and alternative methods of complying with these standards such as installing heat pumps. Familiarisation will therefore not be an issue, but smaller and larger developers will receive varying quotes to account for the economy of scale. As discussed above the starting cost base is already different for smaller businesses.
- 4.10. We intend to use the consultation process to gather up-to-date information about differences in the effects of the regulations on small business; it is worth noting that in the responses to the consultation in Part L 2013, small and micro businesses preferred less significant changes to energy performance standards for each of new and existing, domestic and non-domestic buildings, which seems to indicate that these businesses will be disproportionately impacted by these types of changes involving increases in standards.

## **Social impacts**

### ***Housing supply***

- 4.11. MHCLG has conducted a study of the impacts of the policy on housing supply based on internal viability modelling. In this case, we assume that this policy would lead to increasing build cost, which could deter constructors from building as many houses as it may not be possible to pass this cost onto the price of land. This would then have a negative impact on net additional housing.
- 4.12. We are also aware that the sector will not have had a long lead in time before this change is introduced and so it is unlikely that these costs will be factored into land purchases in the short run (especially where developers have already purchased sites for future pipeline developments). As such, the short term impact on housing supply viability may be slightly more volatile, but we also believe that the system as a whole is sufficiently robust to be able to absorb unanticipated costs in other ways. For example, developers have options to renegotiate their Section 106 or make changes to planning permissions to absorb these costs.
- 4.13. There are a number of ways in which increased costs could manifest, of which a reduction in supply is just one possibility. More analysis would need to be carried out during consultation to understand this better.

### ***Health and well-being impacts***

- 4.14. There are improvements in indoor air quality, and consequently occupant's health and well-being, from the proposed changes to Part F. Improved indoor air quality arises as a result

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<sup>12</sup> This impact is at least partially offset by the current existence of transitional arrangements that allow construction to older building standards provided the development has commenced, however this will not be the case in every instance.

of better air distribution between rooms and simplification of the guidance which should deliver greater compliance and reduce the risk of under-ventilation.

- 4.15. There are also potentially beneficial improvements in health and quality of life from the effect of increased energy efficiency on thermal comfort. We do need to be mindful of the potential effects that tighter building envelopes could have upon indoor air quality and indoor temperatures in summer. Hence, the parallel review of Parts F and L, and a planned consultation on new requirements and guidance to reduce the risk of overheating in new homes.

### **Rural impacts**

- 4.16. Assessing rural impacts means determining whether the impacts on rural areas will be different to those for urban areas, and whether there are specific local or regional effects.
- 4.17. Part L currently includes a fuel factor which differs by fuel type for heating. One purpose was to provide some relief in the target applicable to dwellings that are off the gas grid principally those in rural areas. The fuel factor means that if the chosen heating fuel is more carbon intensive than gas (such as oil or LPG), the carbon emissions target is increased making it less demanding. Without the fuel factor, builders would have to build to higher (and more expensive) fabric and/or services standards in order to meet the same emissions target as homes connected to a gas supply.
- 4.18. The consultation seeks views on the option to remove the fuel factor. Note that due to the changes in carbon emission factors described previously, electricity use is now less carbon intensive than gas and thus the fuel factor is automatically dis-applied for heat pumps or direct electric heating; thus this proposed change has no impact on rural homes adopting an electric heated solution. Note that in this assessment we have continued to apply the fuel factor to the carbon target, rather than the primary energy target, as the carbon target is the harder to achieve for higher-carbon fossil fuels.
- 4.19. Analysis suggests that there may not be any substantive cost difference between retaining or removing the fuel factor in practice if complying with the Part L 2020 option 2 target. It will be challenging in either case to comply with this target using LPG or oil as fuels e.g. the design specifications for Option 2 in Table 4 will not be sufficient as the amount of PV likely to comply would exceed the roof area available (although it may be possible to comply with more expensive and efficient PV panels than assumed in the option 2 specification). A lower cost option is likely to be to change to a low carbon heat source, such as an air source heat pump. As the analysis below Table 5 shows, the adoption of an air source heat pump can be a relatively low capital cost option to meet the Part L 2020 option 2 target. Moving to a low carbon heat source means that the need for a fuel factor becomes redundant.
- 4.20. From discussion with industry, we are aware that there are many homes off of the gas grid that are already being constructed with heat pumps instead of using oil or LPG.

### **Environmental impacts**

- 4.21. The environmental impacts are central to this policy and are therefore covered in the main body of this impact assessment.

### **Administrative burdens**

- 4.22. Administrative burdens are identified as the costs to businesses of legal requirements to provide information.
- 4.23. This consultation is proposing to introduce new mandatory requirements on the developer to provide information to both a Building Control Body and to the householder. The information being provided to each is a new style compliance report, the Building Regulations England Part L report (BREL) and photographic evidence. From discussions with industry we understand that many developers already have photographic evidence of the building work of interest. A compliance report is already produced from SAP software, the extra details required is believed to be little extra burden. There may be costs associated with collating, emailing and printing; but these are believed to be minimal, in the order of <£10 per dwelling. The benefits of improved compliance would likely outweigh the costs significantly.

## Appendix A – Net Completions Projection

Below is the independent analysis conducted by Adroit Economics of the number of net completions broken down by building type. This is used in our cost benefit modelling.

| Building Type       | Annual number of net completions |        |        |        |        |        |        |        |        |        |
|---------------------|----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                     | 2020                             | 2021   | 2022   | 2023   | 2024   | 2025   | 2026   | 2027   | 2028   | 2029   |
| Detached* house     | 71,000                           | 73,000 | 75,000 | 76,000 | 76,000 | 76,000 | 76,000 | 76,000 | 76,000 | 76,000 |
| Semi-detached house | 57,000                           | 58,000 | 60,000 | 61,000 | 61,000 | 61,000 | 61,000 | 61,000 | 61,000 | 61,000 |
| Terraced house      | 38,000                           | 40,000 | 41,000 | 42,000 | 42,000 | 42,000 | 42,000 | 42,000 | 42,000 | 42,000 |
| Flats               | 65,000                           | 67,000 | 69,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 |

\*Bungalows have been included in the detached house category, and represents around 5% over its total

Source: Adroit Economics

These estimates of new build completions are produced by an independent consortium. They are indicative and should be used for appraisal purposes only and do not represent an official forecast of changes in housing supply.

Please note, these projections are not an estimate of 'net additions', which is the figure usually used to calculate changes in housing supply. They do not account for change of use or conversions, which are a significant element of net addition but is outside the remit of this impact assessment; nor does it capture the impact of policy interventions that could increase industry's capacity to build new houses.

## Appendix B – Cost Breakdown

The developed costs are based on the expert view of Currie & Brown's cost specialists, drawing on evidence from their internal cost datasets, recent published cost data and information provided by suppliers.

The cost analysis is intended to reflect typical national costs from Q2 2019 that might be incurred by a medium sized housebuilder using traditional (i.e. masonry) construction methods and with a reasonably efficient supply chain, design development and construction processes. However, costs incurred by individual organisations will vary according to their procurement strategies, the location of their activity (e.g. costs will be higher in London and the South East of England) and the detail of their housing product. These variations design, location and delivery method could result in a cost range of +/- c.30% or more. Notwithstanding these variations, the proportional uplifts associated with moving from one specification to another are likely to be similar across different market segments<sup>13</sup>.

To provide context to the cost variations assessed in the study an indicative overall build cost (£ per m<sup>2</sup>) for each building archetype was estimated using Currie & Brown internal data. This figure is indicative of the level of cost that might be expected for a home built in accordance with the requirements of Part 2013. The build cost should be taken as indicative only as it is sensitive to a wide range of design and specification variables in addition to the economies of scale and regional variations discussed previously.

Base costs for future years are those for the 2019 price year, and subject to adjustments for learning for technologies that have not yet reached a mature market position. It should be noted that construction costs can vary considerably and rapidly with market conditions, particularly where activity levels result in a change in the availability of skills and materials. In these situations, it is not unusual to see quite large (several percentage points) change in overall costs over a period of months.

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<sup>13</sup> Costs increases may be outside the described range for highly bespoke designs, however these homes are typically more expensive to build and so the relative impact on build costs may be similar or potentially smaller than for more typical homes built in higher volumes.

Table B.1 includes details of the cost information used for each specification option, including any variations between building type, costs are only shown for those specifications that vary between the considered specification options.

| <b>Table B.1: Cost data for fabric elements that vary between the selected specifications</b>       |   |                   |                       |
|---|---|-------------------|-----------------------|
| Element   | Specification                                       | Unit              | New cost (£ per unit) |
| External Wall – plasterboard, blockwork, mineral wool brick, lintels, ties and cavity trays/closers | 0.18 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £221                  |
|   | 0.15 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £224                  |
| Ground / Exposed Floor  | 0.13 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £153                  |
|   | 0.11 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £159                  |
| Roof – mineral wool insulation at joist level   | 0.13 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £185                  |
|   | 0.11 W/m <sup>2</sup> .K                            | m <sup>2</sup>    | £187                  |
| Windows uPVC  | 1.4 W/m <sup>2</sup> .K                             | m <sup>2</sup>    | £240                  |
|   | 1.2   | m <sup>2</sup>    | £300                  |
|   | 0.8   | m <sup>2</sup>    | £360                  |
| Waste-Water Heat Recovery   | Vertical pipe system (houses and upper floor flats) | Nr                | £400                  |
|   | Tray system (ground floor flats)                    | Nr                | £1200                 |
| Radiators (installed but excluding heating pipework)  | Standard  | Nr                | £60                   |
|   | Sized for low temperature heating                   | Nr                | £90                   |
| Roof mounted - photovoltaic panels  | Fixed costs for systems <4kWp                       | Per installation  | £1,100                |
|   | Variable costs for systems <4kWp                    | Per kWp installed | £800                  |
|   | Variable costs for systems >4kWp                    | Per kWp installed | £1,100                |

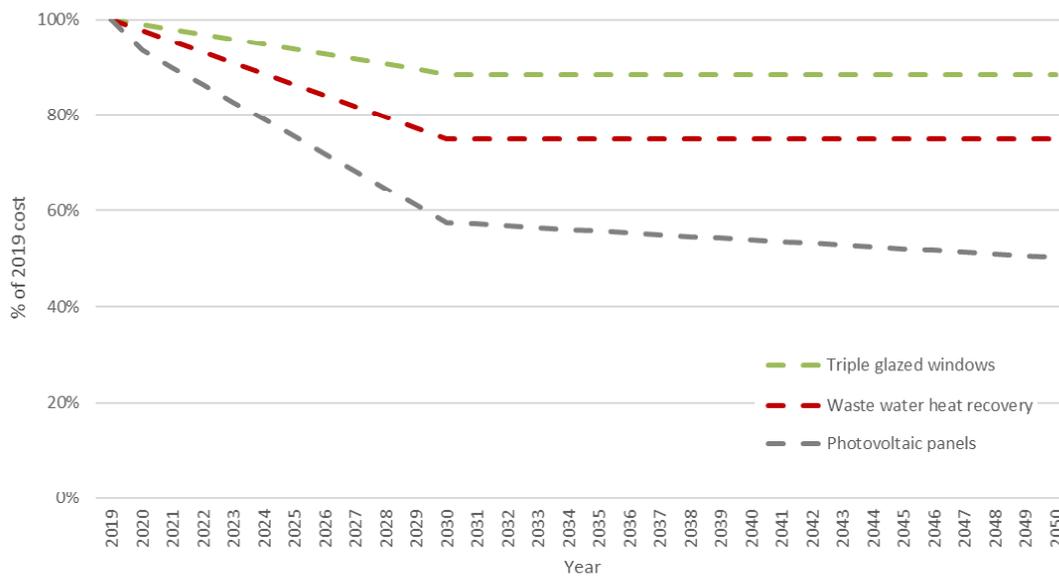
## Cost projections

Cost projections were assigned to each specification option to capture any expected change in the current cost over time. For many building elements no adjustment was applied to the current costs because the technology is deemed mature and unlikely to experience a significant reduction in cost per unit of performance. This does not mean that cost in the future will be unchanged, only that it is not projected to change in a manner that is disproportionate to the wider construction cost base.

For more immature specifications, the potential for future reductions in cost through learning was assessed based on existing published cost projections or by applying appropriate learning rates to global market projections.

Figure A.1 shows the future cost projections of technologies relevant to this consultation. These cost projections are relative to 2019 costs and do not account for other economic and market factors that will impact costs over this period (e.g. market conditions, interest and exchange rates, skills availability and commodity prices).

**Figure A.1 Projected variation in base costs as a result of learning**



The analysis does not include any medium to long term cost savings associated with productivity gains of the sort envisaged by the Construction Sector Deal and the Construction Strategy 2025. Should these savings be realised, then this would have the effect of reducing build costs and the additional costs of more energy efficient and lower-carbon buildings, making the achievement of tighter standards more cost-effective. Further analysis of the relationship between build standards and construction productivity is ongoing.

## Appendix C – Primary energy and carbon factors

The below tables contain the calculated primary energy and CO<sub>2</sub> emission factors used to develop the Part L 2020 options; these can also be found in cSAP.

|   | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Standard tariff</b>                                | 1.602 | 1.593 | 1.568 | 1.530 | 1.487 | 1.441 | 1.410 | 1.413 | 1.449 | 1.504 | 1.558 | 1.604 |
| <b>7-hour tariff (high rate)</b>                      | 1.635 | 1.626 | 1.600 | 1.562 | 1.518 | 1.471 | 1.440 | 1.443 | 1.479 | 1.535 | 1.591 | 1.637 |
| <b>7-hour tariff (low rate)</b>                       | 1.521 | 1.512 | 1.488 | 1.453 | 1.411 | 1.368 | 1.339 | 1.342 | 1.376 | 1.428 | 1.480 | 1.522 |
| <b>Electricity sold to or displaced from grid, PV</b> | 1.715 | 1.697 | 1.645 | 1.567 | 1.478 | 1.389 | 1.330 | 1.336 | 1.405 | 1.513 | 1.623 | 1.718 |

Source: BRE, CO<sub>2</sub> and Primary Energy Summary Tables for AECOM 2019\_04\_26

|                    | PEF   |
|--------------------|-------|
| <b>Mains gas</b>   | 1.130 |
| <b>LPG</b>         | 1.141 |
| <b>Heating oil</b> | 1.180 |

Source: BRE, CO<sub>2</sub> and Primary Energy Summary Tables for AECOM 2019\_04\_26

|  | PEF | Description of Application in Analysis  |
|--|-----|---|
| <b>Renewable heat on-site</b>  | 0   | Applied to heat pumps and solar thermal. Both technologies offset demand and therefore primary energy for other heating fuels.  |
| <b>Renewable electricity on-site</b>   | 0   | PV – applied to portion of electricity generated by PV and used on-site (as calculated in draft SAP 10). The total electricity generated by PV also offsets grid-supplied electricity at the 'electricity sold to or displaced from grid, PV' PEFs in Table C.1 above.  |
| <b>Renewable electricity off-site (as part of grid mix, or exported to grid)</b> | 1   | Affects grid electricity factors in Table C.1 above. PV – applied to portion of electricity generated by PV and exported to grid (as calculated in draft SAP 10). The total electricity generated by PV also offsets grid-supplied electricity at the 'electricity sold to or displaced from grid, PV' PEFs in Table C.1 above. |

Source: BEIS/MHCLG, 21/06/19

|   | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Standard tariff</b>                                | 0.163 | 0.160 | 0.153 | 0.143 | 0.132 | 0.120 | 0.111 | 0.112 | 0.122 | 0.136 | 0.151 | 0.163 |
| <b>7-hour tariff (high rate)</b>                      | 0.171 | 0.168 | 0.161 | 0.150 | 0.138 | 0.125 | 0.117 | 0.118 | 0.128 | 0.143 | 0.158 | 0.171 |
| <b>7-hour tariff (low rate)</b>                       | 0.143 | 0.141 | 0.135 | 0.126 | 0.116 | 0.105 | 0.098 | 0.099 | 0.107 | 0.120 | 0.133 | 0.144 |
| <b>Electricity sold to or displaced from grid, PV</b> | 0.196 | 0.190 | 0.175 | 0.153 | 0.129 | 0.106 | 0.092 | 0.093 | 0.110 | 0.138 | 0.169 | 0.197 |

Source: BRE, CO<sub>2</sub> and Primary Energy Summary Tables for AECOM 2019\_04\_26

|                    | CEF   |
|--------------------|-------|
| <b>Mains gas</b>   | 0.210 |
| <b>LPG</b>         | 0.241 |
| <b>Heating oil</b> | 0.298 |

Source: BRE, CO<sub>2</sub> and Primary Energy Summary Tables for AECOM 2019\_04\_26