Programme Area: Smart Systems and Heat

Project: Value Management

# Title: Overcoming barriers to smarter heat solutions in UK homes - Annexe 3e: Assumptions on current and future levels of insulation


## Abstract:

This document was prepared at the time to contribute to ETI internal thinking and planning only it should be read in the context of the final reports of the Building Retrofit Project on the ETI website


## Context:

This project studied how value can be delivered across a smart energy value chain - in the context of the UK. It built a clear understanding of how smart energy systems can deliver combined consumer value alongside commercial value for market participants - producers, suppliers, distributors. The analysis will help to make the commercial deployment of smart energy systems more likely. This £600,000 project was delivered by Frontier Economics, a leading economic consultancy.

# Overcoming barriers to smarter heat solutions in UK homes

## Annexe 3e: Assumptions on current and future levels of insulation

PREPARED FOR THE ETI

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# 1 Introduction

The assumptions regarding the cost and effect of insulation in the previous version of BMET were such that it was never worthwhile for consumers to take it up. Given this, the ETI decided to carry out a quantitative and qualitative analysis to understand better both:

- the thermal efficiency of the existing housing stock; and
- the potential for (and cost of) further improvements in thermal efficiency through insulation retrofits tailored to the BMET property archetypes.

As a result of this analysis, the assumptions within BMET have been updated, and are used for the analysis in the rest of this report.

This annexe summarises the new insulation assumptions and how they have been derived.

# 2 Thermal efficiency of the existing housing stock

The ETI used a model developed by BRE to define the baseline insulation assumptions. This tool is able to calculate the total gas consumption, based on assumptions regarding the building fabric, usage, and heating technology.[1] The thermal efficiency of each building type (in kWh/year) was derived by dividing this gas consumption by the BRE boiler efficiency.

The ETI first mapped the dwelling characteristics of BMET customer groups to the existing BRE housing archetypes. The BMET customer groups are derived from the customer groups created for the ETI's Optimising Thermal Efficiency of Existing Housing (OTEoEH) project, which already contains such a mapping. For example, Young Starters are assumed to most commonly occupy the following types of property:

- pre-1919 mid-terrace properties;
- 1965-1980 purpose-built, low-rise flats; and
- pre-1919 converted flats.

Customer groups within BMET are assumed to be homogenous (i.e. all customers within the group have the same heat requirements), and the ETI therefore chose a single representative archetype for each group. For Young Starters, this was "pre-1919 mid-terrace properties", the most prevalent property type for this group.

Initial runs of the BRE tool for these archetypes produced extremely high gas consumption figures, which were considerably above typical annual gas consumption figures produced by Ofgem. Further inspection indicated that this was likely due to the BRE archetypes not including retrofits which are already highly prevalent among the population. The English Housing Survey[2] estimates that:

- 66% of English households had cavity wall insulation in 2012;
- 79% of households had full double-glazing; and

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1 The BRE tool includes both a primary and secondary heat source. The secondary heat source was set to electricity, and was not used in calculating the thermal efficiency of the property. This is since BMET uses overall electricity load profiles which will already include an allowance for secondary electrical heating.

2 English housing survey 2012: energy efficiency of English housing report - https://www.gov.uk/government/statistics/english-housing-survey-2012-energy-efficiency-of-english-housing-report

- 89% of households had some loft insulation, with 57% having above 150mm.

The ETI drew such data to update the baseline insulation measures for the different building types.

We cross-checked the resulting gas consumption figures under this baseline to Ofgem's range to ensure that the baseline gas consumption is aligned with Ofgem gas consumption figures.[3] Ofgem publishes "low", "medium" and "high" annual gas consumption figure. These account for the first, second, and third quartile of gas consumption: A quarter of households have gas consumption below the "low" figure, a quarter between "low" and "medium", a quarter between "medium" and "high", and a quarter above "high". **Figure 1** shows that the baseline gas consumption figures under the new set of insulation assumption falls well within Ofgems' range. Under the current set of insulation assumptions, the population weighted mean of total gas consumption is 14,599 kWh, which is slightly higher than Ofgem's medium gas consumption of 13,500 kWh.

The new BMET figures are less dispersed than Ofgem's figures would indicate (no households have a consumption below the "low" figure, while only one group is above the "high" figure). We consider that this is due to the homogeneity of BMET consumer groups. In reality, households within each group would be differentiated, with some being particularly more or less efficient than average (for example due to different occupancy patterns).

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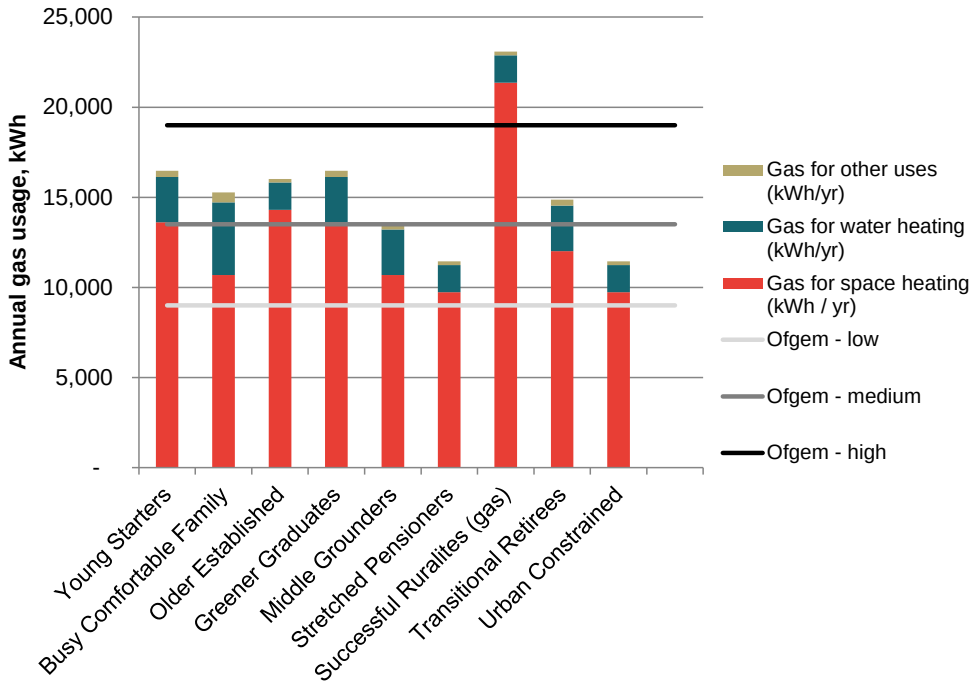
3 Note that boiler efficiency was set to the ESME and BMET default figure of 87% for this exercise.

**Figure 1.** Baseline gas consumption compared to Ofgem's figures




Source: The ETI and Ofgem

The table below summarises, for each BMET group, the BRE archetype that was chosen, and the resulting thermal efficiency.

**Table 1.** Baseline thermal efficiency assumptions

| BMET group | BRE archetype | Modifications made to BRE archetype | Heat requirements (kWh/year) |
|---|---|---|---|
| **Young starters** | Pre-1919 mid-terrace properties | Loft insulation and double-glazing (u-value[4] of 2) added | 11,847 |
| **Busy comfortable family** | Post- 1980 detached | Loft insulation and double-glazing (u-value of 2) and cavity walls insulation added | 9,306 |
| **Older established** | 1965- 1980 detached | Loft insulation, double-glazing (u-value of 2) and cavity walls insulation added | 12,449 |
| **Greener graduates** | Pre-1919 mid-terrace properties | Loft insulation and double-glazing (u-value of 2) added | 11,847 |
| **Middle Grounders** | Post- 1980 detached | Loft insulation and double-glazing (u-value of 2) and cavity walls insulation added | 9,306 |
| **Stretched pensioners** | 1945 -1964, semi detached | Loft insulation, double-glazing (u-value of 2) and insulated cavity walls added | 8,022 |
| **Successful ruralites (gas)** | Pre-1919 semi-detached | Loft insulation and double-glazing (u-value of 2) added | 18,589 |
| **Transitional retirees** | 1919-1944 semi-detached | Loft insulation and double-glazing (u- | 10,455 |

[4] A U-Value is a measure of heat loss from a building element. Higher U-Values indicate worse thermal performance. A U-Value of 2 would be consistent with a relatively recent (but not state-of-the-art) double glazing installation.

**Table 1.** Baseline thermal efficiency assumptions

| BMET group | BRE archetype | Modifications made to BRE archetype | Heat requirements (kWh/year) |
|---|---|---|---|
| | | value of 2) added | |
| **Unconvinced dependents** | 1945-1964, low rise, purpose built flat | Loft insulation, double-glazing (u-value of 2) and cavity wall insulation added | 8,022 |
| **Urban constrained** | 1945-1964, semi detached | Loft insulation, double-glazing (u-value of 2) and cavity wall insulation added | 8,022 |
| **Successful ruralites (oil)** | Pre-1919 semi-detached | Loft insulation and double-glazing (u-value of 2) added | 18,589 |
| **Off grid rural electric** | Pre-1919 semi-detached | Loft insulation and double-glazing (u-value of 2) added | 18,589 |

Source: The ETI, using BRE tool

# 3 Assumptions on upgrades of insulation

To update the insulation packages for each customer group, the ETI used the BRE tool to simulate the effectiveness of different components of an insulation retrofit package in isolation.

A subjective judgement approach was taken to define an appropriate retrofit package for each consumer group. This judgement was made based on the English Housing Survey report and the assumed details of the consumer groups defined in the outputs of the OTEoEH project (e.g. wage bracket and vulnerability).

The individual retrofit measures investigated for each of the consumer groups were:

- external wall insulation;
- internal wall insulation;
- floor insulation;
- window replacement (U-values of 0.8, 1.2, 1.5 and 2.0 investigated); and
- door replacement.

For some of the customer groups, the ETI defined two optimal insulation packages that would entail different capital expenditures: a default and an alternative package. For example, solid walls can be insulated using internal or external insulation. The former is considerably more expensive and reduces floor space, but preserves the exterior look of the property. Urban houses with solid walls were assumed to use external wall insulation by default (due to its cost-effectiveness and an unwillingness to lose floor space in smaller urban properties), while older rural houses were assumed to use internal wall insulation by default (as homeowners might be more concerned about aesthetics, and less about the loss of floor space from larger rooms).

Some consumer groups in BMET may be unable to afford the more expensive package due to credit constraints. The model user can switch between these package options to determine the effect they have on take-up of insulation (and, ultimately, business models). **Table 2** summarises the packages chosen for each consumer group.

Note that many groups have no available insulation upgrade. This is since, based on English Housing Survey data, all groups are assumed to start with double-glazing and loft insulation,[5] and many are assumed to have cavity wall insulation.

**Table 2.** Insulation retrofit options

| BMET group | Insulation measures | Cost to consumer | Resulting Heat requirements (kWh/year) |
|---|---|---|---|
| **Young starters** | External wall insulation | £10,176 | 6,038 |
| | Internal wall insulation | £15,026 | 5,820 |
| **Busy comfortable family** | [None available] | | |
| **Older established** | [None available] | | |
| **Greener graduates** | External wall insulation | £10,176 | 6,038 |
| | Internal wall insulation | £15,026 | 5,820 |
| **Middle Grounders** | [None available] | | |
| **Stretched pensioners** | [None available] | | |
| **Successful ruralites (gas)** | Internal wall insulation | £27,853 | 6,877 |
| | External wall insulation | £19,803 | 7,219 |
| **Transitional retirees** | Cavity wall insulation | £961 | 5,075 |
| **Unconvinced dependents** | [None available] | | |

5 The EHS data, as set out above in this document, indicates that a high proportion of houses have these interventions installed. Within BMET, either all or none of the customers in a group must have the intervention. Since we do not have evidence that any one group has an unusually low take-up of either of these interventions, we have therefore assumed that all groups have them.

**Table 2.** Insulation retrofit options

| BMET group | Insulation measures | Cost to consumer | Resulting Heat requirements (kWh/year) |
|---|---|---|---|
| **Urban constrained** | [None available] | | |
| **Successful ruralites (oil)** | Internal wall insulation | £27,853 | 6,877 |
| | External wall insulation | £19,803 | 7,219 |
| **Off grid rural electric** | Internal wall insulation | £27,853 | 6,877 |
| | External wall insulation | £19,803 | 7,219 |

Source: ETI runs of BRE tool

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