



Programme Area: Buildings

Project: Building Supply Chain for Mass Refurbishment of Houses

Title: Refined costing methodology in the ETI thermal efficiency model

Abstract:

Please note this report was produced in 2011/2012 and its contents may be out of date. This deliverable is number 2b of 7 in Work Package 2. It presents the initial approach to the costing methodology for thermal efficiency improvements to be employed by the project and incorporated into the computer model being developed. Accurate cost information for retrofit interventions is key to ensuring the identification and development of the optimum solutions for each housing archetype previously identified in deliverable D2.1. This costing detail will be incorporated into the definition of retrofit interventions in Work Package 3.

Context:

This project looked at designing a supply chain solution to improve the energy efficiency of the vast majority of the 26 million UK homes which will still be in use by 2050. It looked to identify ways in which the refurbishment and retrofitting of existing residential properties can be accelerated by industrialising the processes of design, supply and implementation, while stimulating demand from householders by exploiting additional opportunities that come with extensive building refurbishment. The project developed a top-to-bottom process, using a method of analysing the most cost-effective package of measures suitable for a particular property, through to how these will be installed with the minimum disruption to the householder. This includes identifying the skills required of the people on the ground as well as the optimum material distribution networks to supply them with exactly what is required and when.

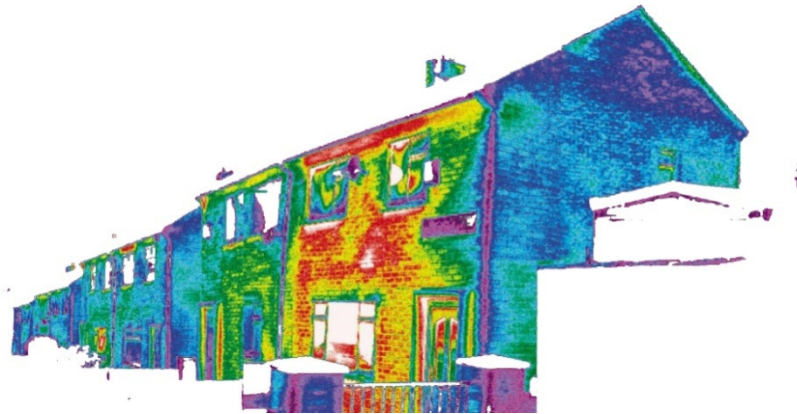
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The **ENERGY ZONE**
CONSORTIUM:

bre



Optimising Thermal Efficiency
of Existing Housing

Refined costing methodology in the ETI-TE model (WP2.2b)

FINAL REPORT

Submitted by BRE on behalf of the
ENERGY ZONE CONSORTIUM

June 30, 2011

EXECUTIVE SUMMARY:

The principal objective of this workpackage item is to provide a set of costs which will form the basis of those used within the ETI Thermal Efficiency computer model. These costs are not intended to be used directly as inputs into the model, but should be used selectively and adjusted as appropriate to investigate alternative scenarios (such as those from an alternative supply chain). The costs should provide sufficient information and flexibility to allow estimates of the cost of refurbishment to be produced under alternative scenarios.

The development of costs for improvements in the project is a three stage process. The initial stage (WP2.2a) discussed how costs should be dealt with by the model. At this stage the costs were defined as either 'fixed' or 'variable', to reflect that some costs are related to, or dependent on, the area of elements being treated (e.g. wall area), but some are not. This differentiation would also allow the user to account for overlapping savings when multiple improvements are applied at the same time.

This note, accompanying spreadsheet and functionality present in the computer model form the second stage of the definition of costs (WP2.2b). At this stage a spreadsheet containing actual costs has been produced, and integrated as part of the ETI computer model itself. The costs are described as interim as they are available for review and comment by partners. The functionality of the model is also under review in relation to its development towards the final (gamma) version .

The final stage of the process (WP2.2c – to be completed by September 2011) is to finalise this spreadsheet and model functionality. This will require any gaps in the spreadsheet to be completed, additional costs to be added if required, and adjustment of any costs in response to comments from partners. Additional functionality which is already agreed to be included is the ability to adjust costs to account for regional factors, and the specific costing of a number of 'pre-defined packages' of improvements which will be specified by the 'whole house solutions' component of the project (WP3).

SUMMARY OF OUTPUTS

To allow costs of improvements to be estimated within the modelling, and the TE project more widely, a set of detailed costs for energy efficiency improvements have been produced by Wates. These indicate, for the twelve most common dwelling types as indicated in the physical stock segmentation (item 2.1a) the costs of installing the measures included in the energy improvements matrix (item 3.3a). Costs are provided for 'simple', 'average' and 'difficult' properties of these types.

These have been produced by considering the work that is required to install these technologies, and providing prices for each element of work from Wates' experience in providing retrofit solutions.

Costs have been split into 'fixed' and 'variable' elements, to reflect that some costs are related to, or dependent on, the area of elements being treated (e.g. wall area), but some are not. This differentiation also allows the user to account for overlapping savings when multiple improvements are applied at the same time. The user is able to adjust these costs in the most appropriate way, to account for savings from items such as access costs, or from installations on a 'whole street level' etc. This allows the user to estimate costs for the specific package or scenario of improvements which they are investigating.

The costs themselves are included in the Excel spreadsheet which accompanies this report (embedded in the word version as Appendix A – and as a separate item in the PDF version), as well as being accessible directly from within the model itself.

Refined costing methodology in the ETI-TE model

INTRODUCTION

This note outlines the approach to the costing methodology for thermal efficiency improvements as incorporated as part of the beta version of the ETI TE computer model. This work is the second of three stages of this process, and will be developed into a final methodology as part of WP item 2.2c. The first stage outlined the overarching methodology to be used for costing, to allow it to be of optimal use for the project. This note provides details of the actual costs themselves (as Appendix A) and the latest model functionality relating to these costs. It also describes the route for the development of final stage in the costing exercise (WP item 2.2c).

This document forms deliverable WP2.2b of the project in conjunction with both the functionality present within the beta-model itself (which allows calculations of the cost of improvements using the costs contained in Appendix A) and the accompanying spreadsheet of costs.

DEVELOPMENT OF THE COSTING METHODOLOGY

Estimates of costs for installing Thermal Efficiency measures are essential to be able to assess the feasibility of a large scale retrofit programme. Realistic costs are required to provide estimates of the resources required for such a programme at both the national level and for any particular sub-section of the stock and carry out the appropriate cost-benefit analysis for particular retrofit solutions.

Initial consideration of the costs of retrofit looked at those recorded for particular retrofit exemplars. However, it is considered that exemplars would not normally be subject to the same budgetary constraints which would be required by a mass retrofit programme, and indeed would often not have the same aims. Exemplars are typically produced to demonstrate a particular technology, to act as a mechanism of finding and highlighting problems for follow-on projects, and to attempt to achieve a particular target (e.g. zero carbon refurbishment). As a result they often have less regard to the cost of improvements than would be required for a mass retrofit programme. Furthermore, they would not be able to benefit from the economies of scale that a mass retrofit would be able to achieve. Whilst the technical lessons from exemplar projects will be of great use to the project as a whole, our costing methodology uses an approach based on costing from first principles.

This approach uses the twelve dwelling types and characteristics as identified in the dwelling archetypes document (WP item 2.1a) combined with the improvement options outlined in the technical solutions matrix (WP item 3.3). A range of costs have been provided for each of these types by Wates team of costing experts which include estimates for the major variables which can affect costs. Specific costs are provided for each dwelling archetype

identified. For example, when costing for a pre-1919 terrace house consideration has been given to how costs will vary with and without bay windows.

In accordance with the methodology outlined in item WP2.2a, costs have been split into two broad types:

- a) Unit costs
- b) Other fixed costs

Unit costs are expressed as a cost per unit area (e.g. cost per square metre of loft insulation). Fixed costs include all other costs associated with installation of the item. By splitting up costs in this way, it allows the user to account for, for example, savings in fixed costs which occur when multiple measures are installed at the same time. This allows the user of the costs (and the model) to take account of items such as 'access cost' savings (scaffolding etc.) when installing new double glazing at the same time as solid wall insulation. This scenario can be simulated in the model by adjusting (or removing) fixed costs when particular measures are installed together. This function is currently performed manually by the user to allow the specific user defined 'packs' of improvements to be defined. The gamma version of the model will also incorporate a set of 'pre-defined packages' which will have already included overlapping fixed costs.

The actual costs themselves have been developed by Wates, and are included below in Appendix A.

BETA MODEL FUNCTIONALITY FOR COSTING

The computer model which is being developed for the ETI includes functionality to allow the consideration of unit costs and fixed costs.

Costs are able to be input for:

- a) Loft insulation
- b) Cavity wall insulation
- c) External wall insulation
- d) Floor insulation
- e) Hot water tank insulation
- f) Replacement windows

These are input by the user directly into the model, with reference to the spreadsheet of costs (reproduced in Appendix A) which the user can access via a button on the form. Details of improvements specified by the user (including these costs) are saved to a database for future analysis or adjustment as required. This functionality is shown in Figure 1 to Figure 3 below.

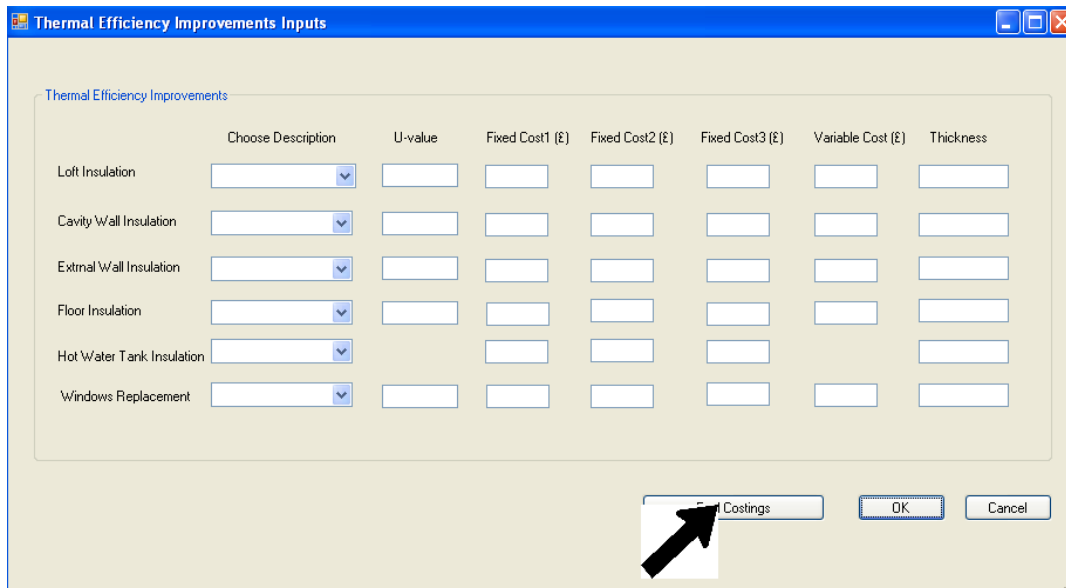


FIGURE 1: THE BLANK COST SPECIFICATION SCREEN IN THE ETI-TE MODEL. ARROW INDICATES HOW TO ACCESS THE COSTINGS SPREADSHEET.

Within the model, the user is able to specify the TE improvements they would like to investigate for their particular house type. This includes specifying the details of the costs being attached to each improvement. This should be done with reference to the detailed costing spreadsheet produced by Wates. Pressing the ‘costings’ button indicated in Figure 1 opens up the costs spreadsheet to allow the user to input costs for any particular dwelling (or set of dwellings). This is shown in Figure 2 below. Users are able to adjust for overlaps or simulate savings to particular measures (for example from an alternative supply chain).

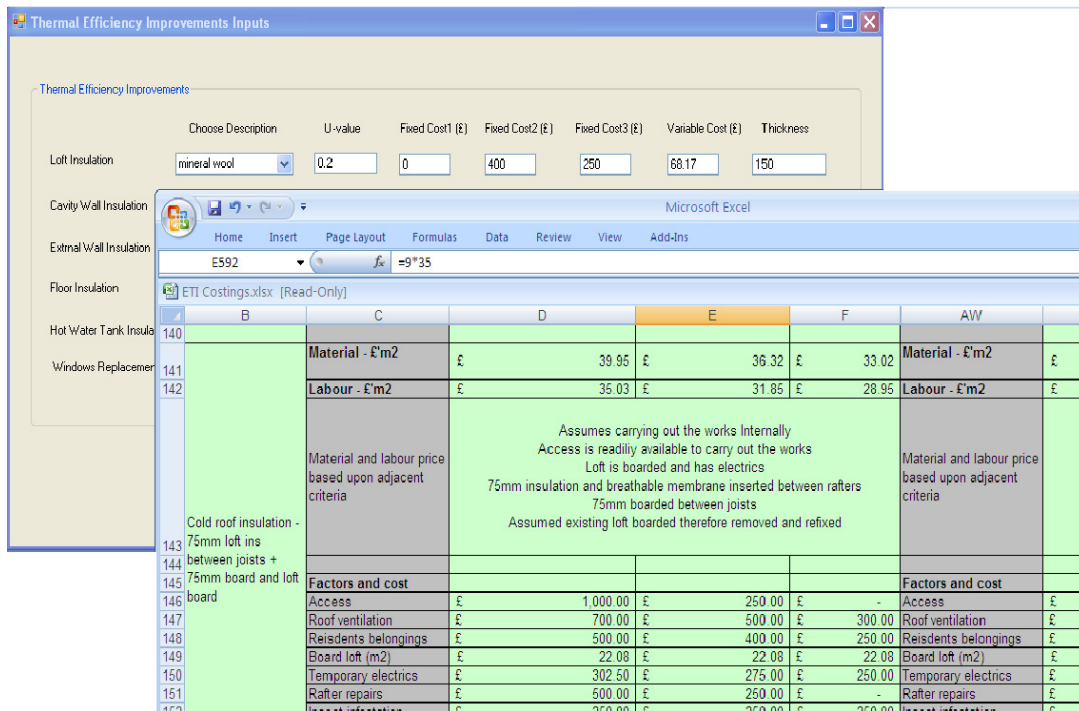
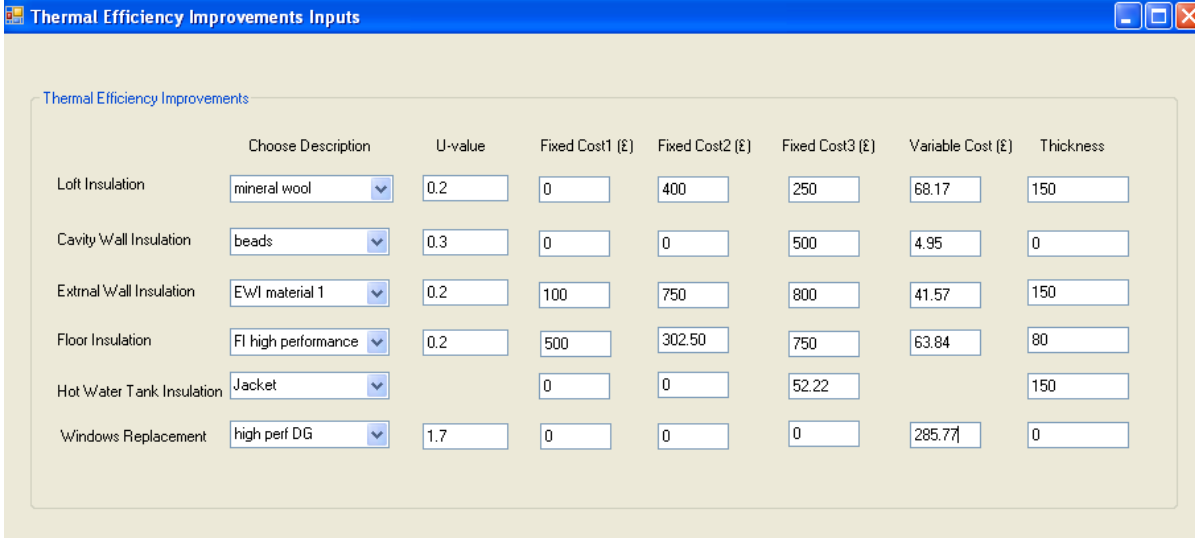


FIGURE 2: BY USING THE COST SPREADSHEETS (OPENED BY PRESSING THE COSTINGS BUTTON) THE USER IS ABLE TO INPUT DETAILS OF FIXED AND VARIABLE COSTS FOR EACH IMPROVEMENT.

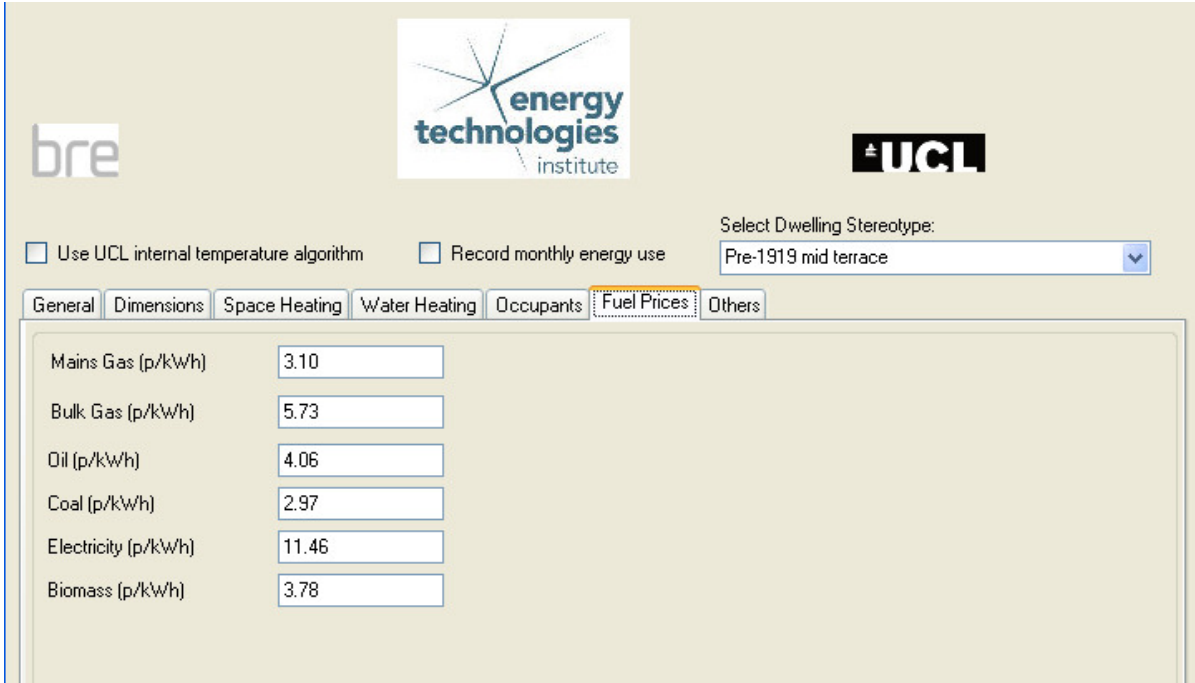
Full costs for each improvement can be specified. Once specified by the user these are saved for use in further scenario work, or for reference.



	Choose Description	U-value	Fixed Cost1 (£)	Fixed Cost2 (£)	Fixed Cost3 (£)	Variable Cost (£)	Thickness
Loft Insulation	mineral wool	0.2	0	400	250	68.17	150
Cavity Wall Insulation	beads	0.3	0	0	500	4.95	0
External Wall Insulation	EWI material 1	0.2	100	750	800	41.57	150
Floor Insulation	FI high performance	0.2	500	302.50	750	63.84	80
Hot Water Tank Insulation	Jacket		0	0	52.22		150
Windows Replacement	high perf DG	1.7	0	0	0	285.77	0

FIGURE 3: DETAILS OF EACH IMPROVEMENT ARE SETUP BY THE USER AND CAN BE RECALLED FOR FUTURE SCENARIOS THAT ARE RUN.

The model also includes the capacity to adjust fuel prices to allow lifetime savings in running costs to be compared to capital costs of measures.



bre energy technologies institute UCL

Use UCL internal temperature algorithm Record monthly energy use

Select Dwelling Stereotype: Pre-1919 mid terrace

General Dimensions Space Heating Water Heating Occupants **Fuel Prices** Others

Mains Gas (p/kWh)	3.10
Bulk Gas (p/kWh)	5.73
Oil (p/kWh)	4.06
Coal (p/kWh)	2.97
Electricity (p/kWh)	11.46
Biomass (p/kWh)	3.78

FIGURE 4: THE ETI-TE MODEL USER INPUT SCREEN ALLOWING FUEL PRICES TO BE SET BY THE USER

DEVELOPMENTS OF THE GAMMA (FINAL) MODEL FUNCTIONALITY FOR COSTING

The development of the final functionality for costing will be guided by the requirements of the users and feedback from the beta model. It has already been agreed that specific costs (including all overlaps etc.) will be included for a number of the 'whole house solution' packages being specified under Work Package 3, and that these packs can be loaded by the user as defaults. Additional functionality will also require the integration of the costs with the 'stock modelling' component of the model (to be developed between July and September 2011). Users will be encouraged to feedback suggestions for additional costing functionality to BRE at future user requirements workshops.

APPENDIX A: COSTS OF INTERVENTION FOR 12 PRIMARY DWELLING TYPES

The following table of costs has been produced by Wates as indicative of the costs for intervention in the 12 most common dwelling types in England. Users of the ETI TE model are referred to these costs when specifying TE improvement scenarios.

There are 12 sets of tables:



Costings for 12 most
prevalent types