Report on the development of an Energy efficiency retrofit cost-benefit calculator

Report for Glasgow Caledonian University, January 2012

This paper describes the development of a spreadsheet, originated by Changeworks, but subsequently taken forward by the Urban Energy Research Group in the School of Built Environment at Heriot-Watt University. The spreadsheet is a design tool, to inform future decision making by social landlords, with potential application for housing providers and individual households. The spreadsheet development was funded under a CIC Start Online Academic Consultancy Award.

Changeworks Consultancy

1.   Executive Summary

This paper reports on the development of a spreadsheet-based calculation and analytical tool, originated by Changeworks. This was subsequently substantially enhanced, in partnership with the Urban Energy Research Group in the School of Built Environment at Heriot-Watt University, using a CIC Start Online Academic Consultancy Award.

The spreadsheet is a design and calculation tool, to inform future investment decisions by social landlords concerned with improving the energy efficiency of their stock. The tool has potential application for private sector landlords and individual households. However, until it was enhanced in collaboration with Heriot Watt, it lacked the necessary functionality and practical applicability for use as a commercial consultancy tool.

This consultancy has delivered an enhanced calculator which can now be applied to assess energy efficiency options for both individual as well as groups of residential properties. This version of the calculator utilises key data from running National Home Energy Rating (NHER) surveys, but could be easily adapted to accommodate data extracted from other modelling tools.

The parameters in the spreadsheet design allow for updating, both in relation to cost data as well as including thresholds for compliance with the Scottish Government's Scottish Housing Quality Standard 2015, or subsequent standards addressing fuel poverty, carbon reduction targets and how these relate to different investment options and best value.

In this report, each sheet in the spreadsheet workbook is described, and a step-by-step guide provides instructions for data input.

The model has direct relevance to assessing future funding opportunities, including the Green Deal and the Energy Company Obligation, and future benchmarking where statutory standards are increased, and their impact assessed. The tool will be the mainstay of Changeworks offering to clients in the social housing sector, helping them develop well targeted and cost effective carbon reductions and interventions aimed at reducing fuel poverty.

The report concludes with an outline brief for subsequent development.

2.   Background

2.1   Need for the model

The concept of a spreadsheet tool for property modelling emerged from discussion with Housing Property Services in Services for Communities, City of Edinburgh Council in 2010 and the need to interpret and analyse energy efficiency data. Changeworks has worked in partnership with the Council on a range of energy efficiency and carbon reduction projects, particularly from 1996, under the Home Energy Conservation Act. This work will also have wider applicability to other social landlords that Changeworks has advised. A spreadsheet model was favoured because:

1.   all local authorities utilise EXCEL and staff are familiar with it

2.   development time and cost are low

3.   future development costs and modifications would be low.

The last point is particularly significant given the progressively higher standards, which social landlords must plan to meet. Currently, the Scottish Fuel Poverty Statement, the local fuel poverty strategy for Edinburgh, and the requirements of the Scottish Housing Quality Standard 2015 are the drivers for developing a design tool. The tool is needed to enable the Council to meet its broader statutory responsibilities in a cost effective way that maximise carbon savings. Such obligations apply to all local authorities and social landlords.

The Council required a facility whereby associated capital costs could be compared, to determine the best value outcomes for its own capital programme. This meant looking at a range of solutions, which could improve a particular building's energy performance, and the associated cost of the measures. This was needed so that the complexities of flatted property types, with a range of differently configured dwellings, could be accommodated.

The Council also needed better information to engage other owners, particularly with the Green Deal as a source of finance for energy efficiency measures in the future. Over two-thirds of the Council's properties have been sold under Right-to-Buy, leaving a significant number of hard-to-treat properties, where, due to the housing archetype and tenure mix, the Council is inhibited in terms of the improvement options that can be carried out, without engaging other owners. The spreadsheet therefore needed to compare the outcomes of partial and whole block improvements, in buildings in multi-ownership.

Changeworks holds a representative sample of energy audit data on council housing in Edinburgh, which was used to develop a baseline against which improvement options could be assessed. This data set is typical of the type of information held by social landlords, and the tool was developed with this as an important parameter. The spreadsheet was therefore designed in such a way as to allow the use of this data to make strategic decisions based on typical energy efficiency information.

Ultimately the tool will have broader applicability, beyond the social or corporate housing sector, as and when minimum standards are applied to the private sector.

2.2   The model's basic functionality as developed by Changeworks

The spreadsheet was initially designed in early 2011 to incorporate:

• dimensional data from record drawings for floors, walls (external and internal), roofs and common areas of properties where there was shared access (tenements)

• variable data to be updated on a periodic basis, including

a. Council cost data based on schedules of tendered costs for energy efficiency and renewables measures

b. energy efficiency standards, National Home Energy Ratings (NHER)/ Standard Assessment Procedure (SAP) and Reduced data SAP (RdSAP) scores, based on the representative sample of different housing archetypes/ construction types

c. energy costs

d. household income data, based on baseline incomes/ benefit dependency, assuming that household circumstances and income vary over time, as well as benefit levels.

A subsequent review of record drawings for piloting one archetype (as referred to below), resulted in multiple sub-archetypes being identified because of locational factors. For example, testing using one council housing archetype, a No Fines 3 storey tenemental property constructed in multiples of six, in three configurations of 6, 12 and 18 properties to a block, yielded 13 sub archetypes. With 3 different improvement scenarios for low, medium and high cost solutions this created 39 separate data sets with common ('U' values) and unique elements (Dimension). For each the tool was able to identify:

- Capital costs per property

- SAP scores and 'Pass' or 'Fail' status in relation to the Scottish Housing Quality Standard 2015

- Carbon savings

- 'Pass' or 'Fail' status in relation to fuel poverty (Energy costs being respectively under or over 10% of income after housing costs).

3.   The role of the School for the Built Environment, Heriot-Watt University

Whilst the initial spreadsheet provided the desired output, it lacked flexibility and adaptability, and needed further development to expedite data input and the generation of output data. To be commercially viable the different data needed to be compatible and automatically updateable, when costs and policies changed. Furthermore the tool needed to be ready to accommodate the Green Deal and anticipated changes in housing quality standards.

Under a CIC Start Online Academic Consultancy award in September 2011, the Urban Energy Research Group in the School of Built Environment at Heriot-Watt was commissioned to configure the Changeworks' existing refurbishment cost model for more widespread use, specifically:

- to substantially improve the user interface, especially the input of energy performance and dimensional data

- to verify the tool's robustness and run a demonstration scenario for a single archetype

- to provide indicative models for different funding streams, including a loan model, based on the Government's proposed Green Deal, and private sector grant support through the utility companies' Energy Company Obligation (ECO) from late 2012

- to provide links to Scottish Housing Quality Standards 2015 compliance (and later standards) and fuel poverty checks, comparing energy costs to incomes

- to enable a test of the impact of fuel cost changes on energy cost savings, compared to spending on measures, as under the Green Deal, as well as on fuel poverty

- to provide graphic outputs which could be used to present the main outcomes to clients

- to enhance the design so additional features could be added at a later date.

The key factor was that the spreadsheet needed to easily accommodate modifications to the input assumptions, so that it could be maintained with the most up-to-date and relevant information.

4. Description of the spreadsheet as subsequently developed by Heriot-Watt, how it is populated, and what data is required

The spreadsheet is in MS Excel 2007, and needs this or a later version for full functionality. The spreadsheet is made up of various input and output-only spreadsheets, using the cost calculations and algorithms provided by Changeworks.

Both inputs and outputs are based on three levels of detail:

1. 'Project', which includes all dwellings being assessed within a given development (such as a selection of homes within a housing association development)

2. 'Archetype', relating to buildings of a similar type (such as a dwellings within the same block of flats)

3. 'Sub-archetypes', describing individual dwellings (such as ground floor flats of a given block). To include dwellings within the same sub-archetype requires them to have identical NHER/SAP modelled results and characteristics.

The user chooses and defines their dwellings, provides NHER/SAP results for the chosen sub-archetypes (in terms of energy consumption), defines up to three refurbishment scenarios, ranging from low-to-high cost, and the amended tool provides capital cost information for these different configurations.

The sheets underwent substantial changes to improve their automation. This included a starting input sheet where the number of dwelling types is defined and labelling can be added. All subsequent calculation sheets are then updated from this information. 'Macros', small programs within MS Excel, were added to improve this automation.

A building input sheet was added to reflect the type of information collected to generate NHERs (relating to construction etc). Details of heating systems and windows can also be added, in related but separate sheets.

A second input datasheet is included to collect detailed information, required for calculating the cost and scale of refurbishment options.

The three refurbishment scenarios can be selected based on a combination of specified technologies, and these are then automatically used in the cost outputs and compared to the baseline, pre-retrofit dwellings. Where necessary dwellings, which are not suitable for a scenario, can be 'overridden', i.e. specific refurbishments for those dwellings are ignored (e.g. not applying cavity-wall insulation to a solid wall dwelling). There is also the option for adding in extra refurbishment technologies that are not currently included.

Detailed costs are calculated automatically for all the technologies across all the identified dwelling types in a separate sheet. This is translated into suitable graphical output to highlight key results.

NHER results are input into the spreadsheet and converted into cost-related outputs, relating to total costs, cost effectiveness (in terms of carbon savings), the effect on fuel poverty, SHQS and other metrics.

All energy use data is based on kWh input from NHER – the tool calculates energy bills from these figures based on the selected tariffs (where split tariffs can be used for both heating and electricity). Billing information is therefore not taken from NHER directly, and so the user can vary bills within the tool by selecting different tariffs. Again, key results are provided in the form of graphical output.

A series of Green Deal output sheets are provided, again automated with the above calculations. The user selects one of the defined sub-archetypes and the sheets provide a Green Deal analysis for that dwelling across all three refurbishment scenarios.

As with the original Changeworks' version of the tool, the assessment is applied to all technologies within that scenario simultaneously. If the user wants to carry out a Green Deal assessment, on a single technology, (as is currently the case for most descriptions of the Green Deal), then the chosen scenario should only have that one specific refurbishment technology.

A technology cost sheet (e.g. price of new glazing) is provided that can be updated where costs change, including where they reduce. Additional technologies can also be added.

5.   The operation of the tool and its application

5.1   Description of worksheets

The workbook has 17 individual sheets, some of which require input from the user, some are used for calculations, while others are used to output information. A number of sheets are hidden and not needed by the user (and so are not included below). A description of the active sheets is provided below.

Sheet 1_Archetypes

This is the first data input page and requires the user to choose the number of archetypes, and sub-archetypes within each archetype (with a maximum of ten archetypes and ten sub-archetypes, creating up to 100 different dwelling types). The user should always use consecutive numbers for archetypes (e.g. if there are three archetypes then they should be archetypes 1, 2 and 3). Additional information can also be added to keep a record of the distinction between each archetype, such as breakdown of social/private sector dwellings (though this is actually input in Sheet **2_PropDetails**). If further categorisation is required, then 'Block' information can be filled in. This allows the user to group a series of dwellings across archetypes.

Sheet 2_PropDetails

The data input sheet loosely follows the outline of the NHER assessor data collection sheet. Sub-archetypes are assigned a column each for data input, though blank columns will be deleted when 'DeleteColumns' Macro is run. Cells highlighted in blue indicate a drop-down menu. Shaded cells will become available depending on data input previously (e.g. Mechanical Ventilation 'TYPE' can only be accessed if it has been indicated that 'mechanical ventilation' is present in the cell above). 'Heating and Hot water' links to Sheet **3_HtngSystems**. Details can be input in Sheet **3_HtngSystems** to describe the system type and then, returning to Sheet **2_PropDetails**, this can then be accessed via a drop-down menu and assigned to the sub-archetypes as appropriate. System data, which can vary between sub-archetypes, such as 'Install Year', is entered on Sheet **2_PropDetails** in the appropriate column.

'Building constructions' provides an outline of constructions associated with each sub-archetype. Preliminary outlining them here allows a later spreadsheet to be updated with references to capture more detailed information (e.g. dimensional information taken from drawings). Ideally this should capture all the different types of construction without having to come back and edit when entering the detailed information (drop down menus stick on the last entered input therefore won't update in response to changes).

Sheet 3_HtngSystems

This data entry sheet captures more detailed information (in line with the NHER Assessor data collection document) relating to space heating and hot water systems. The boxed area (to the right) allows different systems (e.g. boiler, CHP, Electric Heating) to be captured with variables accessible through drop-down menus in the main table (e.g. for boilers – is there boiler interlock – yes/no?) The system labels are referenced by Sheet **2_PropDetails** when detailing which systems are present in each sub-archetype. This sheet is mainly for reference purposes, to maintain a record of baseline heating systems.

Sheet 4_OpeningSchedule

This data input sheet allows details for different window/opening types to be described. Ideally, for similar type windows, separate descriptions should be set up where the openings

exist in different construction types within the same property (e.g. a window in an unfilled cavity wall is different to the same window in a filled cavity wall).

At this point the 'Ctrl + Shift + Q' command should be used to organise data so that is referenced correctly for the following sheets, before detailed information is entered. It is possible to apply this after, but would require data for the following sheets to be rechecked to ensure that the alphabetical organisation has not shifted entered values about.

Sheet 5_WindowData

This data input sheet allows window and opening data, specific to each sub-archetype, to be entered.

Sheet 6_Dimension Data

This data input sheet allows for the construction type to be selected from the drop-down menus in column A and dimensions are completed as appropriate for each sub-archetype, either from record drawings or from measurements taken at the time of the NHER survey. If a construction type is used several times, this can be selected from the drop-down menus. The total value is then summated and reported at the top of the page.

For each construction, the middle section of the input data is based on the assessor data collection sheet. The last section is specific dimension data used in the calculations of costs etc.

Sheet 7_ScenarioMeasures

This is where scenarios are defined. Using columns B, C and D, select the relevant measures for each scenario using an 'x'. In the subsequent columns, use the drop-down to select whether a particular measure should be ignored for a particular sub-archetype. For example, a top floor flat wouldn't use ground floor insulation, and a ground floor flat wouldn't use loft insulation. By selecting 'Override' the spreadsheet will automatically make the cost of that measure in that sub-archetype, zero.

The list of measures on the left hand side is picked up from Sheet **17_MeasuresCosts**. If additional measures are needed, add them into the 'Other' section in Sheet **17_MeasuresCosts**, and they will automatically appear in this sheet. However, these additional technologies will be accounted for on a 'per dwelling' basis, rather than, for example per m2. It is therefore set up for individual technologies that are used on a number-of-units basis, and will not be automatically sized for the specific dwelling.

Sheet 8_ScenarioCosts

This output sheet, requiring no input, calculates the cost of each scenario measure for each sub-archetype, again using the same list from Sheet **17_MeasuresCosts**. Row 27 provides the total cost for each scenario for the sub-archetype (per dwelling).

Sheet 9_ScenariosResults-by SA (sub-archetype)

All results in this sheet are per sub-archetype. In cell 'A12' the appropriate version of SAP, dating of the survey data and the outputs, can be selected. This has been done based on the SHQS list of 2001, 2005 and 2009, but are analogous to v9.81, v9.90 etc. NHER values are entered in the yellow cells and fuel type is chosen from the drop-down menus.

The SHQS calculation is done by recognising which version of SAP has been used; however you do have to select the fuel type (replacing the previous gas/electric version, enabling the

complete choice from the SHQS table. This is in accordance with the broad criteria and elements in Section 35 of the SHQS 2015 (see Appendix 2)).

If the sub-archetype does not meet fuel poverty thresholds (i.e. more than 10% of the stated baseline income is being spent on energy), or if it fails under any of the SHQS calculations, the respective cells will turn red. This sheet also requires the NHER values for the three refurbishment scenarios (if being used). Indicative CO_2 savings are provided at the bottom of each scenario section, across each sub-archetype.

Sheet 10_Sub-archetypeSummary

This is a complete list of all calculated sub-archetype information, upon which other output pages are based.

Sheet 11_ArchetypeSummary

This translates the sub-archetype output into useful archetype-based output. A graphical representation is given for capital costs, CO_2 savings, CO_2 saved per pound Stirling, and SAP improvements. Where appropriate, this is broken down by sub-archetype.

Sheet 12_ProjectSummary

This sheet provides data outputs that are suitable for describing the entire project, i.e. all sub-archetypes originally defined. A comparison between the refurbishment scenarios, and compared to the baseline scenario, is provided across the most important metrics.

Sheet 13_GreenDeal (Scenario)

The calculated information from above is used with capital cost information to show whether the three chosen refurbishment scenarios (hence three sheets) meet Green Deal requirements, adhering to the 'Golden Rule'. As the Green Deal (specifically Golden Rule criteria) is applied to individual dwellings, the user must select the specific archetype to retrieve information on these three sheets.

Whilst the model allows for multiple refurbishment technologies to be included in each scenario, the Green Deal (at time of writing) should be applied to an individual technology. Therefore, for a true Green Deal analysis, only one refurbishment technology should be included in any given scenario. The user can still apply this payback analysis to a scenario of multiple technologies, but should be aware that this is not currently how the Green Deal will work.

Sheet 14_Income

This currently assumes a baseline benefit dependent household income for all dwelling to calculate Fuel Poverty status. However this can be updated to allow different average incomes by sub-archetype, or even by archetype.

Sheet 15_SHQS

This data input sheet is just a database for SHQS analysis, showing the criteria required to pass SHQS 2015 criteria 35 for different SAP versions (Appendix 1).

Sheet 16_FuelCosts

This data input sheet is a database of fuel tariffs. Single and split tariffs can be chosen for a variety of fuels. Columns C, D and E can be updated with new tariff values and split tariff threshold as required.

Sheet 17_MeasuresCosts

This output sheet database lists all the current refurbishment choices and their estimated costs. Again this can be updated with new costs, but also new technologies can be added under 'Other' as required, with associated costs.

Step-by-step instructions on how to use the spreadsheet tool to input, calculate and output useful information are included as Appendix 2) to this paper

6.   Interpretation of the pilot outcomes

6.1   Future development and applicability

As a design tool for wider application, this spreadsheet can provide accurate costs for planning retrofit projects and undertaking feasibility studies, reflecting different options. Its focus on dimensional data and sub-archetypes means that the outputs are far less generic than those delivered through using other software, including Demscot. The model is particularly applicable to multiple blocks and hard-to-treat housing types, both priorities for carbon savings.

This tool has a potential market amongst social and corporate landlords as a cost-effective analysis service, particularly in relation to meeting social landlords' obligations under their SHQS Standard Delivery Plans. A brief commentary on its particular application by the City of Edinburgh Council is described in Appendix 3.

From a longer term perspective, it could be used to simulate the outcomes of different energy efficiency options, not least in relation to likely higher energy performance as outlined in the Scottish Government's 'Conserve and Save- An Energy Efficiency Action Plan for Scotland'

The current spreadsheet is designed to take NHER survey outputs, which are based on averages in relation to heating patterns (the Standard Heating Regime) and demand temperatures. This could be easily updated for a range of other common modelling tools – particularly those used for Green Deal reports.

In relation to moving beyond statutory requirements, there is a broader issue relating to actual patterns of household use, in relation to under or over heating and variances from the Standard Heating Regime would require a variability curve, based on low, average and high energy use, combining aspects of:

- Variability based on low demand temperature/ range 16-24 degrees C

- Variability based on different heating patterns say Standard or Extended Heating Regime

- Variability based on different levels of take-back/ Comfort Factors say 25-75%

- Variability based on different advice models.

Similarly these variability curves could be applied to the Green Deal and separately compared to direct capital spend and take up.

Additional aspects that could be developed further are:

- Side-by-side comparisons of two identical properties, but in very different locations/ weather zones, as defined by National Energy Services being the developers of the National Home Energy Rating Scheme, therefore with very different fuel cost projections

- The potential to filter in various energy supply options, i.e fuel switching including capital costs

- Cost comparisons capital works v paybacks on a per £ basis

- Cost comparisons capital costs v paybacks ratios

- Add-ons to allow for including cyclical maintenance/ servicing or replacement elements costs.

6.2   Sustainable refurbishment

The current spreadsheet allows for different scenarios to be run side-by-side and their outcomes. In the longer term this can be adjusted to reflect higher standards in the future, or to model thresholds where these cannot be met without significantly more radical solutions.

The costing element might be applied across a property portfolio to address whole life costs and best value, including bulk discounts that might be secured by restructuring capital work programmes.

7.0   Commercial development of the tool

Changeworks aims to make the tool available to all Scottish social landlords in early 2012, allowing them to begin planning how their capital programmes can be adapted in relation to the Green Deal and the Energy Company Obligation. A letter will be sent to key managers and events or seminars are also being considered. Opportunities to collaborate with Historic Scotland on future research are also being explored.

A further less obvious market is providing services to energy companies who are seeking to identify carbon savings to meet ECO requirements.

Further promotion will coincide with the finalisation of new housing quality standards, which will drive the review of capital programmes and investment strategies. Changes to how fuel poverty is being measured (the Hills Review) are also being monitored for potential applicability of the model as an advice tool.

Finally, the long term aspiration of providing strategic advice to the private sector will be explored in 2012, when new standards are subject to public consultation, and subsequent implementation.

In 2012 it is expect that half of a full-time equivalent post will be retained and protected, with scope to make this a full-time equivalent post as the market develops.

Appendix 1   A step-by-step description of how to use the spreadsheet

These instructions describe how to input, calculate and output useful information for a given number of dwellings.

STEP 1)
Enter the number of archetypes and sub-archetypes in **Sheet 1_Archetypes**. This allows for a maximum of 100 sub-archetypes (within ten archetypes). Run the 'DeleteColumns' Macro by pressing 'Ctrl + Shift + P.

This will delete superfluous columns throughout the workbook for blank sub-archetypes.

STEP 2)
Enter property details in **Sheet 2_PropDetails**.

STEP 3)
If required, define and label heating and hot water systems in **Sheet 3_HtngSystems**, which will be updated in **Sheet 2_PropDetails**.

STEP 4)
Define window/opening types in **Sheet 4_OpeningSchedule** and run the 'AlphaSort' Macro (press 'Ctrl + Shift + Q'). This will order the information alphabetically (which is required for calculations later on).

STEP 5)
Assign the windows of step 4) for each sub-archetype in **Sheet 5_WindowData**.

STEP 6)
Input the more detailed data required in **Sheet 6_DimensionData**.

STEP 7)
In **Sheet 7_ScenarioMeasures**, choose three refurbishment scenarios by checking (placing an 'x'), in columns B, C and D, the specific refurbishments that are required.

If a particular refurbishment is not valid for a sub-archetype (e.g. cavity wall insulation for a solid-walled dwelling), choose 'override' in the respective drop-down cell (column E onwards).

Appendix 2   Section 35 of the Scottish Housing Quality standard 2015

Element reference number	Description of elements	Element type (internal to dwelling, common element or external to dwelling)	Interpretation for social landlords	Technical notes on measuring failure
A minimum energy efficiency rating (1 element)	All other elements of the energy criteria must be passed in addition to passing criteria 35 in order for SHQS to be met in full.			
35	An energy efficiency rating of either National Home Energy Rating (NHER) 5 or Standard Assessment Procedure (SAP) 2001 of 50 (gas systems) or 60 (electric systems).[4] See conversion table below to adjust SAP 2001 ratings to SAP 2005 or SAP 2009.	Internal dwelling	1. This criteria was referred to as 'additional energy efficiency measures' in the original (2004) guidance. However, we have changed the emphasis of this criteria (though not the criteria itself) to make it clearer and to reflect the fact that the property must meet a certain energy efficiency rating rather than exhibit actual the 'additional energy efficiency measures' themselves. 2. The measures that would enhance energy efficiency will be well-known to landlords but might include (a) going above the minimum to criteria for elements 31-33 e.g. more loft insulation or a highly efficient heating system or (b) introducing other separate heating/insulation measures additional to those outlined in criteria 31-33 such as low energy lighting, double or even triple glazing.	1. If a property has met all of criteria 31,32, 33, 34A and 34B and still fails to achieve a minimum NHER rating of 5 or a SAP 2001 rating of 50 (gas) and 60 (other fuel types) then the aforementioned 'additional energy efficiency' measures should be introduced subject to technical feasibility and proportionate costs. 2. There is no need to re-survey stock given the ongoing changes in the SAP system from SAP 2001 to SAP 2005 and again to SAP 2009 for example. Changes in the SAP scale do not change SHQS which is specified in SAP 2001. 3. A SAP 'conversion table' for SAP 2001, 2005 and 2009 is provided below. This table essentially shows the threshold for a 'pass' on criteria 35. This table may change periodically with ongoing changes to SAP.

1. The failure rates recorded here are substantially higher than expected. This may be because of the technical difficulties in checking for the presence of cavity wall insulation e.g. bore holes have been covered by external rendering, surveyors no longer checking for the presence of CWI by looking down into the cavity from the loft space. These technical difficulties are expected to be reduced or overcome by the time of the 2010 SHCS thus it is quite possible that the 2010 failure rate will be significantly lower than 2009 failure rate.

2. The initial Scottish Executive Guidance (February 2004 and July 2004) on electric storage systems failing if they are 'over 20 years' old should be disregarded. This was an oversight on the part of that Guidance. The correct failure criteria is that systems will fail element 34B if they were installed pre-1984 i.e. 20 years before the first draft of the SHQS was published.

3. The SAP requirements of SHQS (aimed at the social sector) are slightly different from those of the Scottish Government's Energy Assistance Package (which is aimed at all households). Details can be found here: http://www.energysavingtrust.org.uk/scotland/Scotland-Welcome-page/At-Home/Energy-Assistance-Package/Your-Questions-Answered/Energy-Ratings).

Conversion table showing minimum NHER/SAP 2001/2005/2009 ratings necessary to pass SHQS criteria 35				
Fuel source for central heating systems	National Home Energy Rating) NHER	Standard Assessment Procedure (SAP) 2001	Standard Assessment Procedure (SAP) 2005/RdSAP	Standard Assessment Procedure (SAP) 2009
Gas	5	50	50	48
Oil	5	60	54	54
Liquid Petroleum Gas (LPG)	5	60	54	63
Electric	5	60	58	63
Solid Fuel	5	60	59	63
Biomass (new since 2004)	5	60	59	64

Source: The Scottish Housing Quality Standard Annex C May 2011 revision Scottish Government

Appendix 3   Housing Property Services, City of Edinburgh Council
Commentary on the applicability of the spreadsheet

Housing Property Services in the City of Edinburgh Council was involved in the early discussion, and initiated the idea of a design tool with Changeworks. The Council has various challenges to address, in relation to regulatory standards, such as compliance under the Scottish Housing Quality Standard, whilst capital budgets are under increasing pressure. Best value is also a major driver of decision making in the Council.

The initial testing of the Changeworks spreadsheet focussed on one hard-to-treat housing archetype. The Council has sold the majority of its housing stock under Right-to-Buy and with multi ownership often has to present different options to private owners. The spreadsheet has that as just one of several valuable outputs, and this could also prove a valuable tool to summarise planned outcomes to senior management and elected members of the Council, and inform their decision making.

We have subsequently assessed the value of the spreadsheet, to test a further housing archetype a 3 apt, ground floor, gable end flat. Whilst we recognised that aspects of the data entry require significant up front manual input there were certain additional areas of functionality that we recommended, including links to national databases such as SEDBUK and reference default lists for different elements, such as 'U' values for building elements dependent on the age it was installed.

We have also suggested further areas of possible development of the spreadsheet, which we understand are included in a further application for academic support.

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Appendix 4 Biographies of the project team

Changeworks Consultancy

Stuart Hay is Sustainable Futures Manager at Changeworks. He previously worked in policy and campaigning, with Friends of the Earth Scotland, the Scottish Wildlife Trust, Help the Aged and as a researcher in the Scottish Parliament. Since joining Changeworks in 2008, he has led a team developing a range of innovative and awarding winning projects, with a strong focus on energy conservation in the built environment and barriers to the deployment of micro-generation technologies. Stuart has managed ground-breaking research work for a range of high profile clients including the Energy Saving Trust, WWF Scotland, Consumer Focus Scotland, the Joseph Rowntree Foundation and eaga Charitable Trust, as well as offering support to a wide range of Climate Challenge Fund groups across Scotland.

Robert Barnham is a Senior Project Officer at Changeworks. He previously was Director of Energy Action Scotland, and earlier managed a Technical Aid Centre in Dundee, where he set up the first community based insulation project in Scotland. He qualified as an architect and has an MA in Urban Design and a RIBA Diploma in Urban Design. He has worked in the public, private and voluntary sectors. Since joining Changeworks in 1991 he has worked on various pilot projects as well as building-specific projects focussing on energy efficiency and carbon reduction. He has extensive experience of community-based work, developing training resources and delivering training to a wide cross section of client groups.

Gary Pearson is a Surveyor and Technical Officer at Changeworks joining in 1998. He has ten years experience of conducting domestic energy surveys, for a wide range of property types. He undertakes NHER and Energy Performance Certificate surveys and energy analysis, and reports on energy modelling options for local authorities, housing associations and government organisations. Recent work has included energy modelling for the City of Edinburgh Council on hard-to-treat non-traditional properties, and energy efficiency and renewable energy options for rural properties for Historical Scotland. He also carried out the data analysis for the Home Energy Conservation Area reports for three Scottish local authorities and on improvements carried out under the Central Heating Programme and Warm Deal grants, and wrote the related annual reports on behalf of the Scottish Government.

The Urban Research Group, the School for the Built Environment, Heriot-Watt University

Dr David Jenkins is a Research Fellow and has been with the UERG since 2005. His background is in low-energy buildings (their simulation using dynamic building packages), application of future climate projections, fuel poverty and micro-generation. He has worked on several research projects including Tarbase and Low Carbon Futures and leads the Group's consultancy activities. He obtained a PhD in modelling daylight technologies in buildings, with a view to reducing building energy consumption and carbon emissions. He has an MSci in Physics and Astronomy from University College London.

Sophie Simpson has been a Research Associate with UERG since 2010 working on the CALEBRE project, looking at low-carbon refurbishments and the impact of retrofitting a mechanical ventilation system with heat recovery into an existing dwelling, and the energy implications in relation to building air tightness. Prior to this she worked for an engineering company, carrying out detailed building performance simulation and modelling to assist and advise architects and building services on energy efficient designs for domestic and non-domestic buildings. Sophie has an MEng in Product Design and Engineering from University of Glasgow/Glasgow School of Art.

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