Cost to make dwellings in Northern Ireland energy efficient

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Table of Contents

This report is based on the findings of the House Condition Survey 2016 which is published on the Housing Executive's website.

https://www.nihe.gov.uk/house_condition_survey_main_report_2016.pdf

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Introduction

This report summarises the results of modelling work to estimate the cost associated with improving the energy efficiency of dwellings in the Northern Ireland housing stock, using data from the 2016 Northern Ireland House Condition Survey (NIHCS). Energy efficiency improvements have been applied to dwellings under eight different scenarios; three scenarios examine heating measures only, three examine insulation measures only, one examines double glazing and one is a combination of all these scenarios.

Table 1 outlines the energy efficiency improvements made under each scenario, and the method for determining the eligibility of a dwelling to receive an improvement measure. The applied measures largely follow the methodology used for providing recommended improvements during energy performance assessments (EPCs), as outlined in Appendix T of SAP 2012[1]. However, deviations from this methodology occur, especially when a more cost-effective improvement is identified. Appendix A lists the main deviations from the EPC methodology used in this work.

Table 1 – Details of improvement scenarios.

Scenario name	Scenario description
Heating 1	Dwellings with central heating are given a condensing boiler, if one is not already installed. Where a water cylinder is already present in the dwelling, a standard condensing boiler is installed; otherwise a condensing-combination boiler is installed. Where mains gas is available[2], a gas condensing boiler is installed; otherwise an oil condensing boiler is installed.
Heating 2	Dwellings with non-central heating are given central heating with a condensing boiler, on the same basis as above.
Heating 3	Combines heating scenarios 1 and 2.
Insulation 1	Dwellings with unfilled cavity walls (partial or full) with a U-value of > 0.6 W/m^{2}K are given cavity wall insulation.[3]
Insulation 2	Dwellings with lofts and <= 150mm of loft insulation are given 270mm of loft insulation
Insulation 3	Combines insulation scenario 1 and 2, to give dwellings cavity wall and / or loft insulation where appropriate.

[1] BRE 2017. Appendix T: Improvement measures for Energy Performance Certificates, RdSAP 2012 v9.93. https://www.bre.co.uk/filelibrary/SAP/2012/RdSAP-9.93/RdSAP_2012_9.93.pdf

[2] Mains gas is considered available in any dwelling which is situated in an area classed as a ‘large town’ or larger, or where a mains gas heating system is already installed.

[3] The U-value is a measure of the thermal transmittance of a material. U-values are not measured directly in the NIHCS and so RdSAP assumptions are used to infer the U-value based on the age and type of the wall. It is assumed that walls built before 1986 have a U-value of greater than 0.6 W/m^{2}K.

Double Glazing	Dwellings with single glazing, or pre-2006 double glazing, are improved to modern double glazing, with a U-value of 1.6 W/m^2K.
All	Combines heating scenario 3 with insulation scenario 3 and double glazing, to give dwellings all appropriate heating and insulation measures.

This work has applied a measure wherever the criteria described above have been met (and subject to it making a large enough difference to the SAP[4] rating).

There is no threshold over which a dwelling is considered energy efficient and therefore not in need of additional improvements. A SAP rating of 65 is often used as an indication of an energy efficient dwelling. This report looks at the proportion of the housing stock taken above this threshold by the various improvement scenarios, however it should be noted that the mean SAP rating of all dwellings in Northern Ireland is already over 65 and over 60% of dwellings already achieve this level (See Chapter 7 page 81 of the main HCS report 2016).

[4] Standard Assessment Procedure is the Government's standard method of rating the energy efficiency of a dwelling. The SAP rating is a logarithmic scale and the lower the score the lower the energy efficiency and the higher the score (up to a maximum of 100) the higher the efficiency.

Results

Total number of improvements

Table 2 shows the number of improvements installed under each improvement scenario. Over 632,000 dwellings received at least one improvement measure. Double glazing was the highest single measure to be installed (455,000) with heating scenario 2 being the least utilised improvement measure (21,000).

Table 2 – Number of improvements installed for each scenario (1,000s of households).

Improvement measures installed	Heating 1	Heating 2	Heating 3	Insulation 1	Insulation 2	Insulation 3	Double Glazing	**All**
Gas Central Heating	179	8	187	-	-	-	-	**187**
Oil Central Heating	257	13	270	-	-	-	-	**270**
Cavity Wall Insulation	-	-	-	76	-	76	-	**76**
Loft Insulation	-	-	-	-	218	218	-	**218**
Double Glazing (from single)	-	-	-	-	-	-	50	**50**
Double Glazing (from pre-2006 double)	-	-	-	-	-	-	404	**404**
Total number of dwellings improved	**436**	**21**	**457**	**76**	**218**	**260**	**455**	**632**

*Note that some totals may not add up due to rounding, or where cases receive multiple improvement measures within the same scenario (only applicable for Insulation 3).

Effect on SAP ratings

The effect of each scenario on the mean SAP rating in Northern Ireland has been estimated. The SAP ratings of dwellings in each scenario have been calculated by adjusting the base dataset to simulate the effect of each energy efficiency improvement, before recalculating SAP. Improvement measures are only included if an improvement of at least 0.95 SAP points is made to the dwelling. Improvement measures that do not achieve this increase in SAP are not considered to be a cost-effective improvement measure and are therefore discounted from the modelling process.

Table 3 shows the mean SAP rating of the whole stock under each improvement scenario. Including all appropriate improvement measures results in an increase in the mean SAP rating of 8 SAP points; from 65.8 to 73.8.

Table 3 – Mean SAP rating of stock under each improvement scenario.

	Base	Heating 1	Heating 2	Heating 3	Insulation 1 (CWI)	Insulation 2 (LI)	Insulation 3	Double Glazing	**All**
Mean SAP rating (whole stock)	65.8	71.3	66.4	71.9	66.3	66.5	67.0	67.2	**73.8**

Table 4 shows the proportion of dwellings which have a SAP rating above 65 after implementing each scenario. Applying all eligible improvements results in a significant increase in the number of dwellings which achieve a SAP rating of above 65 (from 61.8% to 91%). Of the individual improvement scenarios, heating scenario 1 (install condensing boiler where central heating exists) accounts for most of this increase. Applying the improvements in this scenario increases the number of dwellings achieving a SAP rating of above 65 by 22.4%.

Table 4 – Percentage of dwellings achieving SAP ratings greater than 65 under each scenario.

	Base	Heating 1	Heating 2	Heating 3	Insulation 1 (CWI)	Insulation 2 (LI)	Insulation 3	Double Glazing	**All**
% dwellings with SAP > 65	61.8	84.2	62.6	85	63.8	64	65.9	66.5	91

Cost of improvement measures

The cost of applying improvement measures has been calculated for each dwelling. Mean indicative costs are applied to each improvement measure that a dwelling has received, as is consistent with the methodology used for calculating the cost of improvements in EPCs. This differs from the approach used previously for this work, which was based on an annual uprating of commercial price data that is no longer available. More detail on the applied costs can be found in Appendix B.

Table 5 shows the total cost of installing improvement measures to all eligible dwellings for each scenario. The cost of applying all relevant improvements to the housing stock is around £2.4 billion. Of this, heating scenario 1 has the highest associated total cost of an individual measure, partly due to the high number of dwellings which receive this improvement (56% of the stock).

Table 5 – Cost of improvements applied to dwellings under each scenario (£000s).

Improvement measures installed	Heating 1	Heating 2	Heating 3	Insulation 1	Insulation 2	Insulation 3	Double Glazing	**All**
Gas Central Heating	814,792	38,839	853,631	-	-	-	-	**853,631**
Oil Central Heating	669,109	64,145	733,254	-	-	-	-	**733,254**
Cavity Wall Insulation	-	-	-	76,312	-	76,312	-	**76,312**
Loft Wall Insulation	-	-	-	-	49,072	49,072	-	**49,072**
Double Glazing (from single)	-	-	-	-	-	-	246,451	**246,451**
Double Glazing (from pre 2006 double)	-	-	-	-	-	-	485,164	**485,164**
Total Cost	**1,483,902**	**102,984**	**1,586,885**	**76,312**	**49,072**	**125,385**	**731,615**	**2,443,885**

A ‘cost per dwelling’ for all dwellings in NI, and per dwelling receiving an improvement, is shown in Table 6. The costs for the ‘all’ scenario are approximately £3,133 per dwelling for all dwellings in Northern Ireland, or approximately £3,869 per dwelling for dwellings that have received an improvement in that scenario. Heating scenario 2 has the highest improvement cost, when only considering dwellings which have received the improvement. The mean cost is significantly reduced at a stock level, due to the low number of dwellings that are eligible for the improvement.

Table 6 – Cost of improvements per dwelling for all scenarios (£s).

	Heating 1	Heating 2	Heating 3	Insulation 1 (CWI)	Insulation 2 (LI)	Insulation 3	Double Glazing	**All**
Mean cost (improved only)	3,401	5,000	3,473	1,000	225	482	1,609	**3,869**
Mean cost (all dwellings)	1,902	132	2,034	98	63	161	938	**3,133**

The total cost of the ‘all’ scenario has also been broken down by Council area. This is shown in Table 7, alongside the number of dwellings that have received an improvement under the ‘All’ scenario.

Table 7 – Total improvement costs for each region under the ‘all’ scenario.

Region	**Number of dwellings in region**	**Number of dwellings improved**	**Total Cost of improvements (£000s)**
North Down & Ards	70519	60552	251,046
Armagh, Banbridge & Craigavon	83191	76590	316,597
Antrim & Newtownabbey	59177	43849	184,655
Belfast	156697	93862	316,583
Causeway Coast & Glens	62368	56716	223,506
Derry & Strabane	60065	51484	204,292
Fermanagh & Omagh	49105	44181	177,489
Lisburn & Castlereagh	58349	45703	162,621
Mid & East Antrim	59219	48807	191,686
Mid Ulster	52788	49901	185,217
Newry, Mourne & Down	68523	59933	230,192
All	**780000**	**631578**	**2,443,885**

Cost effectiveness of improvements

Figure 1 shows the cost effectiveness of each scenario, by plotting the improvement in mean SAP for all dwellings in the housing stock against the total improvement cost of the measures installed. All three insulation scenarios (i1, i2 and i3) represent relatively low cost approaches, but also yield lower improvements to the energy efficiency of the stock. Conversely, heating scenario 1 represents the highest energy efficiency improvement for an individual measure (5.5 SAP points) but is one of the most expensive scenarios to implement. This is mostly due to the high proportion of dwellings which receive this improvement measure (56%).

Figure 1 – Cost effectiveness of improvement scenarios for all dwellings in the housing stock.

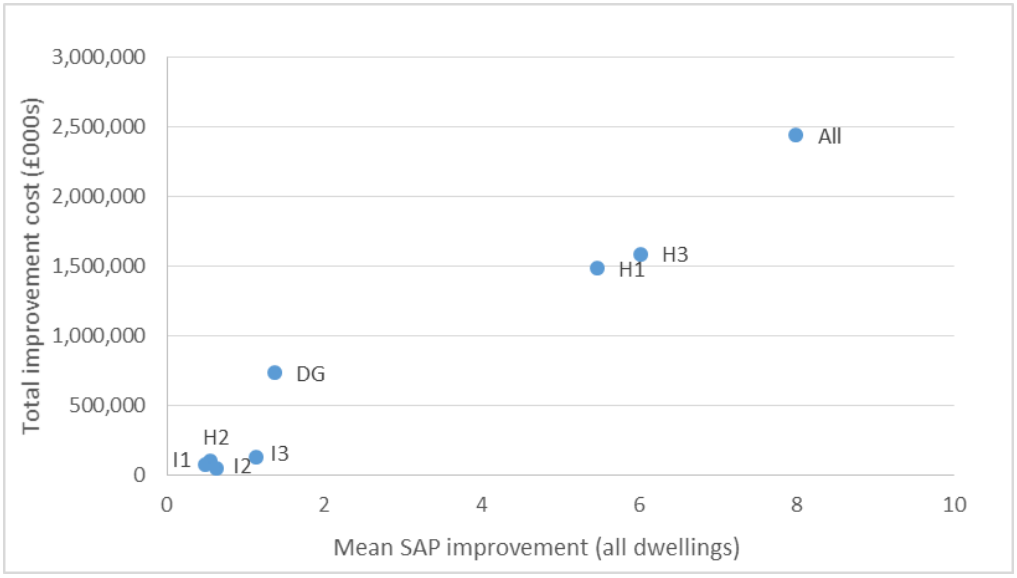
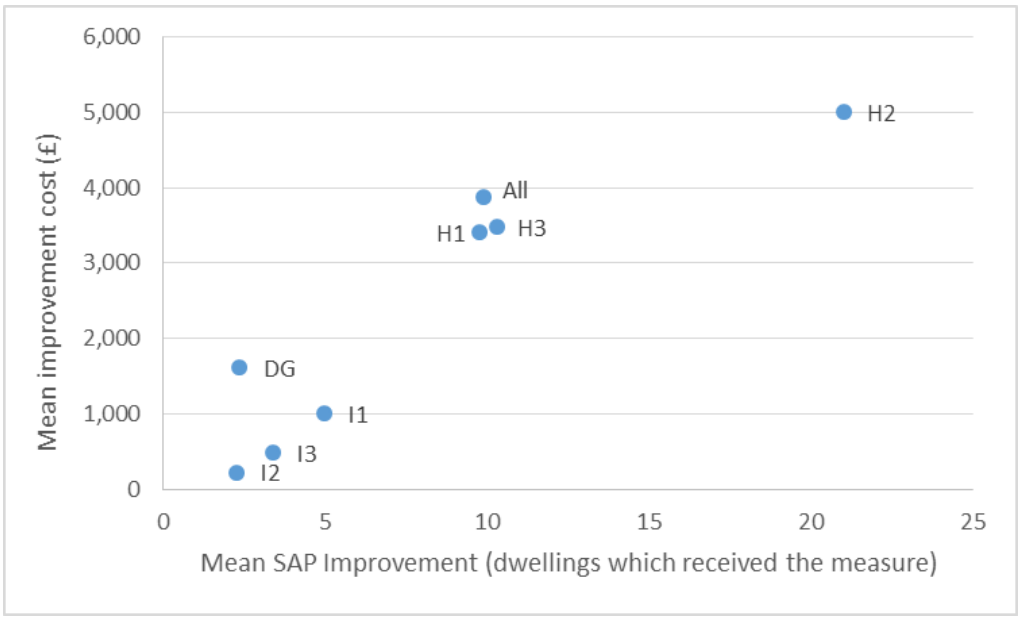


Figure 2 plots the mean SAP improvement of each scenario against the mean improvement cost, for dwellings that have received the improvement measure. Heating scenario 2 results in the biggest improvement to energy efficiency, when only considering dwellings which have received the improvement, despite having a low impact on the SAP rating at a stock level (Figure 1). This shows that whilst only a small proportion of the stock is eligible to receive the improvement, it is an effective scenario for improve energy efficiency when it can be implemented. The double glazing improvement represents one of the least cost effective options; costing more than the three insulation scenarios but offering one of the lowest mean SAP improvements.

Figure 2 – Cost effectiveness of improvement scenarios for dwellings that have received an improvement.



Appendix A – Deviations from EPC methodology

This work closely follows the EPC improvements methodology set out in Appendix T of SAP2012. Deviations from this methodology are as followed:

Deviation number	Methodology followed in this work	Methodology followed in Appendix T
1	Improvement measures are applied individually, and combined where appropriate	Improvement measures are applied cumulatively, following the order outlined in Appendix T
2	Solid fuel room heaters are upgraded to oil central heating, if mains gas is not available	Solid fuel room heaters are not upgraded if mains gas is not available
3	Old / Slimline storage heaters are upgraded to oil central heating if mains gas is not available	Old / Slimline storage heaters are upgraded to high heat retention storage heaters if mains gas is not available.
4	Solid fuel boilers are upgraded to oil condensing boilers if mains gas is not available	Solid fuel boilers are upgraded to biomass boilers if mains gas is not available

Appendix B – Improvement cost methodology

The methodology for applying a cost to improvement measures follows the EPC methodology of using indicative costs that have been produced and included within the Product Characteristics Database (PCDB). The database is maintained by BRE for the purpose of supporting UK building energy performance assessments (EPCs) that are produced using the National Calculation Methodologies for the energy rating of buildings.

For the measures included in this work, a low and high range of costs is provided from the PCDB, and the mean of these has been applied as the cost of improvement. Where deviations from the EPC improvement methodology have occurred, cost equivalent prices have been used. For example, it is assumed that the price of upgrading a heating system to a gas boiler will have the same associated cost as upgrading to the oil equivalent.

Improvement Scenario	Description	Low Cost (£)	High Cost (£)	Mean Cost (£)
Heating 1	Upgrade from non-condensing boiler to condensing boiler (no fuel switch)	2,200	3,000	**2,600**
	Upgrade from non-condensing to condensing boiler (fuel switch)	3,000	7,000	**5,000**
Heating 2	Upgrade from non-central heating to central heating with a condensing boiler	3,000	7,000	**5,000**
Insulation 1	Apply loft insulation to dwellings with <= 150mm of insulation	100	350	**225**
Insulation 2	Apply CWI insulation to dwelling with unfilled cavity walls	500	1,500	**1,000**
Double Glazing	Improve single glazed windows to modern double glazing	3,300	6,500	**4,900**
	Improve pre-2006 double glazed windows to modern double glazing	1,000	1,400	**1,200**

Appendix C – User Guide

Method

The BRE 'Cost to make dwellings in Northern Ireland energy efficient methodology' comprises of;

Eight different energy efficiency improvement scenarios have been created, which simulate a combination of heating and insulation measures, the details of which are outlined in Table 1. For each improvement scenario, a set of criteria has been established to determine the eligibility of a case to receive relevant improvements.

The energy efficiency improvements selected, and the eligibility criteria for each improvement measure, largely follows the methodology used in the recommendation of improvements for energy performance certificates (EPCs), as outlined in Appendix T of SAP 2012. Deviations from this methodology occur where appropriate for this work, and are specified in Appendix A.

2. Re-calculating SAP and applying a cost of improvement

Initially, a base dataset was established using data from the 2016 Northern Ireland House Condition Survey (NIHCS), to represent the current state of the Northern Ireland housing stock, prior to any improvements.

Under each scenario, if a case met the criteria for a specific improvement measure, the base inputs were altered to simulate the installation of the improvement measure. The BRE energy model has then been re-run to produce a new SAP rating for each case. This is the same energy model used in the creation of the published NIHCS 2016 energy efficiency figures.

A cost of applying relevant improvement measures has also been calculated for each case. The costs applied are sourced from the Product Characteristics Database (PCDB), which contains a low and high indicative cost for each improvement measure. Under each scenario, if a case received an improvement, then the mean indicative cost for that improvement measure was applied. This approach is consistent with that used for the recommendation of improvement measures for EPCs.

The mean SAP rating and cost of improvement has been calculated for each improvement scenario and used to compare the scenario's energy improvement potential and cost-effectiveness.

For more information on SAP and how it is measured see Appendix H page 147 of the main 2016 NIHCS report.

https://www.nihe.gov.uk/house_condition_survey_main_report_2016.pdf

Quality information

The quality assurance of the modelling work used to produce this report focused on ensuring that the data translation and modelling processes were performed correctly, to provide accurate and reliable results. The process of development and the creation of results followed an internal procedure so the work undertaken could be reviewed and assessed by project managers.

Examples of the quality assurance undertaken to validate the model and results included:

- Updating and revising the methodology using the latest assumptions for this area of work;
- Checking of transformations undertaken and mathematical formulae;
- Internal checks of data inputs to assure translation was completed correctly;

- Checks of correct units for calculations;
- Check correct and latest external data sources were used;
- Sense check of results;
- Internal review of results and reporting.

Surveyors working on the 2016 NIHCS received training and support to help ensure their collection of energy related data were consistent and robust. A re-fresher training session in 2016 explained the principles, how the form should be completed as well as conducting practical exercises with feedback sessions. While these measures ensure a good level of consistency in judgements, some surveyor variability is to be expected.

Strengths and weaknesses

Strengths

This model uses the more up to date methodology for applying a cost to improvement measures which follows the EPC methodology of using indicative costs from the Product Characteristics Database (PCDB). The database is maintained by BRE for the purpose of supporting UK building energy performance assessments (EPCs) that are produced using the National Calculation Methodologies for the energy rating of buildings.

Where deviations from the EPC improvement methodology have occurred, cost equivalent prices have been used. For example, it is assumed that the price of upgrading a heating system to a gas boiler will have the same associated cost as upgrading to the oil equivalent.

The basis of this report is the 2016 NIHCS dataset. All results should be taken in the context of this background, and the survey and modelling assumptions which occur within these.

Weaknesses

The size of the sample for the NI House Condition Survey 2016 was 3,000 addresses. A weighting and grossing process translated the information gathered into figures that reflected the real world.[5] This provided robust data at Northern Ireland level.

See Appendix A page 88 of the main 2016 House Condition Survey report for more information on for the survey's user guide.

https://www.nihe.gov.uk/house_condition_survey_main_report_2016.pdf

[5] Further information on the sampling, and weighting and grossing processes for the Northern Ireland House Condition Survey 2016 is available in the report https://www.nihe.gov.uk/index/corporate/housing_research/house_condition_survey.htm

Report Ends