BRE Group
Bucknalls Lane
Watford, Herts
WD25 9XX

+44 (0)333 321 8811

enquiries@bregroup.com
bregroup.com

CLIENT REPORT

# Northern Ireland Evaluation of Energy Efficiency Schemes

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Issue 1

PREPARED BY

| | |
|---|---|
| Name | Adele Beaumont and Shefali Rangari |
| Position | Senior Consultants |
| Date | |

## Signature

AUTHORISED BY

| | |
|---|---|
| Name | Helen Garrett |
| Position | National Housing Data & Insights Lead |
| Date | |

## Signature

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# 1. Executive Summary

## 1.1. Aims and Objectives

The aim of this work was to evaluate the performance of the Department for Communities Affordable Warmth (AWS) and Boiler Replacement (BRS) Schemes. Following the methodology established in previous scheme evaluations, BRE has performed improvement modelling to simulate the effect of installing improvement measures through the 2022/23, 2023/24 and 2024/25 AWS and the 2022/23 and 2023/24 BRS and quantified the associated energy savings using the SAP (Standard Assessment Procedure) 2012 methodology.

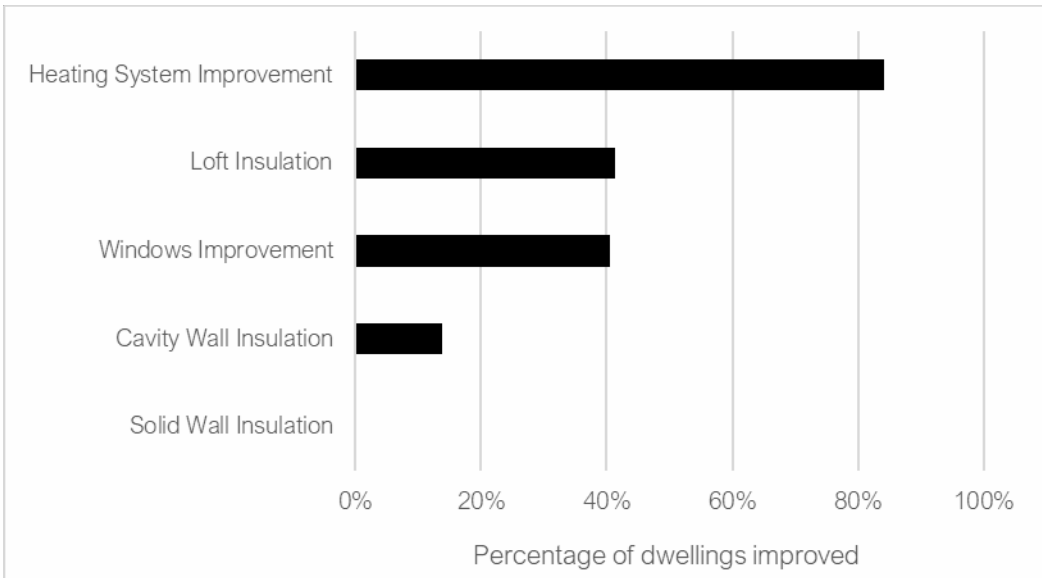
Initially, a base position was established for each case improved through the grant schemes and BRE's SAP model was run to determine the SAP rating of each dwelling prior to any improvements being installed. The base inputs were then altered to simulate the installation of eligible improvement measures, and the model re-run to establish a 'post-improvement' position. The 'pre-improvement' and 'post-improvement' model runs were then compared to quantify the associated SAP rating increase, energy savings and $CO_2$ savings.

For this evaluation, the findings are based on the set of 'realistic' modelling assumptions, consistent with the previous two scheme evaluations, and are deemed to represent the most robust pre- and post-improvement positions for each dwelling, given the grant scheme measures that are installed.

## 1.2. Key Findings

When looking at cases across both the AWS and BRS, over 15,000 improvement measures have been installed across 9,165 cases. This includes 13,739 improvement measures installed through the AWS and 1,372 boiler upgrades performed as part of the BRS. Under the AWS, heating system upgrades were the most common measure installed, followed by installing loft insulation and upgrading windows (Figure E1).

*Figure E1. Percentage of dwellings receiving a grant that have received each improvement measure, under the AWS*




When considering improvement measures from the Affordable Warmth Scheme, the average SAP rating increased by 13 SAP points (Table E1), rising from a mean SAP rating of 51 in the pre-improvement position, to 64 in the post-improvement position. The average modelled annual reduction in energy consumption was 5,688 kWh / year, which equated to an average energy bill saving of £351 per year and an average reduction in $CO_2$ emissions of 2.05 tonnes per year. The total annual energy savings achieved through the AWS was 43.5 GWh, with a total energy cost saving of £2.7 million / year and a total reduction in $CO_2$ emissions of 15.6 thousand tonnes per year.

***Table E1. Average SAP improvement, energy and $CO_2$ savings achieved through the AWS***

| | | |
|---|---|---|
| SAP rating improvement | 13 | |
| Energy Consumption Savings | 5,688 kWh / year | 43.5 GWh / year |
| Energy Cost Savings | £ 351 / year | £ 2.7 million / year |
| CO2 Savings | 2.05 tonnes / year | 15.6 thousand tonnes / year |

Measures installed through the Boiler Replacement Scheme resulted in an average SAP rating increase of 6 points. The average modelled annual reduction in energy consumption was 2,327 kWh following improvement measures being installed, which equated to an average energy bill saving of £166 per year and an average reduction in $CO_2$ emissions of 1.0 tonnes per year. The total annual energy saving achieved through the BRS was 3.2 GWh, with a total energy cost saving of £0.2 million / year and a total reduction in $CO_2$ emissions of 1.3 thousand tonnes per year (Table E2).

***Table E2. Total energy consumption, cost and $CO_2$ savings achieved through the BRS***

| BRS | Average (mean) | Total |
|---|---|---|
| SAP rating improvement | 6 | |
| Energy Consumption Savings | 2,327 kWh / year | 3.2 GWh / year |
| Energy Cost Savings | 166 £ / year | 0.2 million £ / year |
| CO2 Savings | 1.0 tonnes / year | 1.3 thousand tonnes / year |

Measures installed through the Affordable Warmth Scheme resulted in a higher SAP improvement, on average, compared to the Boiler Replacement Scheme (an increase of 13 SAP points compared with 6). Both the total and mean energy and $CO_2$ savings were also higher for cases improved through the Affordable Warmth Scheme compared to the Boiler Replacement Scheme. The greater savings associated with the AWS were due to a wider range of measures being installed to eligible dwellings, as well as modelled pre-improvement SAP ratings being lower, on average, than cases improved through the BRS. For example, households living in dwellings in the least efficient EER bands of E, F and G received predominantly a package of 2 improvement measures; for the dwellings in the worst performing band G, this resulted in an average SAP rating increase of 46 points and for those in band F an average SAP increase of 22 points was achieved. Almost all the dwellings in these bands received a heating system upgrade, in combination with either a windows replacement or loft insulation upgrade.

## 1.3. Conclusion

Compared with the previous evaluations of scheme data (2018/19/20 and 2020/21/22) the average SAP improvement across all cases was similar; for the Affordable Warmth Scheme an average increase of 16 SAP points and 13 SAP points was estimated for the 2018-20 and 2020-22 schemes respectively, compared with an average increase of 13 SAP points for the current evaluation. The total annual energy consumption savings, total annual energy cost savings and total annual $CO_2$ savings are estimated to be higher for 2022-2025 compared with 2020-2022 due to the substantial increase in numbers of improvement measures installed (almost 14,000 over three years, compared with 4,000 over two years respectively). This reflects the return to normal service levels post-pandemic, particularly the ability to install heating improvements.

For the Boiler Replacement Scheme, the current scheme resulted in a slightly reduced average SAP increase of 6 points, compared with the previous 2018-2020 and 2020/22 schemes which had both seen an average increase of 7 SAP points. However, very similar average savings for energy consumption and CO2 savings were seen. The total annual energy consumption savings, total annual energy cost savings and total annual CO2 savings are estimated to be substantially lower for 2022-2024 compared with both 2020-2022 and 2018-2020 due, in the main, to the lower number of boiler upgrades carried out but also because a smaller proportion of LPG/Heating oil boilers were switched to mains gas boilers.

A significant factor governing the potential SAP rating increase is the starting EER band prior to any improvements being installed. These least efficient dwellings are typically the older building stock with a solid wall construction, which are generally more difficult and expensive to insulate than cavity walled homes. Using information published by Ofgem for the ECO4 programme[1], an average sized dwelling built before 1966 with a solid wall construction could expect an increase of between 12 and 16 SAP points, depending on the starting energy efficiency band. However, as this evaluation shows, when heating improvements are applied in combination with other fabric improvements a significant improvement in the energy efficiency rating can be achieved. From the packages of measures installed under the AWS, the benefit of installing multiple measures is clearly seen. When insulation only measures are installed the maximum uplift is estimated to be less than 10 SAP points, whereas when a heating system improvement is made in addition to one or more fabric improvements, the estimated uplift in SAP ratings ranges from 14 to 24 SAP points. For dwellings starting with an EER band E it would be reasonable to expect an average increase of around 14 SAP points.

[1] Analysis to support ECO4 scoring system (see Appendix B)

# 2. Introduction

This report summarises the results of modelling work performed by BRE to evaluate the performance of the Northern Ireland 2022/23, 2023/24 and 2024/25 Affordable Warmth Scheme (AWS) and the 2022/23 and 2023/24 Boiler Replacement Scheme (BRS). Both the AWS and BRS offer grants to households to help with the installation of energy improvement measures.

## Background - AWS

The Affordable Warmth (AW) Scheme commenced in April 2015. In the 10 years to March 2025 the scheme has so far assisted 30,270 homes and grant aided 54,640 measures with a value of £136,094 million to date.

The AWS targets low income households and provides them with a range of heating and insulation measures to improve the thermal efficiency of their home. The energy efficiency improvement measures are specifically designed for the needs of each individual home to provide the best possible and most complete outcome for the householders. The ultimate goal of the fuel poverty measures provided by the Department for Communities is to raise the SAP ratings of these fuel poor households to a level which will provide a warm, comfortable home to improve their thermal comfort and protect them from fuel price fluctuations thus alleviating the health impacts of fuel poverty.

Affordable Warmth measures are only available to private sector households e.g. owner occupiers and private sector tenants where the landlord is registered with the Department for Communities' Landlord Registration Scheme.

The Housing Executive administered the Affordable Warmth Scheme on behalf of the Department for Communities (DfC) in partnership with local Councils. During 2023/24 DfC changed the delivery model resulting in the scheme's targeting and referral partnership arrangements with Local Councils ending. Since 1 September 2023 all initial enquiries for the AWS are assessed - by telephone - through the Housing Executive's NI Energy Advice Service.

Households with a total gross annual income of less than £23,000 are eligible for the scheme. The AWS aims to provide whole-house improvement packages up to £7,500 (or £10,000 solid wall properties) for the following measures in priority order:

- Cavity wall insulation
- Loft insulation
- Draught-proofing
- First time or upgraded heating systems and controls
- Single glazed windows to PVC Double glazing.

## Background - BRS

The Boiler Replacement (BR) Scheme was launched by the Department for Communities in May 2012 and closed in March 2024. The Boiler Replacement Scheme assisted 42,169 homes and in 10 years has invested over £28 million to March 2024.

The Boiler Replacement Scheme offered owner occupied households with an income of up to £40,000 a grant of up to £1,000 towards replacing an inefficient domestic boiler (over 15 years old) with a new one and heating controls.

In order to evaluate the performance of the AWS and BRS, BRE has performed improvement modelling, following the methodology used in the previous scheme evaluations (2018 to 2022), to simulate the effect of installing energy efficiency measures on cases improved through the grant schemes. This has been quantified in terms of the increase to the dwelling's SAP rating, and the savings to energy consumption, energy bills and $CO_2$ emissions.

This review covers work done under the two schemes in 2022/23, 2023/24 and 2024/25 (AWS only) and marked as completed at the point of data delivery to BRE.

# 3. Methodology

To evaluate the performance of the Affordable Warmth and Boiler Replacement grant schemes, it is necessary to estimate the energy performance of the dwellings helped by the schemes both before and after improvement. This has been conducted using the Government's SAP (Standard Assessment Procedure) energy modelling methodology[2]. When interpreting the results presented here, it is important to consider that the energy use, energy costs, and carbon dioxide emissions savings are based on the assumptions built into the SAP methodology. SAP does not attempt to replicate actual behaviour of the occupying household, rather it uses standardised assumptions that permit comparisons between two dwellings regardless of their occupants or location for example.

For existing dwellings, SAP calculations are performed according to the methodology presented in the Reduced Data SAP (RdSAP) documentation[3]. This methodology specifies a list of inputs required and permitted values for those inputs. These are then used to infer values for SAP inputs where they cannot be ascertained directly. An example of this is the U-value of a wall. This cannot usually be measured directly for an existing dwelling and therefore the U-value is inferred based on the dwelling age, the wall type and any applied insulation. Once all inputs (observed and inferred) are in place a full SAP calculation can be performed for that dwelling.

NIHE provided data for each dwelling benefitting from either scheme. The data included details of the measures applied, as well as basic information about the dwelling in its pre-improvement state. The information provided did not include all the required inputs to fully satisfy the RdSAP methodology, however an inference procedure using dwelling archetypes, as utilised in the previous scheme evaluations, was utilised, enabling a SAP calculation to be performed for each dwelling both before and after the application of any improvement measures.

## 3.1. Dwelling Archetype creation

Dwelling archetypes were developed using data from the 2016 Northern Ireland House Condition Survey (NIHCS), to inform the geometric inputs and fabric heat loss values used within the improvement modelling. Each case in the AWS and BRS dataset was able to be assigned to a dwelling archetype, based on the dwelling type recorded by the surveyor. The dimensions and fabric heat loss values associated with that archetype were then used as inputs into the BRE SAP model where needed. For more information on the use of dwelling archetypes as modelling inputs, and the dimensions and fabric heat loss values associated with each archetype, see Appendix A.

## 3.2. Assessment of improvement measures

For each case that received an improvement measure under the AWS or BRS scheme, data were typically available on the associated dwelling characteristics (e.g. dwelling type, age, wall type), the pre-improvement position of some building elements (e.g. current levels of loft insulation) and the energy improvement measures that were installed through each scheme. These data were analysed and a list of measures which could be modelled under the SAP methodology was compiled. These improvement measures, alongside the dwelling characteristics, were used as key inputs in the data modelling and helped to inform the pre- and post-improvement position of each case.

Appendix B lists the improvement measures that have been modelled under each scheme, as well as the assumptions used in the derivation of the pre- and post-improvement modelling positions.

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[2] SAP 2012: https://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf
[3] RdSAP v9.93, Appendix S: https://www.bre.co.uk/filelibrary/SAP/2012/RdSAP- 9.93/ RdSAP_2012_9.93.pdf

## 3.3. Data Modelling

BRE's SAP model was used to quantify the energy savings associated with improvements installed through the AWS and BRS. This is a proprietary model which has been developed to simulate the effect of installing energy efficiency improvement measures in dwellings. The model allows for a SAP rating to be calculated despite having fewer inputs than would normally be required for a full SAP calculation, by combining dimensions and fabric heat loss information from the dwelling archetypes with information on the dwelling collected through the grant schemes.

Initially, a base position was established for each case in the AWS and BRS datasets, using the dwelling characteristics and dimensions data defined in the previous stages. Each case was run through BRE's SAP model to determine the SAP rating of the dwelling prior to any improvements being installed. The base inputs were then altered to simulate the installation of any eligible improvement measures, and the SAP model re-run to establish a 'post-improvement' position. The 'pre-improvement' and 'post-improvement' model outputs were then compared to quantify the associated SAP rating increase, cost, energy, and $CO_2$ savings.

For certain grant scheme measures, uncertainty exists around how pre- and post-improvement positions should be derived, predominantly surrounding the heating efficiencies and level of heating controls associated with heating system upgrades. The same assumptions that were developed for the previous evaluation work were followed to provide consistency in the methodology across the years. A combination of RdSAP imputations and data extracted from the 2016 NIHCS were used to determine the most realistic pre- and post-improvement positions, given the nature of the specific measure being applied. The main findings presented throughout this report are based on these assumptions.

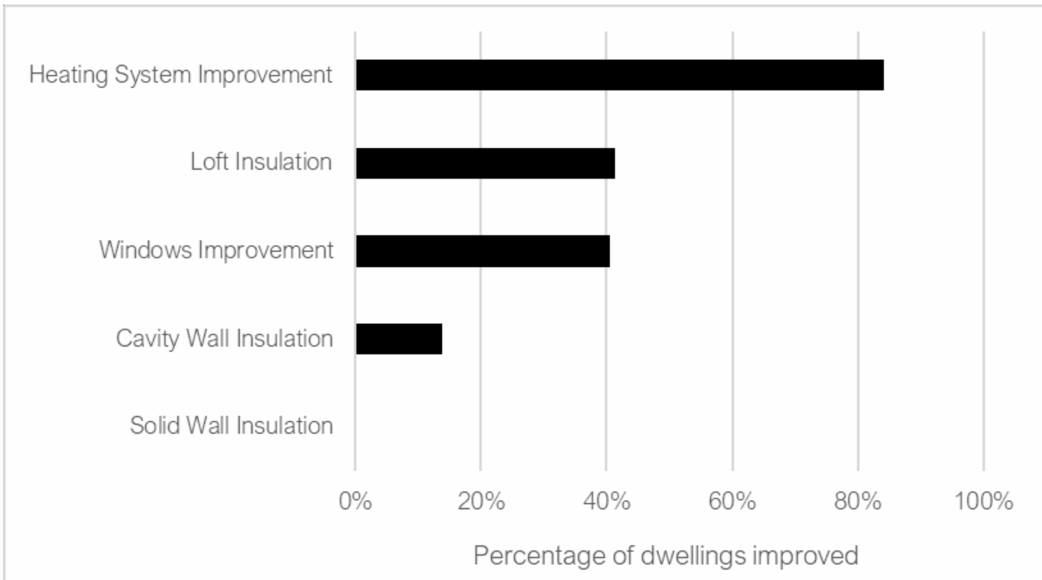
# 4. Findings

## 4.1. Affordable Warmth Scheme

#### 4.1.1. Number of improvements

As part of the AWS 13,739 improvements were installed in total to 7,644 dwellings; 84% of dwellings received an upgrade to their heating system and / or controls, 41% received loft insulation, 40% received double glazing and / or draughtproofing of windows, , 14% received cavity wall insulation, and less than 1% received solid wall insulation[4] (Figure 1). The proportional split of improvement measures is similar to that reported for the 2020-2022 AWS evaluation, although there was a shift to a greater proportion of loft insulation improvements, compared with window upgrades, seen for this latest timeframe.

*Figure 1. Percentage of improved dwellings receiving each improvement measure through the AWS*




When considering the number of improvements applied to each dwelling, the pre-improvement Energy Efficiency Rating (EER) band[5] of the modelled case has a direct impact and Table 1 shows how the number of improvements applied to a dwelling tends to increase as energy efficiency of the dwelling in its pre-improved state decreases.

***Table 1. Percentage of dwellings receiving a given number of improvements through the AWS, split by pre-improvement EER band***

| Pre-improvement EER band | Number of improvements | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4+ |
| C | 54% | 42% | 4% | 0% |

[4] Only 15 dwellings were recommended a solid wall insulation measure in the combined 2022 to 2025 AWS data.
[5] Energy efficiency rating bands are defined by the SAP rating according to Table 14 of SAP 2012. Dwellings in EER band A are highly energy efficient, with energy efficiency decreasing through to EER band G, which represents highly inefficient dwellings.

| | | | | |
|---|---|---|---|---|
| D | 47% | 40% | 12% | 1% |
| E | 32% | 47% | 18% | 2% |
| F | 32% | 49% | 17% | 2% |
| G | 31% | 38% | 25% | 6% |

#### 4.1.2. Impact of improvement measures on SAP ratings

Installing all eligible improvements recorded as part of AWS resulted in an increase to the SAP rating of participating dwellings by an average of 13 SAP points (Table 2). This takes the average SAP rating from 51 (EER band E) prior to any improvements, up to 64 (EER band D) in the post-improvement position.

***Table 2. Average SAP rating increase achieved through the AWS***

| Mean pre-improvement SAP rating | Mean post-improvement SAP rating | Mean SAP increase |
|---|---|---|
| 51 | 64 | 13 |

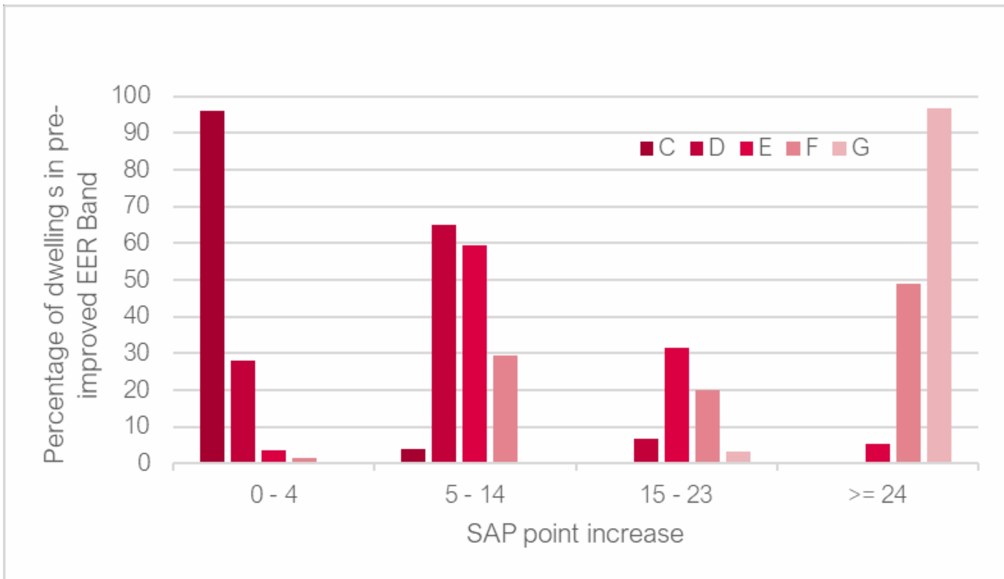
One of the most notable drivers behind the SAP improvement achieved through installing efficiency measures is the modelled EER band of each case, prior to any measures being installed. Table 3 shows that the highest SAP increases are achieved for cases which are modelled to have low pre-improvement EER bands. Cases rated band F or G, prior to any improvement measures being installed, achieve an average SAP rating improvement of 22 and 46 SAP points, respectively. Almost all the dwellings in these bands received a heating system upgrade, in combination with either a windows replacement or loft insulation upgrade. Conversely, cases rated band C prior to any improvements only achieve an average increase of 2 SAP points. This is in part due to the higher number of improvement measures installed in the worst performing dwellings but also that these dwellings typically required both a fabric improvement such as loft or cavity wall insulation, and a heating improvement.

***Table 3. Average SAP rating increase achieved through AWS, by pre-improvement EER band***

| Pre-improvement EER band | *Sample size* | Mean pre-improvement SAP rating | Mean post-improvement SAP rating | Mean SAP increase |
|---|---|---|---|---|
| C | 105 | 70 | 72 | 2 |
| D | 3095 | 59 | 67 | 8 |
| E | 3321 | 49 | 63 | 14 |
| F | 1091 | 34 | 56 | 22 |
| G | 32 | 13 | 59 | 46 |
| All Cases | 7644 | 51 | 64 | 13 |

Figure 2 shows the percentage of cases which achieve banded SAP improvements, based on the pre-improvement EER band of the dwelling. Over 49% and 97% of dwellings with a pre-improvement EER band of F and G respectively, achieved an increase of over 24 SAP points through installing AWS measures. Conversely, 96% of dwellings rated band C prior to any improvements achieve an increase of under 5 SAP points.

*Figure 2. Percentage of AWS cases achieving banded SAP increase, split by pre-improvement EER band*




### 4.1.3. Impact of improvement measures on energy and $CO_2$ savings

Installing improvement measures as part of the AWS results in an average annual energy saving of 5,688 kWh and an average reduction in energy bills of £351 per year (Table 4). This equates to a total annual energy saving of 43.5 GWh. AWS improvements result in an average reduction of $CO_2$ emissions by 2.0 tonnes per year, and a total annual $CO_2$ emission reduction of 15,633 tonnes.

***Table 4. Average and total energy consumption, cost and CO2 savings achieved through the AWS***

| | Mean Annual Savings | Total Annual Savings |
|---|---:|---:|
| Energy Consumption (kWh) | 5,688 | 43,478,126 |
| Energy Cost (£) | 351 | 2,685,720 |
| CO2 Emissions (tonnes) | 2.0 | 15,633 |

As with the SAP rating, the pre-improvement EER band has a marked impact on the energy and $CO_2$ savings that can be achieved through the installation of AWS improvement measures (Table 5). E and F rated dwellings achieve higher average savings in energy consumption, bills and $CO_2$ emissions, than dwellings with an EER band C. It is noted that although the G rated dwellings achieve an average energy cost saving of £1,543, the average energy consumption savings for these dwellings were proportionally less. These cases had no heating system pre-improvement (and were therefore imputed electric room heaters in the SAP methodology); they received a gas/oil central heating system under the AWS scheme which results in a higher energy consumption, but at a lower fuel tariff.

*Table 5. Average energy consumption, cost and CO2 savings achieved through the AWS, split by pre-improvement EER band*

| Pre-improvement EER band | Mean energy consumption (kWh /year) | Mean energy cost savings (£ / year) | Mean CO2 savings (tonnes / year) |
|---|---|---|---|
| C | 1,494 | 52 | 0.3 |
| D | 3,859 | 217 | 1.2 |
| E | 6,156 | 372 | 2.2 |
| F | 9,996 | 665 | 3.9 |
| G | 863 | 1,543 | 4.8 |
| Total | 5,688 | 351 | 2.0 |

## 4.2. Boiler Replacement Scheme

### 4.2.1. Number of improvements

A total of 1,372 dwellings received a new boiler as part of the BRS; 72% of the boilers being replaced were oil boilers, 26% gas boilers and 2% LPG boilers. Of the dwellings improved as part of this scheme, 54% of dwellings received gas boilers, 45% received oil boilers and 2% received LPG boilers[6]. The majority of dwellings that used gas or LPG remained on the same fuel following their boiler upgrade (Table 6), whereas those dwellings using oil as their pre-improvement heating fuel were split between receiving gas and oil (38% and 62% respectively).

*Table 6. Percentage of installed boilers on each fuel post-improvement by the fuel used pre-improvement*

| Pre-improvement Fuel | Post-improvement Fuel | | |
|---|---|---|---|
| | Gas | LPG | Oil |
| Gas | 100% | 0% | 0% |
| LPG | 3% | 90% | 7% |
| Oil | 38% | 0% | 62% |
| Any | 54% | 2% | 45%[6] |

### 4.2.2. Impact of improvement measures on SAP ratings

On average, upgrading a dwelling's heating system through the BRS resulted in a SAP rating increase of 6 SAP points (Table 7), from 65 (EER equivalent band D) in the pre-improvement position, to 71 (EER equivalent band C) in the post-improvement position.

[6] Percentages do not add up to 100% due to rounding.

***Table 7. Average SAP rating increase achieved through the BRS***

| Mean pre-improvement SAP rating | Mean post-improvement SAP rating | Mean SAP increase |
|---|---|---|
| 65 | 71 | 6 |

Generally, it is difficult for cases to achieve a SAP rating increase of more than 14 SAP points through the BRS (fewer than 1% of cases), due to just one improvement measure being installed in the dwelling (Table 8). Where cases have seen a significant increase to the dwelling's SAP rating, this is due to the boiler being upgraded from an expensive heating fuel (LPG) to a cheaper heating fuel (Natural (mains) Gas or Oil). As SAP is cost based, the fuel prices function as a major factor in the SAP rating of a dwelling, and therefore a switch from expensive to cheaper fuels can have a large impact on the change to a dwelling's SAP rating. To achieve larger increases to SAP ratings overall, boiler upgrades would have to be installed alongside fabric insulation measures, as is the protocol for the Affordable Warmth Scheme.

***Table 8. Banded SAP rating increase achieved through the BRS***

| Banded SAP increase | Frequency | Percent |
|---|---:|---:|
| 1 - 4 | 964 | 70% |
| 5 - 14 | 405 | 30% |
| 15 - 23 | 2 | <1% |
| >= 24 | 1 | <1% |
| Total | 1,372 | 100% |

#### 4.2.3. Impact of improvement measures on energy and $CO_2$ savings

Upgrading boilers through the Boiler Replacement Scheme results in an average modelled annual energy saving of 2,327 kWh and an average reduction in energy bills of £166 per year (Table 9). This equates to a total annual energy saving of 3.2 GWh. BRS upgrades result in an average reduction in $CO_2$ emissions of 1.0 tonnes per year, and a total annual $CO_2$ reduction of around 1,300 tonnes per year.

***Table 9. Mean and total energy consumption, cost and CO2 savings achieved through the BRS***

| | Mean Annual Savings | Total Annual Savings |
|---|---:|---:|
| Energy Consumption (kWh) | 2,327 | 3.2 million |
| Energy Cost (£) | 166 | 0.2 million |
| CO2 Emissions (tonnes) | 1.0 | 1.3 thousand |

## 4.3. All dwellings

When looking at cases across both the AWS and BRS, over 15,000 improvement measures have been installed across 9,016 dwellings. This results in an increase to the average SAP rating of 12 SAP points, rising from a SAP rating of 53 in the pre-improvement position, to 65 in the post-improvement position (Table 10). Measures installed through the AWS result in a higher SAP increase, on average, compared to upgrades performed through the BRS (an increase of 13 SAP points compared with 6).

***Table 10. Average SAP rating increase achieved through the AWS and BRS***

| Scheme | Mean pre-improvement SAP rating | Mean post-improvement SAP rating | Mean SAP improvement |
|---|---|---|---|
| AWS | 51 | 64 | 13 |
| BRS | 65 | 71 | 6 |
| *All Cases* | 53 | 65 | 12 |

Across all cases, the average modelled reduction in energy consumption was 5,176 kWh per year following improvement measures being installed, which equates to an average energy bill saving of £323 per year. Installing improvement measures across both schemes results in an average reduction in $CO_2$ emission of 1.9 tonnes per year and a total reduction of 17.0 thousand tonnes per year (Tables 11 and 12).

***Table 11. Average energy consumption, cost and $CO_2$ savings achieved through the AWS and BRS***

| Scheme | Mean Energy Consumption Savings (kWh / year) | Mean Energy Cost Savings (£ / year) | Mean CO2 Savings (tonnes / year) |
|---|---|---|---|
| AWS | 5,688 | 351 | 2.0 |
| BRS | 2,327 | 166 | 1.0 |
| *All Cases* | 5,176 | 323 | 1.9 |

***Table 12. Total energy consumption, cost and $CO_2$ savings achieved through the AWS and BRS***

| Scheme | Total Energy Consumption Savings (GWh / year) | Total Energy Cost Savings (million £ / year) | Total CO2 Savings (thousand tonnes / year) |
|---|---|---|---|
| AWS | 43.5 | 2.7 | 15.6 |
| BRS | 3.2 | 0.2 | 1.3 |
| *All Cases* | 46.7 | 2.9 | 17.0 |

The total energy, energy cost and $CO_2$ savings are higher for cases improved through the AWS because of the wider range of measures installed.

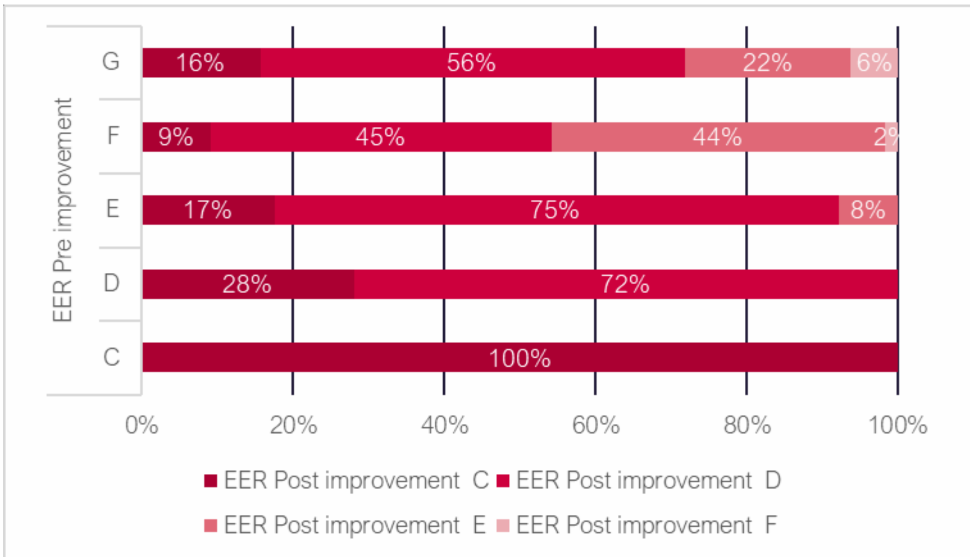
## 5. Conclusion and Discussion

### 5.1. Quantifying improvement in SAP

An average increase of 13 SAP points is estimated to have occurred through measures installed as part of the AWS and 6 SAP points through measures installed by the BRS.

Figure 3 shows the proportion of dwellings that changed SAP band rating as a result of the improvements installed under AWS. After the improvements were carried out, 28% of dwellings in band D, 17% of dwellings in band E, 9% of dwellings in bands F and 16% of dwellings in band G improved to band C. For those pre-improvement G rated dwellings, 56% were improved to a band D, 22% were improved to band E and 6% were improved to band F. No pre-improvement G rated dwellings remained in band G.

*Figure 3. Percentage of AWS cases changing EPC band after improvements*




A significant factor governing the potential SAP rating increase is the starting EER band prior to any improvements being installed. These least efficient dwellings are typically the older building stock with a solid wall construction, which are generally more difficult and expensive to insulate than cavity walled homes. Using information published by Ofgem for the ECO4 programme[7], an average sized dwelling built before 1966 with a solid wall construction could expect an increase of between 12 and 16 SAP points, depending on the starting energy efficiency band. However, as this evaluation shows, when heating improvements are applied in combination with other fabric improvements a significant improvement in the energy efficiency rating can be achieved. Appendix C shows the average SAP rating uplift resulting from the AWS by dwelling type, council and package of measures installed. From the various packages of measures installed under the AWS, the benefit of installing multiple measures can be clearly seen. When insulation only measures are installed the maximum uplift is estimated to be less than 10 SAP points, whereas when a heating system improvement is made in addition to one or more fabric improvements, the estimated uplift in SAP ratings ranges from 14 to 24 SAP points. For dwellings starting with an EER band E it would be reasonable to expect an average increase of around 14 SAP points.

[7] Analysis to support ECO4 scoring system (see Appendix B)

## 5.2. Strengths and weaknesses

It is important that the findings of this report are considered within the context of the data modelling approach taken, both in terms of the assumptions applied during the data translation phase, as well as the underlying modelling methodology followed.

BRE has performed an RdSAP calculation for each case in the grant scheme dataset as provided by NIHE, using our proprietary SAP model. The use of SAP provides a robust calculation framework, which is consistent with the longitudinal monitoring of energy efficiency across the UK performed by National Governments. It is however worth noting that SAP applies standardised assumptions around how occupants heat their home, weather conditions, and the fuel prices applied within the modelling. Actual energy consumption and householders fuel bills are therefore likely to deviate from the modelled outputs and will be highly dependent on occupant behaviour.

A full set of input data typically required to perform an RdSAP calculation was not available for this grant scheme evaluation. The AWS datasets now include data on internal floor area, although for the 2022-23 and 2023/24 data, the data quality for this variable was poor, with 32% of dwellings missing a recorded value. However a new data collection operating system was introduced for the 2024/25 data, which meant that all 1,389 cases had a floor area value recorded, which looked to be of a high data quality. As seen in the previous scheme evaluation, the comparison between the average recorded and archetype floor areas for flats and bungalows showed the archetype floor area to be a reasonable approximation of the mean measured floor area; however there remains a larger deviation seen for detached houses, and so the use of dwelling archetypes with 'typical' dimensions and heat-loss parameters applied to each case means that granularity within the data outputs is likely to be lost. Whilst this is not expected to impact the accuracy modelled energy savings on average, it may lead to the cases with highest and lowest energy savings being unrepresented. Data provided through the grant scheme was generally comprehensive enough to inform the derivation of required input datasets. However, assumptions were applied throughout the modelling where imputations were required.

# Appendix A. Dwelling Archetypes

A full set of input data typically required to perform an RdSAP calculation was not available for this grant scheme evaluation. Therefore, the data translation phase of this work involved utilising dimensions data associated with dwelling archetypes (derived using the 2016 NIHCS data) in combination with information on grant scheme measures installed. The use of dwelling archetypes means that 'typical' dimensions and heat-loss parameters are applied to each case and therefore granularity within the data outputs is likely to be lost. Whilst this is not expected to impact the accuracy modelled energy savings on average, it may lead to the cases with highest and lowest energy savings being unrepresented.

The 2016 Northern Ireland House Condition Survey (NIHCS) has been used to determine the average dimensions and fabric heat loss parameters associated with each dwelling archetype identified from the grant scheme datasets.

Cases in the AWS and BRS were matched to a dwelling archetype and the associated dimensions data (Table A1) were used as an input into the BRE SAP model. For example, any case identified as a detached house was assumed to have a ground floor area of 98.6m$^2$ and a total wall area of 132.8m$^2$. More generic dwelling archetypes have been developed, for when there is no detailed information on the build type of the dwelling contained within the grant scheme datasets (i.e. House, Bungalow, Flat). This includes an 'Unknown' archetype, which simply uses the average dimensions and fabric heat loss parameters of the NI housing stock.

***Table A1. Dimensions inputs associated with each dwelling archetype***

| Dwelling Type | Number of Storeys | Total Floor Area (m$^2$) | Ground Floor Area (m$^2$) | Roof Area (m$^2$) | Wall Area (m$^2$) | Party Wall Area (m$^2$) | Window Area (m$^2$) | External Door Area (m$^2$) | Internal Door Area (m$^2$) |
|---|---|---|---|---|---|---|---|---|---|
| End-terraced House | 2 | 85.9 | 43.0 | 45.2 | 80.2 | 34.8 | 16.4 | 4.0 | 0.0 |
| Mid-terraced House | 2 | 82.0 | 40.2 | 43.3 | 51.1 | 68.4 | 14.1 | 4.1 | 0.0 |
| Semi-detached House | 2 | 98.2 | 50.6 | 58.4 | 76.9 | 35.2 | 20.0 | 4.4 | 0.0 |
| Detached House | 2 | 181.8 | 98.6 | 117.3 | 132.8 | NA | 38.0 | 5.9 | 0.0 |
| Attached Bungalow | 1 | 63.0 | 63.0 | 63.0 | 45.1 | 18.5 | 11.7 | 3.9 | 0.0 |
| Detached Bungalow | 1 | 118.3 | 118.3 | 118.1 | 85.8 | NA | 26.0 | 5.0 | 0.0 |
| Ground Floor Flat | 1 | 60.9 | 60.1 | 60.3 | 43.4 | 7.0 | 5.9 | 0.0 | 1.9 |
| Mid Floor Flat | 1 | 64.9 | 64.9 | 64.9 | 31.6 | 2.2 | 6.2 | 0.0 | 1.9 |
| Top Floor Flat | 1 | 64.3 | 58.1 | 61.8 | 43.0 | 7.2 | 7.1 | 0.0 | 1.9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| House | 2 | 114.2 | 59.4 | 68.0 | 85.0 | 35.3 | 22.6 | 4.7 | 0.0 |
| Bungalow | 1 | 98.4 | 98.4 | 98.4 | 71.2 | 6.7 | 20.9 | 4.6 | 0.0 |
| Flat | 1 | 62.9 | 60.2 | 61.7 | 41.1 | 6.2 | 6.4 | 0.0 | 1.9 |
| Unknown | 2 | 107.3 | 68.0 | 74.2 | 78.9 | 27.1 | 21.1 | 4.5 | 0.0 |

Where RdSAP could not be used to impute fabric heat loss parameters, Table A2 was used to determine the values used within the modelling, based on the dwelling archetype. This is mainly relevant where key building characteristics were unknown (e.g. dwelling age, wall type and glazing type), meaning that the RdSAP imputation methodology could not be followed.

***Table A2. Fabric heat loss parameters associated with each dwelling archetype***

| Dwelling Type | Wall U-value ($W/m^2K$) | Window U-value ($W/m^2K$) | Floor U-value ($W/m^2K$) | Roof U-value ($W/m^2K$) | Loft insulation thickness (mm) |
|---|---|---|---|---|---|
| End-terraced House | 0.84 | 2.51 | 0.64 | 0.36 | 169 |
| Mid-terraced House | 0.89 | 2.51 | 0.53 | 0.38 | 169 |
| Semi-detached House | 0.73 | 2.51 | 0.58 | 0.35 | 172 |
| Detached House | 0.73 | 2.64 | 0.54 | 0.36 | 169 |
| Attached Bungalow | 0.67 | 2.42 | 0.58 | 0.28 | 199 |
| Detached Bungalow | 0.72 | 2.62 | 0.57 | 0.32 | 181 |
| Ground Floor Flat | 0.72 | 2.41 | 0.53 | NA | NA |
| Mid Floor Flat | 0.72 | 2.58 | 0.46 | NA | NA |
| Top Floor Flat | 0.67 | 2.51 | 0.54 | 0.36 | 173 |
| House | 0.79 | 2.54 | 0.56 | 0.36 | 170 |
| Bungalow | 0.70 | 2.55 | 0.58 | 0.30 | 188 |
| Flat | 0.70 | 2.48 | 0.52 | 0.36 | 173 |
| Unknown | 0.77 | 2.54 | 0.56 | 0.35 | 174 |

# Appendix B. Modelling Assumptions Used

Data provided through the grant scheme was generally comprehensive enough to inform the derivation of required input datasets. However, assumptions were applied throughout the modelling where imputations were required.

## 5.3. Affordable Warmth Scheme

The AWS encompasses a multitude of improvement measures that can be installed in eligible dwellings. For the grant scheme evaluation modelling, a number of these improvement measures have been modelled, to quantify the energy savings associated with installing applicable measures. Measures excluded from the analysis are those that have no impact on the SAP rating of a dwelling, and those where the pre- and post-position were unable to be imputed sufficiently based on the data available.

For cases collected using the current AWS data format, information was provided on the characteristics of the dwelling prior to any improvement measures being installed (e.g. loft insulation thickness, wall type, glazing type, heating fuel), and used to determine the pre-improvement modelling position. Measure codes were used to determine the post-improvement position, as specified in Table B1.

***Table B1. Simulated improvements for the Affordable Warmth Scheme***

| Measure Type | Measure Codes | Description | Pre-position | Post-position |
|---|---|---|---|---|
| Loft insulation | 100 | Providing 100 mm insulation | As recorded in dataset | Current loft ins + 100mm mineral wool |
| | 150 | Providing 150 mm insulation | As recorded in dataset | Current loft ins + 150mm mineral wool |
| | 200 | Providing 200 mm insulation | As recorded in dataset | Current loft ins + 200mm mineral wool |
| | 300 | Providing 300 mm insulation | As recorded in dataset | Current loft ins + 300mm mineral wool |
| CWI | FFI | CWI to uninsulated cavity | As recorded in dataset | Cavity insulated |
| | TOP | CWI top-up | As recorded in dataset | Cavity insulated |
| SWI | PSW | SWI | As recorded in dataset | Solid - wall insulated |
| Windows | PVC, RGU, RG2 | Double glazing | As recorded in dataset | Double glazed, Post 2006 |
| Heating Type | NG1, NG2, NG3 | Upgrade heating system to gas | Imputed based on existing fuel | Condensing gas boiler |
| | OI1, O12, O13, OI4 | Upgrade heating system to oil | Imputed based on existing fuel | Condensing oil boiler |

| | | | | |
|---|---|---|---|---|
| | ESH | Upgrade heating system to storage heater | Imputed based on existing fuel | High heat retention storage heater |
| Heating Controls | NG1, NG2, OI1, OI2 | Boiler replacement with new controls | No heating controls [1] | Programmer, roomstat & TRVs |
| | NG3, O13, O14 | Boiler replacement – renew controls | Programmer & roomstat [1] | Programmer, roomstat & TRVs |
| | ESH | Upgrade heating system to storage heater | Imputed based on existing heating system | Controls for HHR storage heaters |

[1] Pre-position heating controls are applied if a boiler is present prior to the heating upgrade. Otherwise, default controls from Table B5 are assumed.

## 5.4. Boiler Replacement Scheme

Only heating upgrades are included as part of the BRS. Measure codes in the BRS dataset (Table B2) are used to determine the post-improvement position of the heating system for each case, and the current heating fuel specified in the dataset is used to determine the pre-improvement heating system, using the fuel lookup in Table B3.

***Table B2. Simulated improvements for the Boiler Replacement Scheme***

| Measure Type | Measure Codes | Description | Pre-position | Post-position |
|---|---|---|---|---|
| Heating Type | A | Natural gas with full controls | Imputed based on fuel | Condensing gas boiler |
| | G | Natural gas | Imputed based on fuel | Condensing gas boiler |
| | N | Natural gas with new controls | Imputed based on fuel | Condensing gas boiler |
| | B | Oil with minimum controls | Imputed based on fuel | Condensing oil boiler |
| | C | Oil with dual controls | Imputed based on fuel | Condensing oil boiler |
| | O | Oil | Imputed based on fuel | Condensing oil boiler |
| | L | LPG | Imputed based on fuel | Condensing LPG boiler |
| | P | LPG with minimum controls | Imputed based on fuel | Condensing LPG boiler |
| | G | Natural gas | Programmer, roomstat and TRVs | |
| | O | Oil | | |
| | L | LPG | | |

| | | | | |
|---|---|---|---|---|
| Heating Controls | N | Natural gas with new controls | Programmer and roomstat | Programmer, roomstat and TRVs |
| | B | Oil with minimum controls | | |
| | P | LPG with minimum controls | | |
| | A | Natural gas with full controls | | |
| | C | Oil with full controls | | |

## 5.5. Default heating efficiencies and controls

Where a case is eligible for a heating upgrade, the heating type assigned to the dwelling and its associated heating efficiency is improved from the pre-improvement to post-improvement position for the applicable fuels, to simulate the installation of a more efficient system (Table B3). For example, were a case on mains gas to be upgraded to a new gas boiler, the winter efficiency would improve from 78.22 in the pre-improvement position, to 93.1 in the post-improvement position. Where a case is not eligible for a heating upgrade, standard efficiencies are used within the modelling for both the pre- and post-improvement positions, determined by the heating fuel of the dwelling.

***Table B3. Heating efficiencies applied during the improvement modelling***

| Fuel | Heating Type | Pre-improvement efficiency [1] | | Standard / non-improved efficiency [2] | | Post improvement efficiency [3] | |
|---|---|---|---|---|---|---|---|
| | | Winter | Summer | Winter | Summer | Winter | Summer |
| Gas / LPG | Boiler | 78.22 | 68.45 | 87.47 | 79.17 | 93.1 | 81.4 |
| Oil | Boiler | 85.37 | 73.66 | 86.06 | 74.44 | 93.1 | 81.4 |
| Solid Fuel [4] | Room heater | 65 | | 65 | | - | |
| Standard electric [5] | Room heater | 100 | | 100 | | - | |
| Economy 7 [6] | Storage Heater | 100 | | 100 | | 100 | |

[1] Pre-improvement efficiencies are applied to the base model run if a dwelling is eligible for a heating measure and are derived from the NIHCS 2016 dataset, by taking the mean efficiency of all matched boilers older than 15 years.

[2] Standard efficiencies are used when a dwelling does not receive a heating measure for both the pre- and post-improvement positions. Standard efficiencies are derived from the NIHCS 2016 dataset, by taking the mean efficiency of all matched boilers between 5 and 15 years old.

[3] Post-improvement efficiencies are applied to the improved model run if a dwelling is eligible for a heating measure. 92% is used as the annual post-improvement efficiency, with the winter and summer efficiencies derived from this.

[4] Dwellings with solid fuel as the main heating fuel are assumed to use coal closed room heaters. Dwellings will never receive an improvement to a solid fuel system. Winter and summer efficiencies are not relevant to room heaters – instead, annual efficiencies are used.

[5] Dwellings with standard electricity as the main heating fuel are assumed to use electric room heaters. Dwellings will never receive an improvement to a standard electric heating system.

[6] Dwellings with economy 7 electricity as the main heating fuel are assumed to use storage heaters. Where a boiler upgrade specifies in the installation of storage heaters, it is assumed that high heat retention storage heaters are installed.

Default heating controls and cylinder details will be assumed throughout the modelling (Table B4), unless an improvement measure specifies otherwise (for example, where a heating measure which specifies the provision of heating controls is applicable, the pre-improvement heating controls listed in Tables B1 or B2 will be applied).

***Table B4. Default heating controls and water heating parameters***

| Heating Type | Fuel | Heating Controls | Cylinder Insulation | Cylinder Thermostat |
|---|---|---|---|---|
| Boiler | All fuels | Programmer, thermostat and TRVs | Impute using RdSAP table S18 based on Age of dwelling | Present |
| Room heater | Solid fuel | No controls | | |
| | Standard electric | Appliance Thermostats | | |
| Storage heater (not HHR) | Economy 7 | Automatic charge control | | |
| Storage heater (HHR) | Economy 7 | Controls for HHR storage heaters | | |

# Appendix C. Average SAP rating uplift

## Uplift resulting from the AWS by dwelling type, council and packages of measures installed

| | | Number of dwellings | Mean SAP improvement |
|---|---|---|---|
| Property type | Bungalow | 799 | 12 |
| | Detached | 2023 | 12 |
| | End Terrace | 852 | 14 |
| | Ground Floor Flat | 72 | 8 |
| | House | 355 | 12 |
| | Mid Terrace | 1453 | 13 |
| | Semi Detached | 1966 | 13 |
| | Top Floor Flat | 124 | 11 |
| | | | |
| | | | |
| Council | ANTRIM AND NEWTOWNABBEY | 657 | 13 |
| | ARDS AND NORTH DOWN | 604 | 12 |
| | ARMAGH CITY BANBRIDGE AND CRAIGAVON | 739 | 12 |
| | BELFAST | 841 | 16 |
| | CAUSEWAY COAST AND GLENS | 779 | 11 |
| | DERRY CITY AND STRABANE | 703 | 13 |
| | FERMANAGH AND OMAGH | 729 | 12 |
| | LISBURN AND CASTLEREAGH | 537 | 13 |
| | MID AND EAST ANTRIM | 643 | 14 |
| | MID ULSTER | 669 | 11 |
| | NEWRY MOURNE AND DOWN | 743 | 12 |
| | | | |
| Measures Installed | Loft insulation | 186 | 4 |
| | CWI | 70 | 1 |
| | Loft ins + CWI | 108 | 6 |
| | Windows | 443 | 3 |
| | Loft ins + windows | 238 | 7 |
| | CWI + windows | 83 | 4 |

| | | | |
|---|---|---|---|
| | Loft ins + CWI + windows | 83 | 10 |
| | Heating measure | 2245 | 11 |
| | Loft ins + heating | 1445 | 15 |
| | CWI + heating | 220 | 14 |
| | Loft ins + CWI + heating | 267 | 19 |
| | Windows + heating | 1303 | 15 |
| | Loft ins + windows + heating | 717 | 18 |
| | CWI + windows + heating | 116 | 17 |
| | Loft ins + CWI + windows + heating | 105 | 24 |
| | SWI (including with other measures) | 15 | * |
| | Total | 7644 | 13 |

* indicates sample size too small for reliable estimate