

Carbon dioxide emissions savings from the Warm Front programme

December 2008

Summary

The Warm Front scheme is an energy efficiency improvement programme operated by the Department for Energy and Climate Change. The scheme was started in June 2000, and offers a range of energy efficiency improvements to private sector households in receipt of various benefits. The primary aim of the Warm Front scheme is the alleviation of fuel poverty, although a significant secondary benefit is the reduction of carbon dioxide (CO₂) emissions from housing.

This analysis presents the results of a scenario modelling procedure to calculate the theoretical CO₂ savings from four of the most important measures offered under Warm Front. These are:

- a) Cavity wall insulation
- b) Loft insulation
- c) Gas central heating
- d) Oil central heating

The analysis suggests that theoretical savings of ~ 0.49 million tonnes of carbon dioxide per year (MtCO₂/yr) have been achieved at the end of March 2008. Assuming a linear rate of installation and savings since the beginning of the Warm Front scheme in June 2000, this corresponds to a total saving of approximately 1.90 MtCO₂.

Warm Front

Warm Front is a grant scheme which aims to reduce levels of fuel poverty in England by providing grants for energy efficiency improvements which will act to reduce household fuel bills.

The scheme is limited to private sector (owner occupied and private rented) households, who are in receipt of certain key benefits (see Appendix B for details). The scheme was launched in June 2000, and was initially known as the new Home Energy Efficiency Scheme (new HEES). In February 2001 the scheme was renamed Warm Front.

Currently, Warm Front provides grants of up to £2,700 to eligible households (£4,000 if oil central heating is involved). These grants are used to cover the cost of insulation and heating improvements. The principal mechanisms for assistance are loft insulation, cavity wall insulation and the installation of gas and oil central heating systems.

In addition to reducing fuel bills, Warm Front funded energy efficiency improvements also act to reduce carbon dioxide (CO₂) emissions. The alleviation of fuel poverty is the principal aim of Warm Front, but the reduction of CO₂ emissions is an additional positive

impact. The analysis presented below aims to quantify the effect of Warm Front on domestic CO₂ emissions in England.

The Methodology

This analysis has used a scenario model to modify the 2001 English House Condition Survey (EHCS) dataset. The installation of the main Warm Front measures of cavity wall insulation, loft insulation and oil and gas central heating has been simulated by adjusting the base data to an improved position. The CO₂ emissions before and after the installations have been calculated, along with the overall savings from these improvements. The savings include a reduction factor, which allows for a 'comfort factor' and other phenomena to be taken into account. Further details of this are outlined below.

Only the effect of the most significant Warm Front measures have been analysed. These are:

- a) Cavity wall insulation
- b) Loft insulation
- c) Gas central heating
- d) Oil central heating

Warm Front also installs a variety of other measures including draughtproofing, low energy lighting, hot water cylinder insulation, boiler replacements and heating repairs. However, the savings from these measures have not been analysed.

Details of the modelling process

The modelling process is carried out as below:

- a) A household from the EHCS survey dataset is selected at random for improvement
- b) The household's eligibility for Warm Front is checked using benefits and household data
- c) Any required measures are installed as long as the total number of installations of that type (as specified in Appendix A) has not been reached.
- d) The CO₂ emissions saving for that case is calculated using the post-improvement energy consumption
- e) Steps (a) to (d) are repeated

Measures are installed in turn until each of the totals listed in Appendix A has been reached. When the total is reached no more improvements of this type are installed. The totals list the total number of installations made over the course of the Warm Front scheme from June 2000 until the end of March 2008, excluding those measures which have been funded through agreements with energy suppliers through the Energy Efficiency Commitment.

The process is undertaken for each of the measures in turn. Because of the random nature of the selection process, repeated runs of the model are required in order to achieve convergence around a mean amount of CO₂ saved.

Details of the modelling assumptions

Estimates of carbon dioxide emissions savings

The estimated CO₂ savings are notional space and water heating savings calculated using a SAP-2005 methodology¹. Emissions for lighting, appliance usage and cooking have not been included in this analysis. It is important to note that the SAP methodology calculates theoretical usage for space and water heating under a defined heating regime. In reality, households may not adhere to this regime and actual emissions will differ significantly from the theoretical SAP-based emissions.

CO₂ savings for all measures have been adjusted by both a comfort factor (a reduction to account for part of the theoretical saving being taken in improved householder comfort) and, in the case of the insulation measures, by an underperformance factor (which account for further reductions due to other factors, such as areas of cavity walls not being filled successfully etc.).

There is evidence that a high level of comfort is taken from Warm Front installations, therefore, the comfort factor has been set at 40% for the calculation of savings from all measures (insulation and heating). This has been combined with an underperformance factor of 41% for insulation measures, giving a total reduction factor of approximately 65% for insulation.

The base dataset

All modelling uses the 2001 EHCS dataset as the base position. This dataset has been chosen as the data collection period (June - December 2001) provides the best match available to the start of the Warm Front grant scheme (June 2000). The EHCS 2001 position will, of course, be slightly better than the actual situation in 2000. However, as we are only interested in the effect of improvements upon a subsection of the stock (those who receive Warm Front improvements) this is unlikely to have a great effect. As the potential for energy efficiency improvements is much larger than the number of installations, the actual base position is of low importance.

Details of measures

The details of how each measure should be applied are based on documentation of the Warm Front installation and grant procedures and experience gained from site visits with a Warm Front surveyor.

Cavity wall insulation

Cavity wall insulation is installed in all cavity wall dwellings with uninsulated walls, which are less than four storeys high. It is always installed in conjunction with loft insulation and central heating where the dwelling requires either of these measures.

¹ Details of the full SAP methodology can be found in 'The Government's Standard Assessment Procedure for the Energy Rating of Dwellings – 2005 Edition.' This is available to download from www.bre.co.uk/sap2005. Note that emissions for lighting, as included in the full SAP 2005 methodology, have not been included in this analysis. This analysis has used a CO₂ emissions factor for electricity of 0.43 kgCO₂/kWh.

Loft insulation

Loft insulation is applied to lofts with 100mm or less of insulation, with an accessible loft space. 270mm of insulation is applied to any uninsulated loft. 270mm is also applied as a top-up if the existing insulation is less than 70mm thick. 200mm of additional insulation is applied as a top-up to any loft with insulation between 70mm and 100mm thick. Loft insulation is always installed in conjunction with cavity wall insulation and central heating where applicable.

Gas and oil central heating

Mains gas central heating is installed where gas is already present in the dwelling, but there is currently no mains gas central heating present. Where there is no gas present to the dwelling, oil central heating may be installed instead. Central heating is always installed in combination with loft and cavity wall insulation where applicable.

Results

Repeated runs of the improvement model are required in order to achieve convergence around a mean value for CO₂ saved. The full distribution of model runs is shown in Figure 1 below. The mean value shows the most likely saving from the installations. The mean saving is approximately 0.49 million tonnes of CO₂ per year (MtCO₂/yr), indicating that this is the most likely annual saving achieved as at 31/03/2008. The lower and upper 95% confidence bounds for the CO₂ saved by the Warm Front programme are 0.42 MtCO₂ and 0.55 MtCO₂ respectively. i.e. we can be 95% certain that the CO₂ savings (under these modelling assumptions) will fall between 0.42 MtCO₂ and 0.55 MtCO₂.

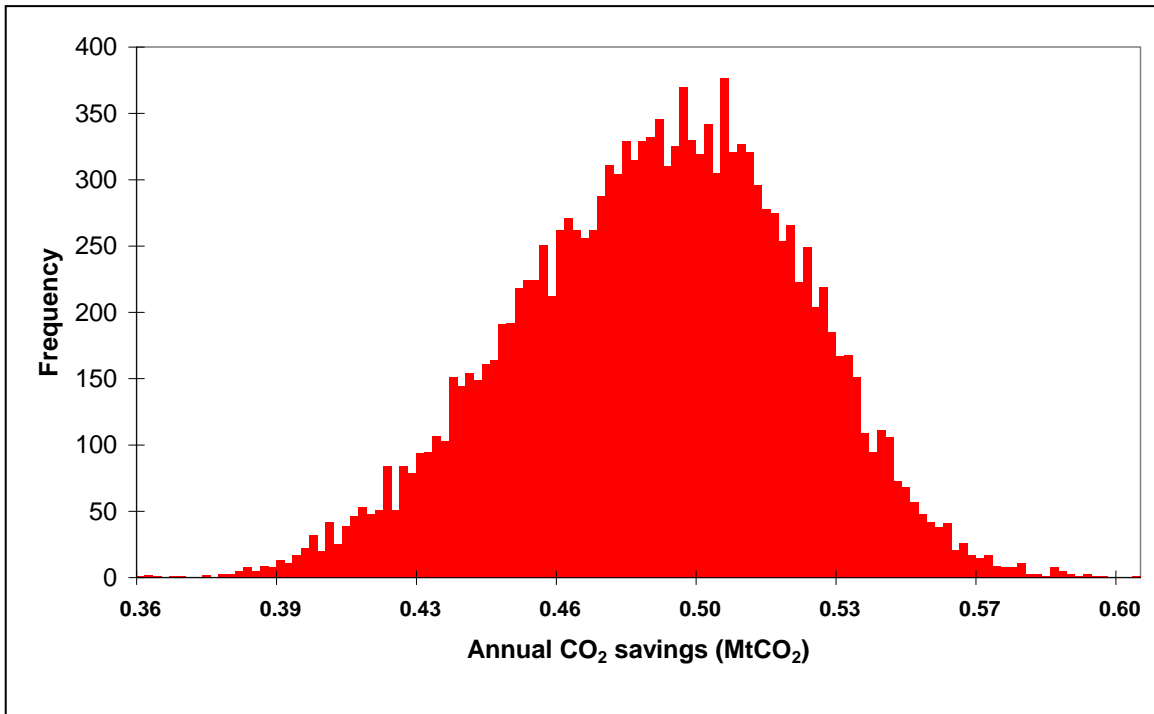


Figure 1: Distribution of possible values for annual CO₂ savings from space and water heating following Warm Front installations in the period 01/06/2000 – 31/03/2008.

The results of the modelling are summarised in table 1 below.

Table 1: Mean annual CO₂ savings from space and water heating following the installation of Warm Front measures in the period 01/06/2000 – 31/03/2008.

| | Mean annual CO ₂ savings from space and water heating (MtCO ₂ /yr) |
|---|--|
| Mean CO ₂ savings per year after Warm Front measures in the period 01/06/2000 - 31/03/2008 | 0.49 |
| Lower 95% confidence bound | 0.42 |
| Upper 95% confidence bound | 0.55 |

If we assume that the Warm Front programme has continued at approximately the same rate since June 2000, we can extrapolate this to the beginning of the scheme to estimate the overall savings. This is shown in figure 2 below. The total CO₂ saved over this period (seven years and ten months) is approximately 1.90 MtCO₂. This assumption is something of a simplification as the number and types of installations has varied over the course of the scheme. However, the variations are relatively minor.

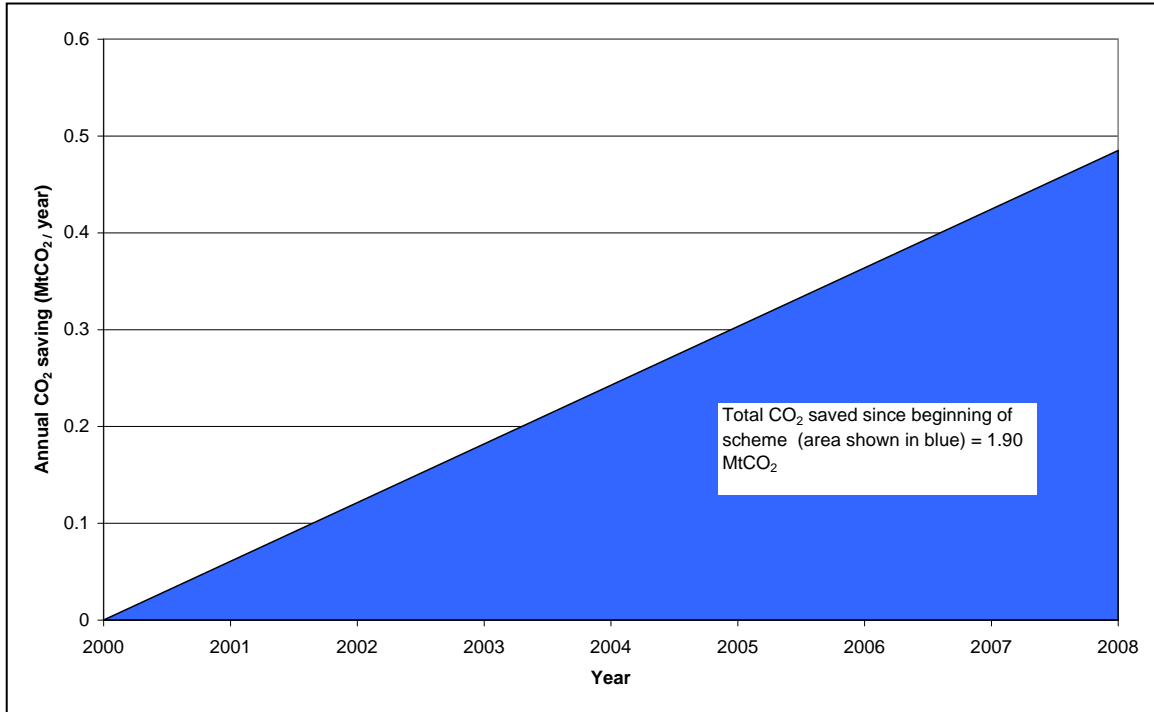


Figure 2: Estimate of total CO₂ saved since the beginning of Warm Front. Assumes a linear level of savings since the beginning of the scheme.

Conclusions

An improvement model has been run which simulates the installation of Warm Front improvements onto the 2001 English House Condition Survey dataset. This model suggests that annual savings of approximately 0.49 MtCO₂ per year have been achieved at the end of the period 01/06/2000 to 31/03/2008. Assuming a linear rate of installation and savings during this period, this corresponds to a total saving of approximately 1.90 MtCO₂.

These savings are based on the installation of cavity wall insulation, loft insulation and gas and oil central heating. The savings from the other measures offered through Warm Front have not been considered as part of this analysis. These include draughtproofing, low energy lighting, hot water cylinder insulation, boiler replacements and heating repairs. While these measures are likely to lead to some additional CO₂ savings, it is likely that the savings will be relatively small. It is also important to recall that the predicted savings are for modelled space and water heating only, under the SAP heating regime. This will differ from the actual energy usage (and CO₂ emissions) of the housing stock.

Appendix A: Scenario control limits

The control limits specify the number of installations which are installed during each run of the model. They are calculated as the total number of installations under Warm Front in the period 01/06/2000 (the beginning of the scheme) to 31/03/2008 minus the total number of Warm Front measures traded under the Energy Efficiency Commitment (Phases I and II)².

| Control limit | Number of installations |
|-------------------------------------|--------------------------------|
| Cavity wall insulation | 269,180 |
| Loft insulation (virgin and top-up) | 456,018 |
| New gas central heating | 145,885 |
| Oil central heating | 1,353 |

Additional measures not included in the modelling include draughtproofing, low energy lighting, hot water cylinder insulation, boiler replacements and heating repairs.

² Total numbers of Warm Front installations are reported in the Warm Front Annual report 2008. The numbers for cavity wall and loft insulations traded through the Energy Efficiency Commitment have been obtained from EAGA.

Appendix B: Warm Front eligibility

In 2008, in order to be eligible for Warm Front, a household needs to be in one (or more) of the following four groups:

1. Householders aged 60 or over in receipt of one or more of the following benefits:

- Income support
- Council tax benefit
- Housing benefit
- Job seekers allowance (income-based)
- Pension credit

2. Householders with a child under 16, or pregnant women with maternity certificate MAT-B1, in receipt of one or more of the following benefits:

- Income support
- Council tax benefit
- Housing benefit
- Job seekers allowance (income-based)
- Pension credit

3. Householders in receipt of one or more of the following benefits:

- Working tax credit (with an income of less than £15,460, and which must include a disability element)
- Disability living allowance
- Child tax credit (with an income of less than £15,460)
- Housing benefit (which must include a disability premium)
- Income support (which must include a disability premium)
- Council tax benefit (which must include a disability premium)
- War disablement pension (which must include a mobility supplement or constant attendance allowance)
- Industrial injuries disablement benefit (which must include a mobility supplement or constant attendance allowance)
- Attendance allowance

The term 'householder' includes the applicant's spouse, or partner, if they are living with the applicant.

This analysis uses 2001 EHCS data, although the overall eligibility throughout the whole of the Warm Front scheme is of interest. Proxies for eligibility throughout the scheme have, therefore, been created using the most appropriate 2001 EHCS variables.