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Environment Agency

Evidence

The CRC Energy Efficiency Scheme: Coverage, Abatement and Future Caps

Report: SC080013/R1

Resource efficiency programme

Evidence Directorate

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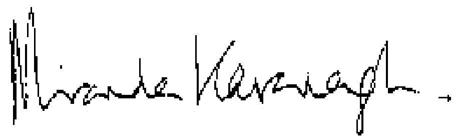


Miranda Kavanagh

Director of Evidence

Executive summary

The CRC Energy Efficiency Scheme (CRC) is a pioneering emissions trading scheme (ETS) aimed at organisations in the services, public administration and non-energy intensive industry sectors. The scheme will come into force in April 2010 with a three-year introductory phase in which there will be no cap on emissions from the scheme. From April 2013, however, total emissions from the CRC sector will be limited through a cap on the number of allowances sold to participants.

In the context of the Committee on Climate Change's (CCC) report on building a low carbon economy (Committee on Climate Change, 2008), this study provides an independent quantification of the technical abatement potential in the CRC sector. Marginal abatement cost curves (MACCs) are constructed using models of energy end use and emissions abatement opportunities in the industry and non-domestic buildings sector.

This report predates the release of "Consultation on the Draft Order to Implement the Carbon Reduction Commitment: Government Response and Policy Decisions" document released on 7 October 2009 by the Department of Energy and Climate Change (DECC). Whilst efforts have been made to ensure that the information and estimations provided are accurate it is advised that the full implications of these changes are not yet known.

Previous estimates of the emissions coverage of the CRC indicate that the scheme would account for around 52 $MtCO_2$. This study concludes that the CRC will cover more emissions than previously estimated in both the public administration, an increase of 2.9 $MtCO_2$, and water sectors, up 2.7 $MtCO_2$. Preliminary calculations in this study show that emission estimates from the health and IT/communications subsectors could also be approximately 3.3 $MtCO_2$ and 5 $MtCO_2$ respectively, higher than previous estimates. However, due to uncertainties in the calculations we have not updated the coverage estimates for these sectors and we estimate the total CRC emissions coverage to be 57.5 $MtCO_2$.

Total potential abatement in the CRC sector is calculated using marginal abatement cost curves for the year 2012, which show available abatement from that year onwards. Quoted scheme abatement potentials are based on the best estimate of technical abatement available. It is estimated that around 11.6 $MtCO_2$ of savings could technically be realised at a benefit to those in the CRC (through measures with a net annualised cost of zero or below), in contrast to a previous technical abatement prediction of 7.5 $MtCO_2$ of savings (NERA/Enviros, 2006). The abatement potential estimated in this report is set against a 2008 baseline for emissions from the scheme, the NERA/Enviros emissions are set against a 2005 baseline.

The CCC calculate 11 $MtCO_2$ of technical abatement potential exists at or below £0/tCO_2 in the non-domestic building sector, with 7 $MtCO_2$ of cost-effective abatement available in the industry sector. No figure is provided for CRC abatement and no subsector breakdown is provided, meaning calculating an equivalent CRC abatement potential is not possible from their published results.

The differences in abatement potential identified in this study and previous studies can be accounted for by the expanded CRC coverage calculated in this report; revised fuel price and economic growth forecasts; and, in the case of the NERA/Enviros (2006) results, possible differences between models and therefore the measures considered.

The maximum abatement level indicated by our modelling is 16 $MtCO_2$; however, for this to be realised an extremely high carbon price would need to be established. The abatement calculated includes emission reductions provided by generation of renewable heat and combined heat and power. However, we do not consider renewable electricity generation due to the policy split between the CRC and Renewables Obligation Certificates (ROCs), which means the CRC is not anticipated to be a driver of renewable electricity generation.

For simplicity these estimates do not assume any reduction in the carbon intensity of electricity generation. If the carbon intensity is reduced by 50% by 2020 as advocated by the Committee on Climate Change (CCC) then the overall emissions from the CRC sector would be lower still but the saving that could be attributed directly to the CRC would be up to 27 per cent less.

Importantly, the abatement potentials identified in this study are expressed as annual technical potentials. Difficulties in realising the full technical potential provided by energy demand reduction measures have been previously documented (see Carbon Trust, 2005). However, the CRC pulls precisely the financial and behavioural levers needed to implement such measures. For this reason, following the example of the CCC, it is felt that all of the technical potential identified for the CRC may be realised. The timescale for implementation of abatement measures is however uncertain, although in principle over time more will be adopted and thus as time progresses the abatement potential will be taken up.

Based on our CRC MACC and following discussion of cap-setting criteria, the principal cap-setting criteria for the CRC should:

- Be guided by and compatible with domestic 2020 targets as recommended by the CCC and EU objectives for the same period.
- Ensure that emission reductions are cost-effective, so that the net present value taking into account the shadow price of carbon should not be negative.
- Consider the level of effort between sectors covered by each policy instrument. Under the EU energy package the UK will have a reduction target for non-EU ETS sectors of 16 per cent by 2020 compared with 2005 figures. Distribution of this reduction between UK domestic measures should take account of abatement costs across the economy, to ensure lowest cost overall. The CCC recommends emission reduction effort over the first three budget periods be split 70/30 per cent between the traded/non-traded sectors (CCC, 2008).
- Consider the effect on the competitiveness of its participants. However, this should be moderated by the fact that the scheme will be revenue neutral to the exchequer and, unlike the EU ETS, it is not possible to apply sector-level caps within the CRC.

We suggest that caps for the CRC should be based on the projected EU ETS carbon price (which the Committee on Climate Change estimated would rise to £40/tCO_2 by 2020 in their December 08 report, although more recent predictions have been lower at nearer £20 /tCO_2). At £40 /tCO_2, carbon dioxide (CO_2) emissions could technically be reduced by 11.9 million tonnes of carbon dioxide (MtCO_2) per year, equivalent to a 29 per cent cut in projected annual CRC emissions for 2020. The relative insensitivity of abatement potential to the carbon price is due to the limited mid-range abatement (in terms of cost) identified in our modelling.

The financial implications of caps based on these carbon prices are generally positive (the total net cost is negative), although the capital costs of abatement measures could be high, with a consequent opportunity cost: that is, better returns on investment could be identified elsewhere with the same capital. From a policy perspective, CRC caps based on the forecast EU ETS allowance price should provide consistency across climate measures and therefore lead to cost-effective abatement in the CRC sector. In addition, the CRC with this level of cap should fit well with existing and future renewable energy policy frameworks.

The report recommends a number of key areas for future research to build on the work done for this study. These include;

- Development of a more accurate model for simulation of abatement potential in the non-domestic building sector (similar to the ENUSIM model for the industry sector);
- Investigation into the realistic timescales for the uptake of the measures available to more accurately predict how quickly abatement can be realised;
- A more detailed review of the applicability of energy efficiency measures listed in the industrial abatement curves for the size of organisation participating in the scheme; and
- Determining assumptions on the rate of decarbonisation of the electricity sector in order that this can be accounted for in the cap setting process.

Contents

1 Background

1.1 The CRC Energy Efficiency Scheme

The CRC Energy Efficiency Scheme (CRC) is a pioneering emissions trading scheme (ETS) aimed at organisations that consume more than 6,000 megawatt hours (MWh) of electricity through half-hourly meters over the course of a year. The scheme will be implemented by the Environment Agency, the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA). The Environment Agency will take the role of the scheme administrator. Organisations qualifying for the scheme will be required to monitor their CRC-covered energy use over the course of each scheme year, which follows the financial year. By the end of July following the end of the scheme year, participants must report their energy use and surrender allowances corresponding to the emissions arising from their energy use. Allowances can be purchased by organisations from three sources:

- An annual sale/auction of allowances operated by the Environment Agency and taking place in April at the start of each scheme year.
- Trading with the secondary market.
- From the Environment Agency through the safety valve. When requested, the Environment Agency will issue new allowances and purchase and cancel a corresponding number of allowances from the EU ETS market.

The scheme will run in phases, with the 'introductory' phase starting on 1 April 2010 and ending on 31 March 2013. In the introductory phase of the scheme, the first compliance year of the Introductory Phase will be a reporting-only year, in the following two years of the introductory period the government (through the Environment Agency) will sell an unlimited number of allowances to participants at a fixed price.

From April 2013, the scheme will enter its 'capped' phase, in which government will limit the emissions arising from the CRC sector by placing a 'cap' on the number of allowances released to the market. Participants will bid for allowances in an auction held at the start of each year. Importantly, government will not impose emissions limits on individual participants, it will place a cap on the total emissions from the scheme as a whole. The government will draw on advice from the Committee on Climate Change (CCC) in setting the level of the CRC scheme cap. The role of the CCC is discussed in more detail in the following section.

1.2 Carbon budgets

In December the CCC published (CCC, 2008) advice on, amongst other issues:

- The level of the UK's first three carbon budgets and the recommended reduction targets in 2020.
    - In the absence of any international agreement on carbon reduction, the UK should adopt an 'interim budget' that requires a 29 per cent reduction in carbon dioxide (CO_2) by 2020 relative to 1990 levels, or 34 per cent reduction in the Kyoto basket of greenhouse gases (GHGs) (CO_2, N_2O CH_4, HFCs, PFCs and SF_6)

- In the presence of a global agreement, the UK should consider an 'intended budget' based around a 40 per cent reduction in CO_2 relative to 1990 levels, or a 42 per cent reduction in total GHGs.

- The relative contribution to the emission reductions which should come from the "traded" and "non-traded" sectors.
- Use of carbon offsets to meet the carbon budgets.

The Department of Energy and Climate Change (DECC) published the Low Carbon Transition Plan in July 2009 which sets out details of the proposals and policies for meeting these first three carbon budgets. Within this plan DECC indicate that the CRC cap will be set in 2012 following advice from the CCC in 2010.

1.3 Study Aims

This report aims to provide the Environment Agency with an overview of how caps might be set for the CRC sectors, what level they may take and what the implications of the caps may be. This is set within the context of the CCC's report to government on the three carbon budgets to 2022 and the compilation of a plan to meet those budgets. The Environment Agency, as administrator for the CRC, should have a view on the level of CRC caps that may form part of the budget delivery plan.

The analysis for the study is arranged in six further chapters:

- In Chapter 2, the coverage of CRC across the economy is established. We review previous estimates of CRC coverage before discussing the potential for updating the estimates for certain subsectors.
- In Chapter 3, the emissions arising from the CRC-covered sectors at present and projected for the future are discussed.
- Chapter 4 reviews the latest abatement potential in the CRC-covered sectors and the models used for deriving CRC abatement.
- In Chapter 5, we describe the criteria that might be used for cap-setting under the CRC.
- The abatement potentials and marginal abatement cost curves (MACCs) generated in Chapter 4 are used in Chapter 6 to consider what levels the caps might be set at and the carbon prices that might result under them.
- Chapter 7 then discusses the GHG, financial and policy interaction implications of the CRC caps derived.

2 CRC coverage

Qualification for the CRC is dependent on electricity consumption only. An organisation will qualify for the CRC if:

- it owns at least one half-hourly electricity meter settled on the half-hourly market within its entire organisation, including subsidiaries; and
- the annual electricity consumption over the qualification period through all half-hourly meters (HHMs) exceeds 6,000 MWh.
    - For the introductory phase, the qualification period is the 2008 calendar year.
    - For the first capped phase, the qualification period will be the 2010/11 financial year.

Ordinarily the responsibility for participation in the CRC lies with the highest parent company or body of each organisation which must be based in the UK however the group can choose to nominate another UK based group member to carry out the schemes administrative requirements on behalf of the group. Alternatively where a Participant so chooses, it will be able to nominate any significant group undertaking (a legally defined subsidiary that would have qualified for the scheme in its own right were it not part of its group) to participate separately. Where the parent company is reporting emissions they will need to sum all electricity use through the following meters for its entire organisation:

- Mandatory HHMs
- Voluntary HHMs
- Half-hourly light meters
- Remotely-read Automatic Meter Reading (AMR)
- Pseudo HHMs

The use of aggregated consumption as the assessment criteria for qualification makes estimating the coverage of the CRC difficult, since electricity consumption through individual HHMs must be assigned to organisations. Aggregating emissions requires knowledge of organisations' structures through all subsidiaries.

Although participation for the scheme is based on electricity use alone, qualifying organisations will be required to include other sources of energy use in the scheme. The CRC makes the distinction between core sources and additional sources. Core sources are obliged to be included in the CRC. They are:

- all electricity consumed through HHMs;
- all electricity consumed though profile class 5-8 meters;
- all gas consumed through daily-read gas meters;
- all non-daily metered gas consumption of more than 73,200 kWh per annum.

The CRC requires that at least 90% of total energy use emissions are covered by the combination of EU ETS, CCAs (for those emissions not otherwise exempted from the scheme, see section 8.3.3 for details of the exemption criteria) and the CRC. All core sources must be included in calculating the proportion of an organisation's energy use covered by EU ETS, CCAs (not otherwise exempted) and the CRC, even if this takes that organisation's combined coverage above 90%. For example, a CRC qualifying organisation, with 75% of energy use covered by the EU ETS and CCAs (not otherwise exempted), 10% comprised of HHM electricity use and another 8% from daily metered gas use, must include all its core sources in the CRC, meaning that 93% of its total energy use emissions will be covered by EU ETS, CCAs (not otherwise exempted) and CRC.

If the coverage under EU ETS, CCAs (not otherwise exempted) and core CRC sources does not reach 90% of an organisation's total energy use emissions, they are required to opt in additional sources until at least the 90% threshold is achieved. Additional sources include all energy use other than the core sources, for example, heavy fuel oil, diesel or coal. However, transport emissions are not included in the CRC.

This section begins by describing previous CRC coverage estimates and the details the updates attempted for this study.

2.1 Previous emission coverage estimates

The origins of the CRC lie with the Carbon Trust who put forward the idea of a UK consumption-based emissions trading scheme (CETS), which would address rising emissions from large companies in the less energy-intensive sectors (Carbon Trust, 2005). These companies were falling outside the current climate change policy framework of the EU ETS, climate change agreements (CCAs) and building regulations. The Carbon Trust calculated potential coverage of the UK CETS based on half-hourly electricity metering as the criteria for qualification using survey data from Datamonitor. They found that 91,000 sites would have been covered with a cumulative electricity consumption of 99 terawatt hours (TWh).

With the evolution of the UK CETS to the CRC, the Department for Environment, Food and Rural affairs (Defra) commissioned a series of studies on the options for implementing a new mandatory UK emissions trading scheme. Analysis carried out by NERA/Enviros (NERA/Enviros, 2006; Defra, 2007) expanded on the Carbon Trust approach using the Datamonitor survey of electricity consumption and the proportion of that through HHMs. NERA/Enviros found that the Datamonitor survey covered around 2,000 organisations from a range of subsectors. However, the survey data seemed to be biased towards more intensive energy users, so an amount of correction had to be carried out. Nonetheless, the analysis estimated the emissions covered by the CRC split by subsector.

Since the NERA/Enviros study was conducted prior to the 6,000MWh threshold being set their calculations are based on a 3,000MWh threshold. The revised coverage and abatement potential for this study are therefore not directly comparable but offer the closest basis for comparison. The coverage estimates from the NERA/Enviros report are listed in Table 2.1 converted to mass of CO_2 rather than carbon. They show that in total the CRC is estimated to cover nearly 52 $MtCO_2$, just under eight per cent of the UK's total emissions in 2005 (including energy use for civil aviation and shipping but excluding land use, land use change and forestry). The blank lines in Table 2.1 represent subsectors of the economy for which the NERA/Enviros analysis suggests there will be no CRC coverage.

The NERA/Enviros coverage estimates have been used widely since their publication and are used by the CCC for the CRC coverage in the calculation of MACC curves for the industry and non-domestic building sectors. They are therefore well established. However the estimates are based on electricity consumption data from 2005 and since their calculation, some regulatory changes have been introduced that could change the coverage estimates. For example:

- Government has decided to aggregate emissions from state schools to their local authority, impacting on the education and public administration sectors.
- Qualification for the CRC is now based on electricity consumption through all HHMs, which had previously not been clear.

The following sub-section describes the attempts made in this study to update the CRC coverage.

Table 2.1: NERA/Enviros estimate of CRC coverage based on 2005 electricity consumption survey data.

Subsector	Emissions covered by CRC (tCO_2/year)	% of total CRC coverage
Aluminium	443,018	0.85
Bricks	-	-
Cement and lime	-	-
Ceramics	521	0.00
Chemical	2,385,948	4.60
Construction	153,241	0.30
Education	380,754	0.73
Electrical engineering	980,034	1.89
Energy	-	-
Food and drink	982,806	1.89
Glass	293,737	0.57
Health and social work	887,487	1.71
Hotels and restaurants	4,425,505	8.52
Mechanical engineering	2,715,310	5.23
Other industries	6,397,175	12.32
Other Non-Ferrous Metals (NFM)	-	-
Paper and board	1,873,832	3.61
Plastics	3,876,477	7.47
Public administration	5,221,374	10.06
Real estate	1,119,100	2.16
Retail trade	6,631,878	12.78
Motor vehicles	-	-
Steel	5,058,493	9.74
Transport, storage and communication	152,629	0.29
Vehicle engineering	2,559,113	4.93
Water	738,855	1.42
Wholesale trade	4,635,202	8.93
Total	**51,912,487**	

2.2 Updating the CRC coverage

Given the timescales of this project it was not possible to rerun the analysis carried out by NERA/Enviros using more recent data. In addition, it could be argued that simply rerunning the analysis with more recent data would still include any methodological problems contained in the original assessment.

Therefore, initial enquiries were made during this study to establish if any other body with an interest in CRC emissions had calculated coverage estimates. Defra, BERR, AEA's National Atmospheric Inventory team and the Environment Agency's CRC implementation team were contacted but none of these organisations had made coverage estimates beyond those already reviewed. Additionally, efforts were made to establish if the UK energy companies had compiled estimates for sectoral coverage of the CRC. To date, none of the major energy companies have confirmed whether they have made such an assessment.

Effort therefore focused on updating those subsectors known to be important or expected to be different from the estimates. From the NERA/Enviros coverage estimates (Table 2.1) the subsectors were: hotels and restaurants, other industries, public administration, retail trade, steel and wholesale trade, accounting for over 62 per cent of the total CRC coverage. As the largest component subsectors of the CRC, it was appropriate to focus attention on these areas. However, contacts with the Retail Trade Association, British Hospitality Association and UK Steel established that none of these industry bodies has assessed the potential coverage of CRC in their sector.

2.2.1 Public administration

In the public administration subsector, CRC regulations have changed since the NERA/Enviros estimates were made; most importantly, energy use from state-funded schools is now assigned to the local authority to which they belong.

For the central government estate, the Sustainable Development Commission publishes figures on emissions; in 2006/07 emissions across all departments totalled 2.3 $MtCO_2$. However, establishing local authorities' (LAs) energy use emissions is less straightforward, since energy use is not collected centrally and the Local Government Association has not carried out an assessment of CRC coverage. The Carbon Trust does, however, carry out a carbon management programme for LAs and was able to provide information on the total energy spend across the LAs involved in the scheme.

The Carbon Trust programme only covers a subset of LAs. Therefore, to arrive at an estimate of energy spend across all LAs, the total from the Carbon Trust programme was linked to the population within the subset of LAs and then scaled corresponding to the population of the UK. Having estimated the total energy spend across UK LAs, this was converted to estimates of energy consumption using data from the Digest of UK Energy Statistics (DUKES) Table 1.7 Sales of Electricity and Gas by Sector. Assuming that the majority of LA energy spend would be comprised of electricity and gas, the gas to electricity ratio of energy spend in the non-industry and non-domestic sector was combined with the price per unit of electricity and gas to arrive at estimated total consumption of electricity and gas. Multiplying these energy consumptions by emission factors for UK grid average electricity and gas combustion provided a value for energy use emissions across all LAs of just over 6 $MtCO_2$.

Total emissions for the public administration subsector are therefore near 8.3 $MtCO_2$. The question is then, how much of these emissions would be covered by the CRC? The government has decided to include all central government departments in the CRC, regardless of whether they meet the qualification criteria. Therefore, the majority of emissions from this sector will be covered. The inclusion criteria will, on the other hand, apply to LAs so an estimate must be made of the proportion of LAs that will qualify for the CRC. Defra has previously estimated that organisations with an annual energy spend greater than £500,000 are likely to meet the qualification criteria. Taking the average energy spend per person in the Carbon Trust subset and applying that to the population of all LAs in the UK allows a simple estimate of the proportion of LAs that we can compare using LAs energy spend against this proxy qualification threshold. Based on this analysis, 96 per cent of LAs are likely to qualify for the CRC. Since these LAs are the more populous ones by nature of the analysis, it is likely that cumulatively, they would represent greater than 96 per cent of the total energy consumption in LAs.

There is considerable uncertainty in the approach used here: that is, assuming that population is a key determinant of LA energy spend and that the average energy spend per person in the Carbon Trust subset is representative of the average LA energy spend per person across the UK as a whole. Therefore, we tentatively suggest that the NERA/Enviros estimate for public administration is on the low side and could be revised upwards by as much as 40 per cent. However, it is recognised that a more rigorous analysis of public administration coverage is needed, since there are additional energy use emissions associated with non-departmental public bodies and public corporations that may not currently be considered in the estimates.

2.2.2 National Health Service

The 'Government Response and Policy Decisions' document issued on 7th October 2009 in response to the Consultation on the Draft Order to Implement the Carbon Reduction Commitment specifies that the NHS will be part of the CRC and subject to qualification criteria, as with other participants. Our estimates show that inclusion of the NHS will significantly increase the overall emissions coverage of the scheme. Energy use statistics for NHS estates and facilities are publicly available. These statistics consist of:

- primary energy input to combined heat and power (CHP) plants;
- consumption of grid electricity, gas, oil and coal;
- local electricity consumption;
- electrical and fossil fuel-derived energy used in centralised processing units.

The NHS statistics department informed this study that energy input to CHP and processing units is almost entirely gas-fired. Therefore, total energy use emissions for all NHS trusts can be calculated. There are a number of NHS sites and CHP plants covered by the EU ETS, which must be removed when considering CRC coverage. Taking this approach arrives at a total energy use emission estimate of 3.29 Mt CO_2, an almost four-fold increase over the NERA/Enviros coverage estimate.

The high level assumptions made for the NHS emissions estimation means that we do not deem it appropriately robust to include in the revised scheme emissions coverage detailed in this report. However, it is clear that the inclusion of the NHS sector will increase the overall emissions coverage of the scheme.

2.2.3 Water

Data on CRC emissions coverage reported by 22 UK water companies, shows that the NERA/Enviros estimate is likely to be too low. Total CRC eligible energy use emissions from the water subsector were over 3.5 $MtCO_2$ in the financial year 2007/08. Since the water companies are not party to CCAs and have only small amounts of emissions in the EU ETS (removed from the coverage estimate), we propose that the coverage for this sector be amended upwards.

2.2.4 IT and communications

Recently much attention has focussed on the rising energy demands of the IT sector and in particular IT data centres. The Department for Energy and Climate Change (DECC) has suggested data centre energy use accounts for three per cent of electricity use in the UK and is projected to double by 2020. The UK final electricity consumption from DUKES Table 5.2 is 342 TWh, therefore data centre consumption can be estimated at 10.3 TWh. This electricity consumption (taking the grid average emission factor) gives rise to nearly 5 $MtCO_2$. We are unable here to ascertain how many data centres and consequently how much of that energy use would be included in the CRC; therefore, we have not updated the emissions coverage for this study. However, anecdotal evidence suggests that average energy use at data centres is high and therefore a significant proportion of the 5 $MtCO_2$ is expected to be included in the CRC. Further analysis of the IT sectors is likely to lead to a significant uplift of the emission coverage of the CRC in the IT sector.

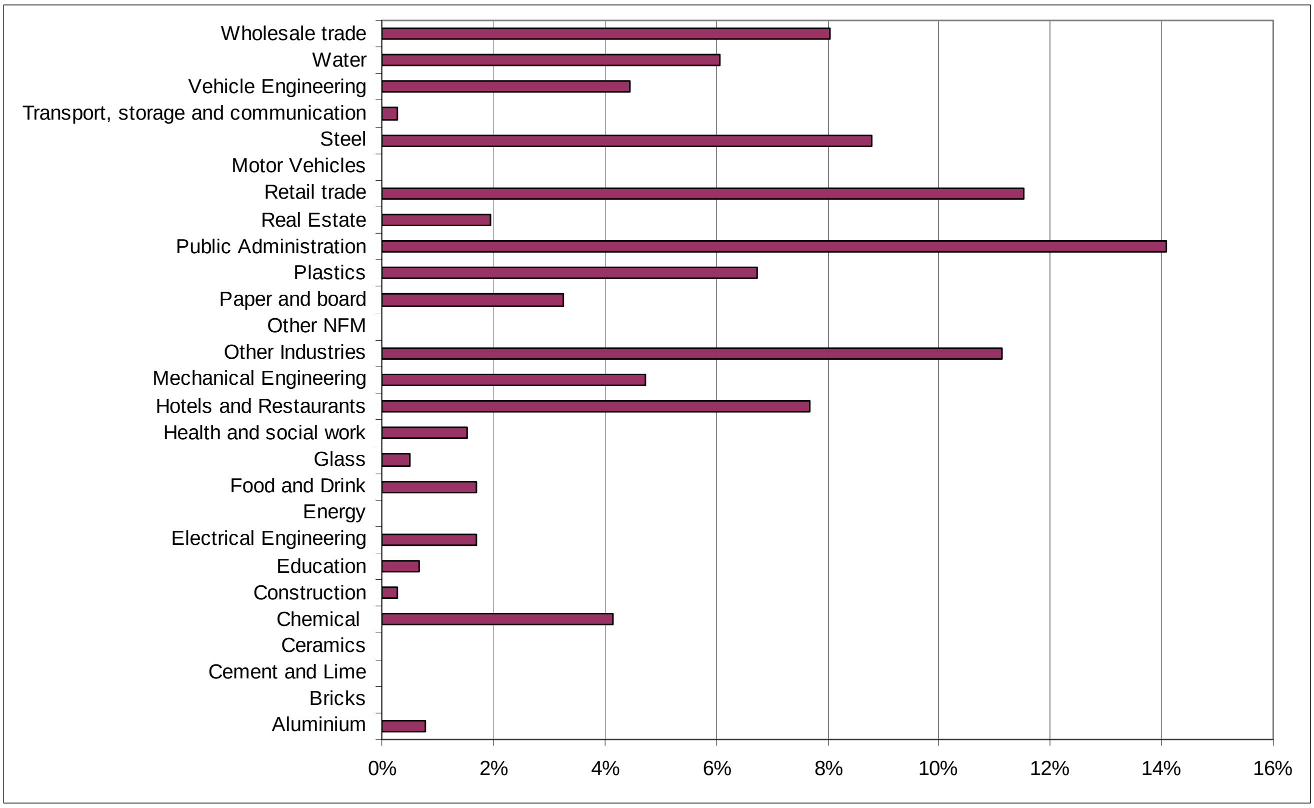
2.2.5 Updated emissions coverage

The updated CRC emission coverage estimates are shown in Table 2.2 below. As was the case for Table 2.1, blank rows show sectors for which it is projected that there will be no CRC coverage. The revised coverage can be seen more easily in Figure 2.1 which shows the public administration sector representing over 14 per cent (up 2.9 $MtCO_2$ from the NERA/Enviros estimate) of the total CRC emissions coverage and the water sector now accounting for approximately 6 per cent (up 2.7 $MtCO_2$).

Table 2.2: Updated CRC emission coverage estimates.

Subsector	NERA/Enviros Emissions covered by CRC (tCO2/year)	Updated emissions covered by CRC (tCO2/year)	Updated % of total CRC coverage
Aluminium	443,018	443,018	0.77
Bricks	-	-	-
Cement and lime	-	-	-
Ceramics	521	521	0.00
Chemical	2,385,948	2,385,948	4.15
Construction	153,241	153,241	0.27
Education	380,754	380,754	0.66
Electrical engineering	980,034	980,034	1.70
Energy	-	-	-
Food and drink	982,806	982,806	1.71
Glass	293,737	293,737	0.51
Health and social work	887,487	887,487	1.54
Hotels and restaurants	4,425,505	4,425,505	7.70
Mechanical engineering	2,715,310	2,715,310	4.72
Other industries	6,397,175	6,397,175	11.13
Other Non-Ferrous Metals (NFM)	-	-	-
Paper and board	1,873,832	1,873,832	3.26
Plastics	3,876,477	3,876,477	6.74
Public administration	5,221,374	8,105,108	14.10
Real estate	1,119,100	1,119,100	1.95
Retail trade	6,631,878	6,631,878	11.54
Motor vehicles	-	-	-
Steel	5,058,493	5,058,493	8.80
Transport, storage and communication	152,629	152,629	0.27
Vehicle engineering	2,559,113	2,559,113	4.45
Water	738,855	3,431,837	5.97
Wholesale trade	4,635,202	4,635,202	8.06
Total	**51,912,487**	**57,489,203**	

Figure 2.1: Subsector make-up of the total CRC emission coverage with updated CRC coverage estimates.



The subsector breakdown of the total CRC emission coverage is useful to consider when assessing the relative contributions of the different subsectors to the CRC. However, it is also interesting to consider for each subsector what proportion of the total energy use emissions is accounted for by CRC coverage. Table 2.3 puts the CRC emission coverage estimates into context against baseline energy use emissions. These results are also presented graphically in Figure 2.2. The subsectors public administration and other industries stand out in this analysis because the CRC coverage represents more than 100 per cent of the total energy use emissions in each subsector. This is a result of differences between the approach used to estimate CRC scheme coverage and the models available and modelling approach used for calculation of the CRC energy use projections. More detailed reasons for this unrealistic outcome are discussed below.

The definition of the “other industries” subsector used by NERA/Enviros in deriving their estimate is different from that used in our modelling here, which includes only the wood subsector. Total energy use emissions arising from all the industries aggregated under NERA/Enviros’ “other industries” sector are likely to be large. Consequently, the CRC-covered component of these emissions is greater than the total energy use emissions from the wood sector, which forms the “other industry” sector in the ENUSIM model used here. Further disaggregation of the NERA/Enviros estimate would be useful to understand the make-up of their estimate and improve consistency; however within the timescales of the current study this was unachievable.

For the public administration sector, the CRC coverage is 77 per cent greater than baseline energy use. It is suggested that in future work, the baseline emissions for this sector are revisited since they lie below both the original NERA/Enviros estimate of CRC-covered emissions and our updated coverage estimate.

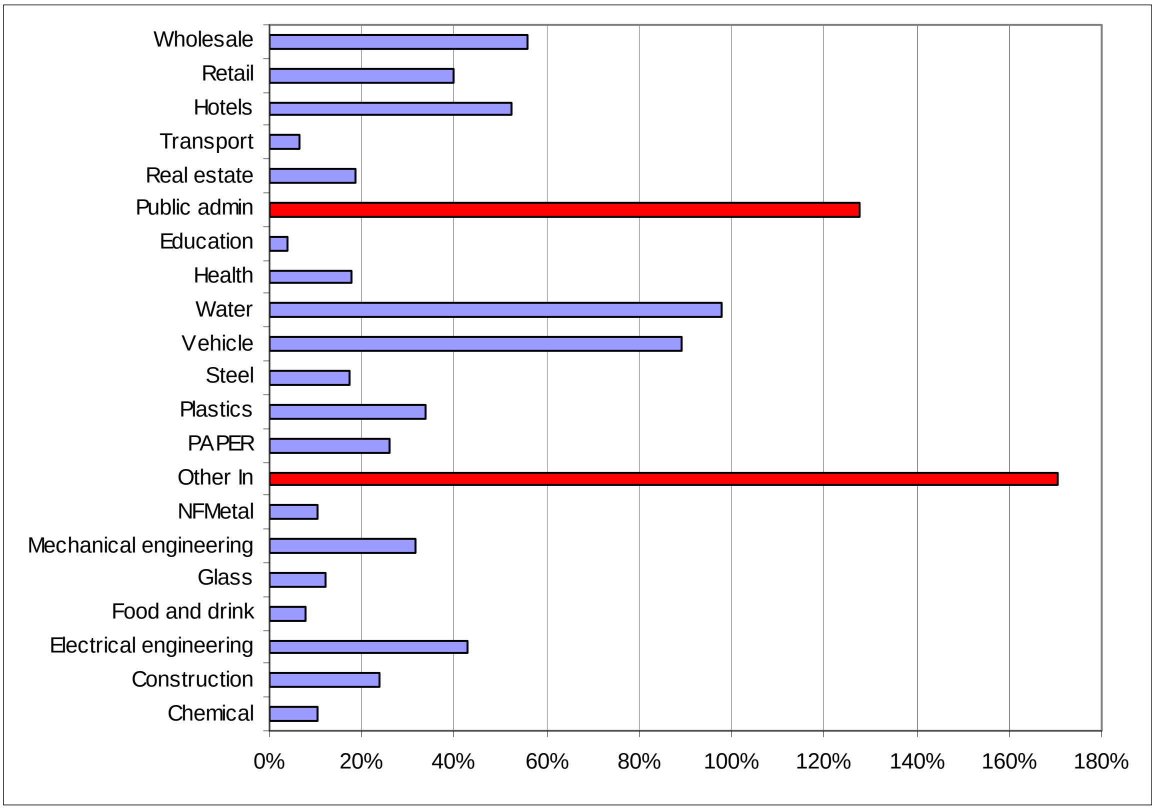
For the purposes of our modelling we have taken the CRC coverage of the other industries and public administration subsectors as 100 per cent of baseline energy use emissions from those sectors. As a result, CRC energy use projections and MACCs relate to CRC energy use emissions coverage of 53.5 MtCO_2 in 2008.

In contrast to the public sector and other industries, some sectors have a very low proportion of their energy end use covered by the CRC. This is because not of all of a sector will necessarily meet the qualification criteria for the CRC. Alternatively some of an organisations energy use may be covered under a CCA or the EU ETS and hence this would mean that only the energy not falling under those schemes would qualify for the CRC.

Table 2.3: CRC coverage of total energy use emissions by subsector.

	Subsectors	CRC coverage estimate	Proportion of total CRC coverage	Energy use emissions	Energy end use covered by CRC
		(tCO_2 eq.)	(%)	(tCO_2 eq.)	(%)
Industry sector	Chemical	2,385,948	4.15	22,589,240	11
	Construction	153,241	0.27	645,638	24
	Electrical engineering	980,034	1.70	2,286,886	43
	Food and drink	982,806	1.71	12,949,870	8
	Glass	293,737	0.51	2,410,266	12
	Mechanical engineering	2,715,310	4.72	8,570,864	32
	Non ferrous metal	443,018	0.77	4,331,079	10
	Other industries	6,397,175	11.13	3,750,988	171
	Paper	1,873,832	3.26	7,189,955	26
	Plastics	3,876,477	6.74	11,510,569	34
	Steel	5,058,493	8.80	29,086,515	17
	Vehicle	2,559,113	4.45	2,874,137	89
	Water	3,431,837	5.97	3,512,725	98
Non-domestic buildings sector	Health	887,487	1.54	5,024,201	18
	Education	380,754	0.66	9,886,364	4
	Public admin	8,105,108	14.10	6,356,061	128
	Real estate	1,119,100	1.95	6,065,653	18
	Transport	152,629	0.27	2,408,287	6
	Hotels	4,425,505	7.70	8,459,479	52
	Retail	6,631,878	11.54	16,600,904	40
	Wholesale	4,635,202	8.06	8,280,814	56

Figure 2.2: Proportion of total subsector energy use covered by CRC.



3 Emission projections

Section 1.1 introduced the qualification criteria for the CRC: half-hourly electricity consumption of greater than 6,000 MWh during the qualification year. Therefore, CRC participants will be formed from the industry and non-domestic buildings sectors.

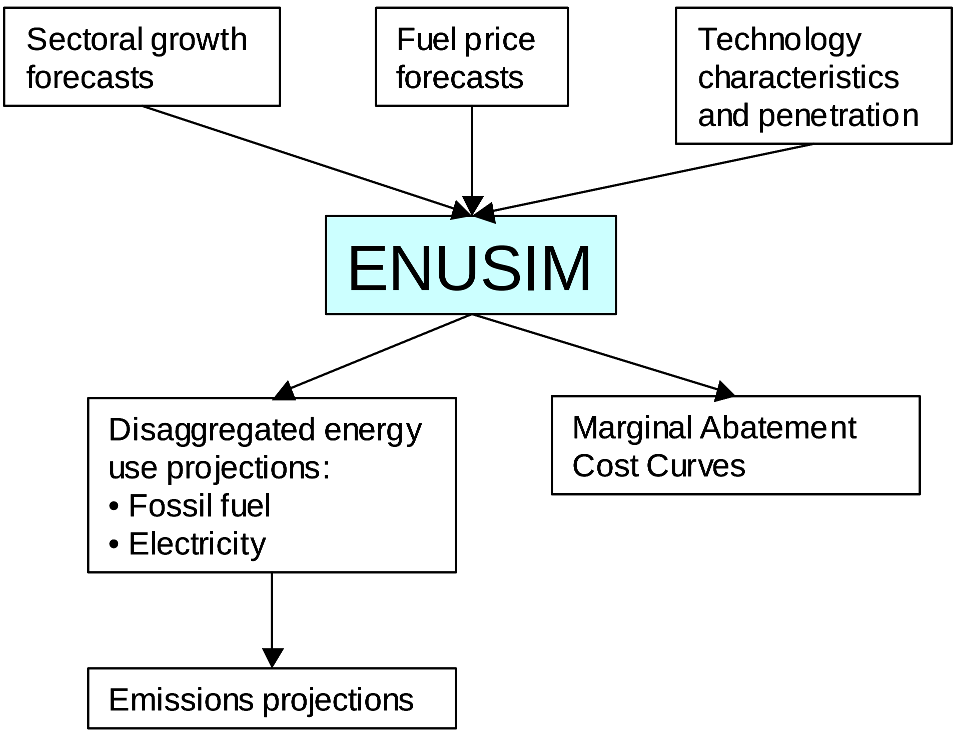
Projections of energy use in these sectors are based on the business-as-usual (BAU) scenario reflected in the pre-2007 Energy White Paper (Updated Energy Projection UEP 29), and therefore do not include the influence of the CRC. This is consistent with the baseline used by the CCC.

Projected emissions from the CRC sector are generated from models and analysis of energy-use in industry and the non-domestic building sector. The following two sub-sections describe the emissions projected from each as well as the construction of projections. Finally, we combine the results from the two models and summarise the projected total emissions from the CRC sector.

3.1 The industry sector

In order to project energy use emissions from the industry sector, the ENUSIM model was used to simulate the uptake of energy-efficient technologies. ENUSIM bases these simulations on assumptions about the base year energy use, the technical detail of the technologies, projections of fuel prices and projections of growth rates (Figure 3.1). The model is described in more detail below, and following that, projections for the industry CRC sectors are shown and discussed.

Figure 3.1: Main inputs and outputs from the ENUSIM model.



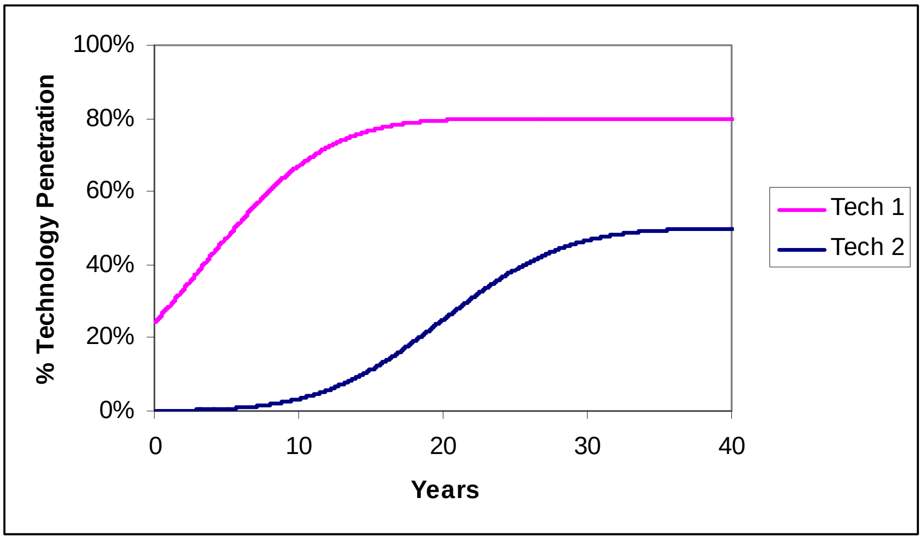
3.1.1 The ENUSIM model

The fundamental methodology of ENUSIM is to predict future energy consumption for each industry subsector as the product of:

- the **output of a production process/sector** (indexed to the base year and determined entirely offline - here by the BERR UEP growth projections); and,
- the **average energy required to produce a unit of output** (indexed to the base year). This energy intensity is largely determined in the model by the take-up of energy-saving technologies within the sector.

The take-up of energy-saving technologies is determined by an index of industry penetration of the technology, represented by an S-curve. As a technology enters the market its initial penetration rate is slow. The penetration rate increases as the market develops and slows as it approaches saturation. The 'S-curve' for each technology is specified by the final penetration and the time taken to reach maximum penetration. The user can also specify the point at which the technology can start along this curve, and as long as the technology remains cost-effective, the penetration of the technology will proceed smoothly along the remainder of the curve. Figure 3.2 shows Technology 1 has been available for some time and is already fitted to 24 per cent of the devices in the base year, whereas Technology 2 is newly available and is not fitted to any device.

Figure 3.2: Example S-curves for two technologies.



The model is set up to simulate three scenarios of the uptake of energy-efficient technologies:

- Business-as-usual (BAU), which assumes that technologies will continue to be taken up at current rates, and that the final saturation point is determined by behavioural preferences in the market, not necessarily determined by the cost effectiveness of the technology option.
- All-cost-effective (ACE), assumes that technologies are taken up wherever it is cost-effective to do so, without regard for constraints on capital, management time and other barriers to uptake.

- All-technically-possible (ATP), which assumes that the technology is applied wherever it is technically possible to do so without any regard for cost effectiveness.

3.1.2 Industry sector emission projections

CRC coverage in each subsector is calculated as the CRC emissions coverage as a fraction of the 2006 base year emissions. This fraction of the subsector is assumed to remain in the CRC for the period of the projections. The ENUSIM projections are also aligned for consistency with the BERR (now DECC) energy use forecasts from their UEP model. Figure 3.3 shows the projected CRC emissions from ENUSIM industry sectors, split between large, medium and small emitting subsectors.

The largest emitting industry sectors are steel, plastics, water, other industries, mechanical engineering and vehicles. The steel subsector is set to increase most significantly while the trend for the other subsectors over the period to 2020 is a more gentle increase.

Emissions from those sectors with lower CRC energy end use emissions are in general projected to increase slightly. The exceptions are emissions from the chemical and non-ferrous subsectors which are set to decline, whereas emissions from the paper subsector are projected to rise.

3.2 Non-domestic buildings sector

The Building Research Establishment (BRE) National Non-Domestic Energy and Emissions Model (N-DEEM) was used previously to estimate energy end use abatement potential for the non-domestic buildings sector for the CCC. However, here we did not have access to the full model and therefore did not employ it to develop emissions projections for this sector.

To consider subsectoral variations, we disaggregated the non-domestic buildings sector to eight subsectors: health, education, public administration, real estate, transport, hotels, retail trade and wholesale trade, although this level of disaggregation was not provided to the CCC. We used earlier analysis to arrive at the subsectoral breakdown. These were aligned with both the total services projections from BERR (now DECC) for pre-Energy White Paper (UEP 29) and the composite non-domestic buildings sector work for the CCC. Insufficient information was available to generate cost curves for the sports and leisure and other subsectors, therefore individual cost curves are not presented for these. Since they form a component of the composite curve used, which is aligned with the CCC's composite non-domestic building cost curve, allowance for abatement in these sectors is included in the overall CRC abatement potential for non-domestic buildings.

3.2.1 Non-domestic buildings sector emission projections

The largest CRC-covered emissions are projected to arise from the public administration, retail trade, wholesale trade and hotels subsectors (Figure 3.4). Emissions are projected to grow in all these subsectors except education, for which emissions are forecast to decrease slightly.

Note that the projections for the non-domestic buildings sector are based on the emissions trend for this sector, broken down to public administration and commercial, calculated by BERR for their UEP 29 forecasts (as used by the CCC). The trend shown by the public sector is one of steadily decreasing emissions to 2020. Emissions from the commercial sector are, however, forecast to increase following a period of approximately stable emissions to the end of 2009.

Figure 3.3: Projected CRC emissions from ENUSIM industry subsectors - central fuel price scenario.

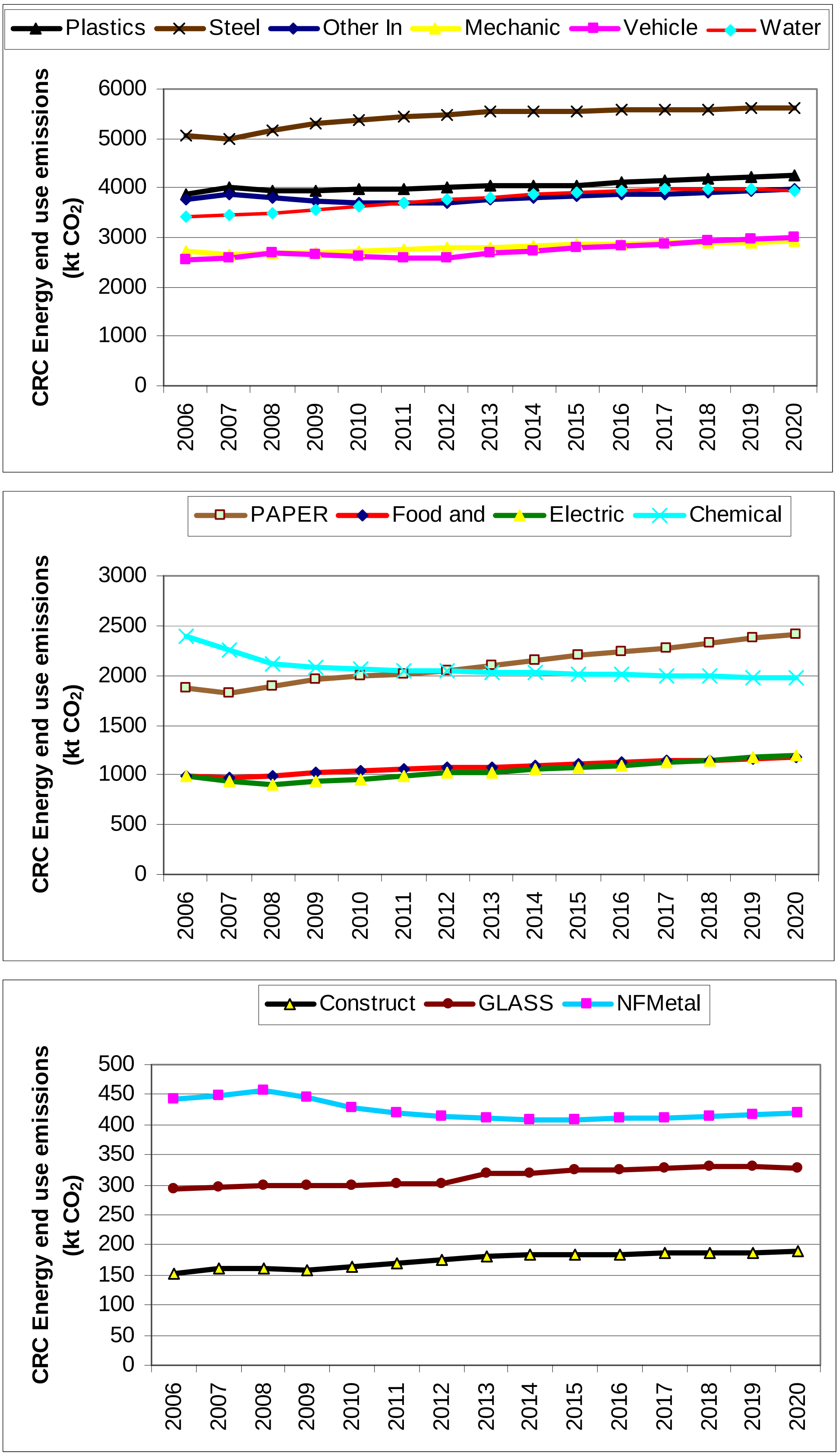
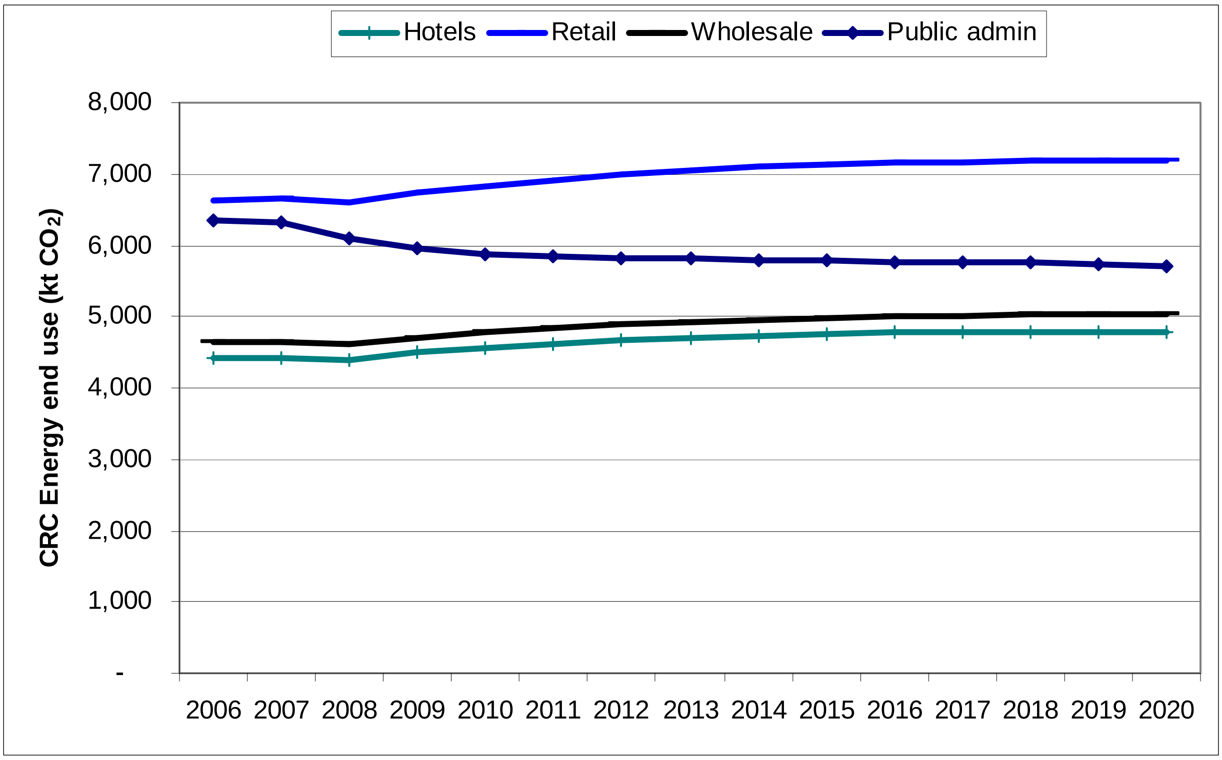
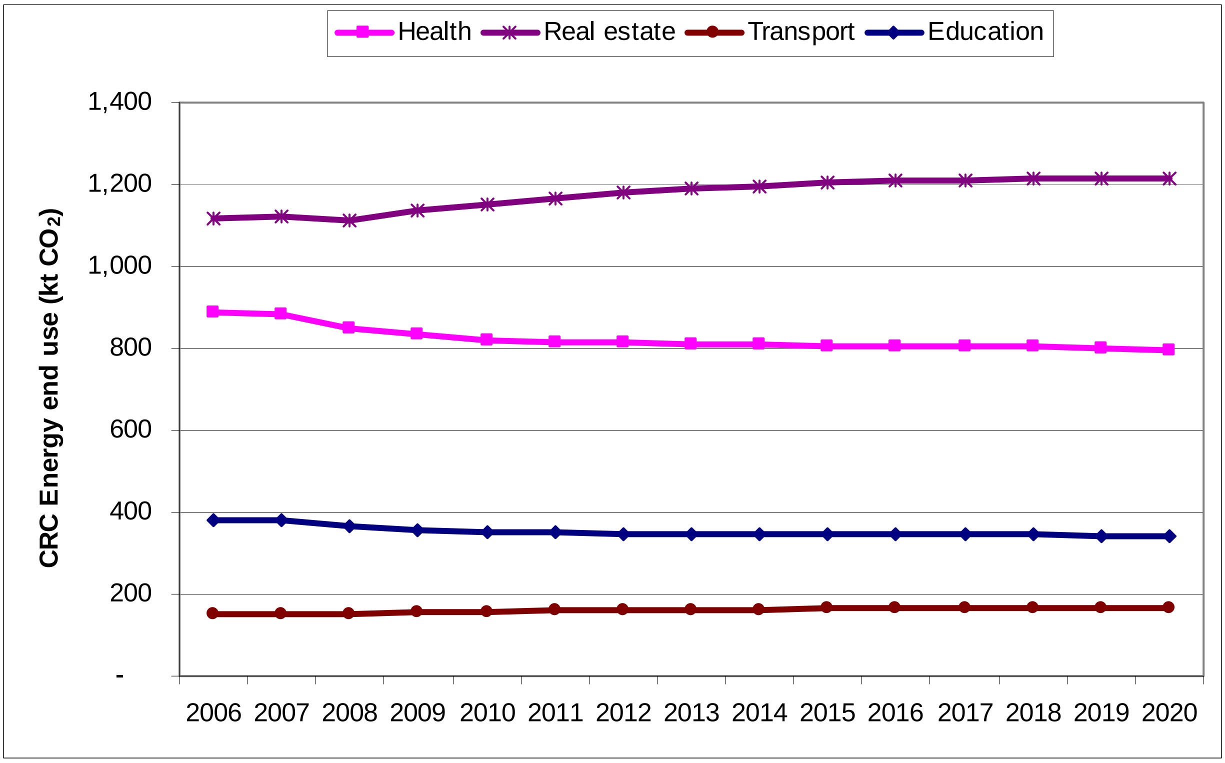


Figure 3.4: Subsector breakdown of CRC energy use emissions in the non-domestic buildings sector.





3.3 Total CRC sector emissions

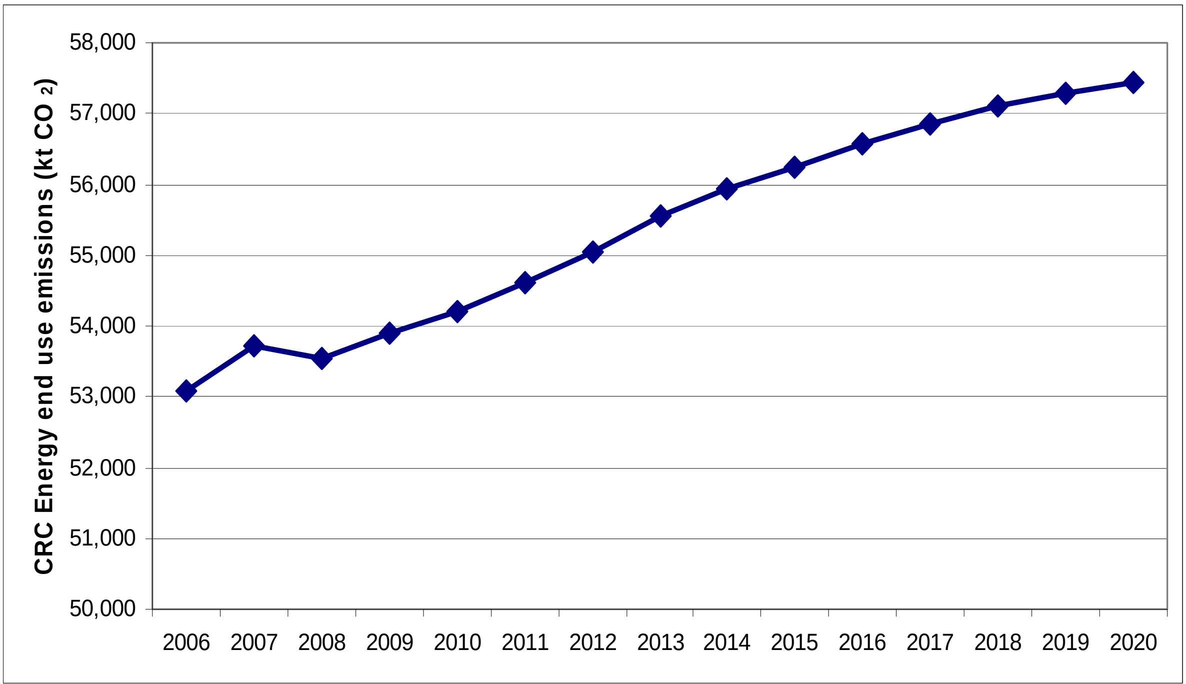
Taking the CRC sector as a whole, according to our business-as-usual projections, after a lull in 2008, emissions will rise in a near linear fashion out to 2020. Total modelled emissions in 2020 are forecast to be 57.4 Mt, up seven per cent from 2008. Modelled emissions in 2008 are estimated as 53.5 $MtCO_2$, taking CRC-covered emissions for the public administration and other industries subsectors as 100 per cent of projected energy use emissions for each (discussed in Section 2.2.5).

Much of the increase shown by these projections is, as we have seen previously, driven by rising emissions in the industry subsectors: steel, plastics, other industries, mechanical engineering and vehicle engineering; and the commercial sectors: wholesale and retail trade and hotels.

The CRC emission projections made here contrast with those reported by the CCC for total emissions from the industry and non-residential buildings sectors. DECC modelling shows emissions from these sectors falling over time. Emissions from energy use in non-residential buildings and industry (whole economy) are projected to fall from around 230 $MtCO_2$ currently, to approximately 200 $MtCO_2$ in 2020, equivalent to a 13 per cent decrease.

The fundamental difference between the emission projections calculated here and those of the CCC is that we have assumed a constant grid average emission factor for electricity, whilst the CCC takes decarbonisation of UK electricity generation into account. The projections calculated here should be viewed as business-as-usual projections, ignoring the influence of other policies on electricity generation. The CCC views the EU ETS as essential for decarbonising electricity if it creates a clear carbon price signal. However, additional policy measures are the financial support and non-financial policy measures of the draft Renewable Energy Strategy, expenditure on carbon capture and storage (CCS) demonstration projects and the building of coal-fired power stations only where there is the clear expectation that they will be retrofitted with CCS capability by the early 2020s.

Figure 3.5: Total CRC sector emissions projection (Note, 2006 emissions take total energy use emissions for the public administration and other industries subsectors).



3.3.1 1990 emissions

Emissions from the CRC sector were estimated for the year 1990 based on the United Nations Framework Convention on Climate Change (UNFCCC) reported energy use emissions from the manufacturing industries and construction (UNFCCC category 1.A.2), and commercial/institutional (UNFCCC category 1.A.4.A) categories. CRC emissions in 2006 were pro-rated back to 1990 based on the emissions change in these categories between 1990 and 2006. This yielded estimated emissions from the CRC sectors of nearly 64 $MtCO_2$.

Implicit in this estimate is the assumption that the emissions trajectory of CRC-covered organisations has followed that of all organisations within the manufacturing industries and construction, and commercial/institutional categories.

4 Abatement potential in the CRC sectors

Technical abatement potential in the CRC sectors is quantified in this chapter through models originally used for the CCC analysis: for the industry sector, based on ENUSIM; and N-DEEM for the non-domestic buildings sectors. In addition, we also consider the provision of carbon reductions to CRC participants through the use of CHP.

Abatement associated with supply of electricity from on-site renewables is not modelled here because of the CRC regulations on accounting for emissions from renewables generation, which is dependent on whether an organisation receives a Feed in Tariff (FIT) or Renewables Obligation Certificates (ROCs) are issued for the electricity generated:

- If so, that electricity must be reported as consumption at the grid-average electricity emission factor.
- If not, then the electricity will be 'zero-rated' for emissions.

This approach is discussed further below. It allows carbon reductions to be attributed appropriately to the Feed in Tariff/Renewables Obligation or the CRC. However, we have no way of forecasting the extent to which FITs/ROCs will be issued for on-site renewable electricity and therefore have not considered its supply as a component of CRC abatement potential. Historically, the value of ROCs has always outweighed the value of carbon and so it is reasonable to assume that in the majority of cases ROCs will be claimed.

More generally the CRC Order proposes that if a participant operates an electricity generation process and exports electricity to the grid, to other users, or uses that electricity itself (in the case of nuclear or EU ETS generators), the participant may be entitled to claim a credit. The credit would be calculated at the grid average emissions factor. Additionally, all electricity credits refer to electricity generated over the course of a particular year and it will only be possible to claim them in connection with the compliance year in which they were generated. If over the course of a compliance year a participant accrues more credits than the organisation's total energy consumption, then the participant will be able to 'net off' energy credits only up to zero. Some situations of specific relevance for the CRC:

- Organisations generating electricity using combined heat and power (CHP) can claim electricity credits for electricity exported to other users or to the grid. The credits received will be equal to the total exports of electricity and can be used to net off electricity consumption across the organisation. However, if the CHP plant is covered by the EU ETS, it will be treated in line with other EU ETS generating plants: credits can be accumulated only up to the level of electricity imported and netted off at plant level only.

Participants' on-site use of electricity from the CHP plant would not need to be reported but electricity imported from the grid for use in the plant would need to be counted at the grid average emissions factor (although this can be netted off against any credits received for export of electricity from the plant).

All heat use from the plant will be zero-rated for emissions.

- As previously discussed, accounting of on-site generation of renewable electricity is dependent on whether FITs/ROCs are issued for that electricity. If ROCs are not issued and the electricity is used on-site, the energy is counted as having zero emissions. If the electricity is then exported, the participant can claim an energy credit at the grid average emission rate. If ROCs are issued the renewable electricity generated must be reported as consumption and counted at the grid average emissions factor. Export of this electricity will be credited at the grid average emission factor, allowing the organisation to potentially net off the effect of considering the ROC-related electricity as energy consumption.

The CRC allowance price along with the value of ROCs will be strong drivers of the level at which participants may choose not to claim ROCs for renewable electricity generation and instead export electricity to generate energy credits to net off against organisational electricity consumption. An amendment to the CRC order, announced on 7 October 2009, was that alongside the CRC performance league table there will be a table which details the organisations increase in onsite renewable generation together with energy efficiency savings. This will allow organisations to gain reputational credit for their investment in onsite renewables. An interesting further study could be, to determine what driver the CRC may represent for renewable electricity in the UK, in the context of the UK's commitments to contribute to the EU goal of 20 per cent renewable energy consumption in 2020 (15 per cent for UK).

4.1 Marginal abatement cost curves

The cost curves (MACCs) calculated here refer to the marginal cost (in £/tCO_2 saved or £/unit of energy saved) to private investors of implementing measures to reduce energy consumption/emissions. Each measure has an associated economic lifetime and assumed investment discount rate; and both the 'annualised' financial and energy or carbon savings of the measures are calculated. The cost effectiveness shown in the MACCs is therefore the annual net cost (either positive or negative) per unit of annual emissions saving (in this case for 2012). The economic costs do not include the cost of carbon; we take this into account when considering cost effectiveness.

4.2 Industry

The energy efficiency measures in the ENUSIM model were updated for the CCC during the recent energy end use analysis project (AEA, 2008). In particular, for each of the non-EU ETS specific sectors (chemicals, food and drink, engineering, textiles, rubber and plastics, construction, water utilities, other industries) base year energy and emissions values were updated to 2006 values, and current device energy use characteristics in each subsector were estimated. For chemicals, food and drink and engineering, the existing technologies/measures were re-evaluated in terms of their costs/energy saving values and current penetration levels. Additionally, for these sectors, new technologies were included with their timescales for introduction. For the EU ETS specific sectors (steel, ceramics, paper etc.), ENUSIM updates had been created earlier for a Defra project in connection with the EU ETS sector allocations.

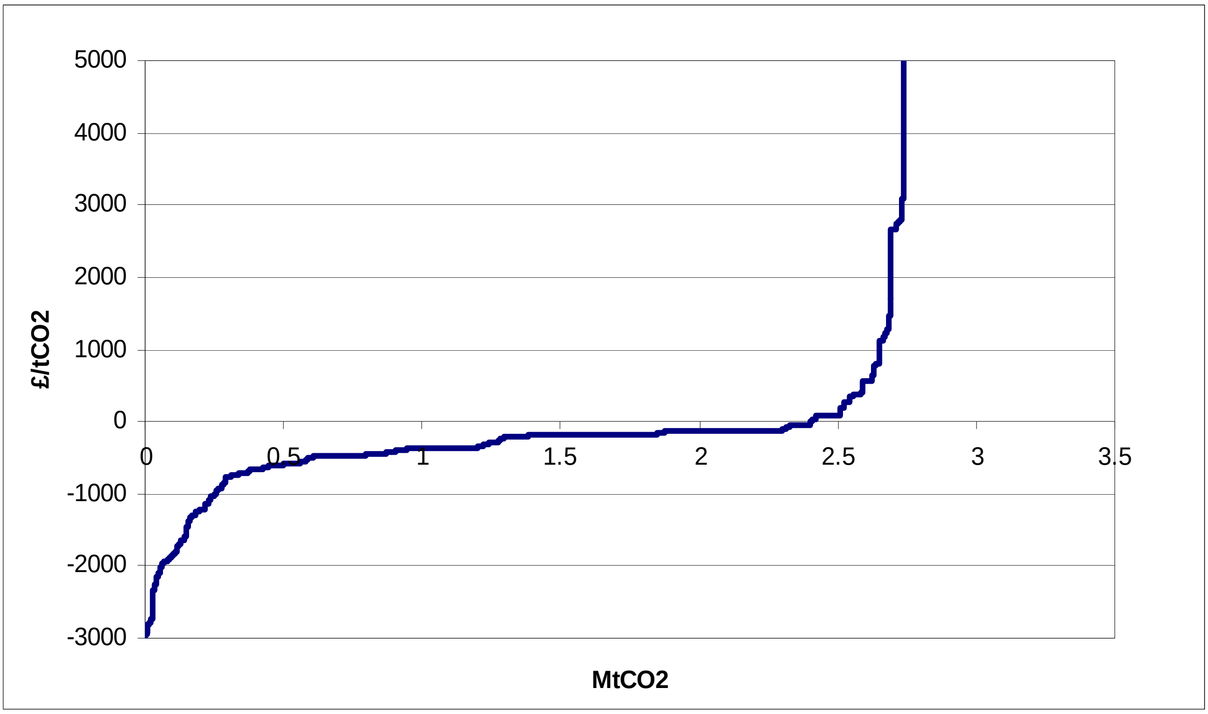
Whereas for the CCC study a composite MACC for the whole of the industry sector covered by CRC was produced, the MACCs generated here were disaggregated to the subsector level, to show how much abatement might be expected from the different sectors. The subsector MACCs are shown in Appendix 1. Also included with the MACCs is a list of the measures that make up the cost curves and an indication of which measures should be investigated further to consider their appropriateness for CRC sites. For example, some measures may only be applicable to large-scale processes, such as energy-efficient furnace technology in the steel sector, and therefore may not be available to CRC qualifying sites. The implications of this are that for some subsectors where the model technologies are more suited to energy-intensive operations, the estimated abatement potential under CRC may be unrealistically high. Estimating the extent to which potential is applicable to the CRC would require a detailed survey of the measures. However, crudely based on the review carried out in this study, 100 per cent of the abatement measures identified in the steel and plastics subsectors could be applicable to large sites. The vast majority of measures in the chemicals and non-ferrous metals subsectors would also be usefully reviewed for CRC appropriateness. The subsectors showing measures of most appropriateness for CRC are the construction, vehicles, paper and other industries subsectors. It may be misleading to try to quantify the error from this situation until further research has been done.

4.2.1 Industry MACC

The composite MACC for CRC energy end use emissions abatement in the industry sector is shown in Figure 4.1. Our modelling suggests that 2.4 $MtCO_2$ could be achieved cost-effectively across the sector at a zero carbon price, therefore offering a direct financial benefit to participants (see Chapter 7 for further discussion).

The marginal cost of further abatement rises steeply above around 2.5 $MtCO_2$ and in total we identify around 3 $MtCO_2$ of 'technical' abatement, although this could only be achieved at an extremely high carbon price (up to £76,000/tCO_2).

Figure 4.1: Sectoral MACC for CRC energy end use in industry.



Generally, some of the most cost-effective measures in the industry sector are: replacing motors with high-efficiency motors; using variable speed drives; more efficient lighting; and improved controls for compressed air systems. At the other end of the cost curve, measures that are typically in the modelling with a high relative cost include: control systems for specific industry processes; some heat recovery operations; and new plant for IT or furnaces.

4.3 Non-domestic buildings

MACCs for the non-domestic buildings (services) sector are based on work undertaken by the Building Research Establishment (BRE), which was reviewed and added to for the CCC. The cost curves are derived from the N-DEEM model.

In a similar manner as for industry, the N-DEEM model was updated for the CCC with information collected on different energy efficiency measures based on a sample of around 700 premises that had been subject to an energy audit.

Other key developments to the MACCs in the CCC study included:

- Reviewing additional measures, with the inclusion of additional renewable heat measures, and product appliance categories.
- Inclusion of hidden and missing costs to reflect real decision making, for example the costs associated with management time or production disruption, primarily based on work undertaken by Enviros (2006).
- Consideration of the timing of measures, and impact of measure cost.
- Behavioural measures, such as turning off lights for longer or reducing the room temperature.

The N-DEEM derived MACC model previously developed for the CCC generates two composite MACCs for the non-domestic building sector:

- The first considers each abatement opportunity in isolation and the MACC curve is therefore an overestimate of the actual likely delivery of CO_2 reductions.
- The second output considers the delivery from an abatement opportunity when all other opportunities have already been implemented. This therefore provides an underestimate of likely CO_2 reductions.

Here, we treat these curves as the upper and lower bounds for the analysis. We advance these calculations by developing a best estimate of abatement potential in non-domestic buildings. The methodology aims to remove the overlaps inherent to the independent measures (upper bound) curve.

Firstly the measures are divided into categories according to use, e.g. heating/insulation or lighting. Then for each category, a cumulative abatement potential is calculated based on the independent measures and the percentage contribution of each.

We then assume that the measures are implemented in order of cost effectiveness with the least cost measure first. As each measure is implemented, we assume that the abatement potential available for subsequent measures (with lower cost effectiveness) is reduced. So, the most cost effective measure within the category achieves the same potential as if implemented independently. The next most cost effective measure achieves the percentage as when implemented independently but scaled by one minus the percentage achieved by the first measure, and so on. Table 4.1 shows an example of the calculation performed. In this case, non-overlapping abatement resulting from measure B is 14*(1-0.14) of the total independent potential. Following this approach, the interacted measures result in a total abatement potential 33% lower than that from the measures implemented independently.

As indicated above, the principal categories for overlap are heating/insulation and lighting. In the case of measures that do not interact because they are mutually exclusive – for example improved insulation of flat roofs cannot be considered in the same instances as improved insulation for pitched roofs – the abatement scaling is not affected by abatement resulting from the non-interacting technology. Similarly, installation of energy efficient printers would not overlap with installation of energy efficient monitors or PCs and hence no adjustment to the potential is made in these cases.

The pseudo-interacted curve was disaggregated to provide MACCs at the subsector level using previous analysis carried out by the Carbon Consortium to analyse policy costing associated with the Energy Efficiency Innovation Review. These curves and the measures that comprise them can be found in Appendix 2 (for best estimate abatement potential). Since the overlaps have been removed from the composite non-domestic buildings sector curve, the overall shape of these curves also take into account interactions. Abatement provided by the inclusion of measures that supply renewable heat is distributed across the measures available in each of the subsectors. In this way, the cost effectiveness and abatement potential of each measure is increased to reflect the supply of renewable energy (heat).

Table 4.1: Example calculation for removing overlaps.

Measure	Independent abatement potential (MtCO2)	Proportion of independent category total	Proportion scaled to remove overlaps	Interacted abatement potential (MtCO2)
A	1.00	14%	14%	1.00
B	1.00	14%	12%	0.86
C	1.00	14%	10%	0.73
D	1.00	14%	9%	0.63
E	1.00	14%	8%	0.54
F	1.00	14%	7%	0.46
G	1.00	14%	6%	0.40
Total	*7.00*	*1.00*	*0.66*	*4.62*

BRE cost curves apply to existing building stock and therefore do not take account of the potential for measures in new build. Additionally, the analysis is based on a static building stock and therefore does not take account of demolition rates or changes to existing stock. This means that the savings that are still available in the current building stock are also available in future years (in the absence of implementation of measures). This may give rise to the unrealistic situation where abatement is considered in the model to be available in the future for a proportion of buildings (and measures that have a slow implementation rate) that would in reality have been demolished. This potential source of error is less significant for this work since we are only considering abatement potential in the year 2012.

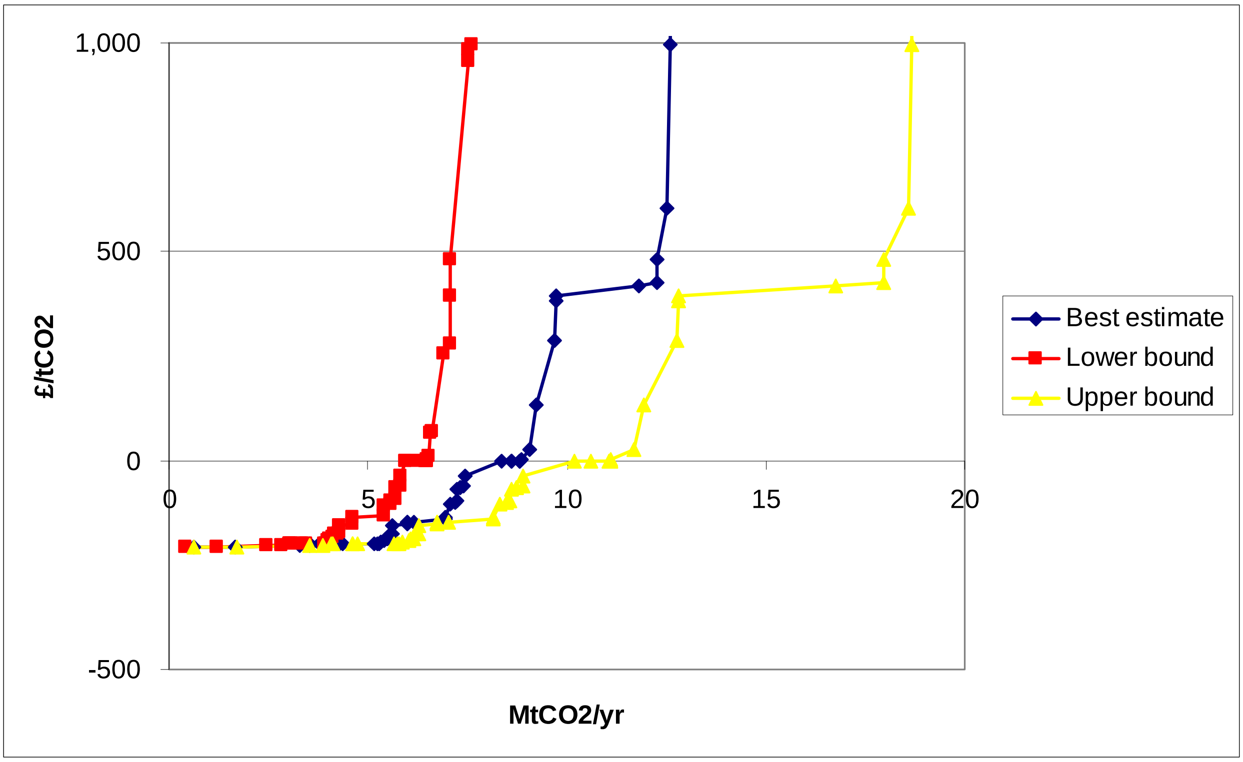
4.3.1 Non-domestic building MACC

Abatement in the non-domestic building sector is shown by our modelling to be greater than that identified for the industry sector. Emission reductions of 8.8 $MtCO_2$ could be realised at zero carbon price, that is, at a financial benefit to service sector participants. Table 4.2 shows cost effective abatement in the non-domestic building sector ranges from 11.1 $MtCO_2$ at the upper end to 6.47 $MtCO_2$ at the lower bound.

Table 4.2: Best estimate, upper and lower bounds cost effective abatement in the non-domestic building sector.

£/tCO2	Abatement at or below zero £/tCO2 (Mt CO2)		
	Best	Upper	Lower
0	8.83	11.09	6.47

Figure 4.2: Sectoral MACC for CRC energy end use in non-domestic buildings.



In the non-domestic buildings sector, the more cost-effective abatement measures are typically: better management of heating and air conditioning; energy management for IT systems; and better management of lights. The most expensive measures include: renewable heat generation; non-cost effective instances of insulation, compressed air management and replacing variable speed drives.

4.4 Combined heat and power (CHP)

In addition to energy end use measures identified for the CRC sectors, it is important to consider the abatement available to participants from the supply of heat and power from CHP plant. For clarity, alternative renewable heat supply technologies are included in the non-domestic buildings MACC. The reasoning for not including renewable electricity supply is given in the introduction to this chapter.

The approach to modelling the abatement potential from the use of CHP links two strands of analysis:

- the economics associated with typical CHP applications;
- how cost effectiveness and their future uncertainty (quantified uncertainty distributions of likely project returns) give rise to perceived risk and how this affects the investment criteria and hence the maximum ‘realistic’ potential.

The model approach can be broken down into three steps, which are discussed below.

Step 1: Size CHP to the heat demand and use heat to power ratio that maximises electricity capacity.

Step 2: Perform a discounted cash flow for the site to provide a rate of return (IRR) value.

These initial sizing and site screening steps use the AEA detailed 'bottom up' model for the analysis of CHP potentials, which was used as the basis of the original 10 GWe (gigawat-electric: 1 billon watts of electric capacity) CHP target. This model was originally sponsored by Defra and contains detailed heat and electricity demand profiles and site size distributions for all main industrial sectors and commercial/services sectors of the UK - retail, leisure, hotels, education, public sector and commercial buildings. These have been updated for their size versus number distributions using EU ETS National Allocation Plan data and recent employee and activity distribution data from statistics from the Office for National Statistics (ONS).

Step 3: Where the financial return is high enough for the project to be attractive, we consider the maximum likely probability of it going ahead.

These steps give an estimate of the realistic upper bound of 'technical' and 'cost-effective' potential from a well-tested 'bottom up' model. AEA's CHP technical team made the final step for the CCC project.

The overall CHP 'realistic' build capacity projection is then a function of the individual site capacity and the number of possible applications, and the likelihood of the projects going forward.

An element of judgement was used in deciding on build rates and the specific timings of the investments, particularly for the larger plants.

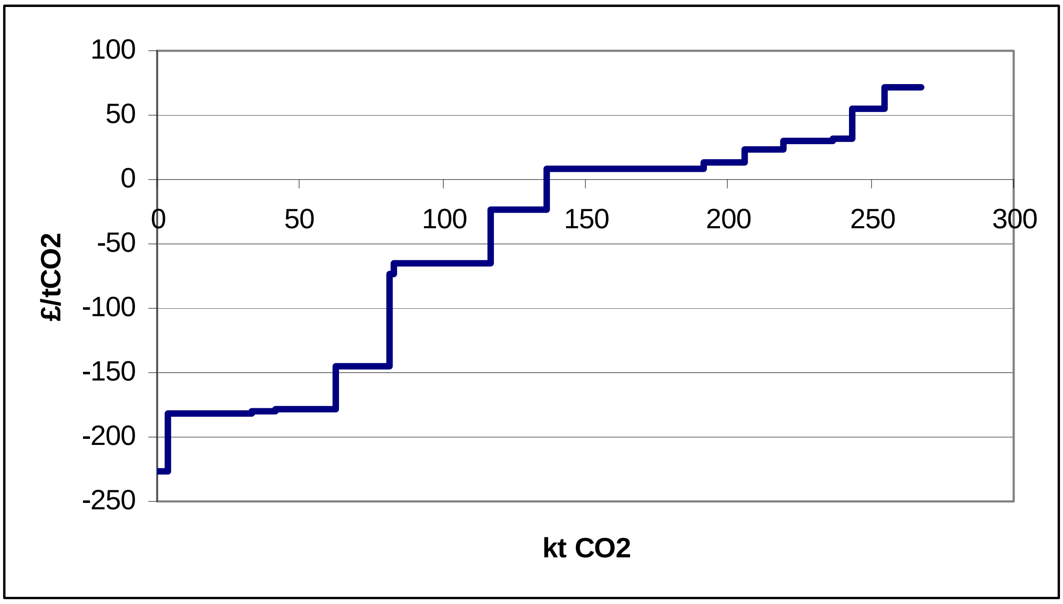
4.4.1 CHP MACCs

MAC curves were developed for the supply of heat and power from CHP in both the industry and services sectors (Figure 4.3). The abatement potential from CHP in the CRC across both sectors realised at zero carbon price is 360 ktCO_2. Total abatement potential is around 491 ktCO_2, which could be realised at a carbon price of £72/tCO_2.

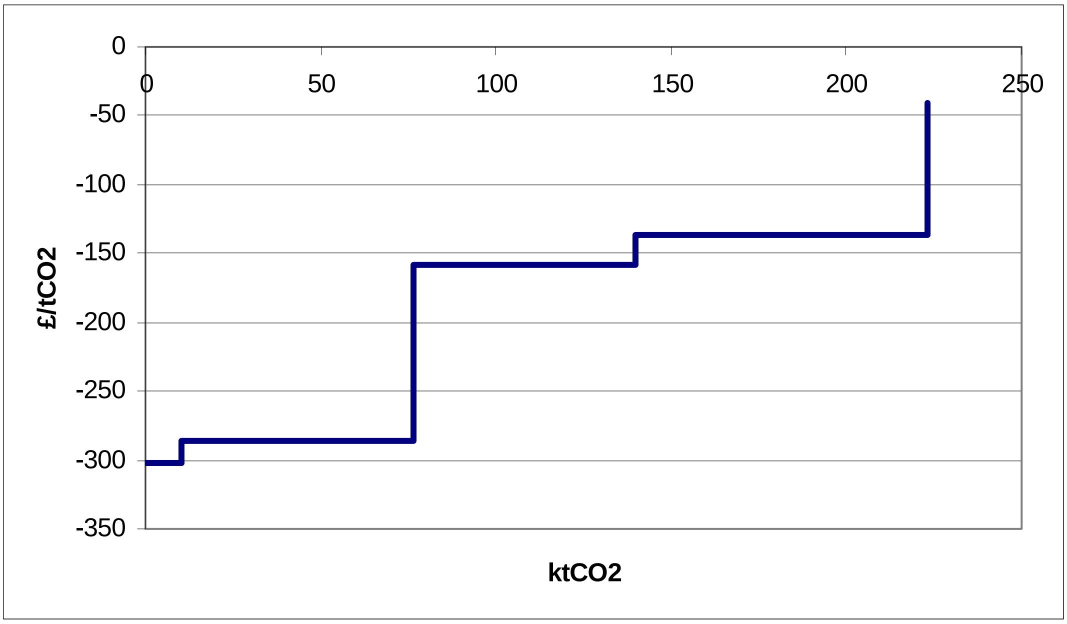
CHP MACCs were added to the industry and non-domestic buildings MACCs to reflect the abatement potential from installation and generation of combined heat and power. Abatement potential discussed subsequently in this study refers to the total available abatement including CHP (unless stated otherwise).

Figure 4.3: CHP MACCs for the industry and services sectors.

Industry



Services



4.5 Total abatement in the CRC sector

As we have seen for industry and non-domestic buildings, total abatement in the CRC sector is a function of the price of carbon. The total emission reduction that could be realised at a benefit to the sector (with a net cost of zero or below), is 11.6 $MtCO_2$. The maximum ‘technical’ abatement indicated by our modelling (taking the best estimate for non-domestic buildings) is over 16 $MtCO_2$; however, for this to be realised a very high carbon price would need to be established.

Available abatement in the CRC is presented for a comprehensive range of carbon prices in Chapter 6 following discussion of cap-setting criteria.

The abatement potentials presented here are derived from the same models and so to that extent are consistent with the composite MAC curves for energy end use emissions abatement in industry and non-domestic buildings, and for CHP, reported by the CCC. The following sections therefore discuss the potential identified here, firstly with CCC estimates for abatement in the industry and non-domestic buildings sectors, and secondly with previous government estimates of abatement by the CRC.

4.5.1 Realistic potential

Non-price barriers have been described previously (see Carbon Trust, 2006) and have the potential to reduce the uptake of cost-effective abatement potential. Examples include:

- Intangible, transaction and transition costs, which would include risks of incompatibility, delivery, or ongoing management/supervision time.
- Market or system failures, which can prevent organisations from benefiting from investment in abatement measures, such as a landlord/tenant split.
- Behaviour and motivation within organisations, for example that of the person responsible for upgrading equipment may be focussed on lowest capital cost at odds with the focus of the energy manager.

The CCC concludes that all these barriers can be tackled by a suitably designed policy framework, which creates price incentives for cost-effective abatement by establishing an appropriate carbon price and also addresses non-price barriers through regulation, information and support for technology deployment.

The CRC is specifically designed to challenge behaviour in participant organisations, through the direct financial lever of an effective carbon price (through the imposition of a suitable cap) and also to leverage an organisation's reputational drivers through emissions reporting and performance ranking.

The CCC concludes that for sectors covered by the CRC, the policy framework will enable all technical potential to be realistically achieved. In this respect, caps should be set for the CRC to ensure this conclusion becomes reality. However, there is further complexity since the MACCs calculated do not provide information on the timescale over which abatement will be delivered. From a policy perspective, the timescale is important. With respect to the conclusion that under the CRC all technical potential may be met, this will require a sufficient length of time for abatement measures to be implemented and the abatement potential accumulated.

Some understanding of the trajectory for implementation of abatement measures can be gained from direct consultation or from econometric modelling. Decision makers and organisations affected by the policy can offer their insights into how and when measures may be taken up under different policy scenarios. Alternatively, econometric models can be employed to demonstrate how a system will respond to policy levers, including the time-dependent uptake of abatement measures. Work undertaken by NERA and Enviros for the Partial Regulatory Impact Assessment arrived at an uptake trajectory for delivery of CRC abatement potential, however, it is unclear what the basis for this curve was, e.g. modelling or judgment. We do not extend our analysis to consider the abatement uptake trajectory and have chosen to conduct the rest of our analysis in terms of technical abatement potential. Our approach therefore remains broadly consistent with the CCC approach of identifying UK abatement potential.

4.5.2 Decarbonisation of UK electricity

As has already been mentioned in the previous chapter, our projections of energy use emissions from the CRC sector exclude the impact of decarbonisation of the UK's grid average electricity supply. This also has implications for the abatement potentials generated here.

The CCC has an ambition (their 'stretch ambition') that if all the required measures are in place, by 2020, the carbon intensity of electricity generation could fall by 50 per cent from current levels (Committee on Climate Change, 2009). In this event, the abatement potentials presented in this chapter would overestimate the abatement available in the CRC in the years leading up to 2020 because any reduction in electricity use in the years leading up to 2020 would be reducing electricity with lower embedded carbon than the present day values used here.

The abatement potentials calculated here are made up of fossil fuel demand reduction measures, renewable heat generation measures and combined heat and power generation measures, in addition to electricity demand reduction measures.

At a net cost of zero or below, these components make absolute and relative contributions to the total emission reduction potential as shown in Table 4.3. Renewable heat is included in the services column of the table.

Table 4.3: Breakdown of contributions to abatement potential by fuel source and sector.

	Industry	Services	CHP
Indirect ($MtCO_2$/yr)	1.19	4.97	
Direct (MtCO2/yr)	1.18	3.86	
Total (MtCO2/yr)	2.37	8.83	0.36
Indirect	10.3%	43.0%	
Direct	10.2%	33.4%	
Total	20.5%	76.4%	3.1%

Indirect contributions refer to electricity demand reduction and direct contributions refer to fossil fuel demand reduction

For this reason and the time dependency of the decarbonisation of the electricity mix, the reduction in abatement potential would be less than the 50 per cent fall in electricity carbon intensity. The maximum adjustment for decarbonisation would only result if the 50 per cent reduction in carbon intensity of electricity generation were achieved in 2012. An alternative scenario is to assume carbon intensity of electricity falls linearly to the 50 per cent lower level in 2020. In the latter case, 17 per cent decarbonisation would be achieved in 2012. The impact of these levels of decarbonisation are shown in Table 4.4.

Table 4.4: Impact of decarbonisation on abatement estimates.

Reduction in carbon intensity cf. current	Indirect (MtCO2/yr)	Total (MtCO2/yr)
0%	6.16	11.56
17%	5.11	10.51
50%	3.08	8.48

For 50% decarbonisation of electricity generation in the year 2012, CRC abatement potential calculated here would be reduced by around 27%. Taking linear decarbonisation would yield CRC abatement around 9% lower than calculated here.

Electricity is an expensive commodity relative to direct energy sources; however, it also has a relatively high emission factor. It is reasonable to assume that measures targeting electricity consumption may be distributed across the cost curve. So, to a first order, we suggest that the impacts of overestimation would not be felt more excessively below any particular carbon price. Decarbonisation of electricity would, however, have greater significance for the non-domestic buildings sector than the industry sector, since electricity use forms a larger proportion of energy use emission in non-domestic buildings.

For the purposes of this study, investigating cap-setting for the CRC, the abatement potentials modelled excluding decarbonisation of UK electricity are a valid starting point. Further work will be needed to determine the actual abatement from the CRC that can be counted towards the UK's carbon budgets.

4.5.3 Committee on Climate Change abatement potential

Modelling undertaken for the CCC during the recent energy end use analysis project (AEA, 2008) identified abatement potential for the CRC; this is summarised in Table 4.5. AEA (2008) also used a constant marginal emission factor for electricity in their study.

Table 4.5: CRC abatement calculated for CCC.

	AEA, 2008 ($MtCO_2$/yr)
Baseline - cost-effective at £0/tCO2	7.83
Baseline (realistic potential) - cost-effective at £0/tCO2	7.73

The AEA (2008) study took the conservative calculation of abatement in the non-domestic building sector. Therefore, comparing the results calculated in this study (summarised in Table 4.6) with those from the AEA (2008) work for the CCC, we can see that there is reasonable agreement with the lower value of 9.2 $MtCO_2$ and the realistic potential of 7.73 $MtCO_2$ and much of the difference can be accounted for in the increased CRC coverage calculated and used in this study.

Table 4.6: Summary of abatement calculated in this study.

Cost effective at £0/tCO2	Original ($MtCO_2$/yr)
Upper	13.82
Best	11.56
Lower	9.20

The CCC does not publish values for the abatement potential of the CRC instead publishing values for abatement in 2020 across the industry and non-domestic buildings sectors in total and covered by the EU ETS, CCAs and CRC collectively.

Total technical abatement at zero or negative cost for the non-domestic building sector is 11 $MtCO_2$ in 2020 whilst industry could technically deliver 7 $MtCO_2$ cost effective at £0/tCO_2. The CRC abatement potential is calculated by summing the product of subsector coverage and subsector abatement potential across all CRC subsectors. The CCC does not publish information on the subsector breakdown of abatement and therefore it is not possible to construct CRC abatement potential from their published results.

4.5.4 Government estimates of CRC abatement

Previous CRC literature from the government (such as Defra, 2007) has suggested that the CRC could deliver 1.8 $MtCO_2$ reduction each year from 2010 to 2015, rising to 4.4 $MtCO_2$/year in 2020. The quoted Government values represent the total annual CO_2 reductions which were believed to be deliverable, according to an abatement potential uptake trajectory defined by NERA/Enviros (2006). These figures are therefore lower than the technical potential (i.e. the total abatement available) identified in the scheme. NERA/Enviros (2006) identified the technical abatement potential to be around 7.5 $MtCO_2$/yr after 5 years of the scheme (at or below a carbon price of zero). In this study, a total 'best estimate' technical abatement of 11.6 $MtCO_2$ at zero or negative cost in 2012 is estimated. As this figure is the technical abatement potential it does not represent what would realistically be achieved in 2012. It is likely that it would take a number of years to achieve these levels of annual abatement.

There are several reasons that may account for the greater abatement potential identified in this study. Government forecasting of fuel prices and economic growth (industrial output) have been updated since the government CRC estimates were made. Since projected fuel prices are likely to be higher in more recent BERR projections, the associated abatement potential is likely to be greater. Finally, the models used to derive the government estimates were different to those used here. Therefore, both the measures considered and the financial profiles of those measures (for example, inclusion of hidden costs) can be expected to be different. The MACCs generated can also be expected to be different. In addition, the estimated emissions coverage of the CRC has been expanded in this study as compared to previous estimates, which can be expected to result in greater abatement potential than for lower coverage estimates.

4.5.5 Comparison summary

In summary, the CRC abatement potential calculated in this study agrees reasonably with previous estimates, which particularly in the case of AEA (2008) took the conservative abatement potential for non-domestic buildings, in line with the lower estimate calculated here.

We suggest that much of the difference between the studies can be explained by the increased CRC coverage in this study, which accounts for around 10% more emissions. Table 4.7 summarises the results of this study and those published previously.

Table 4.7: Summary of CRC abatement potentials for this and previous assessments.

Cost effective at £0/tCO2	This study (MtCO2)	AEA, 2008	NERA/Enviros, 2006
Upper	13.82		
Best	11.56		
Lower	9.20	7.73	7.50

5 Cap setting

Cap or target setting for emission trading schemes is firstly dependent on whether the scheme is a cap-and-trade scheme, with an absolute cap on total emissions that can be produced by those covered by the scheme, or a rate-based system, in which an emission intensity target exists (tonnes of CO_2 per unit output). The CRC is classified as a cap-and-trade scheme and so the following paragraphs discuss cap setting in such schemes.

Distinction should be drawn between the scheme cap and allocation methodology, or the method by which emission allowances are distributed to participants. In practice, however, the two can appear to be linked since the cap is imposed through the allocation. Distribution of allowances can be free of charge or at a cost to the emitter, or a combination of both. There are typically two methods for allocating emission allowances free of charge:

- Grandfathering: Allowances are allocated, or distributed, based on each source's historic emissions. Grandfathering was and is employed by most EU Member States (MS) for EU ETS Phase I and Phase II allocations in most sectors. A cap is imposed in a grandfathered allocation scheme by reducing the allocation as allowances are limited to a proportion of historic emissions.

- Benchmarking: Allowances can also be distributed based on the average or expected performance for the sector as a whole (such as tonne of emissions per unit of output). Typically, benchmarks can be agreed through industry sector organisations and may reflect best available technology (BAT) or practices within a sector. Each participant's output is multiplied by the benchmark factor to establish the number of allowances it should receive. Participants whose emissions per tonne of product are greater than the benchmark would need to purchase allowances to cover the surplus emissions generated. Benchmarking is therefore a form of cap since the benchmarks establish the rate at which allowances are awarded; the use of a production figure means that in isolation, benchmarking does not provide a sure cap on emissions. It can, however, be used to distribute a fixed sector cap, and has been used in this manner to distribute free allowances to new entrants into Phase II of the EU ETS.

Auctioning provides a mechanism for government to sell allowances to eligible entities, which for the introductory phase of the CRC will be limited to participating organisations. Under an auctioning scheme, participants acquire allowances to cover their emissions, based on their projected future emissions and abatement costs. Auctioning redistributes some of the income generated by emissions trading to the government, who can then recycle funds back to participants indirectly through tax cuts or investment in clean technologies, or in the case of CRC directly to participants weighted by their performance in the scheme.

For the CRC, allowances will be distributed entirely through auctioning. Therefore, the cap will be imposed by limiting the number of allowances sold in the auction. Government has decided that, in order to facilitate the smooth introduction of the scheme, that the first compliance year of the Introductory Phase will be a reporting-only year. In April 2011 Participants will have to buy allowances to cover the year 2011/12. Sale of allowances will be through a fixed price auction and there will be no limit on the number of allowances sold, that is, there will be no scheme cap during this introductory phase.

From 2013, sale of allowances will take place as a sealed bid uniform price auction. In this design each participant would submit a bid schedule to the scheme administrator specifying the number of allowances they wish to purchase at different allowances prices. The administrator will then aggregate the demands across all participants. The allowance price which most closely matches the total number of allowances available (the cap) will set the market clearing price and each participant will be sold the number of allowances they requested at that price. However, the auction process could itself impose a cap on the number of allowances sold, if participants decide to bid for less than their expected demand and the aggregate demand for allowances across all organisations is less than the cap. A worked example below shows how the sealed bid uniform price auction will operate.

In a scheme with three participating organisations A, B and C, BAU projected emissions for the coming scheme year are 1,000 tCO_2. In this example the government is aiming to achieve a 10 per cent reduction and will therefore cap allowances in the market at 900 tCO_2. The bid schedule for each organisation are shown in Table 5.1 for allowance prices from 10 to 60 £/tCO_2. The sum of the schedules yields a demand curve for allowances against price. It can be seen in this example to impose this cap, the market clearing price will be 40 £/tCO_2 and organisation A will receive 450 allowances, B 350 and C 100.

Table 5.1: Hypothetical bid schedules for a CRC sealed bid uniform price auction.

Allowance price (£/tCO_2)	A	B	C	Total
10	600	500	200	1300
20	550	420	180	1150
30	500	400	150	1050
40	450	350	100	900
50	400	300	80	780
60	300	240	50	590

We can also see that in an alternative situation where A, B and C decided to put lower bid schedules (relying on the ability to purchase allowances from the secondary market or through the safety valve), if the total demand for allowances is less than 900 for the lowest carbon price, the scheme participants will impose a cap of more than 10 per cent reduction.

5.1 Cap setting in the CRC

The cap to be applied for each CRC phase will take into account many factors. In the first instance, an absolute emissions cap could be set according to environmental need, that is, an emissions target that would enable certain environmental impacts to be avoided. A further factor may be the cost of achieving a given environmental goal, since one would not want to impose costs far in excess of the benefits of reduced emissions. However, in a situation where multiple policy measures are applied for various sectors, as we find in UK climate policy, the position becomes more complex. Cap setting then becomes a decision about the relative effort to be undertaken by various sectors of the economy. In this respect the level of individual sector abatement opportunities becomes a factor. Also important will be whether business sectors within the scheme could be placed at a competitive disadvantage relative to those that are outside that scheme.

The following sections consider the issues raised in the previous paragraph. Since caps will be set for each five-year trading period, the first starting in April 2013, we are concerned with the level of the CRC cap and not the length of the capped period.

5.1.1 Environmental need

The CCC aims to establish carbon budgets consistent with the goal of limiting global average surface temperature change at or close to 2°C, which would require limiting the atmospheric concentration of GHGs to less than 500 ppm. The Climate Change Act establishes a target of at least a 26% cut in carbon dioxide from 1990 levels by 2020 (to be modified to cover GHG emissions) and an 80% GHG emissions cut by 2050. The CCC recommended in December 2008 an interim budget of 29% reduction in CO_2 (34% reduction in GHGs) on 1990 levels by 2020, assuming no international agreement is in place. If a global agreement to reduce emissions is reached, the CCC recommends an ‘intended budget’ based on around 40% reduction in CO_2 (42% reduction in GHGs) in 2020 relative to 1990.

Furthermore, the EU has established an annual emissions reduction for the EU ETS of 1.74 per cent for Phase III of the scheme, equating to a cut of about 21 per cent to 2020 compared with 2005 levels. This is intended to ensure the sector makes a significant contribution to the EU’s 20 per cent emissions reduction target for 2020.

These targets put into context the level of emissions reductions that could be sought from the CRC sectors.

5.1.2 Cost effectiveness

Whilst the overarching emissions targets described above guide the objectives of the CRC, it is necessary to review the overall cost effectiveness of the scheme, taking into account costs and benefits of the likely abatement measures including the shadow price of carbon (SPC). If the net present value (NPV) were to be negative with the shadow price of carbon factored in, the level of cap would not appear cost-effective.

In this respect, the interaction with the EU ETS is important. It will be possible to purchase allowances from the EU ETS, European Union Allowances (EUAs), via the CRC scheme administrator, which can be converted into CRC allowances for use in the CRC. This safety valve limits the costs arising from the CRC cap since it limits the CRC allowance price to that of the EU ETS and consequently avoids the need for more expensive abatement than would otherwise be required from CRC participants. For CRC caps that trigger significant use of the safety valve, therefore, the cost of meeting CRC emissions targets will not be determined by the CRC abatement curve but by that for the EU ETS.

There are two further consequences of this. Firstly, once the CRC safety valve is applied to the scheme the overall cost to participants of purchasing allowances would not be recycled, since funds paid for EU allowances acquired in this way would go to EU ETS operators and not the UK government. This means participants as a whole would be worse off. Secondly, the value of the EU allowances purchased would not necessarily remain in the UK, which would decrease the overall cost effectiveness of the scheme for the country. Both of these points suggest setting the CRC cap at a level that avoids significant use of the EU ETS safety valve by establishing a price for allowances that is not dissimilar to the EUA price. If the CRC allowance price were substantially higher than the EUA price, an artificial price floor would need to be applied to the safety valve. In reality, the price of allowances purchased through the safety valve will be higher than the price of EUAs, since it will include the Environment Agency's administration costs and broker fees.

5.1.3 Effort sharing

With multiple independent climate change policies, it will be necessary for the UK government to consider the distribution of emission reduction targets to be applied for each measure. In principle, lowest cost abatement for the UK as a whole would be achieved where the effective carbon cost for each measure was the same (taking account of administrative costs) and trading between measures was allowed. Since we are concerned here with the cap to be applied to the CRC, with other policies treated as fixed, we require the CRC marginal cost of abatement to not significantly exceed the equivalent cost for abatement within other policies (such as the carbon emissions reduction target for energy suppliers to the domestic sector or climate change agreements in the industrial sector).

This approach would also be consistent with the issue raised in Section 5.1.2 on the CRC safety valve with the EU ETS (which suggests not setting the CRC cap at a level that would otherwise lead to an abatement cost greatly in excess of the EU ETS allowance price).

It is noted that guidance published by the government in July 2009 (Carbon Valuation in UK Policy Appraisal: A revised approach) indicates that differing prices for the traded and non-traded sectors are advised for policy appraisal. This study specifically looks at valuing carbon in policy appraisal however if a similar valuation was used for the CRC allowance price then this would be likely to exceed the EU ETS price and therefore result in excessive use of the CRC safety value mechanism. This is discussed further in section 6.2 and 7.3.5.

In addition to the abatement costs described above, other factors may need to be taken into account when determining the distribution of effort between policies. The impact of measures on particular sectors of society may be relevant; for example, it may be desirable to shelter the fuel poor from the direct impact of policies (suggesting a focus on industrial or commercial emissions). By analogy, the European Parliament recognised GDP/capita in its decision on effort sharing on non-EU ETS sectors.

Finally, sector targets will be relevant. For example, in the current EU Energy and Climate Package the UK will be required to reduce its greenhouse gas emissions from non-ETS sectors by 16 per cent by 2020 compared to 2005 levels. This would mean a less stringent target for these sectors than for the EU ETS sectors, which would imply a lower burden on CRC relative to EU ETS.

5.1.4 Competition from outside the scheme

As has been highlighted with the EU ETS, the imposition of a carbon price to sectors that operate in competition with those outside the scheme raises concerns about competition impacts, since those within the scheme are not able to pass on to customers the additional carbon costs. The net effect of this is argued to be a reduction in profits, the transfer of production outside the carbon zone (carbon leakage) and ultimately the closure of industries in locations with long-standing histories, with all that this entails.

Some important differences between the EU ETS and CRC should be borne in mind:

- The CRC will be revenue neutral to the exchequer and, noting the caveats on the safety valve discussed above, may therefore be broadly revenue neutral to participants taken as a whole, although individually some will gain whilst others will lose. It may therefore be argued that the CRC will not necessarily place the CRC sector at a disadvantage relative to:

  - UK companies not covered by the CRC.
  - Overseas companies not covered by the CRC.

- The EU ETS covers power generation, which in the UK can pass on much of its carbon costs leading to indirect carbon impacts for electricity intensive consumers. By analogy any industry supplied by a CRC sector may experience the effects of CRC carbon cost pass-through. However, it is not clear whether this pass-through or its effects would be significant.
- Notwithstanding the above, it is possible that CRC sectors with low likelihood of profiting from the scheme could be placed at a competitive disadvantage relative to those outside the scheme. The effect would be greatest for energy intensive sectors undergoing significant growth or with limited opportunities for energy savings. The telecommunications sector is a pertinent example.
- Finally, the CRC will not treat commercial sectors differently (unlike sector allocation in the EU ETS). A single cap will apply for all sectors, without disaggregation; therefore any attempt to moderate the cap in response to sector-specific competitiveness concerns will inherently be limited in its effect.

5.1.5 Emissions baselines

Emissions reduction targets can simply be expressed (and derived) in relation to an historic baseline. For example, energy package national non-EU ETS sector targets have been set in relation to 2005 emissions. However, in setting CRC caps it may be preferable to assess CRC and non-CRC sectors on a business-as-usual basis and then determine relative reduction efforts against these, as a means of accurately distributing future effort. The benefit of doing so is that it is then possible to determine the additional contributions from policy measures affecting each sector. Importantly, however, this approach requires abatement curves to be determined on a business-as-usual basis. Business-as-usual projections could recognise:

- Economic growth (or decline) within CRC and non-CRC sectors.
- The impact of fuel price projections on energy mix within CRC and non-CRC sectors.
- Developments in the efficiency of energy use in CRC and non-CRC sectors (including new technologies).
- The impact of other existing policy measures

This last point is important and raises a particular issue regarding the overlap between EU ETS and CRC. There is an overlap in emissions associated with the electricity industry between the two schemes; electricity generation is covered by the EU ETS and the consumption of (some of) that electricity is covered by the CRC. The CRC caps should be set on the basis of the emissions reduction sought from the scheme in addition to those that would arise from the EU ETS.

However, the proposed CRC scheme design largely takes account of this issue, since it is proposed to fix the emissions factors for annual reporting within each CRC phase.

This means any reductions (or increases) in the emission factor for electricity supply would not appear as reductions (or increases) in the emissions reported under the CRC, within each phase. The benefit of this is that the savings reported under CRC are broadly accurate; however, the absolute level of emissions calculated in the scheme will be subject to error. To minimise any accumulation of uncertainties, the emissions factors for annual reporting and cap-setting baselines should be updated every phase, as is planned.

5.2 CRC cap-setting criteria

In summary, we find a number of issues relevant to the cap-setting process:

- As an environmental policy, primary consideration must be given to the environmental objectives. Domestic 2020 targets recommended by the CCC and the EU objectives for the same period would appear most relevant to the forthcoming CRC phases.
- Emissions reductions must be seen as cost-effective, therefore for the CRC sector the NPV taking account of the SPC should not be negative.
- Consideration must be given to the level of effort between sectors covered by each policy instrument. Under the EU energy package, the UK will have a reduction target for non-EU ETS sectors of 16 per cent by 2020 compared with 2005 figures. Notably this is lower than the overall EU ETS target for the same period. The distribution of this between UK domestic measures should take account of abatement costs across the economy, to ensure lowest cost overall. The CCC recommends emission reduction effort over the first three budget periods be split 70/30 per cent between the traded/non-traded sectors.
- The effect of the CRC on the competitiveness of its participants may be a factor. However, this should be moderated by the fact that the scheme will be revenue neutral to the exchequer and that it is not possible to apply sector level caps within the CRC.
- Business-as-usual projections to inform the distribution of effort between sectors covered by the CRC and those covered by other policy instruments should take account of factors as listed in Section 5.1.5.

6 CRC caps and allowance prices

Caps for the CRC will be established for each five-year trading period starting from April 2013. As already discussed in Chapter 5, the scheme cap will be implemented at the auction stage by the CRC administrator (the Environment Agency), who will calculate and put in place an auction clearing price, based on scheme participant bid schedules, that limits the number of allowances sold to the level of the cap. The way in which the scheme cap will be expressed, as an absolute or relative to projected emissions, has not been established by government. A relative baseline would seem more likely since it gives government more scope to adjust allowance supply according to changes in projected emissions between years, for example during periods of economic slowdown.

Since the abatement curves we calculate here demonstrate the ‘technical’ potential for emission reductions for the year 2012 looking forward, we do not comment on the level of cap for each five-year period. Rather, we suggest the level of carbon price that might be necessary to enable appropriate investment decisions to be made and the level of carbon savings that might be realised as a result. Although we recognise that within the CRC, the allowance price does not represent the true carbon price, since the revenue recycling function returns to the allowance purchaser a proportion (greater or lesser) of the expenditure on allowances for compliance. It is yet unclear what price signal CRC participants will respond to, the initial expense generated by the CRC allowance price or the cash flow implications of being separated from that quantity of money between allowance purchasing and revenue recycling. For the purposes of this report, we are assuming the CRC allowance price represents the true carbon price seen by participants as is the case of the EUA in the EU ETS.

This chapter will build on the cap-setting criteria discussed in Chapter 5 to consider possible allowances prices for the CRC. The summary of cap-setting criteria noted that some issues were more important than others and that not all were mutually consistent. Within the scope of this project it has not been possible to consider all the criteria and we have therefore focussed on the two most significant issues, those of environmental effectiveness and cost effectiveness.

6.1 Environmental effectiveness

The targets that any cap for the CRC should be consistent with are:

- The CCC’s target of reducing CO_2 emissions by 29 per cent by 2020 against 1990 levels, in the absence of an international agreement. If an international agreement is reached, the target should be extended to a 40 per cent CO_2 reduction.

- The UK’s responsibilities under the EU’s goals to reduce greenhouse gas emissions to 80 per cent of 1990 levels by 2050. Specifically for the relevant non-ETS sector, this translates to achieving 16% lower emissions in 2020 compared to 2005 emissions.

6.2 Cost effectiveness

Cost effectiveness with the inclusion of the SPC is listed as one of the criteria for cap setting. The importance of this criterion follows from the definition of the SPC. The SPC estimates the sum of all future damage costs resulting from each new unit of greenhouse gas emitted, assuming that the global emission trajectory is on target to meet a goal of stabilisation at 450 to 550 ppm CO_2e. Note that there is substantial debate over the SPC. This focusses particularly on the selection of an optimal stabilisation goal and uncertainties in the science which enable damage costs associated with atmospheric GHG levels to be calculated (see Ekins, 2007; Watkiss, 2007). .

Therefore, if the relative cost of an abatement measure is greater than the SPC, the abatement provided by that measure in effect is more expensive to society than the damage that would result if greenhouse gases were not abated.

This criterion could therefore be met by basing any cap for the CRC on the SPC. The SPC is valued at £25.5/tCO_2e in 2007, increasing by two per cent each subsequent year. The average value for the SPC over the period 2013 to 2022 is thus £31/tCO_2e and we will investigate the use of this value as a possible cap-setting price for further analysis.

In July 2009, Government published its revised approach to valuation of carbon for policy appraisal (DECC, 2009). Following review of the social cost of carbon (SCC), this approach is based on the estimated abatement costs that will need to be incurred to meet specific emission reduction targets. Since separate, independent and non-fungible emission reduction targets are established for the traded (EU ETS) and non-traded sectors in the UK separate costs are calculated for the two sectors. For appraising policies that affect non-traded sector emissions, the non-traded price of carbon in 2012 is valued at £53/tCO_2 (± 50%) rising by £1/tCO_2 each year subsequently. The average non-traded carbon price over the period 2013 to 2020 is therefore £57/tCO_2.

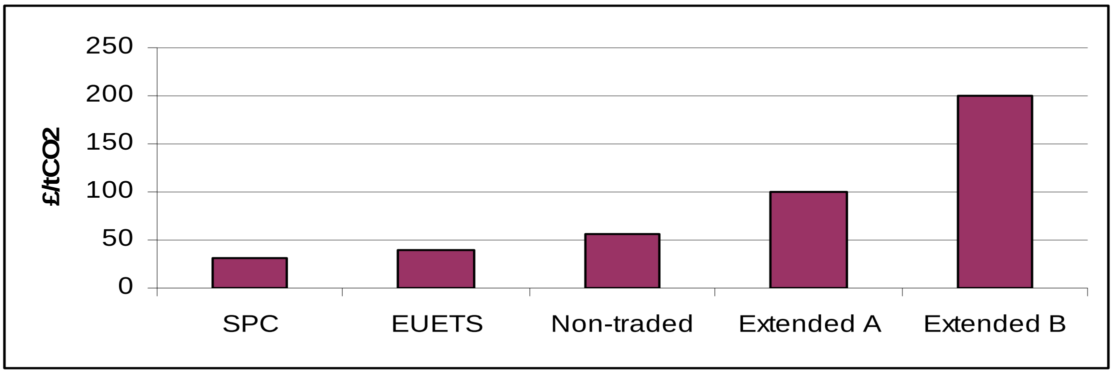
A similar piece of reasoning applies to the non-traded carbon price as for the SPC. If a policy delivers abatement at a cost below the non-traded carbon price, then the policy is delivering emissions reductions from the low cost potential in the UK economy and hence is cost-effective. In light of this new approach to carbon valuation, the cost effectiveness criterion could therefore also be achieved by basing the CRC cap on the non-traded price of carbon over the CRC period.

Alternatively, Section 5.1.2 discussed the importance of establishing a CRC allowance price that is reasonably consistent with the EU ETS allowance price (or at least not substantially greater than that value). We therefore propose as an alternative to the SPC, a CRC cap could be established based on the EU ETS allowance price.

The CCC used the forecast EU ETS carbon price as a basis for analysing greenhouse gas abatement under its current ambition scenario (CCC, 2008). The carbon price it established was based on EU ETS price projections from the DECC EU ETS marginal abatement model. For consistency with the CCC's budget setting advice, we use the same projected sterling EUA prices, £40/tCO_2. However more recent projections from the CCC suggest that the EUA price could be much lower, at approximately £20t/CO_2 (this value was not modelled as it was not known at the time of modelling)

Here we consider the cost-effective abatement realised without a carbon price and against carbon prices including the SPC, non-traded carbon price and projected EU ETS price. In addition, we consider the implications of caps based on extended carbon prices up to £200/tCO_2. The caps considered here are shown in Figure 6.1.

Figure 6.1: Possible future allowance caps analysed in this study.



6.3 Allowance prices and caps

Taking the allowance prices presented in Figure 6.1 and applying them to the MACCs demonstrates the level of cost-effective emission reduction that could be realised for each (Table 7.1). Our modelling suggests that there is currently 11.6 $MtCO_2$ of cost-effective 'technical' abatement in the CRC without the imposition of any carbon price. This abatement would represent a reduction of 21 per cent against BAU CRC emissions projected for 2012. Cost-effective abatement including the SPC rises to 11.9 $MtCO_2$, and the projected EU ETS carbon price, would realise a further 10 $ktCO_2$ beyond that. As the carbon price rises beyond £40/tCO_2, the carbon saving become asymptotic, yielding diminishing returns of abatement against cost.

The final column of Table 6.1 shows potential reduction against 1990 emissions (64 $MtCO_2$ see Section 3.3.1); however, this should be analysed with caution. The most important caveat for these results is that the timescale of delivery of technical abatement is uncertain, therefore the potential reductions against 1990 are tentative and illustrative. They show the percentage reduction should all the annual cost-effective 'technical' abatement suggested by our MACCs be taken up by 2020. Although the trajectory of uptake is uncertain, as measures are implemented over time, the level of 'secured' abatement accumulates and the proportion of the cost-effective 'technical' abatement identified in 2012 increases. The one caveat to this concept is if some measures have a lifetime shorter than nine years; in this case, they could need re-implementation for the abatement to remain secured.

Generating a carbon price of £40/tCO_2, equal to the projected EU ETS price, could bring a reduction of 29 per cent against 1990 levels in the CRC sectors. The curve of potential reduction follows the total abatement curve and becomes asymptotic with increasing carbon price.

Based on these results, it is argued that CRC caps be set based on the projected EU ETS carbon price. Taking such an approach would provide:

- consistency with the budget setting approach used by the CCC;
- consistency between the CRC and current projections for the EU ETS trading sectors;
- a significant effort towards meeting the key environmental effectiveness goals of the scheme; potentially providing more than 20 per cent reduction against 1990 levels.

Table 6.1: CRC allowance prices and cost-effective abatement.

£/tCO2	Cost effective abatement (Mt CO2)			Proportion of 2012 emissions	Potential reduction against 1990 emissions
	Industry	Services	CRC Total		
0	2.50	9.06	11.56	21.0%	28.09%
31	2.60	9.30	11.90	21.6%	28.62%
40	2.61	9.30	11.91	21.6%	28.63%
57	2.64	9.30	11.93	21.7%	28.67%
100	2.73	9.30	12.03	21.9%	28.83%
200	2.74	9.44	12.18	22.1%	29.07%

7 GHG, financial and policy implications of CRC caps

Carrying forward the CRC caps discussed in Chapter 6, in the following sections we discuss the implications of those caps.

7.1 GHG implications

The overall GHG impact of CRC caps has been outlined in Chapter 6 both in absolute terms and, tentatively, in terms of delivery against 1990 values. However, a striking aspect of Table 7.1 is the disparity in delivery of abatement between the industry and non-domestic buildings sectors. Around 75 per cent of the total CRC abatement is projected in our calculations to be met by the non-domestic buildings sector. This is of interest for the Environment Agency as the scheme administrator, and here we disaggregate the abatement delivery further to indicate how much abatement exists in the CRC subsectors under the possible CRC cap prices.

Figure 7.1: Cost-effective abatement in each CRC subsector at a carbon price of £40/tCO_2 as a proportion of subsector projected CRC emissions in 2020 (non-domestic buildings subsectors in red, industry subsectors in blue).

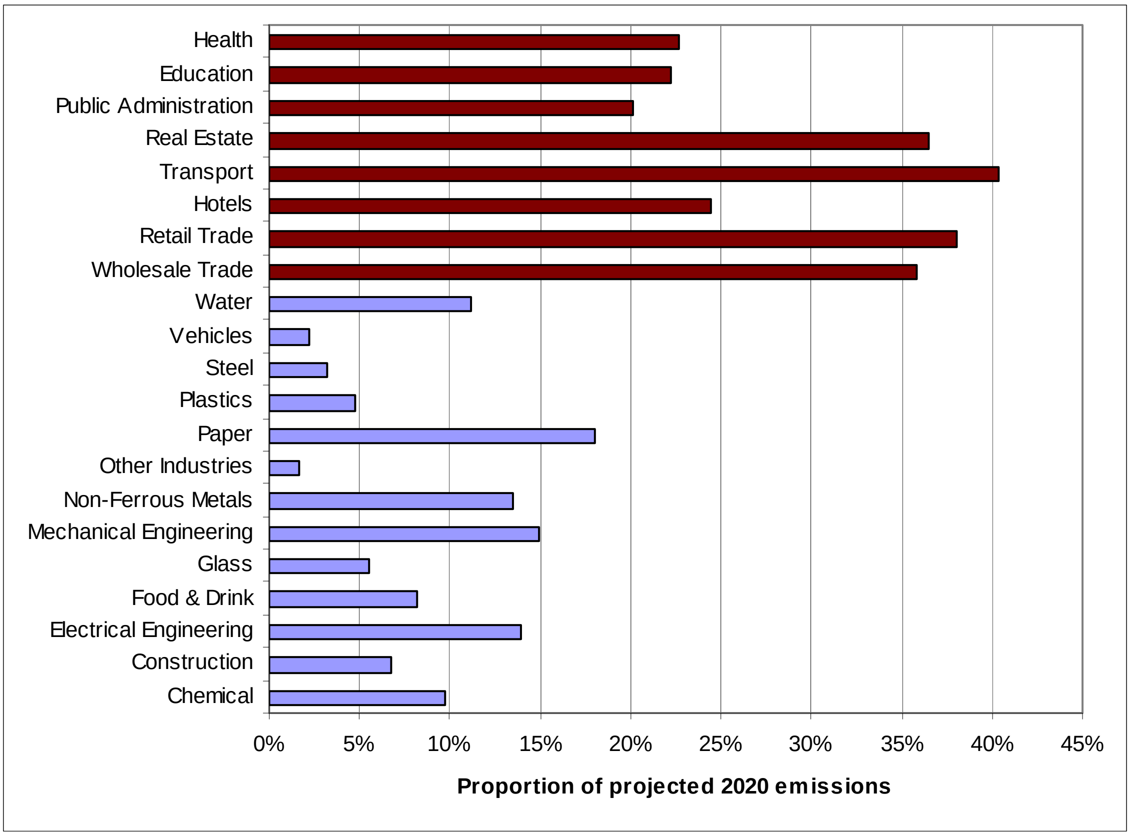


Table 7.1: Cost-effective abatement in the industry subsectors in absolute terms and as a proportion of 2020 emissions.

		Chemical		Construction		Electrical Engineering		Food & Drink		Glass		Mechanical Engineering		Non-Ferrous Metals	
2020 emissions (Mt)		1.97		0.19		1.20		1.17		0.33		2.92		0.42	
		Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020
£/tCO2	0	0.19	9.7%	0.01	6.8%	0.17	13.9%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%
	31	0.19	9.7%	0.01	6.8%	0.17	13.9%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%
	40	0.19	9.7%	0.01	6.8%	0.17	13.9%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%
	57	0.19	9.7%	0.01	6.8%	0.17	13.9%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%
	100	0.19	9.7%	0.01	6.8%	0.17	14.0%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%
	200	0.19	9.7%	0.01	6.8%	0.17	14.0%	0.10	8.2%	0.02	5.5%	0.44	15.0%	0.06	13.5%

		Other Industries		Paper		Plastics		Steel		Vehicles		Water	
2020 emissions (Mt)		3.96		2.41		4.26		5.60		3.00		3.94	
		Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020	Mt CO2	% of 2020
£/tCO2	0	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.18	3.2%	0.07	2.2%	0.44	11.1%
	31	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.18	3.2%	0.07	2.2%	0.44	11.1%
	40	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.18	3.2%	0.07	2.2%	0.44	11.1%
	57	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.18	3.2%	0.08	2.6%	0.44	11.1%
	100	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.26	4.6%	0.08	2.7%	0.44	11.1%
	200	0.07	1.7%	0.43	18.0%	0.20	4.8%	0.27	4.7%	0.08	2.8%	0.44	11.1%

Table 7.2: Cost-effective abatement in the non-domestic buildings subsectors in absolute terms and as a proportion of 2020 emissions.

		Wholesale Trade		Retail Trade		Hotels		Transport		Real Estate		Public		Education		Health	
2020 emissions (Mt)		5.02		7.19		4.80		0.17		1.21		5.71		0.34		0.8	
		Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020	Mt CO_2	% of 2020
£/t CO_2	0	1.63	32.49%	2.42	33.64%	1.06	22.01%	0.06	35.12%	0.41	33.71%	1.08	19.01%	0.07	20.43%	0.16	20.55%
	31	1.80	35.80%	2.74	38.09%	1.17	24.40%	0.07	40.31%	0.44	36.50%	1.15	20.14%	0.08	22.25%	0.18	22.63%
	40	1.80	35.80%	2.74	38.09%	1.17	24.40%	0.07	40.31%	0.44	36.51%	1.15	20.14%	0.08	22.25%	0.18	22.64%
	57	1.85	36.78%	2.78	38.63%	1.20	25.03%	0.07	40.72%	0.45	37.51%	1.19	20.94%	0.08	23.00%	0.19	23.46%
	100	1.85	36.87%	2.79	38.76%	1.21	25.18%	0.07	40.84%	0.46	37.56%	1.20	20.98%	0.08	23.05%	0.19	23.51%
	200	1.89	37.68%	2.84	39.45%	1.24	25.94%	0.07	41.43%	0.46	38.31%	1.23	21.54%	0.08	23.63%	0.19	24.12%

Figure 7.1 clearly shows the non-domestic buildings subsectors contributing a much greater cost-effective reduction relative to their CRC covered 2020 emissions at a £40/tCO_2 price. Table 7.1 and Table 7.2 show this in greater detail for various carbon prices. These also show the greater potential to make carbon savings in the non-domestic buildings sector in absolute and relative terms. The greatest abatement potential in absolute terms is predicted to come from retail trade, wholesale trade, hotels & restaurants and public administration.

In addition, looking at the delivery against carbon price, non-domestic buildings subsectors are more sensitive to the carbon price than industry subsectors. The vehicles and steel subsectors are the only ones to show a change in the cost-effective abatement potential (to two decimal places) as the carbon price moves from £0/tCO_2 to £200/tCO_2. For all other sectors, the measures available in our modelling for energy demand reduction have a high relative cost. This could reflect the fact that low cost abatement measures have already been largely taken or that abatement is costly across most industry sectors. The modelling therefore shows that the non-domestic buildings subsectors possess more mid-range abatement opportunities than the industry sector.

Since MACCs for the sport and leisure and other subsectors could not be constructed (see Section 3.2), the sum of abatement at each carbon price across the subsectors presented in Table 7.2 is lower than the total sector abatement at that carbon price. For example, the total abatement for the services sector is found to be 8.8 MtCO_2 at or below £0/tCO2, whilst the cumulative abatement in Table 7.2 is 6.9 Mt CO_2.

7.2 Financial implications

Up to this point we have not considered the cost to participants in applying caps at the recommended level. In this section, we discuss the costs to the sector as a whole as predicted by the MAC curves.

As has been demonstrated in previous studies, abatement can be undertaken to a certain level at a net benefit to participants; we see in Table 7.3 that the net cost across the CRC of abatement realised at CRC allowance prices up to £200/tCO_2 is negative, implying a benefit to the participant. This benefit is as a result of cost savings through reduced energy use. There is also an income stream resulting from avoided purchase of CRC allowances, and the inclusion of this benefit results in greater benefit for each subsector. Intuitively, with the inclusion of avoided CRC allowances, the net benefit to each subsector increases with increasing carbon price. The win-win situation or emission reduction with a financial benefit is extremely interesting but has sparked debate previously and must, for example, be viewed in the context of other investments that could be made with the same level of spending.

In addition to the cost of abatement, it is interesting to consider the implied capital costs of the measures to deliver abatement. Table 7.3 shows the cumulative implied capital cost of the cost-effective measures for each carbon price for two example sub sectors. In addition it shows how the capital cost of abatement relates to total capital expenditure for each subsector in 2007 (Office of National Statistics, Annual Business Inquiry data - Accessed January 2008). For both retail and wholesale trade, capital expenditure on cost-effective abatement measures represents around 20 and 30 per cent of 2007 total capital expenditure, respectively. In the paper subsector (data not shown in Table 7.3), the total capital cost of cost-effective abatement measures is greater than 80 per cent of the subsector capital expenditure in 2007. Therefore, capital cost of carbon abatement can make up a substantial fraction of current capital expenditure.

Table 7.3: Financial implications of carbon prices on the retail and wholesale trade subsectors.

	Retail trade			
	Net abatement cost	Net abatement cost (including Carbon cost)	Implied capital cost	Fraction of 2007 capital expenditure
£/tCO2	million £			%
0	- 314.45	- 314.45	816.10	22%
31	- 309.78	- 394.64	852.17	23%
40	- 309.78	- 419.28	852.17	23%
57	- 308.13	- 466.40	849.64	23%
100	- 307.25	- 585.83	849.58	23%
200	- 301.10	- 868.15	851.95	23%
	Wholesale trade			
	Net abatement cost	Net abatement cost (including Carbon cost)	Implied capital cost	Fraction of 2007 capital expenditure
£/tCO2	million £			%
0	- 195.83	- 195.83	521.94	29%
31	- 193.44	- 249.18	540.62	30%
40	- 193.44	- 265.37	540.62	30%
57	- 191.35	- 296.67	537.40	30%
100	- 190.95	- 376.15	537.37	30%
200	- 186.16	- 564.72	539.14	30%

With regard to the impact of the current economic climate on cap setting in the CRC, it seems likely that preparations and energy efficiency investments prior to the capped phased of the scheme in 2013 will be most affected. Additionally, the scheme cap will be imposed each year at the auction stage providing more scope for government to adjust the number of allowances into the market to meet expected demand. Government therefore has greater control over the scheme in periods of economic uncertainty during which more dynamic cap setting may be more appropriate than long-term projections.

7.3 Policy implications

There are a number of policy implications of CRC caps as a result of the number of policies and measures in place regarding climate change and renewable energy. We start with a discussion of how the CRC interacts with renewables policy before discussing implications for CCAs and the SPC.

7.3.1 Renewables policy

Renewable heat and renewable electricity will be accounted for in different ways in the CRC. Renewable heat will be zero-rated for emissions, whereas emissions associated with renewable electricity depend on whether ROCs have been claimed for generation of on-site renewable electricity. If they have been claimed, use of the electricity will be counted at the grid average emissions factor. If not, the electricity will also be zero-rated for emissions. In this way the government will distinguish between the influence of the Renewables Obligation and the CRC.

Our current understanding is that the government expects most on-site renewable electricity generation to claim ROCs, which provides a further income stream to that from the sale of the electricity itself. If a stringent cap is applied to the CRC, which delivers high allowance prices, then it would seem reasonable to expect more CRC participants generating on-site renewable electricity not to claim ROCs for the electricity and instead reduce their liability under the CRC. As a result, the CRC would provide an alternative incentive for renewable electricity for scheme participants.

The extent to which the CRC will interact with other policies targeting renewable heat is not yet clear. The government renewable energy strategy is yet to set out in detail how it aims to incentivise renewable heat.

What is clear, however, is that energy demand reduction, on which the majority of our modelling is based, has important implications for the UK's ability to meet the EU's 2020 target; renewable energy should make up 20 per cent of all energy use by this time (15 per cent for the UK). Clearly, any measures put in place prior to 2020 that lead to a reduction in energy demand, have the effect of reducing the capacity of renewable energy generation necessary to meet the target. This interaction is discussed under the government's guidelines for carbon accounting (DECC, 2008), which finds that the avoided costs of renewables would be approximately £18/MWh in 2020.

7.3.2 Ancillary environmental benefits

There are additional benefits to reducing demand for energy from fossil fuels, such as air quality benefits, with associated health and cost benefits. Further issues may be included such as "ancillary cost benefits" of the CRC, for example energy security, behavioural change in employees, pass-through of carbon awareness to customers. However, quantifying the impacts of cap-setting on these is beyond our remit here.

7.3.3 Climate change agreements

Organisations possessing CCAs can be excluded from the CRC through exemption criteria; if an organisation with no subsidiaries has more than 25 per cent of its total energy use emissions covered by CCAs, then the entire organisation will be exempt from the scheme. Similarly if a subsidiary of an organisation possesses CCAs that cover more than 25 per cent of its energy use emissions, the whole of that subsidiary will be exempt from the scheme.

In an effort to reconcile the complex climate change policy space, it might seem logical to amalgamate CCAs with the CRC. Although it is not clear that the level of cap in the CRC would affect this process, energy-intensive industries (those currently with CCAs) may find a stringent CRC cap less appealing than non-CCA CRC organisations because organisations covered by CCAs have been involved in abatement activities for several years already. As a result the remaining abatement opportunities in such sectors can be expected to be fewer than for those sectors that have so far not received specific policy attention.

7.3.4 Shadow price of carbon

The shadow price of carbon (SPC) aims to enable organisations to account for the damage costs of GHG emissions associated with investment or policy decisions. We have previously discussed the SPC in the context of the cap-setting process; here, we consider how the CRC will interact with the SPC during investment or policy evaluation and appraisal.

Some organisations, for example in the water sector, are required to incorporate the SPC when evaluating capital investment projects.

It is our view that the CRC will provide a much stronger incentive for participants to value the GHG impacts of a particular decision because the scheme is compulsory, establishes a carbon price and therefore formally internalises the cost of carbon. However, the CRC only covers energy end use emissions, and thus would not provide impetus for valuation of process emissions, for example. This adds complexity to decision evaluations where the CRC carbon price and the SPC are required and highlights the inconsistency of GHG emissions not liable under the CRC possessing a different value compared with energy use emissions covered by the CRC.

7.3.5 Non-traded price of carbon for policy appraisal

As introduced in section 6.2, Government has published revised carbon valuations for policy appraisal, including one specifically for the non-traded sector. According to Chapter 12 of DECC's paper (DECC, 2009), the new carbon valuations will replace the SPC in impact assessments. In this respect, the same arguments laid out in section 7.3.4 apply, that the CRC formally internalises the cost of carbon for any investment, but does not provide impetus for valuation of process emissions. However, the principal focus of the new carbon valuations is for policy appraisal. It is unclear whether the non-traded carbon price would be incorporated into investment projects.

8 Conclusions

The CCC's inaugural report *Building a low-carbon economy* recommends interim carbon budgets on the pathway to the UK's 2050 target of an 80 per cent reduction in GHG emissions against 1990 levels. This study has examined the abatement opportunities in the CRC, the approach that might be taken to setting scheme caps, what level the caps may take and the GHG, financial and policy implications.

CRC coverage

- Chapter 2 reviewed existing CRC coverage estimates and although we were unable to quantify coverage in all sectors, we considered the most significant ones.
- In total, we found that the scheme would cover nearly 58 MtCO_2 but this value rises to over 60 MtCO_2 when the emissions calculated in this study for the NHS are included. We also found that the IT subsector, in particular data centres, is a large energy user and suggest further analysis of associated CRC emissions coverage since current estimates suggest it is a small CRC subsector in emissions terms.
- Further investigation of emissions from the large emitting sectors is important, since this study has found cause to uplift two subsectors and reasonable evidence that the IT/communications sector could also be much higher than presently estimated.

CRC energy use emission projections

- An assessment of the abatement opportunities within the CRC needs to be set in the context of projected emissions in the absence of the scheme. In Chapter 3 we showed that emissions from the CRC are forecast to rise in a near linear fashion from 2009 to 2020, but importantly this does not take into account the impact of decarbonisation of UK electricity generation. Noting this caveat, total baseline emissions in 2020 (57.4 MtCO_2) are projected to be seven per cent higher than 2008 (53.5 MtCO_2).

Abatement potential in the CRC

- We have made the first independent assessment of abatement potential in the CRC sector based on MAC curves for the industry and non-domestic buildings sectors.
- MACCs were constructed primarily for energy end use reduction technologies but also including the abatement associated with CHP and renewable heat.
- We have developed a best estimate for abatement potential in the non-domestic buildings sector with an upper and lower bound. Since this sector contributes around 75% of the identified abatement for the CRC, this assessment is important.
- Our modelling shows that there is 11.6 MtCO_2 of cost-effective abatement already available in the absence of a carbon price (taking best-estimate non-domestic building sector potential).
- Importantly, the abatement potentials identified in this study are expressed as technical potentials. Difficulties in realising the full technical potential provided by energy demand reduction measures have been previously

documented. However, the CRC pulls precisely the financial and behavioural levers needed to implement such measures. For this reason, following the example of the CCC, it is felt that all of the technical potential identified for the CRC may be realised.

- For simplicity the abatement potentials identified in this study do not assume any reduction in the carbon intensity of electricity generation. If the carbon intensity is reduced by 50% by 2020 as advocated by the Committee on Climate Change (CCC) then the overall emissions from the CRC sector would be lower still but the saving that could be attributed directly to the CRC would be up to 27 per cent less.
- CRC abatement estimates presented in this study were found to be in reasonable agreement with previous estimates for CRC driven abatement calculated by AEA (2008) for the CCC and NERA/Enviros (2006). A number of factors are likely to account for the difference: the expanded CRC emissions coverage estimated and used in this study; changes to fuel price and economic growth forecasts; and, in the case of NERA/Enviros (2006) possibly fundamental differences between models and therefore the measures considered.
- Some subsector abatement technologies are in need of review, such as in the water sector. This is a substantial process and well beyond the scope of this study; however, our analysis would benefit from being revisited with a revised model, which could be formulated with CRC-relevant technologies in mind.

Cap-setting criteria

- The cap setting process has a number of relevant issues of varying significance, which are not all mutually consistent.
- Competitiveness concerns should be moderated in the CRC since the scheme will be revenue neutral to the exchequer and subsector level caps cannot be applied.
- We suggest for this study that environmental and cost effectiveness could be considered the most significant criteria.

CRC caps and allowance prices

- Caps for the CRC scheme could be set based on a carbon price derived from the projected EU ETS price (£40/tCO_2).
- Establishing this price in the scheme could deliver a saving of 11.9 MtCO_2.
- Although we cannot state the timeline for delivery of this reduction using the MACCs developed here, if it could be delivered prior to 2020, it is estimated this would bring a reduction in emissions from the CRC sector of approximately 29 per cent against 1990 levels, a strong step towards the UK's emission targets.

GHG, financial and policy implications of CRC caps

- Taking the projected EU ETS allowance price as the basis for the scheme cap, it is unlikely that substantial quantities of allowances would be purchased through the CRC safety valve, therefore preventing the transfer of significant funding from CRC participants to EU ETS operators. As a result, a large proportion of the total cost paid by participants for CRC allowances would be recycled to the participants. Additionally, the exchequer would benefit from holding a larger fund for the six-month period between the CRC auction and revenue recycle.

- For a scheme cap established using the forecast EU ETS price, based on the financial implications for the wholesale and retail trades, total abatement may provide net benefit to participants, a ‘win-win’ situation.
- The CRC seems most likely to have implications for renewables policies and SPC:
  - A strong cap for the CRC, which drives substantial reductions in energy consumption, will bring additional benefits through the reduction in absolute generation of energy from renewables required to meet the UK’s obligations under the EU target of 20 per cent renewable energy by 2020.
  - For CRC participants, the CRC allowance price will replace the SPC for valuing emission reductions but only for energy use emissions.
- The CRC has additional environmental benefits, for example through improved air quality. Attempting to quantify the cost implications of these benefits under different scheme caps would form a possible future extension to this study.

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9 Appendices

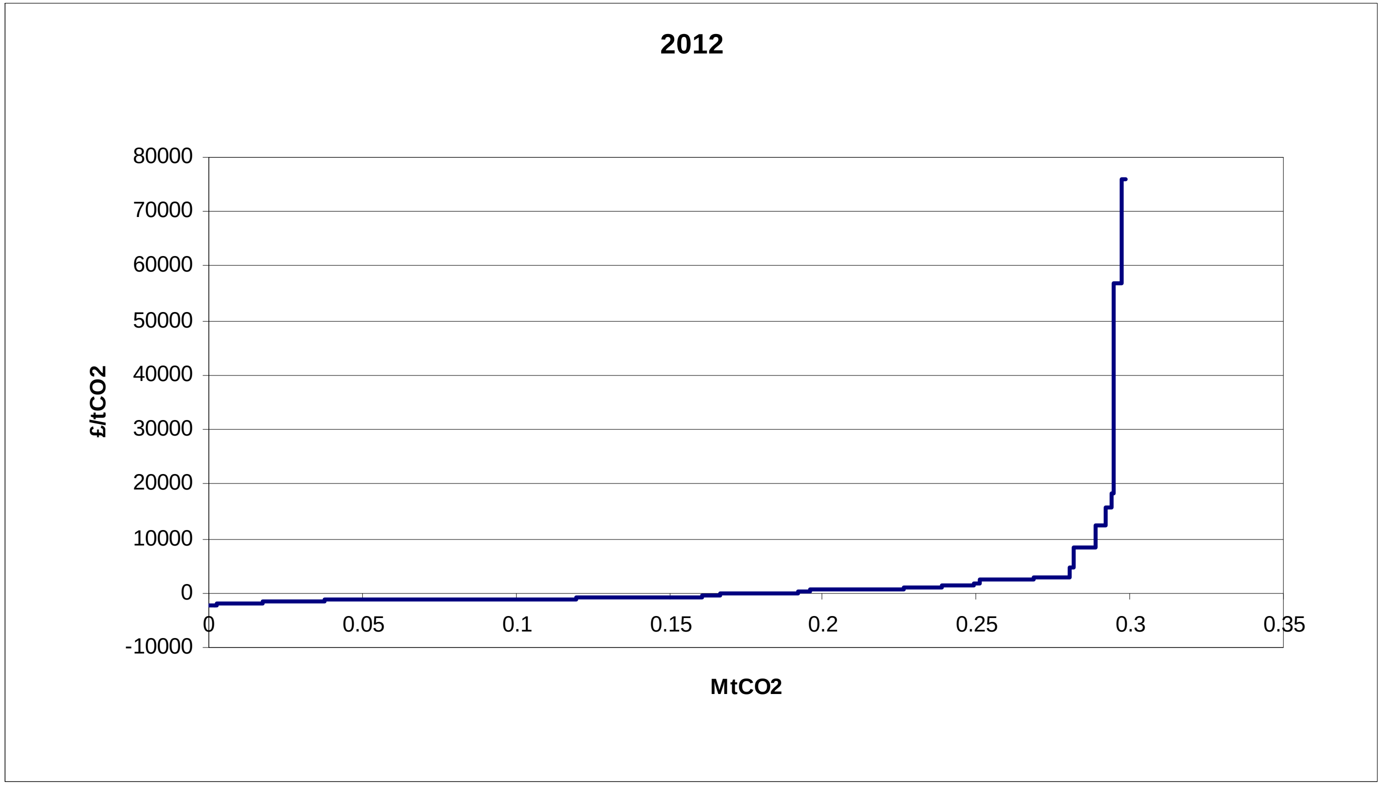
Appendix 1: Industry subsector MACCs

Appendix 2: Non-domestic buildings subsector MACCs

9.1 Appendix 1 - Industry subsector MACCs

Included with the MACCs is a list of the measures that make up the cost curves. Within the measures tables, the measures highlighted in green should be investigated further to consider their appropriateness for CRC sites. For example, some measures may only be applicable for large scale processes, such as an energy-efficient furnace technology in the steel sector, and therefore may not be available to CRC qualifying sites (typically smaller in scale).

9.1.1 Chemicals



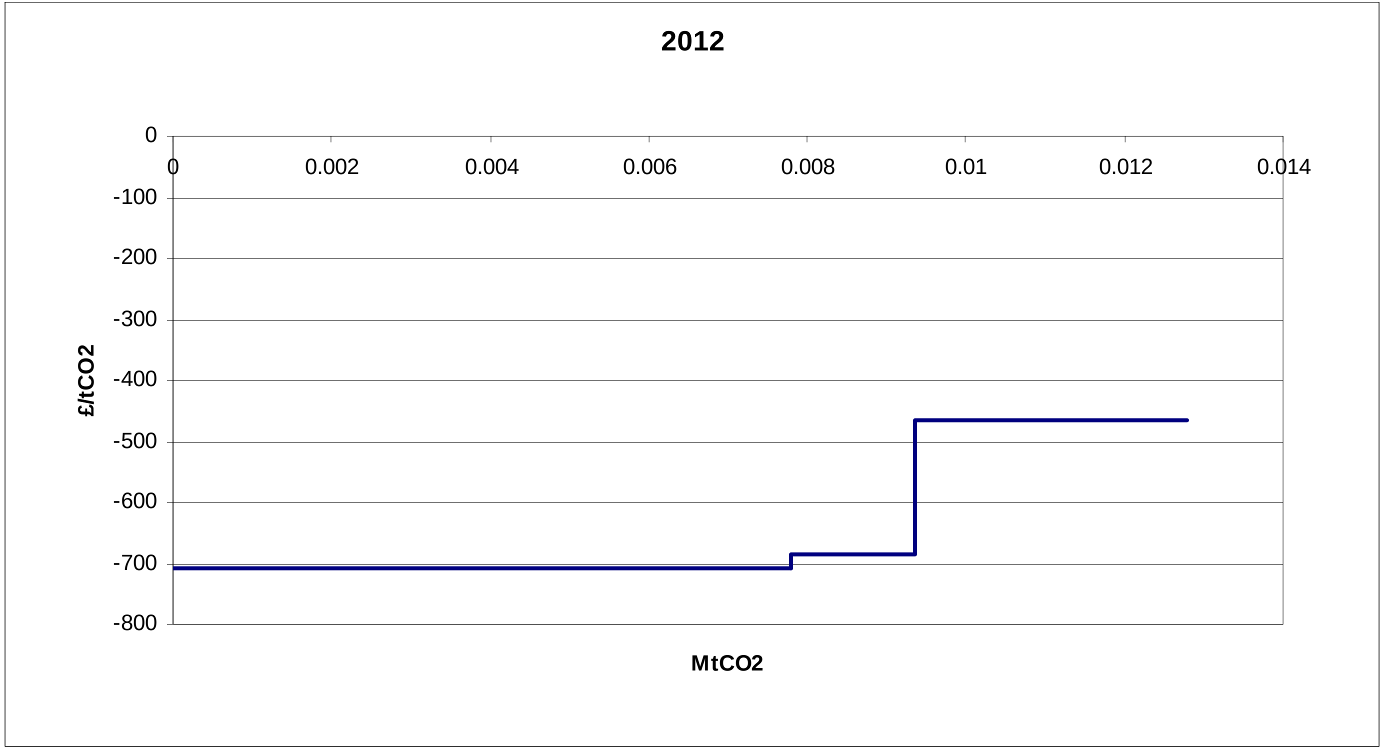
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Chemical	Fertiliser	Pumping	HEMs	1,771.00	-2,382.78
2	Chemical	Fertiliser	Pumping	VSDs	239.01	-2,338.89
3	Chemical	Industrial gases	Pumping	HEMs	81.68	-2,284.16
4	Chemical	Ammonia	Pumping	VSDs	251.39	-2,162.66
5	Chemical	Ammonia	Pumping	HEMs	48.72	-2,028.08
6	Chemical	Fertiliser	Drives	VSDs	521.34	-1,977.09
7	Chemical	Industrial gases	Compressors	HEMs	5,219.16	-1,948.13
8	Chemical	Fertiliser	Drives	HEMs	2,653.87	-1,942.01
9	Chemical	Industrial gases	Compressors	O & M Impr	2,744.54	-1,927.44
10	Chemical	Chloro-alkali	Electrolysis	Control of electrode gap	2,120.20	-1,916.65
11	Chemical	Ammonia	Compressors	Control Sy	193.73	-1,860.39
12	Chemical	Industrial gases	Compressors	Control Sy	1,234.09	-1,829.72
13	Chemical	General Organics	Refrigeration	Impr refrig efficiency	603.48	-1,761.66
14	Chemical	Resins	comminution	Alternative comminution	3,172.47	-1,698.63
15	Chemical	General Organics	Process Heating	Process integration	6,405.79	-1,647.70
16	Chemical	General Organics	Compressors	HEMs	2,615.65	-1,645.65
17	Chemical	General Organics	Compressors	Waste Heat Recovery	2,663.36	-1,634.56
18	Chemical	Chloro-alkali	Electrolysis	Membranes	3,505.12	-1,553.61
19	Chemical	Chloro-alkali	Electrolysis	Waste heat recovery	1,316.35	-1,523.19
20	Chemical	Ammonia	Refrigeration	Improved refrig efficiency	233.48	-1,390.54
21	Chemical	General Organics	Process Heating	Process Control	3,911.42	-1,365.46
22	Chemical	Other Inorganics	Process Heating	Process integration	2,115.50	-1,365.11
23	Chemical	Resins	Process Heating	M&T	2,861.99	-1,316.26
24	Chemical	Resins	Process Heating	Energy management	2,884.51	-1,316.08
25	Chemical	Other Inorganics	Drying	Waste Heat Recovery	585.92	-1,310.32
26	Chemical	Resins	Process Heating	Improved scheduling	6,233.70	-1,294.75
27	Chemical	Misc Chemicals	Distillation	Improved distillation	692.10	-1,291.50
28	Chemical	Resins	Drying	Improved drying	2,964.01	-1,285.78

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
29	Chemical	Chloro-alkali	Pumping	HEMs	2,078.53	-1,275.54
30	Chemical	Resins	Drying	Energy management	754.24	-1,275.52
31	Chemical	Resins	Process Heating	Batch waste heat recovery	2,737.25	-1,272.21
32	Chemical	Resins	Drying	Waste Heat Recovery	2,812.26	-1,257.60
33	Chemical	Ammonia	Process Heating	New plant	6,378.80	-1,250.44
34	Chemical	Misc Chemicals	Process Heating	Process control	11,903.02	-1,232.28
35	Chemical	Chloro-alkali	Compressors	Control Sy	152.94	-1,217.68
36	Chemical	Misc Chemicals	Process Heating	Energy management	3,109.18	-1,212.71
37	Chemical	Misc Chemicals	Drying	Improved drying	176.22	-1,212.64
38	Chemical	Other Inorganics	Drying	Improved drying	446.17	-1,197.48
39	Chemical	Ammonia	Process Heating	Improved control	5,324.10	-1,134.35
40	Chemical	Other Inorganics	Drying	Improved control	1,935.49	-1,132.39
41	Chemical	Misc Chemicals	Drying	Process Control	5,279.82	-1,128.86
42	Chemical	Pharmaceuticals	Refrigeration	Improved refrigeration	155.08	-1,106.59
43	Chemical	Misc Chemicals	Drying	Energy management	2,360.99	-1,073.88
44	Chemical	Pharmaceuticals	Space Heating	Waste Heat Recovery	2,121.61	-1,064.65
45	Chemical	Fertiliser	Drying	Energy management	1,844.04	-1,057.15
46	Chemical	Fertiliser	Drying	Improved control	728.38	-1,049.30
47	Chemical	Misc Chemicals	Evaporation	Energy management	153.06	-1,046.24
48	Chemical	Fertiliser	Process Heating	Improved control	1,159.26	-1,027.99
49	Chemical	Fertiliser	Process Heating	Process integration	2,665.30	-1,025.93
50	Chemical	Misc Chemicals	Process Heating	Process integration	5,335.22	-1,016.18
51	Chemical	Resins	Distillation	Improved packing	529.35	-1,000.07
52	Chemical	Chloro-alkali	Drying	Improved H	63.00	-999.30
53	Chemical	Chloro-alkali	Drying	Improved P	25.75	-998.60
54	Chemical	Resins	Distillation	High efficiency trays	455.93	-996.50
55	Chemical	Fertiliser	Process Heating	Waste Heat Recovery	1,792.48	-918.71
56	Chemical	Pharmaceuticals	Space Heating	Building Insulation	3,922.07	-878.90

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
57	Chemical	Other Inorganics	Process Heating	Process control	2,344.00	-856.64
58	Chemical	Misc Chemicals	Evaporation	Process Control	1,412.73	-854.07
59	Chemical	Resins	Drying	Process Control	2,009.56	-835.12
60	Chemical	General Organics	Distillation	High efficiency trays	3,447.42	-734.36
61	Chemical	Pharmaceuticals	Space Heating	M&T	30.21	-728.98
62	Chemical	General Organics	Distillation	Waste Heat Recovery	3,669.09	-718.43
63	Chemical	Misc Chemicals	Process Heating	Waste heat recovery	4,569.05	-704.68
64	Chemical	Chloro-alkali	Pumping	VSDs	151.24	-661.58
65	Chemical	Other Inorganics	Process Heating	Energy management	2,415.13	-656.70
66	Chemical	General Organics	Pumping	VSDs	9,595.92	-642.55
67	Chemical	Other Inorganics	Process Heating	Waste heat recovery	4,633.83	-633.58
68	Chemical	Pharmaceuticals	Mixing	Improved drives	354.11	-610.12
69	Chemical	General Organics	Process Heating	M&T	5,218.52	-513.63
70	Chemical	Pharmaceuticals	Other	HEMs	573.91	-279.37
71	Chemical	Pharmaceuticals	Space Heating	Process Control	256.16	-262.93
72	Chemical	Chloro-alkali	Electrolysis	Energy management	3,172.36	-247.73
73	Chemical	General Organics	Distillation	Improved packing	14,834.78	-153.74
74	Chemical	Misc Chemicals	Drying	Waste Heat Recovery	4,842.99	-97.89
75	Chemical	Ammonia	Process Heating	Waste heat recovery	1,558.89	-53.07
76	Chemical	Pharmaceuticals	Other	Soft Start	348.64	5.24
77	Chemical	Other Inorganics	Process Heating	M&T	3,289.48	216.44
78	Chemical	General Organics	Pumping	HEMs	655.67	309.99
79	Chemical	General Organics	Process Heating	Energy management	28,748.46	572.16
80	Chemical	General Organics	Compressors	O & M Impr	2,006.99	775.46
81	Chemical	General Organics	Distillation	MVR	12,474.44	1,106.97
82	Chemical	Pharmaceuticals	Distillation	Energy management	664.41	1,206.92
83	Chemical	Pharmaceuticals	Process Heating	Process control	9,827.55	1,451.86
84	Chemical	Chloro-alkali	Drying	Waste Heat Recovery	2,010.57	1,679.62

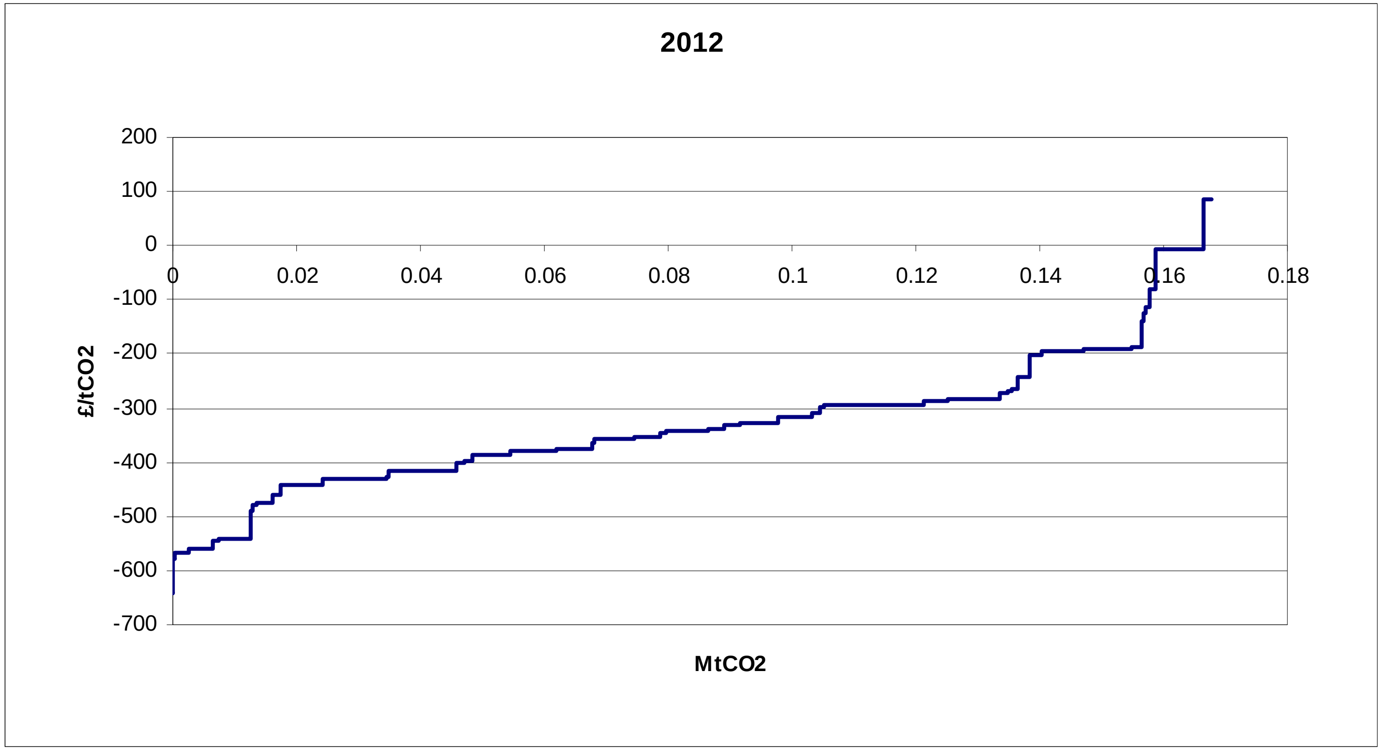
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
85	Chemical	General Organics	Process Heating	Waste heat recovery	17,500.32	2,661.89
86	Chemical	Other Inorganics	Drying	Energy management	5,496.40	2,765.75
87	Chemical	General Organics	Compressors	Control systems	3,943.36	2,787.63
88	Chemical	Misc Chemicals	Evaporation	Waste Heat Recovery	1,918.19	2,873.02
89	Chemical	Pharmaceuticals	Mixing	In-line mixing	1,188.78	4,771.84
90	Chemical	Chloro-alkali	Electrolysis	Process control	7,119.19	8,511.41
91	Chemical	Chloro-alkali	Electrolysis	Process integration	3,565.53	12,292.76
92	Chemical	Pharmaceuticals	Distillation	Waste Heat Recovery	1,882.53	15,740.20
93	Chemical	Misc Chemicals	Distillation	MVR	903.52	18,206.42
94	Chemical	Pharmaceuticals	Space Heating	Efficient ventilation	2,193.24	56,743.43
95	Chemical	Pharmaceuticals	Distillation	Improved distillation	1,371.14	75,887.25

9.1.2 Construction



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Construction	Construction	Electrically-powered veh+eqmt	Good practice	7,784.38	-707.68
2	Construction	Construction	Petroleum-powered veh+eqmt	Good Practice/Process imprvt	1,580.84	-684.12
3	Construction	Construction	Gas-powered veh+eqmt	Good practice	3,416.53	-466.76

9.1.3 Electrical Engineering



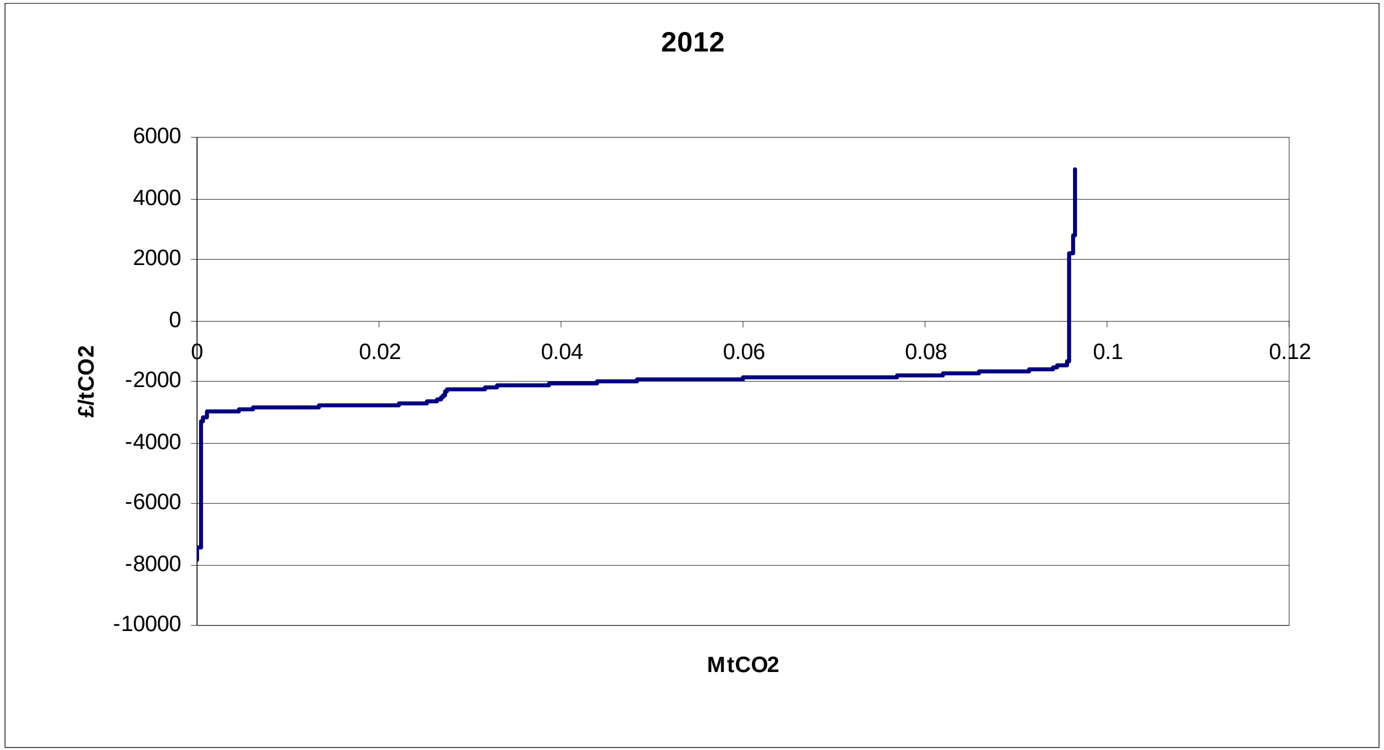
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Electrical Eng	Electrical	Other aux/pumping	HEMs	4.16	-641.04
2	Electrical Eng	Electrical	Other aux/pumping	VSDs	259.98	-579.50
3	Electrical Eng	Electronics	Other aux/pumping	HEMs	2.21	-567.95
4	Electrical Eng	Electrical	Lighting	House and maint	1,582.73	-567.05

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Electrical Eng	Electronics	Lighting	House and maint	588.69	-566.72
6	Electrical Eng	Electronics	Compressed Air	O&M Improv	2,135.38	-560.52
7	Electrical Eng	Electrical	Compressed Air	O&M Improv	1,722.12	-560.14
8	Electrical Eng	Electrical	Other aux/pumping	Soft Start	229.02	-548.63
9	Electrical Eng	Electrical	Lighting	Controls	1,013.75	-543.85
10	Electrical Eng	Electrical	Compressed Air	Control sy	760.40	-542.25
11	Electrical Eng	Electronics	Compressed Air	Control sy	2,631.03	-540.79
12	Electrical Eng	Electronics	Lighting	Controls	1,736.98	-540.34
13	Electrical Eng	Electrical	Lighting	Convert to high effy luminaire	121.65	-491.21
14	Electrical Eng	Electronics	Lighting	Convert to high effy luminaire	649.32	-479.92
15	Electrical Eng	Electrical	Compressed Air	New plant	2,835.86	-476.62
16	Electrical Eng	Electronics	Compressed Air	New plant	1,205.35	-458.63
17	Electrical Eng	Electronics	Air con	Controls	6,291.19	-443.45
18	Electrical Eng	Electronics	Assembly/test	House and maint	439.28	-443.10
19	Electrical Eng	Electronics	Air con	New plant	10,428.80	-429.84
20	Electrical Eng	Electronics	Other aux/pumping	VSDs	143.99	-427.14
21	Electrical Eng	Electrical	Forming/welding/machining	Process improvement	11,062.92	-417.10
22	Electrical Eng	Electronics	Ventilation	New plant	1,363.40	-399.76
23	Electrical Eng	Electrical	Ventilation	New plant	1,032.84	-397.26
24	Electrical Eng	Electrical	Furnaces/Heat Treat	House and maint	895.42	-386.49
25	Electrical Eng	Electronics	Air con	Maintenance	5,390.69	-386.10
26	Electrical Eng	Electrical	Space Heating	New plant	0.00	-384.80
27	Electrical Eng	Electrical	Space Heating	Controls & BMS & insulation	7,360.70	-379.59
28	Electrical Eng	Electrical	Forming/welding/machining	New plant	5,751.68	-376.32
29	Electrical Eng	Electronics	IT	New plant	388.77	-365.05
30	Electrical Eng	Electrical	Painting/curing	Better design	6,376.75	-358.19
31	Electrical Eng	Electronics	Other aux/pumping	Soft Start	126.84	-356.51
32	Electrical Eng	Electrical	Painting/curing	New plant	4,102.67	-351.70

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
33	Electrical Eng	Electrical	Air con	Controls	1,058.48	-347.32
34	Electrical Eng	Electrical	Plating/pickling	New plant	6,808.82	-343.20
35	Electrical Eng	Electrical	Painting/curing	Controls & insulation	2,505.37	-337.50
36	Electrical Eng	Electrical	Painting/curing	House and maint	498.01	-330.99
37	Electrical Eng	Electrical	Furnaces/Heat Treat	new plant	391.13	-330.24
38	Electrical Eng	Electrical	Plating/pickling	Controls	1,693.18	-329.84
39	Electrical Eng	Electronics	Plating/pickling	New plant	5,995.78	-328.38
40	Electrical Eng	Electrical	Space Heating	House and maint	1,314.78	-317.07
41	Electrical Eng	Electrical	Plating/pickling	Process improvement	4,220.00	-315.45
42	Electrical Eng	Electronics	Plating/pickling	Controls	1,487.48	-309.13
43	Electrical Eng	Electronics	Assembly/test	new plant	683.56	-297.78
44	Electrical Eng	Electronics	Space Heating	New plant	16,099.32	-294.61
45	Electrical Eng	Electronics	Plating/pickling	Process improvement	3,710.71	-288.39
46	Electrical Eng	Electrical	IT	New plant	182.94	-287.35
47	Electrical Eng	Electrical	Air con	New plant	1,770.29	-284.11
48	Electrical Eng	Electronics	Space Heating	Controls & BMS & insulation	6,494.97	-281.50
49	Electrical Eng	Electronics	Ventilation	System imp	1,318.66	-271.01
50	Electrical Eng	Electrical	Furnaces/Heat Treat	Controls & insulation	601.74	-267.02
51	Electrical Eng	Electrical	Ventilation	System imp	998.94	-263.15
52	Electrical Eng	Electrical	Plating/pickling	House and maint	1,827.42	-244.25
53	Electrical Eng	Electronics	Forming/welding/machining	Process improvement	2,000.74	-201.34
54	Electrical Eng	Electronics	Space Heating	House and maint	5,478.07	-196.51
55	Electrical Eng	Electronics	Painting/curing	New plant	1,396.14	-193.11
56	Electrical Eng	Electrical	Space Heating	Central to decentral	7,661.63	-191.06
57	Electrical Eng	Electronics	Plating/pickling	House and maint	1,607.04	-185.79
58	Electrical Eng	Electronics	Painting/curing	Controls & insulation	380.16	-140.40
59	Electrical Eng	Electronics	Painting/curing	House and maint	348.85	-123.56
60	Electrical Eng	Electronics	Assembly/test	Controls & insulation	638.35	-114.93

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
61	Electrical Eng	Electrical	Air con	Maintenance	935.73	-80.73
62	Electrical Eng	Electronics	Space Heating	Central to decentral	7,799.49	-8.37
63	Electrical Eng	Electronics	Forming/welding/machining	New plant	1,134.23	85.06

9.1.4 Food & Drink



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Food and Drink	Crisps, snacks & nuts	conveying/pumping	energy management	36.01	-7,866.31
2	Food and Drink	Crisps, snacks & nuts	conveying/pumping	new plant	300.55	-7,463.29
3	Food and Drink	Craft bakeries	mixing	new plant	430.86	-3,328.99
4	Food and Drink	Craft bakeries	conveying/pumping	new plant	274.44	-3,176.06
5	Food and Drink	Crisps, snacks & nuts	conveying/pumping	HEM/VSD	40.96	-3,164.39
6	Food and Drink	Craft bakeries	mixing	energy management	109.34	-2,997.32
7	Food and Drink	Other food	chilling and freezing	new plant	3,407.67	-2,954.92
8	Food and Drink	Confectionery	chilling and freezing	new plant	1,570.74	-2,918.96
9	Food and Drink	Other food	chilling and freezing	comprehensive maintenance	1,055.06	-2,881.72
10	Food and Drink	Other food	chilling and freezing	energy management	463.29	-2,870.74
11	Food and Drink	Oils and Fats	Grinding	new plant	48.18	-2,833.23
12	Food and Drink	Other food	mixing	new plant	46.47	-2,831.57
13	Food and Drink	Ind. bakeries & biscuits	mixing	new plant	63.64	-2,828.79
14	Food and Drink	Confectionery	mixing	new plant	247.60	-2,828.65
15	Food and Drink	Meat, poultry & products	chilling and freezing	new plant	5,326.40	-2,820.83
16	Food and Drink	Dairies and milk	chilling and freezing	new plant	966.47	-2,808.49
17	Food and Drink	Meal enhancers	conveying/pumping	new plant	24.08	-2,801.94
18	Food and Drink	Animal Feeds	Grinding	new plant	418.97	-2,799.67
19	Food and Drink	Pet food	Grinding	new plant	41.85	-2,799.64
20	Food and Drink	Confectionery	chilling and freezing	comprehensive maintenance	414.90	-2,794.66
21	Food and Drink	Meat, poultry & products	chilling and freezing	energy management	964.04	-2,789.56
22	Food and Drink	Brewing incl. Cider	chilling and freezing	new plant	1,005.92	-2,778.41
23	Food and Drink	Soft Drinks	conveying/pumping	HEM	83.15	-2,770.75
24	Food and Drink	Soft Drinks	conveying/pumping	new plant	361.55	-2,770.75
25	Food and Drink	Animal Feeds	mixing	HEM	55.42	-2,770.56
26	Food and Drink	Animal Feeds	mixing	new plant	120.67	-2,770.56
27	Food and Drink	Pet food	mixing	new plant	23.90	-2,770.54
28	Food and Drink	Pet food	mixing	HEM	5.49	-2,770.54

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
29	Food and Drink	Milling	Grinding	HEM	591.22	-2,770.28
30	Food and Drink	Milling	Grinding	new plant	2,580.04	-2,770.28
31	Food and Drink	Ice creams	chilling and freezing	new plant	514.00	-2,758.47
32	Food and Drink	Ind. bakeries & biscuits	conveying/pumping	new plant	326.21	-2,757.98
33	Food and Drink	Crisps, snacks & nuts	Grinding	HEM	51.03	-2,756.41
34	Food and Drink	Crisps, snacks & nuts	Grinding	new plant	208.42	-2,756.41
35	Food and Drink	Meal enhancers	conveying/pumping	HEM/VSD	24.13	-2,752.12
36	Food and Drink	Brewing incl. Cider	chilling and freezing	comprehensive maintenance	229.61	-2,751.23
37	Food and Drink	Meal enhancers	Grinding	HEM	11.76	-2,746.87
38	Food and Drink	Meal enhancers	Grinding	new plant	61.40	-2,746.87
39	Food and Drink	Meal enhancers	conveying/pumping	energy management	20.55	-2,745.44
40	Food and Drink	Beverages	Grinding	HEM	24.29	-2,743.18
41	Food and Drink	Brewing incl. Cider	chilling and freezing	controls	370.53	-2,728.84
42	Food and Drink	Crisps, snacks & nuts	Grinding	energy management	71.88	-2,720.77
43	Food and Drink	Oils and Fats	chilling and freezing	new plant	100.52	-2,716.12
44	Food and Drink	Meat, poultry & products	chilling and freezing	controls	394.36	-2,714.48
45	Food and Drink	Meat, poultry & products	chilling and freezing	comprehensive maintenance	426.30	-2,713.59
46	Food and Drink	Ice creams	chilling and freezing	controls	46.51	-2,712.80
47	Food and Drink	Fresh fish	chilling and freezing	new plant	626.73	-2,705.88
48	Food and Drink	Animal Feeds	conveying/pumping	new plant	142.48	-2,704.08
49	Food and Drink	Milling	conveying/pumping	new plant	349.91	-2,703.78
50	Food and Drink	Confectionery	mixing	energy management	173.06	-2,699.80
51	Food and Drink	Beverages	Grinding	energy management	44.03	-2,694.71
52	Food and Drink	Meal enhancers	Grinding	energy management	20.26	-2,690.34
53	Food and Drink	Brewing incl. Cider	chilling and freezing	energy management	205.44	-2,671.76
54	Food and Drink	Confectionery	chilling and freezing	energy management	118.26	-2,662.95
55	Food and Drink	Dairies and milk	chilling and freezing	energy management	73.01	-2,661.26
56	Food and Drink	Confectionery	mixing	HEM/VSD	180.54	-2,652.22

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
57	Food and Drink	Craft bakeries	mixing	HEM/VSD	52.79	-2,650.73
58	Food and Drink	Oils and Fats	Grinding	energy management	12.02	-2,649.56
59	Food and Drink	Animal Feeds	Grinding	energy management	248.72	-2,645.35
60	Food and Drink	Ind. bakeries & biscuits	mixing	energy management	16.43	-2,635.46
61	Food and Drink	Animal Feeds	mixing	energy management	69.92	-2,627.82
62	Food and Drink	Dairies and milk	chilling and freezing	controls	97.18	-2,616.03
63	Food and Drink	Oils and Fats	Grinding	HEM/VSD	13.18	-2,612.15
64	Food and Drink	Animal Feeds	Grinding	controls	200.84	-2,608.55
65	Food and Drink	Animal Feeds	conveying/pumping	energy management	84.59	-2,581.57
66	Food and Drink	Fresh fruit & veg.	chilling and freezing	comprehensive maintenance	44.09	-2,577.43
67	Food and Drink	Soft Drinks	conveying/pumping	energy management	89.14	-2,573.84
68	Food and Drink	Dairies and milk	chilling and freezing	comprehensive maintenance	63.27	-2,558.24
69	Food and Drink	Pet food	Grinding	energy management	10.43	-2,521.86
70	Food and Drink	Oils and Fats	chilling and freezing	controls	6.80	-2,515.48
71	Food and Drink	Ice creams	chilling and freezing	energy management	33.32	-2,497.08
72	Food and Drink	Fresh fruit & veg.	chilling and freezing	controls	180.21	-2,472.15
73	Food and Drink	Ind. bakeries & biscuits	mixing	HEM/VSD	14.31	-2,437.03
74	Food and Drink	Ice creams	chilling and freezing	comprehensive maintenance	26.47	-2,429.35
75	Food and Drink	Ind. bakeries & biscuits	conveying/pumping	energy management	46.82	-2,418.70
76	Food and Drink	Fresh fish	chilling and freezing	energy management	73.85	-2,409.66
77	Food and Drink	Oils and Fats	chilling and freezing	energy management	6.55	-2,379.21
78	Food and Drink	Craft bakeries	other processes	new plant	252.63	-2,329.26
79	Food and Drink	Pet food	Grinding	controls	8.57	-2,293.03
80	Food and Drink	Fresh fruit & veg.	chilling and freezing	energy management	42.46	-2,280.67
81	Food and Drink	Pet food	mixing	energy management	5.88	-2,278.28
82	Food and Drink	Fresh fish	chilling and freezing	controls/maintenance	249.01	-2,262.61
83	Food and Drink	Craft bakeries	conveying/pumping	energy management	38.76	-2,240.40
84	Food and Drink	Craft bakeries	Baking	new plant	3,866.06	-2,230.66

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
85	Food and Drink	Distilling	fermentation	new plant	317.12	-2,214.49
86	Food and Drink	Ind. bakeries & biscuits	conveying/pumping	HEM/VSD	152.91	-2,188.40
87	Food and Drink	Distilling	fermentation	energy management	109.00	-2,180.26
88	Food and Drink	Brewing incl. Cider	fermentation	new plant	523.58	-2,176.66
89	Food and Drink	Distilling	fermentation	controls	98.72	-2,164.29
90	Food and Drink	Soft Drinks	other processes	new plant	63.43	-2,144.18
91	Food and Drink	Brewing incl. Cider	fermentation	energy management	453.65	-2,139.97
92	Food and Drink	Brewing incl. Cider	fermentation	controls	395.83	-2,130.56
93	Food and Drink	Craft bakeries	Baking	controls	236.06	-2,111.75
94	Food and Drink	Craft bakeries	other processes	energy management	163.21	-2,108.57
95	Food and Drink	Ind. bakeries & biscuits	Baking	New plant	4,355.23	-2,107.55
96	Food and Drink	Craft bakeries	heating	new plant	323.83	-2,097.00
97	Food and Drink	Ind. bakeries & biscuits	other processes	new plant	99.15	-2,096.44
98	Food and Drink	Sugar	other processes	new plant	133.35	-2,096.42
99	Food and Drink	Confectionery	other processes	new plant	121.36	-2,095.28
100	Food and Drink	Ice creams	other processes	new plant	18.46	-2,095.24
101	Food and Drink	Dairies and milk	other processes	new plant	375.96	-2,095.08
102	Food and Drink	Oils and Fats	other processes	new plant	33.28	-2,095.08
103	Food and Drink	Pet food	other processes	new plant	42.89	-2,095.03
104	Food and Drink	Animal Feeds	other processes	new plant	38.65	-2,095.02
105	Food and Drink	Milling	other processes	new plant	167.11	-2,094.95
106	Food and Drink	Fresh fish	other processes	new plant	67.19	-2,094.95
107	Food and Drink	Soft Drinks	other processes	energy management	38.39	-2,090.40
108	Food and Drink	Brewing incl. Cider	other processes	new plant	172.59	-2,089.83
109	Food and Drink	Malting	other processes	new plant	163.43	-2,088.47
110	Food and Drink	Other food	other processes	new plant	420.95	-2,085.29
111	Food and Drink	Meal enhancers	other processes	new plant	51.66	-2,081.22
112	Food and Drink	Crisps, snacks & nuts	other processes	new plant	146.26	-2,081.22

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
113	Food and Drink	Meat, poultry & products	other processes	new plant	603.37	-2,081.07
114	Food and Drink	Distilling	other processes	new plant	115.24	-2,081.07
115	Food and Drink	Meal enhancers	other processes	energy management	45.95	-2,055.43
116	Food and Drink	Meat, poultry & products	other processes	energy management	534.71	-2,049.75
117	Food and Drink	Meal enhancers	hot washing	new plant	73.40	-2,045.61
118	Food and Drink	Distilling	other processes	energy management	102.13	-2,044.54
119	Food and Drink	Crisps, snacks & nuts	other processes	energy management	130.08	-2,044.46
120	Food and Drink	Other food	other processes	energy management	338.69	-2,043.79
121	Food and Drink	Malting	other processes	energy management	119.64	-2,043.16
122	Food and Drink	Brewing incl. Cider	other processes	energy management	352.45	-2,042.36
123	Food and Drink	Fresh fruit & veg.	other processes	energy management	557.59	-2,042.27
124	Food and Drink	Meal enhancers	hot washing	controls	59.01	-2,032.98
125	Food and Drink	Oils and Fats	other processes	energy management	19.10	-2,027.02
126	Food and Drink	Meal enhancers	hot washing	energy management	24.26	-2,021.19
127	Food and Drink	Craft bakeries	Baking	energy management	283.54	-2,019.81
128	Food and Drink	Ind. bakeries & biscuits	Baking	controls	595.14	-2,017.80
129	Food and Drink	Other food	Baking	new plant	1,254.65	-2,016.95
130	Food and Drink	Ice creams	other processes	energy management	4.10	-2,005.97
131	Food and Drink	Animal Feeds	other processes	energy management	56.46	-1,997.66
132	Food and Drink	Dairies and milk	pasteurising	new plant	332.16	-1,997.15
133	Food and Drink	Confectionery	Baking	new plant	594.94	-1,996.98
134	Food and Drink	Brewing incl. Cider	pasteurising	new plant	625.35	-1,994.19
135	Food and Drink	Sugar	Baking	new plant	89.33	-1,990.65
136	Food and Drink	Confectionery	other processes	energy management	70.01	-1,982.59
137	Food and Drink	Dairies and milk	other processes	energy management	215.79	-1,974.86
138	Food and Drink	Ice creams	hot washing	new plant	15.68	-1,967.98
139	Food and Drink	Dairies and milk	hot washing	new plant	471.62	-1,966.66
140	Food and Drink	Brewing incl. Cider	pasteurising	energy management	542.01	-1,960.40

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
141	Food and Drink	Fresh fish	other processes	energy management	38.44	-1,958.24
142	Food and Drink	Crisps, snacks & nuts	Baking	controls	47.07	-1,957.70
143	Food and Drink	Other food	mixing	energy management	30.05	-1,954.52
144	Food and Drink	Soft Drinks	hot washing	new plant	277.45	-1,953.89
145	Food and Drink	Other food	Baking	energy management	47.17	-1,953.17
146	Food and Drink	Brewing incl. Cider	Kilning	new plant	3,918.53	-1,952.76
147	Food and Drink	Brewing incl. Cider	pasteurising	controls	458.42	-1,944.02
148	Food and Drink	Fresh fish	hot washing	new plant	65.20	-1,943.96
149	Food and Drink	Soft Drinks	pasteurising	new plant	349.71	-1,942.15
150	Food and Drink	Malting	Kilning	new plant	4,685.38	-1,937.28
151	Food and Drink	Ind. bakeries & biscuits	other processes	energy management	58.88	-1,935.95
152	Food and Drink	Sugar	drying	new plant	475.36	-1,923.97
153	Food and Drink	Sugar	other processes	energy management	79.15	-1,914.05
154	Food and Drink	Craft bakeries	heating	energy management	33.76	-1,910.39
155	Food and Drink	Dairies and milk	pasteurising	energy management	73.91	-1,906.95
156	Food and Drink	Beverages	conveying/pumping	energy management	1.73	-1,904.33
157	Food and Drink	Soft Drinks	pasteurising	energy management	108.39	-1,901.92
158	Food and Drink	Milling	heating	new plant	185.64	-1,899.81
159	Food and Drink	Pet food	heating	new plant	375.91	-1,899.78
160	Food and Drink	Animal Feeds	heating	new plant	445.15	-1,899.65
161	Food and Drink	Malting	Kilning	energy management	332.75	-1,898.67
162	Food and Drink	Milling	hot washing	new plant	218.34	-1,898.21
163	Food and Drink	Other food	Baking	controls	69.97	-1,896.78
164	Food and Drink	Milling	Grinding	energy management	633.80	-1,896.40
165	Food and Drink	Ind. bakeries & biscuits	heating	New plant	216.20	-1,895.88
166	Food and Drink	Sugar	Baking	controls	46.04	-1,892.68
167	Food and Drink	Brewing incl. Cider	Kilning	energy management	587.07	-1,892.38
168	Food and Drink	Confectionery	Baking	energy management	22.30	-1,891.75

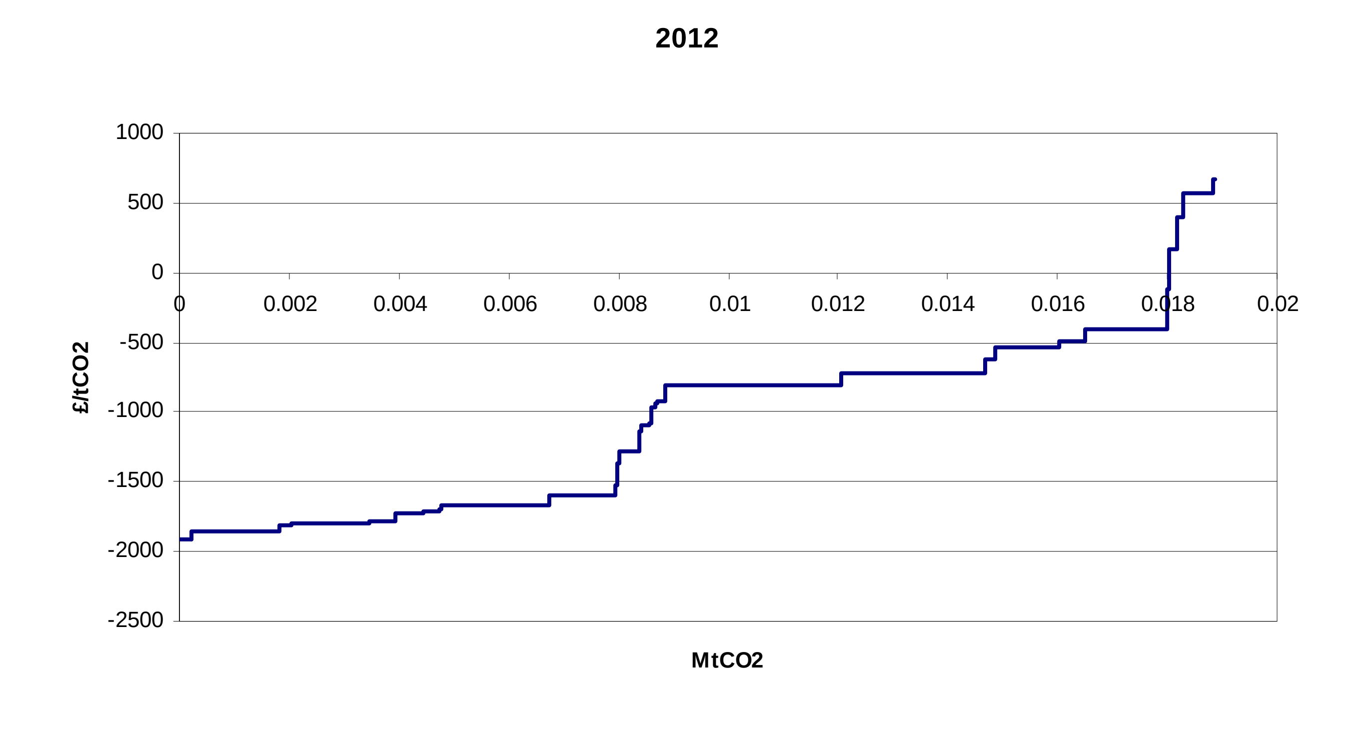
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
169	Food and Drink	Confectionery	drying	new plant	383.56	-1,891.21
170	Food and Drink	Other food	drying	new plant	624.99	-1,891.15
171	Food and Drink	Animal Feeds	drying	new plant	62.49	-1,890.92
172	Food and Drink	Pet food	drying	new plant	79.68	-1,890.92
173	Food and Drink	Crisps, snacks & nuts	Baking	heat recovery	122.45	-1,888.14
174	Food and Drink	Crisps, snacks & nuts	hot washing	new plant	204.78	-1,886.85
175	Food and Drink	Malting	hot washing	new plant	72.22	-1,886.37
176	Food and Drink	Brewing incl. Cider	hot washing	new plant	117.59	-1,886.21
177	Food and Drink	Meat, poultry & products	hot washing	new plant	614.95	-1,885.64
178	Food and Drink	Soft Drinks	hot washing	energy management	68.67	-1,879.74
179	Food and Drink	Dairies and milk	hot washing	energy management	270.85	-1,870.83
180	Food and Drink	Ice creams	hot washing	energy management	3.48	-1,862.90
181	Food and Drink	Meat, poultry & products	hot washing	energy management	211.35	-1,861.87
182	Food and Drink	Ind. bakeries & biscuits	Baking	energy management	113.88	-1,860.19
183	Food and Drink	Meat, poultry & products	heating	new plant	4,740.81	-1,859.46
184	Food and Drink	Malting	hot washing	energy management	64.56	-1,859.03
185	Food and Drink	Brewing incl. Cider	hot washing	energy management	262.83	-1,858.77
186	Food and Drink	Meal enhancers	heating	new plant	427.15	-1,855.00
187	Food and Drink	Brewing incl. Cider	hot washing	boiler operation	374.98	-1,851.73
188	Food and Drink	Crisps, snacks & nuts	hot washing	energy management	68.82	-1,850.58
189	Food and Drink	Malting	hot washing	boiler operation	157.22	-1,844.61
190	Food and Drink	Crisps, snacks & nuts	heating	new plant	897.08	-1,844.01
191	Food and Drink	Ice creams	hot washing	controls	2.87	-1,840.40
192	Food and Drink	Confectionery	heating	new plant	1,267.12	-1,838.45
193	Food and Drink	Other food	heating	new plant	2,585.10	-1,837.33
194	Food and Drink	Pet food	other processes	energy management	24.59	-1,832.32
195	Food and Drink	Meal enhancers	heating	energy management	147.36	-1,830.88
196	Food and Drink	Fresh fish	heating	new plant	269.64	-1,830.66

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
197	Food and Drink	Sugar	heating	new plant	370.51	-1,830.29
198	Food and Drink	Oils and Fats	heating	new plant	623.03	-1,830.29
199	Food and Drink	Crisps, snacks & nuts	heating	energy management	309.44	-1,827.46
200	Food and Drink	Meat, poultry & products	heating	energy management	701.07	-1,822.59
201	Food and Drink	Animal Feeds	heating	energy management	111.96	-1,819.93
202	Food and Drink	Fresh fish	hot washing	energy management	14.47	-1,809.01
203	Food and Drink	Crisps, snacks & nuts	heating	controls	129.26	-1,806.08
204	Food and Drink	Dairies and milk	hot washing	controls	245.28	-1,800.46
205	Food and Drink	Sugar	drying	energy management	232.07	-1,797.78
206	Food and Drink	Animal Feeds	drying	heat recovery	243.45	-1,797.01
207	Food and Drink	Meal enhancers	heating	controls	63.53	-1,796.04
208	Food and Drink	Meat, poultry & products	heating	controls	309.47	-1,792.00
209	Food and Drink	Other food	heating	energy management	231.55	-1,782.21
210	Food and Drink	Oils and Fats	heating	energy management	120.62	-1,782.01
211	Food and Drink	Other food	drying	energy management	54.53	-1,777.14
212	Food and Drink	Ind. bakeries & biscuits	heating	energy management	19.78	-1,776.17
213	Food and Drink	Oils and Fats	heating	heat recovery	558.04	-1,775.42
214	Food and Drink	Animal Feeds	heating	controls	91.50	-1,774.77
215	Food and Drink	Animal Feeds	drying	energy management	78.24	-1,773.27
216	Food and Drink	Sugar	Baking	energy management	41.13	-1,770.72
217	Food and Drink	Craft bakeries	heating	controls	15.62	-1,757.72
218	Food and Drink	Sugar	evaporation	new plant	728.28	-1,756.18
219	Food and Drink	Dairies and milk	evaporation	new plant	1,189.72	-1,754.53
220	Food and Drink	Ind. bakeries & biscuits	heating	heat recovery	39.22	-1,750.82
221	Food and Drink	Confectionery	heating	energy management	112.85	-1,750.45
222	Food and Drink	Ind. bakeries & biscuits	heating	controls	17.88	-1,747.94
223	Food and Drink	Confectionery	drying	energy management	33.48	-1,745.85
224	Food and Drink	Pet food	drying	energy management	14.57	-1,745.06

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
225	Food and Drink	Fresh fish	heating	energy management	49.96	-1,742.81
226	Food and Drink	Dairies and milk	pasteurising	controls	44.63	-1,741.62
227	Food and Drink	Other food	heating	controls/maintenance	971.79	-1,737.12
228	Food and Drink	Pet food	heating	energy management	33.08	-1,736.65
229	Food and Drink	Ice creams	hot washing	heat recovery	8.75	-1,716.75
230	Food and Drink	Dairies and milk	hot washing	heat recovery	670.96	-1,714.68
231	Food and Drink	Distilling	distilling	new plant	3,783.40	-1,691.30
232	Food and Drink	Confectionery	heating	controls/maintenance	470.34	-1,678.49
233	Food and Drink	Dairies and milk	evaporation	energy management	121.14	-1,676.27
234	Food and Drink	Craft bakeries	conveying/pumping	HEM/VSD	49.63	-1,673.30
235	Food and Drink	Craft bakeries	heating	heat recovery	9.00	-1,670.92
236	Food and Drink	Distilling	distilling	energy management	616.10	-1,667.08
237	Food and Drink	Milling	other processes	energy management	95.61	-1,657.57
238	Food and Drink	Sugar	evaporation	energy management	415.94	-1,651.83
239	Food and Drink	Pet food	drying	heat recovery	71.24	-1,642.40
240	Food and Drink	Other food	mixing	HEM/VSD	33.92	-1,631.93
241	Food and Drink	Pet food	heating	controls	28.03	-1,623.04
242	Food and Drink	Distilling	distilling	boiler operation	1,500.98	-1,617.29
243	Food and Drink	Sugar	drying	process control	660.76	-1,614.07
244	Food and Drink	Soft Drinks	hot washing	boiler controls	33.89	-1,607.15
245	Food and Drink	Fresh fish	heating	controls/maintenance	225.54	-1,587.35
246	Food and Drink	Sugar	heating	energy management	183.67	-1,567.74
247	Food and Drink	Fresh fish	hot washing	controls	7.95	-1,565.86
248	Food and Drink	Soft Drinks	other processes	comprehensive maintenance	19.98	-1,556.21
249	Food and Drink	Dairies and milk	evaporation	heat recovery	313.99	-1,539.48
250	Food and Drink	Milling	hot washing	energy management	48.47	-1,474.45
251	Food and Drink	Beverages	conveying/pumping	HEM/VSD	3.44	-1,457.28
252	Food and Drink	Sugar	evaporation	process integration	1,049.17	-1,452.25

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
253	Food and Drink	Milling	conveying/pumping	energy management	86.99	-1,381.43
254	Food and Drink	Milling	heating	energy management	16.30	-1,373.75
255	Food and Drink	Fresh fruit & veg.	hot washing	energy management	49.59	-1,360.29
256	Food and Drink	Milling	heating	controls	13.45	-1,262.35
257	Food and Drink	Beverages	hot washing	energy management	1.79	-1,168.95
258	Food and Drink	Beverages	heating	energy management	1.20	-921.95
259	Food and Drink	Confectionery	Baking	controls	20.55	-722.42
260	Food and Drink	Beverages	heating	controls	2.87	1,570.94
261	Food and Drink	Beverages	hot washing	controls	2.34	2,206.88
262	Food and Drink	Crisps, snacks & nuts	Baking	new plant	512.41	2,211.21
263	Food and Drink	Crisps, snacks & nuts	Baking	energy management	83.34	2,768.69
264	Food and Drink	Beverages	other processes	energy management	0.63	4,977.21

9.1.5 Glass

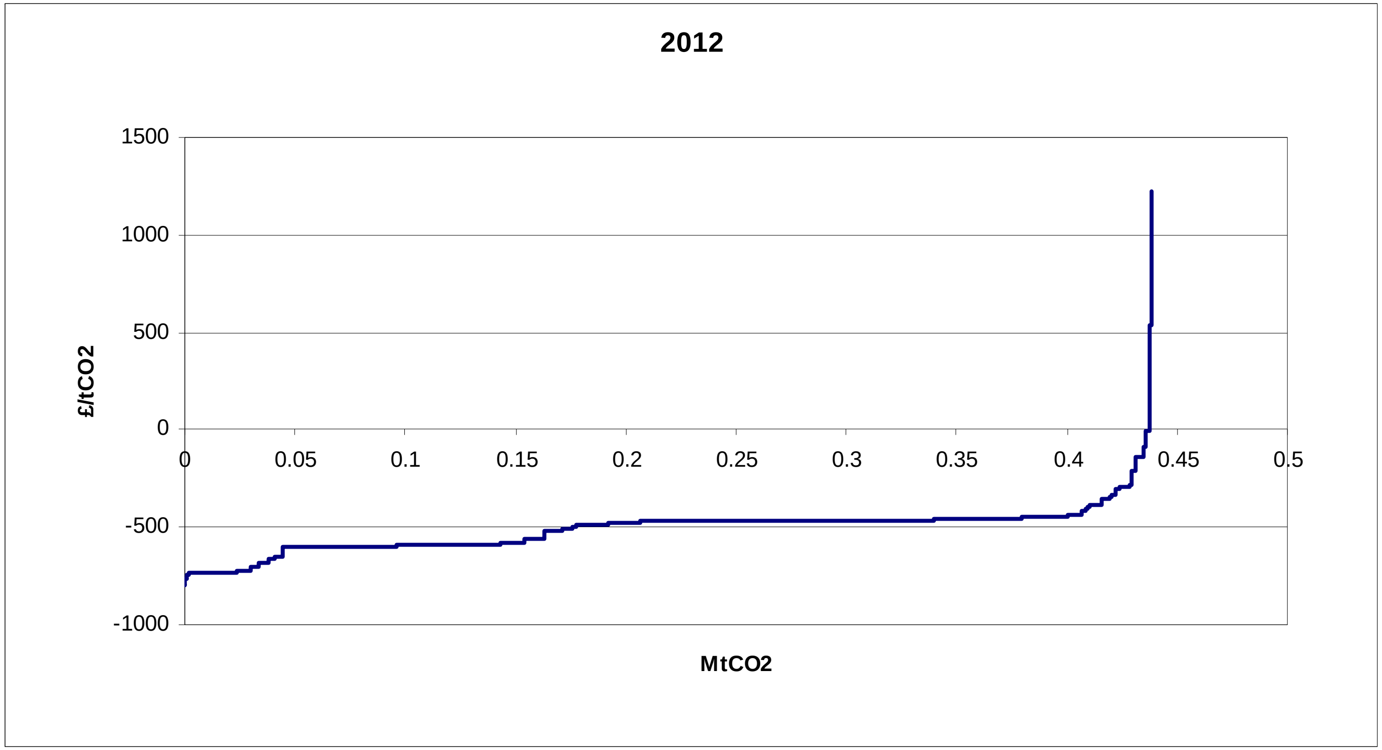


	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	GLASS	OTHER GLASS SECTORS	COMPRESSORS	Control	219.06	-1,917.94
2	GLASS	OTHER GLASS SECTORS	COMPRESSORS	new plant	1,616.66	-1,856.85
3	GLASS	FIBRE GLASS	MIXING & GENERAL DRIVES	HEMs	12.51	-1,817.66
4	GLASS	FLAT GLASS	MIXING AND GENERAL DRIVES	HEMS	17.90	-1,817.63

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	GLASS	FLAT GLASS	MIXING AND GENERAL DRIVES	VSDS	13.59	-1,811.81
6	GLASS	CONTAINER GLASS	MIXING AND GENERAL DRIVES	HEMs	125.33	-1,806.91
7	GLASS	FIBRE GLASS	MIXING & GENERAL DRIVES	VSDs	8.65	-1,806.89
8	GLASS	CONTAINER GLASS	MIXING AND GENERAL DRIVES	VSDs	43.72	-1,804.72
9	GLASS	FLAT GLASS	COMPRESSORS	new plant	1,364.26	-1,796.61
10	GLASS	CONTAINER GLASS	Fans	HEMs	46.63	-1,790.10
11	GLASS	OTHER GLASS SECTORS	MIXING AND GENERAL DRIVES	VSDs	401.56	-1,785.86
12	GLASS	OTHER GLASS SECTORS	MIXING AND GENERAL DRIVES	HEMs	71.09	-1,784.14
13	GLASS	CONTAINER GLASS	Fans	VSDs	3.44	-1,780.18
14	GLASS	FIBRE GLASS	COMPRESSORS	new plant	508.03	-1,727.98
15	GLASS	OTHER GLASS SECTORS	ELECTRIC MELTING	new plant	279.31	-1,705.33
16	GLASS	OTHER GLASS SECTORS	ELECTRIC MELTING	Gob control	50.24	-1,701.17
17	GLASS	CONTAINER GLASS	COMPRESSORS	new plant	1,961.72	-1,674.48
18	GLASS	OTHER GLASS SECTORS	ELECTRIC MELTING	U/S Refining	649.74	-1,602.87
19	GLASS	FIBRE GLASS	TANK FOR ELECTRIC MELTING	new plant	558.68	-1,591.16
20	GLASS	CONTAINER GLASS	Space Ht / other	Compressor HR	41.89	-1,517.55
21	GLASS	FIBRE GLASS	COMPRESSORS	Control systems	7.46	-1,366.22
22	GLASS	FLAT GLASS	FLOAT BATH	Expert system	393.73	-1,274.56
23	GLASS	FIBRE GLASS	COMPRESSORS	O&M	19.11	-1,140.58
24	GLASS	FIBRE GLASS	TANK FOR OXYFUEL	Impr furnace insulation	11.27	-1,127.36
25	GLASS	FIBRE GLASS	CURING	Control system	151.08	-1,098.16
26	GLASS	FIBRE GLASS	NORMAL TANK	Impr furnace insulation	30.79	-1,078.45
27	GLASS	FIBRE GLASS	TANK FOR OXYFUEL	Oxy-Trim	2.16	-1,078.40
28	GLASS	OTHER GLASS SECTORS	TANK FOR OXYFUEL	advanced burner systems	66.89	-965.89
29	GLASS	OTHER GLASS SECTORS	TANK FOR OXYFUEL	Oxy-Trim	3.47	-940.12
30	GLASS	CONTAINER GLASS	COMPRESSORS	Operation & Maint	31.17	-938.26
31	GLASS	OTHER GLASS SECTORS	TANK FOR OXYFUEL	u/s refining	140.10	-921.95
32	GLASS	OTHER GLASS SECTORS	NORMAL TANK	ultrasonic refining	3,005.88	-812.20

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
33	GLASS	OTHER GLASS SECTORS	FOREHEARTHS	Expert system	214.73	-803.22
34	GLASS	CONTAINER GLASS	NORMAL TANK	Add external cullet	2,603.42	-717.05
35	GLASS	FLAT GLASS	STORAGE&SPACE HEATING	Impr controls	10.11	-631.73
36	GLASS	OTHER GLASS SECTORS	COMPRESSORS	Operation & Maint	167.62	-614.22
37	GLASS	CONTAINER GLASS	FOREHEARTHS	Expert system	1,194.37	-536.78
38	GLASS	FLAT GLASS	NORMAL (& OXY) TANK	external cullet	472.18	-494.87
39	GLASS	CONTAINER GLASS	LEHRS	Heat rec	1,491.16	-408.51
40	GLASS	FLAT GLASS	COMPRESSORS	O&M	6.97	-115.37
41	GLASS	FIBRE GLASS	STORAGE&SPACE HEATING	Control systems	176.85	161.39
42	GLASS	CONTAINER GLASS	LEHRS	Control systems	110.64	390.64
43	GLASS	CONTAINER GLASS	LEHRS	Forced Cooling	536.02	569.91
44	GLASS	CONTAINER GLASS	Space Ht / other	Impr control	24.04	668.73

9.1.6 Mechanical Engineering

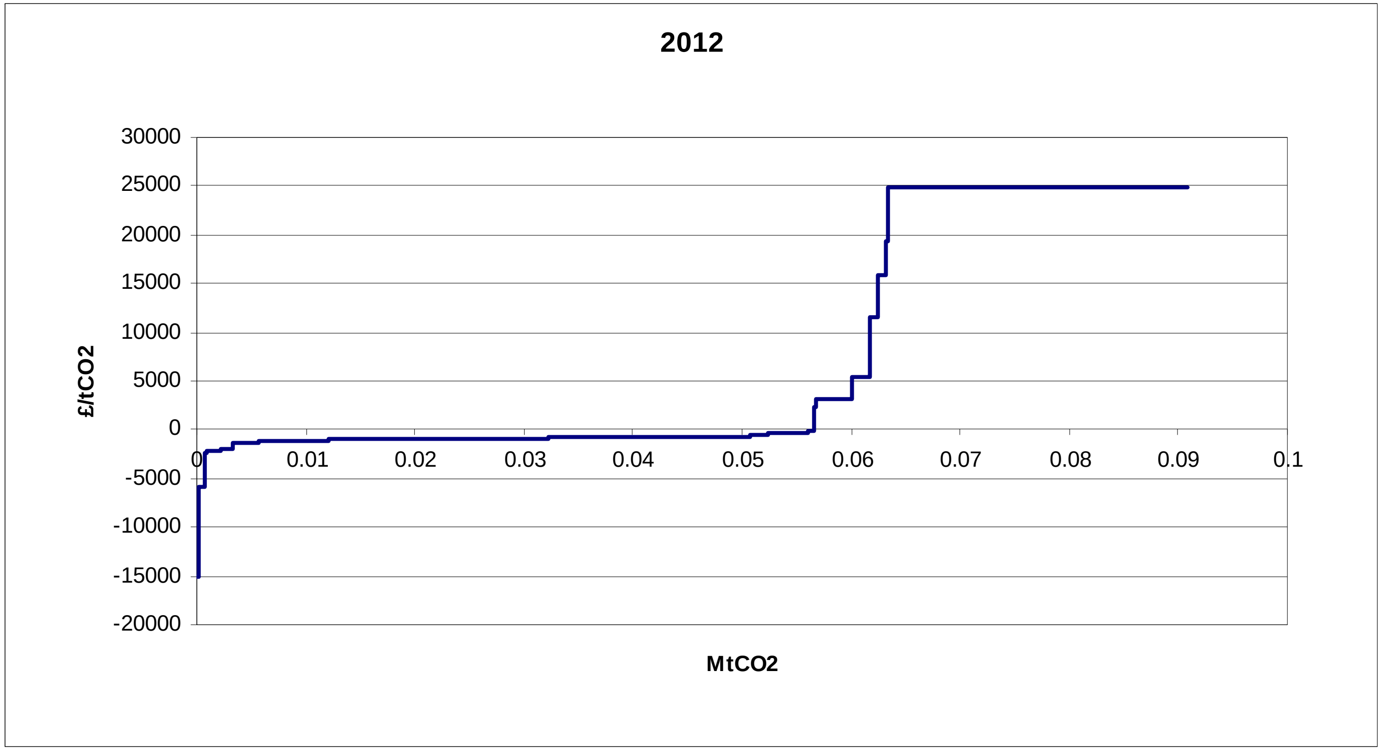


	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Mechanical Eng	Metal Goods	Other aux/pumping	HEMs	48.93	-798.87
2	Mechanical Eng	Metal Goods	Other aux/pumping	VSDs	855.96	-762.08
3	Mechanical Eng	Metal Goods	Other aux/pumping	Soft Start	1,128.68	-744.29
4	Mechanical Eng	Metal Goods	Compressed Air	O&M Improv	21,644.16	-737.17

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Mechanical Eng	Metal Goods	Compressed Air	Control sy	5,800.48	-723.27
6	Mechanical Eng	Metal Goods	Lighting	House and maint	3,511.93	-699.24
7	Mechanical Eng	Mach & Equipment	Lighting	House and maint	682.54	-697.91
8	Mechanical Eng	Metal Goods	Compressed Air	New plant	4,252.31	-681.64
9	Mechanical Eng	Mach & Equipment	Other aux/pumping	HEMs	0.49	-675.02
10	Mechanical Eng	Metal Goods	Lighting	Controls	2,920.63	-661.78
11	Mechanical Eng	Mach & Equipment	Compressed Air	O&M Improv	3,502.33	-656.45
12	Mechanical Eng	Metal Goods	Forming/welding/machining	Process improvement	51,574.88	-601.20
13	Mechanical Eng	Metal Goods	Forming/welding/machining	New plant	46,262.06	-592.25
14	Mechanical Eng	Mach & Equipment	Compressed Air	Control sy	941.65	-590.21
15	Mechanical Eng	Metal Goods	Ventilation	New plant	4,314.01	-584.59
16	Mechanical Eng	Metal Goods	Lighting	Convert to high effy luminaire	6,742.98	-575.47
17	Mechanical Eng	Mach & Equipment	Forming/welding/machining	Process improvement	8,420.14	-556.69
18	Mechanical Eng	Mach & Equipment	Lighting	Controls	538.82	-549.14
19	Mechanical Eng	Metal Goods	Furnaces/Heat Treat	House and maint	3,125.80	-520.48
20	Mechanical Eng	Mach & Equipment	Forming/welding/machining	New plant	5,164.40	-514.56
21	Mechanical Eng	Metal Goods	Ventilation	System imp	4,107.76	-503.90
22	Mechanical Eng	Mach & Equipment	Furnaces/Heat Treat	House and maint	540.88	-502.32
23	Mechanical Eng	Metal Goods	Furnaces/Heat Treat	new plant	1,822.52	-496.08
24	Mechanical Eng	Mach & Equipment	Other aux/pumping	VSDs	133.25	-492.60
25	Mechanical Eng	Metal Goods	Space Heating	New plant	14,302.18	-482.85
26	Mechanical Eng	Metal Goods	Space Heating	Controls & BMS & insulation	14,496.18	-479.97
27	Mechanical Eng	Metal Goods	Plating/pickling	New plant	56,587.50	-471.05
28	Mechanical Eng	Metal Goods	Furnaces/Heat Treat	Controls & insulation	5,765.63	-468.81
29	Mechanical Eng	Mach & Equipment	Plating/pickling	New plant	6,493.56	-468.70
30	Mechanical Eng	Metal Goods	Plating/pickling	Controls	15,432.82	-468.08
31	Mechanical Eng	Metal Goods	Plating/pickling	Process improvement	23,221.65	-464.81
32	Mechanical Eng	Metal Goods	Painting/curing	Better design	8,375.27	-464.63

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
33	Mechanical Eng	Metal Goods	Painting/curing	New plant	16,944.65	-462.51
34	Mechanical Eng	Mach & Equipment	Plating/pickling	Controls	2,746.93	-453.55
35	Mechanical Eng	Mach & Equipment	Ventilation	New plant	741.06	-453.11
36	Mechanical Eng	Metal Goods	Painting/curing	Controls & insulation	9,174.54	-452.77
37	Mechanical Eng	Metal Goods	Space Heating	House and maint	27,061.72	-452.18
38	Mechanical Eng	Metal Goods	Plating/pickling	House and maint	17,701.92	-449.76
39	Mechanical Eng	Metal Goods	Painting/curing	House and maint	2,837.78	-448.47
40	Mechanical Eng	Mach & Equipment	Plating/pickling	Process improvement	4,060.55	-435.87
41	Mechanical Eng	Mach & Equipment	Space Heating	New plant	2,619.28	-431.94
42	Mechanical Eng	Mach & Equipment	Space Heating	Controls & BMS & insulation	2,311.52	-418.65
43	Mechanical Eng	Mach & Equipment	Other aux/pumping	Soft Start	117.53	-404.30
44	Mechanical Eng	Mach & Equipment	Compressed Air	New plant	692.47	-391.63
45	Mechanical Eng	Mach & Equipment	Furnaces/Heat Treat	new plant	623.23	-391.62
46	Mechanical Eng	Metal Goods	Space Heating	Central to decentral	5,646.06	-390.25
47	Mechanical Eng	Mach & Equipment	Plating/pickling	House and maint	3,178.75	-354.38
48	Mechanical Eng	Mach & Equipment	Painting/curing	Better design	1,113.07	-346.10
49	Mechanical Eng	Mach & Equipment	Painting/curing	New plant	1,871.62	-337.68
50	Mechanical Eng	Mach & Equipment	Painting/curing	Controls & insulation	1,668.50	-299.15
51	Mechanical Eng	Mach & Equipment	Space Heating	House and maint	4,588.31	-292.12
52	Mechanical Eng	Mach & Equipment	Painting/curing	House and maint	494.98	-279.65
53	Mechanical Eng	Mach & Equipment	Furnaces/Heat Treat	Controls & insulation	806.95	-263.41
54	Mechanical Eng	Mach & Equipment	Lighting	Convert to high effy luminaire	1,381.83	-207.00
55	Mechanical Eng	Metal Goods	Furnaces/Heat Treat	Heat recovery	3,746.35	-143.92
56	Mechanical Eng	Mach & Equipment	Ventilation	System imp	707.12	- 90.04
57	Mechanical Eng	Metal Goods	IT	New plant	367.70	- 64.85
58	Mechanical Eng	Mach & Equipment	Space Heating	Central to decentral	1,769.67	- 9.79
59	Mechanical Eng	Mach & Equipment	IT	New plant	441.22	535.59
60	Mechanical Eng	Mach & Equipment	Furnaces/Heat Treat	Heat recovery	659.37	1,219.83

9.1.7 Non-ferrous metals



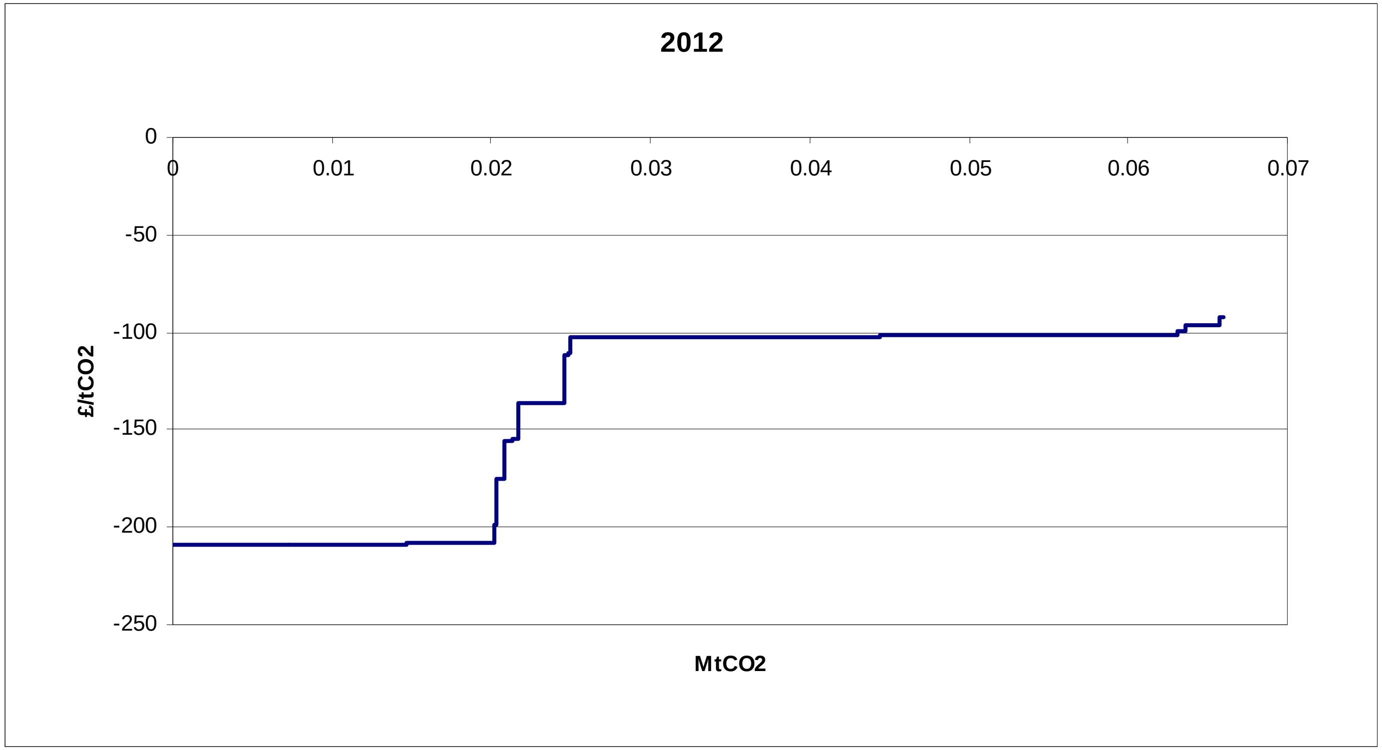
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	NFMetal	Copper: Secondary	Shaft Furnace	Afterburners	108.63	-15,123.97
2	NFMetal	Lead, zinc and tin production	Galvanising	Recup heater	45.70	-12,108.78
3	NFMetal	Aluminium: Finished	Annealing Furnaces	Control system	557.28	-5,953.32
4	NFMetal	Copper: Wrought products	Extrusion	Yield improvement	8.13	-5,280.61
5	NFMetal	Copper: Wrought products	Tube Extrusion	Improved Yield	11.57	-3,409.94
6	NFMetal	Copper: Wrought products	Rolling	Yield improvement	2.99	-2,676.83
7	NFMetal	Copper: Wrought products	Billet and Slab Heating	Rapid heating	182.04	-2,351.51
8	NFMetal	Copper: Secondary	Annealing	Rapid heating	90.88	-2,253.78
9	NFMetal	Aluminium: Finished	Ageing Furnaces	Control systems	1,188.26	-2,146.80
10	NFMetal	Copper: Wrought products	Tubes Billet Heating	Rapid heating	1,033.87	-2,041.50
11	NFMetal	Aluminium: Finished	Reheat Furnaces	Control system	282.01	-1,397.95
12	NFMetal	Aluminium: Secondary	Induction Furnace	Insulation	306.13	-1,391.98
13	NFMetal	Aluminium: Primary	Auxillary Power	HEMs	379.91	-1,319.29
14	NFMetal	Aluminium: Primary	Auxillary Power	Fans	1,266.89	-1,319.23
15	NFMetal	Lead, zinc and tin production	Pumps & Fans (>300kw)	HEMs	3.23	-1,263.39
16	NFMetal	Lead, zinc and tin production	Conveyors & mach (>300kw)	HEMs	42.68	-1,260.56
17	NFMetal	Lead, zinc and tin production	Con and machinery (<300kw)	HEMs	38.44	-1,255.82
18	NFMetal	Lead, zinc and tin production	Conveyors & mach (>300kw)	Soft Starters	123.72	-1,250.87
19	NFMetal	Lead, zinc and tin production	Con and machinery (<300kw)	Soft Starters	111.60	-1,242.10
20	NFMetal	Aluminium: Finished	Rolling Drives	HEMs	1,118.02	-1,228.98
21	NFMetal	Lead, zinc and tin production	Pumps & Fans (>300kw)	VSDs	52.56	-1,227.65
22	NFMetal	Lead, zinc and tin production	Conveyors & mach (>300kw)	VSDs	129.96	-1,223.33
23	NFMetal	Aluminium: Finished	Rolling Drives	Improved management	2,806.54	-1,222.96
24	NFMetal	Lead, zinc and tin production	Con and machinery (<300kw)	VSDs	134.52	-1,192.72
25	NFMetal	Copper: Wrought products	Drive Systems	HEMs	164.70	-1,191.67
26	NFMetal	Lead, zinc and tin production	Pumps & Fans (<300kw)	HEMs	1.45	-1,168.71
27	NFMetal	Aluminium: Finished	Extrusion Drives	Improved management	207.84	-1,140.15
28	NFMetal	Aluminium: Secondary	Induction Furnace	Improved Management	512.03	-1,134.60

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
29	NFMetal	Lead, zinc and tin production	Pumps & Fans (>300kw)	Soft Starters	10.00	-1,132.94
30	NFMetal	Aluminium: Finished	Remelting: Inefficient	Insulation	584.72	-1,110.78
31	NFMetal	Copper: Wrought products	Drive Systems	Soft Starters	371.10	-1,078.53
32	NFMetal	Aluminium: Finished	Other Services	Improved Management	185.51	-1,047.46
33	NFMetal	Aluminium: Secondary	Secondary Smelting: Ineff	New Furnace	931.00	-1,035.19
34	NFMetal	Aluminium: Finished	Ageing Furnaces	Improved design	588.74	-1,030.86
35	NFMetal	Aluminium: Primary	Smelting	Increased Current	6,593.16	-1,026.43
36	NFMetal	Aluminium: Primary	Anode Consumption	Reduced carbon consumption	466.37	-1,016.14
37	NFMetal	Lead, zinc and tin production	Pumps & Fans (<300kw)	Soft Starters	5.43	-995.61
38	NFMetal	Aluminium: Finished	Remelting: Inefficient	Recuperative Burners	684.31	-969.72
39	NFMetal	Other Non-Ferrous	Smelting and refining	Improved Management	1,790.55	-965.30
40	NFMetal	Copper: Wrought products	Drive Systems	VSDs	495.25	-954.25
41	NFMetal	Aluminium: Secondary	Secondary Smelting: Ineff	Insulation	1,159.62	-936.29
42	NFMetal	Other Non-Ferrous	Smelting and refining	HEMs	624.17	-926.40
43	NFMetal	Aluminium: Finished	Reheat Furnaces	Improved design	1,064.96	-918.32
44	NFMetal	Aluminium: Finished	Annealing Furnaces	Improved burners	3,209.86	-908.63
45	NFMetal	Aluminium: Finished	Annealing Furnaces	Recuperative burners	2,534.59	-868.35
46	NFMetal	Aluminium: Primary	Anode Manufacture	Furnace re-build	5,105.53	-770.00
47	NFMetal	Lead, zinc and tin production	Pumps & Fans (<300kw)	VSDs	20.95	-769.87
48	NFMetal	Aluminium: Secondary	Secondary Smelting: Average	Recuperative Burners	2,956.63	-763.34
49	NFMetal	Aluminium: Primary	Anode Consumption	Non-consumable electrodes	8,516.87	-713.53
50	NFMetal	Aluminium: Secondary	Secondary Smelting: Ineff	Improved Management	473.50	-666.29
51	NFMetal	Aluminium: Secondary	Secondary Smelting: Average	Insulation	1,263.12	-662.59
52	NFMetal	Aluminium: Finished	Remelting: Inefficient	Improved Management	221.70	-652.11
53	NFMetal	Aluminium: Finished	Extrusion Drives	HEMs	72.68	-634.82
54	NFMetal	Copper: Secondary	Shaft Furnace	Recuperators	15.53	-575.46
55	NFMetal	Aluminium: Finished	Annealing Furnaces	M&T	327.08	-561.31
56	NFMetal	Aluminium: Finished	Remelting: Efficient	Improved Management	191.59	-552.50

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
57	NFMetal	Aluminium: Finished	Reheat Furnaces	M&T	165.08	-550.97
58	NFMetal	Aluminium: Secondary	Secondary Smelting: Average	Improved Combustion	652.62	-507.79
59	NFMetal	Aluminium: Primary	Other Processes	HEMs	158.53	-437.21
60	NFMetal	Aluminium: Primary	Other Processes	Improved Management	346.50	-428.35
61	NFMetal	Aluminium: Primary	Other Processes	VSDs	569.96	-421.54
62	NFMetal	Aluminium: Primary	Other Processes	Fans	2,068.36	-418.54
63	NFMetal	Aluminium: Primary	Other Processes	Soft Starters	389.45	-382.70
64	NFMetal	Copper: Secondary	Ingot Furnaces	Improved management	21.46	-347.60
65	NFMetal	Copper: Wrought products	Tubes Billet Heating	Radiant tubes	95.49	-336.87
66	NFMetal	Aluminium: Secondary	Secondary Smelting: Efficient	Improved Management	159.46	-296.26
67	NFMetal	Aluminium: Secondary	Secondary Smelting: Average	Improved Management	597.60	- 69.59
68	NFMetal	Copper: Secondary	Reverbatory Melting	Management	22.40	- 62.40
69	NFMetal	Copper: Secondary	Induction Melting	Management	7.19	- 51.75
70	NFMetal	Copper: Secondary	Ingot Furnaces	Improved control	52.77	1,691.31
71	NFMetal	Copper: Wrought products	Billet and Slab Heating	Recuper Burners	132.81	2,391.83
72	NFMetal	Aluminium: Finished	Other Services	Fans	3,173.13	3,098.09
73	NFMetal	Lead, zinc and tin production	Refining	Improved control	6.69	4,078.99
74	NFMetal	Copper: Secondary	Annealing	Stock temp control	9.77	4,613.44
75	NFMetal	Lead, zinc and tin production	Refining	Heat recovery	7.37	4,847.67
76	NFMetal	Other Non-Ferrous	Smelting and refining	Gas recovery	1,642.91	5,398.99
77	NFMetal	Copper: Secondary	Reverbatory Melting	Combustion Imprvs	46.39	5,415.37
78	NFMetal	Lead, zinc and tin production	Refining	Regen burners	9.98	6,677.64
79	NFMetal	Copper: Secondary	Blast Furnaces	Improved Management	12.58	8,535.46
80	NFMetal	Copper: Secondary	Reverbatory Melting	Afterburners	54.76	8,583.46
81	NFMetal	Copper: Wrought products	Billet and Slab Heating	Stock temp control	12.80	8,924.77
82	NFMetal	Lead, zinc and tin production	Primary Smelting	Gas recovery	6.26	9,367.78
83	NFMetal	Copper: Wrought products	Billet and Slab Heating	Baffles	7.84	10,576.29
84	NFMetal	Aluminium: Finished	Other Services	VSDs	656.53	11,615.04

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
85	NFMetal	Copper: Secondary	Secondary Smelting	Process Improvement	57.52	12,358.62
86	NFMetal	Aluminium: Finished	Other Services	Soft Starters	576.00	15,919.72
87	NFMetal	Copper: Secondary	Ingot Furnaces	Afterburners	13.53	16,059.00
88	NFMetal	Aluminium: Finished	Other Services	HEMs	173.85	19,340.25
89	NFMetal	Lead, zinc and tin production	Primary Smelting	Sinter heat recovery	6.12	20,788.08
90	NFMetal	Aluminium: Primary	Smelting	New cell design	27,601.02	24,930.90

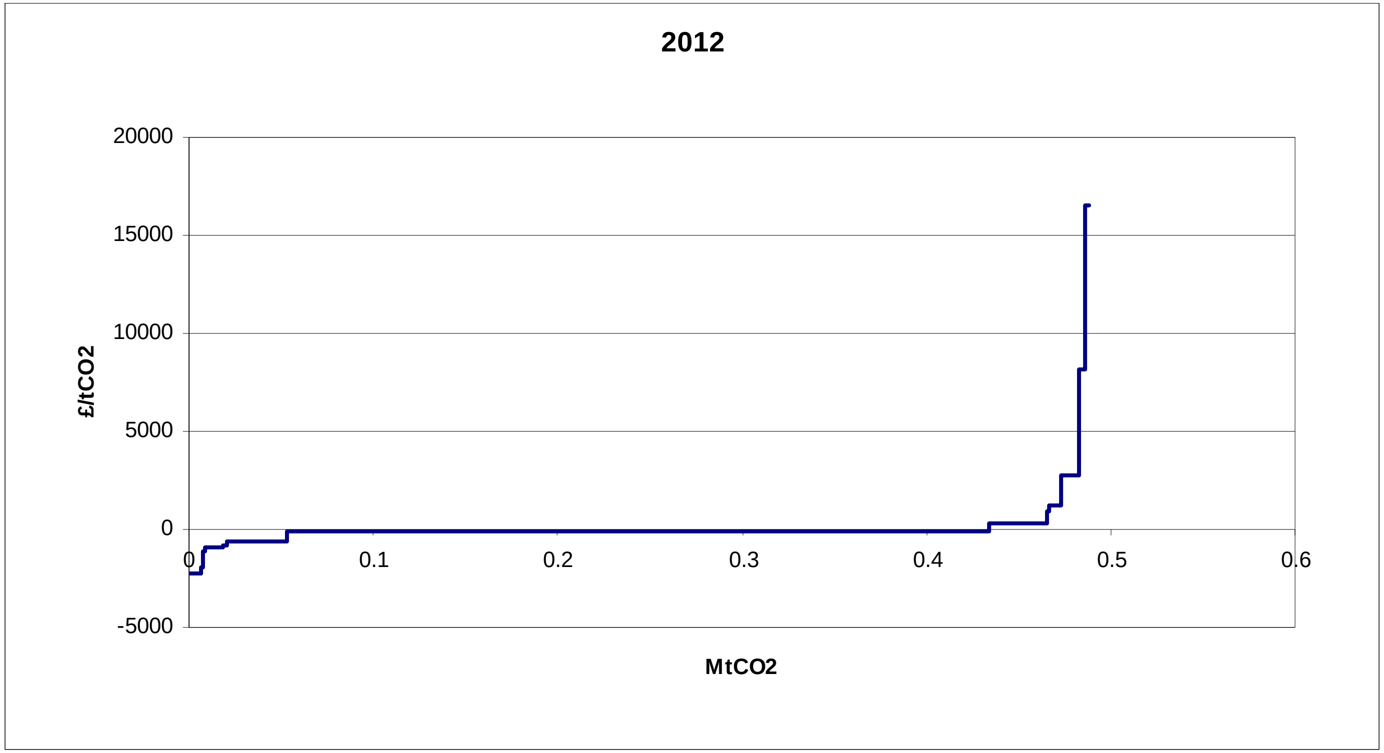
9.1.8 Other Industries



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Other Industries	Sawmilling	sawing	process im	7,328.22	-209.01
2	Other Industries	Sawmilling	planing	process im	7,328.22	-209.01
3	Other Industries	Chipboard	chipping	process im	5,540.03	-208.36
4	Other Industries	Chipboard	pressing	process im	106.75	-199.27

5	Other Industries	Furniture	Woodworking	process im	559.78	-175.07
6	Other Industries	Miscellaneous	all processes	process im	426.63	-155.47
7	Other Industries	Furniture	coating	process im	450.21	-154.47
8	Other Industries	Chipboard	curing	process im	2,855.26	-136.78
9	Other Industries	Furniture	assembly	process im	185.60	-111.63
10	Other Industries	Furniture	upholstery	process im	185.60	-111.07
11	Other Industries	Chipboard	drying of wood	process im	19,471.70	-102.52
12	Other Industries	Sawmilling	drying of wood	process im	18,658.68	-101.37
13	Other Industries	Furniture	space heating	process im	528.47	-98.95
14	Other Industries	Sawmilling	space heating	process im	2,054.71	-96.19
15	Other Industries	Chipboard	space heating	process im	265.54	-91.97

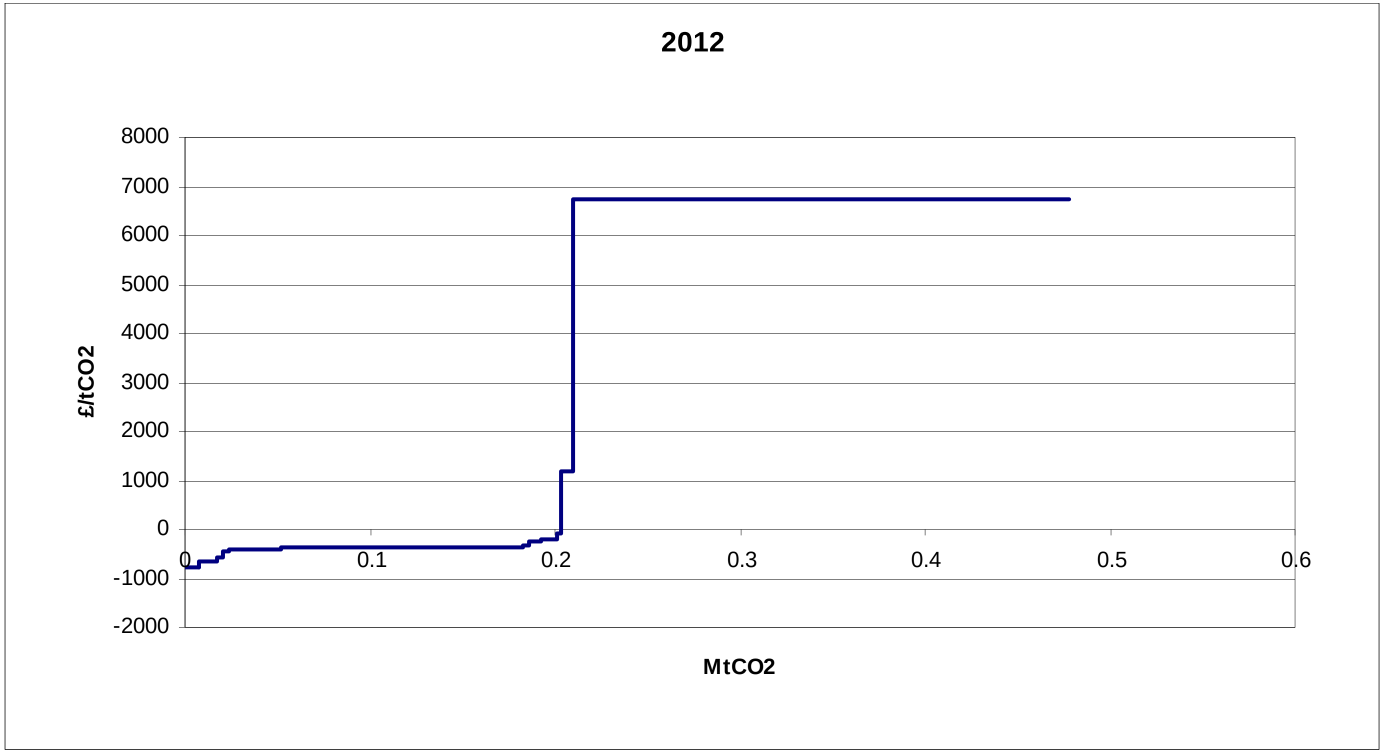
9.1.9 Paper



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	PAPER	PAPER & BOARD	Broke overhead	Caliper control	6,289.72	-2,293.44
2	PAPER	PAPER & BOARD	Drying section	Drying controls	1,099.55	-1,965.05
3	PAPER	PRINTING & PUBLISHING	Pumps and Fans (<300kw)	HEMs	347.00	-1,146.83
4	PAPER	PRINTING & PUBLISHING	Pumps and Fans (<300kw)	VSDs	192.14	-1,145.40

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	PAPER	PRINTING & PUBLISHING	Pumps and Fans (>300kw)	HEMs	172.70	-1,133.29
6	PAPER	PRINTING & PUBLISHING	Pumps and Fans (>300kw)	VSDs	106.02	-1,130.12
7	PAPER	PRINTING & PUBLISHING	Pumps and Fans (<300kw)	Soft Starters	275.80	-1,106.69
8	PAPER	PRINTING & PUBLISHING	Pumps and Fans (>300kw)	Soft Starters	136.90	-1,085.59
9	PAPER	PRINTING & PUBLISHING	Utilities - CA & V systems	Variable Speed vacuum system	9,525.61	-922.40
10	PAPER	PRINTING & PUBLISHING	Conveyors and mach (>300kw)	HEMs	0.00	-859.06
11	PAPER	PRINTING & PUBLISHING	Conveyors and mach (>300kw)	Soft Starters	16.52	-802.09
12	PAPER	PRINTING & PUBLISHING	Refrig and CA (>300kw)	Comprehensive maintenance	2,249.98	-774.73
13	PAPER	PRINTING & PUBLISHING	Refrig and CA (<300kw)	Comprehensive maintenance	16.25	-747.84
14	PAPER	PRINTING & PUBLISHING	Con and machinery (<300kw)	Soft Starters	0.00	-705.61
15	PAPER	PRINTING & PUBLISHING	Conveyors and mach (>300kw)	VSDs	22.11	-665.74
16	PAPER	PRINTING & PUBLISHING	Utilities - CA & V systems	New plant	26,802.99	-658.46
17	PAPER	PAPER & BOARD	Pulping	Improved pulping technologies	5,137.87	-603.02
18	PAPER	PRINTING & PUBLISHING	Con and machinery (<300kw)	VSDs	863.88	-569.60
19	PAPER	PRINTING & PUBLISHING	Utilities - CA & V systems	Energy management	275.76	-523.66
20	PAPER	PAPER & BOARD	Drying section	Impulse drying	380,361.31	-132.92
21	PAPER	PAPER & BOARD	Energy management overhead	Energy management systems	16,561.66	259.15
22	PAPER	PAPER & BOARD	Buildings	Lighting, heating, insulation	14,899.46	345.63
23	PAPER	PAPER & BOARD	Drying section	Steam distribution systems	134.54	455.21
24	PAPER	PAPER & BOARD	Compressed air	Comprehensive maintenance	1,322.54	883.99
25	PAPER	PAPER & BOARD	Forming section	Motors and belts	6,393.67	1,218.11
26	PAPER	PAPER & BOARD	Vacuum systems	Variable speed vacuum systems	9,888.75	2,749.76
27	PAPER	PAPER & BOARD	Press section	Improved pressing technologies	2,899.55	8,180.63
28	PAPER	PAPER & BOARD	Forming section	Vacuum Optimisation	2,470.90	16,572.74

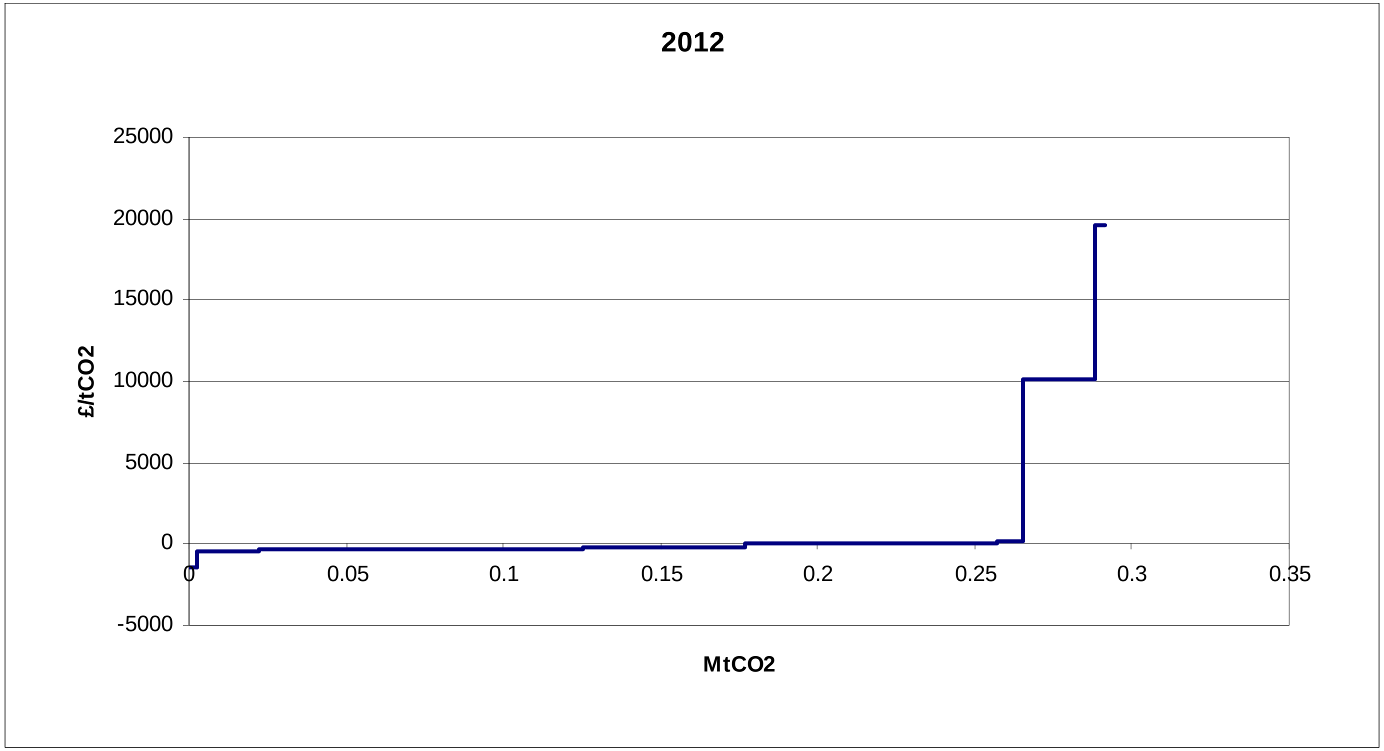
9.1.10 Plastics



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Plastics	Plastics manufacture	Process	Barrel insulation	7,444.75	-761.65
2	Plastics	TYRES	Mixing and milling	Low energy mixing	6,991.04	-658.29
3	Plastics	TYRES	Mixing and milling	Poly preheat	2,539.83	-635.74
4	Plastics	TYRES	Mixing and milling	Control systems	3,686.95	-554.96

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Plastics	GENERAL RUBBER	Mixing and milling	Low energy mixing	3,362.94	-452.77
6	Plastics	Plastics manufacture	Extrusion	Improved process	17,605.44	-408.32
7	Plastics	TYRES	Moulding and curing	Press insulation	3,098.65	-407.43
8	Plastics	TYRES	Moulding and curing	High effic heating	7,641.75	-399.24
9	Plastics	Plastics manufacture	Process	Drive improvements	111,995.29	-380.00
10	Plastics	TYRES	Moulding and curing	Cure control	16,064.16	-377.84
11	Plastics	GENERAL RUBBER	Mixing and milling	Poly preheat	1,075.29	-370.99
12	Plastics	GENERAL RUBBER	Moulding and curing	Press insulation	723.62	-360.00
13	Plastics	GENERAL RUBBER	Moulding and curing	High effic heating	3,249.35	-324.77
14	Plastics	GENERAL RUBBER	Moulding and curing	Cure control	6,790.89	-231.54
15	Plastics	Plastics manufacture	Injection Moulding	Barrel insulation	9,215.63	-212.23
16	Plastics	GENERAL RUBBER	Mixing and milling	Control systems	1,397.61	- 81.38
17	Plastics	Plastics manufacture	Space Heating	Machine heat recov	7,334.32	1,170.50
18	Plastics	Plastics manufacture	Injection Moulding	Drive improvements	267,961.36	6,721.17

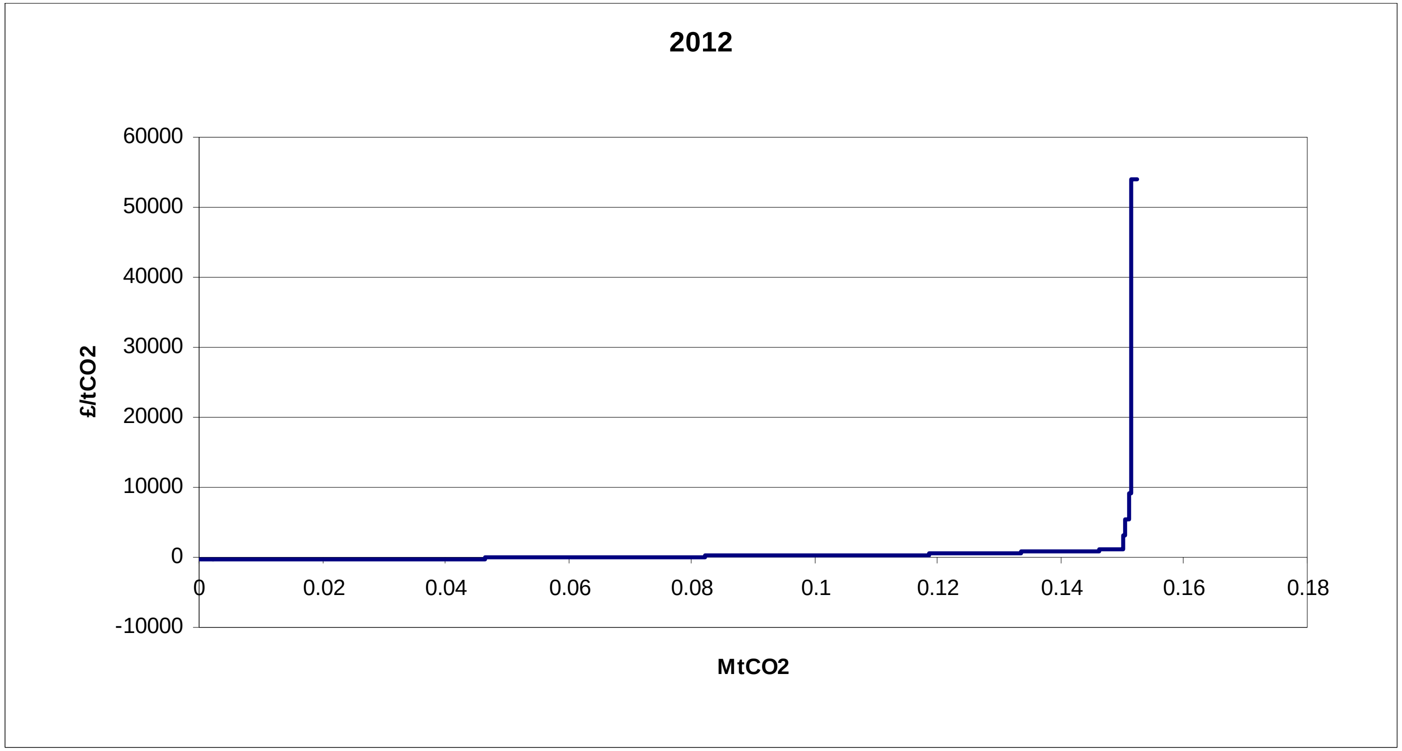
9.1.11 Steel



	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Steel	Blast Furnace Route	Blast/BOS Furnace	coal injection	2,742.53	-1,461.76
2	Steel	Blast Furnace Route	Sinter Strands	Partial exhaust HR	14,736.98	-471.10
3	Steel	Blast Furnace Route	Blast/BOS Furnace	other savings	5,103.06	-469.02
4	Steel	Blast Furnace Route	Blast/BOS Furnace	new plant (ecotech)	103,086.77	-372.65

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Steel	Blast Furnace Route	Sinter Strands	process control	2,129.13	-209.77
6	Steel	Blast Furnace Route	Boilers/Flare	Increase gas collection	49,406.62	-197.73
7	Steel	EAF Route	EAFs	Tower furnace	80,111.94	93.38
8	Steel	Blast Furnace Route	Sinter Strands	Full exhaust HR	7,810.51	177.07
9	Steel	EAF Route	EAFs	Scrap preheating	23,163.94	10,181.08
10	Steel	EAF Route	EAFs	DC EAF	3,404.76	19,640.73

9.1.12 Vehicles



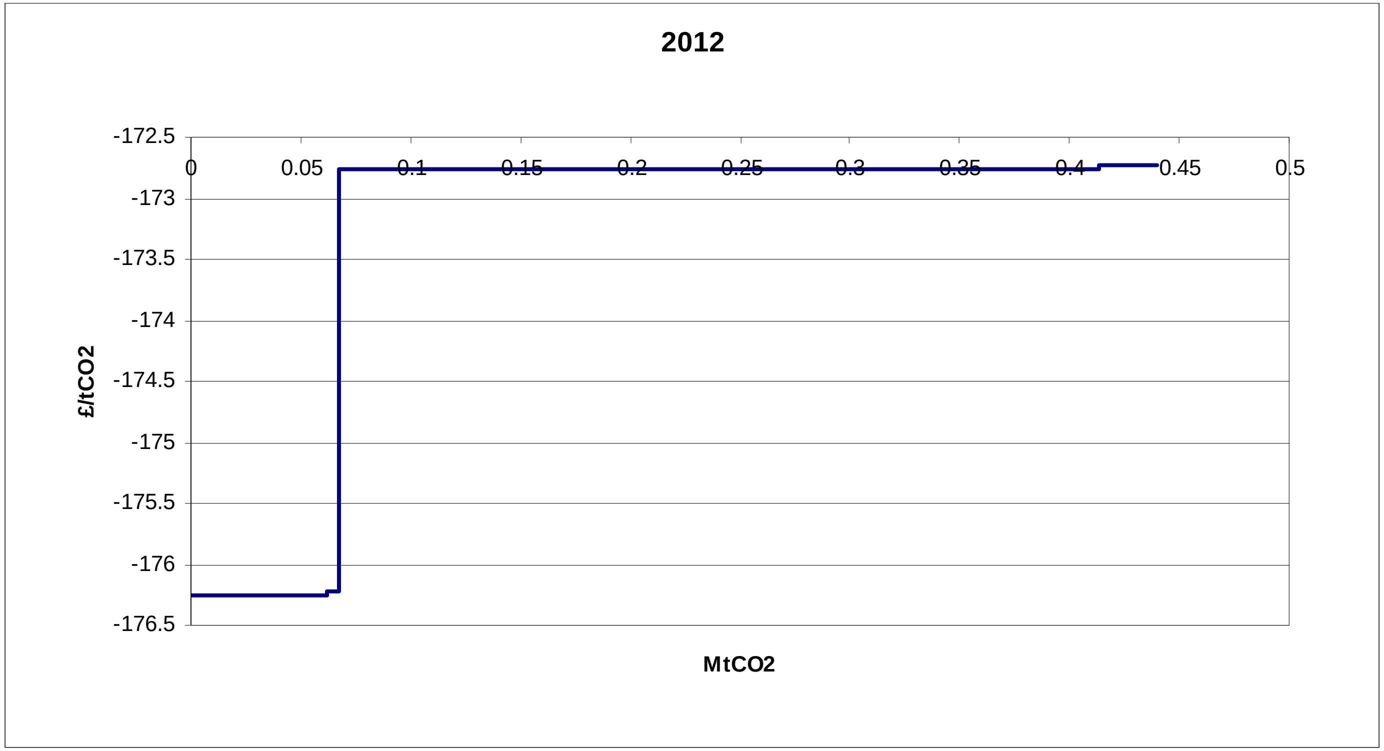
	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Vehicle Eng	Land Transport	Lighting	House and maint	2,288.55	-258.17
2	Other Vehicles	Other Transport	Lighting	House and maint	636.88	-255.33
3	Other Vehicles	Other Transport	Lighting	Controls	613.29	-235.44
4	Other Vehicles	Other Transport	Other aux/pumping	VSDs	29.86	-230.92

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Other Vehicles	Other Transport	Other aux/pumping	Soft Start	136.98	-217.60
6	Vehicle Eng	Land Transport	Forming/welding/machining	Process improvement	10,637.28	-214.71
7	Other Vehicles	Other Transport	Compressed Air	Control sy	1,245.85	-205.02
8	Other Vehicles	Other Transport	Forming/welding/machining	Process improvement	2,309.10	-196.10
9	Vehicle Eng	Land Transport	Ventilation	New plant	1,700.05	-189.83
10	Other Vehicles	Other Transport	Lighting	Convert to high effy luminaire	111.09	-188.66
11	Other Vehicles	Other Transport	Ventilation	New plant	286.40	-186.06
12	Other Vehicles	Other Transport	Forming/welding/machining	New plant	1,697.73	-175.07
13	AEROSPACE	Aerospace	Forming/welding/machining	Process improvement	9,829.94	-174.17
14	Other Vehicles	Other Transport	Compressed Air	New plant	1,006.98	-172.41
15	Other Vehicles	Other Transport	Furnaces/Heat Treat	House and maint	314.74	-167.30
16	Other Vehicles	Other Transport	Plating/pickling	New plant	2,517.33	-164.10
17	AEROSPACE	Aerospace	Lighting	House and maint	1,568.34	-162.30
18	Vehicle Eng	Land Transport	Compressed Air	O&M Improv	2,817.09	-158.91
19	Other Vehicles	Other Transport	Plating/pickling	Controls	662.01	-158.46
20	Other Vehicles	Other Transport	Plating/pickling	Process improvement	998.83	-152.32
21	Other Vehicles	Other Transport	IT	New plant	245.61	-149.44
22	Other Vehicles	Other Transport	Painting/curing	Better design	585.49	-146.59
23	AEROSPACE	Aerospace	Lighting	Convert to high effy luminaire	2,144.73	-145.30
24	Other Vehicles	Other Transport	Painting/curing	New plant	1,022.17	-144.58
25	Other Vehicles	Other Transport	Space Heating	Controls & BMS & insulation	1,028.01	-143.76
26	Other Vehicles	Other Transport	Space Heating	New plant	3,414.41	-139.86
27	Other Vehicles	Other Transport	Furnaces/Heat Treat	new plant	405.87	-139.25
28	AEROSPACE	Aerospace	Compressed Air	O&M Improv	1,655.31	-138.55
29	Other Vehicles	Other Transport	Painting/curing	Controls & insulation	654.74	-135.79
30	Other Vehicles	Other Transport	Compressed Air	O&M Improv	323.12	-133.27
31	Other Vehicles	Other Transport	Painting/curing	House and maint	259.34	-131.75
32	AEROSPACE	Aerospace	Ventilation	New plant	1,231.75	-129.59

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
33	Vehicle Eng	Land Transport	Ventilation	System imp	1,944.58	-112.24
34	Other Vehicles	Other Transport	Ventilation	System imp	282.83	-108.56
35	Other Vehicles	Other Transport	Furnaces/Heat Treat	Controls & insulation	412.15	-104.77
36	AEROSPACE	Aerospace	Ventilation	System imp	1,179.11	-103.59
37	Other Vehicles	Other Transport	Plating/pickling	House and maint	445.67	- 92.13
38	Vehicle Eng	Land Transport	Furnaces/Heat Treat	House and maint	277.38	- 91.08
39	Other Vehicles	Other Transport	Space Heating	Central to decentral	751.73	- 88.50
40	Other Vehicles	Other Transport	Space Heating	House and maint	1,256.93	- 85.19
41	AEROSPACE	Aerospace	Space Heating	Controls & BMS & insulation	0.01	- 81.13
42	AEROSPACE	Aerospace	Space Heating	House and maint	0.00	- 60.57
43	AEROSPACE	Aerospace	Lighting	Controls	1,210.62	- 57.07
44	AEROSPACE	Aerospace	Other aux/pumping	HEMs	100.28	- 29.64
45	Vehicle Eng	Land Transport	Painting/curing	Central to decentral	2,310.88	- 28.81
46	AEROSPACE	Aerospace	Compressed Air	Control sy	631.22	- 15.70
47	AEROSPACE	Aerospace	Forming/welding/machining	New plant	9,643.31	40.71
48	Vehicle Eng	Land Transport	Lighting	Controls	4,305.69	50.53
49	AEROSPACE	Aerospace	Other aux/pumping	VSDs	3,183.65	95.92
50	AEROSPACE	Aerospace	Compressed Air	New plant	2,288.32	180.22
51	AEROSPACE	Aerospace	Space Heating	New boiler plant	153.89	180.46
52	AEROSPACE	Aerospace	Direct process	House and maint	187.54	222.07
53	AEROSPACE	Aerospace	Indirect process	Central to decentral	1,028.18	223.50
54	AEROSPACE	Aerospace	Other aux/pumping	Soft Start	568.30	289.07
55	Other Vehicles	Other Transport	Furnaces/Heat Treat	Heat recovery	213.59	293.90
56	AEROSPACE	Aerospace	IT	New plant	2,123.39	346.70
57	Vehicle Eng	Land Transport	Forming/welding/machining	New plant	18,322.02	369.05
58	Vehicle Eng	Land Transport	Compressed Air	Control sy	3,282.10	381.70
59	Vehicle Eng	Land Transport	Space Heating	Controls & BMS & insulation	8,022.59	415.13
60	Vehicle Eng	Land Transport	Other aux/pumping	VSDs	3,313.91	499.09

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
61	Vehicle Eng	Land Transport	Compressed Air	New plant	9,594.22	630.65
62	AEROSPACE	Aerospace	Indirect process	Replace plant/refurb	2,117.78	653.78
63	Vehicle Eng	Land Transport	Space Heating	New boiler plant	11,721.13	798.53
64	Vehicle Eng	Land Transport	Other aux/pumping	Soft Start	1,114.38	949.47
65	Vehicle Eng	Land Transport	IT	New plant	3,728.54	1,269.05
66	AEROSPACE	Aerospace	Direct process	New plant/refurb	424.43	3,229.85
67	Vehicle Eng	Land Transport	Furnaces/Heat Treat	new plant	458.43	5,512.46
68	Vehicle Eng	Land Transport	Furnaces/Heat Treat	Controls & insulation	446.59	9,139.65
69	Vehicle Eng	Land Transport	Furnaces/Heat Treat	Heat recovery	1,027.16	53,860.16

9.1.13 Water

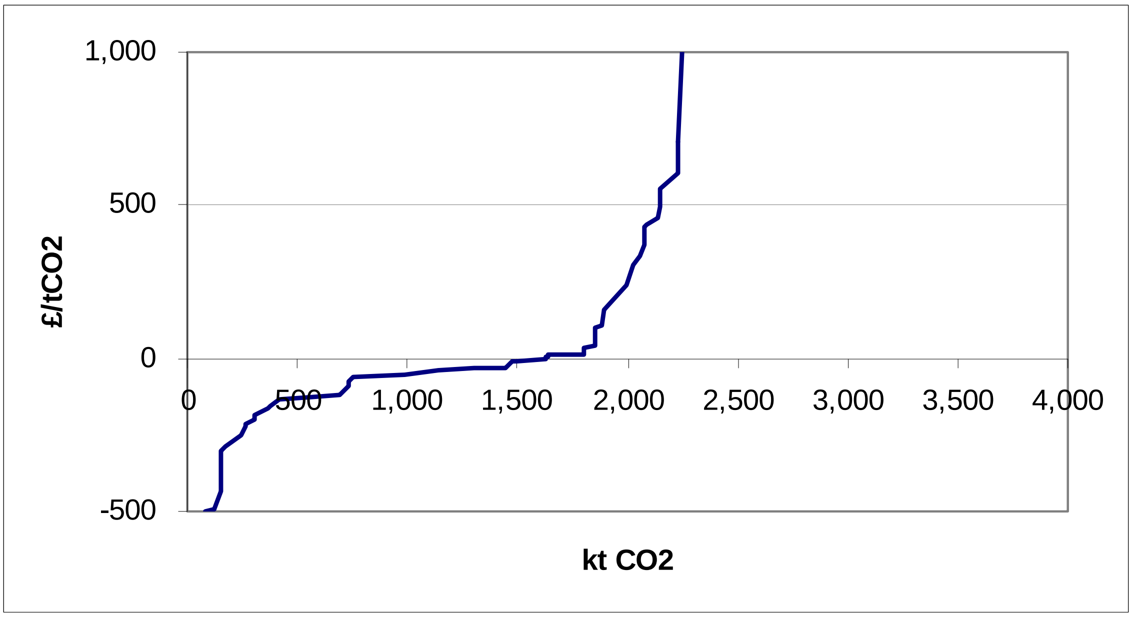


	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
1	Water	Water	Other	Variable Speed Drives	62,271.30	-176.25
2	Water	Water	Other	High Efficiency Motors	5,290.92	-176.23
3	Water	Water	Collection and Purification	Variable Speed Drive	140,533.45	-172.76
4	Water	Water	Distribution	Variable Speed Drive	205,286.87	-172.76

	Sector	Subsector	Device	Technology	Carbon saving (tCO_2/year)	Cost effectiveness (£/tCO_2)
5	Water	Water	Distribution	High Efficiency Motors	15,595.10	-172.74
6	Water	Water	Collection and Purification	High Efficiency Motors	10,675.96	-172.74

9.2 Appendix 2 - Non-domestic buildings subsector MACCs

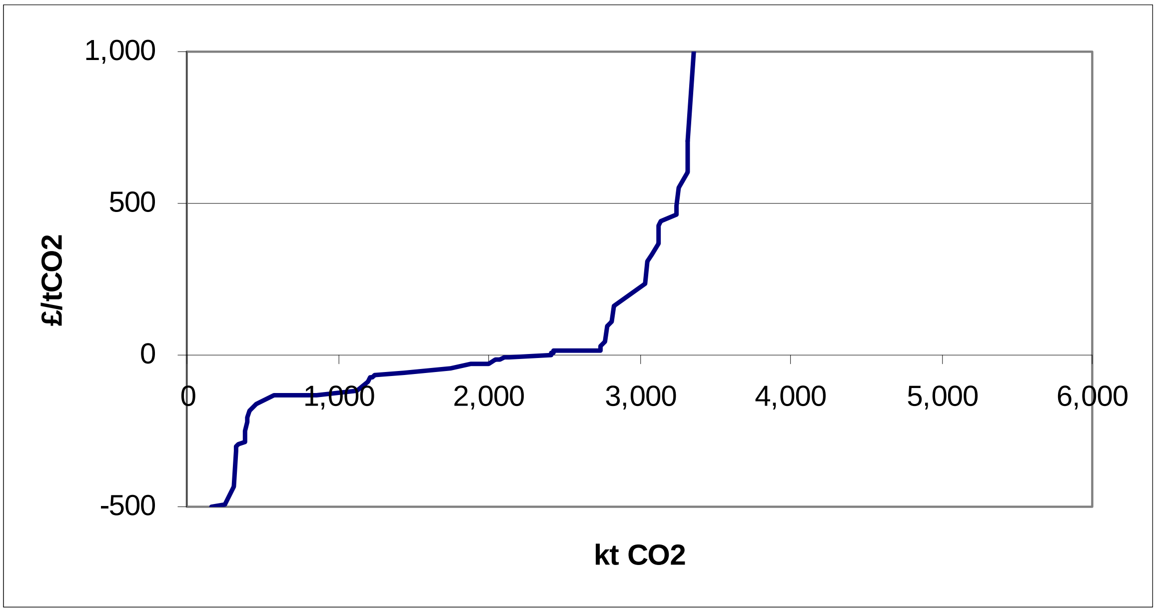
9.2.1 Wholesale trade



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	82.45	- 499.04
2	Computing	Computers - Energy Management	120.60	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	148.67	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	150.76	- 315.77
5	Computing	Inkjet Printer - Energy management	150.81	- 302.28
6	Computing	Laser Printer - Energy Management	160.36	- 293.89
7	Computing	Monitors - Energy Management	177.52	- 287.86
8	Process	Large Photocopiers - Energy Management	249.14	- 247.62
9	Process	Small Photocopiers - Energy Management	265.10	- 222.25
10	Catering	Vending Machines on standby	266.77	- 217.54
11	Process	Medium Photocopiers - Energy Management	305.32	- 203.23
12	Computing	Fax Machine - Energy Management	309.95	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	367.83	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	374.14	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	420.31	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	558.04	- 129.13
17	Lighting	Turn off Lights for an extra hour	690.03	- 119.62
18	Lighting	Basic Timer for Lighting	733.36	- 89.58
19	Catering	Most CE Fridge-Freezers	734.34	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	742.79	- 71.58
21	Lighting	Sunrise-Sunset Timers	754.45	- 62.62
22	Heating	Heating - Reducing Room Temperature	982.49	- 55.53

23	Lighting	Fixed Period Timers (Stairwell)	1,136.50	- 41.18
24	Heating	Most CE Boiler	1,298.79	- 32.30
25	Heating	Heating - TRVs Fully Installed	1,446.47	- 30.09
26	Catering	A Class Fridge	1,462.15	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	1,470.14	- 17.03
28	Computing	Flat Screen Monitors	1,479.45	- 7.67
29	Catering	Most CE Freezers	1,492.54	- 6.16
30	Lighting	Presence Detectors	1,632.39	- 0.00
31	Lighting	ECG Compact Fluorescent Lamps & CFLs	1,632.61	4.73
32	Heating	Insulation - Roof - Pitched 200mm	1,640.09	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	1,640.78	8.60
34	Heating	Most CE Insulation - Cavity Wall	1,644.68	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	1,644.97	14.69
36	Lighting	Light Detectors	1,645.55	14.84
37	Heating	Optimising Start Times	1,645.57	14.84
38	Heating	Building Management Systems	1,645.63	14.84
39	Lighting	HF Ballasts	1,795.69	14.86
40	Heating	Most CE Insulation - External Cladding	1,796.28	14.87
41	Heating	Most CE Boiler	1,796.28	14.88
42	Catering	Most CE Fridge-Freezers	1,796.78	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	1,797.96	14.88
44	Heating	Heating - TRVs Fully Installed	1,798.23	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	1,798.30	31.48
46	Heating	Most CE Insulation - External Cladding	1,847.86	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	1,850.71	95.50
48	Catering	A Class Fridge	1,852.04	97.34
49	Heating	Insulation - Roof - Pitched 200mm	1,880.35	106.95
50	Lighting	Basic Timer for Lighting	1,881.45	107.02
51	Catering	Most CE Freezers	1,884.92	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	1,892.81	159.37
53	Lighting	Presence Detectors	1,990.20	235.60
54	Heating	Insulation - Roof - Flat 75 mm	2,022.65	305.84
55	Heating	Most CE Insulation - Cavity Wall	2,055.87	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	2,075.46	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	2,079.28	426.63
58	Lighting	Sunrise-Sunset Timers	2,083.83	439.26
59	Lighting	Fixed Period Timers (Stairwell)	2,134.32	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	2,143.11	492.32
61	Computing	Flat Screen Monitors	2,145.63	550.05
62	Heating	Most CE Double Glazing Replace Single	2,229.61	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	2,229.78	709.48

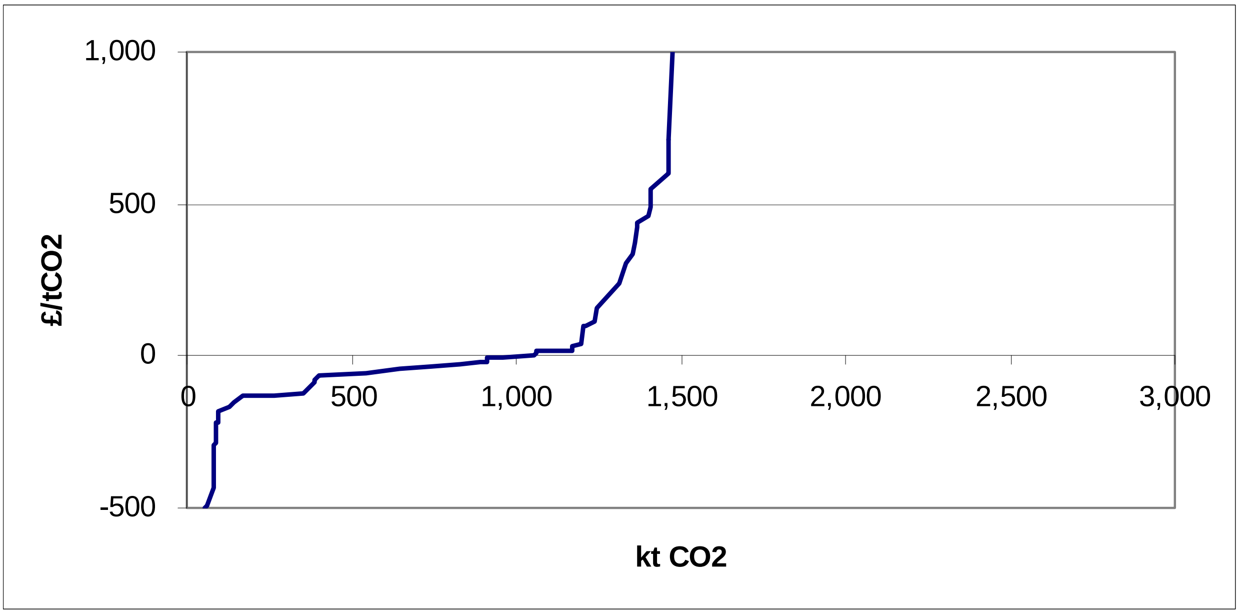
9.2.2 Retail trade



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	165.24	- 499.04
2	Computing	Computers - Energy Management	257.57	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	313.83	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	318.90	- 315.77
5	Computing	Inkjet Printer - Energy management	319.02	- 302.28
6	Computing	Laser Printer - Energy Management	342.12	- 293.89
7	Computing	Monitors - Energy Management	383.67	- 287.86
8	Process	Large Photocopiers - Energy Management	392.10	- 247.62
9	Process	Small Photocopiers - Energy Management	393.98	- 222.25
10	Catering	Vending Machines on standby	398.72	- 217.54
11	Process	Medium Photocopiers - Energy Management	403.26	- 203.23
12	Computing	Fax Machine - Energy Management	414.48	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	462.42	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	486.20	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	578.74	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	854.75	- 129.13
17	Lighting	Turn off Lights for an extra hour	1,119.26	- 119.62
18	Lighting	Basic Timer for Lighting	1,206.08	- 89.58
19	Catering	Most CE Fridge-Freezers	1,208.87	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	1,225.80	- 71.58
21	Lighting	Sunrise-Sunset Timers	1,249.17	- 62.62
22	Heating	Heating - Reducing Room Temperature	1,438.05	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	1,746.69	- 41.18
24	Heating	Most CE Boiler	1,881.11	- 32.30
25	Heating	Heating - TRVs Fully Installed	2,003.43	- 30.09
26	Catering	A Class Fridge	2,047.77	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	2,077.90	- 17.03
28	Computing	Flat Screen Monitors	2,100.44	- 7.67
29	Catering	Most CE Freezers	2,137.45	- 6.16

30	Lighting	Presence Detectors	2,417.72	- 0.00
31	Lighting	ECG Compact Fluorescent Lamps & CFLs	2,418.15	4.73
32	Heating	Insulation - Roof - Pitched 200mm	2,424.34	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	2,426.95	8.60
34	Heating	Most CE Insulation - Cavity Wall	2,430.18	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	2,431.29	14.69
36	Lighting	Light Detectors	2,432.44	14.84
37	Heating	Optimising Start Times	2,432.46	14.84
38	Heating	Building Management Systems	2,432.51	14.84
39	Lighting	HF Ballasts	2,733.22	14.86
40	Heating	Most CE Insulation - External Cladding	2,733.71	14.87
41	Heating	Most CE Boiler	2,733.71	14.88
42	Catering	Most CE Fridge-Freezers	2,735.05	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	2,737.41	14.88
44	Heating	Heating - TRVs Fully Installed	2,737.62	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	2,737.67	31.48
46	Heating	Most CE Insulation - External Cladding	2,776.62	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	2,782.33	95.50
48	Catering	A Class Fridge	2,785.83	97.34
49	Heating	Insulation - Roof - Pitched 200mm	2,808.08	106.95
50	Lighting	Basic Timer for Lighting	2,810.28	107.02
51	Catering	Most CE Freezers	2,819.43	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	2,835.23	159.37
53	Lighting	Presence Detectors	3,030.40	235.60
54	Heating	Insulation - Roof - Flat 75 mm	3,055.90	305.84
55	Heating	Most CE Insulation - Cavity Wall	3,082.00	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	3,121.28	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	3,128.93	426.63
58	Lighting	Sunrise-Sunset Timers	3,138.04	439.26
59	Lighting	Fixed Period Timers (Stairwell)	3,239.22	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	3,246.13	492.32
61	Computing	Flat Screen Monitors	3,252.24	550.05
62	Heating	Most CE Double Glazing Replace Single	3,318.23	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	3,318.87	709.48

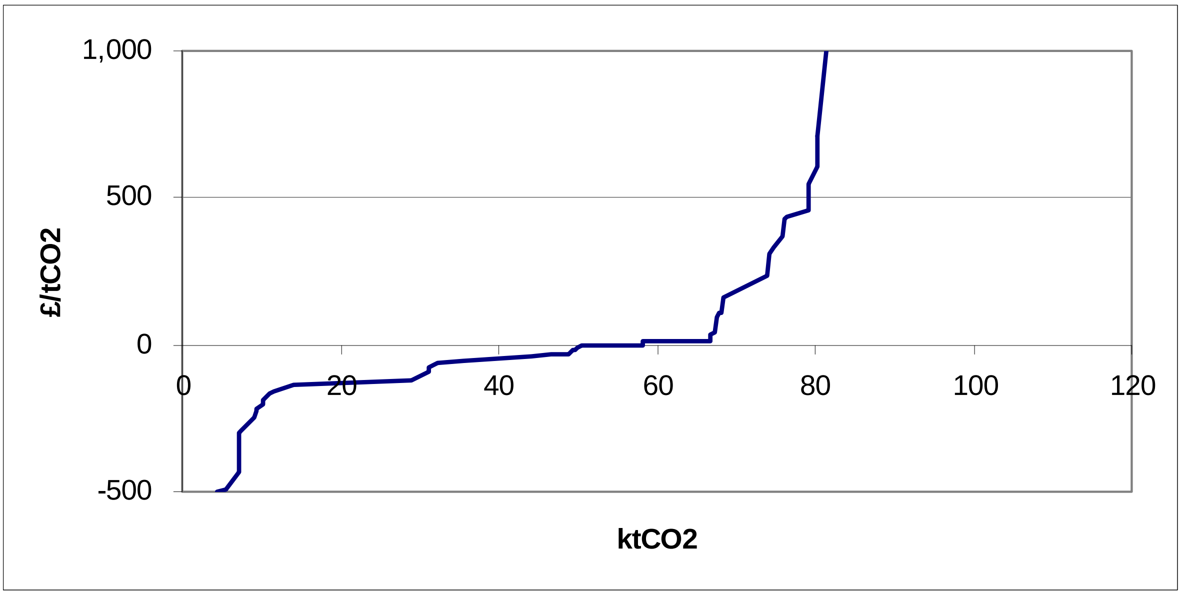
9.2.3 Hotels



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	56.15	- 499.04
2	Computing	Computers - Energy Management	61.97	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	81.09	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	81.41	- 315.77
5	Computing	Inkjet Printer - Energy management	81.42	- 302.28
6	Computing	Laser Printer - Energy Management	82.87	- 293.89
7	Computing	Monitors - Energy Management	85.49	- 287.86
8	Process	Large Photocopiers - Energy Management	86.97	- 247.62
9	Process	Small Photocopiers - Energy Management	87.30	- 222.25
10	Catering	Vending Machines on standby	93.83	- 217.54
11	Process	Medium Photocopiers - Energy Management	94.62	- 203.23
12	Computing	Fax Machine - Energy Management	95.33	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	130.25	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	141.50	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	172.94	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	266.73	- 129.13
17	Lighting	Turn off Lights for an extra hour	356.61	- 119.62
18	Lighting	Basic Timer for Lighting	386.11	- 89.58
19	Catering	Most CE Fridge-Freezers	389.94	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	395.69	- 71.58
21	Lighting	Sunrise-Sunset Timers	403.63	- 62.62
22	Heating	Heating - Reducing Room Temperature	541.21	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	646.08	- 41.18
24	Heating	Most CE Boiler	743.98	- 32.30
25	Heating	Heating - TRVs Fully Installed	833.08	- 30.09
26	Catering	A Class Fridge	894.05	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	908.29	- 17.03
28	Computing	Flat Screen Monitors	909.72	- 7.67
29	Catering	Most CE Freezers	960.59	- 6.16

30	Lighting	Presence Detectors	1,055.83	- 0.00
31	Lighting	ECG Compact Fluorescent Lamps & CFLs	1,055.97	4.73
32	Heating	Insulation - Roof - Pitched 200mm	1,060.49	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	1,061.72	8.60
34	Heating	Most CE Insulation - Cavity Wall	1,064.07	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	1,064.60	14.69
36	Lighting	Light Detectors	1,064.99	14.84
37	Heating	Optimising Start Times	1,065.00	14.84
38	Heating	Building Management Systems	1,065.04	14.84
39	Lighting	HF Ballasts	1,167.22	14.86
40	Heating	Most CE Insulation - External Cladding	1,167.57	14.87
41	Heating	Most CE Boiler	1,167.57	14.88
42	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	1,168.37	14.88
43	Catering	Most CE Fridge-Freezers	1,170.30	14.88
44	Heating	Heating - TRVs Fully Installed	1,170.46	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	1,170.50	31.48
46	Heating	Most CE Insulation - External Cladding	1,200.65	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	1,202.59	95.50
48	Catering	A Class Fridge	1,207.62	97.34
49	Heating	Insulation - Roof - Pitched 200mm	1,224.85	106.95
50	Lighting	Basic Timer for Lighting	1,225.59	107.02
51	Catering	Most CE Freezers	1,238.75	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	1,244.12	159.37
53	Lighting	Presence Detectors	1,310.43	235.60
54	Heating	Insulation - Roof - Flat 75 mm	1,330.17	305.84
55	Heating	Most CE Insulation - Cavity Wall	1,350.38	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	1,363.73	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	1,366.33	426.63
58	Lighting	Sunrise-Sunset Timers	1,369.42	439.26
59	Lighting	Fixed Period Timers (Stairwell)	1,403.80	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	1,409.15	492.32
61	Computing	Flat Screen Monitors	1,409.54	550.05
62	Heating	Most CE Double Glazing Replace Single	1,460.62	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	1,460.92	709.48

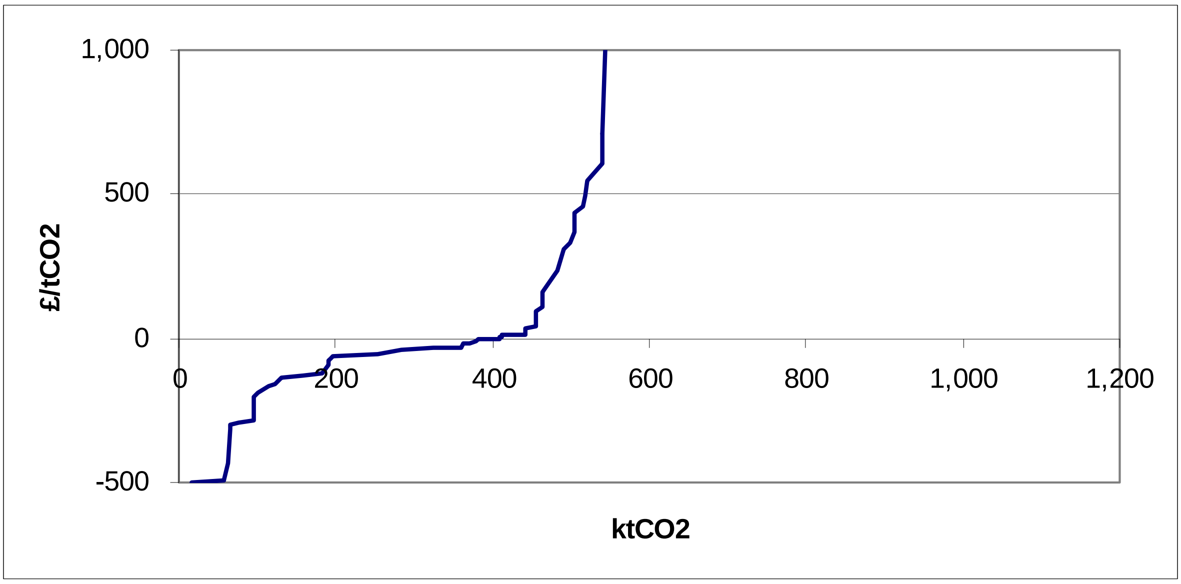
9.2.4 Transport



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	4.52	- 499.04
2	Computing	Computers - Energy Management	5.53	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	7.07	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	7.13	- 315.77
5	Computing	Inkjet Printer - Energy management	7.13	- 302.28
6	Computing	Laser Printer - Energy Management	7.38	- 293.89
7	Computing	Monitors - Energy Management	7.84	- 287.86
8	Process	Large Photocopiers - Energy Management	9.14	- 247.62
9	Process	Small Photocopiers - Energy Management	9.43	- 222.25
10	Catering	Vending Machines on standby	9.49	- 217.54
11	Process	Medium Photocopiers - Energy Management	10.19	- 203.23
12	Computing	Fax Machine - Energy Management	10.31	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	11.16	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	11.55	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	14.08	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	21.63	- 129.13
17	Lighting	Turn off Lights for an extra hour	28.86	- 119.62
18	Lighting	Basic Timer for Lighting	31.23	- 89.58
19	Catering	Most CE Fridge-Freezers	31.27	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	31.73	- 71.58
21	Lighting	Sunrise-Sunset Timers	32.37	- 62.62
22	Heating	Heating - Reducing Room Temperature	35.72	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	44.16	- 41.18
24	Heating	Most CE Boiler	46.55	- 32.30
25	Heating	Heating - TRVs Fully Installed	48.72	- 30.09
26	Catering	A Class Fridge	49.25	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	49.74	- 17.03
28	Computing	Flat Screen Monitors	49.98	- 7.67
29	Catering	Most CE Freezers	50.43	- 6.16
30	Lighting	Presence Detectors	58.09	- 0.00

31	Lighting	ECG Compact Fluorescent Lamps & CFLs	58.10	4.73
32	Heating	Insulation - Roof - Pitched 200mm	58.21	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	58.26	8.60
34	Heating	Most CE Insulation - Cavity Wall	58.31	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	58.33	14.69
36	Lighting	Light Detectors	58.36	14.84
37	Heating	Optimising Start Times	58.36	14.84
38	Heating	Building Management Systems	58.36	14.84
39	Lighting	HF Ballasts	66.59	14.86
40	Heating	Most CE Insulation - External Cladding	66.60	14.87
41	Heating	Most CE Boiler	66.60	14.88
42	Catering	Most CE Fridge-Freezers	66.61	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	66.68	14.88
44	Heating	Heating - TRVs Fully Installed	66.68	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	66.68	31.48
46	Heating	Most CE Insulation - External Cladding	67.35	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	67.51	95.50
48	Catering	A Class Fridge	67.55	97.34
49	Heating	Insulation - Roof - Pitched 200mm	67.93	106.95
50	Lighting	Basic Timer for Lighting	67.99	107.02
51	Catering	Most CE Freezers	68.10	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	68.53	159.37
53	Lighting	Presence Detectors	73.87	235.60
54	Heating	Insulation - Roof - Flat 75 mm	74.31	305.84
55	Heating	Most CE Insulation - Cavity Wall	74.76	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	75.83	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	76.04	426.63
58	Lighting	Sunrise-Sunset Timers	76.29	439.26
59	Lighting	Fixed Period Timers (Stairwell)	79.06	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	79.18	492.32
61	Computing	Flat Screen Monitors	79.24	550.05
62	Heating	Most CE Double Glazing Replace Single	80.38	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	80.39	709.48

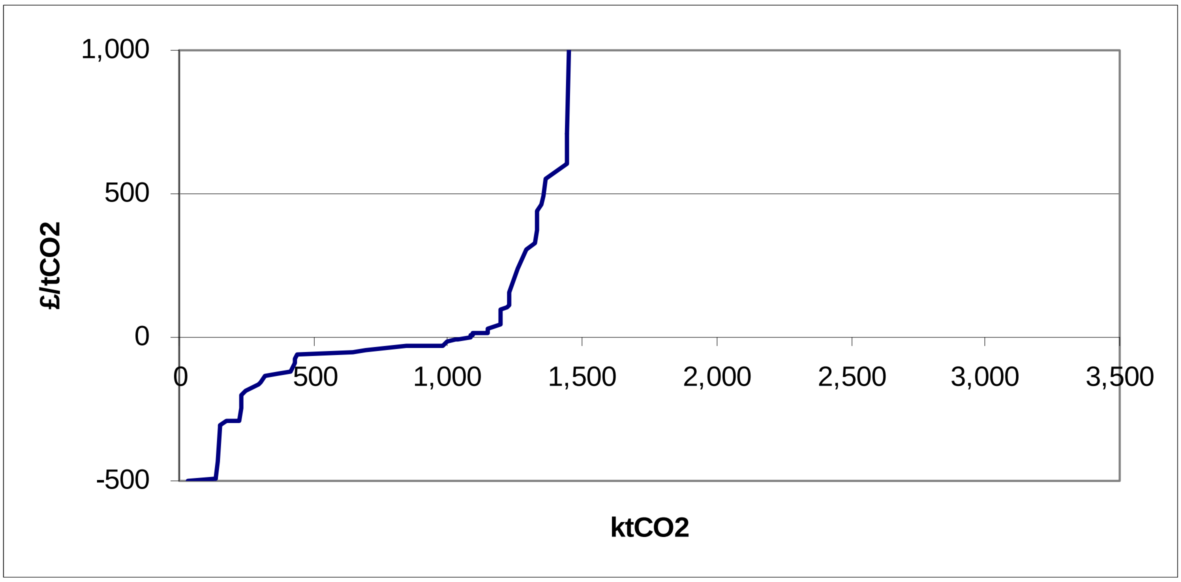
9.2.5 Real Estate



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	16.14	- 499.04
2	Computing	Computers - Energy Management	58.14	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	63.64	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	65.94	- 315.77
5	Computing	Inkjet Printer - Energy management	66.00	- 302.28
6	Computing	Laser Printer - Energy Management	76.51	- 293.89
7	Computing	Monitors - Energy Management	95.40	- 287.86
8	Process	Large Photocopiers - Energy Management	95.48	- 247.62
9	Process	Small Photocopiers - Energy Management	95.50	- 222.25
10	Catering	Vending Machines on standby	95.67	- 217.54
11	Process	Medium Photocopiers - Energy Management	95.71	- 203.23
12	Computing	Fax Machine - Energy Management	100.81	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	115.22	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	121.67	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	130.71	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	157.67	- 129.13
17	Lighting	Turn off Lights for an extra hour	183.52	- 119.62
18	Lighting	Basic Timer for Lighting	192.00	- 89.58
19	Catering	Most CE Fridge-Freezers	192.10	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	193.75	- 71.58
21	Lighting	Sunrise-Sunset Timers	196.04	- 62.62
22	Heating	Heating - Reducing Room Temperature	252.81	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	282.97	- 41.18
24	Heating	Most CE Boiler	323.37	- 32.30
25	Heating	Heating - TRVs Fully Installed	360.14	- 30.09
26	Catering	A Class Fridge	361.73	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	369.90	- 17.03
28	Computing	Flat Screen Monitors	380.15	- 7.67
29	Catering	Most CE Freezers	381.48	- 6.16
30	Lighting	Presence Detectors	408.86	- 0.00

31	Lighting	ECG Compact Fluorescent Lamps & CFLs	408.90	4.73
32	Heating	Insulation - Roof - Pitched 200mm	410.77	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	411.47	8.60
34	Heating	Most CE Insulation - Cavity Wall	412.44	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	412.74	14.69
36	Lighting	Light Detectors	412.86	14.84
37	Heating	Optimising Start Times	412.86	14.84
38	Heating	Building Management Systems	412.88	14.84
39	Lighting	HF Ballasts	442.26	14.86
40	Heating	Most CE Insulation - External Cladding	442.40	14.87
41	Heating	Most CE Boiler	442.40	14.88
42	Catering	Most CE Fridge-Freezers	442.45	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	442.68	14.88
44	Heating	Heating - TRVs Fully Installed	442.75	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	442.77	31.48
46	Heating	Most CE Insulation - External Cladding	454.90	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	455.46	95.50
48	Catering	A Class Fridge	455.59	97.34
49	Heating	Insulation - Roof - Pitched 200mm	462.52	106.95
50	Lighting	Basic Timer for Lighting	462.74	107.02
51	Catering	Most CE Freezers	463.08	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	464.62	159.37
53	Lighting	Presence Detectors	483.69	235.60
54	Heating	Insulation - Roof - Flat 75 mm	491.64	305.84
55	Heating	Most CE Insulation - Cavity Wall	499.77	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	503.61	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	504.36	426.63
58	Lighting	Sunrise-Sunset Timers	505.25	439.26
59	Lighting	Fixed Period Timers (Stairwell)	515.13	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	517.28	492.32
61	Computing	Flat Screen Monitors	520.06	550.05
62	Heating	Most CE Double Glazing Replace Single	540.62	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	540.80	709.48

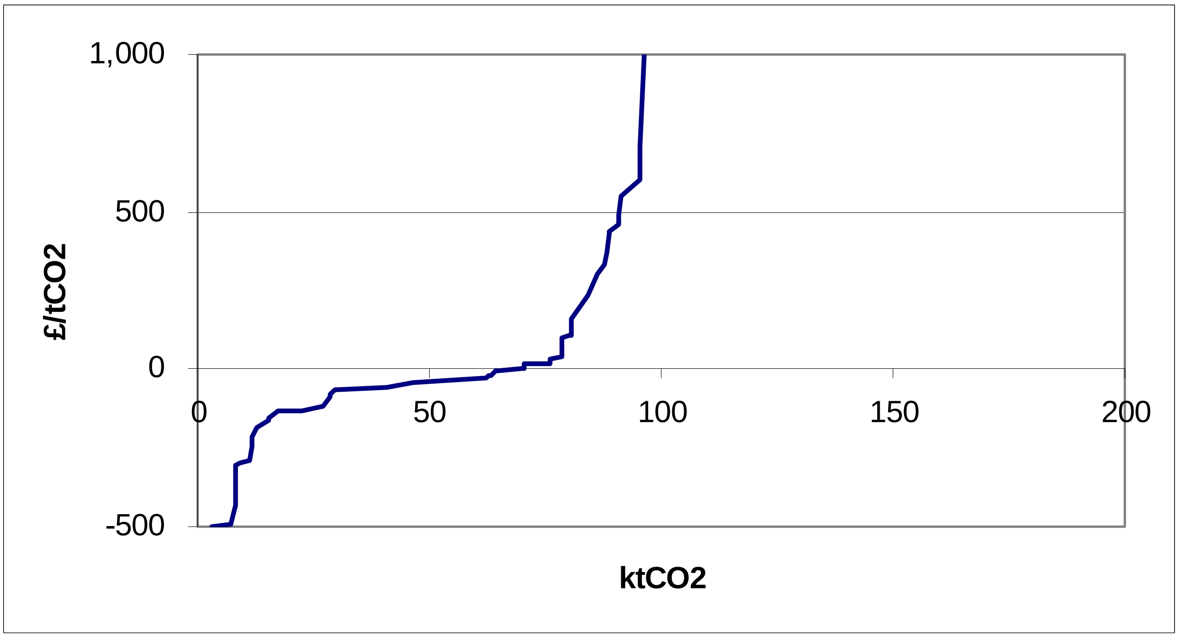
9.2.6 Public Administration



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	28.25	- 499.04
2	Computing	Computers - Energy Management	133.77	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	143.39	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	149.18	- 315.77
5	Computing	Inkjet Printer - Energy management	149.32	- 302.28
6	Computing	Laser Printer - Energy Management	175.71	- 293.89
7	Computing	Monitors - Energy Management	223.20	- 287.86
8	Process	Large Photocopiers - Energy Management	227.98	- 247.62
9	Process	Small Photocopiers - Energy Management	229.05	- 222.25
10	Catering	Vending Machines on standby	230.44	- 217.54
11	Process	Medium Photocopiers - Energy Management	233.02	- 203.23
12	Computing	Fax Machine - Energy Management	245.84	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	298.91	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	303.75	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	319.57	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	366.77	- 129.13
17	Lighting	Turn off Lights for an extra hour	412.00	- 119.62
18	Lighting	Basic Timer for Lighting	426.84	- 89.58
19	Catering	Most CE Fridge-Freezers	427.66	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	430.55	- 71.58
21	Lighting	Sunrise-Sunset Timers	434.55	- 62.62
22	Heating	Heating - Reducing Room Temperature	643.64	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	696.42	- 41.18
24	Heating	Most CE Boiler	845.22	- 32.30
25	Heating	Heating - TRVs Fully Installed	980.64	- 30.09
26	Catering	A Class Fridge	993.62	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	999.75	- 17.03
28	Computing	Flat Screen Monitors	1,025.52	- 7.67
29	Catering	Most CE Freezers	1,036.35	- 6.16
30	Lighting	Presence Detectors	1,084.28	- 0.00

31	Lighting	ECG Compact Fluorescent Lamps & CFLs	1,084.35	4.73
32	Heating	Insulation - Roof - Pitched 200mm	1,091.21	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	1,091.74	8.60
34	Heating	Most CE Insulation - Cavity Wall	1,095.32	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	1,095.54	14.69
36	Lighting	Light Detectors	1,095.74	14.84
37	Heating	Optimising Start Times	1,095.76	14.84
38	Heating	Building Management Systems	1,095.82	14.84
39	Lighting	HF Ballasts	1,147.24	14.86
40	Heating	Most CE Insulation - External Cladding	1,147.78	14.87
41	Heating	Most CE Boiler	1,147.78	14.88
42	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	1,148.18	14.88
43	Catering	Most CE Fridge-Freezers	1,148.60	14.88
44	Heating	Heating - TRVs Fully Installed	1,148.85	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	1,148.90	31.48
46	Heating	Most CE Insulation - External Cladding	1,194.65	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	1,195.63	95.50
48	Catering	A Class Fridge	1,196.71	97.34
49	Heating	Insulation - Roof - Pitched 200mm	1,222.84	106.95
50	Lighting	Basic Timer for Lighting	1,223.22	107.02
51	Catering	Most CE Freezers	1,226.05	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	1,228.75	159.37
53	Lighting	Presence Detectors	1,262.13	235.60
54	Heating	Insulation - Roof - Flat 75 mm	1,292.08	305.84
55	Heating	Most CE Insulation - Cavity Wall	1,322.74	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	1,329.46	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	1,330.76	426.63
58	Lighting	Sunrise-Sunset Timers	1,332.32	439.26
59	Lighting	Fixed Period Timers (Stairwell)	1,349.62	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	1,357.74	492.32
61	Computing	Flat Screen Monitors	1,364.72	550.05
62	Heating	Most CE Double Glazing Replace Single	1,442.23	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	1,442.36	709.48

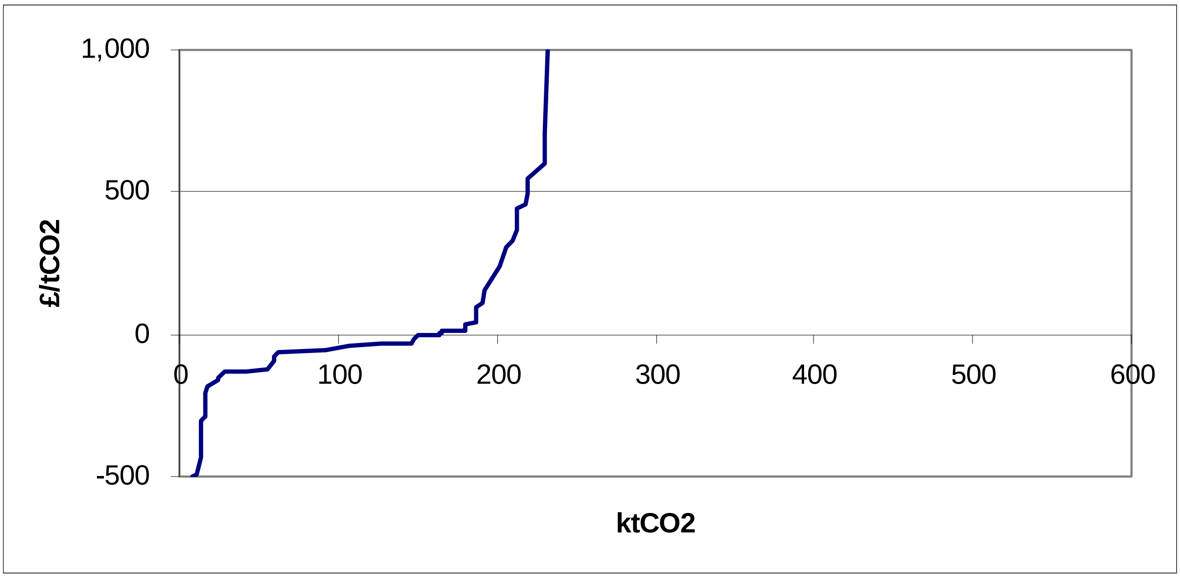
9.2.7 Education



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	3.02	- 499.04
2	Computing	Computers - Energy Management	7.07	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	8.09	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	8.32	- 315.77
5	Computing	Inkjet Printer - Energy management	8.32	- 302.28
6	Computing	Laser Printer - Energy Management	9.33	- 293.89
7	Computing	Monitors - Energy Management	11.16	- 287.86
8	Process	Large Photocopiers - Energy Management	11.61	- 247.62
9	Process	Small Photocopiers - Energy Management	11.71	- 222.25
10	Catering	Vending Machines on standby	11.80	- 217.54
11	Process	Medium Photocopiers - Energy Management	12.04	- 203.23
12	Computing	Fax Machine - Energy Management	12.53	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	15.45	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	15.51	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	17.20	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	22.24	- 129.13
17	Lighting	Turn off Lights for an extra hour	27.06	- 119.62
18	Lighting	Basic Timer for Lighting	28.65	- 89.58
19	Catering	Most CE Fridge-Freezers	28.70	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	29.01	- 71.58
21	Lighting	Sunrise-Sunset Timers	29.43	- 62.62
22	Heating	Heating - Reducing Room Temperature	40.94	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	46.58	- 41.18
24	Heating	Most CE Boiler	54.77	- 32.30
25	Heating	Heating - TRVs Fully Installed	62.22	- 30.09
26	Catering	A Class Fridge	63.00	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	63.08	- 17.03
28	Computing	Flat Screen Monitors	64.07	- 7.67

29	Catering	Most CE Freezers	64.72	- 6.16
30	Lighting	Presence Detectors	69.83	- 0.00
31	Lighting	ECG Compact Fluorescent Lamps & CFLs	69.84	4.73
32	Heating	Insulation - Roof - Pitched 200mm	70.22	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	70.22	8.60
34	Heating	Most CE Insulation - Cavity Wall	70.42	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	70.42	14.69
36	Lighting	Light Detectors	70.45	14.84
37	Heating	Optimising Start Times	70.45	14.84
38	Heating	Building Management Systems	70.45	14.84
39	Lighting	HF Ballasts	75.94	14.86
40	Heating	Most CE Insulation - External Cladding	75.97	14.87
41	Heating	Most CE Boiler	75.97	14.88
42	Catering	Most CE Fridge-Freezers	75.99	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	76.04	14.88
44	Heating	Heating - TRVs Fully Installed	76.05	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	76.05	31.48
46	Heating	Most CE Insulation - External Cladding	78.61	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	78.72	95.50
48	Catering	A Class Fridge	78.78	97.34
49	Heating	Insulation - Roof - Pitched 200mm	80.24	106.95
50	Lighting	Basic Timer for Lighting	80.28	107.02
51	Catering	Most CE Freezers	80.46	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	80.74	159.37
53	Lighting	Presence Detectors	84.31	235.60
54	Heating	Insulation - Roof - Flat 75 mm	85.98	305.84
55	Heating	Most CE Insulation - Cavity Wall	87.70	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	88.41	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	88.55	426.63
58	Lighting	Sunrise-Sunset Timers	88.72	439.26
59	Lighting	Fixed Period Timers (Stairwell)	90.57	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	91.02	492.32
61	Computing	Flat Screen Monitors	91.29	550.05
62	Heating	Most CE Double Glazing Replace Single	95.62	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	95.62	709.48

9.2.8 Health



	Application	Measure	Carbon saved ktCO2/yr	£/tCO2
1	Lighting	16mm Fluorescent Tubes Replace 38mm	8.11	- 499.04
2	Computing	Computers - Energy Management	11.22	- 495.06
3	Lighting	Reflective Tungsten Halogen - Spots	13.98	- 434.82
4	Computing	Dotmatrix Printer - Energy Management	14.15	- 315.77
5	Computing	Inkjet Printer - Energy management	14.15	- 302.28
6	Computing	Laser Printer - Energy Management	14.93	- 293.89
7	Computing	Monitors - Energy Management	16.33	- 287.86
8	Process	Large Photocopiers - Energy Management	16.41	- 247.62
9	Process	Small Photocopiers - Energy Management	16.43	- 222.25
10	Catering	Vending Machines on standby	16.57	- 217.54
11	Process	Medium Photocopiers - Energy Management	16.62	- 203.23
12	Computing	Fax Machine - Energy Management	17.00	- 185.90
13	Heating	Heating - Energy Efficient Air Conditioning	24.50	- 164.56
14	Cooling+vent	Low Watt Inline & Axial Fan	24.53	- 155.49
15	Lighting	16 mm Fluorescent Tubes Replace 26mm	29.07	- 134.12
16	Lighting	ECG Compact Fluorescent Lamps & Tungsten	42.61	- 129.13
17	Lighting	Turn off Lights for an extra hour	55.58	- 119.62
18	Lighting	Basic Timer for Lighting	59.84	- 89.58
19	Catering	Most CE Fridge-Freezers	59.92	- 76.48
20	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	60.75	- 71.58
21	Lighting	Sunrise-Sunset Timers	61.90	- 62.62
22	Heating	Heating - Reducing Room Temperature	91.46	- 55.53
23	Lighting	Fixed Period Timers (Stairwell)	106.60	- 41.18
24	Heating	Most CE Boiler	127.64	- 32.30
25	Heating	Heating - TRVs Fully Installed	146.78	- 30.09
26	Catering	A Class Fridge	148.09	- 18.20
27	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	148.12	- 17.03
28	Computing	Flat Screen Monitors	148.88	- 7.67
29	Catering	Most CE Freezers	149.97	- 6.16
30	Lighting	Presence Detectors	163.72	- 0.00

31	Lighting	ECG Compact Fluorescent Lamps & CFLs	163.74	4.73
32	Heating	Insulation - Roof - Pitched 200mm	164.71	6.24
33	Cooling+vent	Compressed Air (with and without reduced inlet temp)	164.71	8.60
34	Heating	Most CE Insulation - Cavity Wall	165.22	13.22
35	Cooling+vent	Variable Speed Drives (small. Medium and large)	165.22	14.69
36	Lighting	Light Detectors	165.28	14.84
37	Heating	Optimising Start Times	165.28	14.84
38	Heating	Building Management Systems	165.29	14.84
39	Lighting	HF Ballasts	180.04	14.86
40	Heating	Most CE Insulation - External Cladding	180.11	14.87
41	Heating	Most CE Boiler	180.11	14.88
42	Catering	Most CE Fridge-Freezers	180.15	14.88
43	Lighting	Cumulative Floodlights (Metal Halide & Low Voltage)	180.27	14.88
44	Heating	Heating - TRVs Fully Installed	180.31	16.47
45	Heating	Heating - Energy Efficient Air Conditioning	180.31	31.48
46	Heating	Most CE Insulation - External Cladding	186.87	42.18
47	Lighting	Reflective Tungsten Halogen - Spots	187.15	95.50
48	Catering	A Class Fridge	187.26	97.34
49	Heating	Insulation - Roof - Pitched 200mm	191.01	106.95
50	Lighting	Basic Timer for Lighting	191.11	107.02
51	Catering	Most CE Freezers	191.39	110.74
52	Lighting	ECG Compact Fluorescent Lamps & Tungsten	192.16	159.37
53	Lighting	Presence Detectors	201.74	235.60
54	Heating	Insulation - Roof - Flat 75 mm	206.03	305.84
55	Heating	Most CE Insulation - Cavity Wall	210.43	331.66
56	Lighting	16 mm Fluorescent Tubes Replace 26mm	212.35	369.54
57	Lighting	ECG Compact Fluorescent Lamps & CFLs	212.73	426.63
58	Lighting	Sunrise-Sunset Timers	213.18	439.26
59	Lighting	Fixed Period Timers (Stairwell)	218.14	460.93
60	Heating	Most CE Ultra Low E Double Glazing Replace D.Glazing	219.30	492.32
61	Computing	Flat Screen Monitors	219.51	550.05
62	Heating	Most CE Double Glazing Replace Single	230.62	603.32
63	Cooling+vent	Motors 4 Pole Cumulative (Eff1 &Eff2)	230.62	709.48

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