Advisory

Sustainability & Climate Change

Determining cost-effective action for business to reduce emissions

Final Report

BIS | Department for Business Innovation & Skills

PRICEWATERHOUSECOOPERS

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1. Executive Summary

1.1 Executive summary

In December 2008, the Committee on Climate Change (CCC) recommended that the Government adopt a target of an 80% reduction in carbon dioxide emissions by 2050. The CCC proposed interim carbon budgets through to 2022, which set the emissions trajectory to meet the longer term goal, and stated that "the cost of these emissions cuts is manageable". There have been a number of economy-wide studies, in addition to that by the CCC, which have quantified the potential to reduce emissions, and reached two key conclusions. First, that a significant reduction in emissions can be achieved at relatively low carbon prices and second, that there exist a number of opportunities in various sectors of the economy to reduce emissions at no or negative cost (i.e. where energy cost savings over the lifetime of the measure outweigh the upfront capital costs). These measures sit 'below the line' on a Marginal Abatement Cost Curve (MACC).

Given 'rational' behaviour by firms and individuals, these opportunities should not exist. The fact that they do suggests that a number of barriers (behavioural or otherwise) are affecting business decisions, and/or that some of the assumptions that underpin the economic analysis of the MACC are not applicable to all businesses. There is an extensive literature on barriers to investment in energy efficiency measures which identifies three types of barriers: economic, behavioural and organisational. Some studies have attempted to quantify the scale of these barriers; however the extent to which these barriers operate within specific sectors is unclear as is the relative importance of each barrier. Furthermore, it is not known to what extent the current economic downturn has affected the actions taken by businesses to reduce emissions.

PricewaterhouseCoopers (PwC) was commissioned by BERR to undertake a study to better understand the business perspective of the issues and barriers associated with implementing cost-effective actions to lower carbon emissions. The approach taken was primarily qualitative – with evidence gathered through interviews with energy managers and investment planning teams from 24 companies or industry associations. The objective of this work was to develop a methodology to identify cost-effective actions taking into account barriers such as capital availability. This methodology was tested on two contrasting sectors: Chemical and Retail.

The key findings from this study are:

- Most companies interviewed in both sectors reported that they had already implemented many of the measures that are below the line on the MACC – in other words much of the low hanging fruit has been picked. Implementing these measures (such as using low energy lighting, switching off lights, not leaving engines to idle, ensuring building heating is not competing with cooling and addressing steam leaks) is routine and is described simply as 'good house-keeping'. Although it is challenging to quantify how successfully these measures have been implemented and the extent to which further measures are still available, our findings suggest that the MACC may overestimate the carbon reductions that can be achieved at low or negative cost.

- Companies stated that the biggest challenge to tackling emissions growth is the lack of suitable projects (i.e. projects which meet their investment criteria – typically to pay back in 2-4 years) rather than particular barriers to implementing particular low cost measures. In many cases, the next measures available to companies such as renewable energy generation or combined heat and power are either less economic than competing projects within the company or are considered to be beyond the company's core business.

- The priority given to identifying and implementing measures to reduce carbon emissions depends on the materiality of energy costs to the business and the size of the business. Smaller companies commented on the lack of capacity to identify and implement anything but the most obvious and straightforward energy management projects. In larger companies, energy managers or teams of energy managers have a good understanding of the next most cost-effective measures available to reduce energy consumption or carbon emissions. The barrier to these measures may be that they are not cost effective or are relatively unattractive compared to alternative uses of the capital within the company. However, some larger retailers with public carbon reduction commitments suggested that they would be willing to extend the range of paybacks considered once opportunities which payback in less than 4 years are exhausted.

- Many of the barriers identified by earlier studies (by AEA Technology, Enviros and the University of Sussex[1]) were confirmed by smaller companies in both retail and chemicals sector. In addition to the hidden or missing costs associated with implementing 'cost-effective' measures (identifying projects, cost of disruption etc), particular barriers identified by companies included:

    - Practicalities: some measures (energy efficiency improvements, upgrades to lighting and other fittings) can only be implemented during major refits of a retail site or when the chemical plant is having a major routine shutdown and maintenance event. So it may be several years between identifying a measure and implementing it at a particular site.

    - Strategic priorities: carbon reduction measures have to compete with other projects within the company, including in some cases operating sites overseas. In some circumstances, the head office may make a strategic decision about where capital should be invested, therefore limiting the options of UK subsidiaries.

    - Behavioural issues: where carbon reduction measures are dependant on behavioural changes (such as switching off lights, managing heating and cooling, or quickly addressing steam leaks), the early benefits may decline over time as staff priorities are focused elsewhere.

- In both sectors, companies noted that energy and carbon management is a competitive issue. Companies may therefore be reluctant to reveal precisely how they evaluate particular energy management measures and the degree and success of their implementation. This may explain why the MACC may misestimate the potential of the cost-effective measures.

- **Retail:** The main challenge to retailers is that the next measures to reduce emissions being considered do not meet their investment criteria (to pay back within 2 -4 years for all those interviewed). Access to capital was not perceived to be a critical issue for most participants to implementing projects, even during the current recession. Access to capital is more of an issue for smaller retailers than larger ones. Some retailers noted that for some technologies (e.g. installing doors on chilled display units or installing LED lighting) there were concerns about interference with the customer experience that had held back investment in these measures. However, these views were not universally held and some with practical experience of the measures suggested that there had been no adverse customer reaction. Implementation of some measures may require behavioural changes on the part of both staff and customers which suggests that education and awareness raising should be part of any strategy to support better energy management.

- **Chemicals:** Chemicals manufacturers, many of which are multinationals, noted that energy management projects have to compete for capital with other projects at that facility and with other business units in the company which may be overseas. The competition for capital and limited access to bank loans means that, to be considered, energy management projects need to yield high returns or require minimal capital. Capital investment in energy management measures also needs to fit within the strategic priorities of the company.

- With large numbers of relatively small sites, retailers have the opportunity to trial particular technologies in individual stores before rolling out the successful ones across the portfolio. With small numbers of large sites (or often just one facility), there is much greater technical risk to chemical manufacturers when installing a new technology or process change which could be disruptive. Therefore they are only likely to adopt proven technologies. Even in these cases, a facility may need to be shutdown to install the new equipment which either adds to the overall cost, or the projects are delayed until major routine overhaul events at the facility which may only be once every four to five years.

Recommendations:

- Particular barriers to new technologies were identified by both retailers and chemical companies. Specific technologies or measures such as Combined Heat & Power or installing doors on fridges have varying success in different companies. Chemicals companies consider technical or process changes high risk as they could be

[1] Review and development of carbon dioxide abatement curves for available technologies as part of the Energy Efficiency Innovation Review, Final Report, Enviros Consulting Ltd, 2005 and updated by AEA Technology for the Committee on Climate Change; Barriers to Energy Efficiency in Public and Private Organisations - Steve Sorrell, Dr Joachim Schleich, Dr Sue Scott, Eoin O'Malley, Fergal Trace, Ulla Boede, Katrin Ostertag, Dr. Peter Radgen, SPRU, University of Sussex, 2000.

disruptive to the facility. Therefore a 'one size fits all' approach to energy or carbon management technologies or measures is only likely to be cost-effective across the economy in specific cases – such as low energy light bulbs. A clear and robust business case is needed before Government incentivises particular measures. There may also be an opportunity for government to support demonstration projects of particular technologies or measures, to encourage their wider deployment.

- A barrier for some smaller companies is the lack of management time and internal capacity to identify and implement anything but the most obvious and straightforward energy management projects. It is likely that the opportunities below the line on the MACC are in smaller businesses which lack capacity to identify or implement them.

- Given that a key barrier among smaller companies is lack of time, and limited understanding of the efficacy of given low carbon or low energy measures, raising awareness of the cost-effectiveness of particular measures. Looking forward, Government action, perhaps through information campaigns or resource support, to encourage small businesses (and therefore presumably individuals) to address emissions or energy management may yield the greatest dividends. Some smaller participants suggested that greater help through information campaigns or workshops may help overcome resource constraints. These participants also highlighted the need for low or no cost advice, including consultancy advice. BERR or industry associations could help facilitate this process by providing advice through a number of channels.

2. Introduction

2.1 Linking theory and practice

In December 2008, the Committee on Climate Change (CCC) published an inaugural report looking at the carbon abatement opportunities across the economy, and urged the Government to commit to reducing emissions of all greenhouse gases (GHGs) in the UK by 80% by 2050 and at least 34% by 2020 relative to 1990 levels[2]. The CCC stressed that meeting these targets is necessary to contain the threat of climate change.

The proposed budgets of the CCC suggested that these targets are achievable and feasible through a number of measures, including energy efficiency improvement in buildings and industry, carbon efficiency improvement in road vehicles, and a significant shift towards renewable and other low carbon power generation. The CCC looked at carbon abatement opportunities across the economy and generated Marginal Abatement Cost Curves (MACC) for reducing carbon in electricity generation, residential buildings, transport and wider industry and service sectors.

The MACC are an assessment tool developed by the CCC and others, to look at the level of emissions reductions which a range of measures could deliver at a given point in time, against a projected baseline level of emissions. They show how much CO2 each measure could save (the level of abatement potential) and the associated marginal cost per tonne of CO2.

The MACC suggest that, at a macro level, there are a number of abatement measures that generate net benefits and therefore do not require a high or positive carbon price to make them commercially viable. Given rational behaviour and perfect markets these opportunities should not exist. The fact that they do suggests that there may exist a number of barriers (behavioural or otherwise) that are affecting business decisions, and/or that some of the assumptions that underpin the economic analysis of the MACC are not applicable at the business level.

There has been an extensive body of literature on the abatement potential and barriers to investment in energy efficiency measures. A research report commissioned by Department for Environment, Food and Rural Affairs (DEFRA) in 2007[3] (hereafter the Oakdene Hollins-Grant Thornton report) identified the total value of no-cost and low-cost resource efficiency savings to the UK at £5.6 – 7.4billion annually. Of this, energy savings make up just over half at £3.3billion.

A study by the Science and Technology Policy Research, University of Sussex, looked at barriers which led to gaps between the opportunities for cost-effective energy efficiency investment identified in energy models and the levels actually seen in practice[4]. The literature identified three types of barriers: economic, behavioural and organisational. Economic barriers include: lack of access to capital, hidden costs such as those associated with project identification and management, split incentives of tenants and landlords in energy management within a building; and lack of access to information. Behavioural barriers include: bounded rationality (where individuals do not make economically optimal decisions because of lack of time or use of imprecise rules of thumb), or human factors such as values and beliefs. Organisational barriers include cultural factors such as organisational silos and the low status associated with energy management in many organisations.

Some attempts have been made to quantify the scale of some of these barriers (see for example Department for Environment, Food and Rural Affairs (DEFRA)[5]). However, there is less evidence on understanding the extent to which these barriers stack up and affect the decision making process within management in practice, and how widespread the barriers are across industries.

The Department for Business, Enterprise & Regulatory Reform (BERR) wishes to understand practical experience of businesses in their approach to adopting cost-effective measures to reduce carbon emissions.

2.2 The current economic downturn

A second objective for BERR is to understand the impact of the current economic downturn on the progress of firms in undertaking cost-effective actions to reduce carbon emissions.

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[2] Building a low-carbon economy - the UK's contribution to tackling climate change, Committee on Climate Change, 2008

[3] Quantification of the business benefits of resource efficiency, A research report completed for the Department for Environment, Food and Rural Affairs by Oakdene Hollins and Grant Thornton, October 2007.

[4] Barriers to Energy Efficiency in Public and Private Organisations - Steve Sorrell, Dr Joachim Schleich, Dr Sue Scott, Eoin O'Malley, Fergal Trace, Ulla Boede, Katrin Ostertag, Dr. Peter Radgen, SPRU, 2000.

[5] Review and development of carbon dioxide abatement curves for available technologies as part of the Energy Efficiency Innovation Review, Final Report, Enviros Consulting Ltd, 2005

While the carbon prices are expected to be an incentive for emissions reduction, the global carbon market has been shaken by the world financial crisis and economic gloom. In late 2008 and early 2009, carbon prices (as evidenced by prices of EUAs and CERs[6]) have fallen dramatically. The CER price – which is the closest indicator of global carbon price – which peaked in early July 2008 at around €23, fell to under €8 in February 2009. Investors and companies are also affected by falling energy prices (oil prices exceeded $140 per barrel in mid 2008, compared to just under $50 per barrel in April 2009), and an anticipated drop in emissions from lower industrial production. These could collectively lead to a downward effect on investment in carbon reduction activities.

Even for measures that generate net benefit regardless of carbon prices (i.e. those below the line on the MACC), there are concerns that some of the barriers may have been exacerbated by the recession. Businesses across a wide range of sectors claimed that access to credit has worsened considerably, with potential impact on measures that require significant up-front capital investment. When dealing with significant uncertainties for the future, managers may focus on shorter term returns or become more risk averse.

BERR is keen to explore how the barriers to carbon reduction measures are affected by the economic downturn, in particular disentangling factors that are inherent from those that are caused by the recession. This could enhance BERR's understanding and add to the evidence base that informs short and long term policy measures that promotes a cost-effective transition to a low carbon economy.

2.3 Objectives for this study and Scope of Work

PricewaterhouseCoopers (PwC) has been commissioned by BERR to undertake this study to:

- Develop a methodology to identify cost-effective actions at a sector level, taking into account economic and non-economic barriers;
- Identify the barriers to cost-effective carbon reduction actions; and
- Develop recommendations to address the barriers.

Specifically, at the scoping meeting it was agreed with BERR that we should pilot the methodology with two sectors, Retail (with a focus on grocers) and Chemicals, to examine the barriers and cost-effective actions, through a series of interviews. These interviews helped to inform potential barriers when developing the methodology. It was recognised we would not be able to get a representative sample of companies from each sector and that there would be potential for some self-selection bias, i.e. companies willing to be interviewed are likely to be more advanced on this issue. It was also agreed that, this study was not intended to recreate the quantitative and theoretical analysis that underlies previous studies including the marginal abatement cost curves. Instead, the study was more qualitative, aimed at identifying and assessing the range of actual barriers and/or practical difficulties faced by businesses in implementing the carbon abatement opportunities.

2.4 Structure of the report

The remainder of this report is organised as follows:

Section 3 discusses our approach in this study.

Section 4 provides the methodology we developed.

Sections 5 and 6 summarise the two sector studies for Retail and Chemicals respectively.

Section 7 provides a summary of the barriers presented by participants and Section 8 concludes.

[6] EUAs are European Union Allowances, issued under the EU Emissions Trading Scheme (EU ETS), and CERs are Certified Emissions Reductions awarded for generating carbon credits in the UN Clean Development Mechanisms (CDM).

3. Our approach in this study

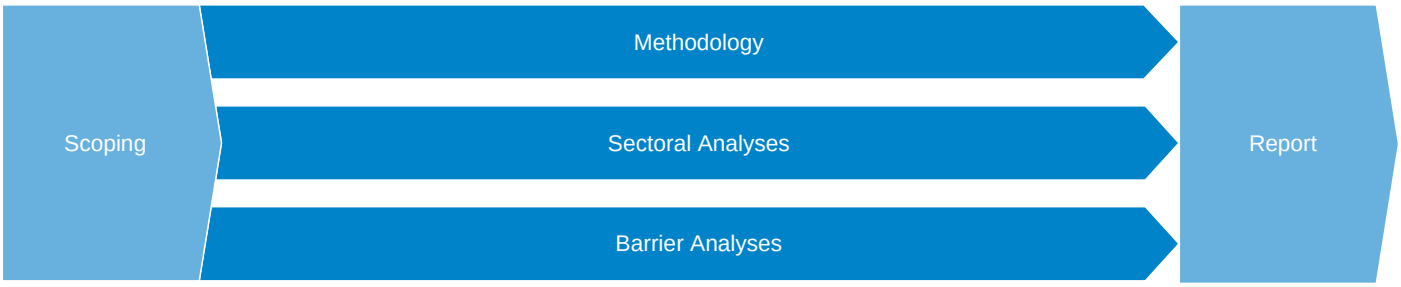
3.1 Overview of this study

We adopted two iterative processes to this research project:

- Methodology Development: To develop a methodology for identifying cost-effective actions and identifying barriers to actions; and
- Sectoral analyses: To identify barriers at the sector level through workshops and case studies, and to test the methodology developed.

Each of the two work streams above informed the other and fed into the third work stream of identifying the barriers to businesses. This helped to ensure that the methodology had been 'road tested' and can be applied to other sectors. To ensure that the two work streams were well integrated, the team developing the methodology supported the sector specialists in their analyses of the opportunities and barriers to action to reduce emissions, and vice versa. This approach was discussed and agreed with BERR.

Figure 1: Overall approach of this study



The timescale for this project was limited – we were given approximately 5 weeks to complete the study. As a result, there were a number of limitations to our approach, which are discussed throughout this report.

3.2 Methodology Development

This research project aimed to develop a methodology that supports existing studies on identifying carbon reduction activities, taking into account practical barriers faced at the sectoral or firm level. The next section presents our proposed methodology and identifies its merits and limitations.

3.3 Sectoral Case studies

We applied the methodology to two sectors, retail and chemicals. The sectoral case studies are intended to unveil a wide range of abatement options and barriers to their uptake. With this objective in mind, the two sectors were chosen specifically because the challenges that face the two sectors are different in nature, which could expose a wider range of carbon abatement actions and barriers:

- **Capital intensity:** Chemicals businesses are typically more capital intensive than retailers which tend to have higher operational costs.
- **Regulatory scope:** Some members within the chemicals sector are covered by the EU ETS, which implies that carbon pricing affects their operations directly. In comparison, the retail sector is excluded from the EU ETS, but could be affected indirectly via energy costs.
- **International competition:** The chemicals sector is relatively more affected by international competition, whereas the competition within the retail industry is mostly domestic (even though some retailers would also have international operations).
- **Greenhouse gases:** While our study focuses primarily on carbon emissions, we considered the extent to which the two sectors (as industrial and service sectors respectively) emit different types of greenhouse gases. For example the widespread use of refrigeration within the grocery retail sector means that refrigerant leakage is an important source of GHGs in the sector.

- **Customer base:** The retail sector's customers tend to be end consumers; whereas the chemical sector tends to be in the earlier part of product's value chain. This may be relevant if decisions are affected by the types of stakeholders.

For each sector, we have focused on one or a few sub-sectors of the industry. Our experience with businesses in both sectors suggests that differentiation within a sub-sector (e.g. different size) is likely to be more insightful than differentiation across sub-sectors. However, there are clearly opportunities to extend the sectoral analysis beyond this pilot study.

For each sector, we identified a full sample list of companies within the sub-sector(s). PwC, supported by BERR, determined the final sample of companies that PwC approached, by considering a balanced spread of size, types of operations and ownership structure. We have also excluded companies with operations that are likely to be un-representative of the sector. For example, we have excluded plastics or pharmaceutical manufacturers from our selection of Chemicals companies. The total number of companies and sector associations approached was 35 (20 in Retail and 15 in Chemicals).

Our final set of interviewees was determined by the rate of response by companies. We conducted 19 interviews in total from the companies approached. We supplemented these with interviews with 2 oil companies and 3 industry associations to assess whether the issues raised are similar in other sectors. While every attempt has been made to ensure that the sample size of the sector includes a balance spread of participants, we are limited by the response rate of the participants, as well as the time limited for this study. As a result, this report draws indicative and emerging findings based on the responses of our participants, and may not be considered representative of the views of any individual company within the two sectors.

4. Our proposed methodology

4.1 Objectives of the methodology

This research project aimed to develop a methodology to determine the cost-effective actions for businesses to reduce emissions and the barriers that impede these actions. The methodology is designed to achieve the following objectives:

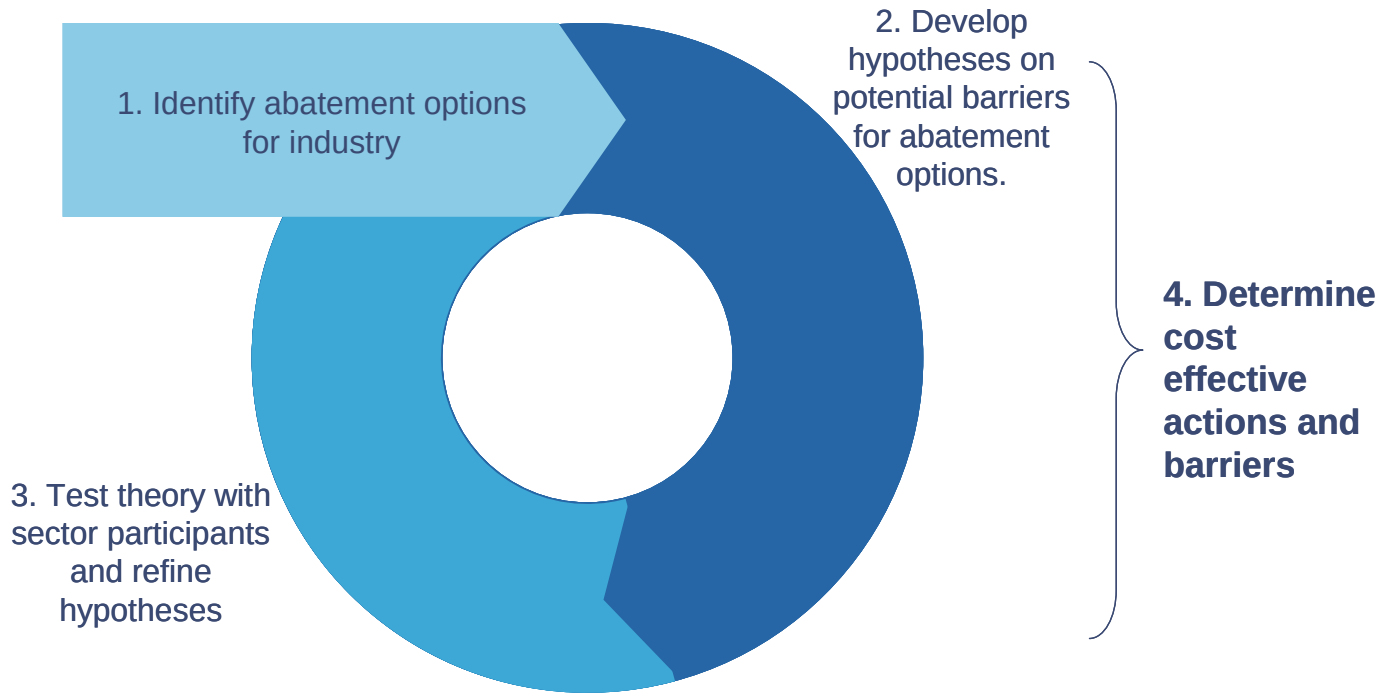
- Obtain views from businesses on the actions that are identified to be cost-effective, and the extent to which these actions are undertaken.
- Consider cost-effective actions which have not been undertaken and identify barriers that impede their take-up.
- Assess the impact of the current economic downturn on reducing carbon emissions and the effect on the barriers.

The methodology is not intended to recreate the quantitative and theoretical analysis that underlies previous studies including the marginal abatement cost curves. Instead, this approach is aimed at identifying the practical difficulties faced by businesses in implementing what the theoretical analysis predicts. It is also an opportunity to evaluate at a high level the applicability of the theory, i.e. whether the scale of carbon abatement opportunities is consistent in both theory and practice.

As this study was underpinned by practical experiences from businesses, the responses we received are of qualitative nature. The project was designed to test this with two sectors, Retail and Consumer, as described in the previous section.

4.2 Overview of the proposed methodology

Figure 2: Overview of the Methodology



We adopted a relatively straightforward approach as illustrated in Figure 2. The individual stages are described in further detail as follows.

Stage 1: Identify abatement options for industry

1 Refer to existing studies on marginal abatement cost curves or studies that identified carbon abatement options.

2 The ideal studies would include the range of abatement options, their carbon abatement potential and the economic costs and benefits

Stage 2: Develop hypotheses on potential barriers for abatement options

1 Identify the range of barriers that apply to the industry. This should be informed by the findings of this study.

2 Develop hypotheses on whether barriers exist against the abatement options and the magnitude of the barrier e.g. high-medium-low.

3 This would include forming a view on the likelihood that the barriers impede action, and whether barriers are industry-wide or firm-specific. This is likely to be subjective and may vary from sector to sector.

4 This stage is designed to promote thinking and up front research on the issues faced by industries before testing them with the sector.

Stage 3: Test theory with sector participants and refine hypotheses

1 Conduct a series of interviews or focus groups to identify whether participants agree with the hypotheses developed in Stage 2.

2 The interviewees or focus groups would need to identify:

- Cost-effective carbon reduction actions
- Approach to business investment decisions
- Barriers to implementing cost-effective carbon reduction actions.

3 Sample size of case study would vary from sector to sector and depends on the sector composition. General guidelines to sample selection would include considerations of:

- Size: This includes identifying the composition of the business. For example, large players in some industries are characterised by many small plants/subsidiaries/branches (e.g. banks, retail). This could pose different issues and barriers to industries where large players have fewer but larger physical premises or operations.
- Types of sub-sector: If sub-sectors are likely to have common issues and barriers, there is less need to increase sample size. However if sub-sectors are likely to have unique issues, the case studies may need to include more participants to ensure that views of a minority sub-sector are not extrapolated to the whole industry.
- Ownership/ management structure: There may be differentiation based on whether businesses are foreign-owned or UK-owned, public or private.

4 The ideal sample for testing the hypotheses would be one which included sufficient variability in the sample in order to capture the range of barriers and how they are relevant to different types of companies.

5 Repeat Stage 2 if necessary to refine hypotheses.

Stage 4: Determine cost-effective actions and barriers

1 Confirm the list of cost-effective actions based on responses from participants. This includes referring to the available abatement options identified in Stage 1 and compare the extent to which options have been undertaken. This is supplemented by desk research on the companies within the sectors interviewed on publicly available information or commentary on the progress and challenges on undertaking carbon reduction actions.

2 Identify barriers that impede actions and develop recommendations/tools to overcome the barriers

3 Update the findings on barriers if necessary for other sectors.

4.3 Practical issues in implementing the Methodology

Several practical considerations are important when implementing the methodology. Our pilot study with the two sectors has identified a number of issues as discussed below. Subject to limitations posed by these issues, the findings of our study are summarised in the next two sections of this report.

4.3.1 Type of information

Our proposed approach is designed to identify typically qualitative information – as the primary objective is to understand practical barriers that impede carbon abatement options. There is relatively little focus on quantitative methods either to determine the size of the reduction opportunity available to / achieved by the company, or the cost-effectiveness of particular measures. With fuller data collection, quantitative analysis may be possible, but data availability remains a problem with issues which are commercially sensitive (see next sub-section).

By relying on mainly qualitative evidence, there is limited comparability between sectors, carbon reduction options and strength of barriers. As this project is interested in the diversity of responses comparability is not a strong focus. However this does limit the ability to extend the study for other purposes beyond the objectives set out by BERR for this study.

4.3.2 Commercial sensitivities and interview approach

Many companies are constrained from sharing their experience for reasons of commercial sensitivities. Some forms of information, particularly those which involve financial performance or business decision activities, are less likely to be provided. In sectors where energy costs are a competitive issue, or where leadership in sustainability or climate change could act as a differentiating factor, businesses are less willing to divulge their experience that may be made available to potential competitors.

Focus groups, in particular, may not work well to gather information that is considered commercially sensitive e.g. hurdle rates, investment decisions. Individual interviews that include guarantee of confidentiality and anonymity work better to gather this form of information. However, the latter are more time consuming, and by discouraging an open discussion with peers, the results or information may not be directly comparable. For example one company's interpretation of the importance of a particular barrier may differ from its peers.

4.3.3 Knowledge Barrier on Abatement Options and Barriers

One barrier to some participants in undertaking carbon abatement activities relate to their lack of knowledge of available cost-effective measures. This presents issues to the study. The interviewer needs to be able to identify both the *perceived* and *real* cost-effective measures and barriers for the participants. Interviews or focus groups need to probe for the real barriers, but should avoid asking leading questions.

The ability to discuss and compare abatement options might be limited to the level of specificity. For example, discussions on "lighting measures" could encompass a wide range of options including switching to energy efficient light bulbs to experimenting on alternative lighting such as LED. The former example may be relatively cost-effective which have been adopted by the participant, whereas the latter may be perceived to be cost ineffective. By grouping these into the same types of measures, interviewers may trigger different responses from participants. The ability to drill-down requires knowledge from both interviewer and interviewee on the measures or technologies discussed.

5. Testing the methodology: the retail sector

5.1 Overview of the sector

5.1.1 Sector Profile

The retail sector accounts for almost 8% of GDP (UK retail sales were £278 billion in 2008), over a third of consumer expenditure, and employs just under 3 million people, or 11% of the total workforce[7].

The sector enjoyed a relatively benign economic environment between the ten years 1998 to 2007, delivering retail sales growth averaging 4% a year, ahead of the UK long-run annual GDP growth rate of 3%[8]. This sustained period of retail sales growth and high levels of consumer confidence was brought about by a buoyant housing market, easy access to credit and low interest rates. Much of the growth in retail sales has also been supply-led as retailers opened more and larger stores.

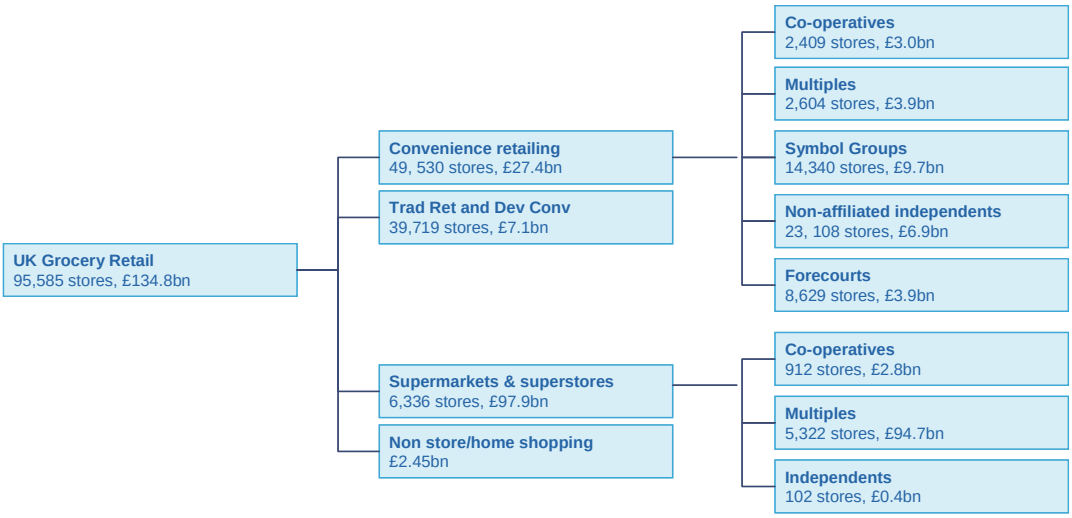
Trading conditions have deteriorated considerably since 2007. All of the key drivers of consumer confidence, other than interest rates, have been negatively impacted. As a result, retail sales growth slowed in 2008 to 2.1% according to Verdict, driven largely by price inflation as sales volume only grew at 0.9% (compared to 3.4% in 2007). Forecasts for retail sales in 2009 indicate a reversal in growth, Verdict Research predicting a decline of 0.6% (-0.9% inflation, +0.3% volume). 2010 offers only a modest recovery in sales volumes.

5.1.2 The grocery sector context and our sample

We have selected the grocery sub-sector as a focus for this study. However due to the number of grocers declining to be interviewed (for a variety of reasons) we also spoke with two general retailers to enhance our sample of participants.

The grocery sector in the UK accounts for 37% of retail sales[9]. Grocers are here defined as non-specialised stores that sell predominantly food and drink products plus a variety of non-food products such as cleaning products, toiletries and household goods (e.g. supermarkets, convenience stores etc.). The Institute for Grocery Distribution (IGD) estimated that groceries (sold through all types of store) account for 12.8% of all household spending, the third largest area of expenditure after housing and transport and 49% of all retail sales. The sector comprises a wide variety of store formats and ownership structures (see Figure 3), however, supermarkets and superstores dominate, accounting for 73% of grocery sales value. Of these, multiples or chains account for the majority of sales.

Figure 3: Composition of the Grocery Retail sector



Source: IGD, 2008

[7] Source: British Retail Consortium

[8] Source: Verdict, PwC Macro-economics

[9] Source: Office of National Statistics

The sector is clearly dominated by multiple supermarket operators. This sector structure has developed through attrition of independent and specialist stores, large expansion programmes of superstore operators and consolidation in the sector. Market share data from Verdict Research indicates that the leading three grocers accounted for over 55% of the market in 2007, up from 45% in 2002.

Figure 4: Composition of large retailers' share of the total grocery market

Table 14: Retailers share of the total grocery market 2002-2007e

	2002 %	2003 %	2004 %	2005 %	2006 %	2007e %
Tesco	20.2	22.4	23.8	25.4	26.8	27.6
Asda	12.3	12.9	13.3	13.4	13.7	14.1
Sainsbury	12.8	12.5	12.6	12.8	13.4	13.8
Morrison	3.8	4.2	10.3	9.6	9.7	9.9
Somerfield Chain	2.9	2.8	3.0	3.7	4.1	3.9
Co-op Group	2.8	3.2	3.0	2.9	2.8	3.8
* M&S	3.3	3.4	3.4	3.5	3.6	3.8
Waitrose	2.5	2.6	2.8	3.0	3.2	3.3
Iceland	1.7	1.6	1.5	1.4	1.4	1.5
Lidl	0.9	1.0	1.1	1.3	1.4	1.5
Aldi	1.1	1.1	1.0	1.1	1.2	1.3
Netto	0.5	0.6	0.6	0.6	0.6	0.6
Kwik Save	2.0	1.8	1.6	1.3	0.7	—
Safeway	8.2	7.8	2.4	—	—	—
Sub total	**75.1**	**77.9**	**80.4**	**78.0**	**82.6**	**85.1**
Others	24.9	22.1	19.6	20.0	17.4	14.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

* M&S market share relates to food sales only

Source: Verdict Research VERDICT

These leading operators have moved rapidly on format development, from the traditional supermarket format to larger superstore and hypermarket outlets supplemented by smaller, convenience store formats in high street, neighbourhood locations. As well as physical stores, most of the leading players have well developed non-store retail propositions, including substantial online retail offers. The range of outlets within a portfolio provides different challenges and investment payback periods for energy efficient measures planned and implemented. In particular, high value capital investment programmes in the retail sector are predominantly focused on estate development, be that new store openings or major refit and refurbishment activity.

Non-affiliated independents, an indicator of small independent retailers, account for roughly one-quarter of the number of stores in the UK, but their revenue makes up only 5% of UK grocery retail revenue. This long tail of small retailers (e.g. the local convenience store) could therefore be responsible for a significant proportion of carbon reduction potential.

Participants in our study included large, medium and small retailers, selling to a wide range of customers and two industry associations. Our sample of retailers interviewed collectively covers revenue of £60bn, over 7,000 stores in the UK, and over 550,000 employees. This accounts for just over 20% of UK retail sector revenue. Looking specifically at grocery retail, our sample accounts for 40% of UK grocery sector revenue, but only 5% of UK stores. There is a long tail of small grocery retailers with stores that are not included in our study.

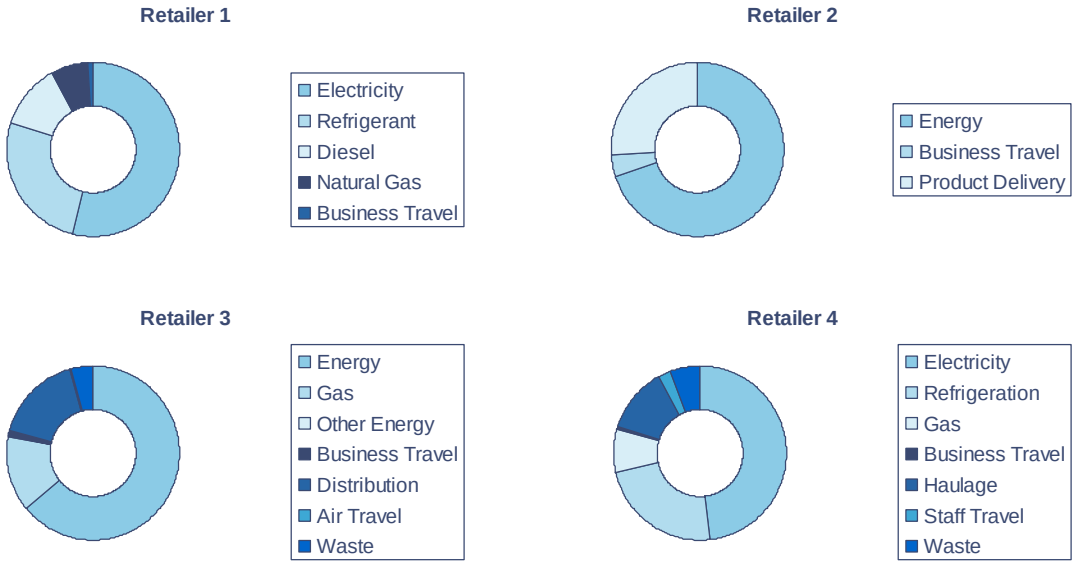
Figure 5: Participants in the Retail sector

Participant	Subsector	Size[10]
1	Industry association	Members: grocery retailers
2	Industry association	Members: general retailers
3	Grocer	Large
4	Grocer	Large
5	Grocer	Medium
6	Grocer	Small
7	Grocer	Small
8	Food retailer	Medium
9	Clothing retailer	Large
10	General retailer	Medium

5.1.3 Carbon Emissions

The retail sector accounts for around 18% of UK non-domestic building floor space and a significant proportion of UK energy use.[11] The Carbon Trust estimates that the retail sector is responsible for over 5 million tonnes of CO_2 emissions per year. It also suggests that the retail sector (as with other sectors) could achieve savings of up to 20% in energy use (equivalent to more than £300 million of energy costs) through the implementation of low or no-cost energy efficiency measures. This compares with the 11% estimated energy savings by Oakdene Hollins-Grant Thornton report (estimated savings of £130m albeit probably at significantly lower energy prices).

Figure 6: Real examples of carbon footprints of UK grocers and wider retailers



Source: Corporate Social Responsibility reports for four UK retailers

[10] We consider size of retailers by revenue. Large retailers include those with revenue over £5bn, medium retailers are those with revenue between £100m and £5bn, and small retailers are those with revenue less than £100m. Note that this is not consistent with EU definitions of SME for businesses.

[11] Large scale energy surveys in the UK retail sector. 29 September 2006 N. Brown et al, De Montfort University, Leicester, United Kingdom

Electricity used for lighting, refrigeration and air conditioning within stores is the main source of carbon emissions from the retail sector – typically comprising around 50% of the carbon footprint of a major supermarket chain. Greenhouse gas emissions arising from refrigerant leakage is the next largest source - comprising around a quarter of the typical footprint. Recent research has revealed that grocers are the biggest source of hydrofluorocarbon gases (HFCs) emissions in the UK. In 2005 their refrigeration and air conditioning equipment containing HFCs emitted the equivalent of 2 million tonnes of CO2.[12]

Lighting can be as much as 40% of a building's electricity consumption. The correct use of lighting controls to reflect actual occupation and daylight linking can reduce operating costs by between 25% and 50%[13].

Carbon footprint data for distribution can vary significantly between retailers depending on the ownership and structure of logistics operations. Distribution is an area where collaboration between retailers and contractors (or third party service providers) is fundamental to reducing energy costs in the supply chain, including inventory planning, replenishment management and logistics.

5.1.4 Carbon Regulation

The larger grocery businesses in the retail sector are or will be affected by the following carbon regulations:

- Climate Change Agreements (CCAs), containing energy efficiency improvement targets signed up to in order to gain an 80% rebate from the Climate Change Levy.

- Carbon Reduction Commitment (CRC), around 20,000 organisations that consume more than 6000 MWh through half hourly electricity meters must participate in the scheme from 2010 onwards. The list of companies affected is yet to be published at the time of writing, but supermarkets and large retailers are expected to be captured under the CRC.

5.1.5 Voluntary Action on Carbon

The retail sector has historically viewed its action on climate change and energy management as a competitive issue and has therefore been less inclined to share information and best practice. However, leading retailers have individually been investing in energy efficiency over the past decade and made public commitments on medium term carbon reduction. In April 2008, the British Retail Consortium launched "A Better Retailing Climate"[14], which is a voluntary climate change agreement comprising 5 overall goals and 21 commitments, including 2 carbon reduction targets:

- cutting energy-related emissions from buildings by 15% on 2005 levels by 2013; and

- aiming for a reduction of 15% in energy-related transport CO2 emissions from stores deliveries by 2013 compared with 2005 levels.

This agreement has been signed by around 12 leading retailers. For some retailers, these commitments are a first step, for others they have already committed to more demanding company targets. The agreement was a response to retailers' recognition that they have an important role in helping to respond to the threat of climate change within their operations. Key to this is also in the role retailers can play with suppliers and customers to reduce their carbon emissions. These goals aim to support government policy, with particular reference to those targets contained in the Climate Change Bill.

In January 2009 the UK's top grocery retailers, brands and manufacturers committed to an industry-wide food waste reduction objective for the first time. This will be delivered under WRAP's (Waste & Resources Action Programme) Love Food Hate Waste campaign, which will result in considerable savings to UK consumers of more than £370 million and a saving of almost 700,000 tonnes of CO2.

[12] LACORS and ENVIROS 2007

[13] Energy Services and Technology Association

[14] http://www.brc.org.uk/showDoc04.asp?id=3558&moid=5603

5.2 Potential carbon reduction actions

Carbon Trust has identified, in 2006, a range of "low-cost quick-wins" and "invest to save" measures[15]. The former comprise measures that require little or no cost to achieve carbon emissions reduction. "Invest to save" measures usually involve some up-front investment, which typically pay back over a period of time (payback period will vary from measure to measure). These include measures in lighting, heating, ventilation and air conditioning, refrigeration, building fabric, and energy management.

Separately, PwC has identified the following (non-exhaustive) list of measures that the retail sector could undertake, based on our understanding of abatement measures for non-domestic buildings and logistics[16]. This list was tested with the interviewees for this study to identify the extent to which they have been considered or undertaken.

Figure 7: Examples of carbon reduction actions

Category	Measures
Electricity	Lighting Measures (ballasts, basic controls)
	Lighting – low energy lighting e.g. compact fluorescent lighting
	Lighting –LED (signage, display lighting, etc.)
	Lighting Controls - photo cells and time clocks
	Optimise Building Controls
	Building Controls occupancy sensors
	Building Controls - Centralised Switch-off point for non essential circuits
	Voltage Optimisation
	Automatic Meter Reading (AMR) – Half Hourly Meter Reading
	Sub Metering
	Full glass doors on chilled cabinets
	Refrigeration - Night blinds
	Refrigeration - Coldroom lighting & pack controllers
	Heating, Ventilation and Cooling (HVAC) - Demand based ventilation, free cooling
	Air-conditioning -Variable Speed Drives
	Energy efficient appliances e.g. refrigerators, ovens, vending machines, office equipment etc.
Transport	Electric Vehicles
	Diesel-Electric Hybrid Vehicles
Gas	Boiler Controls
	Gas boiler & valve, flange & pipe insulation
	Automatic Meter Reading (AMR) – Half Hourly Meter Reading
	Sub Metering
	Greenhouse Gas leakage reduction in refrigerators
	Heat recovery
	Warehouse heating, sealed back door
	Heating Control - Door Closers & Curtains
Low carbon or renewable energy	Solar -- Photo-Voltaic
	Solar Thermal

[15] Retail: Energy management — the new profit centre for retail businesses, Carbon Trust, 2006.

[16] The list also includes a number of options/tools to measure energy / carbon use (e.g. half hourly meters), which do not reduce carbon emissions in themselves but help monitor energy / carbon use and promote efficiency in energy management.

Category	Measures
	Ground Source Heat Pump – heating and refrigeration
	Biomass boiler
	Wind turbine
	Embodied Energy Materials
	Micro Combined Heat & Power unit
	Ground/river/lake water cooling (direct coupled, open loop)
	Biomass CHP
	Anaerobic digestion
	Gasification/Pyrolysis of food waste
	Alternative Fuel Vehicle
	Biodiesel Vehicle
Building Envelope	Sun Scoops
	Door and Window Seals
	Insulation - draft proofing
	Insulation - cavity wall
Behavioural	Appointed a carbon champion
	Set carbon targets for refurbishment
	Implement an energy/environment campaign (e.g. switch off campaign, labels on switches, etc.)
Strategic Energy Management	Energy Performance Certification
	Feedback Display
	Reducing room temperature
	Thermal Photography
	Planned Efficiency Servicing (In Conjunction Program Performance and Management)
	Tele Conferencing
	Deliveries and storage system
	Compliance / Auditing
	Laundry
	Computers - energy management
	Bottle Coolers volume (Blanks)
	Thermal Equalisation
	Car Share
	Radiator Deflectors
	Landscaping - Watercourses

5.3 Practical Experience – Our findings[17]

5.3.1 Impact of the Recession

The general outlook of companies interviewed on their future was positive despite the current economic situation. Most of those interviewed stated that although sales growth has slowed, it remains positive. For some, their general business strategies have been to focus on profit margins rather than sales volume, which they felt had left them less vulnerable to the slow down. Others cited earlier readiness for the recession as reasons for their positive outlook.

Most interviewees reported that budgets are under greater scrutiny, but where projects involve driving down costs or efficiencies, the business case is still strong. The commitments by the CEO or management board to carbon reduction as a continuing strategic priority has in some cases helped underpin internal efforts on energy management. The prominence of the issue in a cost cutting period has also placed energy reduction front of mind with store managers keen to tap into every cost saving opportunity. This heightened focus has resulted in a reduction in energy use at some larger retailers significantly beyond target. Some companies did voice concerns during our discussions over smaller projects being shelved, however large scale projects remain funded and on track to deliver significant cost and carbon savings.

5.3.2 Reduction in Energy Use

The majority of companies interviewed could demonstrate some reduction in energy or carbon intensity across their entire property portfolio over the past few years (energy use or carbon emissions per square foot of sales or total floor space). This includes energy use in stores, warehousing and distribution. The larger companies in the sector have been investing in energy efficiency over a number of years and have seen significant reductions in carbon intensity. For these companies the most cost-effective opportunities to reduce energy and carbon may have already been adopted. Despite this there is an expectation amongst larger retailers that the downward trend in energy intensity will continue as projects progress and the benefits of past investments continue to accrue.

> "From a 2006/07 baseline, M&S has already reduced its like-for-like electricity consumption by over 6% and sourced over 30% of its electricity from renewables, including five distributed generation sites featuring wind turbines, anaerobic digestion plants and small hydro schemes."
>
> Source: Marks & Spencer website, press release - 16 February 2009

A focus on logistics by a number of retailers has contributed to the decline in energy use in recent years, with companies investing in efforts to monitor driver behaviour, use smaller lorries for smaller stores, improve the streamlined design of their vehicles and use backhauling.

For smaller retailers the expected trend is likely to plateau as low or no cost actions are realized quickly. One company interviewed had worked with the Carbon Trust to successfully reduce energy and carbon emissions by 18% over a three year period. This saving was achieved without much capital outlay. However the company are now at the stage where they believe they need to make large investments of capital to achieve further savings and lack the opportunity to do so, primarily due to constraints on capital. In this case, which may be true for other smaller retailers, energy consumption is likely to remain stable for the foreseeable future without increased capital availability.

5.3.3 Drivers to undertake carbon reduction measures

Cost reduction was cited by all interviewed as the primary driver for energy efficiency investment. A number of larger retailers reflected that maximising financial or shareholder return is the top priority. In some cases retailers suggested that satisfying societal needs beyond those of investors, customers and employees was a factor but only once cost-effectiveness was proven. One large grocer wished to highlight that a strategy of recouping the cost of a carbon reduction investment as soon as possible by meeting or exceeding a specific financial return (e.g. return on invested capital) can support other strategic objectives such as reputational enhancement, entry into new markets or enhancing energy security.

[17] While the quotes cited in this section are from the interviewees, the examples provided in this report are sourced from public domain. Those obtained from the public domain do not reflect the identity of participants in our sample, and we have not sought to verify the accuracy of these examples.

A number of retailers have sought to assess their carbon footprint because of pressure from employees, NGOs and investors keen to understand their environmental impact. Concerns over the fact that they "should know this information" and "what if someone asked us?" were strong drivers. At least two companies interviewed who had recently gone through a carbon footprint mapping exercise found energy efficiency measures were highlighted as a consequence. The process highlighted critical areas within their business where high energy spikes were then tackled by cost-effective energy efficiency improvement measures.

"act on issues we feel may become "headline" issues with the ambition to be placed well within the pack on sustainability"

Source: Medium sized retailer interviewed

Linked to stakeholder pressure is business reputation. One small retailer stated that a key driver in determining their move to improve their carbon footprint came from a fear of becoming a "headline" case. In this instance the retailer was conscious that their brand was exposed to media pressure had they not acted to understand and publicise energy commitments. In this case the retailer was explicit that their ambition was to be placed well within the pack on sustainability.

Regulatory change was cited by one retailer as a driver for change with new rules on air conditioning gases given as an example. This change has forced the company to investment in new, more efficient technology.

5.3.4 Decision making at the business level

There were a variety of arrangements cited for managing investments in energy efficiency. Some retailers set aside a budget for investment in energy efficiency measures - this was either a smaller annual budget for low cost measures under the control of the energy manager or a larger capital budget outside the energy manager's control. Several retailers suggested that they had no separate capital budget for energy efficiency which was therefore treated in the same way as any other investment and subject to the same investment criteria.

Committed budget to energy efficiency programmes

"An £18 million efficiency programme has been initiated to reduce electricity and gas consumption even further by 2012, by which time we also plan to be generating 15% of our energy from our own renewable sources."

Source: Co-operative website on "Ethics in Action"

The majority of larger companies interviewed follow a process of trialling new energy efficient technologies or approaches at a few stores in order to show cost savings, which then may become a wider pilot scheme before the decision to fully roll out the action across their portfolio. For those smaller retailers interviewed the process is mirrored but the scale reduced. The focus of work generally begins with low cost, quick win, low-tech solutions to ensure easy energy saving opportunities are not missed, before moving on to more hi-tech and expensive actions.

Larger retailers have adopted the approach of constructing iconic stores, often termed eco-stores, to pilot a range of cost efficient measures under one roof. Examples include Tesco's first Ecostore in Cheetham Hill Manchester, that opened in January 2009 and Sainsbury's Dartmouth store that opened in August 2008. These stores then acts as a blueprint for all other future development and retrofitting. They tend to cost more to build than a standard store but are significantly more energy efficient than those constructed just a couple of years ago. Initial extra costs are quickly recouped once the store is operational. Scenario modelling is sometimes used for larger projects such as Eco-Stores but is very much considered on a case-by-case basis.

Assessing cost effectiveness and feasibility of projects

Lidl published a report to consider a selection of cost effective options for the Lidl Foodstore & Residential Development in Croydon, to meet a CO2 reduction target of around 10%.

Renewable and low carbon technologies that have been taken into account included solar thermal, solar photovoltaic (PV), wind, biomass heating, CHP & micro CHP and ground source heat pumps (GSHP). Following a meeting of the design team certain options were deemed inappropriate – CHP, solar thermal and solar photovoltaic – for reasons ranging from lack of suitability of the development (e.g. lack of space and waste heat) to cost-effectiveness.

Four possible scenarios were considered from the other technologies, and the team identified a best fit solution and ranked by environmental performance, fitness for purpose, cost and consideration of local residents.

Source: Renewable Energy Feasibility Statement, Lidl, February 2007

Pilot eco-store

Tesco's Cheetham Hill store

A 52,000 sq ft eco-store opened in Manchester's Cheetham Hill district on January 2009, which has a carbon footprint 70% smaller than an equivalent store built in 2006, and cost around 10 per cent more to build than an equivalent structure using conventional methods. The property uses a combination of energy-efficiency measures, CO2-cooled fridges and is fuelled with recycled cooking oil in combined CHP. Sustainable store interior features include: timber frame, roof lights, hanging signage made of cardboard; reduced materials in shelving; and fully recyclable plastic moulded checkout packing areas. The entrance lobby reduces the store's heat load.

The store is hailed as a blueprint for future Tesco openings.

Source: www.building.co.uk, January 2009

Sainsbury's Dartmouth store

Sainsbury's new flagship green store opened in Dartmouth, Devon, in August 2008. The store is expected to save 40% of its overall CO2 emissions. Measures include the use of 'biomass boiler' that will heat both the building and water, using locally sourced wood that would otherwise be wasted. By using renewable energy, the amount of energy consumed from the national grid has been dramatically reduced by 50%.

"Sainsbury's Dartmouth has been designed to leak fewer draughts and employs other measures, such as "quiet revolution wind turbines", to power the checkouts. This is contributing to cutting electricity usage (kWh) by a third overall.

Further carbon savings are made through the use of lower lighting levels and increased use of daylight, and cool air will be collected from chillers to keep the store cool during warmer months.

Rainwater harvesting is one of the techniques being used to reduce water consumption. Collected rainwater is used to flush customer and colleague toilets, and to irrigate plants. The store will save over one million litres of mains water every year, and uses 60% less water overall as a result."

Source: Sainsbury's website, http://www.j-sainsburys.co.uk/cr/

The cost of energy efficiency measures varies significantly depending on whether the measure is being implemented in a new store or distribution centre or being retrofitted to an existing store. The majority of those interviewed would favour using the opportunity of a major store refurbishment or extension to retrofit energy efficiency measures. For some of the fastest growing supermarkets stores can be refurbished every 6-10 years, suggesting that some of the carbon savings achieved in Eco stores could be rolled out across the entire store portfolio in that time period. For the smaller retailers, the time periods between refurbishments were significantly longer and often equipment such as ovens and refrigerators would remain operational for 20 years or more, suggesting much longer time lags for recent improvements in the efficiency of equipment to filter through the store portfolio.

Most large retailers have investment planning teams in place that decide on new projects. Implementation and maintenance of projects is usually managed via a mixture of staff including energy managers and engineers. For example, one large retailer has a 12 member energy team that includes people responsible for areas such as procurement, energy efficiency and SMART meters (collating and communication of results). Others retailers take the approach of having an energy manager in every store reporting to an area energy manager and then regional energy managers. Smaller retailers are less able to afford this – frequently the person responsible for energy also wears many other hats in the organisation.

"The short term view has always been taken with energy projects - treated as any other business project"

Source: Multiple retailers interviewed

The majority of retailers interviewed, with the exception of those privately owned, work with a two to four year payback period on all projects across the business. A two year payback period for all projects with was mentioned by at least two

of the companies we interviewed. This payback period is managed extremely closely. Incidentally this short and strict timeframe was given as a reason for the reduced impact the recession has had on companies. For one retailer an investment board assess all proposals purely based on current costs compared to return. On rare occasions this equation can be an overridden by senior management team for reasons such as competitor pressure. For one retailer we interviewed the payback period for investment was a little more relaxed. This privately owned company had recently invested in new and significantly more efficient refrigeration equipment that will not pay back for at least ten years.

"store refits have taken place this year, allowing energy efficiency measures to be incorporated into these stores. Each re-fit has an energy assessment within the capital investment assessment, which aligns with companies strong ethical values, but the main driver is financial"

Source: Large retailer interviewed

One retailer mentioned that enhanced capital allowances (ECAs) for energy efficiency projects were considered in the appraisal phase, but it was unclear whether the company actually followed through to claim the ECAs from the government once the technologies had been installed.

At least half of the companies interviewed stated that future energy and carbon prices were factored to varying degrees into return on investment requirements. One high street non-grocer interviewed informed us that they have forecasted increasing costs of energy and additional costs associated with carbon emissions and climate change related taxes. These are factored into any energy related investment decision, and this has improved the outlook of the projects that can now be considered.

5.4 Barriers to implementation

5.4.1 Priority given to carbon and energy management

The size of the retailer's energy bill was seen as a key issue in determining the level of priority afforded to energy efficiency actions. A couple of these interviewed suggested that the rise in energy prices in 2008 had resulted in a significantly higher priority attached to energy management than in the past. However, the subsequent drop in energy prices had resulted in the issue being de-prioritised within the business.

One retailer interviewed has integrated carbon reduction within its company objectives to force the business to act. Essentially the individual interviewed felt it was necessary to create the need to act in order to overcome an internal barrier. By subsequently going public on its carbon footprint and making it a board level ambition, it has become a mainstream focus for employees within the business.

Clear focus on carbon reduction

"We recognise that, like all supermarkets, we have an impact on the environment which is why respect for our environment is integral to our commercial decision-making."

Source: CEO statement in Sainsbury's Corporate Responsibility Report 2006

At this stage in the economic cycle, many of those interviewed felt that there were a number of competing priorities that meant energy management had received less attention than in the past:

"The company has just gone through a restructuring process that included cost reductions and some redundancies. This process has been a major barrier and put on hold CSR activity over the last 6 months"

Source: Small retailer interviewed

At least two of the retailers we spoke with had seen energy efficiency efforts affected by internal restructuring. Restructuring can lead to the loss of a number of actions in train and a general loss of impetus. Where leadership projects are centralised the pace of action may reduce. Devolved management of projects was shown by one retailer to be an effective way of accelerating energy efficiency projects. In one case all actions, including cost-effective measures planned were delayed indefinitely due to a significant restructuring of the business.

5.4.2 Opportunity Cost/Payback Period

The majority of those interviewed used payback criteria of between 2-4 years to assess energy efficiency investments. Some suggested that they would only consider investments that fell outside this range if they were large scale projects with high customer visibility and significant reputational benefits.

For most participants access to capital was not perceived to be a critical barrier to implementing projects, even during the current recession, although some commented that budgets were increasingly under pressure. Most felt that they had sufficient capital to implement any projects that they could identify as falling within their investment criteria, the issue was rather one of opportunity cost given the availability of more attractive alternative investments in the business. One retailer did comment that they were struggling to overcome the cost of Smart Metering and suggested the government should mandate their use, as they contribute significantly to understanding and reducing energy costs. For another larger retailer interviewed suggested that automated meter readings are now available at 82% of its high street stores.

One smaller retailer we spoke with, who is just too large to qualify for the Carbon Trust interest free loan scheme, has found itself in a position of limbo because of the lack of availability of capital. The retailer has already implemented a number of cost negative energy efficiency actions but told us they would have to fund any further efforts by themselves. As a family run concern they would entertain the option of implementing cost positive actions but only if financial help was available.

"I have discussed this with the Carbon Trust and found that we are outside of their SME's interest free loan scheme and would have to fund our own costs"

Source: Small retailer response to our study

5.4.3 Resource constraints and lack of opportunities

Many retailers both large and small commented that they had picked the low hanging fruits of energy efficiency. The benefits of these actions had been realised or are being realised by the companies so there is now a much smaller number of potential cost-effective actions left to consider.

From our discussions with retailers it is clear that the resource capacity for identification and implementation of cost-effective measures is not always available. Companies struggle to find the time to commit to extra work that goes beyond already budgeted expenses. This is true for large and small retailers but for very different reasons. Larger retailers employ tight and efficient models of delivery, with any extra work needed to deliver unbudgeted projects frowned upon.

"…the issue is actually finding the projects to spend the money on"

Source: Large retailer interviewed

Smaller retailers are stretched to deliver compliance based actions and rarely find the time to think more strategically. One retailer in particular suggested that there "only so many things you can do". Those retailers restricted by headcount and resource have yet to reap the rewards of the low hanging fruit, with one retailer highlighting a "fair amount left to do".

"Alongside issues with project management competency, technical competence has been a significant restriction"

Source: Small retailer interviewed

The process of energy project identification and management is unclear and undefined at a number of companies interviewed. It appears that a key barrier may exist in the actual time afforded to project identification. No retailer could really articulate the process by which they actively pursue new cost-effective energy efficiency projects. One retailer claimed to have many people, in different departments (finance, property, operations and corporate responsibility), researching and analysing energy use, and determining reduction on energy intensity usage but was unclear as to how these are all joined up. Another retailer suggested that the high cost of project identification is linked to a lack of internal expertise within retailers. Another large grocer cited a lack of technical competence within the company as the main barrier to further cost-effective action. The availability of able staff to rollout large projects that require specialized technical knowledge and the management skills to maintain them is a key obstacle. A grocer interviewed believed that significant savings were not being realized because of this dearth of talent within the company. The interviewee

understood this problem was not exclusive to their company. When pressed on whether they had considered external help on large scale projects, the grocer highlighted internal political challenges that arise from such a strategy.

There is a general sentiment amongst those interviewed that it is difficult to get external advice in this area. The reasons given for this position were both the lack of market expertise from consultants and industry but also because of cost. This is especially true for smaller retailers seeking low cost advice or free assistance from consultants.

"…free assistance by consultants on what equipment could be adapted or changed would help"

Source: Multiple small retailers interviewed

Expertise in advising what equipment could be adapted or changed was highlighted by one retailer as fundamental. There was a general appreciation amongst smaller retailers for advice, maybe through a workshop format, on what they can do to practically reduce energy consumption.

5.4.4 Technology substitutability/applicability

A number of retailers voiced concerns over the availability of appropriate technology to fulfil their needs. There is an expectation that energy efficient replacement technologies should provide users with the same, if not better, quality and reliability of service. One retailer interviewed has worked with leading lighting specialists to look at the possibility of installing LED lighting but concluded that the technology does not yet provide the same quality, colour and brightness of light as the existing in-store lighting technology. These issues may appear trivial but for many companies they are an essential part of their customer proposition and brand.

A number of those interviewed suggested that they had considered whether their property portfolio could support on-site wind generation, but had been unable to identify any of their own sites with sufficient wind speeds to make the technology cost-effective. This is particularly an issue for those with a high proportion of in-town stores, where other buildings interfere with wind. Some had also looked at near-site or off-site locations for wind generation but this had raised questions about the true nature of their business – i.e. retailing or energy generation.

"…not windy enough at our sites and warehouses for turbines"

Source: Large retailer

Some new and expensive technologies remain unproven over a long period of time and have lead to retailers not fully committing despite the cost-effective argument. Alternative refrigerants (where greenhouse gases are not used to cool produce) used in commercial refrigeration have emerged as one such technology. Retailers are not taking up this unproven technology especially as it involves a massive investment. One company interviewed stated that it had yet to consider a complete roll out of very new and hi-tech energy efficient equipment because the evidence was unclear as how it may be more cost efficient than its current approach.

One retailer was optimistic for further energy efficient improvements but was cautious and wished to make clear that the immaturity of certain actions meant it was too early to understand if they were truly cost-effective in practice. This is true for those retailers with longer payback periods of four years who may not have yet received the reward for their investment.

5.4.5 Policy/Regulatory burden

Retailers criticized the number of regulatory and policy areas related to energy and carbon reduction. The overriding message was the need for simple signals based on fair regulation in order to "level the playing field" for all retailers, whatever their size. Retailers complained about the complex nature of frequently changing legislation. One retailer cited the latest CRC consultation, a 400 page complex document, as a case in point. Areas of concern and uncertainty focus on biofuels, green energy reporting, the CRC and specifically Renewable Obligation Certificates (ROCs).

One area of contention, primarily for the larger retailers was around renewables under the Carbon Reduction Commitment (CRC). Under the previous rules of the CRC, any company that accessed the government's renewables incentive schemes and had Renewable Obligation Certificates (ROCs) issued for the energy it produced could not then count the same energy towards a reduction in carbon emissions. Instead, it had to assume the energy from renewable sources had the same carbon footprint as the grid average. This issue was highlighted when a group of more than 40 UK businesses and NGOs issued an open letter calling on the government to reform urgently carbon-reporting rules or risk numerous high-profile renewable energy projects being scrapped. This collaborative reaction achieved its purpose and

changed the government's stance. Credit is now planned for all electricity produced through renewables. The quick response by the government was welcomed but did emphasize the large levels of uncertainty associated with new legislation.

Another issue flagged by one large retailer regards the definition of a biofuel. The retailer was unclear what actually comprised a biofuel despite support from both BERR and Defra they felt specifications were unclear and different for transport and electricity fuel. The retailer interviewed had to resort to producing their own biofuel for vehicles because they were able to understand what was not allowed in the fuel but was uncertain as to what should be in it.

One retailer mentioned the need for business rates to be used to reward carbon reduction and energy efficiency. They felt that without this reward system in place, and without actually knowing if they would benefit from such an approach, the sector would not move at the pace required by government. The retailer believed that this strategy would positively add to the cost-effective nature of energy efficiency actions.

The restrictions and cost associated with planning applications were mentioned by a number of retailers as a barrier to action, especially in terms of renewable projects. Rejection of plans for a wind turbine at an early stage in the planning process meant the project was shelved at one retailer before other opportunities were really even explored. This is especially true when thinking about older buildings in inner city areas. One small grocer informed us of the added cost to an extensive energy efficiency program that included screens to hide new refrigeration on the store's roof. The extra expense reduced the cost-effectiveness of the overall project.

"Applications for planned efficiency improvements are being restricted by planning authority on listed buildings"

Source: Small retailer interviewed

According to the magazine 'Building', Tesco's corporate-affairs director has asked that green stores "should be given a fast track not a slow track through the planning system".

The retailer said that one-fifth of its planning applications to build wind turbines at stores have been either rejected or delayed.

Source: www.building.co.uk, January 2009

Failure in planning applications for improvements to efficiency in listed properties was another obstacle stressed by one retailer. The retailer highlighted the fact that they were prevented from updating to significantly more efficient lighting in a building because it was listed. This counterintuitive position by local and national government may need further exploration.

5.5 Carbon abatement options undertaken

5.5.1 Cost effective measures

Our sample of retailers appeared to be focused on four main areas of carbon reduction:

- Energy use in stores and distribution centres – Actions retailers have already implemented include measures such as building management systems, controls and timers for stores and distribution centres, automatic metering and sub-metering, lighting, lighting controls, changes in refrigeration and chilled display cabinets; heating, ventilation and air conditioning (HVAC) measures such as boiler controls and insulation. Carbon Trust estimated that 20-40% of electricity costs in most organisations come from lighting, which can be reduced by up to a third while reducing the carbon footprint without affecting the working environment. They also estimated that 90% of all building control systems (across industries) are inadequate.

Examples of low-cost measures

At one major retailer, lights are switched on one minute before opening time and switched off when the shop closes.

A large food retailer installed night blinds to all of the refrigerated display cabinets. The costs were paid back over three years. The initial cost of installation would have been halved if they were installed at the outset. The company now specifies night blinds and strip curtains whenever they purchase new or replacement refrigeration equipment.

Source: Carbon Trust

- Building design including orientation, use of north lights and sun scoops and insulation.

Examples of low-cost measures

A shopping centre in Southern England uses a combination of low and high level openings (e.g. secured windrows and roof vents). This is useful at night when stored heat that has accumulated in the building during the day can be removed without mechanical ventilation.

Source: Carbon Trust

- Transportation and logistics – Retailers have already invested considerable resource in improving the efficiency of their vehicles, their drivers, routing and backhauling. Some have also piloted and now use alternative fuels in a proportion of their fleet. Retailers also tried supply chain consolidation of deliveries – one retailer suggested that it had managed to reduce five deliveries a week down to one with certain suppliers.

Examples of measure to tackle emissions from transportation, logistics and warehousing

In September 2007 Sainsbury's opened an energy-efficient distribution centre at Northampton, which uses just half the energy compared to similar buildings. The site has its own power plant with a combined heat, cooling and power unit, which provides a significant proportion of electricity required for the depot. Other features include a large rainwater collection and recycling system, which is expected to reduce annual water consumption by 50%; a day-lit roof to reduce the need to switch on artificial lighting during the day; and increased air tightness to cut the amount of heating required.

Sainsbury's claimed that "every stage of the building process was measured for CO2 emissions. This information was collated in order to produce a carbon footprint of the building itself, and each element of the footprint has then been reduced using the features mentioned."

Separately, the retailer also piloted grocery deliveries using a lorry powered by the bio-methane produced from rotting rubbish, expected to save up to 60% in CO2 emissions compared with diesel fuel. The gas is captured from landfill and purified, and the bio-methane produced is then used to power the truck. The lorry uses a Dual-Fuel™ system which enables heavy duty diesel engines to operate on a combination of bio-methane and diesel.

Source: Sainsbury's website, http://www.j-sainsburys.co.uk/cr/

- Employee action – Programs to encourage employees to reduce energy consumption through energy champions or targeted campaigns to "switch it off" have shown considerable returns. One retailer claimed it was the biggest saving that they could make. When their "switch if off" program was originally rolled stores saw a 10-15% reduction in energy, however this saving did drop considerably as people reverted to their old habits after a short period of time. In this case incentivisation was not used alongside the employee education program primarily due to the large number of employees this would need to cover. Other retailers have used incentives with store managers to drive through efficiency at a local level but it is still difficult to maintain momentum. At one large retailer periodic reporting

using smart meters is sent to each store from the regional energy managers showing position relative to other stores. This competitive approach is supported by incentives.

- Incentivising suppliers - One retailer spoke about how it uses its contract leverage to engage suppliers of energy efficiency equipment on a results basis. Suppliers are paid dependent on the level of reduction the measure achieved. This has forced many suppliers to consider if their offering is really the right solution for the retailer.

5.5.2 Renewables

There is interest and some work underway to experiment with renewables. The most cost effective measures were believed to be gasification of waste, anaerobic digestion, biomass CHP and biofuels. Several of the larger retailers are also investigating wind power. Most suggested that solar thermal was not a realistic option for them as they did not have appropriate levels of hot water demand to make the technology cost effective.

5.6 Conclusions

The majority of large and medium retailers in our sample of interviewees broadly agreed that many of the cost-effective actions to reduce carbon emissions have already been undertaken, and that they are increasingly looking at more capital intensive investments, typically through a formal investment appraisal and/or pilot projects. Barriers to the take-up of carbon reduction measures range from length of payback period to the lifecycle of store refurbishment to obtaining planning permissions, but generally speaking the largest retailers are increasingly venturing into large-scale investments that are expected to generate significant carbon savings.

The smaller retailers in our sample provided slightly more mixed messages. Again, many of the low or no cost actions have been undertaken, and while there is appetite for more investments in this area, their resource constraints meant that they do not have the time to research the availability and potential of carbon reduction measures. Capital availability, for example obtaining loans, may also affect the take-up of larger scale projects for some retailers. A strong caveat is that these retailers in our sample are relatively large compared to the local, non-affiliated independent convenience stores identified in Figure 3. The long tail of small convenience retailers was not captured in our study due to the short timeframe available. It is likely that problems faced by the “small” retailers in our study (resource constraint, understanding the type of projects available) are likely to be much more significant for these small independents.

6. Testing the methodology: the chemicals sector

6.1 Overview of the sector

6.1.1 Sector Profile

The UK chemicals industry comprises a range of activities including:

- Manufacture of organic bulk and speciality chemicals
- Manufacture of inorganic bulk and speciality chemicals
- Manufacture of agrochemicals

The sector also includes businesses carrying out largely trading, logistics and transport activities. We have not considered pharmaceutical production to be part of this sector.

As a whole, the sector represents turnover of over £50 billion/year, with around 175,000 – 200,000 employees employed by 3,000 companies. More than 90% of these companies employ less than 250 employees each. In 2007 around 50% of UK production was exported (although this has been even higher in recent years).

The chemicals sector has undergone significant structural change over the last 10 years, with declines in the number of operational sites and employment. However, productivity increases have meant that despite reductions in number of sites and employment, total output has changed relatively little. Businesses in the sector compete in global markets and have become leaner and more efficient over recent years.

Some larger sites have been broken up and are now separately owned and operated. For example, the former ICI site at Wilton now consists of seven separately owned and operated businesses. Business ownership in general has changed significantly, with an increase in non-UK ownership of individual sites.

6.1.2 Sub-sectors and our sample

We have not selected a specific sub-sector as a focus for this study. However we have selected companies involved in chemical manufacture, rather than businesses carrying out the following activities:

- Plastics manufacture (although some of the participants also produce polymer-based products)
- Pharmaceutical manufacture (as noted above, we have not considered these businesses to be part of this sector)
- Chemical trading and logistics (although some of the participants will be carrying out these activities in addition to chemical manufacture).

Participants included both bulk and speciality chemicals manufacture, selling to a wide range of customers. Participants belong to the medium or large company size categories – no small company identified was willing or able to participate in the timeframe of the study. We estimate that participants represent approximately 5% of UK chemicals industry greenhouse gas emissions.

Figure 8: Participants in the Chemicals sector

Participant	Subsector	Size (based on EU SME definition)
1	Industry association	Members: generally medium - large
2	Industry association	Members: mostly small - medium
3	Bulk chemicals manufacture	Large
4	Speciality chemicals manufacture	Large
5	Bulk chemicals manufacture	Large
6	Speciality chemicals manufacture	Large

7	Speciality chemicals manufacture	Large
8	Coatings manufacture	Large
9	Speciality chemicals manufacture	Medium

6.1.3 Carbon emissions

Businesses in the sector contribute to greenhouse gas emissions primarily through the following.

- Emissions of carbon dioxide from on-site burning of fossil fuels in combustion plant to provide heat and power.
- Indirect emissions of carbon dioxide from purchased electricity (and in some cases, steam).
- Emissions of greenhouse gases, particularly carbon dioxide and nitrous oxide, from production processes.
- Emissions of carbon dioxide from transport of products.
- Other emissions of greenhouse gases during a chemical product's lifecycle.

While process emissions can be significant for specific businesses, energy-related emissions are the most significant source for the sector as a whole. Energy costs are generally 40% - 70% of variable costs (although some businesses view energy as a fixed cost) and have been a cost-reduction focus across the industry for several years.

6.1.4 Carbon Regulation

Larger businesses in the chemicals sector tend to come under carbon-related regulatory regimes, in particular:

- The EU Emissions Trading Scheme (EU ETS). Chemicals companies are currently covered through any on-site combustion plant >20MW, with specific chemicals processes joining in Phases II and III.
- Climate Change Agreements (CCAs), containing energy efficiency improvement targets signed up to in order to gain an 80% rebate from the Climate Change Levy.

The sector was also active in energy efficiency prior to these regulatory regimes, for example through agreeing a voluntary energy efficiency programme.

Other regulatory regimes can also have an impact on carbon emissions. For example, many chemical manufacturing sites come under the UK environmental permitting regime (which implements, amongst others, the EU Integrated Pollution Prevention and Control Directive). These permits contain requirements limiting process emissions and in some cases controlling energy efficiency.

6.2 Potential carbon reduction actions

There are various abatement options in the chemicals sector, ranging from large capital investment measures to small behavioural change initiatives. The interviewees for this study considered that although there are some major projects that can reduce CO_2 emissions, there are also a myriad of simple measures that should not be underestimated and that when grouped together have a significant impact on a plant's emissions. An example of a basic cost-effective abatement option is switching off lights, which can save up to 15% of lighting costs[18].

Given the sector's structural changes over the last 10 years in the UK, there are substantial sub-sectoral variations in chemical industries, not only according to the size of the businesses, but also in terms of the type of products that are produced. Therefore, an abatement option that is cost-effective for one company might not be cost-effective for another company in a different sub-sector, which might even operate in a different regulatory context. Some of the firms interviewed for this study, for example, were not large enough to be part of the EU Emissions Trading Scheme (EU ETS).

[18] Source: Manufacturing: Introducing energy saving opportunities for business, The Carbon Trust, 2007

Uncertainties in both the impact of abatement opportunities and their costs are unavoidable to the process of determining the MACCs[19]. Hence, any listing of abatement options and their cost-effectiveness should be interpreted as "directional estimates rather than exact quantifications"[20]. With this caveat in mind, the list below identifies the 10 more significant abatement options out of the 30 abatement measures identified in the latest revised study on Global Marginal Abatement Costs Curves[21] for the chemicals sector.

Energy efficiency

- **Motor Systems:** introduction of energy saving measures in motor systems, such as adjustable speed drive and mechanical system optimization.

- **Process Intensification:** includes a number of levers, such as, continuous processes, improved process control, logistical improvements, preventative maintenance, more efficient burners and heaters.

- **Catalyst optimization:** includes a number of levers, such as, chemical structure of catalysts, design to lower reaction temperatures and chain reaction improvements.

- **Combined Head and Power (CHP):** using energy losses in power production to generate heat for processes.

- **Ethylene cracking:** includes a number of levers, such as, better cracking tube materials and improved separation and compression techniques that lowers the direct energy used in the cracking process

Fuel shift

- From coal powered systems to biomass powered systems.

- From oil powered systems to gas power.

Carbon Capture Storage (CCS)

- **CCS Ammonia:** capturing and storing CO2 emitted from Ammonia production.

- **CCS Direct:** applying carbon capture and storage to the exhaust emissions coming from direct energy use.

Decomposition of non-CO2 GHG

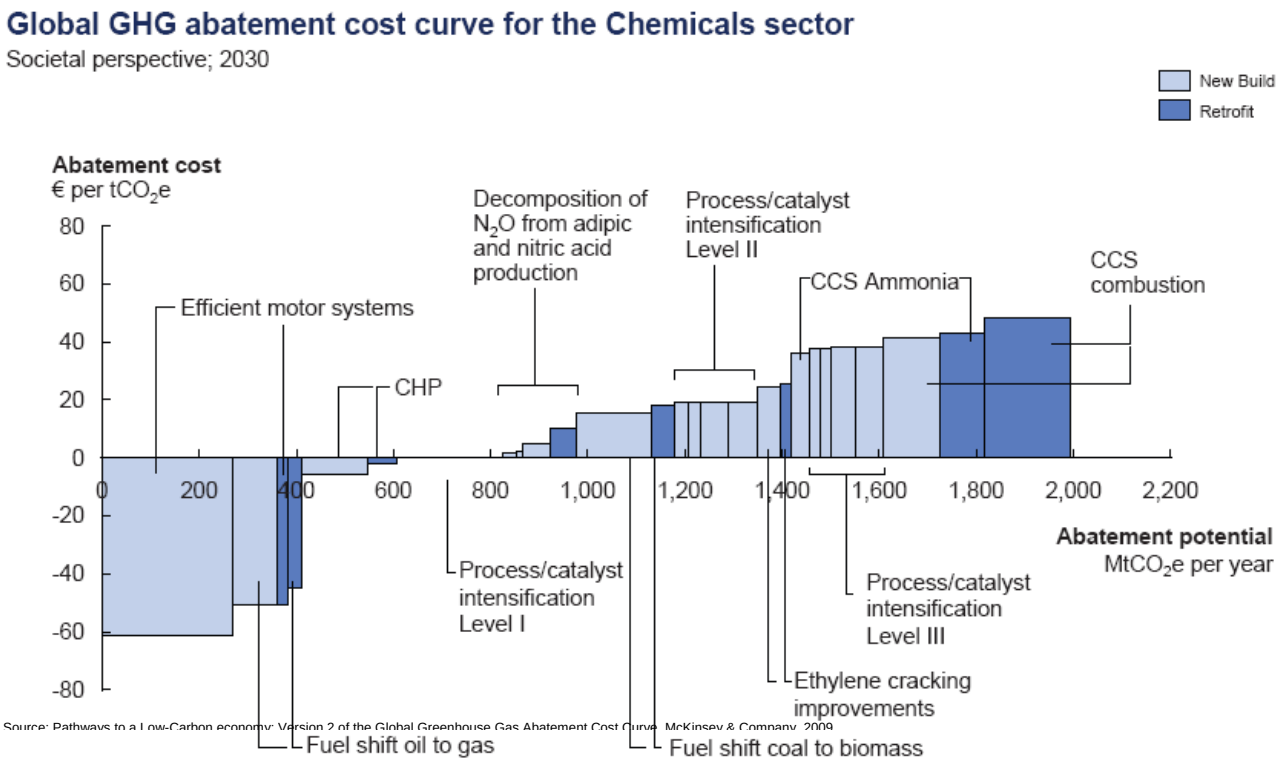
- **Adipic acid:** decomposition of the greenhouse gas N_2O (produced in the process of making adipic acid) into oxygen and nitrogen through the use of catalysts.

- **Nitric acid:** applying filtering measures in order to decompose N_2O from the tailgas of nitric acid production, where N_2O is produced as a process emission.

Figure 9 shows the abatement measures above plotted against their cost for the chemicals sector at a global level[22]. The types of abatement option and scale of cost are likely to be broadly relevant to the UK sector. Theoretically, efficient motor systems, fuel shift from oil to gas and CHP have negative costs, while the other measures have positive costs, with CCS presenting the higher cost. However, as suggested previously, MACCs involve estimates on the cost of abatement that are sensitive to the assumptions about energy prices, the rate of future technology development and interest rates.

[19] Source: Pathways to a Low-Carbon economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve (pg. 52), McKinsey & Company, 2009
[20] Ibid.
[21] Ibid.
[22] Ibid.

Figure 9: Global GHG abatement cost curve for the Chemicals sector



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

The Committee on Climate Change provided us with a list of measures considered for the chemicals sector, identified by sub-sectors.

Figure 10: Abatement measures identified by the Committee on Climate Change (CCC)

Sub-sector	Measures
Ammonia	Pumping HEMs
	Compressors Control System
	Refrigeration Improved refrigeration efficiency
	Process Heating New plant
	Process Heating Improved control
	Process Heating Waste heat recovery
Chloro-alkali	Electrolysis Waste heat recovery
	Electrolysis Control of electrode gap
	Pumping Variable speed drives (VSDs)
	Compressors Control System
	Drying Waste Heat Recovery
	Electrolysis Process control
	Electrolysis Process integration
	Drying EEIR

Sub-sector	Measures
Fertiliser	Pumping VSDs
	Drying Improved control
	Drying Energy management
	Process Heating Process integration
	Process Heating Waste Heat Recovery
	Drives VSDs
	Drives HEMs
	Process Heating Improved control
	Drying EEIR drying
General Organics	Compressors Waste Heat Recovery
	Process Heating Process integration
	Compressors HEMs
	Distillation Waste Heat Recovery
	Distillation High efficiency trays
	Process Heating Process Control
	Process Heating M&T
	Pumping VSDs
	Compressors O & M Improvement
	Distillation Improved packing
	Process Heating Waste heat recovery
	Compressors Control systems
	Process Heating Energy management
	Distillation MVR
Industrial gases	Pumping HEMs
	Compressors HEMs
	Compressors O & M Improvement
Resins	Drying Waste Heat Recovery
	Process Heating Energy management
	Process Heating M&T
	Drying Energy management
	Process Heating Improved scheduling
	Process Heating Batch waste heat recovery
	Distillation Improved packing
	Distillation High efficiency trays
	Alternative comminution
	Drying Process Control
	Drying Improved drying
	Drying EEIR drying
Other Inorganics	Drying Waste Heat Recovery
	Process Heating Process integration

Sub-sector	Measures
	Drying Improved drying
	Drying Improved control
	Process Heating Process control
	Process Heating Waste heat recovery
	Process Heating Energy management
	Process Heating M&T
	Drying Energy management
	Drying EEIR drying
Misc Chemicals	Drying Improved drying
	Process Heating Process control
	Process Heating Energy management
	Distillation Improved distillation
	Drying Process Control
	Drying Energy management
	Evaporation Energy management
	Evaporation Process Control
	Process Heating Process integration
	Drying Waste Heat Recovery
	Evaporation Waste Heat Recovery
	Drying EEIR drying
	Distillation MVR

Besides the abatement options abovementioned, there are further measures that might or might not apply to specific chemical companies in the UK, depending on how much ahead in energy efficiency maturity they are.

Energy Sourcing

- Use of renewable energy sources for onsite generation; and
- Purchase of lower-CO2 energy (electricity).

Energy Use

- Lighting (switch lights off; make use of natural light; and replace light bulbs);
- Elimination of steam and compressed air leaks (reduce air pressure; review frequency of checks);
- Changing building fabric (separate warm from cold space; insulate roofs, skylights and cavity walls; and redirect heat); and
- House keeping/maintenance (ensure plant and equipment, including energy efficiency elements, are working effectively).

Transport

- Logistics optimisation; and
- Use of alternative transport modes.

Overall, the cost-effectiveness of the abatement measures listed in this study will vary typically according to the type and size of firms, energy prices, availability of technology and interest rates.

6.3 Practical Experience – Our findings[23]

6.3.1 Impact of the recession

The chemicals industry is the second largest manufacturing exporter in the UK, thus the sector is, by nature, dependent on international demand. Therefore, unavoidably, the global economic crisis has affected the business environment. Some firms had seen their revenues and profit fall significantly. However, many companies have diversified customers and have been able to avoid significant impacts from the economic downturn. One of the companies interviewed, for example, supplies for more than 7,000 costumers worldwide, ranging from automotives and personal care to construction. Additionally, other firms operate in niche spaces which have long pipelines, such as marine and aerospace, and therefore have not been hugely impacted by the downturn.

All interviewees demonstrated concerns over the length and depth of the downturn and the implications for carbon reduction actions. In the short term, the availability of capital may restrict investments that are required. Over the medium or longer term, participants are more concern about the re-assessment of retro-fitting or replacing plants that are now reaching the end of their economic life.

6.3.2 Energy reduction

The UK chemicals industry as a whole has improved energy efficiency by around 35% since the early 1990s. While we have no quantitative data on how this reduction was shared between companies of different type and size, all interviewees stated that significant energy use reductions and energy efficiency gains had been made over the last 15 years. In addition to policy drivers for this, cost savings from improved energy efficiency have been an element in the industry's increasing cost-effectiveness.

"Our energy consumption over the last ten years has remained almost exactly the same, but production has increased by 17%"

Source: large chemical company interviewed

6.3.3 Drivers

There are two key drivers for energy efficiency improvements in the chemicals industry:

- Opportunity to reduce energy costs (or cost of purchased carbon) through greater efficiency; and
- Policy/regulation – the need to decrease energy use to meet policy or regulatory targets.

We have no data on the relative importance of these two drivers to the energy efficiency gains made by the industry since the early 1990s.

In some cases, other issues may also be a factor in making investments that contribute to energy efficiency improvements. For example, investments are made to increase security of energy supply or increase insulation against energy price change that has an effect on energy efficiency. In some businesses, improved production technology investments need to be made, and these can also contribute to energy efficiency gains.

6.3.4 Decision making at the Business Level

In most cases proposed capital projects with an energy efficiency or carbon abatement element go through the same approval process as any other capital project. Initially, drivers for a proposed project are needed (see above)

"Energy intensive businesses simply have to manage this issue effectively."

Source: industry association

[23] While the quotes cited in this section are from the interviewees, the examples provided in this report are sourced from the public domain. Those obtained from the public domain do not reflect the identity of participants in our sample, and we have not sought to verify the accuracy of these examples.

Once a project is under consideration, companies in the sector apply a variety of assessment processes, including the use of scenario planning. Decision making on a project is subject to a range of factors, including:

- Whether the project is required to meet regulations or is based on a return on investment.
- Strict application of investment criteria such as IRR or payback period.
- Flexible application (but often with basic thresholds) of investment criteria.
- Consideration of other factors, such as reputation and other community related issues.

Payback periods in the sector are relatively low – generally not more than three years. The exception is when other non-financial factors make the investment desirable. Some participants noted that in the current economic downturn, payback periods of around one year were needed. One participant applied payback periods more leniently to energy projects, perhaps accepting 5-6 years for a desirable project.

6.4 Barriers to implementation

"There is a big difference between what is technically feasible and what is practically achievable."

Source: large energy company

The following barriers were identified during the study, in particular to the implementation of abatement options that are not necessarily cost negative.

6.4.1 Access to capital

We identified that following ways in which access to capital can become a barrier:

- Access to bank loan facilities.
- Competition with other projects.
- Competition with other sites within a Group.
- Availability of grants and other funding.

Access to bank loan facilities can be challenging for chemicals businesses, but this has worsened in the current economic downturn. One participant provided an example of banks withdrawing funding due to the banking crisis.

While some participants reported strict investment criteria (such as an internal rate of return threshold), the majority of participants looked at a range of factors flexibly in making investment decisions.

"… the Board won't even look at a project if it doesn't have a 20% IRR…"

Source: large chemical company

"… the IRR can be adjusted, with inclusion of other factors …"

Source: large chemical company

With restricted capital (even outside the economic downturn), projects with a carbon abatement element are often in competition with other capital projects. Carbon abatement projects can miss out on funding if there are other projects that are more favourable (due to economics, risk or other factors). Capital projects in the UK can also face competition from projects at non-UK sites belonging to the same Group. These could be elsewhere in Europe or worldwide. Projects at non-UK sites can attract investment with more favourable short term returns or because of strategic investment decisions (particularly where sites have a longer life and/or serve growing markets). The commercial challenges are even greater when a project (such as installing a CHP facility) requires the approval of a number of separate businesses which are integrated in the process.

"We compete for capital with sister sites…"

Source: large chemical company

Availability of supporting funding such as regional grants is essential in many cases in making the economics of a major capital project favourable. This is particularly the case where the project is required to comply with legislation (but has a carbon abatement effect). One participant provided an example of a regulatory-driven plant upgrade with a cost of around £100million that would also lead to around 15% gain in energy efficiency for that process. This investment would not achieve a reasonable rate of return and would need to be supported with grant funding to avoid closure of the process.

"Investment support is needed … particularly in a recession"

Source: large chemical company

INEOS TO MOVE FORWARD WITH CONSTRUCTION OF ENERGY FROM WASTE CHP PLANT AT RUNCORN, CHESHIRE (UK)

Further to the announcement today that Viridor Laing (Greater Manchester) Limited has achieved financial close on the Private Finance Initiative waste and recycling contract with Greater Manchester Waste Disposal Authority, INEOS ChlorVinyls is able to announce that it has secured the necessary funding to proceed with construction of its Energy from Waste CHP plant at Weston Point, Runcorn, Cheshire…

The capacity of the Energy from Waste CHP plant upon full completion is expected to be 750,000 tonnes of SRF, which will generate around 100MW of electricity and heat - equivalent to around 20% of Runcorn Site's total energy demand…

Comments Chris Tane, CEO INEOS ChlorVinyls: "We are pleased that in partnership with Viridor Laing we are now able to move forward with construction of our Energy from Waste CHP plant.

"The new plant is vital to our business in that it will allow us to move away from being completely reliant upon very expensive gas to produce the electricity and steam we need to power our site. Rising energy costs continue to put significant pressure on our business and this project, when completed, will help to protect the long-term viability of the Runcorn Site operations in addition to playing a vital part in the North West's waste management strategy."

Source: Ineos ChlorVinyls press release, 8 April 2009

6.4.2 Policy/regulatory uncertainty

Policy and regulatory uncertainty pose barriers which can make investment decisions more difficult, more risky or not possible. Key areas of uncertainty identified during this study are as follows.

- Phase III of the EU ETS:
  - Benchmarking
  - Measures to address carbon leakage

"Where benchmarks get set is very important"

Source: large chemical company

- Carbon price for EU ETS participants that have a regulatory requirement to meet an emissions cap or trade in carbon.

Participants recognised the use of benchmarks to determine free allocations of CO_2 allowances but considered that level of auctioning is a key factor in the economics of larger abatement projects. Draft and final benchmarks are not expected from the European Commission until mid-late 2010.

Further, the availability of free allowances for energy intensive sectors that are exposed to international competition, particularly from 2020, was also an important factor for some participants. The European Commission and member states are currently investigating sectors and businesses exposed to carbon leakage and determining appropriate actions.

Participants accepted that a policy implementation process is needed, but recognised that investment decisions sometime need to wait on progress in policy implementation. In addition, several participants held views that Government approaches to some carbon issues involving multiple departments (for example, BERR, DEFRA and/or DECC) were not always "joined-up".

Several participants noted that carbon price can be an important factor in investment planning, and the current volatility and uncertainty on future prices makes decision making more challenging.

6.4.3 Access to current and new technology

While in the retail sector, a grocer may trial a measure in one store before wider roll-out, it is generally difficult for the chemicals industry to trial new technologies, and availability of demonstration projects affects ability to utilise technology. Only one participant stated that new technology could be piloted at a site, with a view to rolling out where successful.

"We don't like experimenting, it's too risky"

Source: large chemical company

The complexity in the number and depth of current and new low carbon technologies for the chemical sector can be perceived as a barrier to implement new technologies.

- One of the interviewees, for example, pointed out that there are over 100 specific technologies already available across different chemical sub-sectors and that only through industry collaboration companies would be able to make the best out of new abatement opportunities;

- Another interviewee mentioned that although the company is piloting new technology to develop a completely energy self-sufficient plant, this is only a small future oriented pilot, conducted in another country, and that the focus in the UK is on the optimization of the operations.

One participant also noted that procurement of alternative energy plant (such as wind) can be a challenge. In particular, there are substantial planning barriers in developing alternative energy sources such as energy from waste combustion plant and wind power.

Furthermore, the barriers for access and deployment of new technology were the topic of a recent study undertaken by PwC, and commissioned by the UK government, into barriers impacting low carbon technologies[24]. Some of the key barriers identified were:

- Focus on renewables rather than low carbon technology;

- Difficulties in access to information (e.g. poor signposting - who to talk to and when);

- UK's electricity network and infrastructure are underdeveloped / incompatible with low carbon energy supply technologies.

6.4.4 Resource constraints

A common barrier to the implementation of abatement options noted by the majority of companies was the pressure on human resources. These can take a series of forms, as follows:

- The chemical industry is already quite leanly resourced and energy managers increasingly spend their time in complying with climate change regulation, such as the EU ETS or CCAs;

- Particularly in smaller companies, learning about new regulation/new compliance requirements takes priority over learning about new technologies and thinking strategic direction for the business;

- People change difficulties, for example, with the retirement of experienced staff and/or changing roles and responsibilities part of the knowledge gets lost;

[24] The study was undertaken in January and February 2009 and was based on stakeholder consultation through qualitative research survey (more than 50 interviews) and two workshops.

- Lack of trained staff and/or difficult to find the right staff in the UK to implement new technologies. This finding is corroborated by a recent study undertaken by PwC, and commissioned by the UK government, into barriers impacting low carbon technologies[25].

"The obvious solutions have been done, more novel schemes are needed"

Source: large chemical company

One way of helping reduce elements of human resources barriers is to have opportunity to share experience. To help its members overcome some of the barriers to the implementation of abatement measures, the Chemical Industry Association (CIA) has established a number of networks including a Responsible Energy Network.

Through regular meetings and teleconferences, practitioners share their experiences, successes and frustrations. Since many of the companies in the chemicals sector are suppliers of one another, there is often a cooperation, rather than competitive, atmosphere in the group. Tips on the completion of planning permission for installation of onsite wind turbines and procurement requirements are some of the examples of best practice shared amongst the group. This initiative also has the additional benefit of providing a forum, where practitioners from chemical industries can feel part of a group, as practitioners realize they are not alone and isolated in their business and that the barriers they face are similar across the industry.

Source: Chemical Industry Association (CIA)

6.4.5 Business focus

One participant noted that any development of an energy source that resulted in generation of excess energy to supply to the grid would need careful consideration, as this would not be core business. This could be a common barrier across many medium to small sized companies as these companies are unlikely to be able to make full use of the energy generated by CHP for example.

6.5 Carbon abatement options undertaken

There are broadly three categories of abatement options:

- Abatement options that are almost always cost negative. This category includes insulation, heat exchange and process optimisation.

- Abatement options that can be cost negative in the right circumstances. For example, Combined Heat and Power (CHP) plants can be worthwhile investments provided a site has appropriate energy needs.

- Abatement options that are significantly cost positive. For example, large process technology changes or abatement plant to reduce process emissions.

Among study participants, cost negative abatement options have been almost entirely taken up (apart from some relatively minor improvements and improvements relating to new technology). These have often been the initial "low hanging fruit" that have been priority improvements to meet CCA commitments or simply to reduce costs. In addition, a significant degree of CHP application at suitable sites has occurred over the last 10-15 years, although there may still be some potential for further application. Cost positive abatement options are generally more complex, involve a greater degree of business risk and appear to be exposed to more barriers.

"The Croda factory at Hull, for example, has had a strategy to improve the efficiency of its utility usage for the last seven years. During this time energy efficiency (gas and electricity consumption per tonne of manufactured product) has improved by 52% with a corresponding reduction in carbon dioxide emissions… These improvements have been achieved through the application of three key principles: investment, maintenance and change in culture. For example,

[25] Ibid.

there has been investment in a new boiler, air compressors and energy efficient lighting and motors. Installation of energy monitoring equipment on every plant has also supported process development work, allowing yields and plant feed rates to be improved. Improvements through maintenance have included demolition of redundant plant, replacement of steam traps and steam leak repairs. Finally, there has been a progressive change in culture through regular communication and involvement of everyone in the setting of challenging usage targets."

Source: Croda CSR Report, 2007

7. Barrier Analysis

7.1 Potential barriers identified

The following barriers were identified in the two sectors studied.

Retail

- Priority – other issues perceived to be more important in the business
- Payback period – projects not financially attractive enough to invest in
- Lack of opportunity – low hanging fruit has been picked and there is the perception that there are no or limited further abatement opportunities. Further investment in energy efficiency is expected to produce diminishing returns.
- Resource constraints – in particular, not have time to invest in looking at potential opportunities.
- Technology – energy efficient technology does not always deliver the quality or level of service required, and uncertainty over implementation of unproven technologies.
- Regulatory – concern and uncertainty due to complexity of regulatory measures, particularly in relation to biofuels, green energy, CRC and ROCs.

Chemicals

- Access to capital – issues in relation to availability of private or public funding, and competition between company sites and projects for available capital.
- Policy/regulatory uncertainty – uncertainty of future implementation and practical working of Phase III of the EU ETS, and uncertainty on future carbon price.
- Access to current and new technology – challenges in trialling and implementing new technologies.
- Planning – planning process challenges in implementing alternative energy sources.
- Human resources – constraints on time and skills.
- Business focus – concern over resources expended on non-core business activities such as generation and sale of surplus energy.

While the two sectors studied are very different in structure and activities undertaken, there were many areas of common ground in barriers between the two and all identified barriers could be compared and aligned between the sectors (except for the planning issue identified in the chemicals sector – these issues will also exist in the retail sector, although generally this sector has more planning expertise than in the chemicals sector). This was confirmed by our discussions with the two oil companies and other industry associations.

7.2 Commonalities and variation across sectors

The following table sets out key areas of commonality and variation between barrier themes identified in the two sectors.

Figure 11: Sectoral comparison of barriers identified

Theme	Commonality between sectors	Variation between sectors
Access to capital	Access to capital was not considered to be a major issue (especially for larger companies) provided the strict payback criteria are met.	In the retail sector there was a particular focus on strict payback period, with the view that carbon abatement projects could sometimes be unattractive investments. This was generally not the case in the chemicals sector, where greater energy intensity meant that good cost savings could often be made on investments in energy efficiency. The greater challenge in the chemicals sector was competition from other projects with a more attractive return. While there appeared to be less challenge in getting capital in the retail sector (as long as payback periods were met), one small retailer stated that availability of capital was a problem. The chemicals sector, on the other hand, is generally more concerned about obtaining funding.
Lack of opportunity	Many participants in both sectors expressed views that most, if not all, “low hanging fruit” had already been picked. Some participants in both sectors noted that there was little else that could be done.	In the chemicals sector, some participants stated that there were major abatement options still available (although these were all major capital investments, often involving large scale changes to energy supply or process technology). In retail, only the smaller retailers interviewed expressed further potential to undertake carbon reduction actions that are also cost effective.
Resource constraints	In the retail sector the focus of this constraint was time to identify, assess and implement abatement options. This was also an element of the broader human resources constraint in the chemicals sector, which also included skills and experience.	
Technology	Participants in both sectors highlighted challenges around unproven technology. In the retail sector, it was noted that it can be difficult to implement expensive unproven technologies. In the chemicals sector there was also concern over unproven technologies, not just on the basis of cost but also bearing in mind the criticality of energy in production processes, difficulties in physically putting new technology in place, safety risks around hazardous substances and challenges in shutting down and restarting plant. Some participants in the chemicals sector stated that demonstration projects could help to overcome this barrier.	One issue noted by participants in the retail sector was that energy efficient technology does not always provide the same quality or level of service compared to conventional technology. For example, lighting can be a brand defining factor in the sector, and energy efficient products do not always provide an appropriate quality of output. The chemicals sector is generally not public-facing in this respect so this was not identified as an issue. Retailers with multiple and differentiated sites could pilot certain types of projects; the chemicals sector has less opportunity to do so given the composition of their sites (few, large, nearly identical sites).
Policy/regulatory uncertainty	Participants from both sectors expressed concern over policy/regulatory uncertainty. In the retail sector there was also concern over complexity of regulation. This was also present in the chemicals sector but to a lesser degree, perhaps due to experience and acceptance of complex regulation on other issues in the chemicals sector.	Businesses in the two sectors are impacted by different regulatory regimes, so the issues of interest differed (although there was some crossover, for example businesses in both sectors generate ROCs).
Business focus/priority	Barriers identified in both sectors highlight the broader business context that carbon abatement sits within in the sectors.	In the retail sector there was recognition that other business priorities sometimes take precedence over carbon abatement, for example a restructuring exercise. In the chemicals sector this particular view was not identified (perhaps because carbon abatement projects are usually undertaken because of clear cost reduction or a regulatory requirement) but one participant did note that projects generating significant surplus energy would need careful consideration as this would involve commitment of resources to non-core business activity.

7.3 Recommendations

Access to capital

Aside from the current economic downturn and banking crisis, the key area in which the sectors have interface with Government or government bodies is through provision of grant support and other incentives. In the retail sector, increased incentives could help overcome internal payback period criteria. Further support may be required in particular to help smaller retailers implement abatement measures. In the chemicals sector some participants considered that more certainty over availability of funding and support for continuation of the industry in the UK would be helpful in investment planning. It was recognised that support and funding do currently exist, but several participants considered that the UK chemical industry had less support than in some other EU countries.

Lack of opportunity

As participants suggested that many of the cost-effective actions have been undertaken, this suggests that the next "wave" of carbon reduction actions would need to be the focus of government's carbon reduction measures. Efforts to promote the take-up of these measures need to be scaled up, including measures that make these actions increasingly cost-effective.

On the other hand, some of the cost-effective actions have yet to be implemented by smaller companies (particularly in the retail sector). A differentiated approach to large and small players in a sector may be required.

Technology

Specific technologies or measures such as Combined Heat & Power or installing doors on fridges have varying success in different companies. A 'one size fits all' approach to energy or carbon management technologies or measures is only likely to be cost-effective across the economy in specific cases – such as low energy light bulbs. A clear and robust business case is needed before Government incentivises particular measures.

Two chemicals sector participants considered that more Government support for relevant technology demonstration projects would help them consider whether implementation was appropriate for them.

Policy/regulatory uncertainty

Participants held views that the following would support investment planning in relation to policy/regulatory uncertainty:

- More recognition that significant investment decisions can be held up by the policy process.
- More widespread implementation of carbon abatement measures in the chemicals industry outside the EU.
- More commitment from the Government for a continuing UK chemicals industry in making policy decisions.

Resource constraints

Some smaller participants suggested that greater help through informational campaigns or workshops may help overcome resource constraints. These participants also highlighted the need for low or no cost advice, including consultancy advice. BERR or industry associations could help facilitate this process of providing advice through a number of efforts. Industry associations could group SMEs together to share the cost of advice, which would reduce the cost for each participant. The government could also subsidise resource or consultancy support provided to small participants.

8. Conclusions

8.1 Developing a methodology to identify cost-effective actions

8.1.1 Merits and limitations of our approach

We developed a relatively straightforward approach, designed to be an iterative process to enable an update of the understanding of carbon reduction actions and barriers.

Applying the methodology to the retail and chemicals sector raised a number of issues. First, we interviewed twenty four companies and industry associations in total – not a representative sample – so our study would have benefitted from greater diversity in a larger sample. Secondly, given the commercial sensitivities around carbon and energy management and investment decision making, companies are reluctant to reveal specifics concerning the implementation of particular projects. This makes it very difficult to quantify the degree to which a particular measure as been implemented within a sector (or even within a company) or how successful it has been, and therefore it is difficult to say what the cost-effective abatement potential remains within the sector. Thirdly, the study focuses on qualitative evidence provided by businesses, rather than a quantitative analysis or a re-evaluation of the MACC by including the hidden or missing costs associated with particular measures.

8.1.2 Implications for further research

Our proposed methodology could be supplemented by more quantitative methods of information collection. One approach could be conducting an online survey prior to interviews to capture a wider participant base, and collecting primary data. However, any quantitative information collection should only be viewed as supplementary evidence, as the qualitative interviews have proven essential in understanding the real barriers. An alternative option could be to conduct a more detailed quantitative study within particular companies where access is given.

8.2 Barriers and Recommendations

Most companies interviewed in both sectors reported that they had already implemented many of the measures that are below the line on the MACC – in other words much of the low hanging fruit has been picked. Implementing these measures (such as using low energy lighting, switching off lights, not leaving engines to idle, ensuring building heating is not competing with cooling and addressing steam leaks) is routine and is described simply as ‘good house-keeping’. However it is challenging to quantify how successfully these measures have been implemented and the extent to which further measures are still available, our findings suggest that the MACC may overestimate the carbon reductions that can be achieved at low or negative cost.

In both sectors, companies noted that energy and carbon management is a competitive issue. Companies may therefore be reluctant to reveal precisely how they evaluate particular energy management measures and the degree and success of their implementation. This may explain why the MACC may misestimate the potential of the cost-effective measures.

Companies stated that the biggest challenge to tackling emissions growth is the lack of suitable projects (i.e. projects which meet their investment criteria – typically to pay back in 2-4 years) rather than particular barriers to implementing particular low cost measures. In many cases, the next measures available to companies such as renewable energy generation or combined heat and power are either less economic than competing projects within the company or are considered to be beyond the company’s core business.

The priority given to identifying and implementing measures to reduce carbon emissions depends on the materiality of energy costs to the business and the size of the business. In larger companies, energy managers or teams of energy managers have a good understanding of the next most cost-effective measures available to reduce energy consumption or carbon emissions. The barrier to these measures may be that they are not cost effective or are relatively unattractive compared to alternative uses of the capital within the company. However, some larger retailers with public carbon reduction commitments suggested that they would be willing to extend the range of paybacks considered once the sub 4 year opportunities were exhausted.

Smaller companies commented on the lack of capacity to identify and implement anything but the most obvious and straightforward energy management projects. It is likely that the opportunities below the line on the MACC are in smaller businesses which lack capacity to identify or implement them.

Looking forward, Government action, perhaps through information campaigns or resource support, to encourage small businesses (and therefore presumably individuals) to address emissions or energy management may yield the greatest dividends. Some smaller participants suggested that greater help through information campaigns or workshops may help overcome resource constraints. These participants also highlighted the need for low or no cost advice, including

consultancy advice. BERR or industry associations could help facilitate this process by providing advice through a number of channels.

Appendix I – List of potential barriers

This table presents a generic list of barriers that may apply to companies considering carbon reduction measures.

Table 1: Barriers Guide

Barriers
Financial
(Liquid) capital availability
Lack of access to capital
Does not meet return or payback criteria
High capital cost of measure
Ongoing monitoring costs
Cost savings not absorbed by business
Cost of required process changes
Cost of disruption
Staff training costs
Non-monetary project costs (Hidden and missing costs)
Project identification
Project evaluation
Project design
Procurement of project (including bureaucratic e.g. planning permissions)
Construction and installation
Downtime / Production disruption
Project commissioning
Ongoing management
Management and behavioural
Rule of thumbs approach to investment decisions
Low priority on energy issues
High risk of delivery (project carries risk and cost of failure)
Level of risk aversion (linked to risk of delivery)
Management of multiple sources (many point sources / decentralised management)
Lack of understanding of impacts of climate change / energy efficiency (imperfect / inaccurate information)
Lack of understanding of abatement opportunities (imperfect / inaccurate information)
Split incentives: tenant-landlord
Split incentives: employer-employee
Disruption to processes
Customer inconvenience
Technological
Unproven technology / benefits
Lack of access to technology (e.g. no local suppliers of required technology)
Technology not applicable in practice

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