Climate Change Agreements in UK: A Successful Policy Experience?

Matthieu Glachant, Gildas de Muizon[1]

24th April 2006[2]

[1] CERNA, Ecole des Mines de Paris, address for correspondence: 60, boulevard St Michel, 75272 PARIS cedex 06, glachant@ensmp.fr.

[2] We thank Ita McMahon and James D. Godber from DEFRA and Tim Atkinson from Natsource for the useful information they provided to us. We thank Resources For the Future for financial support.

1 Introduction

As part of the national strategy to meet Kyoto obligations, the UK Government launched 48 Climate Change Agreements (CCAs, hereafter) negotiated with trade associations representing energy intensive industries in 2001. These CCAs exhibit two original features. To begin with, they are embodied in a sophisticated policy mix in which they are combined with an energy tax, the Climate Change Levy, and an emission trading system. The levy provides the sectors with an incentive to enter in CCAs by granting an 80% tax rebate to participating companies while they can comply with their CCA target by purchasing allowances through the emissions trading scheme (ETS).

A second characteristic of CCAs is that they look like the ideal voluntary agreement in the sense that they fit quite well with the recommendations on the design of voluntary agreements found in reference policy documents (e.g. OECD, 2004). They were designed under a clear and credible threat (paying the full energy tax). Significant efforts were made during the negotiation process to establish the Business-As-Usual trend in order to measure the genuine strictness of the CCA targets. Monitoring and enforcement provisions are also particularly well-specified. Agreements are enforceable contracts which allow punishing non compliant companies. Clear final as well as interim targets are set. To sum up, CCAs seem well equipped to be efficient.

Have CCAs met these expectations? In particular, have they led to more environmental improvements than what would have been observed without CCAs? In this chapter, we describe this policy experience and implement a novel methodology to assess the environmental strictness of CCAs targets. This method exploits the idea that the ETS market price reveals the marginal abatement costs of the CCA participants.

The structure of the paper is as follows. Section 2 describes the UK Climate Change policy and the context in which CCAs were negotiated. In section 3, we describe carefully the contents of CCAs. Section 4 is dedicated to the interim assessment of CCAs' achievements from the participants' point of view. We develop our own assessment in section 5. The overall conclusion is that CCAs have clearly been successful in meeting the energy consumption targets. But those targets were probably modest for the majority of CCA companies. Contrary to the expectations based on theoretical considerations, CCAs may not have delivered much more emissions abatements than what would have happened anyway.

2 The UK Climate Change policy

The UK has been a strong supporter of the Kyoto Protocol and has played an active role in international negotiations. Accordingly, the UK's target under the European burden sharing agreement exceeds the average EU target and it is one of the few EU Member States to be on course to meet its Kyoto obligations (if we except the specific situation of the New Member States of Central and Eastern Europe). By 2004, UK greenhouse gases[3] emissions had fallen by 14.6% relative to 1990 levels. As shown in Figure 1, the UK complies with its Kyoto

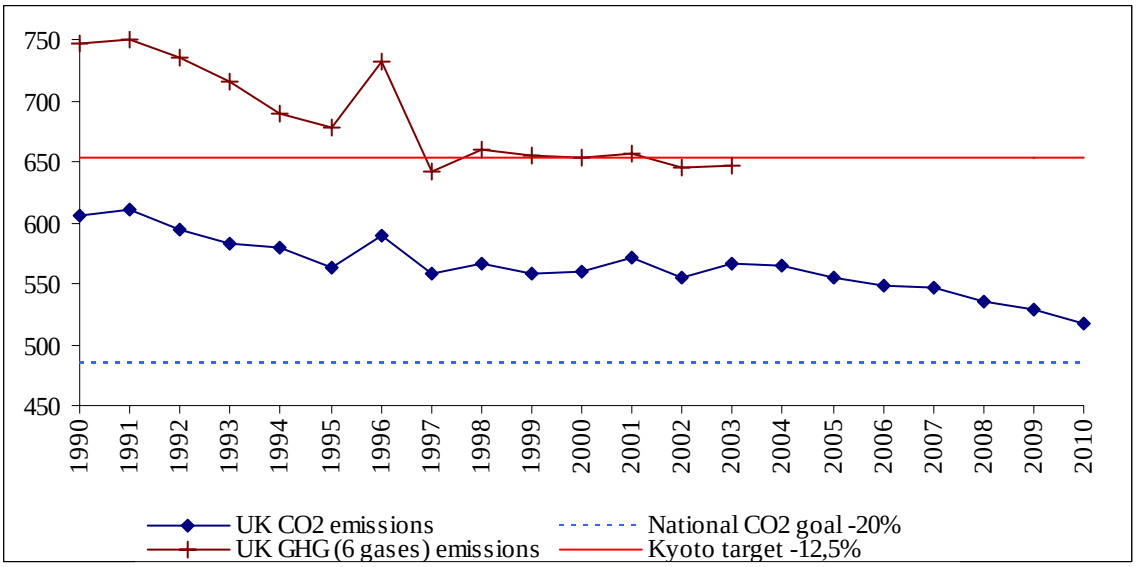
[3] The basket of greenhouse gases consists of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, weighted by global warming potential. The base year is 1990 for carbon dioxide, methane and nitrous oxide, and 1995 for fluorinated compounds.

targets since 2002-2003. The relative ease with which the UK would be able to meet its obligation by national measures has led it to take little interest in the Kyoto project mechanisms.

To a large extent, UK's proactive position on climate change derives from its declining trend in emissions during the nineties. On one hand, an important driver has been a large-scale fuel switching, mainly the displacement of coal by gas in electricity generation and manufacturing. On the other hand, emissions of methane and nitrous oxide, the other two major greenhouse gases, fell by 50 per cent and 40 per cent respectively since 1990. Emissions of the fluorinated compounds have fallen by 25 per cent since 1990 and by 40 per cent since 1995.

Focusing next on carbon dioxide emissions, Figure 1 shows a 5.6% reduction between 1990 and 2004. But emissions remain significantly above the horizontal blue line representing the national CO_2 goal included in the UK's climate change programme. This programme was published in November 2000. It sets out a far-reaching strategy for reducing emissions and for adapting the effects of climate change. It contains an integrated package of measures to reduce emissions of greenhouse gases across all sectors of the economy and announced the Government's commitment to move beyond its Kyoto Protocol target, by aiming to reduce UK CO_2 emissions by 20% below 1990 levels by 2010.

Figure 1: UK CO_2 and GHG emissions (1990-2010), in MteCO_2



Sources: DTI (2004), DEFRA (2005)

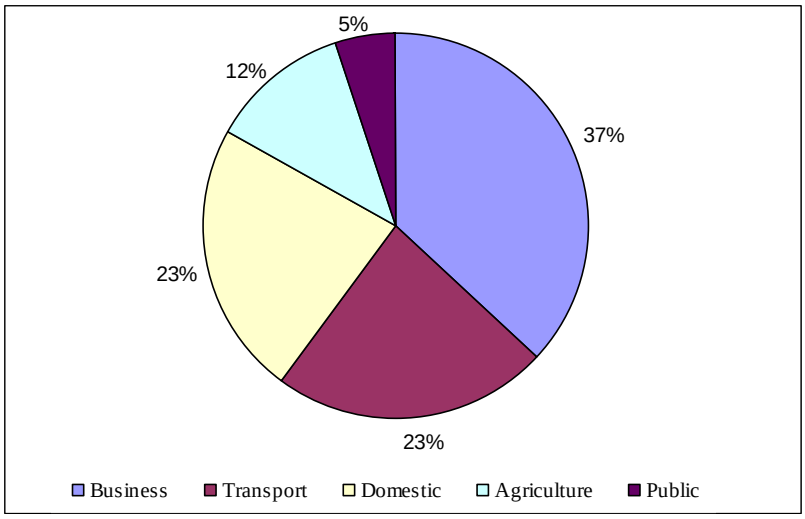
The target of 20% reduction in CO_2 has been presented as an interim step toward an ambitious long-term goal to reduce CO_2 emission by some 60% by about 2050. This is also supported by the idea that there will be many benefits for the UK from taking early actions to cut its emissions as the Government and the devolved administrations are convinced that big cuts in emissions are inevitable in the next decades. This reflects the UK willingness to establish a leadership over climate change issues in the international arena.

Whereas projections indicate that the UK is likely to meet its Kyoto target, the national CO_2 target is unlikely to be achieved. In 2004, the Department of Trade and Industry stated that a reduction of 14% was more likely (DTI Updated Emissions Projections, 11 November 2004) and Tony Blair announced that *"We are on track to meet our Kyoto commitment (…) But we*

have to do more to achieve our commitment to reduce carbon dioxide emissions by 20% by 2010" in September 2004.

Turning next to the policy measures adopted to meet those targets, the UK programme provides a particularly rich and complex example of policy interaction. In particular, it has developed an innovative and interdependent policy mix to reduce the emission of the business sector which is the most significant emitter of GHG. As shown in Figure 2, GHG business emissions accounted for about one third of total UK emissions in 2000.

Figure 2. UK GHG emissions by sector, 2000



Source: DEFRA, quoted by Parliamentary Office of Science and Technology (2004)

In this policy mix, the role of economic instruments is pre-eminent, following the main conclusions of Lord Marshall's report (1998) to the Chancellor of the Exchequer. This report examines economic instruments to reduce efficiently emissions of GHG. The Climate Change Levy, launched in 2001 is a downstream tax on energy used in the industrial, commercial and public sectors. Its rationale was to shift the burden of taxation from employment to CO_2 emissions, in accordance with a double dividend argument. In this view, the levy is revenue neutral: receipts are recycled back to business through both a reduction in employer national insurance contributions and the financing of schemes promoting energy efficiency. The tax covers all types of energy sources but fuel oil which was already targeted by another tax. Depending upon the energy source, the CCL rate ranges from £5 per ton of CO_2 (for Coal) to £10 (for electricity)[4].

Lord Marshall's report also recognized the need *"for the levy to be designed in a way that delivered worthwhile improvements to energy efficiency and reductions to carbon emissions whilst at the same time safeguarding the competitiveness of UK business and, in particular, the energy intensive users"*. This is the concern which led to the introduction of CCAs: the Government offered an 80% levy reduction to selected industrials sectors in exchange of a quantified negotiated commitment to reduce their energy consumptions or CO_2 emissions.

[4] £3 per ton of CO_2 for LPG but it is a marginal industrial energy source.

In addition to the levy and the CCAs, the UK also set up a pilot emissions trading scheme which was launched in 2002, that is three years before the EU ETS launched on January 1, 2005. Again, this reveals the UK willingness to become a leader on climate change issue, and to benefit from a first-mover advantage, both by giving its industry an advantage over their international competitors, through learning-by-doing and providing an opportunity for the city of London to become established as an international centre for emissions trading. The UK ETS was initially a Cap & Trade scheme with voluntary participation of non CCA companies through the auction of an incentive subsidy to take absolute targets of abatement. It has been quickly extended to include CCA participants which can enter the market on a Baseline & Credit model.

3 Description of the Climate Change Agreements

3.1 Sector coverage

Agreements essentially consist in quantitative objectives of energy use reduction to be met by 2010. They were negotiated with 48 sectoral associations (covering 44 industrial sectors) but two of these have since been terminated by the sectors (Reprotech and Vehicle builders and repairers). The scheme covers around 12,000 individual sites (5,500 companies) and nearly 44% of total UK industry emissions.

As we have seen, the introduction of the CCAs with a tax exemption is the result of the willingness of the British government to reduce the tax burden for energy-intensive firms. A limited number of industrial activities were initially identified by the UK government to be eligible for the scheme: aluminum, cement, ceramics, chemicals, food and drink, foundries, glass, non-ferrous metals, paper and steel. This choice was based on IPPC criteria to select energy-intensive industries. In the end, the sector coverage is much larger. For instance, the agribusiness and the motor industry are included even if these sectors are not particularly energy intensive. In the meantime, lobbying efforts were made by sectors willing to benefit from the tax exemption. Last but not least, the participation to CCAs was voluntary. But, unsurprisingly, all eligible sectors have opted for a CCA.

3.2 Targets

CCAs' contribution to British Climate Change policy is quite significant since they are expected to represent more than 25% of CO_2 abatement in industry. It corresponds to a reduction of 9.2 $MtCO_2$ below Business-as-usual by 2010 and an average 12% reduction below 2000 levels.

The CCAs targets could be relative, i.e. per unit of output, or absolute, i.e. irrespective of their production level. Thus, four type of expressing the target have been proposed: relative energy (GJ primary energy per unit of output, *'Rel E'* in table 1), relative carbon (tons of carbon per unit of output, *'Rel C'* in table 1), absolute energy (GJ primary energy, *'Abs E'* in table 1) or absolute carbon (tones of carbon). For most industries, expressing their target in terms of

carbon or energy savings is equivalent as carbon emission is directly linked to energy consumption. However, expressing the target in terms of energy consumption does not allow for fuel switching even if it could lead to carbon savings. In practice, almost all sectors have opted for primary energy use targets for practical reason: energy consumption is already monitored. Only two sectors agreed on targets expressed in specific carbon emissions: aluminum and metal packaging. The rationale for the aluminum sector to refer to carbon is that carbon savings do not only come from energy efficiency improvements but also from savings in process.

All but two sectors have opted for relative targets. The two exceptions are the aerospace and the steel industry which have committed for absolute target. The advantage of relative objectives for business lies in the fact that they prevent fluctuations of the future output level to affect compliance efforts. By contrast, absolute targets may be interesting for sectors anticipating a decrease in production. This might be the motive underlying the steel and aerospace industry's choices. By the way, the steel industry has been subject to several operational difficulties and major structural changes meaning output has been significantly reduced in the last years.

Negotiated targets vary a lot across sectors as shown in Table 1. This reflects the influence of sector specific variables such as growth rate, hypothesis on technological evolution, market structure, negotiating skills of the sector association… The baseline year the targets refer to is also sector specific because of differences across sectors in terms of energy data availability or early actions of energy efficiency.

Table 1: Summary of sector targets

Sectors	Type	Target by 2010	Base year
Aerospace	Abs E	-8.5%	2001
Agriculture supply	Rel E	-7.1%	1999
Aluminum	Rel C	-32.2%	1990
Brewing	Rel E	-11.6%	1999
Cathode Ray Tubes	Rel E	-21%	2000
Cement	Rel E	-25.6%	1990
Cementitous slag	Rel E	-10%	1999
Ceramic - non fletton	Rel E	-12.4%	2000
Ceramic - fletton	Rel E	-8.1%	2000
Ceramic - refractories	Rel E	-10.33%	2000
Ceramic - white wares	Rel E	-10.22%	2000
Ceramic - materials	Rel E	-10.1%	2000
Chemicals	Rel E	-18.3%	1998
Craft bakeries	Rel E	-9%	1999
Dairy industry	Rel E	-9.2%	1999
Egg product (NFU)	Rel E	-11.5%	1995-2000
Egg product (BEPA)	Rel E	-9.3%	1999
Food & Drink	Rel E	-8.1%	1999
Foundries	Rel E	-11%	1999
Glass	Rel E	-9.2%	2000
Gypsum products	Rel E	-7.2%	1999
Leather	Rel E	-9.8%	2000
Lime	Rel E	-7.9%	1999
Malting	Rel E	-7.8%	1998
Metal Packaging	Rel C	-9%	1999
Metal Forming	Rel E	-7%	1999
Mineral wool	Rel E	-14.9%	2000
Motor manufacturers	Rel E	-15.3%	1999
Non-ferrous	Rel E	-14.7%	1995
Paper	Rel E	-24%	1998
Pigs	Rel E	-16%	1997
Poultry meat processing	Rel E	-12.5%	1995-2000
Poultry meat rearing (BPC)	Rel E	-13.7%	1999
Poultry meat rearing (NFU)	Rel E	-13.7%	1999
Printing	Rel E	-12%	2000
Red meat	Rel E	-10.8%	1999
Rendering	Rel E	-9%	1999
Rubber	Rel E	-10.3%	1999
Semiconductors	Rel E	-59%	2000
Spirits	Rel E	-4.5%	1999
Steels	Abs E	-11.5%	1997
Supermarkets	Abs E	-4.5%	1999
Surface engineering	Rel E	-10.3%	1999
Textiles	Rel E	-9%	1999
Vehicle builders and repairers	Rel E	-10%	2000
Wallcoverings	Abs E	-9%	1999
Wood panel	Rel E	-7.3%	1999

Source: ETSU (2001)

3.3 Contractual design

The CCAs share a common design across sectors even though they have been modified where necessary to reflect particular circumstances. Three structures for agreements have been proposed: (1) one full sector model with one target and a one stage all pass/all fail evaluation (2) an umbrella agreement between the Department of Environment, Food and Rural Affairs (DEFRA) and the sector association and underlying agreements between DEFRA and each company and (3) an umbrella agreement between DEFRA and underlying agreements retained and managed by the sectors.

Option 1 was hardly chosen. Companies have been reluctant to enter in a scheme based on a mechanism of collective compliance, generating potentially free riding behaviors: a company could loose the exemption even if it has complied with the target in the case the whole sector fails to comply. The majority of sectors uses option 2. Under this option, the compliance verification is made in two steps: the first step checks if the sector target is met. If so, all target units are deemed to have met their target and there is no second step. The second step comes only if the sector target is not met. In this case, each target unit is re-certified if it has met its individual target. Option 3 is quite similar to option 2 and has been chosen by six sectors. The rationale for this multi-level target is to avoid the cost of individual verification in case of global compliance. The initial idea was also that over-achievement by one participant would compensate for the under-achievement of another.

3.4 Monitoring and enforcement aspects

Contrary to most negotiated agreement observed in other EU countries, CCAs include a complete monitoring and enforcement apparatus. CCAs set a final 2010 target but also interim targets for each of the two-yearly milestones (2002, 2004, 2006 and 2008). For each milestone, individual sites have to report energy and production data to their sector association. Independent crosschecks can be undertaken by DEFRA. As far as enforcement is concerned, the key feature of CCAs is that they are both based on a collective liability principle through the umbrella agreement and an individual liability principle through the underlying agreement signed by individual sites. More specifically, if the sector target is met, there is no further action. Otherwise the non-compliant sites are identified. They are not re-certified for the discount and lose their tax exemption for the next two years even though they don’t have to pay back the rebate corresponding to the non-compliance period. At the end of the next milestone, they could again benefit from the discount if they succeed to comply with the next interim target. In 2010, if a site fails to comply with its target, it will have to pay back the whole exemptions it has enjoyed.

3.5 CCAs and emission trading

Even if the detailed rules governing the interactions between emission trading and the CCAs had not been developed yet at the time they were negotiated, provision for emissions trading was included in the agreements. The emission trading scheme was launched in April 2002. It involves two types of participants: the so-called Direct Participants and the CCA companies.

The participation of the Direct Participants (DPs, hereafter) is totally voluntary. More specifically, the government offered incentive payments to UK companies committing to

greenhouse gas emission reductions. The incentive payments amounting 215 M£ were allocated by an Internet auction in March 2002. The auction was conducted with a descending price clock, on account that it was a procurement auction (or "reverse auction"): the government sought to purchase emission reductions at minimum cost. The government posted a price per unit of emissions reductions, and firms bid the quantity of emission reductions that they were prepared to make at that price. In each new round, the government announced a successively lower price and bidders indicated the quantity of emission reductions that they were prepared to make at the lower price, until the market cleared.

All companies which were not involved in a CCA could participate. In the end, thirty four qualified for the incentive and share among themselves the incentive payments for accepting a total abatement of 4 Mt CO_2 to 2006. After taking into account the effect of the yearly abatement profile and corporate tax, the incentive rewards each ton of CO_2 with around £12. These companies are either large oil companies (BP, SHELL), which are not eligible for a CCA since the Climate Change Levy does not target fuel oil, companies emitting non CO2 gases such as HFC (INEOS) or non energy intensive enterprises such as banks and supermarkets.

In parallel, CCAs firms were offered the opportunity to participate to the scheme on a Baseline & Credit basis: if CCA participants over-comply with their target, they can receive emission credits which can be traded on the emission market. Conversely, a CCA participant can buy emissions permits on the market to comply with its target. Linking the CCAs with emission trading rewards over-achievement and can increase their cost effectiveness.

We have seen that nearly all CCA participants use relative targets whereas DPs are required to meet absolute targets. One consequence is that, under particular conditions, trading between both types of participants can lead to reduce the environmental outcome of the DPs. To preserve the environmental integrity of the UK ETS, a Gateway mechanism has been designed: any transfer of allowance between a relative participant and an absolute one is approved by the public authority if and only if the net total flow of permits toward the relative sector is positive. This restriction is designed to ensure that whole scheme does bring about real absolute, rather than relative, emissions reductions. Given the risk of erosion of the environmental impact through the transfer of permits to the absolute participants, one could wonder why a simple prohibition of any permit transfers from the relative to the absolute group could not have done the job in a simpler way. The Gateway is seen as a better mechanism than a simple one-way trading since it increases the thickness of the market as the number of trading participants is increased by the connection of the two groups. Indeed, it could reduce some liquidity problems and sequential transactions which may prevent some cost-effective transactions from occurring. In practice, the Gateway has remained open since the beginning of the UK ETS. This means that the net flow of permit comes from the DPs to the relative CCA participants. When assessing the environmental strictness of CCA targets in Section 5, we will come back to that issue.

4 Programmatic accomplishment: the regulator's view

4.1 Ex-ante identification of the baseline scenario

The evaluation of the expected environmental impact of any CCA target requires establishing at first a baseline scenario. This baseline scenario describing what would have occurred without CCAs or any other instrument. As it is a hypothetical scenario, it is necessary to make many assumptions on parameters like the sector growth rate, the likely technological trajectory etc. Significant efforts were made during the negotiation to identify a baseline scenario in order to provide a benchmark for judging the strictness of the targets. It is quite original when comparing with voluntary agreements in other fields and countries.

Energy consultants of ETSU were mandated by DEFRA to give assistance. They have compared the CCAs targets with two reference scenarios:

- A baseline Business-as-usual scenario (BAU) which describes what would have occurred if firms did not change their behavior. This scenario is basically an extrapolation of the recent trend.
- An All-Cost-Effective scenario (ACE) in which all cost effective measures of energy efficiency are implemented by the companies. In comparison with the BAU scenario, ACE measures include major plant replacement, retrofit of particular components and better energy management. The forecasting of the investments is based on standard assumption of plant replacement schedules on the investment criteria that are believed representative in the particular sector. It also assumes neither restriction on capital availability or on managerial time.

ETSU (2001) has estimated that if all cost-effective measures were implemented in the sectors covered by CCAs, it would lead to reduction of 14.6 Mt CO_2 by 2010. In comparison, the completion of CCAs' targets results in a reduction of 9.2 Mt CO_2 beyond the Business-as-usual scenario. Thus the Agreements will lead to bridge about 60% of the gap between BAU and ACE.

Do these figures indicate strict targets? Basically, the answer depends on the judgment about the strictness of the ACE scenario. On the one hand, it can be viewed as a particular "Business-as-usual" scenario if we assume that companies spontaneously implement cost saving options. On the other hand, the assumptions of unlimited management time and capital availability are very optimistic. To give a reference point, ETSU has estimated that the price effect of the full-rate levy with no agreements would give rise to savings of 0.9 Mt CO_2[5]. Put differently, the CCAs are 10% less environmentally effective than the full tax. Based on this evidence, ETSU drew up a very positive assessment of the negotiation outcomes and estimated that the CCAs' targets would lead to real improvements below the BAU scenario and result in a very modest lowering of the environmental impact in comparison with the full-rate levy.

[5] 10.1 Mt CO_2 beyond the BAU for the full tax scenario instead of 9.2 MtCO_2 for the CCAs scenario.

The Association for the Conservation of Energy[6] disagrees with ETSU conclusions. Its view is that CCAs' targets are very close to BAU (ACE, 2000). It quotes two different studies, one made by the European Commission, the other by the Department of Industry and Trade which respectively estimate that the BAU scenario will result in a 9% and 13% reduction of CO_2 emissions by 2010. Comparing those figures with the CCAs' targets (an average 12% reduction in the period 2000 – 2010), its conclusions are far less optimistic.

Who is right between ETSU and the Association for the Conservation of Energy? It is not possible to conclude without detailed information on the methodology used in the different studies to elaborate the baseline scenarios. This is a common difficulty of ex-ante assessments that have to rely on many assumptions which are always questionable.

4.2 Results of the first two periods

CCAs specify two-yearly interim targets. Future Energy Solutions[7] (2004, 2005) has been mandated by DEFRA to assess the results of the first and second periods.

At the end of the first period (2001-2002), 33 out of 48 sectoral associations met their target as a whole. 5042 sites have been re-certified while 700 have either left the agreements, or not been re-certified or did not submit any data at the end of the milestones period which implies that their agreements have been terminated. Overall, around 88% of target units have been re-certified. It is estimated that the cumulative absolute energy saving compared to the baseline years is equivalent to 15.8 $MtCO_2$. This figure has to be compared with the overall target which was 6 $MtCO_2$. By far, the main contributor to these over achievements is the steel industry. Due to major changes in this industry (several operational difficulties and major structural changes meant that output and CO_2 emissions were significantly reduced), steel accounted for 9.4 $MtCO_2$ of the 15.8 $MtCO_2$. DEFRA and the steel sector agreed to a target adjustment which increased from 1.4 $MtCO_2$ to 7.7 $MtCO_2$ for the first period. Taking this adjustment into account, the overachievement of the CCA sector for the first period was estimated to 3.5 $MtCO_2$.

The results of the second period 2003-2004 are even better. Indeed, 42 out of 46 sectoral associations have been re-certified. 4420 target units comply while 255 have not been re-certified. This means that 95% of target units have been re-certified. There has been also a big overachievement of around 8.9 $MtCO_2$ (5.1 after the steel target adjustment) while the overall target for the second period was 5.5 $MtCO_2$ (9.3 after the adjustment). There has been a continued improvement in the overall performance across all sectors.

In addition, the FES assessment also points out that the CCAs have also brought a change in attitude to energy management in industry. In addition to the savings from the reduced rate of CCL, they estimated that CCA participants collectively save over 650M€ per year from their reduced energy consumption.

[6] The Association for the Conservation of Energy was formed in 1981 by a number of major companies active within the energy conservation industry. It aims to encourage a positive national awareness of the need for and benefits of energy conservation. www.ukace.org

[7] As part of the AEA Technology Environment business, Future Energy Solutions (FES) has evolved from the Energy Technology Support Unit (ETSU) set up by the UK Government in 1974. Today it is a private-sector business.

4.3 The 2004 target renegotiation

Each agreement specifies a final 2010 target but also interim target for each of the two-yearly milestones (2002, 2004, 2006 and 2008). Renegotiations of the targets are allowed at the second and fourth checkpoint. In particular, CCAs require adjustments to the targets of sectors or individual sites with absolute target if annual output has decreased by more than 10%.

The 2004 review gave an opportunity for both industry and government to re-examine the assumptions behind the setting of targets and to see if they were too low or too high. The table 5 in annex sums up the percentage of target adjustment. Unsurprisingly, because of the better than expected performance for the majority of sectors in 2002, the review has resulted in a tightening of target for 25 sectors. The exceptions concern 8 sectoral associations (two of which, Red Meat and Foundries, did not meet their target in 2002 and their targets have not been revised) and one sector (Ceramic –fletton) whose target has been judged unrealistic and has been slackened.

In the end, the view of DEFRA and the CCA companies on the programme accomplishments is very positive. Overall, emissions reduction is twice as larger than expected. In addition, the scheme appears very cost effective thanks to its connections to the emissions trading scheme. Also, it would have led to very significant cost savings by fostering behavioral changes in energy management.

The extent of that success in terms of goal attainment may cast some doubts over the genuine environmental strictness of CCAs. Why have profit making entities decided to abate beyond the targets if abatement is costly? We now turn to our own assessment.

5 Programmatic accomplishments: outside analysis

In this section, we assess the environmental impacts of the Climate Change Agreements. We seek to identify whether the CCAs have led to additional GHG abatement relative to the Business-As-Usual scenario.

5.1 Methodology

From a general point of view, measuring the environmental effectiveness of a voluntary agreement is frequently a difficult task for it requires the identification of the baseline scenario. But, in our case, the fact that CCAs are linked with an emission trading scheme offers a simple assessment method. It rests on the idea that the prices observed on the emission market reveal the abatement costs of the market participants. According to standard microeconomic theory, the price simply equates the marginal abatement costs of any participant if the market is competitive. This result is easily established by contradiction: if one participant's marginal cost was less than the price, he would sell credits or buy if their marginal cost is higher. As a consequence, observing non-zero prices means that all participants bear positive abatement costs in equilibrium. Put differently,

Proposition 1 *If the market price is positive, the aggregate abatement delivered by all market participants is higher than BAU abatement. Furthermore, the higher the price, the higher the difference between observed abatement and BAU abatement.*

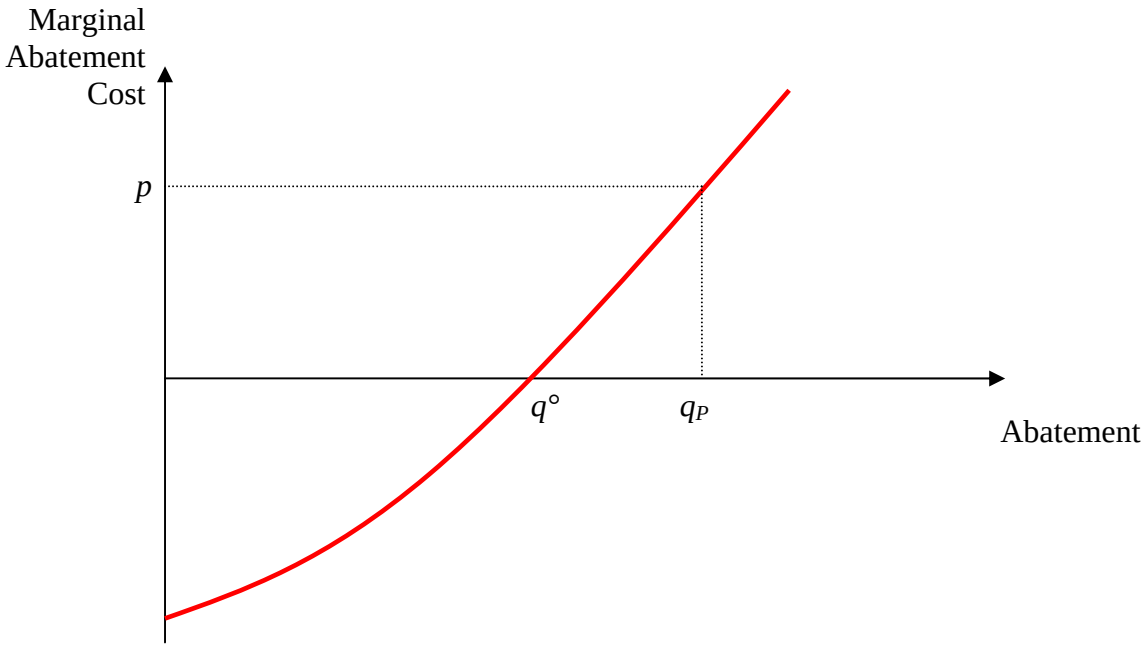
Before going further, it is necessary to clearly state the limits of this general approach. They are twofold. First, market prices only reflect *ex post* additionality. And since the actors have set CCA targets several months, or possibly a year, before abatement actions have actually been implemented, *ex post* additionality may diverge significantly from *ex ante* additionality. For instance, if a sector experiences a drastic production downturn, meeting absolute targets becomes far less easy than expected and a target additional in the *ex ante* sense might not be *ex post* additional. We will indeed see that significant and probably unexpected economic fluctuations have occurred in certain sectors (e.g. steel industry). However, this drawback is mitigated by the fact that most CCA targets are relative.

A second potential problem is related to what BAU abatement precisely means. Proposition 1 assimilates BAU abatement to profitable abatement activities. In practice, companies may not implement profitable abatement actions in a Business As Usual scenario for informational or organizational reasons. If the CCA contributes to remove these barriers, it leads to additional abatement which is not costly *ex post*. Our general approach is not able to measure the additionality of profitable abatement, meaning that we tend to under-estimate the CCA environmental effectiveness.

Having made these general remarks, we come back to the presentation of the details of our methodology. If the CCA companies were the only market participants, Proposition 1 would make the evaluation straightforward. We would directly infer the strictness of the target from the observation of the market price. But there are other types of market participants in the ETS market. In particular, the Direct Participants have been granted CO_2 permits through the auctioning process previously evoked. In this context, Proposition 1 only implies that the sum of the Direct Participants' allocation and of the CCA participants' target yield additional abatement if the price is positive. It does not mean that CCA targets alone are additional.

Let us clarify this point using Figure 3. In this graph, we adopt the point of view of an individual CCA participant acting in the ETS market. The graph shows its marginal abatement cost as a function of his abatement level denoted q (the red curve). Note that the marginal cost is negative below a certain level of abatement $q°$ implying that the polluter selects this level of abatement in the absence of policy. Hence, $q°$ is BAU abatement. In the same graph, the horizontal line shows the market price p. In this context, microeconomic theory predicts that it selects the level of abatement q_P. In market equilibrium, additional abatement beyond BAU is simply the difference $q_P - q°$.

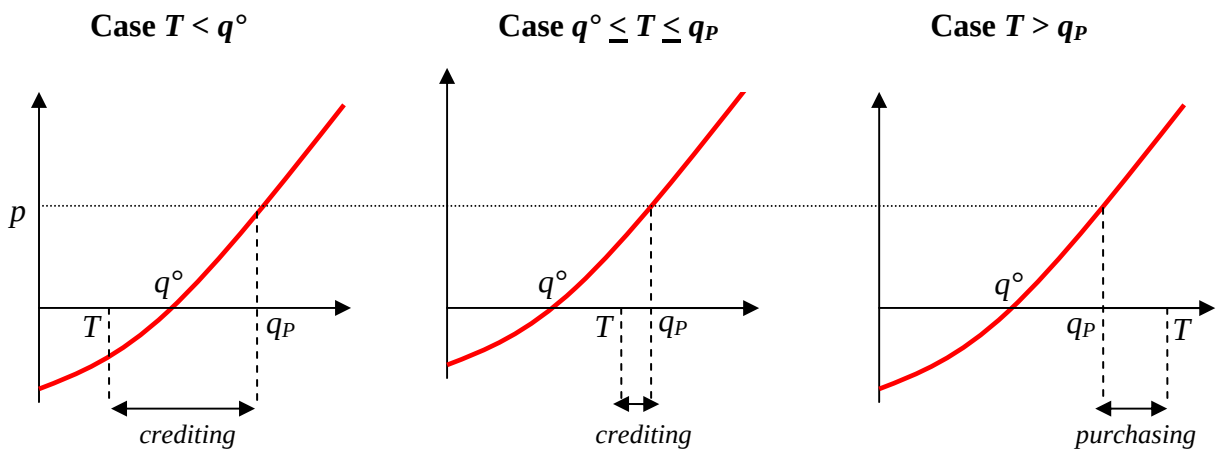
Figure 3. Abatement response of a CCA company



In summary, Figure 3 shows that an individual CCA company makes additional abatement, just like all other market participants if the market price is strictly positive. But, it does not necessarily mean that its CCA target is additional. To see that, let T denote the target. Then, Figure 4 shows what happens for different levels of T. We have three cases:

- If the target T is less than $q°$, the CCA does not have any impact on abatement, and the company over complies with its CCA target, meaning that it get credits.
- If the target lies in between $q°$ and q_P, the CCA target yields additional abatement relative to the baseline. And we observe over compliance as well.
- Finally, if the CCA target exceeds q_P, the firm complies with the CCA obligations by abating a quantity q_P and purchasing the additional credits necessary to fill the gap between q_P and T.

Figure 4. Abatement response under different CCA targets



Additionality = 0 | Additionality = $T–q°$ | Additionality = $T–q°$

So far, we have considered the decision made by a CCA company based on its knowledge of its marginal cost curve. Now, let us adopt the point view of an outside evaluator who is not informed about individual marginal abatement cost. He only observes the price p, the initial target T and the equilibrium abatement q_P. In this informational context, he can only infer with certainty that the CCA target of a company is additional when the firm is a net buyer of credits, that is if $T < q_P$. By contrast, he cannot conclude when the CCA firm exceeds target and receives credits. We can only suspect that those receiving a small amount of credits have an additional target so that $q° \leq T \leq q_P$, but without any precise idea of the crediting volume above which the CCA target falls below the BAU level ($T < q°$). To summarize,

Proposition 2 *If a CCA company buys credits, its target exceeds the BAU reduction. By contrast, we cannot conclude if the company is a seller.*

Propositions 1 and 2 provide the basis for evaluating CCA environmental effectiveness in the following. We proceed in two steps. First, we present data on prices in order to get an idea of the overall environmental strictness of the obligations imposed to both Direct Participants and CCA participants. Then, we analyze the market behavior of CCA participants in order to identify whether they are net buyers.

5.2 ETS prices

One must be cautious when interpreting UK ETS prices. There is not a unique official source of information. In practice, many traders report transaction prices which are then pooled in time series by analysts.

Figure 5 shows the evolution of prices between April 2002 and April 2005. We observe an initial 8 months-long period during which the price has increased rapidly up to a peak of about £18 reached in October 2002. Afterwards, the price collapsed very quickly. Since then,

it varies in a narrower range between £2 and £5. The initial period is most probably an anomaly. At that time, many participants did not have their initial allocation yet and the volume of transactions was extremely small. In what follows, we reason on the £2-5 range.

Figure 5. UK ETS prices in £/teCO_2 (Period: April 2002 – October 2005)

The fact that this price is positive unambiguously signals that the overall initial allocation to DPs and CCAs yields additional abatement effort in comparison with the baseline. But how does this level compare to other reference prices? Table 2 reports different benchmarks. To begin with, we compare with the price observed in other CO_2 markets. The UK price appears slightly higher than the price of CDM (Clean Development Mechanism) credits. As CDM crediting is surrounded by much uncertainty, observers generally agree that this price is quite low. The UK ETS price is slightly higher than the price in the Chicago Climate Exchange market as well. It is not surprising since the participation in the Chicago Climate Exchange market is purely voluntary. By contrast, it is much less than the price of the EU emissions trading. But the EU emission trading market is also probably too recent - it has been launched in 2005 – to provide a reliable reference point. Recall that the UK prices reached a peak of £12 in the first year.

Table 2 also reports the rates of the Climate Change Levy. Recall that entering in a CCA provides the company with an 80% tax rebate. The initial philosophy was to obtain the same abatement efforts under the CCA while reducing the tax burden. Excluding liquid petroleum gas which is a limited source of energy in the industry, Table 2 shows that CCL rates are all higher than the ETS price. This suggests that abatement may not be as large under the CCA.

Table 2. Comparison of the UK ETS price with other reference prices

	Price range in £ per ton eCO_2
• **UK ETS**	2-5
• **Other CO_2 markets**	
- (Kyoto) MDP credits (Segalen 2005)	1-4
- Chicago Climate Exchange market (CCX, April 2006)	2-3
- EU carbon market (Pointcarbon, April 2006)	20
• **Climate Levy Rate**	
Liquid Petroleum Gas	3
Coal	5
Gas	8
Electricity	10

All in all, UK ETS prices seem quite low. Yet the US acid rain program has shown that there may be a significant gap between (long term) marginal abatement costs and prices, implying that prices may be an imperfect proxy of additionality. This discrepancy has been observed in the US because many firms anticipating too high prices made irreversible abatement investments before the price was observed (they installed a lot of scrubbers before the market was launched). Ex post, the use of low sulfur western coal provided a much cheaper compliance alternative than scrubbers.

We believe that the story is not the same in the UK because the timing is different. In the US, the SO_2 market was launched several years after the allowances had been allocated, leaving a lot of time to make investment errors. In the UK, the market participants also anticipated higher prices as suggested by the price of the reverse auction (£12) and market prices observed during the first ten months. But it is doubtful that these wrong anticipations led to inefficient investments for the CCA targets were set just one year before the launching of the market.

5.3 The market behavior of CCA participants

The UK ETS market price is undoubtedly positive. But as previously evoked, it does not mean that CCA targets are additional for that CCA participants may have been large sellers of ‘hot air’. In this sub-section, we analyze the market behavior of CCA companies in the ETS market.

Data

We rely on the transaction log of DEFRA which registers every operation made on each market participants’ account. More precisely, it yields

- the allocation of allowances (crediting). For a CCA firm, it corresponds to the quantity of credits granted to a company over complying with its CCA target

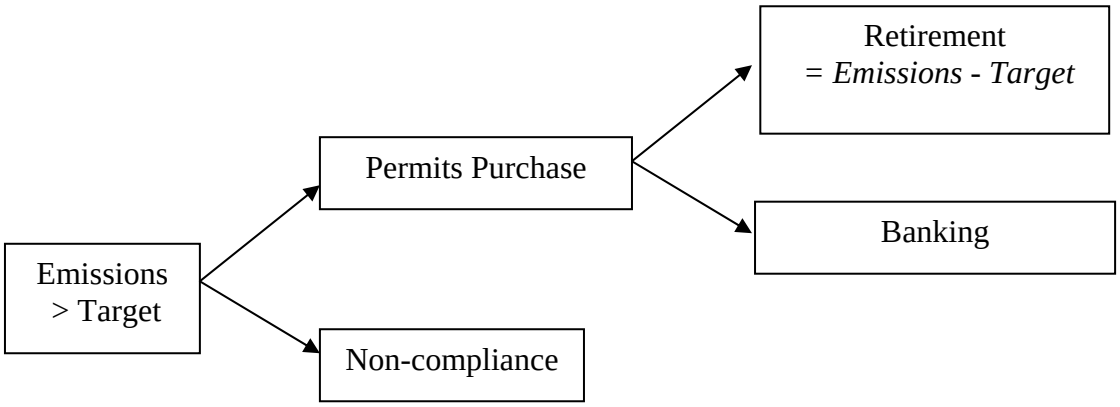
- the retirement of allowances. For a CCA participant, it is the quantity of allowances retired to cover liabilities in respect of their CCA target.
- the quantity of allowances bought and sold.

We complete with information from Future Energy Solutions AEA Technology (2005) on ring-fencing. Ring fencing occurs when a CCA participant over-complies with its target. In this case, he has to ring-fence his overachievement otherwise this overachievement is lost for him and helps the global compliance of his sector association. Once the over-achievement has been ring-fenced, it has to be verified to obtain an allocation of permits. The verification can be done at a later period, which enable participant to add the ring-fenced over-achievement over several periods and to make the verification only once.

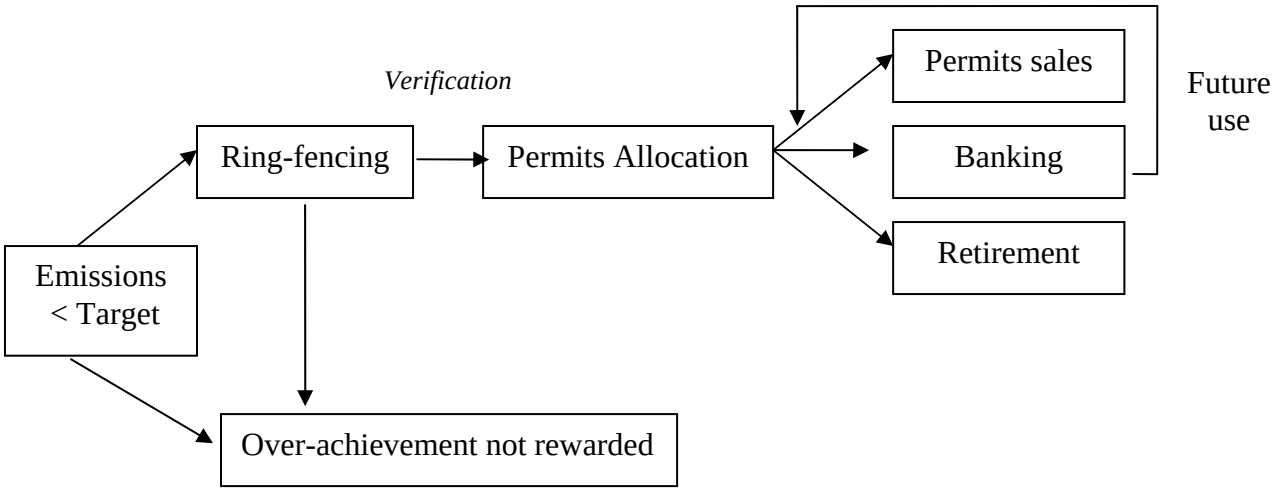
To make clear these distinctions before entering into the analysis, Figure 6 describes the relationship between emissions and the use of allowances. We contrast the case 1 where emissions of the CCA company are less than its target (under-achievement) and case 2 describing the opposite pattern (over-achievement).

Figure 6. The relationships between emissions and allowances

Case 1: under-achievement



Case 2: over-achievement



If a CCA participant does not comply with its target (Case 1), he has two possibilities: he can either buy an amount of permits at least equal to the gap between his emission level and his target, or decide not to comply, which means that he will be subject to the full CCL at least for the next period. After having purchased some permits, the CCA participant needs to retire a number of permits equal to its under-achievement. If he has purchased more permits than needed for retirement, he can bank them for a future use.

Instead, an over-compliant CCA ring-fences its overachievement. Then it has to be verified to obtain an allocation of permits. Finally, allocated permits can be sold on the market, banked for a future use or retired at a later period if the CCA participant needs to use them.

Analysis

Table 3 reports the quantity of allowances generated and their use by the different market participants. A first striking fact is that only 1,243 CCA companies out of 5,500 have ever traded using the ETS market. The vast majority of the CCA companies have preferred to meet targets through direct action as opposed to trading in the market. We come back on these companies later on.

Table 3 shows that the 1,243 CCA companies having made transactions on the market are net buyers of 0.95 MtCO2e. Proposition 2 thus suggests that the CCA scheme is additional in the aggregate.

Table 3 also identifies the 1036 CCA companies (out of 1,243) which have got an allocation less than retirement - meaning that they were obliged to buy allowances to meet their CCA targets. Proposition 2 tells us that their individual target was stricter than the BAU level. Note that they have banked some permits. A possible explanation is that they did so hoping higher permit prices in the coming years.

By contrast, 207 companies have got more permits allocated than retired - allowing them to sell 0.58 MtCO2e of allowances in the market and to bank 1.91 MtCO2e for future use. Those are the only companies for which there is the doubt over the strictness of their CCA target.[8]

[8] Table 3 also reports data on Direct Participants. While they are only 31, emitting about 30 millions tons of CO2 as compared with 100 millions tons by the CCA companies, their overachievements amounted to 7 MtCO2 at the end of 2003. This suggests that the DPs' initial allocation was very generous.

Table 3. Market behavior of UK ETS participants

	Number of firms	Allocation (MtCO2e) (1)	Retirement (MtCO2e) (2)	Net Allocation (MtCO2e) (1) – (2)	Net sales (MtCO2e) (3)	Banking (MtCO2e) (1) – (2) – (3)
CCA participants	**1243**	**2.76**	**1.35**	**1.41**	**-0.95**	**2.37**
• CCA with Allocation > Retirement	207	2.73	0.24	2.49	0.58	1.91
• CCA with Allocation ≤ Retirement	1036	0.03	1.11	-1.08	-1.53	0.46
CCA Period 1: 2001–2002		1.44	0.59	0.85	-0.60	1.32
CCA Period 2: 2003-2004		1.32	0.76	0.56	-0.36	0.92
Direct Participants: 2002-2003	31	59.54	52.38	7.16	0.92	6.24

Source: our personal analysis of UK ETS Transaction Log

What about the CCA companies which have not made any transactions on the market? A first possible explanation would be that they have neither exceeded nor fallen below their CCA target so that they had nothing to purchase or buy. In fact, this explanation does not hold: they have ring-fenced a very large quantity of overachievements: 3.20 MtCO2e for the Period 2001-2002 and 5.40 MtCO2e for the Period 2003-2004. These quantities are far larger that the over-achievement of companies having traded in the ETS market.

In our setting where we assume rational enterprises unwilling to undertake costly abatement beyond their target, this suggests that their targets were not additional.

Why haven't they converted these overachievements to allowances they could have sold in the market at a positive price? The explanation most probably lies in the verification cost borne by the company to convert overachievements to allowances. According to Dairy Energy Savings, it might cost about 1000£ per site. The importance of ring fencing shows that this cost has created a barrier to the entry in the ETS market.

As an aside, the cost of verification only hinders the entry of sellers since purchasers obviously have no emissions to be verified. Consequently, this transaction cost reduces the supply of permits in the market. Accordingly, the market price would have been less £2-5 per ton eCO_2 if transaction costs were zero. This is not without consequence on our assessment of the UK ETS price carried out in subsection 5.2. The £2-5 price probably overestimates the marginal abatement cost of the CCA companies in equilibrium (including those having not traded using the market).

In summary, 1036 are shown to have targets stricter than BAU abatement. For 207 companies, it is not possible to conclude while the target of more than 4,000 companies would not be additional in the *ex post* sense.

5.4 Comparison with abatement under a full tax regime

So far, we have assessed the strictness of the CCA targets against the BAU scenario, meaning the scenario with neither CCAs nor Climate Change Levy. But, if we want to measure the specific contribution of the CCAs to abatement, the relevant benchmark is the level of abatement which would have been obtained under the full tax regime.

As previously evoked, ETSU estimated that the CCAs were 10% less effective than the imposition of the full CCL rate. The observation of the ETS market price provides new insights. The market price of the permit lies between £2 and £5 while the level of the tax is equivalent to a price between £5 and £10 per ton of CO_2. It clearly establishes that the CCAs are less effective than the CCL.

From a national interest perspective, it does not necessarily mean that the implementation of CCAs has harmed social welfare for that they also aim at avoiding possible damages on the UK industrial competitiveness.

5.5 Cost effectiveness

Let's complete the assessment by considering abatement cost issues. Key is the connection of the CCAs with the ETS which provides in theory the opportunity to minimize aggregate abatement cost. We have seen that only 20% of the CCA companies have participated in the market due to high transaction (verification) costs. Thus, ETS has not been able to reap all the gains from trade and marginal abatement costs are probably not equalized across CCA emissions sources (particularly between buyers and sellers).

6 Conclusion

CCAs exhibit an innovative design. They are negotiated agreements embodied in a sophisticated policy mix as they are combined with a tax exemption and an emission trading scheme. The combination with the tax exemption is supposed to secure the environmental strictness of the negotiated targets while providing a valuable tax burden reduction to industrial companies subject to harsh international competition. The combination with the ETS should increase the cost efficiency of the CCAs by providing flexibility to companies.

In four years, abatement achieved is impressive as the 2010 target has already been exceeded. However, this huge over-achievement may cast some doubts about the genuine environmental strictness of the CCAs targets. We develop an original method to assess the environmental additionality exploiting the fact that the ETS price reveals marginal abatement costs of the CCA participants.

Our conclusion is mitigated. Market prices have remained quite low (£2-5/tCO2e) suggesting low marginal abatement costs. About 1036 CCA companies have bought permits at this positive price which proves unambiguously that their target has been stricter than the BAU level. They represent around 20% of the CCA companies.

Around 80% of the CCA companies have simply never traded using the ETS market while they have exceeded their target by a large amount of 8.8 MtCO2. This is presumably due to high verification (transaction) costs which have hindered their entry in the market. Reduced verification costs would have led to even lower prices. As these overachievements have not been sold on the market, they probably correspond to actions which were profitable, and thus not additional.

One may argue that we measure the *ex post* environmental additionality of the CCAs and not the *ex ante* additionality the actors had in mind when they were setting the targets. This might be a problem in that ambitious targets in a world of economic fluctuations can easily become slack *ex post*. The fact that most CCA targets are relative probably mitigates this objection.

Finally, it is often argued that voluntary agreements contribute to remove informational or organizational barriers hindering the implementation of profitable abatement actions. If this applies to CCAs, they can yield additional abatement which is not costly *ex post*. Our methodology fails to address this issue, meaning that we tend to under-estimate the CCA environmental effectiveness.

7 References

CCX (2006). http://www.chicagoclimatex.com

DEFRA (2003). Transaction Log April 02 - April 03

DEFRA (2004). Transaction Log 01-04-03 to 31-03-04

DEFRA (2005). Transaction Log 01-04-04 to 31-03-05

de Muizon Gildas and Glachant Matthieu (2004). “The UK Climate Change Levy Agreements: Combining Negotiated Agreements with Tax and Emission Trading", In A. Baranzini and P. Thalmann, Eds., "Voluntary Agreements to Climate Policies An Assessment", Ashgate - London, Edward Elgar Publishers

DTI (2004). Updated emissions projection – final projections to inform the National Allocation Plan, 11november.

ETSU (2001). Climate Change Agreements – sectoral energy efficiency targets, Version 2, AEA Technologie, October

Future Energy Solutions (2004). Climate Change Agreements – results of the first target period assessment.

Future Energy Solutions (2005). Climate Change Agreements – results of the second target period assessment.

Marshall (1998). Economic instruments and the business of energy, report for the Chancellor of the Exchequer, November.

OECD (2004). Voluntary approaches for environmental policy, effectiveness, efficiency and usage in policy mix.

Parliamentary office of science and technology (2004). Climate Change and business, Postnote number 213, January.

Pointcarbon (2006). www.pointcarbon.com

Segalen, L. (2005). Etat actuel des marchés CO_2, European Carbon Fund, CDC Ixis.

8 Annex

The next table sums up:

- The sectoral associations
- The percentage of change of targets resulting from the 2004 review of targets. A positive value means a tightening of targets and a negative value means an easing of targets. 'TBA' indicates that the review is still to be agreed.
- The percentage of target units that have been re-certified at the end of the first and second period. 100% mean that the sector met its global target. A percentage inferior to 100% indicates a sector that did not meet its target and give the proportion of target units that have been re-certified.

Table 5: 2004 review and first and second period compliance

Sectors	2004 review	First period	Second Period
Aerospace	1%	100%	100%
Agriculture supply	3%	100%	100%
Aluminum	TBA	100%	100%
Brewing	2%	100%	100%
Cathode Ray Tubes	3.2%	100%	100%
Cement	0%	100%	100%
Cementitous slag	6.1%	100%	100%
Ceramic - non fletton	0.5%	100%	100%
Ceramic - fletton	-11.5%	100%	100%
Ceramic - refractories	0.6%	93%	100%
Ceramic - white wares	6.7%	98%	100%
Ceramic - materials	12.3%	91%	100%
Chemicals	3.6%	100%	100%
Craft bakeries	18.4%	100%	100%
Dairy industry	2.25%	100%	FAILED
Egg product (NFU)	TBA	99%	100%
Egg product (BEPA)	TBA	68%	100%
Food & Drink	2%	100%	FAILED
Foundries	0%	95%	100%
Glass	1%	100%	100%
Gypsum products	0%	100%	100%
Leather	0%	100%	100%
Lime	0%	100%	100%
Malting	0.2%	100%	100%
Metal Packaging	1%	95%	100%
Metal Forming	TBA	100%	100%
Mineral wool	0%	100%	100%
Motor manufacturers	3%	100%	100%
Non-ferrous	TBA	100%	100%
Paper	2.78%	100%	100%
Pigs	TBA	100%	100%
Poultry meat processing	TBA	98%	FAILED
Poultry meat rearing (BPC)	TBA	99%	100%
Poultry meat rearing (NFU)	TBA	83%	100%
Printing	3%	96%	FAILED
Red meat	0%	97%	100%
Rendering	2.5%	100%	100%
Rubber	12.6%	100%	100%
Semiconductors	0%	100%	100%
Spirits	1%	100%	100%
Steels	0.8%	100%	100%
Supermarkets	TBA	100%	100%
Surface engineering	TBA	100%	100%
Textiles	3%	100%	100%
Vehicle builders and repairers	-	21%	CCA TERMINATED
Wallcoverings	TBA	100%	100%
Wood panel	1.87%	100%	100%

Source: Future Energy Solutions (2004, 2005)