

Living with a carbon allowance: the experiences of Carbon Rationing Action Groups and implications for policy

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Abstract

Carbon Rationing Action Groups (CRAGs) are grassroots voluntary groups of citizens concerned about climate change, who set themselves a carbon allowance each year and provide support to members seeking to reduce their direct carbon emissions from household energy use and personal transport. Some groups have a financial penalty for carbon emitted in excess of the ration, and systems whereby under-emitters are rewarded using the monies collected from over-emitters. CRAGs therefore operate the nearest scheme in existence to the proposed policy of Personal Carbon Trading (PCT). This paper reports the findings of a study of the opinions and experiences of individuals involved in CRAGs ('CRAGgers'). In general, interviewees have made significant behavioural changes and emissions reductions, but many would be unwilling to sell spare carbon allowances within a national PCT system. The choices made by CRAGgers with respect to the design and operation of their 'carbon accounting', their experiences of reducing fossil fuel energy use, and their views on personal carbon trading at CRAG and national level are discussed. Some possible implications for PCT and other policies are considered, as well as the limitations of CRAGs in informing an understanding of the potential impacts and operation of PCT.

Keywords

Carbon Allowances; Personal carbon trading; Carbon Rationing Action Groups

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1. Introduction

The UK government's 2007 energy white paper attributes 42% of UK carbon dioxide (CO₂) emissions directly to individuals, through their use of energy in the home and for personal transport (DTI, 2007). Significant reductions must be made in household-level fossil fuel energy use if the government's target of an 80% cut in UK greenhouse emissions by 2050 is to be met. Personal Carbon Trading (PCT) has been proposed as a policy to facilitate this (Fleming, 2007; Hillman and Fawcett, 2004). PCT would involve giving individuals carbon emissions allowances, and would operate as a 'cap and trade' system, analogous to the EU Emissions Trading Scheme operating in the industrial sector.

The Sustainable Development Commission has repeatedly recommended PCT to the UK government (SDC, 2005a, 2005b, 2006), and David Miliband was favourable towards investigating the idea while Secretary of State for the Environment (Miliband, 2006). An early study concluded that PCT would be technically viable (Starkey and Anderson, 2005). As a result of its 'pre-feasibility study' of PCT, the Department for Environment, Food and Rural Affairs (Defra) concluded that the concept "is currently ahead of its time"; nevertheless, the report recognised that "there may be circumstances in the future where personal carbon trading is a cost effective and desirable policy option" (Defra, 2008a, p. 21). The House of Commons Environmental Audit Committee published a report on PCT that was much more positive about the concept (EAC, 2008), and the Institute for Public Policy Research (IPPR) argues that policymakers should keep the option open for the future, in case other policies fail to deliver the necessary emissions reductions (Bird and Lockwood, 2009). It has so far proven difficult to engage the public in significant energy-related behavioural changes despite concern about climate change: 37% of respondents in a recent study say they are not doing anything to tackle climate change, despite 82% reporting feeling 'very' or 'fairly' concerned (Downing and Ballantyne, 2007).

There are important issues to consider regarding the ability of individuals to engage with PCT, such as whether they would be able to understand a carbon allowance and budget their fossil fuel energy use, whether they would be able to reduce their emissions significantly if they wish to, and whether they would be willing and able to trade in carbon credits. Work on the potential for trialling PCT concluded that a trial that could meaningfully attempt to explore any of these questions could cost between £500,000 and £950,000 and take between 2.5 and 3 years (Fawcett et al., 2007). However, there exists in the UK a movement of grassroots Carbon Rationing Action Groups (CRAGs) that, in theory at least, operate (on a voluntary basis) the nearest scheme in existence to PCT. The study reported here was therefore designed to learn about the functioning of CRAGs and the experiences and opinions of individuals involved, and to determine whether (and to what extent) these could offer any insights into the potential operation, impacts, and design considerations of a compulsory PCT policy.

2. Personal carbon trading

Two main variants of a PCT scheme have been considered by the UK government: Domestic Tradable Quotas (DTQs), first proposed by Fleming (1996, 1997), who later referred to them as Tradable Energy Quotas (Fleming, 2007), and an alternative referred to as carbon rationing or Personal Carbon Allowances (Fawcett, 2004; Hillman, 1998, Hillman and Fawcett, 2004)¹. Bottrill (2006a) provides a summary of these proposals, and the variations between them. In essence the two schemes are similar, and throughout this paper the term

¹ Note that other variants have been proposed; see Fawcett and Parag (2010) and Eyre (2010) for details.

'PCT' is used to mean any system of tradable carbon allowances allocated free to individuals to cover their direct energy use (home energy and personal transport). The allowances would decrease by publicised increments over the years, in order to meet stated emissions reduction targets.

2.1 Receiving, using, and trading carbon allowances

Every eligible adult would have a 'carbon account' (and associated 'carbon card'), similar to, and perhaps linked with, a bank account, which would be automatically credited with their free carbon allowance (composed of 'carbon credits') at regular intervals. Parents might receive an extra allowance for children (Fawcett, 2004), or else the existing child benefit system could be used to compensate parents (Fleming, 2007).

Fossil fuels (principally gas, oil, coal, petrol, and diesel), electricity generated from non-renewable sources, and possibly travel tickets would be assigned a carbon rating, based on the amount of CO₂ emitted by using these goods. Individuals would be required to surrender the rated carbon credits for these purchases, as well as monetary payment.

Carbon credits would be legally tradable between individuals. Those with spare credits could sell them on a regulated market to individuals who required more than their free allocation. This is an important aspect of PCT, since the allowance necessary to cover current CO₂ emissions varies considerably between individuals – a study of 40 people revealed that their annual emissions differed by a factor of 12 (Keay-Bright and Fawcett, 2005). It would also provide an incentive for individuals to cut their emissions below the allowance level, which would not exist if they could not sell spare credits.

Individuals would be able to check their carbon accounts and buy or sell credits at post offices and banks, by phone, or using the internet. They would also be able to buy carbon credits at point-of-sale when purchasing carbon-rated fuels and travel tickets. (Note that these are the only goods that would be carbon-rated, as PCT schemes are not designed to cover 'embedded' emissions in products such as food and clothes.)

2.2 Existing research

Fawcett (2010) provides a comprehensive overview of research into PCT. I mention here that which is particularly relevant to a consideration of the effects on an individual of having a carbon allowance.

Capstick and Lewis (2008) provide an overview of perspectives from psychology and behavioural economics relating to the theoretical effects that PCT might have on social norms and personal behaviour. They then used a computer simulation to investigate respondents' energy-use choices in response to an allowance (Capstick and Lewis, 2010). Wallace et al. (2010) and Parag et al. (2011) employed questionnaires to discover whether and how respondents expected they would change their behaviour in response to PCT. These studies provide a useful indication of 'first responses' to PCT across a variety of respondents; the value of interviewing CRAGgers is that we can learn from their longer-term engagement with the issues around PCT, and their lived experiences of carbon budgeting, reducing emissions, and – in some cases – buying or selling carbon credits.

Other work has considered the knowledge and skills required to understand and budget for carbon emissions (Parag and Strickland, 2009; Whitmarsh et al., 2009). Whitmarsh et al. (2009) suggest that there are currently low levels of 'carbon capability' among the UK population. Seyfang (2007) considers lessons for PCT from the operation of complementary currencies (such as LETS); she found that the skills and capabilities of participants was one of five factors critical for the success of such schemes.

3. Carbon Rationing Action Groups

3.1 History²

Andy Ross first articulated the idea of forming local carbon rationing groups after the climate change march in London in December 2005, inspired by George Monbiot's speech calling for 90% emissions cuts by 2030 (Monbiot, 2005; see also Monbiot, 2006), and influenced by Hillman and Fawcett's (2004) proposal for carbon rationing. Ross published his draft proposal on the Campaign against Climate Change website later that month (Ross, 2005). Following this, CRAGs were formed in Oxford, Leamington and Hereford in the first half of 2006 by Ross and other concerned citizens. There are now (December 2010) 21 groups listed on the website as 'active' in the UK (see 3.3).

3.2 Aims and principles of the movement

In *CRAGs: a short guide*, Ross (2006) set out details of how he envisaged the groups would operate. The stated aims were:

1. To make us all aware of our personal CO₂ footprint
2. To find out if it can help us make radical cuts in our personal CO₂ emissions
3. To help us argue for (or against!) the adoption of similar schemes at a national (DTQ) and/or international (C&C) [Contraction and Convergence] level
4. To build up solidarity between a growing community of carbon conscious people
5. To share practical lower-carbon-living knowledge and experience.

The *Guide* envisaged that each CRAG would agree a fixed, equal-per-capita ration for members' CO₂ emissions for the 'carbon year', and would have a 'carbon accountant' to whom members would regularly send details of energy usage in order for their emissions to be calculated using agreed conversion factors. It was suggested that only home energy use, travel by private vehicle, and flights should be accounted for, for the sake of simplicity. Household emissions would be divided by the number of members of the household, whatever their age (in other words, children would get a full carbon allowance), but vehicle emissions would be deducted solely from the owner's ration, again in order to keep the scheme simple. Each CRAG was advised to agree on its own price per kilogram for CO₂ emitted over the ration for the year, to be paid by over-emitters into a 'carbon fund', and to determine how the funds would be distributed. Carbon trading was not assumed: suggestions for use of the carbon fund included giving it to under-emitters in proportion to their share of the total savings, to a charity or an environmental project, or a combination of any or all of these possibilities.

In practice, different CRAGs have developed different ways of functioning. Some do not have a fixed ration and many do not have a financial penalty for over-emitters. In general, one could say that many CRAGs are groups formed to encourage members to reduce their carbon footprints, rather than to engage in carbon *rationing* as such, and some groups have chosen to call themselves Carbon *Reduction* Action Groups.

3.3 Current CRAGs

It is questionable whether all 21 UK groups listed as 'active' on the CRAG website really are active; members of two of these CRAGs expressed doubt when interviewed about whether their CRAG was still functioning. One of the active CRAGs, WSP Personal Allowance

² For full details of the movement's history, see <<http://www.carbonrationing.org.uk/wiki/how-did-crags-get-started?>> and <<http://www.carbonrationing.org.uk/wiki/crags-chronology?>>.

Carbon Tracking (WSP PACT), is run by the WSP Environment & Energy consultancy business for its employees; the others are all local community groups formed by concerned citizens. At the time of this study, the groups typically had 8-12 members, although one had only three active members and WSP PACT had 54. Approximately 200-300 people were involved in a CRAG; many more individuals have registered themselves on the website although they are not members of a particular CRAG.

There has also been interest in CRAGs in other countries; the website currently (December 2010) lists active CRAGs in the USA, Canada, and China.

4. Method and participants

In order to obtain the opinions and experiences of CRAGgers, I carried out semi-structured interviews between June and August 2008 with 23 members of the movement, from 10 different CRAGs. Five were telephone interviews; the rest were conducted face-to-face. I interviewed two couples as couples; the other interviews were one-to-one. The interviews were digitally recorded and transcribed in full, then analysed and coded. The structure of the interviews led to coding using broad, pre-determined themes including ‘targets’ (see section 5.1); ‘accounting’ (5.2); ‘financial penalty’ and ‘PCT’ (5.3); ‘carbon literacy’ (5.4); and ‘behaviour change’ (5.5), but within these themes codes were allowed to emerge from examining the data, a technique borrowed from grounded theory (Bryman, 2001).

Using contacts gained from the website, I recruited interviewees through emails targeted to particular CRAGs chosen to ensure that a good range of variants was represented: longer-established groups and newer ones, rural and urban CRAGs, those that had a penalty and those that didn’t, those that operated a form of trading and those that had chosen not to give the financial penalties to under-emitters, and CRAGs which had fixed targets, percentage reduction targets and individually chosen targets (see Table 1). Participants were offered £20 for their time.

Table 1: Features of particular interest in the CRAGs included in this study

CRAG	Interviews	Details of interest
Hereford	3	Into third year; rural CRAG; equal-per-capita target; no penalty.
Oxford	3	2 years completed; equal-per-capita target; financial penalty but no trading.
Hackney and Islington	2	Into second year; equal-per-capita target; operates rudimentary carbon trading.
Glasgow	3	Into second year; equal-per-capita target; operates rudimentary carbon trading.
Leeds	2	Completed one year; individual targets and penalties; no trading; denotes itself a Carbon <i>Reduction</i> Action Group.
York	2	Completed one year; equal-per-capita target; no penalty; denotes itself a Carbon <i>Reduction</i> Action Group.
WSP PACT	3	Part way through first year; workplace-based CRAG; penalty and reward.
Fownhope	3	Part way through first year; rural CRAG; percentage reduction rather than equal-per-capita target; no penalty.
Peckham	1	New CRAG still starting up; no penalty.
Edinburgh ^a	1	A ‘failed’ CRAG.

^a Since this research was carried out, a new CRAG was started in Edinburgh

5. Living with a carbon allowance: experiences, learning and opinions

In what follows, participants are identified by pseudonyms. I have in some cases given an indication of what proportion of interviewees subscribed to a particular view or action, but caution must be exercised in making any generalisations; the interviewees were not necessarily representative of the CRAGs they belonged to, or of the movement as a whole.

Unsurprisingly, the CRAGgers interviewed would generally be classified as ‘positive greens’ in Defra’s (2008b) environmental segmentation model. ‘Positive greens’, who make up 18% of the UK population (Defra, 2008b), exhibit the most pro-environmental attitudes, beliefs, and behaviour of the general public as a whole. Questions about involvement with other voluntary groups, whether interviewees address concerns other than climate change through their lifestyle choices, and the factors influencing purchasing decisions, revealed that they largely fit the ‘egalitarian’ type in cultural theory (Dake and Thompson, 1999; Michaelis, 2007). Egalitarians are politically engaged and often make consumption choices based on ethical (including social and environmental) concerns rather than tradition, fashion or price. The interviewees from WSP PACT (the workplace-based group) were less atypical of the general public than most of the CRAGgers interviewed. While having some environmental concerns, they did not mention current spare-time involvement in non-governmental organisations, or specify many consumption/lifestyle choices in response to ethical concerns apart from climate change. In general, the changes they had made to reduce their carbon footprints were less radical than those made by many other interviewees.

5.1 Allowances

Most CRAGs have chosen an equal-per-adult ‘carbon allowance’ or target, but a few have decided to operate differently. For example, Sevenoaks CRAG targets a differentiated annual percentage reduction from each individual’s baseline (the emissions for the year immediately preceding the current one), ranging from 25% reduction per year for those who start with a footprint of 15-20 tonnes, down to 5% reduction for those who start with a footprint of 5 tonnes or lower. In Fownhope all members are targeting a 10% reduction on their baseline footprint. Leeds CRAG allows members to choose their own target, so long as it is lower than the previous year’s footprint. The rationale given for variable targets was to encourage low emitters to continue trying to reduce their emissions, while not being too off-putting to high emitters.

In general, equal-per-capita allowances were considered ‘fair’. However, one group that started with a fixed target decided after its first year to switch to variable allowances, partly because they have decided that these are fairer:

...if you are at work you get access to heated lighted premises up to five days a week, whereas if you are retired you don’t. So until all aspects are carbon counted then setting personal allowances in the group is a way of taking account of these inequities. (Redland Bristol CRAG, from the website)

Of the 21 ‘active’ CRAGs listed on the website, 11 give children a full allowance, at least for home energy use (it is not always clear what happens when car mileage is being counted), while for six groups there is no information. The other groups have adopted a variety of positions, including giving children under 16 no allowance, giving children under 12 half an adult allowance, and allowing the first two children in a family a full allowance but further children none. A couple of CRAGgers thought that full allowances for their children were/would be problematic as the children do not need an adult’s share. On the other hand, two interviewees had noticed an increase in their household energy use as a result of having a baby and one of these specifically stated that he thought it was important to take this into account.

Most groups that have a per capita allowance started with 4500 kg, a 10% reduction on a rounded approximation of the UK average for direct emissions. Langport CRAG based their first year target of 8400 kg on a 10% reduction in their group average footprint instead, and Glasgow CRAG, which achieved major reductions in their first year, opted for a second year allowance as low as 2000 kg, a 10% reduction on the estimated global average footprint.

5.2 Carbon accounting and scheme boundaries

Most interviewees do their own ‘carbon accounting’ using agreed conversion factors or a specific footprint calculator, though some groups have a ‘carbon accountant’ to do the calculations.

Whether or how to account for ‘green electricity’ tariffs and journeys by public transport have been sources of great debate in several CRAGs.

Many CRAGgers argue that signing up for a ‘green electricity’ tariff does not reduce one’s carbon footprint since it does not create more demand for renewables than already exists due to government measures, and renewable energy generation is already accounted for in the electricity conversion factor on a carbon calculator. However, most groups want to give some credit to those who ‘do the right thing’ so a majority of groups use a lower conversion factor for such tariffs.

Some CRAGs include journeys by public transport in their carbon accounting, others none or only long-distance/regular commuting trips. One CRAG accounts for journeys by public transport at half the usual conversion factors for buses and trains, in order to encourage switching from car travel.

5.3 Financial penalties/trading

Of the 21 ‘active’ CRAGs listed on the website, 13 have a financial penalty for exceeding the carbon target, ranging from 2p to 10p per kilogram, with Leeds CRAG allowing members to choose their own penalty. Many of these groups cap the amount that an individual has to pay in any one year (typically at £100). Six CRAGs have chosen not to have a penalty, and for two CRAGs there are no data.

However, at the time of this study, only two CRAGs were definitely operating any form of carbon ‘trading’, where under-emitters receive payments from over-emitters. Of these, the Glasgow CRAG has since decided, in common with most groups that have a penalty, to give the monies to environmental charities and campaign groups, while the Hackney and Islington CRAG has stopped financial settlements altogether. CRAGgers I interviewed gave various reasons why their group had decided not to have a financial penalty:

I think they felt it was too sort of Big Brother [...] we were there to encourage each other but not to police each other. (Ann)

...we decided not to have a financial penalty because of people’s different financial situations. (Anthony)

The idea of a fine for going above a certain amount was thought that it would put potential members off. (Justin)

Similarly, there were various reasons why some CRAGs with a penalty had decided not to give the money to under-emitters, effectively imposing a carbon tax rather than a trading system:

...those of us who are under-emitters were partly because we’d already done all the cheap measures in our houses, it’s not like we could use the money to buy a load of efficient light bulbs or loft insulation because we’ve got all that stuff already [...] we decided we wanted to do the thing that gave us the most carbon offsetting for our money. (Liz)

We felt that there was no point paying money to a well-off middle-class person. (Richard)

There seemed to be a general “embarrassment factor of gaining at somebody else’s expense, especially somebody who knew that you were and who you knew”. (Simon)

The two CRAGs that operated a (necessarily rudimentary and limited) form of carbon ‘trading’ were Glasgow, and Hackney and Islington. In each case the financial penalty was fixed and financial settlements took place at specified intervals. In a national PCT system the carbon price would depend on the market (and therefore fluctuate) and trading would take place in real time. In neither CRAG were members prevented from over-emitting because of being unable to buy extra ‘credits’, as could be the case in a national PCT system. In Glasgow there was no overall emissions cap, and in Hackney and Islington under-emitters saved more CO₂ than the others had emitted over the target.

Many interviewees who were members of a group that had a financial penalty did not think that it had affected their behaviour, partly because the penalties were quite small (though considerably higher than the market price of carbon). Other interviewees felt that although the possibility of *receiving* money did not drive behaviour changes, having to pay out might have more effect. One interviewee stated that although he would be willing to make some changes to his lifestyle, he would not be willing to cut out holidays that involve flying. Interviewees who did actually have to pay, or thought it likely they would have to, seemed happy to do so, though one participant suggested that at least one person who had dropped out might have done so because of the prospect of having to pay a large penalty because of a taking a long-haul flight during the year.

When it came to the question of whether they would trade within a national PCT system, several CRAGgers who would clearly have spare allowances to sell, at least in the early years of such a scheme, said they would not do so on principle, or would only sell if they were convinced that the national cap on emissions was low enough:

...it would depend [...] on what the overall budget was. If we had a situation like we have with the phase one ETS, I wouldn’t [sell my spare allowance]. Because it’s far too high and it’s almost meaningless, the only way you can make it meaningful is by destroying the credits. (Steve)

I don’t think I’d want to trade it because one of my worries is the whole issue of global warming and if you trade it then you’re merely allowing somebody else to use more. (Ann)

Other interviewees said they would not be willing to sell any spare allowances on an open market, but would consider giving them away or selling them to people for a ‘good cause’. A couple of CRAGgers said they would save their spare allowances in order to be able to fly in the future. A minority of interviewees were happy to trade within a national system and said that whether they sold or saved any spare allowances would depend on the carbon price and what they expected their needs to be. One CRAGger offered the very unusual view (among members of the movement) that it would be wrong to ‘retire’ spare allowances:

If enormous quantities of these things get bought up and torn up and they can’t be used, you’re likely to have a collapse of the economy. (Evie)

One interviewee said that if he found himself going over the national allowance he would “find it quite hard to justify why I’d have to pay or make an effort to get more” (Joe) but this was an atypical view.

Despite their reluctance to trade within such a system, just over half the interviewees expressed qualified to enthusiastic support for the introduction of a national PCT scheme in the UK. One of the main reasons that it found favour was the perception that it would be a redistributive policy. There were concerns, however, among supporters and opponents, about public or political acceptability, the practicalities of implementing a scheme, and about issues of fairness:

...it would have to be quite complicated in order to make sure that people weren't losing out unfairly, so people that were living in the countryside, somebody with... they probably don't call them iron lungs any more but whatever it is ... (Bob)

Somebody who's not very bright, who lives in poor housing, it's not really their fault if their gas bill turns out to be astronomic. (Richard)

A couple of interviewees had decided that an upstream 'cap and share' system would be preferable to PCT because of the lower costs or because they saw it as a more realistic way forward politically, and one CRAGger preferred the idea of environmental taxation because he saw allowances as too controlling. A small number of interviewees were confused about how a national PCT scheme would work.

5.4 Carbon literacy

Increased carbon literacy was perhaps the most obvious outcome of involvement in a CRAG. Most interviewees said that they now have a greater understanding of where their emissions come from and the relative impact of different activities than they did prior to joining the group. There were various mechanisms that increased carbon literacy. Many mentioned monitoring their energy use more closely, and therefore becoming more aware of it:

I used to perhaps do it once a year. Just add everything up, whereas now [...] I'd take my readings more often and I'm checking. So for example this year I know that gas consumption will be more than last year because I've been checking every couple of months... (Liz)

[W]hen a bottle of gas runs out as it has today, [...] we write it down on the calendar so we've got an idea of how long they're lasting. (Lara)

One CRAGger mentioned getting an energy monitor and later said, "I could just go round this room: telly, DVD, video, hi-fi, telephone, gas fire, and pretty much tell you how much carbon would be used by each one in an hour or a day or something." (Steve)

Related to monitoring is the effect of seeing a statement of all one's measured carbon emissions over a period of time:

I can see that, in Q1 I had a massive 'other journeys', and that was one tonne just associated with the flight to Paris, and [...] even as an energy professional, if somebody had said to me a year ago, [...] "what would you think a return journey to Paris is equivalent to?", I wouldn't have been able to. (Daniel)

'Ella' had calculated her carbon footprint years before joining the CRAG, which led to her "realising what a massive impact flying had, that was quite an eye opener and that was really important". Monitoring, and seeing the figures, helps to make CO₂ emissions both more 'real' and more salient:

CO₂... it's quite an abstract concept isn't it, to grasp [...] I needed something visual in my mind or some figures on a bit of paper to bring it to consciousness so that was good. (Lara)

The third mechanism was the group discussions and learning from other CRAGgers:

We've shared loads of information about gadgets like eco-kettles and things that turn your standby off and that sort of thing. (Steve)

I have learnt more about climate change since being in a CRAG than I'd learnt in the previous 15 years or so. Now we discuss the issue about food, which is a really big issue. (Ian)

This latter comment illustrates that interviewees became more knowledgeable about, or aware of, *indirect* emissions, and was echoed by others:

...being a part of [the CRAG] has raised our awareness of all those other things that involve energy. (Dave)

...I realised that consumption of meat and overseas food was a much bigger deal from a carbon creating point of view than I realised before. (Calum)

Those who didn't think they had learnt more about their emissions said that was because they had already known a lot beforehand.

Some interviewees found that being in a CRAG has enabled them to see more potential for reducing their emissions than they initially thought there was. For example, 'Sally' had done more than she thought she could "simply because one becomes so conscious of it".

5.5 Emissions reductions/behavioural changes

Using data from five CRAGs (Oxford, Hereford, Leamington, Glasgow and Sevenoaks) that submitted figures for group/individual emissions both for the year before they started in the CRAG ('baseline emissions') and for their first carbon year, it was calculated that the members of these groups reduced their average per capita footprint by 32% in their first year, from 4.95 tonnes down to 3.36 tonnes³. This average 3.36 tonne footprint is 35% below the UK average of 5.2 tonnes for direct carbon emissions, excluding emissions from public transport (which some of the CRAGs include in their calculations but others don't, or only partially), but including a multiplier of 3 for emissions from air travel (Hillman and Fawcett, 2004). The average baseline footprint was 5% below the UK average. Members of these CRAGs were not, therefore, starting from an emissions position very significantly differently from other members of the general public.

Interviewees had generally already started trying to reduce their carbon emissions before they got involved in a CRAG. Many had lower than average emissions at the time that they got involved, and quite a few were already under the target that was set for their group. Nevertheless, most felt that they had continued to change their behaviour and reduce their emissions further since becoming involved in a CRAG. Not all interviewees attributed these changes to their involvement with the CRAG, but some thought that although they would have made changes without the CRAG, being part of the group did make a difference:

The CRAG has basically accelerated everything really... (Ian)

...without [the CRAG], I don't know, maybe I would still be living like this but I know that I have benefited from support and just having other people who are reinforcing your behaviours... (Ben)

Still others were clear that the changes they have made are a result of involvement in a CRAG.

Two interviewees who had not reduced their emissions since they joined the CRAG said that this was because their emissions were already so low when they started that there was little more they could do.

Table 2 shows behavioural and technological changes made by interviewees (including all those mentioned, not necessarily only those that were the result of involvement in a CRAG).

By far the most common barrier to making changes mentioned by the interviewees was cost, generally of home energy improvements or renewable energy technology. Other barriers that make home energy conservation or technological improvements difficult included living in an old home, being a tenant, or sharing with less interested others. The need for legislation, infrastructural changes, and grants (e.g. for external insulation) to enable individuals to cut their emissions was mentioned by two interviewees.

When it came to transport, a few interviewees felt they could not give up flying completely, although they had cut down, because of family commitments. The cost and 'hassle factor' of travelling by train rather than flying was also mentioned. The need to drive for work or other reasons was an issue for some, especially in rural areas.

³ This assumes that the baseline figure for the 33 members who calculated it is representative of the baseline emissions for all 58 members who then recorded their emissions during the first carbon year of their CRAG.

Table 2: Changes made by interviewees, showing the number who mentioned each action

Home energy actions	No.	Transport actions	No.
Turn lights/appliances off/use less	8	Cut down/given up flying	18
Fitting/improving insulation	6	Got rid of car	3
Bought more efficient appliances	5	Lift sharing	2
Installed solar hot water system	3	Chose home location to cut travel	2
Considering home renewables	3	Used biodiesel from used oil	2
Turned down heating/use less	3	Cycle instead of using car/tube	2
Installed secondary glazing	2	Bought more efficient car	1
Installed wood burning stove	2		
Converted Rayburn to wood	1		

Behaviour change was not restricted to those areas where emissions are counted by CRAGs:

[W]e don't use supermarkets anymore. I use local food shops. [...] I don't buy cosmetics that aren't organic [...] I don't buy new clothes. I buy and sell on eBay. (Lara)

Sometimes lower-carbon behaviours led to unforeseen problems and very occasionally to tension within families:

For two years I was running the car on biodiesel which was made from waste vegetable oil [...] unfortunately the car had a lot of problems with it just recently; the fuel line has blocked up and it was mainly because I don't top up very often. (Oliver)

I've made a few mistakes about not realising how far something is away and making the children walk when we should have thought of bikes [...] then they've got really upset and sad because they're too tired for walking or whatever and then it's like crisis moment and it starts raining and [my daughter] starts wailing "I want a car". (Evie)

However, several interviewees said that they found living a lower carbon lifestyle easy, and some had discovered positive benefits:

... we have just looked at alternative ways [of travelling] and I think to be honest to date we've found it a bit of an adventure and quite exciting. (Felicity)

... spending time with the children when we're travelling on buses or walking or cycling and trains is much more pleasurable family time than strapping them in the back [of a car] and turning up the story tape or whatever. (Evie)

Obviously if you can reduce your energy use, you reduce your cost... (Daniel)

Some interviewees considered that reducing emissions from home energy use was easier than reducing their transport footprint, while others had found the opposite.

6. Discussion

6.1 Allowances

One of the central claims made by proponents of PCT is that equal-per-capita allowances are 'fair' (e.g. Fleming, 2007; Hillman and Fawcett, 2004), but the choice of variable targets by some CRAGs suggests that this may be controversial. This accords with results from recent research on public opinions of PCT (Bird and Lockwood, 2009; Bristow et al., 2010; Jagers et al., 2010; Owen et al., 2008) in which some participants were concerned that the needs of particular groups such as elderly people would not be taken into account under an equal-per-capita allocation system, and argued that certain groups should receive higher

allowances. At the end of an extensive study of the literature on distributive justice, Starkey (2008) concludes that the only justification for equal-per-capita allowances is that this is the fairest allocation in practice, if not in theory, but he also argues that it is not clear that this fairest-in-practice argument actually holds.

In the present study, some CRAGs had chosen to allow variable and even self-chosen rations for the purely pragmatic reason of encouraging participation; they would not necessarily argue that their system is fair. But others regard their system of variable targets as more equitable than a fixed allowance (see 5.1). It is possible that campaign organisations working for the interests of vulnerable groups, such as senior citizens or disabled people, could oppose the idea of equal-per-capita allowances in a national scheme, and that there would be some sympathy for their position. On the other hand, if the general public were to understand that the allocation of larger allowances to some citizens would automatically mean smaller allowances for everyone else, unlike in CRAGs, the debate could become very complex. Another possibility, discussed for example by Seyfang et al. (2007) would be some form of compensation (e.g. through the benefits system) for certain vulnerable groups in recognition of their extra needs, or government grants to improve energy-inefficient housing, although such intervention would be costly.

Similarly, the decision by most CRAGs to effectively give children a full carbon ration may indicate that proposals for a compulsory system that would give children only a partial allowance, or no allowance at all, would be unpopular. Again, in CRAGs this choice did not mean that the standard allowance was smaller than it would otherwise have been. If it had, there might have been more debate about the issue of child allowances, and some different decisions. Bristow et al. (2010) found that households with children were, unsurprisingly, particularly keen that children should be given allowances in a theoretical national PCT scheme. It is hard to know how the debate between households with children who would stand to gain from full child allowances, and those who would lose (especially single senior citizen households) might shape in the national arena. Fleming (2007) asserts that an increase in child benefit would compensate families without the need for carbon allowances for children but provides no empirical evidence that this would be effective or acceptable.

6.2 Carbon accounting and scheme boundaries

The detailed, and occasionally heated, debates that CRAGgers have engaged in over what is included in their carbon accounts, and what conversion factors are used, suggest that if the government were to introduce a mandatory PCT scheme, it might need to be prepared to provide information about, and justification for, the conversion factors used in the accounting of such a scheme. A lack of transparency in this respect could possibly lead to opposition, or at least a lack of support, from those who might otherwise be expected to welcome PCT, if they felt that the conversion factors were incorrect in some way. For example, if no multiplier were applied to CO₂ emissions from aircraft to take into account the other pollutants that they emit, and the effects of emissions at high altitude, environmentalists might well regard this as a distorted or even dishonest calculation of the impacts. They could argue that the resulting rules about the number of permits required to fly effectively subsidise those who continue to engage in polluting behaviour. The use or lack of a multiplier for flights appeared to be an important influence on behaviour within CRAGs. While most interviewees had cut down on flights, or attributed their inability to meet the carbon target for the year to flying, two interviewees, both belonging to the WSP PACT scheme, mentioned that they were planning to continue to fly for holidays. The WSP PACT footprint calculator does not include the multiplier for CO₂ produced by aeroplanes that other CRAGs use, so flights have a

significantly lower impact on the overall footprint of WSP PACT members than they do on other CRAGgers.

Arguments could also arise about the inclusion or otherwise of green electricity tariffs and journeys by public transport in a national scheme. Since many of the CRAGs do not make exceptions for green electricity or public transport use because they consider that to do so results in an inaccurate carbon footprint, they might possibly oppose a PCT scheme that has different boundaries. However, it seems plausible that in a national scheme environmentalists might accept that green electricity tariffs and public transport journeys should not require the surrender of carbon allowances, at least to begin with, in order to encourage the general public to accept renewables and switch from car use to public transport. The exclusion of green electricity from an allowances scheme, for example, might promote enough consumer demand to encourage more renewable energy generation, whereas at present the action of a few CRAGgers in switching to a renewable energy tariff makes no difference to the overall energy mix of UK electricity supply. There is a strong case to be made for excluding journeys by public transport in the early years of a national scheme, for reasons of simplicity, keeping costs down, and because public transport contributes only a small proportion of most individuals' emissions (Bottrill, 2006b).

6.3 Financial penalties/trading

Given that CRAGs are not actually operating carbon trading, there is little we can infer from them about the implementation of this aspect of a PCT scheme. However, it is interesting to find that so many CRAGgers, whom one might expect to be supporters of personal carbon trading, would actually be unwilling to sell their spare allowances on an open market. If a large proportion of under-average emitters were unwilling (or failed for other reasons) to trade their spare allowance, this could have serious implications for the effective functioning of the market and therefore of the scheme as a whole. Over-emitters need to be able to buy spare allowances easily, at least in the early years of the scheme, since lifestyle and technological changes will take some time to implement. There is no reason to assume that this unwillingness to sell for moral/environmental reasons will be replicated in the general public, given that it has so far demonstrated less willingness to make such changes in order to cut emissions. Nevertheless, this finding does suggest a need to explore further individuals' willingness to trade their allowances.

The fact that CRAGgers who had to pay a financial penalty found it negligible, even at a carbon price that far exceeds the current market price, suggests that the price of allowances (or transaction costs) in a national scheme would have to be high in order to encourage behavioural change among those unmotivated by environmental concerns, at least those on a reasonably comfortable income. This finding is similar to that of another voluntary carbon trading project in which carbon price did not make an impact on the magnitude of carbon emissions reductions (Prescott, 2008).

6.4 Carbon literacy

The increase in carbon literacy that CRAGgers report is a major benefit of the movement. This was largely due to members having to monitor their transport and home energy use and calculate their own carbon footprint, which individuals would not be required to do in a national PCT scheme. Although CRAGgers did not have difficulty budgeting their fossil fuel energy use, the unrepresentative nature of the sample means we should be cautious about generalising from this. Nevertheless, the fact that even 'positive greens' learnt a lot from joining a CRAG suggests that increased carbon literacy could well be an outcome of PCT, to

the extent that a PCT scheme encouraged people to pay more attention to their energy use and associated emissions. Even if individuals did not monitor their emissions as closely as CRAGgers, making a high-carbon purchase or discovering that one's allowance was running low might prompt attention and learning.

A PCT system should also include the provision of regular statements (preferably monthly or at least quarterly) to enable individuals to understand their allowance, and promote carbon budgeting. The statements could show a breakdown of the different elements that allowances are used for (electricity, gas, etc) and the proportion of the quarterly spend and the annual allowance that these represent, in order to encourage awareness of the relative contribution of different activities. CRAGgers' comments about the impacts of seeing their carbon footprint figures suggest that such statements could improve carbon literacy.

In the absence of PCT, other policies such as smart metering, carbon labelling, and/or providing information on household energy bills and fuel and airline ticket receipts about the emissions associated with these purchases might help promote carbon literacy. The UK government currently plans to trial the effects of providing comparative feedback on energy bills (Cabinet Office, 2011), but the aim is to promote energy conservation through social norms, rather than carbon literacy; information on emissions will not be provided. Interviewees' comments suggest that bills that provide comparisons with energy use during the same month of the previous year might also be useful, but carbon emissions really become 'concrete' when understood as a proportion of a total footprint and comparisons can be made between different consumption sectors. It seems unlikely that the practice of carbon budgeting will become much more widespread in the absence of comprehensive statements and allowances. One way forward might be to develop an individual 'recommended annual allowance' based on a per capita share of national emissions targets, and offer information on what proportion of the recommended allowance a particular transaction (flight, energy bill etc) represents.

6.5 Emissions reductions/behavioural changes

This study suggests that motivated individuals can achieve carbon footprints that are significantly lower than the UK average. The CRAGgers I interviewed reported few absolute barriers to change, although there was mention of the need for government action and grants to make some changes easier. However, many of the interviewees were home-owners, which facilitates reduction of emissions from home energy use through installation of insulation, secondary glazing and renewable energy technologies that are unlikely to be considered by those who rent their homes. They were willing to spend time and money to cut their emissions, and to make sacrifices in convenience such as giving up a car (see 5.5). By contrast, Ipsos-MORI (2008) reports that 26% of the general public believe that "Individuals should be expected to do things like recycling and turning lights off at home but no more", and only 13% agree that "Individuals should be expected to make significant and radical changes to their lifestyle". Capstick and Lewis (2010) found, however, that members of the general public who took part in an experimental simulation of carbon allowances did exhibit budgeting behaviour in response to a declining allowance, and made carbon-conserving decisions.

One of the main ways in which CRAGgers had cut their emissions was by reducing or eliminating air travel from their lifestyles. This suggests that it would be important to include air travel tickets within the remit of any national PCT scheme in order to allow individuals more choice about how to reduce their emissions. Cutting down on flights offers individuals a means to (often significantly) reduce their footprint that is arguably easier than many other behavioural changes (at least in practical terms, once the hard decisions have been made), as

well as cheaper if the flight is not replaced by long-distance overland travel. For example, taking a holiday in the UK rather than flying to the Caribbean might involve a once-a-year 'tough decision', whereas commuting to work by public transport rather than using a car necessitates an ongoing commitment. Inclusion of air travel in a PCT scheme offers those who have few options with regard to cutting other emissions (such as those who live in rented accommodation) more opportunity to manage their carbon allowance. The difficulty is that this could lead to double-counting of emissions given that aviation will be included in the EU-ETS from 2012. (This issue applies equally to electricity, already included in the EU-ETS.) However, Prescott (2008) argues that Kerr and Battye's (2008) analysis of the efficiency of PCT suggests that, since policymakers have in practice imposed multiple economic instruments on the same unit of energy precisely because upstream instruments do not seem to change behaviour sufficiently, there is room for both PCT and the EU-ETS.

The fact that behaviour change was not restricted to those areas where emissions are counted by CRAGs may be evidence of 'spillover' effects (Thøgersen and Ölander, 2003), perhaps induced by learning about greenhouse gas emissions from sources other than direct energy use, or because certain behaviours (e.g. reducing home energy consumption) are seen as strongly related to others (e.g. reducing consumption more generally). It may be that some behavioural changes lead naturally to others e.g. using a bicycle rather than a car for grocery shopping might facilitate/necessitate doing shopping more locally, which might in turn lead to a reassessment of whether to use supermarkets. Alternatively, meeting new people through a CRAG might lead to exposure not only to new information but to different social norms. Thøgersen and Crompton (2009) note that evidence for spillover effects is contested and suggest that strong pro-environmental values and norms are necessary for spillover; this might be a factor in the apparent success of some CRAGs in facilitating this effect. Potentially, some spillover effects could be seen as a result of a PCT scheme, (or other policies to induce behavioural changes), where they are not dependent on the specific characteristics of CRAGgers (high motivation, particular values etc) – where they occur because certain behaviours are strongly linked to others, for example. A policy of consistently promoting 'bundles' of behaviours as being closely related might encourage spillover.

7. Conclusions

This study offers an understanding of how a particular group of individuals actually experience living with a carbon allowance, as opposed to exploring the idea theoretically. Many of these motivated CRAGgers had achieved carbon footprints significantly lower than the UK average, though not all attributed the technological and behavioural changes they had made to their involvement in the movement. Most did feel they were more carbon literate than when they joined a CRAG, and their comments reveal different mechanisms that facilitated this, with implications for policy.

In some respects the findings offer insights into the potential design and operation of a national PCT scheme; indicating, for example, that there may need to be careful consideration and justification of conversion factors and scheme boundaries to increase public acceptability of a PCT policy, and corroborating more theoretical research such as that showing that equal-per-capita allowances will not be seen as 'fair' by everyone. However, CRAGs can tell us little about the trading aspect of PCT. The atypical concern and motivation generally exhibited by CRAGgers also means that we cannot draw conclusions from this study as to the likely response to PCT of the general population in terms of emissions reductions. It is clear that further research is needed into the carbon literacy, or 'carbon capability', of the general public, including the ability to understand carbon statements and budget with a carbon

allowance, and also to investigate individuals' willingness and ability to trade carbon credits and to make emissions reductions.

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