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Contents

| | |
|--|-----------|
| Rationale | p. |
| Executive Summary | p. |
| Visibility, feedback, PCT and carbon taxation | p. |
| Individual decision making and behavioural economics | p. |
| Social Psychology: Norms, attitudes, motivations and habits | p. |
| Parallel Currencies | p. |
| Framing Policy: Positive and negative aspects of PCT | p. |

Appendices

| | |
|---|-----------|
| A. Suggestions for future research | p. |
| B. Current unpublished work on PCT | p. |
| C. A comment on methodology | p. |

Rationale

The report assesses the contribution (and potential contribution) of aspects of psychological science to the evaluation of PCT as a policy option.

The impetus for the report arises from a number of claims made by PCT advocates and commentators based on empirically untested psychological assumptions. PCT, it is proposed, will be different and better than, say, eco-taxes, because it will result in a greater degree of individual ‘engagement’ with carbon emissions.

As an example, Starkey and Anderson (2005) in their paper for the Tyndall Centre for Climate Change Research, suggest that if individuals are confronted with an explicit ration of carbon units,

“they will become more *aware* of their emissions, and more *engaged* with and *focused* upon the task of emissions reductions than they would under other instruments. And if *individuals* spend more time and effort *considering* ways to reduce their emissions, then emissions reduction would be more efficient under [PCT] than under other instruments” (italics added)

Roberts & Thumim (2006) also argue that PCT is attractive because it “appears to reach aspects of human behaviour... immune to other policies... it maximises the collective intelligence and imagination applied to the task”. Fawcett et al. (2007) similarly refer to PCT’s potentially positive “psychological effect” beyond that which could be achieved by more indirect means. Originators of the idea of PCT, Fleming (1997) argues that the anticipated effectiveness of PCT derives from its ‘immediacy’ to the individual, compared with indirect measures such as carbon taxation, and Hillman (2006) speaks of government obliging individuals to “exercise their responsibilities” through the scheme. In a Masters dissertation on the issue, Sivester (2006) refers to PCT’s theoretically “high level of personal involvement” effecting behaviour change.

Sorrell (2006) also emphasises putative psychological aspects of PCT, while pointing out that those making these claims have not cited any empirical evidence to support them. The most extensive research project to date examining PCT – ‘Carbon Limited’, an ongoing Royal Society for the Arts project – has identified the need to explore behavioural aspects including decision-making and ‘engagement’ alongside technical, regulatory and economic aspects (CarbonLimited, 2007; Atkinson, 2007).

Despite the identified importance of such psychological claims in arguing for or against PCT as a policy, there has however been almost no systematic theoretical or empirical evaluation of them (although PCT trials as advocated by Fawcett et al. (2007) are a step in the right direction¹).

¹ As identified by these authors themselves, the numbers of researchers working on PCT is a full-time equivalent of around 3-4 people. It should not be surprising therefore that there has not yet been full exploration of the range of relevant issues.

The purpose of this review is to identify and apply a range of related theory and evidence to critically analyse how PCT may come to influence individual decisions and behaviour.²

What Kind of Psychology?

Daniel Kahneman, a psychologist, jointly won the Nobel prize in economics in 2001 (with Vernon Smith). This, in no small way, legitimised the application of psychology (and in particular cognitive psychology, which covers perception, thinking and decision making) to economics. While research in economic psychology, which has a broader remit, has been going on for some time, work in behavioural economics (which brings together the expertise of cognitive psychologists and experimental economists) has more appeal to many as it does not require wholesale re-writing of economic assumptions about rational decision making, only that there are systematic exceptions to these assumptions, which need to be taken into account. The most famous and well researched ‘anomalies’ including framing effects, endowment effects and mental accounting will be considered in the current paper with respect to PCT as will other relevant aspects of cognitive psychology.

Cognitive psychology is not the only show in town; insights from social psychology are highly relevant as well. This literature champions the role of internal states such as motives, values and attitudes in influencing economic decision making and also underscores the essential ‘social’ nature of decisions, that individual choices are based on the choices of others.

The importance of social, personal and moral norms in influencing environmentally-significant behaviour, and their interaction with aspects such as attitudes and beliefs, is recognised in a number of theories used in environmental psychology, such as Schwartz’s ‘Norm-Activation Theory’, Stern’s ‘Value-Belief-Norm’ theory, and Ajzen’s ‘Theory of Planned Behaviour’. It is also important to appreciate that many of our environmentally-significant behaviours are habitual. For many people, for example, driving to work in the morning is not something they make a conscious decision about on each occasion: they just do it.

Jackson (2005) suggests that making sense of environmentally-significant behaviour requires, in summary, an understanding of: motivations, attitudes and values; contextual and situational factors; social influences; personal capabilities; and habits.

The review carried out here draws on such conceptual frameworks and issues as described above, though is grouped in such a way as to address the aspects particularly pertinent to PCT. Thus for example one of the central characteristics of PCT proposed to affect people’s decision-making and behaviour is the rendering explicit and visible of carbon information. For this reason how such ‘visibility’ may influence learning and behaviour

² Whilst Personal Carbon Trading assumes the capacity for buying, selling and other exchange of carbon to be central to how the scheme operates, it is as important to be aware that carbon also has the potential to be treated as a unique resource which is conserved, budgeted and managed. Therefore, when we speak of PCT this is often more in respect of people’s expected treatment of a Personal Carbon Allowance.

Where this review discusses (carbon) taxation, it is acknowledged that price effects obtaining from e.g. upstream trading may also be alternative policy options. However, from the point of view of the individual consumer, the distinction is likely to be minimal: in both cases energy use is made more expensive, though unlike with PCT this is in a considerably more embedded (i.e. less noticeable) fashion. Therefore we use the term taxation to refer to any price-embedded system.

change is considered, drawing on evidence from a range of studies. A further relevant area for consideration of PCT, often overlooked, is the range of effects which might be expected or encouraged through carbon operating as a form of parallel currency within PCT.

Practical and theoretical insights from disparate areas of Psychology are considered. These bring with them a range of methodologies and approaches; for a discussion of these, see Appendix C.

Executive summary

Nature of the review

- One of the key claims in the PCT literature is that the scheme will result in heightened ‘engagement’ with carbon emissions-related behaviour
- These claims are supported by almost no empirical evidence
- The review evaluates and explores how psychology and behavioural economics can inform understanding of PCT
- Predictions and propositions derived require targeted research to assess their validity

Likely effects of PCT

Visibility of carbon information and the role of feedback

- The visibility of carbon information within PCT underlies many of its likely effects
- Feedback mechanisms (information loops promoting understanding of behavioural consequences) engendered by PCT are likely to have positive effects on emissions
- PCT would work best in tandem with other feedback mechanisms (e.g. smart metering) and psychological processes (such as goal-setting); there is no ‘silver bullet’ for effecting reductions in carbon emissions behaviour

Implications from behavioural economics

- Speculations based on the relevant behavioural economics literature are mixed
- Mental accounting effects may lead to carbon allowances being treated more incautiously than PCT proponents currently anticipate
- Endowment effects might lead, conversely, to a tendency to conserve carbon resources; however, these effects usually only occur with variably-priced resources
- Budgeting as a cognitive process may encourage carbon conservation
- Availability effects (degree of attention to information, related to visibility) should promote heightened awareness of carbon during decision-making

Social norms and motivations

- Social norms and habits are difficult to change
- PCT has the potential to engender carbon-conservation norms; however, it would be in competition with strong pre-existing norms (e.g. car use), and be limited in its social effects through being introduced ‘from above’
- PCT also risks ‘crowding out’ favourable intrinsic motivations
- The potential for emergence of undesired norms exists, for example carbon debt and borrowing becoming commonplace
- Supportive environmental attitudes and acceptable behaviour are not simply linked

Issues arising from parallel currencies

- A carbon currency, with non-utilitarian associations, is an overlooked characteristic of how PCT could work; this could strengthen the connection between attitudes and behaviour, fostering a ‘moral economy’
- The success or failure of PCT will depend on how it is framed e.g. whether it is perceived as a loss or a gain, a ration or an entitlement

Further research

- Experimental work using computer simulations is proposed to evaluate cognitive and behavioural economic propositions relating to PCT
- Piloting/ trialling PCT is proposed to evaluate behavioural influences of PCT

Feedback mechanisms

Feedback works through providing useful and personalised information about energy use.

The literature concerning the role of feedback in moderating energy use is extensive and has been subject to a number of reviews (Abrahamse et al., 2005; Darby, 2006a; Dwyer et al., 1993). Within this body of work, feedback refers, broadly, to the provision of information to better inform households about consumption and motivate conservation. Studies examining feedback systems have looked mainly at home energy use, for example through interventions that use (computer-display) 'smart meters' (Owen & Ward, 2006); appliance-specific information (Wood & Newborough, 2007); so-called 'informative billing' which incorporates information broken down according to historical use, and in comparison with other households (Roberts, 2004; Wilhite & Ling, 1995); and home energy audits (McMakin, Malone & Lundgren, 2002). Attempts to influence energy use in these ways have had mixed success, varying from 0% to 20% in terms of reductions achieved (Darby, 2006a). Differences in types of feedback used make a difference: direct and continuous feedback (such as from a display meter) has in studies achieved higher savings overall than indirect and intermittent feedback (that which is delayed or processed, e.g. from billing). PCT might be expected to fall into the latter category for home energy use, and the former for transport. As pointed out by Darby (2006a), periodic/ indirect feedback will show up longer-term effects best, such as savings from insulation. Direct feedback (e.g. smart meters) will better demonstrate the significance of moment-to-moment behaviour.

An opportunity for carbon emissions feedback

PCT may help reduce carbon emissions through operating as a novel form of feedback.

Within a PCT scheme, carbon units would be debited alongside normal payment at the point of sale (e.g. when purchasing petrol or plane tickets), or at time of payment (e.g. when settling a gas bill or charging a key meter). In these scenarios – provided the amount of carbon debited in a transaction is noticed by the individual – the information within PCT has the potential to act as an additional, novel form of feedback.

Carbon usage revealed in this way may firstly be expected to act as a form of 'consequent feedback', influencing (future) behaviour through the recognition of its consequences (Abrahamse et al., 2005). The sooner such feedback occurs after performance of a particular behaviour, the more likely it is to be effective, as immediate feedback creates a salient psychological connection between action and consequence. Ideally, therefore, feedback should occur immediately after the behaviour occurs (Geller, 2002).

Within a PCT scheme, some behaviours such as carbon debiting/ payment alongside fuel purchase for personal transport at the forecourt, have the potential to be re-created as a new form of immediate consequent feedback in this way. Others, such as carbon debiting alongside payment of electricity bills would however be expected to offer rather more limited feedback potential. This is because – with present arrangements at least – any feedback usually occurs some time after energy-use behaviour and with energy-use behaviours aggregated.

Degree of continuity of feedback has also been found to be relate to reduction in energy use. van Houwelingen & van Raaij (1989) for example have found a 12.3% reduction in gas usage for householders receiving continuous (daily) feedback compared to 7.7% reduction for those receiving monthly feedback. McClelland & Cook (1980) similarly obtained a high level (12%) reduction in electricity through continuous feedback.

Depending on the way PCT operates and is accessed by people, the scheme also has the potential to provide a similarly continuous form of feedback. Provided PCT data (i.e. one's carbon account balance and transactions) are easily accessible, such as via statements or online, this generates the opportunity for individuals to receive more regular and direct feedback on personal carbon use. Of course, for PCT feedback to work in this way requires people to take the trouble to monitor their carbon spending, but this could be facilitated by design aspects such as monthly emails containing usage and account information. A PCT system may even be structured to allocate carbon credits on a monthly or quarterly rather than annual basis, thus encouraging continuity in feedback mechanisms.

- Box 1 about here -

Visibility of information

A key reason why feedback works is that it makes information more visible to people. PCT could achieve this too, hence has the potential to positively affect behaviour.

Perhaps the most important reason feedback can work is through its rendering visible the otherwise hidden. Thus when Brandon & Lewis (1999) discussed with study participants their experiences of the process, they found that making energy consumption visible (in this case through computer displays) was considered key to prompting behaviour change. Even where there was ambivalence in this study about whether participants felt it was appropriate to 'bring one's environmental attitudes home', making consumption visible worked in any case through financially motivating change.

It may be that in a similar fashion, the dual aspects of PCT – where units inherently represent emissions *and* a monetary value – may enable such a dual process approach. Where individuals perceive personal responsibility for carbon emissions, units represent a visible means of attending to this; conversely for people unconcerned about the environment, PCT feedback still maintains a financial aspect.

Theory of feedback

Feedback works through helping people learn about the consequences of behaviour; learning about the carbon consequences of behaviour could be a useful feature of PCT.

Theoretical attempts to understand and shape the effects of feedback have emphasised its role in learning, habit formation, and internalisation of behaviour (van Houwelingen & van Raaij, 1989). Feedback is firstly suggested to enable individuals to learn the energy consequences of particular behaviours, by providing quantifiable data in respect of them. Within PCT, the provision of quantified carbon emission data similarly has the potential to enable learning about the financial and environmental consequences of behaviours, both in

absolute terms (amount of carbon units) and relative terms (comparing the effects of, say, car and air travel, or to others' emissions).

van Houwelingen & van Raaij also argue that feedback enables habit formation, through the behavioural reinforcement of energy conserving acts; and that feedback helps develop energy-conscious attitudes through the individual being directly confronted with the consequences of their own behaviour (as in consequent feedback). Given a prominent enough feedback mechanism via PCT, the effecting of equivalent desirable habit change with respect to carbon emissions is certainly a plausible proposition.

Darby (2006b) has argued that a more complete understanding of how people make sense and meaning of energy information through feedback is needed. It is not enough, in other words, to think solely in terms of 'inputs' and 'outputs' but also to be aware of social learning and contexts. In light of this, she suggests that feedback processes should be carefully integrated with other awareness and educational campaigns to ingrain 'energy consciousness' and tacit understandings of energy use. Darby makes the point that despite growth in generalised environmental concern in the UK, there is a shortfall when it comes to linking specific everyday actions with their impacts. The relevance for PCT is in the suggestion that it may be able to go some way towards achieving such linkages.

PCT working together with other mechanisms

PCT could be combined with techniques such as 'goal-setting' and customizing information.

It is as well to caution that PCT feedback would probably work most effectively in tandem with other measures. Indeed, a thread running through much of the literature is that feedback alone, or without structure, may have little, limited or even a counter-productive effect (Kluger & DeNisi, 1996): what has been found to work best is a range of measures operating synergistically (Darby, 2006a,b).

Abrahamse et al. (2007) for example have used feedback comprising personalised information (advice specific to individual circumstances), goal setting (getting people to aim towards a reduction target), and tailored feedback (again, specific to individual behaviours and energy use) to achieve reductions in energy use. Energy savings of just over 5% were achieved by experimental participants – a modest reduction, though in line with the goal of 5% savings participants were aiming for (and compared to a slight though statistically not significant energy increase in the control group). The study also concludes that combining interventions in this way encouraged households to adopt a very wide range of energy-savings behaviours that was sustained over time, and that lead to higher knowledge of energy conservation. McCalley & Midden (2002) and McCalley (2006) also find strong effects by combining feedback with goal-setting, arguing that having a self-set or assigned target helps direct attention towards achieving the desired end of energy conservation. With pre-determined allowances a central tenet of PCT, it is tempting to think that these too may come to function as targets to be met, and so manifest as a systematic form of 'goal-setting'. Where one has an allowance of, say, 6000 carbon units, this may function as a *de facto* target or limit to be kept within. As argued by McCalley & Midden (2002) tendency to meet targets is however likely to depend to an extent on personality factors (as to whether people accept and work towards goals that are assigned to them).

Is PCT necessary for feedback?

There are no 'silver bullets': PCT and other mechanisms should be designed to work together.

It can indeed be argued that a PCT system is not necessary to achieve energy savings through feedback – a self-evident point given that a range of studies have used a variety of means to do so. Other policies, such as widespread introduction of smart meters, could also have profound effects on energy usage, and may indeed present greater opportunities for real-time feedback in the case of home energy use. The uniqueness of PCT though is in its ability to span a range of disparate behaviours (both within and outside the home) that reinforce both the financial and environmental costs of behaviours.

There are probably no silver bullets – whether smart meters, informative billing or PCT. The record of decades of attempts to implement single-strategy approaches to changing behaviour is mixed at best. Abrahamse et al. (2007) argue instead that the range of options for intervention work better when used in combination because of the complex range of barriers that vary considerably between households (Gardner & Stern, 2002).

One specific advantage of PCT in contrast to other feedback interventions, is that its introduction would be permanent and continuous. As outlined by De Young (2000), many of even the most successful interventions have not had their effects sustained over the long-term (or have required constant re-introduction); PCT by contrast is not likely to be something that will go away. Whilst people could be expected to become accustomed to the new requirements of PCT, this does not mean its novelty would necessarily wear off (we have not, after all, grown tired of the currency in our pocket). Rather, PCT could best be anticipated as a new means of paying closer attention to the range of everyday impacts on the environment, and the decisions that influence these.

PCT would, in summary, likely represent a valuable additional feedback and educative component contributing to reduction of emissions and energy use, provided it is well aligned to other approaches. PCT would best be conceived as operating in a complementary, rather than 'either/or' fashion.

Taxation and upstream trading

Taxation and upstream trading, as less visible costs, would not have many of the effects of PCT at the level of the individual. However, if both schemes could be unpopular, the 'abstruseness' of upstream trading may be politically desirable.

Government may well favour an upstream trading approach, even carbon taxation, because they are less visible to the consumer than would be a new PCT carbon currency. Dresner (2005) indeed suggests that in respect of upstream trading “its very abstruseness is a political strength” and that PCT could be “an easy political target precisely because it was so visible. There’s a danger that the whole idea of limiting carbon could become discredited for populist reasons”.

The evidence certainly suggests that indirect taxation (such as would be effectively the case with upstream trading) is less visible to consumers than direct taxation (as with

carbon taxation) (Lewis, 1982). PCT would in all likelihood be yet more visible than either taxation or upstream trading, and by design. An important distinction to be made here is whether the intention of a policy is to encourage individuals' taking of responsibility in respect of carbon emissions, as would be the aim of PCT, or for the market and price effects to be left to do so. It is also worth noting in respect of Dresner's remarks, that whilst upstream trading, and the European Emissions Trading Scheme (ETS), are indeed 'hidden' from consumers, their rendering carbon explicit and visible – a commodity that needs to be costed and considered – is an important characteristic at the level of industry.

The failure to uncover hidden costs

People in general prefer hidden to visible costs, though this can depend on perceptions of fairness.

Pursuant to the previous paragraph, McCaffery & Baron (2004) have found evidence that people prefer indirect or hidden taxes – nominally paid by some third party – because they do not draw the (logical) conclusion, in which they as individuals bear the true cost. The authors relate their hypothesis to the endowment effect: consumers will not feel they are 'losing' wealth that was never theirs.

McCaffery & Baron's experiments refer more broadly to comparing conditions where people were asked to think about income tax (direct) and social security contributions (hidden), however they are informative for how upstream taxation/ upstream trading may be conceived in comparison to PCT (though see next section). Through getting people to appraise the favourability of different costs, before and after being given positive frames regarding their desirability and fairness, they suggest that people do not generally think about wider or long-term effects of different imposed costs when making initial judgements about their desirability.

In policy terms, this suggests that unless PCT *is* perceived to be a more fair system it will be perceived less favourably than taxation. This goes against some assumptions in the literature that simply 'slotting in' PCT will be enough – a belief in the fairness of the system will instead be highly desirable.

Taxation as cost, PCT as cost or benefit

Taxation always involves incurring costs; PCT could lead to costs or benefits, and so may be more favourably received.

People in general fail to make the connection between the costs of taxation and the benefits of public expenditure (Lewis, 1982). Because the fiscal connection is not made, green taxes on fuel for example will simply be viewed as a cost (unless linked by a process of hypothecation to 'green' expenditure). The benefits rather than just the costs of PCT might therefore be more obvious. In addition, from a purely self-interested perspective PCT does present the opportunity to make actual individual financial gains: individuals remaining within their allowance limit are able to sell units and so profit overall from the scheme.

There may be other ways besides hypothecation to make green taxes more palatable. Dresner et al. (2006) in reporting on focus group results from a European study to assess public responses to eco-tax reform, state that:

“[Participants] made a number of suggestions for ways to provide visible ‘carrots’ as well as ‘sticks’. Both Danish and German focus groups perceived the existing [eco-taxes] in their countries as a ‘punishment’ because it was not seen as very easy to lower energy consumption. The Danish focus groups proposed that people should be given incentives to lower their energy consumption. One way suggested was to give people a rebate if they met an energy conservation target.”

Mental accounting

All money is not the same: it depends how it is conceived and perceived.

Central to the theory of mental accounting is the notion that money and resources are regarded differently depending on how they are labelled and grouped (Kivetz 1999); mental accounting is the set of cognitive operations by which people perceive, experience and evaluate financial activities (Thaler, 1999). Mental accounting findings are important for the variety of ways they violate neoclassical economic ‘fungibility’ principles, that is, the notion that money is treated the same no matter what its source or label.

One means by which PCT may be conceived to have different effects on behaviour than a pricing mechanism such as carbon taxation is in terms of the mental accounting processes occurring in individuals’ managing of carbon allowances.

An effect of ‘free’ carbon allocations?

Some research suggests that unearned income – which is what PCT would be – tends to be treated frivolously; this would be an undesirable side effect of PCT.

One area where mental accounting potentially bears directly on PCT is in the area of income accounting (Thaler, 1999), wherein type of source of income has been found to affect mode of spending. O’Curry & Strahilevitz (2001) have found experimentally that subjects are inclined to more frivolously spend money discovered in a jacket pocket or won by gambling, e.g. on eating out, than money that is earned or obtained from a tax refund, which is more likely to be put to more serious uses such as paying bills. Arkes et al. (1994) find comparable effects for use of windfall funds versus subjects’ own money, where windfall gains are spent more readily than other types of asset. Kivetz (1999) argues, compared to earned money, an equivalent unearned amount is perceived as less serious and ‘costless’.

For PCT, these results suggest that the ‘income’ of carbon allowances, may not perhaps be treated as seriously as PCT’s advocates desire or expect. Carbon allowances are by definition unearned, handed over by government to everyone independent of any criteria other than citizenship: income accounting results suggest this could adversely affect how people treat this resource.

What happens when carbon is no longer free?

Unlike taxation, carbon would be cost-less for a time; there would be a tipping point where it began to affect finances. This may help emphasise the finite nature of PCT allowances.

A further inference that can be made from mental accounting theory is in the area of reference prices, the standards against which the value of a resource is judged (Mazumdar, Raj & Sinha, 2005). Commonly applied in marketing, reference price effects are behind the idea that a £50 product is more attractive if it is ‘half price’ than the original full price. More broadly, reference price is conceived as a price expectation based on prior

experience (Briesch et al., 1997) or based on what is considered fair or reasonable (Campbell, 1999).

A curious feature of PCT pertaining to reference price, is in the tipping point set to occur once an individual reaches their allowance limit. When this occurs, carbon at once moves from being a free, unearned and saleable resource to one with cost attached. Thus, having purchased fuel and electricity unproblematically for much of their carbon year, the consumer is subsequently made aware that every such transaction now incurs a financial penalty. Aside from how this may be appraised politically³ price reference implications may however practically generate with some salience a central tenet of PCT: that everyone has the right to a certain amount of emissions, but that exceeding that limit will incur costs.

Endowment effects

Endowment effects (goods owned are valued more than their market value) may mean PCT carbon units are conserved.

Potentially operating in opposition to the matter of how carbon as unearned income may affect people's perceptions of their allowance, is the so-called endowment effect. This is the well-observed phenomenon whereby people place a higher value on something which is in their possession, than when that same thing is not owned by them (Kahneman, Knetsch & Thaler, 1990). A range of simple but illuminating experiments have shown that the consequences of this – a discrepancy between a ‘willingness to pay’ (WTP) and ‘willingness to accept’ payment (WTA) for a product – is a robust phenomenon. van Dijk & van Knippenberg (1996) for example gave half their participants bargaining chips, the value of which they were told would turn out to be somewhere between \$1 and \$3. Sellers were then invited to indicate their minimum selling price (WTA) to those without chips, and buyers their maximum buying price (WTP). A clear difference was found here, with buyers only prepared to offer an average of \$1.60 for chips but sellers requiring a minimum \$2.20

Endowment effects applied to PCT might suggest a degree of ‘loss-aversion’ attached to carbon, i.e. a tendency to hold onto carbon credit. This would imply that conservation of carbon (and therefore emissions-lessening behaviour) be consolidated by the endowment effect.

This may however be an over-simplistic interpretation. Endowment effects are considered to operate far more prominently in matters which are open to bargaining and negotiation, and where prices are uncertain or unfixed. In the case of routine economic transactions, where fixed prices are expected, the effect is much reduced or disappears (Kahneman, 1992).

The implications for this for PCT are that, where the scheme is designed such that there is variability in the price of carbon units, endowment effects could be expected. Should carbon trading operate with a fixed price of carbon, however, the effect could be expected to be less pronounced.

³ The situation whereby some months into a smooth-running PCT scheme, increasing numbers of people suddenly begin to feel the pinch of expired allowances should give any PCT proponent pause for thought.

Endowment effects obtained through a PCT scheme could therefore be expected – in the right circumstances – to engender prudence with carbon as a resource, which would in itself be a desirable outcome. On the other hand, if PCT operates as a simple currency exchange system in which the value of carbon is fixed, then a reduced or zero endowment effect might be expected.

Certainly, there are expectations in some quarters that real, variably priced trading at an individual level would take place within PCT. The RSA Carbon Limited project⁴ has set up a mechanism whereby people are able to trade carbon within closed groups for real money at a variable market price. So far, the prices obtained for carbon has been highly variable (varying by around 100% over the period January-February 2008) and it is not yet clear what have been the underlying interpersonal mechanisms behind this. Means of trading in an operational PCT scheme are likely to be between individuals and banks, post offices or other organisations, as well as opportunities for individual to individual trading.

Of course, the decision as to whether carbon unit prices are fixed or market-driven will be based on far more than anticipated endowment effects. Indeed, there are many other potential effects of a market-based system, not least in terms of price effects as demand grows. For example, would it be the case that towards the end of every carbon year as demand grows relative to supply, the price of carbon will consequently soar?

Living within a carbon budget⁵

Budgeting is a natural cognitive process which could be expected to occur through PCT and assist conservation of carbon.

A further feature of PCT that may affect mental accounting of carbon funds is in the area of budgeting, whereby resources are managed through the process of mentally labelling and constraining income and expenditure according to different categories. Thus again all money is not equal; in terms of cognitive budgeting processes there are important differences between bill money and beer money. Put more formally, budgeting enables rational trade-offs between competing demands, and self-control (Thaler, 1999). The concept of trade-offs are particularly relevant to PCT: the universal carbon measure does not censure or permit any activities; what it *does* imply is that one's (emissions) resources are finite and so choices need to be made through budgeting.

Budgeting, as experienced by most of us, enables individuals and households to keep track of and limit spending. Money may be kept back and attached to food or holiday budgets, for example. The idea of a carbon 'budget' may thus potentially facilitate self-control with regard to emissions, as competing demands for carbon (home energy use, transport, aviation etc.) are kept within budgetary constraints. This may perhaps be an idealistic scenario, however is more likely to occur within PCT than some non-limiting, non-budgeted system.

For budgeting to work, specific expenses must be noticed and assigned to relevant accounts (Heath & Soll, 1996). Through PCT, it seems likely that both the principle of a

⁴ See <http://carbondaq.rsacarbonlimited.org/main/howtrade> for the ideas and methodology behind this.

⁵ 'Living within a carbon budget' (Bows et al., 2006), uses this term considerably more widely than we do here, however how such a concept applies to the individual is crucial to an understanding of PCT.

predetermined budgetary limit and the explicit linking of an emissions ‘resource’ with particular behaviour and spending implications would facilitate such budgeting behaviour. Although carbon allowances may be ignored or only weakly attended to by some, it is reasonable to expect that for others this deliberately emissions-linked allocation will enable a more considered and so better managed environmental resource.

‘Availability’ heuristics and decision-making

Similar to effects of visibility, the readiness to bring carbon to mind (availability) in PCT could lead to heightened prominence of carbon in decision-making.

It is generally acknowledged that due to limited attentional capacity, cognitive abilities such as decision-making are restricted (e.g. see Pashler, 1998) and as a result people use a range of heuristics or ‘rules of thumb’ to simplify the process. The large body of work on heuristics derives primarily from the work of Tversky & Kahneman (1974). It has since been demonstrated a number of means by which heuristics, whilst primarily an adaptive feature, may also lead to ‘biases’ (Evans, 2004).

A heuristic with particular relevance to decision-making within a PCT scheme is that of ‘availability’. Availability here refers to the relative ease by which different pieces of information relevant to decision-making are brought to mind, with those more ‘available’ exerting more influence accordingly⁶

The availability heuristic has been discussed with relation to perception of risk with regards to climate change, Sunstein (2006) arguing that inaction has arisen through the lack of ‘available incidents’ that indicate it is a tangible and serious threat. The implication of availability for PCT is in the degree to which the previously unconsidered is made explicit, the unattended-to made ‘available’; emissions “add-ons” rendered less “shrouded” (Gabaix & Laibson, 2006).

In terms of energy-use behaviour, it seems reasonable to suppose that specific, quantified information about carbon emissions’ impact upon the environment will not for most people usually be at the forefront of thinking when making everyday decisions. Where though it becomes necessary to attend to consideration of carbon allowances as part of everyday energy-use behaviours, as in PCT, this has the potential to affect decision-making in a way that policies such as embedded carbon taxation likely would not.

Because attention is limited, the success of any attempt to affect environmentally-significant behaviour will be related to its ability to grab people's attention, by making limited but effective cognitive demands in the context of the behaviour rather than through informational appeals elsewhere (Stern, 1999). In the case of environmentally-significant behaviour, what will ideally be brought to attention is information that is simple, concrete and meaningful in the context of the behaviour under consideration, and that also directly relates to the broader and more usually nebulous and indistinct issue of climate change. PCT, with its minimal but context-specific carbon information that nevertheless directly relates to individual impact on the environment, could be expected to perform such a

⁶ A classic example is the following question: “How many words, in four pages of text, will have ‘ing’ as the last three letters? How many words in these same pages, will have ‘n’ as the second-to-last letter?” Most people give a higher answer for the former question, though logically this is a mistake; this is because examples of words ending “ing” are more easily brought to mind (Tversky & Kahneman, 1984).

function. That the individual's attention is necessary at a practical level (need to carry a carbon card, use of cards in readers etc.) may also help bring the problem of climate change into an individual context.

This suggests that building into the complexities of behavioural and decision-making processes a simple, yet noticeable, message about the carbon effects of choices – as in the case of PCT – has the potential to change behaviour in a targeted fashion. (This argument should not be seen as separate from those made above regarding 'visibility' of information; rather the distinction is in the literature's approaching the phenomena in two different ways: feedback work tends to consider information as an external influence on behaviour, whereas cognitive psychology would view it as a factor in internal decision-making.)

Reconnecting cause and effect

Environmental problems are often ignored because they are temporally removed; PCT may have the effect of bringing the issue of climate change closer to home.

Related to the issue of availability (how easily information can be brought to mind) is the effect of time delays between costs and benefits, or between behaviours and consequences. Discussions of temporal effects are found in the behavioural economics literature, as when length of time from payment to benefit effects 'payment depreciation' (Gourville & Soman, 1998) or conversely where time between benefit and payment has the effect of exaggerating the cost impact (the 'buy now pay later' effect; Siemens, 2007). Within the environmental psychological literature, temporal effects have been considered in terms of the discounting (i.e. lessening) of perceived seriousness of even as severe unfavourable outcomes as global warming or nuclear risks, where such eventualities are considered to lie somewhere in the distant future (Hendrickx & Nicolaij, 2004; Svenson & Karlsson, 1989). Highly relevant to the area of carbon emissions is the question of a sense of obligation to future generations and the non-human world; this issue is complex, however, and in addition seems to have as much to do with the framing of research questions such as whether people value lives in the future as much as those in the present (Frederick, 2003).

Modern industrialised society is in any case confronted with the paradox of the 'temporal extension' of major environmental costs on the one hand, and the simplicity, certainty and immediacy of economic and social benefits on the other (Vlek, 2000). Unfortunately for the environment, we find it far easier to think of the here and now, than we can the long-term and widespread; the here and now are cognitively more 'available'.

That it requires an effort of imagination to consider that one's actions in the present affect wider and delayed environmental problems, suggests that any efficacious solution to this would be one that heightens the immediacy in mind – that temporally reconnects – behaviour and consequences. It may be that both taxation and PCT both have the potential to fulfil this requirement – it is important to note though that this would be by proxy, through imposing financial/ carbon costs for behaviours.

PCT might be seen as being more desirable in terms of making more proximal the consequences of actions, as it is by design more aligned with actual issue at hand (carbon units corresponding to carbon emissions) and as discussed above is also noticeable and demanding of attention. Against this, any real financial costs within PCT are *themselves* temporally delayed or non-existent; for anyone keeping within a carbon budget there

would be *no* actual costs. Taxation by contrast imposes a real financial cost at the exact time a payment is made; against this, as this is price-embedded any *awareness* of cost incurred could be expected to be minimal.

Waste heuristics and environmentally oriented rules of thumb

We have natural tendencies to conserve resources, which could be tapped by PCT.

Arkes & Hutzler (1997) report three series of experiments which they suggest provide insight into the paradoxical human motivation not to waste, on the one hand, yet also be motivated to acquire new products even when there is no real need to do so.

They concluded that where resources under consideration appear to be in abundant supply (in their experimental cases, value-equivalent choices between new or old factories or dehumidifiers) people will tend to be wasteful. Conversely, where money or natural resources are concerned – items in limited supply – experimental subjects acted against wastefulness. It was found furthermore that in conditions in which nature was cued, even in subtle ways, the motivation not to waste and to conserve natural resources was overriding.

The implications for a PCT scheme of Arkes & Hutzler's waste heuristic are in the connotations attached to carbon units. Where it can be supposed that people consider these to relate (1) to a limited resource and (2) to a natural resource, it could be expected that such a heuristic might come into play, inducing conservation behaviour. (Theoretically, it should be noted however that the idea of a 'waste heuristic' has not been much developed, and that the experiments giving rise to it were on fairly small samples of undergraduates.)

PCT as a frugal but not regressive system

Being frugal may be seen as doing without, but may also be intrinsically rewarding. PCT should be designed to tap the latter.

De Young (2000)⁷ also provides evidence from a review of nine studies that 'frugality' constitutes a key component of intrinsic motivation (i.e. motivation to do something for its own inherent rewards) to behave in a pro-environmental way, and alludes to an evolutionary component to this, referring to human survival having depended on "the careful stewardship of finite natural resources". De Young argues that frugality within his reviewed studies is a virtue that was once commonplace (Nash, 1998) and has been shown to be intrinsically satisfying, as well as being able to be adopted on utilitarian grounds.

The challenge for a PCT programme would be to present itself, and to be seen, in these terms. The notion of a ration or limited allowance does have the potential to tap into traditional and even natural tendencies to be frugal. There are real risks though that frugality could come to be perceived as 'stinginess' or 'doing without' (entreaties to thrift tend often to be vulnerable to counter-assertions that environmentalists want everyone to go back to the sixteenth century). De Young, however, elsewhere finds study participants do not necessarily view intrinsic satisfaction obtained from modern conveniences and luxuries as the antithesis to frugality (De Young & Kaplan, 1986). Using open-ended

⁷ De Young's work derives more from a social psychological than cognitive approach; this illustrates the sometimes blurred boundaries between the sub-disciplines.

interviews with people involved in conservation, this latter study set out to enquire whether conservation and frugality outlooks were somehow unique or fringe; specifically, whether conservation was dependent on a type of austere outlook or whether it might instead provide payoffs (satisfactions) of a more ordinary and commonplace kind. Results were interpreted as evidence against the notion of a ‘spartan elite’, the authors arguing instead that ‘mainstream’ orientations (such as a desire for comfort) were reconciled by people in environmental terms by emphasising in addition qualities of products such as durability (i.e. sustainability) and the use of a wider context in justifying one’s behaviour.

Mapping these ideas onto how a PCT scheme might operate and be perceived, offers some potentially optimistic outcomes. Managing a (relatively) finite carbon allowance requiring frugality but not austerity could be aligned with people's own intrinsic motivations. In relation to this, pilot work by this report's authors finds some of those voluntarily trialling a version of PCT (see below) enthusiastically report the notion of a universal carbon measure which enables one to live within a fair allowance without damning particular behaviours; one participant cheerfully reported various activities undertaken, including flying within Europe, whilst still keeping within a carbon allowance.

Norms influencing behaviour

Norms are prominent in influencing environmental behaviours.

Norms are non-formal rules or obligations people feel they should follow – what is ‘normal’ either in terms of what is morally correct or simply customary. The British traits of queueing and remaining quiet in libraries, are both good examples of norms compelling people to behave in a certain manner.

There exists an extensive literature and general consensus about the potency of norms as means by which social expectations affect people's conduct (Biel & Thøgersen, 2007). The interaction between prevailing norms and normative standards of behaviour and a PCT scheme – and even the engendering by PCT of new or modified norms – is therefore likely to be a key determinant of the success of such a scheme.

An example of the influence of norms is in the case of littering, where social and personal norms act to influence behaviour (Do Valle et al., 2005; Cialdini, Reno & Kallgren, 1990). In line with normative expectations, people are found to litter more in already-littered areas than in clean ones, because both constitute relatively ‘normal’ behaviour (Reiter & Samuel, 1980).

Research has also investigated the role of norms in, for example, promoting energy conservation (Black, Stern & Elworth, 1985), green consumerism (Thøgersen, 1999) and taking the decision to use public transport over the car (Bamberg, Hunecke & Blobbaum, 2007). Other studies have found personal norms affect willingness to reduce energy use and to behave in a more general pro-environmental way (Steg, Dreijerink & Abrahamse, 2005) – these last authors equate this to a sense of ‘moral obligation’ that relates in turn to one's values and beliefs. Kaiser (2006) also finds that ‘moral’ norms, which he considers overlap with environmental attitudes, are particularly prominent in affecting environmental behaviour.

Nordlund & Garvill (2003) have also obtained results illustrating the importance of personal norm for willingness to reduce car use, framing their results in terms of willingness to cooperate in a ‘social dilemma’. More generally, it is suggested that within social dilemmas (in which there is a conflict between maximizing personal gain and the greater social good) are generated social normative pressures that favour collective outcomes (Biel & Thøgersen, 2007; Biel, Eek & Garling, 1999) in which the violation of such norms through unfair acquisition of a collective resource is seen to violate the social norm of equity (Kerr, 1995). This may have limited power, however, as in the so-called ‘tragedy of the commons’ where the taking of more than one's share may result in common goods becoming terminally depleted (Hardin, 1968; 2006); as Bamberg, Hunecke & Blobbaum (2007) put it: “the unfortunate fact that many behaviours which tend to serve our personal well-being are detrimental to the environment”.

Norms in the context of PCT

It may be possible for PCT to help encourage more environmental carbon-conserving norms.

An important question for PCT in relation to these results, is whether its structural and operational aspects have the capacity to contribute to the creation of a social norm (or norms) to reduce or restrict carbon emissions. The aims of those advocating PCT certainly are clear: within the scheme people are both expected and encouraged to assume responsibility for emissions. Thus their carbon ‘allowance’ is based on the principle of an equal right to pollute and an expectation of personal responsibility. That one may buy more ‘right’ to pollute through a simple financial transaction makes this moral argument rather murkier, but is integral to the trading component of PCT.

Norms may indeed exist in large part for the purpose of restricting self-interested behaviours in favour of collective outcomes (Biel & Thøgersen, 2007; Biel, Eek & Garling, 1999). Given this, it would seem that a PCT scheme lends itself to an alignment with normative influences. In this manner, normative aspects of PCT may be equated with systems such as local government recycling, in which (until recently at least) participation could occur only through morally-motivated voluntary participation (Thøgersen, 1996).

It may furthermore be the case that a timely and well-constructed implementation of PCT is able to engender wider societal norms about carbon emissions, just as government-led campaigns to reduce drink-driving have done. This may depend to a large extent on how well PCT is received; in the case of road charging, Jakobsson, Fujii & Garling (2000) have found that acceptance of the policy of road pricing decreased with how much it was perceived to be unfair and to infringe on personal freedom. Steg, Dreijerink & Abrahamse (2005) also find that acceptability of energy policies are influenced by beliefs about personal responsibilities and personal norms.

It is worth noting with respect to information campaigns (e.g. television adverts) that historically, the most typical result of simply offering information about the benefits of pro-environmental behaviours is that those behaviours don’t change (Stern, 1999). With reference to ten studies examining the effects of information campaigns, Stern concludes that even the most carefully crafted informational interventions can only achieve modest behavior changes, and that these are on the whole limited to certain targeted behaviours which are simple and can be changed with little inconvenience or expense (e.g. littering). Little or no effect is likely where there are external barriers to behaviour change such as cost or inconvenience. Stern points out furthermore that informational efforts have done little to change the purchase of important products, such as cars or boilers, in a pro-environmental direction.

Problems with the idea of PCT engendering or working with norms

Whilst PCT may help engender carbon-conserving norms, the imposition of norms ‘from above’ is problematic; there are also existing norms to compete with.

Such linkages appear to imply potential alignment of PCT with social norms and hence behavioural change. However, an important problem for the proposition that PCT could engender new or more salient norms to restrict emissions, lies in the prescriptive nature of such an intended normative standard. As Peyton-Young (1998) argues, social norms usually evolve from the cumulative effect of many decentralized interactions by individuals, as such it is not in the nature of norms for them to be imposed in a top-down fashion (people may also actively resist such an attempt).

For this reason, recognition of the highly social origins of norms is also important; some of the most successful programmes to change environmental behaviour are based around group-based and community-oriented programmes (Staats, Harland & Wilke, 2004; De Young, 1996), yet proposals for implementation of PCT are presently detached from any attempts to incorporate such potentially powerful social aspects. Norms work most effectively in offering solutions to commons dilemmas in small, closely-knit circumstances (Ostrom, 1990). As such, it is unclear whether any hopes that PCT-related norms could emerge across society, which is heterogenous in many important ways, would easily be realised. As well as desiring norms to emerge across different sectors of society, PCT as a scheme also crosses into different domains of life. Thus it would also be ambitious to hope that all-encompassing PCT norms would neatly be engendered.

Moreover, development of norms with regard to PCT would in many cases be in opposition to pre-existing norms. In the case of travel mode particularly, as argued by , any normative pressure for non-car alternatives is in competition with the highly salient social norm that is the actual driving behaviour of a huge proportion of the population (Tertoolen, van Kreveld & Verstraten, 1998; Kallgren, Reno & Cialdini (2000). Given the widespread acceptability of car use, individuals' sense of environmental obligation or responsibility towards using alternatives is, as a result, generally low.

The potential for the emergence of undesired norms

PCT could have counter-productive effects, if for example it becomes 'normal' to accrue carbon debt.

With regard to emergence of norms in relation to PCT, there is the further possibility, apparently not addressed within the PCT literature, for alternative and even contradictory norms to emerge.

One area where counter-productive norms may arise from PCT is in the potential for carbon debt to become prevalent. Within a fully functional PCT system, it seems likely that banks and others will be able to facilitate trade, but also credit in carbon units. Given the high levels of financial debt commonplace in the UK and elsewhere, with borrowing now so normal as to be considered almost a 'national pastime' (Tora, 2004; Muellbauer, 2005), the scenario must be envisaged for something similar to occur with PCT. Even were borrowing to be prohibited in PCT, it might still quickly become normal for people to treat a PCT allowance in much the same way as a pay-as-you-go mobile phone, where users perform a simple transaction to 'top up' their carbon allowance where required.

Whether PCT generates norms of responsibility and restraint, no discernible or efficacious norms, or worse, counter-productive norms of credit and profligacy, are therefore important considerations for the implementation of such a scheme and the marketing and messaging associated with it.

Attitudes and values

Strong pro-environmental attitudes often do not lead to pro-environmental behaviour.

The so-called 'value action gap' is now commonly invoked to point out (and lament) the fact that whilst people may possess strongly pro-environmental attitudes, they will not necessarily act on these, and they may be weak predictors of actual behaviour (Kollmuss & Agyeman, 2002; Fransson & Gorling, 1999). One recent study suggested no more than 10% of variance in environmental behaviour across studies can be explained by environmental concern (Bamberg, 2003).

The research field is complicated by the fact that attitude may refer to specific attitude towards specific behaviours (e.g. driving), or whether people possess more underlying 'biospheric' (environment-centred) or 'egoistic' (self-centred) values (Schultz & Zelezny, 1999; 2003). Some authors (e.g. Stern & Dietz, 1994) have suggested that particular attitudes are causally preceded by more general beliefs and values; or that there are wider sequential relationships moving from social and institutional factors, exerting influence on values, which then shape beliefs and worldviews such as environmental concern and norms, which *then* affect specific attitudes and so behaviour (Clark, Kotchen & Moore, 2003; Stern, Dietz & Guagnano, 1995). Other authors have argued that attitudes are in fact unstable and highly context-dependent (Schwartz & Bohner, 2001).

Theoretical frameworks and predictive models have had most success in accounting for the role of attitude where it is incorporated as one factor out of many. One prominent model that does so is the 'Theory of Planned Behaviour' (TPB, Ajzen, 1991; Armitage & Conner, 1999) which postulates that the performance of a behaviour such as recycling or energy conservation is determined by intention to carry out that behaviour, this intention in turn being determined by attitudes, 'perceived behavioural control' (the extent to which one believes one is able to exercise choice) and social norms. Given data on each of these factors, TPB has been reported to account for up to 80% of variance of pro-environmental behaviour (Kaiser & Gutscher, 2003).

What emerges from such work overall is that there are complex, interrelated structures in which a range of internal variables influence each other. Any simplistic attempt to change attitude alone with the expectation of clear behaviour change, without taking this into account, will therefore likely be limited in success.

Attitudes in the context of policy

Development of positive or negative attitudes towards behaviour require clear signalling about environmental effects of that behaviour.

From a review of a large number of studies considering the role of attitude in environmentally-significant behaviour, Fransson & Garling (1999) conclude that clear knowledge of the extent of environmental effects of particular actions is necessary for people to have an influential attitude in this respect:

“If people are not convinced that a specific factor contributes to environmental deterioration, they will not have a negative attitude towards it.”

Given that climate change is a complex problem that at present still confuses many people (Lorenzoni, Nicholson-Cole & Whitmarsh, 2007) it seems reasonable to suggest that the carbon measure in PCT could provide an opportunity for sending a clear message about how much impact each of a range of behaviours have. Few people at present might know that 1 mile travelled by car is approximately equivalent to 6 kWh of electricity, but within

PCT this could become clearer. It seems unlikely that such a comparative awareness effect could be obtained from an embedded tax.

Habit

Many of our behaviours are habitual and require little conscious thought. This means they can be hard to break - "old habits die hard".

Habitual behaviour occurs with little attention needing to be paid by the individual (Verplanken & Aarts, 1999). For example, someone whose routine it is to drive every day, will not have to give this a second thought, or engage in a decision-making process every time they are about to leave in the morning: they just do it.

As Biel, Dahlstrand & Grankvist (2005) point out, many behaviours with environmental consequences, such as energy use and travel mode, are well-ingrained and habitual, often performed in a stable context (Thøgersen, 2006), with high frequency and with little reflection. Environmental psychologists have therefore often examined the processes by which such habitual behaviour can be disrupted, and potentially new habits created. As argued above, one way PCT may affect behaviour is through the potential for feedback to reinforce new habits. Further means by which PCT may affect well-worn patterns of behaviour are also reviewed here.

Habit and routine may be conceived of as patterned social (or socio-technological) practices (Keirstead, 2006; Shove, 2003) in which conscious consideration may not necessarily be given to energy-use behaviour, instead occurring as a function of cultural or social practices. Verplanken & Wood (2006) argue that successful habit change requires the disruption of situational factors that automatically cue habitual behaviour. Emphasising that information alone (such as media campaigns) rarely have much effect, they suggest two more effective means by which habit change can occur: through targeting behaviour specifically at times when habits are vulnerable to change, e.g. when moving house, and through changes to the "structural conditions in which people's behaviors are embedded", citing economic incentives and legislation as methods by which this may be achieved.

Opportunities for PCT to break old habits

PCT has the potential to break habits through changing the structural conditions in which behaviours currently occur.

Certainly, the implementation of a PCT framework would constitute a major change to economic and societal structural conditions in the UK (indeed, politically this is probably the scheme's biggest obstacle). In terms of affecting habitual behaviour, Roberts & Thumin's (2006) suggestion that PCT could reach aspects of behaviour immune to other policies may, however, well be valid in this instance. Whilst it is probably a step too far to state that implementation of PCT would have an equivalent effect on habit disruption to moving house, the novel structural aspects of the scheme could certainly be considered to represent a combination of both changed decision context and relevant financial (dis)incentives.

Even at a basic level, an example of a study using a simple economic incentive to change habit is Thøgersen & Møller (2004)'s study involving provision of free public transport

passes to Copenhagen drivers, which was found to double bus use. A limitation of this study was the reversion of drivers to their cars once the experiment was over, though it may be that within more permanent schemes such as PCT such behaviour change may be more durable. Indeed, specifically in the case of transport choice, should the recommendations of Bottrill (2006) be taken up, public transport would be excluded from a PCT scheme in any case, as such reduction in car use could well be a realistic outcome. Bamberg et al. (2003) also report doubling of public transport use with incentives, concluding that a “strong behavioural reaction” can be obtained even in habitual transport choice, by using a simple financial incentive. They suggest this is because structural changes permit “sensible” re-evaluation of choices and heightened sensitivity to new information.

It may be countered, financial incentives are able to be put into place without PCT; congestion charging in London, for example, has proved successful in reducing car use through pricing alone (Beavers & Carslaw, 2005). However, in this particular example as in others, it is worth considering whether aspects such as high levels of advance publicity and structural changes (road markings, signs, surveillance, needing to actively pay the charge etc.) were also an integral part of effecting such widespread behaviour change. For PCT, the presence of carbon cards and readers, and extensive advance publicity would also be very noticeable to people.

With Stern (1999) furthermore arguing that one of the most important combinations influencing pro-environmental behaviour is to give people information and incentives, the implication for PCT is that were it combined with an effective education campaign this could be particularly effective in bringing about change.

Environmental Morale & Motivation

Environmental morale and motivation can be fostered through the right sort of legislation.

Frey & Stutzer (2006) provide a useful review of the ways in which environmental morale and motivation can be fostered, with a number of implications for how people might be expected to react to PCT.

These authors refer to the theoretical framework of social dilemmas in which environmental damage is considered to arise through the problem of free-riding. (In social dilemmas, people may act in a self-interested fashion which is contrary to the collective good: an example of this is over-fishing of seas, for which the collective good would require restraint but self-interest leads to maximising catches.)

Frey & Stutzer suggest that such problems of cooperation caused by free-riding can be overcome through legislation where this is perceived to be fair and legitimate (Tyler, 1990). Environmental policy can be expected to foster desirable morale and motivation in circumstances where it has an “expressive” function, that is to say communicates an expectation to people that environmentally friendly behaviour is expected. This, they conclude, can be used to reinforce existing pro-environmental motivation. McCaffery & Baron (2004) also argue that moral motivations will be ascribed to direct (e.g. PCT) but not indirect legislation (e.g. taxation).

Such arguments would seem to indicate that PCT, which is based on principles of equity (Fleming, 1997) and with a deliberate emphasis on personal responsibility, would represent both a fair and expressive policy, as such might be expected to affirm environmental morale and motivation. Frey & Stutzer however move on specifically to critique the very notion of tradeable emissions rights (encompassing PCT) in the context of the so-called “crowding out” effect.

The potential for ‘crowding out’ intrinsic motivation

Extrinsic rewards and punishments (e.g. financial (dis)incentives) can be counter-productive by damaging intrinsic motivation (e.g. acting through altruism) – this is a potentially unwanted side-effect of PCT.

Crowding out occurs when a behaviour which was previously performed as a result of intrinsic motivation begins to be rewarded, or where previously intrinsically-motivated refraining from behaviour begins instead to be controlled through penalties. In such circumstances, intrinsic motivation can be destroyed through (albeit well-intentioned) efforts to use extrinsic incentives such as financial rewards and penalties. (A somewhat unhappy example of such an effect, cited by Frey & Stutzer, is that of Kazdin (1982) who reports the case of an old people's home where rewards were introduced for carrying out chores such as bed-making; over time residents lost any sense of moral obligation to do these tasks, having come to expect payment for their efforts.)

Whilst there may be various circumstances where crowding out may occur, it is of concern that Frey & Shutzer take aim specifically at the policy of tradable emissions quotas (including at a personal level), arguing that its structure and presumptions are likely to adversely affect people's intrinsic motivation to behave in a pro-environmental fashion. They attack PCT-type systems for conveying the notion that “it is acceptable to sin, provided you pay for it”, even comparing the idea to indulgencies sold in the Middle Ages.

These authors argue that the crowding-out effect is likely to happen also with taxation, however they present the case that it would be more salient for PCT. They argue that emissions trading fosters a cynical attitude, as such strongly undermining positive motivations to conserve. In the case of taxation, it is argued, the expressive connotation is however quite different: charging for damaging the environment makes it clear that it is an undesired activity always better not undertaken. Frey & Stutzer suggest that, whilst under taxation a crowding out effect could still be expected (because such a system reduces the extent of individuals’ self-determination and so relevance of value-based motivations), the message that damaging the environment is undesirable is clearer. Such arguments made by these authors are problematic, however. Firstly, it is questionable whether policy instruments that present *all* carbon emissions as being undesirable are appropriate – very few people could reasonably be expected to live in a zero-carbon way. Secondly, their arguments against emissions trading and taxation, on the basis of crowding-out, are that self-determination is reduced by these systems. It is however at least as realistic to argue that PCT enables quite the reverse: the explicit taking of responsibility for one’s carbon impacts.

Certainly though the discussion relating to crowding out of motivation should give any PCT proponent pause for thought. It may optimistically be imagined that people will think “I have an obligation to keep within my fair share of emissions”, where just as easily may

arise the sense that “I have paid for these emissions rights and so it is my entitlement to use them”.

Where then people consider PCT equivalent to obtaining indulgences, crowding out could be seriously counter-productive. Where people consider PCT ‘expressive’ of ‘fair’ expectations, by contrast this may shore up environmental motivation. Ultimately, it will be through the marketing and structuring of any PCT scheme, and ensuing wider debates, which perspective would come to prevail.

Parallel currencies

Carbon within PCT could be considered a 'parallel currency'; research exploring other such parallel currencies can inform how carbon comes to be perceived.

It is helpful when considering the likely impact of PCT implementation to refer to the range of other complementary currencies which have come into being, often as a result of community initiatives.

In one of the few attempts to date to link PCT to a conceptual and theoretical framework, Seyfang (2007) undertakes to compare the hypothetical PCT 'carbon currency' with three such complementary currencies:

- Local Exchange Trading Schemes (LETS), in which goods and services are exchanged between members of local groups in the UK, either without the use of cash or using locally invented currency
- Nu Spaarpas (NU), similar to a green loyalty card or reward scheme, operated in Holland, in which rewards were earned through pro-environmental behaviour such as recycling or use of public transport
- Time Banks, a means of converting voluntary hours into time credits (social capital) which can then be exchanged with others (UK scheme)

Perhaps closest in character to a PCT carbon currency, as discussed by Seyfang, is the Netherlands NU Spaarpas scheme⁸ which as well as being concerned directly with the issue of sustainable consumption (though more broadly than just carbon emissions) also operated through a technical, electronic system in which card-holders redeemed and acquired 'points' when making purchases. The 18 month pilot of this scheme was able to achieve 10,000 cardholders and 1.5 million points issued.

According to the literature arising from this scheme, its successes were related to the scheme's enabling people to "gain a new, tangible way of acting and learn more about the sustainability of products and services" (van Sambeek & Kampers, 2004) in which social objectives were combined with commercial goals. In light of much of the discussion above regarding visibility (i.e. tangibility), learning through feedback, and achieving change within a social context, there are signs that perhaps the closest social currency experiment to PCT ever implemented was indeed able to achieve many of the aims that might be hoped for from PCT. It should be noted however that there are important differences between PCT and the NU scheme: in the former the individual's carbon account is debited over time, whereas in the NU scheme, points are accrued in a similar way to a supermarket rewards card system. This may of course influence people's reactions to the two schemes in different ways.

Comparing PCT units and complementary currencies

⁸ See also http://www.nuspaarpas.nl/www_en/html/info.htm

Carbon units have the potential to have a more potent effect than money through being invested with specific meanings.

Seyfang argues that, like other complementary currencies, PCT is designed to achieve particular goals “that mainstream money cannot address” through economic, social justice and environmental objectives. She argues however that whereas other complementary currencies have grassroots strengths and may be aligned with social movements, PCT is a fully top-down mechanism, and that the PCT literature has only given cursory consideration to social and cultural issues. In addition, it is argued that the deeper understanding of carbon budgets and their relation to behaviour change is an undeveloped competency, also glossed over in the PCT literature:

[Carbon emissions] have always been an externality of economic activity, which consumers are now being asked to account for, budget and reduce. This requires a new set of carbon literacy skills, but there is very little acknowledgement of this in the PCT literature; the presumption seems to be that simply introducing [PCT] will be sufficient to redirect... consumer decision-making.

For Seyfang, the advantages of complementary currencies are that they are able to prioritise different behaviour patterns and incorporate different 'essential functions' to money. Whereas traditional money works as a unit of account, store of value and medium of exchange, a complementary currency (such as carbon units) may instead be seen explicitly as a tool to constrain emissions, and to encourage self-awareness and accountability.

To date, it is fair to say that whilst there is discussion in the PCT literature about underlying principles of equity and taking responsibility for emissions, the notion that the newly developed 'carbon currency' could have inherent to it a symbolism and meaning concerned with those very aims which it is actually trying to achieve – pro-environmental change – has not been developed. Possibly, a concern with traditional economic credibility is behind this, but any PCT scheme would be missing important opportunities for translating its philosophy into practice if it limited itself to being implemented as a 'neutral' system, solely conceived as a “rationalist...utilitarian market-based mechanism” (Seyfang, 2007).

Currency as more than ‘unit of account’

Carbon units in PCT may help contribute to the idea of a ‘moral economy’.

Highly relevant to a consideration of PCT therefore is an acknowledgement of the non-neutral nature of a currency, contrary to the usual conception of money as merely a ‘yardstick’, as value-free as kilograms or litres⁹.

Even when comparing traditional currencies, such assumptions do not always hold. For example, in two recent studies contrasting mental accounting processes for Euro and pre-Euro currencies – in which experimental subjects were asked to forecast prices according to whether they were in Lira/ Deutschmark or Euros – Ferrari & Lozza (2005) and Jonas et al. (2002) both find important differences (which in the latter study at least were not

⁹ Consider though how 'neutral' imperial and metric measures were found to be in light of introduction of EU Weights and Measures regulations; also the emotionally-loaded 'Save the Pound' campaign of the 2001 UK election (Collings & Seldon, 2001).

related to attitudes towards the Euro); Ferrari & Lozza use their findings to argue that money is “laden with substantive symbolic value and affective connotations”. In the case of national/ Euro currencies, there was absolute interchangeability in terms of value, yet people still thought about them differently. In a general sense, the implication of this is that the type of currency used in a society encourages or discourages specific emotions or behaviour patterns (Lietaer, 2001: 4). Greco (2001:147) similarly cites the example of casino gaming chips: these have an exact and unchanging equivalence to the national currency, yet the psychological effect of using chips is an increase in likelihood that money will be treated recklessly.

The lesson here is not that a carbon currency should be seen either as equivalent to a new Euro or gaming chips, rather that it may – either by design or socially constructed meaning – also come to possess important non-utilitarian associations. These could include the promotion of the expression of values (Greco, 2001: 16) or more widely the objective of fostering a 'moral economy' (Peacock, 2006).

Unlike under a carbon taxation system, there are opportunities for a carbon currency to be invested with social and environmental associations. To ignore these would be to overlook the potential leverage which these associations could enable.

Framing Policy; Positive and negative aspects of PCT

Framing

PCT has considerable potential to be perceived in very positive, or very negative lights.

The literature on framing has established that the presenting of different scenarios, identical in substance but 'framed' or presented in a different fashion, can elicit entirely different decision-making processes (Tversky & Kahneman, 1986; Levin, Schneider & Gaeth, 1998); 'half full' is not the same as 'half empty'.

Thus, people may, for example, make different decisions on two equivalent health programmes dependent on whether they are described as resulting in lives saved or people dying (Tversky & Kahneman, 1981). More broadly, the idea of framing implies that "reality always needs to be represented" when conveying environmental policy (Lindseth, 2004). Strategically, certain aspects of an issue may be made more salient than others to encourage a particular moral evaluation of an issue.

It seems likely that PCT has plenty of scope for a variety of interpretations¹⁰, and so plenty of opportunity to be seen in either a positive or negative fashion. Table 1 illustrates a number of ways that this could occur.

Table 1: Positive and negative connotations of PCT

| Negative connotations | Positive connotations |
|------------------------------------|---|
| Rations, allowances | Fair shares, entitlement |
| Risk of financial costs (losses) | Opportunities for financial rewards (gains) |
| Imposition of obligation | Exercising responsibility, self-efficacy |
| Inconvenience, hassle | Simplification of complex problem |
| Proscription of lifestyle choices | Non-judgemental, flexible budgeting |
| Restriction of individual freedoms | Collective effort to solve a problem |
| Reduction of morality to finance | Synergy of market and morals |

Rations versus entitlement

As argued already from within the PCT literature, the idea of 'rations' (Hillman, 2004) brings to mind images of wartime austerity (Sorrell, 2006) likely to be a problematic framing of PCT. Even 'allowances' (Fawcett, 2004) suggests something permitted by an authority. Although neither of these interpretations are wrong in any absolute sense, a preferable way of framing would be to use more neutral terminology, such as 'personal budgets' or 'units', or a positively loaded frame such as 'entitlement'. All these terms are equally valid, but could be received very differently.

¹⁰ It may even be argued that PCT is a form of framing itself; a means of providing a meaningful interpretation of the expansive issue of climate change at an individual level.

Carbon gains and losses

People are highly sensitised to whether matters are portrayed in terms of gains or losses. Even in comparable situations where the net loss for an individual is the same, people much prefer frames which emphasise bonus to penalty (McCaffery & Baron, 2004). Relevant to these two different interpretations of PCT is the idea of 'goal framing' (Levin, Schneider & Gaeth, 1998) wherein the potential to obtain a gain, versus the potential to avoid a loss, strongly affects how people think about and appraise decisions.

One of the central advantages of PCT relative to taxation is that built into its design is a genuine opportunity to turn a real financial profit through careful management of one's carbon budget. Thus whilst it will be important to make people aware that exceeding one's limit will result in financial costs, it will be equally important to emphasise the potential personal benefits of the scheme. Within PCT, pro-environmental behaviour can actually be materially rewarded.

For those wishing to do so, there should also be provision to 'retire' carbon (i.e. put beyond use; Starkey & Anderson, 2005) and so the opportunity to forego financial profit in favour of pro-environmental retiring can be framed in a way that may ameliorate any potential 'crowding out' of intrinsic motivation (cf. Frey & Stutzer, 2006).

Obligation and responsibility

Being compelled to act by government is very different to feeling a sense of responsibility for doing so. As Jackson (2008) argues and with some force, the idea that government can assume influence over consumer choice is almost sacrilegious in modern society.

Furthermore, whilst a sense of 'moral obligation' is found to affect people's tendency to behave pro-environmentally (Steg et al., 2005) this varies between people, and also it cannot be assumed that perceptions about an obligation imposed by government will in any way be seen as the same thing as a personal moral obligation.

Moral obligation is, however, also related theoretically (as well as perhaps causally preceded) to a sense of responsibility for energy problems (Steg et al., 2005). Thus when PCT proponents speak of PCT enabling people to take responsibility for their emissions, this may indeed be a fruitful means of framing the introduction of this scheme. Again there is a subtle but important difference between being encouraged to take responsibility and being made to do so.

Inconvenience versus simplification

Even a relatively uncomplicated PCT scheme would require people to carry a carbon card, and/or register on a system, use their card on a regular basis, keep track of their balance, purchase more units when required etc. These aspects might be beneficial in a psychological sense of bringing carbon emissions more explicitly to mind than at present or compared to taxation, however there is a real risk that this could be seen unfavourably as a hassle, an extra demand on already busy people's attention and time. Such a negative perception could create opposition in advance of a scheme's introduction, and affect willingness to participate once introduced.

This is a difficult issue to get around; there is no doubt that many of the positive psychological benefits relating to attention and visibility at the same time create extra cognitive and time demands; but without making *some* demands on people's psychological resources, there is no point in even having such a scheme.

The flip-side to this is that through being able by design to equate a range of behaviours with the 'common denominator' that is carbon, a complex problem that at present confuses many people is made considerably simpler. Thus for anyone with even the slightest desire to 'do their bit' with respect to climate change, PCT represents a highly parsimonious and comprehensible scheme. The framing of PCT as an easy way of understanding and being able to act on one's personal contribution, is thus a potential means by which to pre-empt arguments against PCT that centre around its inconvenient nature.

Simplicity of a carbon currency is associated with universality; the idea that one unit of measurement can account for the environmental impact (in terms of carbon emissions at least) of everything from comparing the costs of driving versus taking public transport, choosing an energy supplier and monitoring home energy use, and even measuring the embedded carbon in a box of imported kiwi fruit or plasma-screen TV.¹¹

Proscription versus flexibility

Any 'command and control' legislation has the risk of being perceived in this way; in the case of PCT it might be felt that certain behaviours are being damned through attachment of large carbon prices. Particularly were aviation to be included in the PCT scheme, people could find a major new obstacle to their being able to take flights whenever they chose. This would appear particularly salient because, unlike the gradual accumulation of carbon costs in other areas, flying is done by most people on a fairly irregular basis.

The advantage of PCT on the other hand is that, whilst many actions have a carbon cost, one is free to spend carbon in any way within one's allowance. Thus there is no moral condemnation of driving 4x4s or flying (whatever people may think of these, they can be pretty much guaranteed to dislike being told they shouldn't do either); rather the point made that if the choice is taken to do these things, frugality might be necessary elsewhere. Choice is thus effectively encouraged by PCT – up to a point. Unlike in the case of taxation, there are no inevitable costs in PCT, it all depends how people choose to budget.

Initial research from Bath University, involving interviews with individuals involved in a voluntary carbon accounting and rationing scheme (see Appendix B), suggest that some people have indeed come to view a carbon accounting scheme in this way. Whilst many of those involved in the scheme are committed environmentalists, the perspective has been expressed that provided one keeps within the carbon limit, one is free to spend carbon however one wishes.

Interests of self and society

The contrast between self-interest and wider societal good could become a key reference point around which debates about PCT are shaped. Fully self-interested individuals would

¹¹ PCT schemes do not propose to include the last of these - embedded carbon - at this stage, though Starkey & Anderson (2005) refer to a hypothetical 'Rate All Products and Services' scheme in their discussion of PCT which may be a possibility in the future.

hardly be pleased to be required to participate in a PCT scheme, however where an alternative emphasis is placed on the social, collective aspects to PCT – “maximising collective intelligence and imagination” towards reducing carbon emissions (Roberts & Thumim, 2006) – this may help engender a more participatory perspective. It is well-established that people's tendencies to contribute to greater social goods, even beyond one's fair share, can be elicited through the right structural conditions (Fehr & Schmidt, 1999). The portrayal of PCT as a means by which society as a whole can achieve its emissions aims, and within which we can all play our part, seems a desirable option. Thus where Fleming (2005) refers to engendering 'common purpose' through PCT, this is an aspect to be emphasised in messaging.

As Lindseth (2004) points out in a discussion of the messaging associated with the international 'Cities for Climate Protection Campaign', framing can be used to effectively translate the expansive issue of climate change into a manageable, locally solvable problem; this should be an aim when portraying PCT.

Markets and morals

If a carbon currency shares all the characteristics of money as viewed by traditional economists (a unit of account, a store of value and so on) then carbon budgeting becomes a personal financial management issue like any other. The consequences of this are that one can 'spend' carbon by driving a 4X4 or taking a plane guiltlessly providing this is done within the budget. Depending on your point of view this can be seen as a strength as well as a weakness. Most economic psychologists would argue that it would be a good thing for a carbon currency to have non-utilitarian associations, giving people the opportunity to match their pro-environmental attitudes with their behaviour, fostering a 'moral economy'. It may be under these circumstances that people even choose to 'retire' some of their carbon altogether.

Summary and conclusions

Personal Carbon Trading remains a hypothetical and untested system, with very little direct and completed research able to inform psychological arguments for or against its institution. This contrasts markedly with the vast undertaking that would be the actual implementation of PCT.

This review has examined a range of empirical research and theoretical arguments from across psychology and related areas of social science. The studies considered for the most part have been conducted without reference to PCT as such, but are able to offer clues as to how PCT might be received and interpreted by people. Because it has been necessary to utilise indirect research, conclusions drawn by this study should be considered primarily to be propositions and predictions warranting further investigation.

The balance of evidence suggests that PCT would have different effects on people's carbon emissions behaviours than would pure price effects. Making carbon information explicit, visible and requiring to be managed and attended to by people presents opportunities for influencing behaviour not possible under a taxation or upstream trading system. A large body of research suggests that, where information relating to energy use is made more visible and related to energy-use behaviours, behaviour change in a pro-environmental direction can follow.

The way we think about financial and other resources influences our choices over and above the actual financial value placed on them. That PCT carbon allowances are made distinct as a resource separate from, but parallel to, normal currency has implications for their treatment. A new type of carbon budgeting and carbon conservation might be expected from the separating out of carbon in this way. By contrast, other research suggests that unearned income (of which carbon allowances might be considered to be a type) can be treated incautiously by people.

PCT has the potential to be aligned with new social norms of carbon-conserving behaviour. The inherent features of the scheme – that individual self-interest is restricted within a pre-specified limit for the 'greater good' – are commensurate with theory of how norms operate in social dilemmas contexts. It is a hugely ambitious task, however, to set about changing the norms of society, which cannot be assumed to be susceptible to influence by government-imposed programmes. There are, furthermore, risks of 'crowding out' (i.e. weakening) intrinsic, pro-environmental motivations through use of incentivised systems such as PCT.

The fact that many environmentally-significant behaviours are habitual, has presented a particular challenge to environmental psychologists attempting to change them. Research however suggests that incentives and contextual changes combined can be efficacious in changing habits – PCT may go some way towards achieving both of these conditions.

The conceptualisation of carbon as a 'parallel currency' as might be achieved through PCT, distinguishes PCT further from other policy options such as carbon taxation. The potential exists for a PCT carbon currency to prioritise and encourage desired functions such as environmental self-awareness and accountability.

Many of the psychological reactions to PCT are likely to be mediated by a range of framing and presentation effects. PCT has the potential to be perceived in various positive and productive ways (e.g. as a collective effort, an opportunity to exercise individual responsibility), but also in various negative and counter-productive ways (e.g. as a restriction on freedoms, an inconvenience).

Research underway and proposed should set out explicitly to investigate psychological aspects of PCT. Without a more substantial evidence base, many of the claims and speculations associated with PCT cannot be supported.

References

- Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2007). The effect of tailored information, goal setting and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, 27, 265–276.
- Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology*, 25, 273-291.
- Ajzen, I. (1991). The theory of planned behaviour, *Organizational Behavior and the Human Decision Process*, 50, 179-211.
- Arkes, H. & Hutzel, L. (1997). Waste Heuristic: The desire not to waste versus the desire for new things. In: M. Bazerman, D. Messick, A. Tenbrusel & K. Wade-Benzoni (Eds.), *Environment, Ethics and Behavior: The psychology of environmental valuation and degradation*. San Fransisco: Lexington Press.
- Arkes, H., Joyner, C., Pezzo, M., Nash, J., Siegel-Jacobs, K. & Stone, E. (1994). The Psychology of Windfall Gains. *Organizational Behavior & Human Decision Processes*, 59, 331-347.
- Armitage, C. & Conner, M. (1999). The theory of planned behaviour: Assessment of predictive validity and 'perceived control'. *British Journal of Social Psychology*, 38, 35-54.
- Atkinson, N. (2007). Personal Carbon Accounts. *Conservation in Practice*, 8 (1), 36-37.
- Bamberg, S., Hunecke, M. & Blobaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology*, 27, 190-203.
- Bamberg, S. (2003). How does environmental concern influence specific environmentally related behaviours? A new answer to an old question. *Journal of Environmental Psychology*, 23, 21-32.
- Bamberg, S., Rolle, D. & Weber, C. (2003). Does habitual car use not lead to more resistance to change of travel mode? *Transportation*, 30, 97-108.
- Beevers, S. & Carslaw, D. (2005). The impact of congestion charging on vehicle emissions in London. *Atmospheric Environment*, 39 (1), 1-5.
- Biel, A., Dahlstrand, U., & Grankvist, G., (2005) Habitual and Value-guided Purchase Behavior. *AMBIO: A Journal of the Human Environment*, 34 (4), 360-365.
- Biel, A., Eek, D. & Garling, T. (1999). The importance of Fairness for Cooperation in Public-Goods Dilemmas. In Juslin, P. & Montgomery, H. (eds.) *Judgement and Decision Making*. London: LEA.

Biel, A. & Thøgersen, J. (2007). Activation of social norms in social dilemmas: A review of the evidence and reflections on the implications for environmental behaviour. *Journal of Environmental Psychology*, 28, 93-112.

Black, J., Stern, P., & Elworth, J. (1985). Personal and contextual influences on household energy adaptations. *Journal of Applied Psychology*, 70, 3-21.

Bottrill, C. (2006). *Personal Carbon Trading: Excluding Public Transportation*. UK Energy Research Centre, London.

Bows, A., Mander, S., Starkey, R., Bleda, M. & Anderson, K. (2006). *Living within a carbon budget*. Manchester: Tyndall Centre for Climate Change Research.

Brandon, G. & Lewis, A. (1999). Reducing Household Energy Consumption: A Qualitative and Quantitative Field Study. *Journal of Environmental Psychology*, 19, 75-85.

Briesch, R., Krishnamurthi, L., Mazumdar, T. & Raj, S. (1997). A Comparative Analysis of Reference Price Models. *Journal of Consumer Research*, 24 (2), 202-214.

Campbell, M. (1999). Perceptions of Price Unfairness: Antecedents and Consequences. *Journal of Marketing Research*, 36, 187-99.

CarbonLimited (2007) The CarbonLimited Programme (briefing paper). RSA (Royal Society for the encouragement of Arts, Manufactures & Commerce). Available at http://www.rsacarbonlimited.org/uploads/documents/CarbonLimitedBriefingPaperOct06_6.pdf (accessed December 2007).

Cialdini, R., Reno, R. & Kallgren, R. (1990). A Focus Theory of Normative Conduct: Recycling the Concept of Norms to Reduce Littering in Public Places. *Journal of Personality and Social Psychology*, 58 (6), 1015-1026.

Clark, C., Kotchen, M., Moore, M. (2003). Internal and external influences on pro-environmental behavior: Participation in a green electricity program. *Journal of Environmental Psychology*, 23 (3), 237-246.

Collings, D. & Seldon, A. (2001). Conservatives in Opposition. *Parliamentary Affairs*, 54 (4), 624-637.

Darby, S. (2006a). *The Effectiveness of Feedback on Energy Consumption: A Review*. Oxford: Environmental Change Institute.

Darby, S. (2006b). Social learning and public policy: Lessons from an energy conscious village. *Energy Policy*, 34, 2929-2940.

De Young, R. (2000). Expanding and Evaluating Motives for Environmentally Responsible Behavior. *Journal of Social Issues*, 56 (3), 509-526.

De Young, R. (1996). Some psychological aspects of a reduced consumption lifestyle: The role of intrinsic satisfaction and competence. *Environment and Behavior*, 28, 358-409.

- De Young, R. (1993). Changing behavior and making it stick: The conceptualization and management of conservation behavior. *Environment and Behavior*, 25, 485-505.
- De Young, R. & Kaplan, S. (1986). Conservation behavior and the structure of satisfactions. *Journal of Environmental Systems*, 15, 233-242.
- Do Valle, P., Rebelo, E., Reis, E. & Menezes, J. (2005). Combining Behavioral Theories to Predict Recycling Involvement. *Environment and Behavior*, 37, 364-396.
- Dresner, S. (2005) *Distributional, Practical and Political Implications of Carbon Taxing and Trading*. Paper delivered at workshop run by UK Energy Research Centre. Cited in Starkey & Anderson (2005).
- Dresner, S., Dunne, L., Clinch, P. & Beuermann, C. (2006). Social and political responses to ecological tax reform in Europe: an introduction to the special issue. *Energy Policy*, 24, 895-904.
- Dwyer, W., Leeming, F., Cobern, M., Porter, B. and Jackson, J. (1993). Critical review of behavioural interventions to preserve the environment: research since 1980. *Environment and Behaviour*, 25 (3), 275-321.
- Evans, J. (2004). Bias in deductive reasoning. In R. Pohl (Ed.) *Cognitive Illusions*. Hove, UK: Psychology Press.
- Fawcett, T. (2004). Carbon Rationing and Personal Energy Use. *Energy and Environment*, 15 (6), 1067-1083.
- Fawcett, T., Bottrill, C., Boardman, B. & Lye, G. (2007). *Trialling personal carbon allowances*. Oxford: Environmental Change Institute.
- Fehr, E. & Schmidt, K. (1999). A theory of fairness, competition, and cooperation. *Quarterly Journal of Economics*, 114, 817-68.
- Ferrari, L. & Lozza, E. (2005) Psychological consequences on prices expectations of the currency as a unit of account. *Journal of Economic Psychology*, 26, 313–325.
- Fleming, D. (2005) *Energy and the Common Purpose: Descending the energy staircase with Tradable Energy Quotas (TEQs)*. London: The Lean Economy Connection.
- Fleming, D. (1997). Tradable Quotas: Using Information Technology to cap national Carbon emissions. *European Environment*, 7, 139-148.
- Fransson, N. & Garling, T. (1999). Environmental Concern: Conceptual definitions, measurement methods and research findings. *Journal of Environmental Psychology*, 19, 369-382.
- Frederick, S. (2003). Measuring Intergenerational Time Preference: Are Future Lives Valued Less? *The Journal of Risk and Uncertainty*, 26 (1), 39–53.

- Frey, B. & Stutzer, A. (2006). *Environmental Morale and Motivation*. Zurich: Institute for Empirical Research in Economics.
- Gabaix, X. & Laibson, D. (2006). Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets. *The Quarterly Journal of Economics*, 121 (2), 505-540.
- Gardner, G. & Stern, P. (2002). *Environmental problems and human behavior*. Boston: Pearson Publishing.
- Geller, E. (2002). The challenge of increasing proenvironment behavior. In R. Bechtel, & A. Churchman (Eds.), *Handbook of Environmental Psychology*. New York: Wiley.
- Gourville, J. & Simon, D. (1998). Payment Depreciation: The Behavioral Effects of Temporally Separating Payments from Consumption. *Journal of Consumer Research*, 25, 160-174.
- Greco, T. (2001). *Money: Understanding and Creating Alternatives to Legal Tender*. Vancouver: Chelsea Green.
- Hardin, G. (2006). The tragedy of the commons. In D. Kennedy (Ed.), *Science magazine's State of the Planet*. Washington: Island Press.
- Hardin, G. (1968). The tragedy of the commons. *Science*, 162, 1243-1248.
- Heath, C. and Soll, J. (1996). Mental accounting and consumer decisions, *Journal of Consumer Research*, 23, 40-52.
- Hendrickx, L. & Nicolaij, S. (2004). Temporal discounting and environmental risks: the role of ethical and loss-related concerns. *Journal of Environmental Psychology*, 24, 409-422.
- Hillman, M. (2006). Personal carbon allowances. *British Medical Journal*, 332, 1387-1388.
- Hillman, M., (2004), *How we can save the planet*, Penguin Books, London.
- Jackson, T. (2008). Sustainable consumption and lifestyle change. In A. Lewis (Ed.), *The Cambridge Handbook of Psychology and Economic Behaviour*. Cambridge: Cambridge University Press.
- Jackson, T. (2005). *Motivating Sustainable Consumption: a review of evidence on consumer behaviour and behavioural change*. A report to the Sustainable Development Research Network. Surrey: Centre for Environmental Strategy.
- Jakobsson, C., Fujii, C. & Garling, T. (2000). Determinants of private car users' acceptance of road pricing. *Transport Policy*, 7, 153-158.

Jonas, E., Greitemeyer, T., Frey, D. & Schulz-Hardt, S. (2002). Psychological effects of the Euro – experimental research on the perception of salaries and price estimations. *European Journal of Social Psychology*, 32, 147-169.

Kahneman, D. (1992). Reference points, anchors, norms, and mixed feelings. *Organizational Behavior and Human Decision Processes*, 51, 296-312.

Kahneman, D., Knetsch, J. & Thaler, R. (1990). Experimental tests of the endowment effect and the Coase-theorem. *Journal of Political Economy*, 98, 1325-1348.

Kaiser, F. (2006). A moral extension of the theory of planned behavior: Norms and anticipated feelings of regret in conservationism. *Personality and Individual Differences*, 41, 71–81.

Kaiser, F. & Gutscher, H. (2003). The proposition of a general version of the Theory of Planned Behaviour: Predicting ecological behavior. *Journal of Applied Social Psychology*, 33 (3), 586-603.

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and Social Psychology Bulletin*, 26, 328-338.

Kazdin, Alan E. (1982). The Token Economy: A Decade later. *Journal of Applied Behavioural Analysis*, 15, 431-445.

Keirstead, J. (2006). Evaluating the applicability of integrated domestic energy consumption frameworks in the UK. *Energy Policy*, 34, 3065-3077.

Kerr, N. L. (1995). Norms in social dilemmas. In D. Schroeder, (Ed.), *Social dilemmas: Perspectives on individuals and groups*. Westport: Praeger, pp. 31-47.

Kivetz, R. (1999). Advances in Research on Mental Accounting and Reason-Based Choice. *Marketing Letters*, 10 (3), 249-266.

Kluger, A. & DeNisi, A. (1996). The Effects of Feedback Interventions on Performance: A Historical Review, a Meta-Analysis, and a Preliminary Feedback Intervention Theory. *Psychological Bulletin*, 119 (2), 254-284.

Kollmuss, A. & Agyeman, J. (2002). Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8 (3), 239-260.

Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes*, 76 (2), 149-188.

Lewis, A. (1982). *The Psychology of Taxation*. Blackwell: Oxford/St Martin's Press: New York.

- Lietaer, B. (2001). *The Future of Money: Creating New Wealth, Work and a Wiser World*. London: Century.
- Lindseth, G. (2004). The Cities for Climate Protection Campaign (CCPC) and the Framing of Local Climate Policy. *Local Environment*, 9(4), 325-336.
- Lorenzoni, I., Nicholson-Cole, S. & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17, 445-459.
- McCaffery, E. J. (1994). Cognitive theory and tax. *UCLA Law Review*, 41, 1861-1947.
- McCaffery, E. & Baron, J. (2004). Framing and taxation: Evaluation of tax policies involving household composition. *Journal of Economic Psychology*, 25 (2004) 679–705.
- McCalley, L. (2006). From motivation and cognition theories to everyday applications and back again: the case of product-integrated information and feedback. *Energy Policy*, 34, 129-137.
- McCalley, L. & Midden, C. (2002). Energy conservation through product-integrated feedback: The roles of goal-setting and social orientation. *Journal of Economic Psychology*, 23, 589-603.
- McClelland, L., & Cook, S. (1980). Energy conservation effects of continuous in-home feedback in all-electric homes. *Journal of Environmental Systems*, 9, 169-173.
- McMakin, A., Malone, E., & Lundgren, R., (2002). Motivating residents to conserve energy without financial incentives. *Environment and Behavior*, 34, 848-836.
- Mazumdar, T. Raj, S. & Sinha, I. (2005). Reference Price research: review and propositions. *Journal of Marketing*, 69, 84-102.
- Muellbauer, J. (2005). UK Household Debt: A threat to growth or stability? *Economic Outlook*, 29 (1), 5-11.
- Nash, J. (1998). On the subversive virtue: Frugality. In D. A. Crocker & T. Linden (Eds.), *Ethics of consumption: The good life, justice and global stewardship*. New York: Rowman & Littlefield.
- Niva, M. & Timonen, P. (2001). The role of consumers in product-oriented environmental policy: can the consumer be the driving force for environmental improvements? *International Journal of Consumer Studies*, 25, 331–338.
- Nordlund, A. & Garvill, J. (2003). Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. *Journal of Environmental Psychology*, 23, 339-347.
- O'Curry, S. & Strahilevitz, M. (2001). Probability and Mode of Acquisition Effects on Choices Between Hedonic and Utilitarian Options. *Marketing Letters*, 12(1), 37-49.

- Ostrom, E. (1990). *Governing the Commons: The evolution of institutions for collective action*. Cambridge University Press.
- Owen, G. & Ward, J. (2006). *Smart Meters: Commercial, Policy and Regulatory Drivers*. Sustainability First.
- Pashler, H. (1998). *Attention*. Psychology Press.
- Peacock, M. (2006). The Moral Economy of Parallel Currencies: An Analysis of Local Exchange Trading Systems. *American Journal of Economics and Sociology*, 65 (5), 1059-1083.
- Peyton-Young, H. (1998). Social norms and economic welfare. *European Economic Review*, 42, 821-830.
- Reiter, S. M., & Samuel, W. (1980). Littering as a function of prior litter and the presence or absence of prohibitive signs. *Journal of Applied Social Psychology*, 10, 45-55.
- Roberts, S. (2004). *Consumer preferences for improving energy consumption feedback*. Centre for Sustainable Energy.
- Roberts, S. & Thumim, J. (2006). *A Rough Guide to Individual Carbon Trading: The ideas, the issues and the next steps*. Report to DEFRA from the Centre for Sustainable Energy.
- Ross, A. (2006). CRAGs: A Short Guide. Available at: <http://www.carbonrationing.org.uk/wiki/crags-a-short-guide> (accessed December 2007).
- Schultz, P. & Zelezny, L. (2003). Reframing environmental messages to be congruent with American values. *Human Ecology Review*, 10 (2), 126-136.
- Schultz, P. & Zelezny, L. (1999). Values as predictors of environmental attitudes: Evidence for consistency across cultures. *Journal of Environmental Psychology*, 19, 255-265.
- Schwartz, N., & Bohner, G. (2001). The construction of attitudes. In A. Tesser, & N. Schwarz (Eds.), *Intraindividual processes* (Blackwell Handbook of Social Psychology, Vol. 1). Oxford: Blackwell.
- Seyfang, G. (2007). Personal Carbon Trading: Lessons from Complementary Currencies. CSERGE Working Paper ECM 07-01.
- Shove, E. (2003). Users, technologies and expectations of comfort, cleanliness and convenience, *Innovation*, 16 (2), 193-206.
- Siemens, J. (2007). When Consumption Benefits Precede Costs: Towards an Understanding of 'Buy Now, Pay Later' Transactions. *Journal of Behavioral Decision Making*, 20, 521-531.

Sivester, R. (2006). An investigation into the feasibility and effectiveness of personal carbon trading in tackling carbon dioxide emissions. Unpublished Masters thesis: Imperial College London.

Sorrell, S. (2006). Submission to the Environment, Food and Rural Affairs Committee inquiry on *Climate change: citizen's agenda*. University of Sussex.

Staats, H., Harland, P. & Wilke, H. (2004). Effecting Durable Change: A Team Approach to Improve Environmental Behavior in the Household. *Environment and Behavior*, 36, 341-367.

Starkey, R. & Anderson, K. (2005). *Domestic Tradable Quotas: A policy instrument for reducing greenhouse gas emissions from energy use*. Tyndall Centre for Climate Change Research, technical report 39.

Steg, L., Dreijerink, L. & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN theory. *Journal of Environmental Psychology*, 25, 415-425.

Stern, P. (1999). Information, Incentives, and Proenvironmental Consumer Behavior. *Journal of Consumer Policy*, 22, 461-478.

Stern, P. & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, 50, 65-84.

Stern, P., Dietz, T., Kalof, L., & Guagnano, G. (1995). Values, beliefs, and proenvironmental action: Attitude formation toward emergent attitude objects. *Journal of Applied Social Psychology*, 25, 1611-1636.

Stern, S. (2005). Encouraging conservation on private lands: a behavioral analysis of financial incentives. *Arizona Law Review*, 48 (3), 541-584.

Sunstein, C. (2006). The availability heuristic, intuitive cost-benefit analysis, and climate change. *Climatic Change*, 77, 195-210.

Svenson, O., & Karlsson, G. (1989). Decision-making, time horizons, and risk in the very long-term perspective. *Risk Analysis*, 9, 385-399.

Tertoolen, G., van Kreveld, D., & Verstraten, B. (1998). Psychological resistance against attempts to reduce private car use. *Transportation Research Part A*, 32 (3), 171-181.

Thaler, R. (1999). Mental accounting matters. *Journal of Behavioral Decision Making*, 12, 183-206.

Thøgersen, J. (2006). Understanding repetitive travel mode choices in a stable context: a panel study approach. *Transportation Research Part A: Policy and Practice*, 40 (8), 621-638.

Thøgersen, J. (1999). The Ethical Consumer: Moral Norms and Packaging Choice. *Journal of Consumer Policy*, 22 (4), 439-460.

Thøgersen, J. (1996). Recycling and morality. *Environment and Behavior*, 28 (4), 536-558.

Thøgersen, J. & Møller, B. (2004). *Breaking car-use habits: The effectiveness of economic incentives*. Third International Conference on Traffic and Transport, Nottingham, UK.

Available at:

<http://www.psychology.nottingham.ac.uk/IAAPdiv13/ICTTP2004papers2/ITS/Thogersen.pdf>

Tora, B. (2004). Consumers have lost their fear of debt and borrowing is turning into a national pastime. *Money Marketing*, 8th May.

Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *Journal of Business*, S251–S278.

Tversky, A. & Kahneman, D. (1984) Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review*, 90, 293–315.

Tversky, A. and Kahneman, D. (1981). 'The framing of decisions and the rationality of choice', *Science*, 211, 453-458.

Tversky, A. & Kahneman, D. (1974) Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124-31.

Tyler, T. R. (1990). *Why People Obey the Law*. Hew Haven: Yale.

van Dijk, E. & van Knippenberg, D. (1996). Buying and selling exchange goods: Loss aversion and the endowment effect. *Journal of Economic Psychology*, 17, 517-524.

van Houwelingen & van Raaij (1989). The Effect of Goal-Setting and Daily Electronic Feedback on In-Home Energy Use. *Journal of Consumer Research*, 16, 98-105.

van Sambeek, P. and Kampers, E. (2004) *NU-Spaarpas: The sustainable incentive card*. Rotterdam: Stichting Points.

Verplanken, B. & Aarts, H. (1999). Habit, Attitude, and Planned Behaviour: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity? *European Review of Social Psychology*, 10,

Verplanken, B. & Wood, W. (2006). Interventions to break and create consumer habits. *Journal of Public Policy and Marketing*, 25 (1), 90-103.

Vlek, C. (2000). Essential Psychology for Environmental Policy Making. *International Journal of Psychology*, 35 (2), 153-167.

Whitmarsh, L., Kean, S., Russell, C. & Peacock, M. (2005). *Connecting Science: What we know and what we don't know about science in society*. British Association for the Advancement of Science.

Willhite, H. & Ling, R. (1995). Measured energy savings from a more informative energy bill. *Energy and Buildings*, 22, 145-155.

Wood, G. & Newborough, M. (2007). Dynamic energy-consumption indicators for domestic appliances: environment, behaviour and design. *Energy and Buildings*, 35, 821-841.

Appendix A. Suggestions for future research

We conclude this review by recommending an uncomplicated additional methodology by which insights can be obtained into the currently untested psychological aspects of PCT, and in the near future.

Experimental simulation comparing taxation and PCT

Research drawing on the behavioural economics paradigm is proposed to investigate whether people respond differently to carbon taxation and PCT. The hypothesis to be tested is that lower carbon choices will be made in a PCT condition, than a taxation condition, *even where financial costs are equivalent*. This is because participants will be required to attend more closely to data on carbon in a PCT scheme (availability effects) than in a (hidden) taxation scheme.

The simulation would test three future possibilities: control (no policy change), carbon taxation and PCT. The use of a computer simulation is proposed to evaluate and compare individuals' choices:

- Simulated carbon year comprising 52 responses over 52 'weeks' (alternatively a shorter version could be divided into fortnights, months etc.)
- Participants make personal spending choices according to budgets (provided and updated after each choice) and circumstances (narrative descriptions of various scenarios)
- Four conditions: control, visible carbon taxation, embedded (invisible) carbon taxation, PCT (visible carbon units)
 - The control condition would aim to be representative of real contemporary costs, e.g. for driving vs. public transport
 - The taxation and PCT conditions would comprise control prices + additional costs (tax or carbon units)
 - Taxation and PCT costs would be exactly the same financially, but framed differently
- Participants in the first three conditions will need to manage finances according to spending choices; participants in the PCT condition will be required to manage finances *and in addition a parallel carbon budget*
- PCT condition will contain components that mirror how a real system might work, including the necessity to be aware of carbon funds and to purchase more units where their allowance is used up

Table 2 illustrates how one such 'week' of this simulation might appear, contrasting the visible taxation, embedded taxation and PCT conditions. N.B. the 'C' under the PCT description refers to carbon unit currency (as in £ or \$).

Table 2: Comparing tax vs. PCT in a computer simulation

| Experimental condition | General description of circumstances | Condition-specific description | Condition-specific costs | Forced choice (select one option) |
|------------------------|--|---|--|---|
| Visible taxation | A number of social events are planned for this week, requiring travel to nearby towns. You have available to you a car, but can also look into taking local buses and trains (...) | The carbon tax for the following options are ... | Car only: £25 + £7.20 tax | 1. Travel by car to all events (most convenient) 2. Travel by car to some events, public transport to others (fairly convenient) 3. Use public transport (PT) only (inconvenient) |
| Embedded taxation | | | Car / PT mix £30 + £3.60 tax | |
| PCT | | No additional description | As above but embedded i.e. car only: £32.20... | |
| | Your current carbon balance is C3764. The carbon costs for the following options are... | Car only: £25 + 720 carbon units Car / PT mix £30 + 360 carbon units PT only £35 + 0 carbon units | | |

Appendix B. Current unpublished work and proposed research

As discussed in the review, in the case of PCT there has been almost no empirical research undertaken whatsoever to evaluate potential psychological aspects of the scheme. It seems hardly likely (or desirable) that such a scheme could ever get off the ground without at least some evidence base to inform the range of possible effects it might have.

Current and proposed research

RSA Carbon Limited

The largest research project examining PCT at the present time is the RSA Carbon Limited project (rsacarbonlimited.org.uk) which is considering PCT within a wide remit. Aspects under consideration include:

- technical aspects to the scheme (use of smart cards, IT database etc.)
- market and scheme design (how trading would actually operate)
- economic efficiency (including modelling economic impacts)
- public dialogue and debate

Carbon Limited has an online simulated trading exercise in operational development at the time of writing, with groups also being set up that are intended to use real financial (dis)incentives. No formal research findings have yet been forthcoming from this project, though are to be expected during 2008. It is also proposed that ideas for practical field-based research and development will be forthcoming during 2008.

Oxford University Environmental Change Institute

The Oxford Environmental Change Institute has also been very active in promoting the idea of PCT and in December 2007 published an extensive document (Fawcett et al., 2007) outlining the necessity for as realistic as possible a trial of PCT (here called personal carbon allowances, PCA). These authors propose that a PCA trial would:

- investigate participants' opinions of PCA
- monitor the effectiveness of PCA in motivating attitudinal and behavioural change
- assess which aspect of PCA motivated any attitudinal or behavioural change (e.g. feedback or economic effects)
- test structural aspects (e.g. allocation rights for children)
- consider implications for policy

The thrust of the Fawcett et al. proposals are for one of three large-scale trials. Given the level of detail and timescales concerned, were their proposed methodologies to be implemented this would no doubt become the primary testing ground for evaluating PCT. Set against this rigour, their 'basic' trial is costed at £500,000 and proposed to take 2.5 years; two further versions are costed at £900,000 and £950,000 and proposed to take 3 years each.

Reflections on RSA and ECI research

The proposed work of RSA and ECI will undoubtedly offer some of the most important contributions to date towards understanding PCT. However, only the latter programme

intends to research psychological aspects in detail, and the theoretical framework for this is largely unspecified.

The three-year timescale proposed by ECI is of some concern; given the unavoidably radical nature of PCT it is far from certain how prominent its place will remain on the political agenda by 2011. Given the range of potentially promising impacts PCT *could* have on reducing carbon emissions, it is clearly also important that it also receives research attention in the short to medium term.

Carbon Rationing Action Groups (CRAGs) – a real-life experiment with PCT

CRAGs are a loosely affiliated network of groups of concerned individuals involved in trialling versions of PCT. The organisation's guide (Ross, 2006) refers explicitly to a version of PCT (DTQs: Fleming, 1997); the guide also indicates key parallels between (intended) operation of CRAGs and PCT:

- allocation of individual carbon 'rations' with calculable monetary value
- formulae for conversion of energy use to carbon equivalent
- mechanisms whereby those exceeding carbon ration are penalised, and those using less rewarded

This 'real-life' version of PCT can offer important insights into aspects of PCT, despite limitations of self-selection of participants and how close autonomously evolving CRAG versions of PCT are to a formal, mandatory policy. This is because even within this quasi-experimental design, people are able to experience such facets of CRAG/PCT as 'learning a carbon currency' and developing personal awareness and responsibility for carbon emissions.

Research into CRAG experiences

Research initiated from within Bath university is looking at CRAG participants' experiences of the process. This is in its early stages, however contact has been established with three (of perhaps fourteen active) UK CRAGs and interviews are ongoing with members of these. A national survey is also planned, in collaboration with a member of one of the groups.

Interviews have thus far provided data about mode of operation of CRAGs, such as carbon allocation and targets. Comments from participants have suggested that participating in the process has heightened awareness and led to self-reflection about values, e.g.:

“I'd say you learn masses about where it is that you're wasting energy and emitting CO₂ in a way that isn't improving your quality of life at all and it makes you start thinking about what you really value...”

The function and value of carbon counting as an instrumental, non-moralistic means of regulating carbon has been referred to, with interviewees emphasising that CRAGs did not designate certain behaviours as 'wrong', rather that everything had a calculable carbon output (one stated that “you learn the currency”); in this way, for example, one individual was pleased to report they had been able to take a flight and yet stay within their group's carbon limit.

Carbon counting as part of the CRAG process has been suggested to have directly affected energy use, e.g. “we're fantastically more thrifty about the heating now because it's being carbon thrifty”. A perception of a relation between structural aspects of CRAG and

cognition has been emphasised: “once you start counting then you start thinking... and then you see what needs to be done”.

In response to direct questioning about participants' conceptions of engagement, aspects of individual responsibility and heightened behavioural control have been referred to: one person for example stated that engagement within CRAG was “about being an agent of your own [emissions] restriction rather than the state doing it directly through tax”.

Frequency of feedback has been associated with CRAG participation, for example regular recording of travel and meter readings. Group effects and social norms have also been referred to by participants (though this may be quite specific to the CRAG organisation). One person for example stated that “I don't want to be the one person who goes over [their 4500kg limit]”.

Appendix C. A comment on methodology

This review has used evidence and theoretical discussion from a number of disparate areas to suggest some of the likely effects of PCT on thinking and behaviour. This it is suggested lends important insights and from different research disciplines and paradigms. It is worth pointing out a number of the different presumptions and standpoints present within the range considered.

The feedback studies considered have in general tended to take a largely behaviourist approach to environmental issues. Within this research paradigm, the approach has generally been to 'intervene' e.g. within a household, and see what happens. Thus participants in studies may be provided with technological equipment that gives them additional data about their energy usage, such as smart meters, or various motivational techniques may be used, such as getting people to aim towards a goal/ target and ascertain what effects this has. As has been pointed out (Darby, 2006a,b) a theoretical framework has often been lacking in these approaches; it has been enough for many researchers to consider the outcome of behavioural change as being of primary importance. Where theory is constructed, this has tended to emphasise the effects of the interventions on getting people to learn about the consequences of behaviour (again, a fairly behaviourist perspective). Feedback/ intervention studies as described have tended to focus on home energy use, largely ignoring transport or other forms of energy/ carbon emissions.

The studies examining the roles of norms (and related factors such as attitudes to behaviours, beliefs, values, etc.) have by contrast developed some highly detailed theoretical frameworks to account for behaviour. In some cases, research has taken an intervention-based approach, but surveys are also widely used. In the latter case, members of the public are commonly sent questionnaires to ascertain beliefs, attitudes etc.; statistical models are then used to model hypothesised chains of causation of different variables. Work on the role of norms in Psychology does tend to be rather mechanistic, that is to assume that causal structures are in place by which, for example, values affect beliefs, which affect norms, which affect behaviour. These models can often seem rather rigid and inflexible, and practically achievable outcomes are sometimes hard to draw from them.

Work on mental accounting and 'bounded rationality' has its heritage in cognitive psychology and economics. Thus its concern is the way in which thinking about choices and probabilities occurs. The experimental approach is very common in research. Participants may be given a series of judgements or choices to make, based on the description of a situation. What at first sight can appear very concise and simple designs have been shown to reveal apparently powerful biases in reasoning. Behavioural economics has however been criticised for lacking a coherent theoretical framework; at worst, that findings are in effect a collection of oddities. The criticism can also be levelled, that simple experiments, often performed on undergraduate volunteers, are not necessarily representative of the population or real world at large.

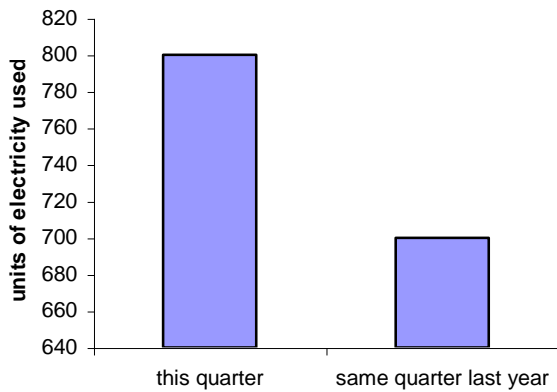
It is rare overall for studies to explicitly consider 'carbon' either as a factor influencing behaviour or as a factor in thinking. If in a scheme such as PCT the common denominator is to be a measure of carbon, it would be of value to determine how this could be conceived of differently by people, as studies from parallel currencies suggest it could.

Box 1: 'Informative billing'

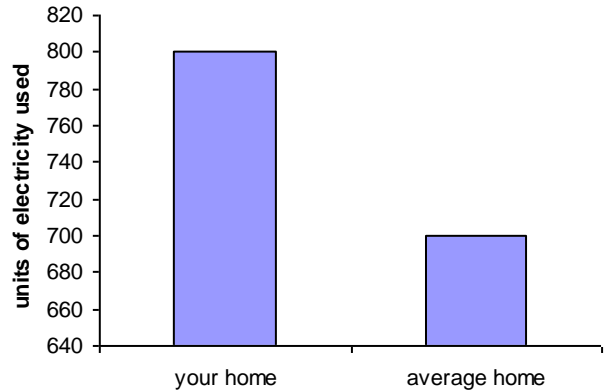
Informative billing – providing comparative and dis-aggregated data on home energy use – has been considered as a means by which feedback to consumers could enable energy reduction. Within a PCT scheme, such an approach could be used in an analogous fashion to provide feedback regarding carbon usage. (Energy charts adapted from Roberts et al., 2004.)

Informative billing: energy use...

Historical: How much electricity have I used?

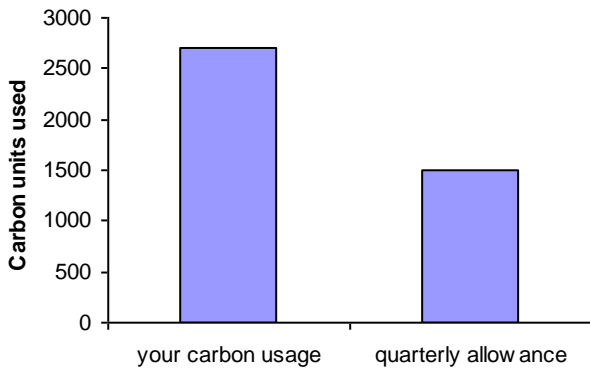


Comparative: How much electricity have I used?

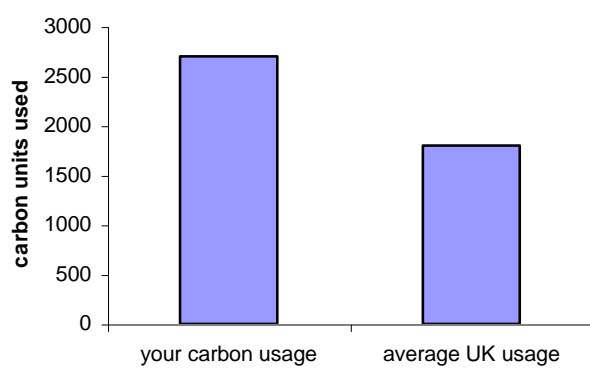


... and how this might work for carbon allowances

Usage and allowance: How much carbon have I used?



Comparative: How much carbon have I used?



How have I used my carbon this quarter?

