

Seyfang, Gill; Lorenzoni, Irene; Nye, Mike

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Personal carbon trading: Notional concept or workable proposition? Exploring theoretical, ideological and practical underpinnings

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Gill Seyfang¹, Irene Lorenzoni, Mike Nye

**Centre for Social and Economic Research on the Global Environment (CSERGE),
School of Environmental Sciences, University of East Anglia,
Norwich, NR4 7TJ, United Kingdom**

¹Corresponding author contact details:

**Tel: +44 (0) 1603 592956
Fax: +44 (0) 1603 593739
Email: g.seyfang@uea.ac.uk**

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Abstract

To effectively mitigate climate change in the long-term, limiting carbon dioxide emissions at the individual level has been proposed. Known as personal carbon allowances, these would be decreased year-on-year. Trading in personal carbon allowances would be encouraged, as a means to effectively and equitably reduce emissions overall. This conceptual paper aims to critically examine personal carbon trading (PCT) by questioning the assumptions underlying this proposal and identifying the gaps in current thinking. The paper first discusses the origin and development of the PCT idea, identifies key players and proponents of the proposal, and examines its economic basis as a market instrument. Drawing on lessons from several related areas of experience (the EU Emissions Trading System, voluntary Carbon Rationing Action Groups, and Complementary Currencies), these are used to examine likely success factors and inform future policy and implementation of PCT. A set of four critical issues are identified, which straddle political, social, economic, environmental, cultural and ethical domains, and which demand greater attention before the PCT idea can be progressed.

Key words: Personal carbon allowances, policy, climate change, mitigation, carbon management

1. INTRODUCTION

“[Imagine] we carry bank cards that store both pounds and carbon points. When we buy electricity, gas and fuel, we use our carbon points, as well as pounds. To help reduce carbon emissions, the Government would set limits on the amount of carbon that could be used.”

(Miliband, 2006)

The issuing of tradable personal carbon allowances to citizens is a recent policy proposal aimed at reducing carbon dioxide emissions from individuals, to enable year-on-year reductions to the overall national carbon budget and so mitigate climate change. The idea has been enthusiastically endorsed by key actors in the UK government, notably the Rt. Hon David Miliband, previous Secretary of State for Environment, Food and Rural Affairs (Miliband, 2006). Although some work is in progress to explore technical feasibility, legitimacy and acceptability issues (RSA, 2007a; Bottrill and Fawcett, 2007; Roberts and Thumim, 2006), to date there are no completed trials or studies exploring how such a scheme would work in practice.

Our aim in this paper is to critically examine the idea of personal carbon trading (PCT) from a range of perspectives and furthermore to develop areas of theory and potential practice which – we contend - have hitherto been somewhat uncritically accepted by commentators. We present a conceptual paper to open up a new field of inquiry, to identify the gaps in current thinking, and to problematise the assumptions underlying it. We achieve this by first discussing the origin and development of the PCT idea, identifying the key players and proponents of the proposal, and examining its economic basis as a market instrument. We then draw on lessons from several related areas of experience to the untried model of PCT (the EU Emissions Trading System, voluntary Carbon Rationing Action Groups, and Complementary Currencies), to examine likely success factors and inform future policy and implementation of PCT. On the basis of this discussion, a set of four critical issues are raised, which straddle political, social, economic, environmental, cultural and ethical domains, and which demand greater attention before the PCT idea can be progressed. We present our initial thoughts and set out a research agenda for a sophisticated analysis of the PCT idea, together with critical implications for climate change policy.

By asking difficult questions about this policy proposal, we intend to expose its implicit assumptions and reflect upon their accuracy and appropriateness, and identify the critical questions and issues at its heart. Is personal carbon trading a model of ecological

modernisation? Or is it rather a red herring, offering the false hope of an individualised market solution to a collective action problem?

2. PERSONAL CARBON TRADING: THE STATE OF KNOWLEDGE

A radical new policy proposal to mitigate climate change is to regulate carbon dioxide emissions through a system of tradable carbon allowances. Ideas of carbon quotas were put forward in the early 1990s by Mayer Hillman when head of the Policy Studies Institute environmental group (Roodhouse, 2007) and David Fleming who both envisaged progressively stricter carbon allowances as a plausible method of achieving large-scale cuts in carbon emissions.

Both conceptualisations derive from the global framework of Contraction and Convergence (C&C) proposed by the Global Commons Institute in the early 1990s (Meyer, 2000). Ensuring fairness and security, the proposal is to cap global emissions to stabilise atmospheric concentrations of greenhouse gases to a level that would prevent 'dangerous anthropogenic interference with the climate system'¹ (as per Article 2 of the UNFCCC, 1992). Such a cap would be reached by reducing emissions globally through time ('contraction'), by assigning emission rights to countries on a per capita basis. This would ensure that emissions eventually result in per capita emissions equal for each human being ('convergence').

The UK government has endorsed the principle of C&C. Following recommendations by the Royal Commission on Environmental Pollution (RCEP, 2000), the two most recent Energy White papers and the Climate Change Bill now going through Parliament enshrine the target of reducing national carbon dioxide emissions by 60% by 2050², thus acknowledging the seriousness of anthropogenic climate change and the need for urgent mitigative action, as reiterated recently by the Stern Review (2006) and the IPCC's Fourth Assessment Report (2007).

¹ Equivalent to atmospheric carbon dioxide concentrations equivalent of between 450 and 550 ppmv (parts per million volume).

² For the UK, converging towards the limit of 550 ppmv by 2050 implies reducing national CO₂ emissions by 60% by 2050, and by 80% by 2100, according to recommendations by the Royal Commission on Environmental Pollution. The Commission's analyses are centred on the need to stabilize atmospheric concentrations of carbon dioxide and reaching these by implementing a C&C approach, based on a globally equal per capita allowance (RCEP, 2000:2).

To implement C&C at the UK level, Hillman (2004) and Hillman and Fawcett (2005) developed the notion of personal carbon allowances (PCAs), whereas Fleming elaborated his original idea of fuel quotas into Domestic Tradeable Quotas (DTQs) and more recently Tradable Energy Quotas (TEQs) (Fleming 1996, 2005), also examined by Starkey and Anderson (2005).

Underlying all models is the notion that human sources of carbon dioxide emissions would be reduced and eventually stabilized at some established policy level by allocating emissions and allowing trading. One of the most striking differences between DTQs and PCAs is that in the former a policy scheme would manage all carbon emissions within the whole national (i.e. 'domestic') economy, thus covering all end-users purchasing fossil fuel based energy, including individuals, organisations and government. This quantity based 'cap-and-trade' system would set an overall UK carbon emissions budget for a given time period (based on achieving the stated government emissions reduction target), would auction off 60 per cent to businesses and the public sector, and would divide the remaining 40 per cent (representing household direct energy-related emissions) into a free and equal per capita allocation for all citizens.

On the other hand, PCAs only cover personal carbon emissions, without defining the structures that would need to exist to administer the scheme (Bottrill, 2006). Individuals would be allocated a certain amount of carbon dioxide emissions³ (or carbon allowances or carbon credits), which could be traded within a compulsory scheme ('personal carbon trading' or PCT). One way of visualising such a scheme is to consider it as a downward extension of the European Union (EU) 'cap and trade' Emissions Trading Scheme which – although voluntary - currently applies to specific installations within the EU.

There are three key elements to PCT, namely setting the national carbon budget, setting individual allowances and surrendering allowances, which Bottrill outlined in 2006. Both PCA and DTQ models propose that carbon credits might be stored on a 'smart card', and be spent alongside money when purchasing fuel or energy. In essence, it is the creation of a new form of national currency, based on carbon, which would be used by all citizens either explicitly (surrendering carbon units when paying bills) or implicitly (carbon costs being incorporated into petrol pump prices, for instance). Allowances will be tradable, and high-energy users will need to purchase additional carbon credits, while low-energy users will be able to sell their surplus credits for profit; each year the overall budget will be reduced.

³ Although scientifically incorrect, carbon dioxide emissions in the context of personal allowances and trading are often referred to in the literature as simply 'carbon emissions'.

Furthermore, the costs of embedded carbon in other consumer goods and services will be included in market prices (passed down from producers and retailers). Long-run carbon budgets allow individuals and businesses to plan for future restrictions in carbon allowances, creating an incentive system to encourage adaptation towards a low-carbon economy, rewarding those who adapt early in switching to low-carbon energy sources and reducing energy demand through conservation and efficiency measures.

Models also vary in other details such as what precisely is included in the allocation (e.g. public transport) and how children are accounted for (e.g. no allowance for children, or a half-allowance). Roberts and Thumim (2006:3) assert: “the differences between the schemes appear to be less important at this stage than the largely untested assumptions shared by them all about public response and political feasibility”.

The benefits of PCT over regulation and taxation, according to Fleming, are that it allows flexibility of response, it engages a sense of common purpose and active citizenship (in contrast to taxation which breeds resentment, as seen with the fuel tax escalator in the UK which prompted fuel blockades), and that it offers the certainty of a predefined cap on emissions. These proposals were examined in depth by climate change researchers at the Tyndall Centre for Climate Change Research, who found the tool to be potentially more effective, more equitable and more empowering than traditional policy measures of taxation, information and regulation, for the following three reasons. First, low-income households tend to be low-energy users, and would benefit financially from selling their surplus credits, whereas high-income households are more able to afford the extra cost of purchasing additional carbon credits. Second, by engaging with individuals at the household level, PCT encourages a bottom-up adaptive process, whereby individual actions for carbon reduction have immediate personal effect. Third, by allowing individuals to respond to the price signals flexibly, it allows people to choose and make trade-offs between different sources of carbon emissions – e.g. between running a tumble drier, and taking personal flight – and between different carbon-reduction options – e.g. between fitting double-glazing and installing a solar water-heater – to achieve the same overall goals (Starkey and Anderson, 2005).

Although often criticised for not being acceptable, the idea of carbon allocations – originally proposed by individuals associated with environmental organisations, then taken up by academics – is slowly gaining political attention and permeating policy spheres. A Private Member's Bill to establish a domestic trading system for carbon dioxide emissions was introduced by the Labour MP Colin Challen (2004). The notion of tradeable PCAs was promoted and publicly discussed in 2006 by the Secretary of State for Environment, Food

and Rural Affairs, David Milliband. DTQs were recently billed by the Sustainable Development Commission as a “virtually guaranteed” way of reducing household emissions significantly as a contribution towards the 60% CO₂ reductions by 2050⁴ (Clover, 2007). The previous minister for the environment, Elliott Morley, categorised the scheme within the realm of ‘thinking the unthinkable’ suggesting that this may be a way of encouraging individuals to actively contribute towards climate change mitigation, although uncertainties and reservations concerning the practical aspects of the scheme are being discussed and researched. Anecdotal evidence suggests the business sector also supports PCAs and PCTs, given its focus on individual action.

Currently the UK House of Commons Environmental Audit Committee is undertaking an inquiry into Personal Carbon Allowances. The first evidence session was held on 10 July 2007. PCAs are part of the UK Green Party’s policy on climate change, whereas the UK Lib Dem party support contraction and convergence, but through a carbon tax. Bottom up interest in ‘carbon rationing’ and contraction and convergence as expressed by the Carbon Rationing Action Groups (CRAGs), has resulted in the posting of an e-petition urging the British PM to adopt these. The Institute of Public Policy Research are currently assessing the advantages and disadvantages of personal carbon trading; the RSA (2007a) will be piloting PCAs on a voluntary basis with 2,000 people who have logged their emissions, and are even exporting their Carbon *Limited* project on the functioning and impacts of a Personal Carbon Trading (PCT) scheme to the US in the autumn of this year. PCAs are now included within the gamut approaches for workable systems to carbon reduction even reports for business on public perceptions of climate change (AccountAbility and Consumers International, 2007) and as the sole option within a TEQ for eliminating Britain’s carbon emissions by 2027 (CAT, 2007). The economics think-tank Feasta are issuing prototype “Citizen’s Emissions Entitlements” as part of their Cap and Share campaign to raise awareness of the concept. The Fair Shares Fair Choice have produced “the world’s first personal carbon card” – albeit of cardboard- as part of a DEFRA-funded initiative, and consultancy Design Stream are planning a card that will make its users aware of the environmental impact of their shopping (Shrubsole, 2007a).

2.1 Economic rationale

The economic rationale behind carbon trading is fairly straightforward and empirically well established, at least in terms of neo-classical economic theory (see Dales, 1968, Baumol and Oates, 1971). A carbon-trading scheme limits the ‘supply’ of emissions by creating

⁴ Supported by the three major UK political parties and the Greens.

standardised emissions allowances. Scarce allowances become valuable commodities, which can be traded on an emissions market or transferred between participants. The addition of a carbon market equalises the maximum marginal abatement cost for all participants whilst offering an added dimension of flexibility to compliance options (Joskow et al, 1998). This flexibility offers the potential to reduce emissions at lower cost than what could be achieved with less flexible, mandated standards.

Ideally, carbon abatement or purchasing decisions are made using the market price for carbon as a price signal. It is generally assumed that participants will behave in a rational manner, choosing the least cost method of compliance. Such assumptions about the behaviour of participants reflect a degree of faith in neo-classical economic rationality on the part of participating individuals. However, it may be imprudent to assume (at least so hastily) that a synthetic, market-based *policy instrument* would function in the same manner as a 'free market' (see Nye, 2007) or that participants in the former would and could behave as *homo economicus*, and so take advantage of market flexibility and the cost effectiveness it can provide. This latter point is especially important in the context of the issues discussed in this paper. Recent study into financial capability for example indicates that although most people in the UK are competent at 'making ends meet,' almost half are unable/ unwilling to plan for the future and that there is "wide variation" in the degree to which people stay informed about things which are likely to affect their finances (Atkinson et al, 2007: 33). Research on corporate participation in emissions trading also indicates that participants may lack the skills and knowledge to maximise their utility in a carbon market (Nye, 2007).

For instance, under a PCT system, it is assumed that a commuter choosing whether to take the train or to drive to work would compare the cost of taking a train to the market value of permits that would need to be surrendered or purchased alongside the purchase of petrol, and choose whichever transport mode was cheapest. This is clearly an overly simplistic example, because it does not account for factors like transaction costs or price fluctuations, which can distort the accuracy and trustworthiness of the market price signal. More importantly, it does not account for the 'bounded rationality' (see Simon, 1955) of scheme participants who may (among other 'irrational' activities) discount future costs, irrationally hoard emissions allowances, or simply lack the up-to-date information and procedural knowledge to make a strategic price comparison.⁵

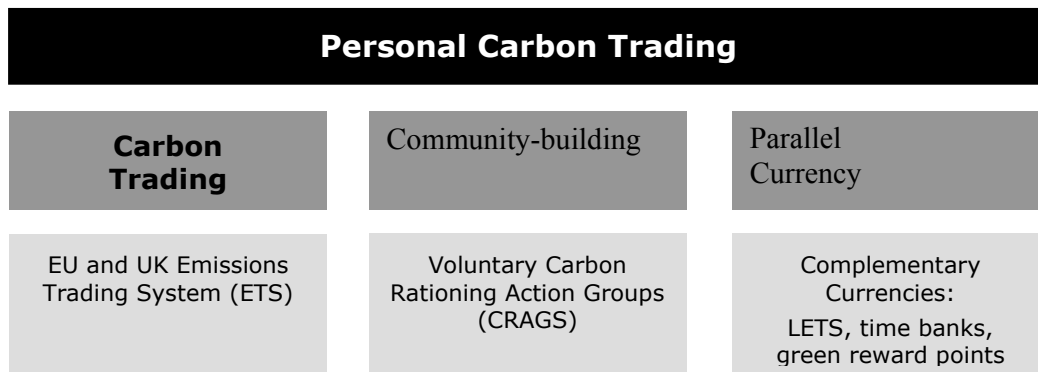
⁵ See also Tversky and Kahneman (1986) or Rabin (1998) for a discussion of more generalised 'irrational' behaviour in regards to financial decision-making.

When broken down in this manner, it becomes apparent that even the most 'basic' decisions within a carbon-trading scheme hinge on a fairly complicated and interrelated set of economic, knowledge-based and cognitive factors.

3. LEARNING FROM RELATED EXPERIENCES: WHAT DO WE ALREADY KNOW?

Given that existing knowledge of PCT is based on theoretical models rather than empirical evidence, we argue that an examination of lived experience will throw important issues into relief, to help develop theory and understanding of PCT. We consider areas where key facets of PCT have already been implemented through different initiatives in recent years, and draw from these experiences transferable lessons for theoretical and practical contributions to PCT. Figure 1 illustrates three key activities (carbon trading, community-building and new currencies), which incorporate elements of a PCT scheme, and the case studies we briefly examine⁶.

Figure 3.1: Aspects of Personal Carbon Trading and examples of related experiences.



Note: LETS (Local Exchange Trading Schemes)

The concept of Personal Carbon Trading (PCT), by centring on an overall reduction of carbon emissions through individual allocation and trading, has often been referred to as 'rationing' (e.g. Hillman and Fawcett, 2005; Adam, 2006; Clover, 2007; CRAGs, 2007). Although the term accurately describes the purpose of PCT, it is nevertheless avoided by PCT advocates for its assumed negative connotations of wartime scarcity, curtailment of

⁶ Other lessons could be drawn, for instance, from comparisons with the introduction of decimal currency in the UK; with the conversion to the Euro in continental Europe; with the IT systems required to record millions of supermarket loyalty point transactions every week.

personal freedom (Dresner, 2005) and government control. Alternatives such as 'allowances', 'quota' or 'entitlement' are generally preferred (Miliband, 2006; Hillman, 2006). Public acceptance of rationing during the Second World War was based on trust in the government administration of fair scheme suitable for purpose, evasion being swiftly punished. The promotion of wartime rationing based on the strict fairness of shares for all helped to foster support for the scheme (Roodhouse, 2007).

A much more recent example of rationing is Cuba, where during the 1990s the Cuban government allocated food and fuel rations as a means of coping with the radical changes imposed by the demise of the former Soviet Union. We recognise that the island's political, geographical, historical, and social characteristics differ considerably from those of the UK. Nevertheless, despite the special circumstances specific to Cuba, we propose that the changes to household relations and intra-household allocation issues raised by the Cuban experience may be of relevance in terms of informing a PCT. During the 'special period' resource use generated gender imbalances: Pearson (1997) found that women increasingly expressed concern for, and tried to satisfy the basic needs of, other members of the family (children, elderly) before themselves. As adjustments to consumption expectations occurred, people's activities were reduced to those of the family and households. Secondary incomes were also extended in conjunction with activity on the black market. Some argued this presented an opportunity for individuals and family groups to take responsibility for their own livelihoods and creatively develop networks and roles that would lead to the establishment of a "more autonomous civil society" (e.g. Secade 1994, in Pearson 1997: 701). Similar issues, instigated by resource limitations, also emerge from the three examples discussed below.

3.1 *Experience with existing carbon trading schemes*

Research on carbon trading in other contexts also provides some important insights as to how participants might behave in a carbon market, and how a carbon market might operate in a practical sense. The most studied, and perhaps best understood, example of emissions trading in practice is that of ongoing the US sulphur dioxide (SO₂) trading scheme. The scheme began in 1996 and cover edissions of sulphur dioxide from coal fired electricity plants. The development of the US SO₂ market has generally been regarded as a successful transition to a well-traded and efficient market (Kruger, 2005). However, the early years of the SO₂ scheme were marked by fairly dismal market performance (Schmalensee et al, 1998), and in particular, a lack of trading volume due to over-compliance, inexperience and unfamiliarity with the trading mechanism, and self supply or fuel switching on behalf of participants (Ellerman et al, 1997, McDermott, 1997, Bohi and Burtraw, 1997).

Industry-level emissions trading programmes elsewhere have arguably met with less success. The UK Emissions Trading Scheme (2002-2006) was heavily criticised because the voluntary, incentive-based scheme designed to reduce CO₂ emissions from key industries attracted fairly undemanding targets overall (NAO, 2004, ENDS, 2002) which required little, if any, operational commitment from participants (Roeser and Jackson, 2003). Similarly, the current cap and trade EU Emissions Trading Scheme (into which the UK ETS was subsumed), has been criticised as delivering very little in the way of actual emissions reductions because the initial national allocations are, on the whole, too accommodating (Matthes et al, 2005; Ecofys, 2004, Betz et al, 2006,). This is due in no small part to a lack of good quality data for estimating emissions levels and for creating accurate and robust national allocation plans in almost all member states (e.g. Buchner et al, 2006; Ellerman and Buchner, 2007). These experiences suggest that carbon markets may take time to develop (in terms of participants behaving 'properly') and reinforce the idea that allocation issues can make or break a trading scheme.

Findings like these raise two important considerations for the design and successful functioning of a PCT scheme. Firstly, it is important to recognise that markets take time to develop. Initially, participants may be 'irrationally' reluctant to utilise the trading mechanism for compliance or, more commonly, may lack the skills and knowledge to use the market effectively as a price signal. Either of these user-based failings can seriously erode the flexibility, and hence the cost savings, that could be achieved with a trading scheme as opposed to 'command and control measures (e.g. Ellerman et al, 1997, McDermott, 1997). Secondly, the level of the cap, and the initial allocation of permits appear to be a crucial factor in governing the longer-term liquidity and general environmental and economic health of a trading scheme. The cap must be environmentally robust and allocated emissions levels must go beyond business as usual to avoid oversupply, market power, perverse windfalls, and poor demand for permits (see Godby, 2002 Cramton and Kerr, 2002).

3.2 Experience with voluntary Carbon Rationing Action Groups

Carbon Rationing Action Groups (CRAGs) are community-based groups who agree to reduce their carbon footprints through creation of individual carbon targets. Over 30 groups have been created in distinct communities across the UK (CRAGs, 2007). The members of each CRAG decide on a CO₂ target per person at the beginning of a 'carbon year' and the price per kg of carbon (usually in excess of current EU ETS prices, to reflect the CRAGs

purpose of making a key contributor to climate change directly tangible for individuals)⁷. Each Cragger records his / her personal carbon emissions from air and car travel plus home energy use (electricity and heating), using the same metrics. At times the services of 'carbon accountants' are used to keep track of these. At fixed dates members share their results with others in the group. At the end of the year, members exceeding the agreed personal target pay a financial penalty for non-compliance, i.e. price per kg of emissions above target. Penalty monies are paid into a bank account and then redistributed to Craggers who saved carbon as agreed by participants. The CRAG system was developed to achieve carbon reductions through increasing personal knowledge, facilitating emissions reductions through a simple measuring system, socially encouraged and supported.

Two main goals of the CRAG system are to make individuals more aware of their carbon emissions and to build cohesion or a sense of support amongst like-minded individuals in a particular community (CRAGs, 2007). The latter goal includes both encouraging others to remain committed to a low carbon lifestyle, and sharing knowledge with others about how to do so more effectively. As Shrubsole (2007) explains: "You feel encouraged that others are doing this too; individual actions are less isolated and seemingly pointless. You also feel a little pressurized to meet your target." Such social diffusion of both practical knowledge and commitment to action could prove to be particularly strong drivers for a change in emitting practices. Studies of other environmentally significant practices (notably recycling) indicate that pro-environmental behaviour can be encouraged through public commitments (e.g. Oskamp 1991) and perception of a strong pro-environmental norm amongst the community (Hopper and Nielson, 1991).⁸

The CRAG system essentially works as a pricing instrument, in that the financial penalty is set iteratively and there is no absolute cap on overall emissions. A drawback could potentially arise when all Craggers are in credit, having saved emissions (Shrubsole, pers. comm. 2007). In this sense, the mechanisms of CRAGs are somewhat different to those in a cap and trade emissions trading system like PCT. Nevertheless, there are some important elements of overlap between the two schemes, particularly in regards to carbon awareness

⁷ In terms of emissions from multi-individual households, the CRAGs guide suggests that each individual should bear proportional responsibility for the household's emissions (e.g. if four people live in the house, an individual's carbon ration would cover a fourth of the household's emissions, no matter how much each individual contributed to the total). An individual would also have to include within their ration any carbon emissions produced by the use of a mode of transport solely owned by him / her (CRAGs, 2007).

⁸ No specific criteria exist to measure CRAG success. However, discussions amongst Craggers in August 2007 identified the following key elements: social support, simple joining instructions; and easy carbon accountability. Aspects that have caused CRAG groups to fold include divergence in opinions about discussion topics, purpose and management of financial penalties.

and capability both for individuals, and amongst the wider community, social learning, building a sense of 'common purpose' and mutual support.

More importantly, the focus on community-building and social learning inherent in CRAGs highlights what may be a serious gap in the current set of assumptions about PCT systems. As mentioned previously, PCT assumes a rational, atomistic, *homo economicus* at the core of an emissions market in which all emitters face the same marginal abatement costs, but not the same opportunities/ options for abatement. In the domestic case, differing options for abatement are heavily determined by surrounding infrastructure and systems of provision. Individuals can only do what local transport systems, recycling facilities or energy infrastructures allow them to do in terms of abatement or conservation. Accordingly, there is an element of locally-relevant knowledge necessary for the smooth operation of a PCT scheme. Without knowledge about how to achieve emissions reductions in specific places and spaces, the individual is left with a drastically reduced set of generalised and fairly unattractive emissions reduction options based on curtailment. A successful PCT system will place greater responsibility on community leaders to disseminate practical and locally relevant knowledge for change in a way that can be easily understood and correctly applied by others.

The CRAG system could be considered the first voluntary experimental trial of personal carbon allowances and trading, albeit in a very confined and limited 'market' composed of members within a group trading once or twice a year. Most Craggers support the idea of nationwide personal carbon rationing and trading nationwide. It is therefore possible that the CRAGs could develop to trade emissions between groups between settlement periods although "having sufficient foresight and financial literacy, of course, is tricky." (Shrubsole, pers. comm., 2007).

3.3 Experience with complementary currencies

Complementary currencies (CCs) are new systems of exchange (or parallel currencies), which operate alongside conventional money and have been rapidly growing in number since the 1990s in both developed and developing countries. The term includes commercial schemes such as air miles and supermarket loyalty points, as well as community-based initiatives with economic development, social justice and environmental protection objectives such as Local Exchange Trading Schemes (LETS), Time Banks and green reward points (DeMeulenaere, 2007; Seyfang, 2006). The rationale for CCs is that 'money' is a socially-constructed institution which carries with it specific incentives and inherent characteristics to promote particular types of behaviour. For instance mainstream money values some types of

labour and not others, values scarcity, promotes competition, and externalises certain costs. CCs are specifically designed to meet objectives which mainstream money neglects (Lietaer, 2001; Boyle, 2002). While the scope, scale and development of CCs and PCT are vastly different, there are a great many similarities between the models, and lessons to be learned. Carbon trading is clearly introducing carbon as a new, parallel currency (a medium of exchange and a unit of account, if not a store of value) to be issued and spent alongside conventional money – it is a CC. Furthermore, like other CC systems, PCT is designed and structured in a particular way in order to achieve a particular goal which mainstream money cannot adequately address – in this case, carbon emissions reductions. Given this fundamental similarity, what lessons can be gleaned from experience with CCs?

A comparative analysis of a diverse range of CCs with social, economic and environmental objectives by Seyfang (2007) reveals five critical success factors for CC development which are likely to be of central importance to the successful adoption and effectiveness of PCT. First, a supportive policy context is essential for ensuring top-down support and resources, but lack of ‘joined-up thinking’ can result in policy barriers. For example, while some CCs aim to tackle social exclusion and reach out to the most marginal groups in society with an accessible model of informal employment and social support, state benefit regulations can penalise the most disadvantaged groups from participating, by considering those people to be unavailable for work, or earning (cashless) income. Second, a supportive social context is required for a CC to thrive; the most successful projects work either in small groups where personal contact is quite high and people get to know each other, such as a Time Bank, or else in wider more anonymous systems where the overall societal culture is conducive to the activities encouraged by the CC, such as the Dutch green reward points. Third, the mechanisms a CC uses must be easy to understand and use, credible, and convenient if it is to become mainstream. High transaction costs (from personal interaction) and unfamiliar technologies are off-putting; smart-cards and loyalty points are common systems today, and the Dutch system successfully utilises this technology. The system must also be well-designed to avoid hoarding, low-trading levels and stagnation which are natural consequences of people’s lack of faith in the system, and an inability to use the initiative to purchase the goods and services they require – known as a ‘skills gap’ in LETS and Time Banks. Fourth, the skills and capabilities of participants are critical to CC success. Many smaller community-based CCs require intense social interaction and regulation (c.f. anonymous mainstream money), and others trade in new and unfamiliar units such as time. Larger systems adopt more modern modes such as loyalty-points and smartcards, with which people are already skilled and comfortable. The credibility and usability of these currency items are vital to their wider success, and imitating the presentation and tools of the

mainstream economy mitigates against marginalisation. Finally, CCs succeed best when they harness the energy of collective action. For many LETS and time banks members, for instance, the empowering act of co-creating new social institutions (which express alternative values) is the biggest benefit of participation. These currency initiatives are at least as concerned with social goals as with economic ones.

4. DISCUSSION: CRITICAL ISSUES FOR PERSONAL CARBON TRADING

Building on our initial description of PCT theory, and drawing evidence from our three related areas of experience above, this section examines a series of critical issues around the theory and potential practice of PCT. We argue that these represent a set of key questions around aspects of PCT – which relate to much wider issues around societal responses to climate change - have previously not been adequately researched. In this section, we explore the bounds of some of the deeper methodological, social and economic issues raised by the characteristics and requirements of contexts in which a PCT would operate. We ask those questions and consider ways in which they might be answered.

4.1 Developing carbon capability

The preceding section discussed how the proposed system of PCT is akin to introducing a new carbon currency; here we extend the analogy further and consider how consumers need to be as skilled in handling carbon as they do with money. Indeed, there are the same driving forces, and comparable consumer issues with both, requiring a holistic approach to learning about sustainable consumption in both financial and resource terms.

Excessive levels of material consumption in developed countries is widely acknowledged as a principal cause of unsustainable development: if the whole world consumed at the rate of North Americans, we would need five Earths to supply the resources (Simms, 2006). Yet beyond basic necessities, this growth in consumption is not matched by increases in well-being or happiness – what Jackson terms the ‘well-being paradox’ (Jackson, 2007). Several explanations have been put forward for this, ranging from psychological and social theories about the importance of relative rather than absolute affluence (Ropke, 1999; Jackson 2007.) to more structural theories such as the capitalist economy’s need for continual expansion (Daly, 1992). In all cases, an outcome is a growth in consumption which threatens the viability of foundational Earth – and eco-systems. Another outcome is increasing consumer spending – financed by borrowing - and over-indebtedness, representing in itself a profound

cultural shift over the last couple of generations. Dixon (2006:1) suggests that “our society has moved from a ‘thrift ethic’ where people limited their consumption of goods to what they could afford at the time, to a ‘consumption ethic’, where people buy now and pay later” and furthermore are considered ‘good citizens’ for doing so.

This ‘credit culture’ has been fuelled by the consumption pressures outlined above, and enabled by deregulation of, and technological changes in financial institutions, and is doubtless the foundation of the current period of economic success in developed nations (Cohen, 2007). But arguably the sheer intangibility of credit finance (dealing less and less with hard cash and more with abstract balances) has also contributed to its widespread acceptance, bringing attendant social problems. In the UK, almost one in ten households finds its unsecured debt a ‘heavy burden’ and during 2005/6 there was an increase in households with mortgage arrears, house repossessions, credit card arrears and personal insolvencies. The forecast for 2006/7 was for ‘a more challenging year’ for consumers (DTI, 2006:9), a prediction which appears to have been realised as a result of steadily rising interest rates. Given the state’s reliance upon this model of economic development, government’s response to this has been to emphasise the responsibility of individuals to navigate this perilous financial market successfully, and to promote ‘financial literacy’ (also referred to as financial capability, to imply actions as well as knowledge) as a basic skill requirement for financial inclusion. Binkley (2006) describes this as a ‘governmentality’ model, whereby a deregulated economy is governed not by government, but rather by individual producers and consumers’ self-restraint and competences. In the increasingly intensive consumer realm, “it is increasingly imperative that one know how to expose oneself to seductions without surrendering to them entirely” (witnessed in the pathology of shopaholism) especially given “the impenetrability of consumption behaviours by rationalities of self-control developed in other realms” (Binkley, 2006: 345, 356).

Everything that has been said here about consumption and financial behaviour is equally applicable to the consumption of energy and its embedded carbon. It too is an abstracted concept, intangible and unfamiliar to the consumer. Consequently, we can begin to discern a need for new skills and capabilities to engage with the new carbon currency and understand its full ramifications. How is this need addressed in the PCT literature? While the major PCT writers acknowledge that major awareness-raising campaigns will be needed to ensure public acceptance of PCT, they nevertheless claim that “understanding [PCT] is not a prerequisite for using it” (Starkey and Anderson, 2005: 30). The presumption appears to be that simply introducing the carbon trading system will be sufficient to redirect (rational, utilitarian) consumer decision-making towards low-carbon behaviour. Consumers could

legitimately sell their allowances immediately, and ‘pay as they go’ instead, without directly engaging in carbon budgeting at all – albeit paying more for the privilege (Fleming, 2005). However, previous experience with both complementary currencies and with the ETS demonstrates that participants’ skills, capabilities and confidence in the new carbon currency are crucial to its success. Some advocates claim that using PCT will be a technically trivial matter, almost invisible in everyday transactions, but the deeper issue of genuinely understanding and managing carbon budgets – an intangible concept and a previously externalised cost – is an unacknowledged and undeveloped competency. The challenge is therefore to identify the range of skills, which are required for PCT to achieve its objectives of inducing behaviour change towards carbon reduction – which we term ‘carbon capability’ as an analogue of financial capability.

Financial capability can be defined as “the ability to make informed judgements and to take effective decisions regarding the use and management of money” (National Foundation for Educational Research, quoted in AdFLAG, 2000 para 4.2). A recent study for the UK’s Financial Services Authority established indicators of financial capability and conducted a baseline survey to measure levels of financial capability in the UK population. It covered four key areas of attitudes and practice: managing money (living within one’s means and keeping track of finances), planning ahead (e.g. for retirement), choosing products (knowledge, attitudes to risk, behaviour and confidence) and staying informed (about the economy, products and sources of advice) (Atkinson et al, 2006: 4-5).

Translating these concepts and techniques into carbon management, ‘carbon capability’ can be defined as:

the ability to make informed judgements and to take effective decisions about behaviour so as to manage down the emission of greenhouse gases expressed as carbon equivalents (hereafter referred to as carbon), through both individual behaviour change and collective action.

Carbon capable individuals will have a good grasp of the causes and consequences of carbon emissions, the role they themselves play in producing them, the scope for adaptation and reductions in one’s personal life and what is possible through collective action, how to manage a carbon budget, where to get help and information, and so on (Roberts and Thumim, 2006, come to similar conclusions). Initiatives currently working to develop these carbon capability skills include the RSA’s Carbon DAQ voluntary online (virtual) carbon market and the voluntary carbon rationing groups discussed above. Further evidence of this

vital cultural shift is appearing as the concept of 'carbon footprints', for example, has become widespread over the last year or so (Siegel, 2007; see also www.carbonfootprint.com). CRAGs also help familiarize people with their carbon footprints and emphasise the transferability of carbon choices within lifestyle sectors, e.g. transport and home; "like offsets and carbon labels, they are another way of improving popular 'carbon literacy'." (Shrubsole, pers. comm., 2007). In ongoing research, the authors are working with environmental charity Global Action Plan to develop and test a carbon trading board game, as a practical tool to boost carbon capability. The RSA are also considering the technological implications to support carbon capability (RSA, 2007b). However, and referring back to the more general analysis of consumption behaviour above, the wider picture must retain a focus on helping people to resist - and create alternatives to - broad social pressures to consume in ever higher quantities.

4.2 *Inter-household carbon allowance allocation*

Both the environmental robustness of a cap and trade emissions trading scheme and the eventual performance of its market are dependent on the level or stringency of the emissions cap and the allocation of allowances. Optimal allocation is by no means a given, as the experience with trading scheme elsewhere (particularly the EU and the UK ETS) shows. Over-supply of allowances ('hot air') degrades the environmental effectiveness of a scheme and tends to decrease the demand for permits, which in turn dampens the ability of the market to function as an accurate price signal for abatement decisions. Conversely, an excessively tight allocation will create a high marginal abatement cost that could over-burden those in lower income brackets, particularly if the cost of energy efficient products and services rises as a result of increased demand, or if there is a time lag between increased demand for such products and their widespread availability.

This latter point is especially important in terms of fuel poverty and the purported progressiveness of the PCT system (as proposed by Fleming, 2005, and discussed by Starkey and Anderson, 2005; see section 2). Those who cannot afford to make energy efficiency improvements, those who cannot do so (if they live in rented or social accommodation) and those who do not live close to public transport will find themselves at the mercy of the emissions market, which in turn reduces the flexibility (and cost effectiveness) of the emissions trading scheme for these groups. Whereas it is true that those in lower income deciles tend to emit less on average than those in higher brackets, there is a high degree of variability within particular income deciles (Dresner and Ekins, 2004). As such, the poor may not automatically be compensated by lower average emissions. Indeed, fuel-poor individuals could be significantly worse off in a system of PCT,

particularly under more stringent allocation levels. Some form of redistribution could be used to help correct this problem, although more proactive intervention by government may be necessary to bring the less economically advantaged up to a reasonable and competitive standard of energy efficiency (Starkey and Anderson 2005). Although the costs of such an intervention are unknown, they are likely to be considerable. DEFRA (2004) estimates the number of social and private households living below 'decent standards' of energy efficiency and thermal comfort to be around 2 million.

Implementing a system of equal, per capita emissions levels may also prove politically difficult. The flat-rate allocative system seems to be based on the principle that everyone should be allowed to emit the same amount of carbon into the atmosphere (Starkey and Anderson, 2005). Whilst there is support for this principle amongst important government advisory bodies (RCEP, 2000), in practice, prior use of a common resource (in this case, the assimilative capacity of the atmosphere) is often normatively understood to grant implicit rights (Raymond, 2003) or differential entitlements (Nozick, 1973) to that resource on behalf of historic users. The 'current time slice' or 'end state' arguments implicit in the equal per-capita allocation principle "do not capture the whole story" about rights and distributive justice (Simmons, 1995: 151) and so may be open to political manipulation/ contestation. Starkey and Anderson (2005) sum up this idea quite well: "Whilst it would be convenient if support for an equal per capita allocation were to be found within the various contested approaches to justice...this would not appear to be the case. Hence, to justify an equal per capita allocation one has ultimately to justify an approach to distributive justice that supports such an allocation" (2005: 7).

It seems reasonable to conclude that those with a historic interest in emitting more (predominantly 'the rich' and coincidentally those with better access to policy-making structures and policy networks) will fight to retain their intrinsic emission 'rights' to emit and so seek a greater allocative share based on factors like relative economic output.

Another undecided, and potentially contentious allocation issue relates to the inclusion or exclusion of children from coverage in the scheme. The TEQ and DTQ systems recommend allocating allowances only to adults, on the basis that children do not work and do not purchase energy (Starkey and Anderson, 2005: 11). However, this seems a fairly facile criterion for assessing the overall household energy *demand* that children bring to bear in terms of energy needed for heating, appliances, cooking and personal transport requirements. Furthermore, as recognised in the CSE 2006 report, by this standard *any* member of a household (child or adult) who does not work and does not pay energy bills

should be excluded from the allocation. The exclusion of children on this basis raises serious fairness issues when compared to other groups of adults such as ‘homemakers,’ carers and pensioners who do not work in paid employment, drive, or pay energy bills directly.⁹ Such a system would effectively penalise single parents whilst providing windfall allowances to adults who care for an elderly or infirm relative in their home.

Hillman (2004) suggests giving partial allowances to children through PCAs as a sort of compromise between the rights to emit and recognition that children do contribute less overall to UK domestic carbon emissions. However, it should be noted that this arrangement might be environmentally controversial, because it would increase the size of the emissions cap, which then decreases the environmental robustness of the scheme. Dresner and Ekins (2004) explored the option of giving extra credits to parents without increasing the cap. However, the redistributive effects were negligible (in that the amount of people worse off and better off were about the same in a standard DTQ scheme or one in which parents were given more allowances). Increases in child benefit could probably achieve the same results, without shrinking the overall pot of allowances for adults without children (Starkey and Anderson, 2005).

4.3 Intra-household resource allocation

The politics of internal allowance allocation and redistribution of allowances within the household also deserve further study. There are two elements to this. Firstly, in order for carbon allowances to be treated as a commodity, (and so for a carbon trading system to work efficiently) they must be easily transferable, or giftable, between individuals¹⁰. For instance, individuals that share a car for commuting purposes should be able to contribute their relative share of carbon allowances alongside their contribution to petrol costs. Although carbon allowances can be purchased for a premium at the point of sale (and so transfer is not strictly *necessary* – see Starkey and Anderson, 2005) such point of sale purchase impose significant transaction costs that could distort the efficiency of the carbon market. Transaction costs arising from difficult or complicated allowance transfer facilities/ infrastructure could also severely impact the fuel poor and other low-income groups. This latter issue especially merits further research attention in the context of PCT.

⁹ Such a ‘relative contribution’ based argument would also seem to add fuel to the ‘historical entitlement’ argument discussed in the preceding section.

¹⁰ Some allowance for gifting of carbon credits may need to be built into PCT, which would again distinguish it from rationing in the 1940s and 1950s where this was not permitted (Roodhouse, 2007).

Secondly, the distribution of allowances *within* the household, and the interactions of this distribution with a diverse range of issues gender ethics, relative economic advantage and fuel poverty need to be better understood. Although mainstream economic theory tends to treat the household as a single unit or black box with a common purpose there is evidence (particularly from work in development studies and feminist economics) that resources are not necessarily shared or distributed equally or equitably amongst family members (Folbre, 1986; Katz, 1997). In reality, household or family members rarely have fully aggregated or solidly altruistic preferences. For instance, males and females tend to prioritise spending of earned income in very different ways (Phipps and Burton, 1998). They also tend to distribute it differently amongst the household. Women tend to be more altruistic and egalitarian in their intra-household income distribution when compared to men (Doss, 1996, Folbre, 1986). However, it is also recognised that women traditionally do not have the same degree of bargaining power as men when it comes to the distribution of household resources (Agarwal, 1997, Doss, 1996). Considerations like these suggest that the internal distribution of allowances within households, and the way that different family members prioritise the surrender or purchase of allowances, could have a tremendous impact on the overall efficacy of a PCT scheme, and its impact on the quality of life for a given household. It is not difficult to imagine scenarios in which one household member favours fuelling a private car at the expense of a warm home. These are especially salient concerns for those in fuel poverty or those in lower income deciles for whom using the market to buy extra allowances will impose higher relative transaction costs.

4.4 Citizenship

The utilitarian perspective under which PCT schemes are currently being developed does not fully give consideration to drivers of human behaviour beyond that stipulated by the rational actor model (i.e. maximising personal utility). Research in social and environmental psychology, as well as experiences of 'rationing' during the world war and more recently in Cuba, demonstrate that individuals are generally resilient and respond to changes in their living environment by adapting their personal, household and social practices to survive and benefit. In other words, these experiences support Giddens' theory of structuration (1984) whereby action at the individual level as well as social rules and regulations contribute to shaping social life. Similarly, in 1985 Granovetter argued that individual behaviour does not occur as an atomised form in a vacuum; neither are institutional arrangements so predominant that they drive action at the individual level. Rather, he made the case that it is social relations, and therefore the links and relationships individuals build and foster between themselves and other societal structures that drive action.

As we have outlined above, little is known about how moral economies of households are shaped and developed, despite this being a well-researched area in the developing world. This calls into question therefore the longevity and practical feasibility of a PCT driven by the current utilitarian model ascribed to by most Western capitalist governments, couched in ecological modernisation terms. Not only does it be based on a very simplistic model of individual behaviour, but it would also ignore those more affective, intuitive and ethical motivations that spur people to act. Both Hillman and Fleming have argued that PCT could not take place in isolation, relying solely on individuals to 'do their bit'. Rather its success would build upon a sense of 'common purpose', where community activities are developed to meet shared aims and targets, fostering collaboration, collective action based on mutual understanding, support, transfer of knowledge and acquisition of skills. The CRAG system is focussed around the well-known 'weight watchers effect'¹¹ whereby actions that are accountable socially e.g. to a group are usually accomplished more successfully than those that remain invisible (see also Marshall and Bannister, 2000; Gardner and Stern, 2002; Staats et al., 2004). The philosophy underlying CRAGs initiatives is that people are not automatons; each individual adapts to, and shapes, his / her circumstances and environment according to ability, understandings, interests and peer support. Thus, nascent grass-roots initiatives are reinterpreting the experience of wartime rationing survivors to actively mitigate against the threat of global climate change, coupling strong individual motivation, group trust and community spirit (Muir, 2007).

However, the historical experience of rationing in the UK during 1940s and 1950s suggests that there would be greater buy-in from the population and longer-lived support for PCT if it were considered a fair and equitable system, correctly administered. This begs the question, therefore, of whether a PCT is viable despite the lack of trust in today's governing institutions.

Recently government policy and initiatives aiming towards a low carbon economy have come under severe scrutiny. Despite being a world leader in terms of climate change policy (e.g. shortly to be enshrined in law through the Climate Change Bill), many have argued that these aims fall short of being translated into practice. Especially socialist thinkers have criticised the current political discourse for farming climate change as a priority issue but allowing this to be suitably vague and malleable to meeting other and diverse policy objectives (e.g. Harriss-White and Harriss, 2006). Others have criticised the bureaucratic involvement with science and underscored the human impacts and costs (intended in the

¹¹ A proposal to implement PCT based on similar motivators was suggested by Fawcett in 2005.

widest sense of the world) of moving towards a low carbon economy, arguing these have been underestimated and even ignored by governments (e.g. Boehmer-Christiansen, 2003). Whilst the first is a contentious statement and we do not propose to debate it here, the latter considerations are important and deserve open and honest debate in relation to PCT. In fact, the underlying weariness and unease with which some UK Government departments currently view PCT ideas could be a sign of these at work.

The flourishing of small-scale bottom up initiatives based on environmentally-balanced community living, including in some cases treading the path towards a decarbonised UK economy, could be interpreted as the expression of “ecological citizenship” (see Dobson, 2003; Wolf, 2007) among concerned individuals. Reflecting upon CRAGs, Guy Shrubsole concludes “I think they have begun to demonstrate that a new form of environmental citizenship is needed to address climate change ... In order to take behaviour change to a new level ... we need new social inventions. CRAGs may point the way to this – or they may prove to be too demanding of members to be that popular.” Here he touches upon one of the key questions in relation to PCT: is it achievable? The notion of a shared ‘common purpose’ might not suffice in today’s society as a strong enough motivation for the British, as citizens, to enact their personal responsibility towards current and future generations by supporting PCT. We currently live in a culture where individualism and personal spending as a means of gratification are encouraged and rewarded, where climate change is near enough to cause concern, but far enough to not warrant immediate action.

5. CONCLUSIONS

In this paper we have examined the notion of personal carbon trading assessing its merits from a purely neo-classical economic perspective, concluding that for such a scheme to become implementable much deeper consideration has to be devoted to the wider set of personal and social factors which influence individual choice, decision-making and behaviour. We thus considered the existing experiences of carbon trading within industry emissions trading schemes and within Carbon Rationing Action Groups, in addition to complementary currencies. Our view is that these experiences raise many of the issues that would be need to be addressed before a fully-functional PCT could be rolled out nationally. In other words, different aspects of PCT are already being trialled albeit in other – some context specific - situations, which demonstrate that some PCT elements are not dissimilar to those already tested elsewhere and that development of a PCT requires learning from existing examples. These also contribute to raising key questions for PCT. Specifically we

underline issues of units of measurement, distributive justice within society and households, skills required to ‘manage’ carbon and the role, responsibilities and duties of individuals as part of society and the state. Within this paper we have identified areas that are currently under-developed with regards to PCT thinking and suggest that future PCT research should prioritise the following, which may affect the functionality and acceptability of PCT.

Scale of implementation

The prevalent PCT model focuses on individuals as actors within society. However, we have repeatedly underlined that individuals do not operate solely within these two spheres. A big unknown is household dynamics and group interactions. How will individuals allocated carbon allowances negotiate with others within their immediate operational environment? How will living with carbon quotas shape consumption, living and relationships? The CRAG system highlights the need for personal interaction and exchange, which raises additional questions about the implications of geographical extent on the success of a PCT scheme: this may depend on the level of trading (e.g. community, regional or national) as well as the system involved (PCAs vs. all tiers within the economy, e.g. TEQs).

Equity and justice

Carbon quotas have been promoted as equitable policy options. However the literature, based exclusively on theoretical studies to date, is contradictory, suggesting in some cases that the poor may be detrimentally affected (e.g. Dresner and Ekins, 2004). Our analysis also raises the complex question about the technicalities of ensuring ‘equitable’ allocations, in addition to considerations about ‘uncounted’ individuals within the UK such as recent migrants or people without a permanent abode. Debate about the ‘real’ vs. perceived costs of a PCT scheme abound in the literature and website discussions. Civil liberties campaigners have also expressed reservations about privacy and security implications, while other critics maintain that the bureaucracy involved in administering millions of records could harbour potential for errors, tampering, and even fraud.

Carbon capability

On a practical level the implementation of a PCT also implies acquiring skills to understand carbon dioxide and manage trading. We have argued earlier in this paper that developing carbon capability is likely to enhance the success of a PCT scheme¹². However, as CRAG demonstrate, there are different levels of carbon capability, which relate to practical

¹² The recent PCT literature has rather myopically focussed on carbon dioxide, which raises practical considerations about meaningful mitigation considering the impact of a variety of other greenhouse gases beyond solely CO₂.

considerations about how the scheme is administered. Little research has been undertaken on the less technologically aware groups of society and their interaction with the scheme. Elderly people, for instance, may benefit from a “carbon accountant” (as some Craggers do) to keep track of individual carbon emissions in a year. Records of carbon credits and debts could be accessible through the internet (in the same way bank accounts are today) and carbon managers could also be available in person for those who cannot or are not able to use this form of access. Developing PCT upon existing credit and debit card infrastructure (Fleming, 2005; Starkey and Anderson, 2005) may prove unreliable given a significant proportion of the UK population is not part of a reward card system (RSA, 2007b).

Motivators for national uptake

Mark Roodhouse’s analysis on rationing concludes that a PCT scheme cannot be enforced without public support. The sticking point underlying PCT models is both engendering support and enacting behavioural change. Even some environmental groups have expressed concern about the duty and responsibilities on individuals that the proposed system implies. They argue the transition and implementation of the scheme should be supported structurally, in other words that the barriers to its implementation should be meaningfully addressed by government and industry before any such scheme could come into force. Marketing research has even identified the characteristics of individuals that influence others’ behaviours and impact policy (Duffy and Pearce, 2007). Our analysis of PCT in relation to the emerging sense from concerned and active individuals of their moral commitment towards mitigating climate change raises the structuration question of whether PCT to act as a catalyst for renegotiating the role and commitment of individuals in relation to their own communities and state. It is very likely that duties for and responsibilities of climate change mitigation would require current societal systems and arrangements to be revisited in the light of collective action towards a common goal.

Overall, PCT developed and implemented in its fullest sense will require a brave and considerate act on behalf of the UK. We should not lose sight of the fact that the implications of a PCT scheme associated with meaningful emissions reductions will be very profound and wide ranging. Although as a worldwide consumer of goods and services it may be able to exert some leverage in international low-carbon procurement, many of the changes will need to be internal. It would affect every aspect of our current lives. It effectively calls upon careful examination and rethinking of our current social structures, our economic agreements, engineering fabric, policy agreements and objectives, in order to still guarantee at the very least basic provisions of resources and services, if not the high living standards its citizens generally enjoy today. However, the UK does not currently operate in isolation. Were it to

attain a low carbon economy, it would undoubtedly bear huge repercussions way beyond its national boundaries, including changes in relative prices as climate change externalities are internalised into the economic system, shaking up world trade and relationships with developing countries, raising profound issues of international justice and equity.

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