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Abstract

To effectively mitigate climate change in the long-term, capping 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 origins and development of the PCT ideas, identifies key players and proponents of the proposals, and examines their economic bases. Lessons from several related areas of experience (the EU Emissions Trading System, voluntary Carbon Rationing Action Groups, and Complementary Currencies) 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, trading.

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 dioxide (CO_2) emission rights to citizens is a recent proposal to mitigate climate change. It aims to cap individuals' emissions, enabling year-on-year cuts in the national carbon budget. The idea has received attention from key actors in the UK government (Miliband, 2006) but while some work is underway exploring technical feasibility, legitimacy and acceptability issues (Starkey and Anderson, 2005; RSA, 2007a; Roberts and Thumim, 2006), to date there have been no full trials, and limited studies exploring how such a scheme would work in practice (Fawcett et al., 2007) or attempting to experimentally simulate the policy (Capstick and Lewis, n.d.).

This paper critically examines the idea of personal carbon trading (PCT) from a range of perspectives and identifies areas of theory and practice requiring further development, especially those which – we contend - have hitherto been somewhat uncritically accepted by commentators. As a conceptual paper it aims to open up a new field of inquiry, to provide an overview of the subject and identify the gaps in current thinking, and to problematise the assumptions underlying this policy proposal. In doing so, we expose the implicit assumptions of PCT, and reflect upon their accuracy and appropriateness. We first discuss the origins and development of PCT ideas, identifying key players and proponents, and the scientific, economic and political contexts for their development. We then draw lessons from related areas of experience (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. From this discussion, four critical issues emerge, which straddle political, social, economic, environmental, cultural and ethical domains, and which demand greater attention before the PCT idea can progress. We conclude with initial thoughts for a research agenda and critical implications for climate change policy.

2 – Personal Carbon Trading: scientific, economic and political rationales

Proposals for carbon emission 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. Both envisaged progressively stricter national carbon budgets as a plausible method of achieving large-scale cuts in global CO_2 emissions through a Contraction and Convergence (C&C) framework. C&C was proposed (Meyer, 2000) in response to Agarwal and Narain's (1991) propositions about equitably distributing responsibility for tackling climate change. Under C&C global emissions should be capped to stabilise atmospheric concentrations of greenhouse gases to a level that would prevent dangerous climate change. Assigning emission rights to countries on a per capita basis and converging, then reducing, these over time ('contraction') would eventually result in globally equal per capita emissions ('convergence') at levels lower than currently. UK government policy is partly based on C&C, following recommendations by the Royal Commission on Environmental Pollution (RCEP, 2000; chapter 4): the two most recent Energy White Papers and the Climate Change Bill (OPSI, 2008) enshrine the target of reducing national carbon dioxide emissions by 80% by 2050, in line with recommendations the Stern Review (2006) and the IPCC (2007).

To implement C&C at the UK level, Hillman (2004) and Hillman and Fawcett (2005) developed the notion of personal carbon allowances (PCAs); Fleming evolved his original idea of fuel quotas into Domestic Tradable Quotas (DTQs) and more recently Tradable Energy Quotas (TEQs) (Fleming 1996, 2005), also examined by Starkey and Anderson (2005). All models propose mandatory schemes allocating emissions permits[1] and allowing trading, to reduce and stabilise anthropogenic CO_2 emissions at some scientifically-established policy target level[2], but there are striking differences between specific proposals. DTQs encompass all carbon emissions within the national (i.e. 'domestic') economy, thus covering all end-users (individuals, organisations and government) purchasing fossil fuel energy. This quantity based 'cap-and-trade' system would set an overall UK CO_2 emissions budget for a given time period (based on achieving government emissions reduction targets), would auction off 60 per cent to the market, and divide the remaining 40 per cent (representing household direct energy-related emissions) into a free and equal per capita allocation for all citizens. PCAs only cover individual CO_2 emissions (thus excluding organisations, business and government), and do not define the administrative structures required. Individuals would be allocated a certain amount of tradable carbon emissions[3] (or carbon allowances or carbon credits).

In this paper we refer generically to 'Personal Carbon Trading' (PCT), by which we mean both the allocation of DTQs to individuals, and PCA schemes, and any variants of these which relate to compulsory issuing of carbon emission rights to individuals. There are three key elements to PCT: setting the national carbon budget, distributing individual allowances and surrendering allowances (Fleming, 1996). Both PCA and DTQ models propose that carbon credits might be spent alongside money when purchasing fuel or energy, either explicitly (surrendering carbon units when paying bills) or implicitly (carbon costs being incorporated into petrol pump prices). 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. Long-run carbon budgets allow individuals 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. Embodied carbon in goods and particularly imports are outside the scope of PCT which deals only with direct energy use within the UK. Proposals vary in details such as the precise coverage of allocations (e.g. public transport) and how children are treated (e.g. no allowance for children, or a half-allowance). Nevertheless, Roberts and Thumim (2006, p.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", and it is following this rationale that we address the different schemes generically as PCT.

The claimed benefits of PCT over traditional policy measures of information, regulation and taxation are fivefold: it is empowering, allowing individuals to respond to the carbon price

[1] PCT is often referred to as 'rationing' (e.g. Hillman and Fawcett, 2005; Adam, 2006; CRAGs, 2007). Although the term accurately describes the purpose of PCT, it is nevertheless avoided by advocates for its assumed negative connotations of wartime scarcity, curtailment of personal freedom and government control. Alternatives such as 'allowances', 'quota' or 'entitlement' are generally preferred (e.g. Miliband, 2006).

[2] The PCT literature rather myopically focuses on CO_2, which raises practical considerations about meaningful mitigation considering the impact of a variety of other greenhouse gases.

[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'.

signals flexibly (unlike regulation); it generates 'common purpose' and active citizenship, encouraging individuals to actively contribute towards climate change mitigation (in contrast to taxation which can provoke resentment, as seen with fuel protests prompted by the UK fuel tax escalator); it is effective, offering the certainty of a predetermined emissions limit (unlike taxation); it is equitable, as 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; and as a market mechanism is more efficient than direct regulation (Fleming, 2005; Starkey and Anderson, 2005).

Fundamentally the principles of PCT draw on assumptions from neo-classical economic theory about markets and consumer rationality.[4] The basic premise is that market mechanisms and prices offer a more efficient and lower-cost alternative to emissions *regulation* or 'command and control' of quantities. Under a 'cap and trade' system, scarce allowances become valuable commodities, and a carbon market equalises the maximum marginal abatement (emissions reduction) cost of meeting targets for all participants, whilst offering added options for compliance (Joskow et al, 1998). The cost effectiveness of PCT hinges on the *option* to use the market should the marginal cost of abatement prove higher than the cost of an allowance (a participant need never trade to benefit from the increased efficiency of an emissions market over mandated standards). Ideally, carbon abatement or purchasing decisions respond to the market price for carbon, and participants behave in a utility-maximising manner, choosing the most cost-effective method of compliance. Although Fleming (2005) espouses a 'common purpose' as an intended *end* of PCT, the day-to-day *practice* of carbon trading necessarily represents an exercise in cost-minimisation. He argues there is "a shared incentive to reduce our dependence on oil, gas and coal… because the price I have to pay for units is affected by your demand" 2005, p.19), presupposing considerable faith in neo-classical economic rationality on the part of consumers. However, it may be imprudent to assume (at least so hastily) that a market-based *policy instrument* would function in the same efficient manner as a model 'free market' or that participants in the former would and could behave as *homo economicus*, with the knowledge and skills to maximise their utility in a carbon market (Nye, 2008). This is a key issue to which we return below.

Whereas the concepts of personal carbon allowances (PCAs) and associated personal carbon trading (PCT) have been the subject of academic theorisation for over fifteen years, to date there is very little research of how such a scheme may work in practice. There are many theoretical variants of PCA, all centred around key issues (see section below).

The idea of carbon allowances slowly started permeating the UK political realm following a Private Member's Bill to establish a domestic trading system for carbon dioxide emissions (CO_2) (Challen 2004). PCT was publicly discussed by the then Secretary of State for Environment, Food and Rural Affairs, David Miliband in 2006, who called for a 'thought experiment' on the idea, effectively hoping to test the effectiveness of these concepts against other proposals. Most of this interest was spurred by the realisation that the UK's ambitious target of a 60% cut in CO_2 emissions by 2050 should be underpinned by effective public engagement in mitigation through behavioural change, to date elusive. In this context, PCT was seen as having "great potential as a policy tool" (EAC, 2008: 5).

[4] We recognise that PCT advocates do not necessarily endorse a neo-classical economic perspective, but the PCT model is a market mechanism reliant upon utilitarian principles.

However, political light shifted away from the concept of PCT with the arrival of the new Secretary of State for the Environment, Food and Rural Affairs – Hilary Benn - who succeeded David Miliband at the end of June 2007. Already in the summer of 2007, Miliband had suggested that the government might be keener to observe other studies on PCT that commission its own (Tempest, 2007). DEFRA's pre-feasibility study (2008) into personal carbon trading consisted mainly of citizen feedback studies (focus groups), and was premised on a rational-actor assumption of economic behaviour (see below for more discussion on this). It concluded there were some problems (high implementation costs, burden on the vulnerable, concerns about public acceptability – although in the report no insurmountable technical obstacles were found) with PCT as a tool for reducing individuals' emissions. In an example of policy running ahead of science, and bound by personality reshuffles, the UK government shelved any further considerations of this option.

The Environmental Audit Committee (EAC) inquiry into PCT (2008), concluded after DEFRA's feasibility study was published, expressed disappointment by government's disinterest in pursuing this option further, arguing that political and public acceptability should be the subject of further work, endorsing the potential of this tool in climate change mitigation. The EAC in fact, suggested that public acceptability towards PCT might be increased if individuals could be convinced of the following: (a) essential need to reduce emissions; (b) achievable only through individual endorsement of personal responsibility; (c) PCT as a more effective and fairer means of mitigation at personal levels than taxation. The EAC accepts that any scheme based on the PCT concept needs to be investigated in terms of the inequalities and opportunities raised, and the former addressed to make it practically feasible.

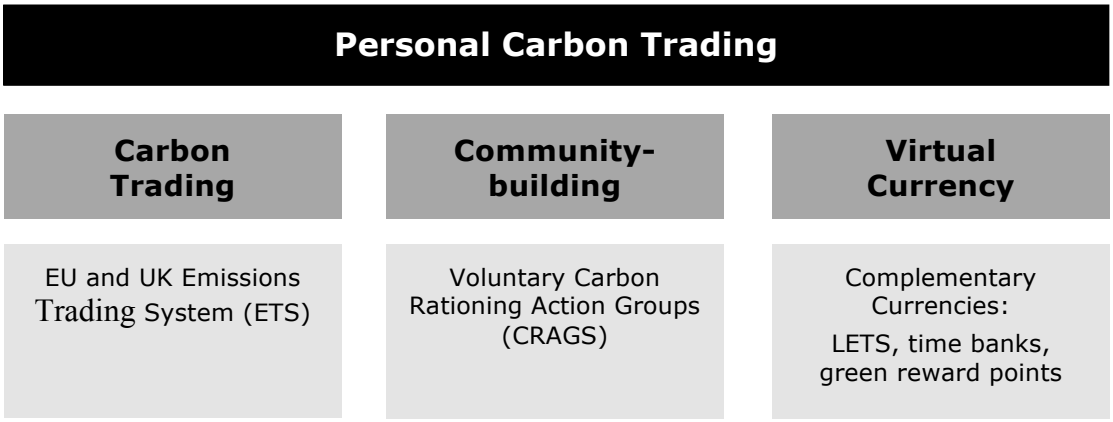
Outside the doors of Westminster, PCT has received considerable and ongoing interest. DTQs were recently billed by the UK's Sustainable Development Commission as a 'virtually guaranteed' way of significantly reducing household emissions (SDC, 2007); PCT is part of the UK Green Party's climate change policy. Bottom-up interest in C&C (such as Carbon Rationing Action Groups (CRAGs)) prompted an e-petition urging the UK government to adopt PCT (PM, 2007), provoking the official response that the government "is looking into the potential value of personal carbon trading (PCT) … addressing high level questions relating to the economic value of PCT and its strategic fit, equity and distributional issues, public acceptability, and technical feasibility and cost." (ibid). The Institute of Public Policy Research is currently assessing the advantages and disadvantages of PCT, and it is increasingly represented in reports for business on public perceptions of climate change (AccountAbility and Consumers International, 2007); according to one alternative energy strategy, PCT is the sole option for eliminating Britain's carbon emissions by 2027 (CAT, 2007). Experimental voluntary, intermediate initiatives (adopting some elements of PCT) include: the RSA (2007a) piloting voluntary PCAs with 2,000 people recording their emissions; sustainable economics think-tank Feasta issuing prototype "Citizen's Emissions Entitlements" to raise awareness of PCT; the Fair Shares Fair Choice has produced "the world's first personal carbon card" as part of a DEFRA funded initiative; Capstick and Lewis (n.d.) have experimented with a PCT simulation, and are conducting a national survey on attitudes to the proposal; and consultancy Design Stream is planning a card to make its users aware of the environmental impact of their shopping (Shrubsole, 2007).

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 highlight issues important to

understanding of PCT. We consider three areas where key facets of PCT have already been implemented through different initiatives, and draw transferable theoretical and practical lessons for PCT. Figure 1 illustrates three key activities which offer experience with partial aspects of a PCT scheme (carbon trading, community-building for emissions-reduction, and virtual currencies), briefly examined below[5].

Figure 1: Aspects of Personal Carbon Trading and examples of related experiences.



Note: LETS (Local Exchange Trading Schemes)

3.1 - Experience with existing emissions trading schemes

Research on carbon trading in other contexts provides important insights into how participants might behave in a carbon market, and how this market might practically operate. The most studied, and perhaps best understood, emissions market is the US sulphur dioxide (SO_2) trading scheme. Although the SO_2 scheme's coverage is more localised and traceable than carbon trading, it offers some important lessons for the development of a carbon market, particularly in the early years. The scheme began in 1996, covering SO_2 emissions from coal-fired electricity plants, and is now regarded as a successfully developed and efficient market (Kruger, 2005). However, the early years of the SO_2 scheme were marked by dismal market performance (Schmalensee et al, 1998), and in particular, a lack of trading volume due to over-compliance, lack of familiarity with the trading mechanism, and fuel-switching to lower-sulphur coal (made economically viable by changes in railway transport regulations) (Ellerman et al, 1997, Bohi and Burtraw, 1997).

Industry-level emissions trading programmes elsewhere have also met with variable success. . The UK Emissions Trading Scheme (the first ever economy-wide emissions trading scheme, which ran from 2002-2006) was heavily criticised because the voluntary, incentive-based scheme designed to reduce CO_2 emissions from key industries attracted fairly undemanding

[5] Other lessons could be drawn from comparisons with the introduction of decimal currency in the UK; the conversion to the Euro in continental Europe; the IT systems required to record millions of supermarket loyalty point transactions every week, and with fuel rationing in Cuba when oil supplies were scarce following the collapse of the former Soviet Union.

targets (NAO, 2004) which required little, if any, operational commitment from participants (Roeser and Jackson, 2003). Similarly, Phase 1 of the current cap-and-trade EU Emissions Trading Scheme (into which the UK ETS was subsumed), has delivered little emissions-reduction because the initial national allocations are too accommodating (Ecofys, 2004, Betz et al, 2006,), largely due to a lack of good quality data for estimating emissions levels and for creating accurate and robust national allocation plans (e.g. Ellerman and Buchner, 2007).

These findings raise two important considerations for the design and successful functioning of a PCT scheme. Firstly, an efficient emissions market relies on a fairly delicate chain of well-informed, neo-classically rational users making correct market decisions in a relatively liquid market, driven by sufficient demand for permits (dependent on a sufficiently tight cap and allocation). Ideally, this chain would be supported by a series of procedural conditions including "perfect competition …absence of market power and perfect enforcement in the case of non-compliance" (Woerdman, 2001, p. 295). Secondly, markets take time to develop, and significant transaction costs can arise, particularly in early years, around establishing these effective administrative structures and procedural conditions. Participants may be 'irrationally' reluctant to utilise the trading mechanism for compliance or may lack the skills and knowledge to use the market's price signals strategically when making emissions-reduction decisions (Nye, 2008). It is reasonable to assume that planning and organising carbon budgets will take significant time, especially in the early years, which could decrease the cost effectiveness of the system compared to other, more familiar market instruments like taxation. Other transaction costs observed in emissions trading schemes, include costs for the negotiation of trades, approval and regulatory costs, external risk monitoring charges, and 'ex-ante' costs associated with designing and implementing a controversial instrument amongst a political field of competing interests (see Woerdman, 2001). Whilst we do not envision high brokering or risk monitoring charges for a system of PCTs, the political controversy surrounding the implementation and design of PCTs does bear mention here.

We should not lose site of the fact that the relative efficiency and transaction costs of a PCT scheme are strongly dependent on the nuances of its final design *and* the processes by which it got there (e.g., Krutilla,1999).

3.2 - Experience with voluntary Carbon Rationing Action Groups

Carbon Rationing Action Groups (CRAGs) are community-based organisations whose members (Craggers) agree to reduce their carbon emissions. CRAGs were developed to facilitate carbon emissions reductions using a simple measuring system, and by increasing personal knowledge, in an encouraging and supportive social context. There are over 30 groups across the UK, and the idea has spread to the USA and Canada (CRAGs, 2007). The members of each CRAG decide on a CO_2 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, as CRAGs aim to make climate change mitigation directly tangible for individuals)[6]. Each Cragger records their personal carbon emissions from air and car travel, plus home energy use (electricity and heating), using the same metrics. Sometimes 'carbon accountants' are used to keep track of these. At regular intervals members share their results with others in the group, and in some groups at year-end, members exceeding their personal target pay a financial penalty for non-compliance, i.e. price per kg of emissions above target. Generally penalty monies are paid

[6] In multi-person households, CRAGs suggest that individuals bear proportional responsibility for the household's emissions, but have to solely account for all emissions from any mode of transport they own (CRAGs, 2007).

into a bank account and then redistributed to Craggers who saved carbon. No specific criteria exist to measure CRAG success, but key factors are: social support, simple joining instructions, and easy carbon accountability (Shrubsole, 2007a; Howell, 2009).

CRAGs aim to make individuals more aware of their carbon emissions, and build community cohesion and support amongst like-minded individuals (CRAGs, 2007). The latter goal includes both encouraging others to remain committed to a low-carbon lifestyle, and sharing knowledge about how to do so. Shrubsole (personal communication, 2007) explains: "You feel encouraged that others are doing this too; individual actions are less isolated and seemingly pointless. You also feel a little pressurised to meet your target." Social diffusion of both practical knowledge and commitment to action could prove to be particularly strong drivers for behaviour change and emissions-reduction. Studies of other environmentally-significant practices (notably recycling) indicate that pro-environmental behaviour is encouraged by making public commitments and pledges (e.g. Oskamp 1991) and where communities have strong pro-environmental norms (Hopper and Nielson, 1991).

CRAGs can be considered the first experimental trial of some aspects of PCT, albeit in a very confined and limited voluntary 'market', giving people the experience of working with others towards personal emissions-measuring, targets and reduction. Most Craggers support the idea of nationwide PCT. The CRAG system is essentially a monitoring and in some cases, a pricing instrument: the financial penalty is set iteratively and there is neither absolute cap on overall emissions, nor a market (potentially all Craggers could be in credit, having saved emissions) (Shrubsole, personal communication, 2007). However, the mechanisms of CRAGs are unlike a cap-and-trade system like PCT. Certainly, the voluntary, self-selecting membership of CRAGS suggests that they involve only the already-committed carbon-reducers, and are in no way representative of the wider public. What, then, can be learned from this case? We argue that despite these differences, there are some principles evident here that could inform the implementation of a wider mandatory PCT project – in particular, the importance of carbon awareness and capability for individuals and communities, and the role of building a sense of 'common purpose' and mutual support (Howell, 2009). This element of support is significant: for domestic households, options for emissions-reduction are often determined by surrounding infrastructure and systems of provision. Individuals can only do what local transport systems, living arrangements, or energy infrastructures allow them to do (Van Vliet et al, 2005). Accordingly, locally-relevant knowledge about how to achieve emissions reductions in specific places and spaces is necessary for the smooth operation of PCT (or any market-based instrument for carbon-reduction). Without this, individuals face a severely reduced set of generalised and fairly unattractive emissions-reduction options based on curtailment. This places greater responsibility on community leaders to disseminate practical and locally-relevant knowledge for change in an accessible format and context.

3.3 - Experience with complementary currencies

Complementary currencies (CCs) are new systems of exchange which operate alongside conventional money, and have been rapidly growing in number since the 1990s in developed and developing countries. They include mainstream commercial schemes (air miles, supermarket loyalty points), and community-based initiatives for economic development, social justice and environmental protection (Local Exchange Trading Schemes (LETS), Time Banks) (DeMeulenaere, 2007; Seyfang, 2006). The rationale for CCs is that 'money' is a socially-constructed institution which promotes particular behaviours. Mainstream money is part of a system of exchange which exists within current market conditions of capitalist,

consumerist economies. It is not a value-free, neutral technology: it has characteristics which incentivise unsustainability: it values some types of wealth and not others (commodified exchange value, not use-value), values scarcity (encouraging over-exploitation of essential public goods such as ecosystem services), promotes competition (as it is itself scarce), and externalises certain costs. In contrast, CCs are specifically designed to overcome these problems and incentivise sustainable development, for example by internalising environmental costs, or valuing non-marketed labour (Lietaer, 2001; Boyle, 2002).

Economists traditionally define money according to its functions: as a means of exchange, a unit of account, and a store of value (Lipsey and Chrystal, 2007), although money need not serve all these (potentially conflicting) functions in one form (Boyle, 2002). PCT, with its 'carbon budgets', 'carbon points' and 'carbon credit cards' is proposing a new carbon currency, to be budgeted and spent alongside money. It operates as a medium of exchange (permits are surrendered in exchange for the CO_2 emissions associated with purchased goods and services – petrol, electricity, heating oil, flights etc); it is a unit of account (representing permission to emit a standard unit of CO_2), but it is not a store of value (permits expire after a certain time). Although carbon credits can be exchanged for money, they are nevertheless spendable in their own right, and can be considered a 'limited purpose' or 'special money' with particular distinguishing socio-technical meanings which will influence its use (Dodd, 1994; Zelizer, 1994). Indeed, internalising carbon emissions into decision-making, and making them tangible, requires that consumers begin to count the carbon cost of their actions. Carbon allowances would be conceptualised and used ('spent' and 'saved') much as other virtual currencies (e.g. air miles) are at present, and it is useful to see PCT in this light to consider how public experience with using CCs offers lessons for PCT, despite vastly different scope, scale and development.

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, CCs tackling social exclusion are hampered by welfare benefit regulations preventing the most disadvantaged groups from participating. Second, CCs require supportive social contexts, either small groups with high personal contact (Time Banks), or larger city-wide systems with a conducive culture (Dutch green reward points). Third, CCs must use easily comprehensible, credible, and convenient mechanisms to be widely adopted and successfully utilised; the Dutch system successfully utilises familiar smart-card technology. Fourth, the skills and capabilities of participants are critical to CC success, particularly when dealing with new and unfamiliar units of value such as time. Finally, CCs succeed best when they harness collective 'active citizenship' energy and values, empowering users to co-create new social institutions.

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 (relating to wider issues around societal responses to climate change) which we argue have not previously been adequately researched.

4.1 - Carbon Capability

The preceding section discussed how PCT is akin to introducing a new carbon currency; here we extend the analogy and consider how consumers need to be as skilled in managing 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 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 (Max-Neef, 1995) – what Jackson (2007) terms the 'well-being paradox'. Several explanations have been put forward for this, ranging from psychological and social theories about using consumption to meet non-material needs for status, display, distinction, and the importance of relative rather than absolute wealth (Ropke,1999; Jackson 2007) to structural theories about the capitalist economy's need for continual expansion (Daly, 1992). In all cases, an outcome is rising consumption (threatening ecosystem viability) and increasing consumer spending (financed by borrowing) and over-indebtedness, representing in itself a profound cultural shift from 'thrift ethic' to 'consumption ethic' over the last couple of generations (Dixon, 2006, p. 1).

This 'credit culture', fuelled by social pressure to consume, and enabled by deregulation and technological changes in financial institutions, is doubtless responsible for developed nations' recent period of economic growth (Cohen, 2007). The sheer intangibility of credit finance compared with cash has also contributed to its widespread acceptance (although recently cash has made a comeback, as a visible way of controlling spending, BRC, 2008), bringing attendant social problems. In the UK, almost one in ten households finds its repayments a 'heavy burden' and during 2006/7 there was an increase in households with mortgage arrears, house repossessions, credit card arrears and personal insolvencies (BERR et al., 2007), and of course recent financial crises have demonstrated the precariousness of this economic model for growth, and the vulnerability with which it leaves individual consumers. Given the state's reliance upon this economic development model, government's response has been to emphasise individuals' responsibility to successfully navigate perilous financial markets, and to promote 'financial capability' (implying both actions and knowledge) as a basic skill required 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 competencies. In the intensifying consumer realm, "it is increasingly imperative that one know how to expose oneself to seductions without surrendering to them entirely" i.e. with the pathology of shopaholism (Binkley, 2006, p. 345). Managing material consumption, and managing carbon emissions, raise some similar issues.

Carbon emissions persist as an abstracted concept, intangible and unfamiliar to the consumer. Consequently, new skills and capabilities are required to engage with this new commodity and understand its full ramifications. How is this need addressed in the PCT literature? While the major PCT writers acknowledge that 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, p.30). The presumption appears to be that 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', without directly engaging in carbon budgeting at all – albeit paying more for the privilege (Fleming, 2005). However, previous

experience with both CCs and the ETS demonstrates that participants' skills, capabilities and confidence in the new carbon trading system are crucial to its success. Using PCT may be a technically trivial matter, almost invisible in everyday transactions, but we argue that it will be *socially non-trivial* as the issue of genuinely understanding and managing carbon budgets is an unacknowledged and undeveloped competency. The challenge is therefore to identify the range of skills required for PCT to achieve its objectives of inducing behaviour change towards carbon reduction. We term this '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 established indicators of financial capability and conducted a UK baseline survey. It covered four key areas of attitudes and practice: managing money, planning ahead, choosing products and staying informed (Atkinson et al, 2007). It found that although most people in the UK are competent at 'making ends meet,' almost half are unable or unwilling to plan for the future and 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, p. 33). Translating these concepts and techniques into carbon management, 'carbon capability' therefore refers to technical, material and social aspects of knowledge, understanding and practice.

Carbon capability implies having a good grasp of the causes and consequences of carbon emissions, the role individuals 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 (Whitmarsh et al, 2008, 2009; see also Parag and Strickland, 2009). Initiatives currently working to develop carbon capability include the RSA's Carbon DAQ voluntary online (virtual) carbon market (RSA, 2007b) and the CRAGs discussed above: "like offsets and carbon labels, they are another way of improving popular 'carbon literacy'." (Shrubsole, personal communication, 2007). Further evidence of this vital cultural shift is appearing as the concept of 'carbon footprints' has become widespread (Siegel, 2007; see also www.carbonfootprint.com). However, there is some way to go before we have a carbon-capable populace. Recent empirical research into public levels of carbon capability by Whitmarsh et al (2008) has revealed large gaps in public understanding of carbon, and the relative contribution to climate change of different actions. Furthermore, few make direct cognitive links between their actions and climate change, and very few engage in any type of collective action to reduce carbon emissions through systems of provision. The authors recommend two strands of action to both re-materialise, and help people to budget, energy use. This builds on evidence such as that reviewed by Burgess and Nye (2008) of initiatives such as energy monitors and carbon labels and consumer demand-reduction. This study contends that "re-materialising energy use patterns… gives consumers the opportunity to question both the inconspicuous nature of their energy consumption and the lifestyle choices that underpin their energy use" (ibid: 4458. These findings indicate that carbon-re-materialisation initiatives have the potential to contribute to greater carbon capability, both by enabling immediate feedback about carbon emissions generated, but also by encouraging wider consideration of the limitations for individual behaviour-change and the need for wider, structural responses. Referring back to the more general analysis of consumption behaviour, carbon capability must retain a focus on helping people to resist - and create alternatives to - broad social pressures to increase consumption, in order to effectively manage carbon budgets.

Finally, and thinking in more practical terms, using PCT will introduce new technologies, procedures and demands on people, but little research has been undertaken on the less technologically-able groups in society, and their likely modes of interaction with a PCT 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. More research is needed on the components of carbon capability, and the further skills required to use PCT effectively.

4.2 - Allocating Allowances Fairly

The environmental robustness of an emissions cap-and-trade scheme and its eventual market performance are dependent on the stringency of the emissions cap and the allocation of allowances. Optimal allocation is by no means a given, as experience elsewhere (particularly the EU and the UK ETS) shows. Over-supply of allowances ('hot air') degrades the environmental effectiveness of a scheme and reduces demand for permits, which in turn dampens the market's ability to provide accurate price signals for emissions-reduction decisions. Conversely, an excessively tight allocation will create a high marginal abatement cost, particularly if time lags between increased demand and widespread availability cause the cost of energy-efficient products and services to rise. This latter point is especially important in terms of fuel poverty and the potential progressiveness of the PCT system (claimed by Fleming, 2005). Without some sort of proactive government intervention in the market on behalf of the fuel poor, those who cannot afford to make energy efficiency improvements, or those who cannot do so (for instance, those who live in rented accommodation or council owned housing) will find themselves 100% reliant on their allocation and the price of carbon in the market to meet their carbon allowance obligations. This reduces the flexibility of the PCT scheme for these groups, which in turn erodes its potential cost-effectiveness. Moreover, it is also worth noting that energy demand on behalf of lower income households is more price elastic than for those in higher income brackets (eg Reiss and White, 2005). Lower-income households do tend to emit less on average than higher-income households, but 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. Fluctuations in the permit price could seriously disrupt the lives and well-being of lower income families who cannot afford to change their living circumstances or invest in energy saving improvements.

Another potentially contentious allocation issue relates to the inclusion or exclusion of children in the allowance allocation The TEQ and DTQ systems recommend allocating allowances only to adults, on the basis that children generally do not work or purchase energy (Starkey and Anderson, 2005, p.11). However, general energy purchasing power could be an insufficient yardstick for assessing the general energy requirements of children in terms of home heating, appliance use and a share of private transport (see Roberts and Thumim, 2006 on this point). 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. Unfortunately, the practicalities of including children in PCT appear no less problematic. Hillman (2004: 142; 156) suggests giving partial allowances to parents on behalf of children as a compromise between being 'fair to children' in terms of their right to emit and recognition that children do contribute less overall to UK carbon emissions. This arrangement might be environmentally controversial, because it would increase the size of the emissions

cap, reducing the environmental robustness of the scheme. Dresner and Ekins (2004) found the redistributive effects of this allocation to be negligible (there were no more people worse-off and better-off than with a standard DTQ allocation). Ultimately, the solution might be to redistribute the burden outside the emissions market, perhaps by increasing child benefit for parents (Starkey and Anderson, 2005).

4.3 – Inter-personal Redistribution

The issue of redistribution of allowances between individuals also deserves further study. There are two elements to this. Firstly, in order for carbon allowances to be treated as a commodity, (and so for PCT to work efficiently) they must be easily transferable, or giftable, between individuals (distinguishing PCT from rationing in the 1940s and 1950s where this was not permitted (Roodhouse, 2007)). For instance, car-sharing individuals should be able to contribute their share of carbon allowances alongside their contribution to petrol costs. Although necessary carbon allowances can be purchased at a premium (surcharge) rate at the point of sale and so transfer is not strictly *necessary* (see Starkey and Anderson, 2005), in the absence of easy transferability, such premium purchases represent a significant transaction cost detracting from PCT scheme efficiency. More study is needed to explore the ways in which these costs might be overcome, and possible pathways to easy inter-personal transferability without significantly increasing PCT administrative and setup costs.

Secondly, the redistribution of carbon allowances within the household raises a range of issues including gender relations, relative economic advantage and fuel poverty, which need to be better understood. Although mainstream economic theory tends to treat the household as a single unit or 'black box', there is evidence (particularly from work in development studies and feminist economics) that pooled resources are not necessarily shared or distributed equally or equitably amongst family members (Folbre, 1986). Household or family members rarely have fully aggregated or solidly altruistic preferences. For instance, men and women tend to prioritise the spending of earned income in very different ways, mentally earmarking men's income and women's income for different purposes, even to the point of them being almost separate currencies (Zelizer, 1994; Phipps and Burton, 1998; Pahl, 2000). Women tend to be more altruistic and egalitarian in their intra-household resource distribution (Doss, 1996, Folbre, 1986), but have less bargaining power over resources (Agarwal, 1997, Doss, 1996).

The internal redistribution of valuable carbon allowances within households, and differentiated prioritisation of the surrender or purchase of allowances, could have a tremendous impact on the overall efficacy of a PCT scheme, by disrupting the efficient use of market signals to direct behaviour. It also impacts on a household's quality of life – for example choosing to fuel a private car at the expense of a warm home – especially for lower-income households who would struggle to purchase extra allowances at premium rates to compensate for the selfish behaviour of other household members. A number of key questions remain unanswered: How will individuals allocated carbon allowances negotiate with others? How will living with carbon quotas shape consumption, lifestyles and relationships? We need to know more about how moral economies of households are shaped, to assess the equity and efficiency of PCT.

4.4 – Engaging With Citizenship

The utilitarian perspective underlying PCT does not give full consideration to drivers of human behaviour beyond that stipulated by the rational actor model (i.e. utility-

maximisation). Research in social and environmental psychology, as well as experiences of rationing during and after World War 2 demonstrate that individuals are generally resilient and respond to material changes in their living environment by adapting their personal, household and social practices to survive and thrive. These experiences support Giddens' theory of structuration (1984) whereby individual action as well as social rules and regulations contribute to shaping social life. Similarly, Granovetter (1985) argued that individual behaviour is not atomised in a vacuum; neither are institutional arrangements so predominant that they drive action at the individual level. Rather, actions are driven by individual factors, social relations, by the links and relationships between individuals and other societal structures.

Not only is PCT based on a neo-classical, utilitarian market mechanism with a 'consumer' model of individual and household behaviours, but it also ignores those more affective, intuitive and ethical 'citizen' motivations that spur people to act. Both Hillman and Fleming have argued that PCT could not effectively take place as an isolated policy instrument, relying solely on individuals to 'do their bit'. Rather its success would depend upon a sense of 'common purpose' and shared aims and targets to foster collaboration, collective action and mutual understanding, support, transfer of knowledge and skills acquisition. Comparisons are sometimes made to post-war rationing, where significant and long-lasting cuts in consumption were imposed on the British population by government. In this instance, a sense of everyone being in it together, and strong leadership from the government, for the public good, contributed to the acceptability of those drastic measures (Simms, 2003).

CRAGs build on these factors for their voluntary community-based carbon-reduction initiatives, and adopt the well-known 'weight-watchers effect' whereby actions that are socially accountable (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), and Fawcett (2005) proposed implementing PCT using similar motivators. Our examination, echoing both Hillman and Fleming, suggests that PCT's success (and public acceptability) will depend upon nurturing a sense of collective responsibility, manifested through citizens actively aiming to achieve larger sustainability goals (an expression of 'ecological citizenship' (Dobson, 2003)), rather than simply addressing them as sovereign consumers in a carbon market. In other words, PCT is a necessary but not sufficient instrument for inducing behaviour change, and further work is needed to explore how it might act as a catalyst for renegotiating the role and commitment of individuals in relation to their communities and state.

5 – Conclusions

We have examined proposals for PCT, and sought to unravel some of their assumptions and rationales, in order to fully explore its potential usefulness as a climate change-mitigation policy in the UK. We identified PCT as a market instrument emerging from a neo-classical economic perspective (although its proponents might not agree with the political implications of their economic model), albeit one which has yet to be implemented or trialled. Turning, therefore, to existing initiatives which offer related experience in partial aspects of PCT (other emissions-trading schemes, voluntary carbon rationing groups, and complementary currencies), we sought transferable lessons for PCT, and indications of the critical issues to be addressed before a fully-functional PCT scheme could be rolled out in the UK.

Overall, we conclude that for PCT to be implemented, more research is needed into the wider set of personal and social factors which influence individual choice, decision-making and behaviour, and which would therefore impact on the functionality (efficiency, equity and effectiveness) of a PCT scheme, and its public acceptability. Specifically we highlight issues of units of measurement, distributive justice within society and households, skills required to 'manage' carbon budgets, and the role, responsibilities and duties of individuals as citizens. We argue these critical areas are currently under-developed in PCT thinking, and we recommend they become priorities for future PCT research in order to more fully understand the potential of this policy proposal.

The flourishing of small-scale bottom-up initiatives based on environmentally-balanced community living, including in some cases moving towards a decarbonised UK economy, indicates that there is interest in citizenly activities for sustainable development. Reflecting upon CRAGs, 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 a key question for PCT: is it achievable?

The notion of a 'common purpose' might not suffice in today's society as a strong enough motivation for UK citizens to enact their personal responsibility towards current and future generations by supporting PCT. Our consumerist culture rewards individualism and personal spending as a means of gratification; climate change is near enough to cause concern, but far enough away to not warrant immediate individual action. Nevertheless, despite the reservations of both politicians and publics to implement more radical measures to reduce domestic CO_2 emissions, we feel that the concept of PCT appears to have merit as a means of making our contributions to climate change tangible, and of exploring how to manage energy demand equitably and efficiently. We feel that the potential of PCT deserves further exploration, alongside other possibilities for individual and community carbon reduction.

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