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A Rough Guide to Individual Carbon Trading

The ideas, the issues and the next steps

Report to Defra

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Contents

Executive Summary

Defra commissioned the Centre for Sustainable Energy in mid-August 2006 to undertake a short study to provide some initial analysis of the ideas and issues involved in the concept of individual carbon trading. The primary purpose of the study was to assess the range of questions which arise when such a concept emerges from the rarefied atmosphere of academic debate and 'think-tanking' to be considered seriously as a potentially practical policy option.

At a theoretical level, individual carbon trading – variously described as personal carbon allowances, domestic tradable quotas, personal carbon rations, carbon credits – is an attractively simple idea. By giving everyone a limited allowance to cause carbon dioxide emissions, total emissions from the population can be limited. Those who need or want to emit more than their allowance have to buy allowances from those who can emit less than their allowance.

This 'cap-and-trade' system thereby has the potential to constrain in an economically efficient, fiscally progressive, and morally egalitarian manner the 40 – 50% of UK carbon dioxide emissions caused directly individuals. This is, of course, assuming both that the political system managing it can maintain and tighten the cap on total emissions and that the population has access to opportunities to curb their own emissions.

The state of the debate (Section 1)

In assessing the current state of the debate on individual carbon trading, we found a range of interests largely focused on the operational minutiae of specific schemes and on examining the minor theological differences between them. Yet the differences between the schemes appear to be less important at this stage than the largely untested assumptions shared by them all about public responses and political feasibility.

We also found a range of arguments being raised against individual carbon trading schemes which make equally untested assumptions about public acceptability (or lack of it), operational problems, scheme costs, and political feasibility. Such arguments often make far more positive (but still largely untested) assumptions about the relative merits of other policies to curb carbon emissions, particularly carbon taxes.

We believe there is a strong risk that the debate on the relative merits of individual carbon trading will descend quickly into confrontational debate in which practical understanding and analysis take second place to the preservation of increasingly entrenched positions.

We conclude that it is important at this early stage to ground the debate quickly in considerations of political and practical feasibility – and that all potential policy instruments for achieving UK carbon emission reduction goals are considered on a similar basis.

The various individual carbon trading schemes (Section 2)

There are three main schemes proposed for individual carbon trading: Tradable Energy Quotas (TEQs by Fleming); Domestic Tradable Quotas (DTQs by Starkey and Anderson at Tyndall – a development of Fleming's work) and; Personal Carbon Rations or Allowances (PCAs by Hillman, Fawcett and Boardman's team at Oxford).

The principal variables with the schemes are:

Participation: who participates (individuals, organisations, or both),

Allocation: to whom are permits allocated and what proportion of national emissions are included
Scope: what carbon emissions are included

All share a similar approach to system management:

- an independent body sets and polices the cap, with limits established well in advance
- people can either surrender allowances as they buy energy, petrol or flights, or they could sell their allowances in advance and pay for the carbon as part of the price of each qualifying purchase (as visitors to UK would).
- individuals would have something like a carbon credit card to 'swipe' to surrender their allowances from their carbon allowance accounts.

	TEQs	**DTQs**	**PCAs**
Participation	Individuals (40% free) and organisations (60% tendered, principally to market makers from whom organisations then buy as required)	As TEQs	Individuals only (assumes organisations covered by another, unspecified scheme). At least 40% of UK emissions (i.e. all domestic plus aviation)
Allocation	Adults only equal per capita (plus organisations as above) on weekly rolling basis	As TEQs	Adults full equal per capita allowance; children under 18 half an allowance
Scope	Gas, electricity, coal, oil, road fuels	As TEQs plus personal aviation	Gas, electricity, coal, oil, road fuels, personal aviation, (not public transport)

The main areas of dispute and debate between the schemes relate to the approaches required to prevent fraud, the inclusion (or exclusion) of children, and the inclusion (or exclusion) of personal air travel.

Section 2 also examines voluntary trading schemes, offsetting at point of purchase, upstream trading and carbon taxation.

Other relevant fields of research (Section 3)

There are a number of other fields of research which may be relevant for understanding the implications of introducing and operating an individual carbon trading system.

Research for the Financial Services Authority indicates that less than 20% of UK adults have financial problems caused by being poor at making ends meet and keeping track of their finances. If this research 'reads across' to carbon allowances, most of the population would be able to manage and keep track of their allowances. It may not be relevant to understanding how well people would be able to deal with trading, though the approach taken in the FSA research may well enable such questions to be explored more fully.

Literature on loyalty cards exposes the scale of system development which has been achieved in other fields of consumer behaviour. Simplistic estimates indicate that Tesco Clubcard is collecting, storing and analysing some 50 billion pieces of data a year from the company's financial

transaction system as 12 million cardholders buy their shopping. This compares with an estimate of 15 billion pieces of data a year for an individual carbon trading system.

Literature exploring (variously) the introduction of the Euro and public responses to the introduction of VAT on domestic fuel and increases in road fuel duty may also help inform understanding of the operational, political and public implications of introducing individual carbon trading.

What we need to know about individual carbon trading (and how little we already do know)

Section 4 details a range of questions which need to be answered to enable a reasonable assessment of individual carbon trading as a future policy tool. These cover:

- Political Acceptability (what are the conditions for political acceptance?
- Political and institutional viability (what is needed institutionally to make it work?)
- Public reaction and 'acceptability' (how will the public understand it, react to it and respond within it?)
- Related measures (how does it relate to other policy instruments, particularly other trading schemes?)
- Market reaction (what will happen in energy, housing, transport markets and what 'carbon trading' schemes and scams will emerge without careful management?)
- Technical and operational feasibility (can it work and be resilient and sufficiently fraud proof – and can the banking system provide the foundations?)
- Set up and operational cost (how much to set up and run?)
- Economic impact (how does its impact compare with other ways of constraining carbon in the economy?)
- Equity, justice and distributional impacts (who wins and who loses, by how much and where?)

Most of the questions detailed here have yet to be answered and, in much of the literature, have yet to be asked.

There is analysis which concludes that it would be **technically feasible** to run an individual carbon trading scheme but no real estimates of **cost** or even system specifications. A presumption that any system would need to be highly resilient to fraud (even though the value of carbon allowances is likely, at least initially, to be relatively low) has tended to cloud the debate on costs with that surrounding biometric ID cards. A more simple approach may be to look to the existing banking and financial transaction systems to manage carbon accounts and transactions, and to existing government personal databases for allocating allowances to individuals.

In terms of **economic impacts**, we have found no attempts to model the impact of introducing individual carbon trading. We also note that any such modelling in future must distinguish between the general economic impact of constraining the economy's carbon emissions and the particular impact of using an individual carbon trading scheme to do so.

Modelling to date of **distributional impacts** indicates that individual carbon trading is less regressive than carbon taxes (particularly if personal air travel is included), even if a carbon tax system manages to optimise the recycling of revenues through the benefits and tax credit systems to compensate those of lower incomes. Indeed, individual carbon trading can be moderately progressive.

Section 4 also examines some of the possible interactions between a system of individual carbon trading and upstream trading such as the EUETS, a post EEC3 energy supplier cap-and-trade, and current UK Climate Change Programme policies.

Developing a road map (Section 5)

Using the questions identified in Section 4, we consider a sequence in which the questions could be answered to build up sufficient knowledge and understanding to enable rational and informed decisions to be made about the value of individual carbon trading as a policy tool. These are mapped out over a five year period (see Section 5.2).

We also explain why we believe that it would not be a good idea to initiate a public pilot of individual carbon trading, either in the near future or at all. This principally because the main issues with any such scheme are the quality of the transaction system (which will inevitably be unrefined and fault-ridden in a public pilot) and the compulsory nature of participation (which cannot be tested in a pilot).

We suggest instead a programme of system development and testing 'off line' (as occurred with the London Congestion Charge, which was never publicly piloted) and the development of simulation games and trading system games to see how individuals and groups respond. Such an approach, alongside other steps on the road map, will expose weaknesses and frustrations in any system while also gathering 'real world' carbon emission data for individuals and households which could assist modelling work.

The first year 'next steps' in the road map focus on:

Political acceptability:	Understanding the basis on which politicians would decide to do this
Institutional feasibility:	Exploring how our political system (electoral cycles, oppositional politics, need for independent authority) could handle this
Public reaction:	Understanding the basis on which people will judge a system 'acceptable'
Modelling:	Improve models of individual carbon emissions and improve understanding of abatement opportunities and costs to create 'testing rig' for systems and model distributional impacts (particularly fuel poverty)
Systems design:	Examine potential for full alignment with banking system and simple allocation system based on existing registries

We believe that focusing on these questions early will provide solid foundations to base future assessments of the potential value of individual carbon trading as a policy tool to curb domestic carbon emissions in the UK.

1 Introduction

Following undertakings made in the Energy Review 2006[1] and ideas explored publicly by the Secretary of State[2] in July 2006, Defra commissioned the Centre for Sustainable Energy in mid-August 2006 to undertake a short study to provide some initial analysis of the ideas and issues involved in the concept of individual carbon trading.

The primary purpose of the study was to assess the range of questions which arise when such a concept emerges from the rarefied atmosphere of academic debate and 'think-tanking' to be considered seriously as a potentially practical policy option.

What do we need to think about, find out, model, or test, to establish whether this concept has practical merit in the real world? How does it compare with, and relate to, other tools of public policy and private persuasion designed to achieve the same objectives?[3]

1.1 Outline of this briefing

This briefing therefore describes the various individual carbon trading schemes which have been proposed and some of the differences and 'disputes' between them. We then examine the technical, economic, social and political issues which arise from these schemes to expose what is and is not 'known' – and we compare this with other approaches to carbon trading (such as voluntary schemes, upstream trading, and offsetting).

We also review how a scheme might interact with other anticipated policy instruments, most notably the EU ETS and the post-EEC3 cap-and-trade household energy supplier obligation. We touch on other areas which may have relevance to questions of technical and political feasibility (specifically supermarket loyalty cards, research into financial literacy, the launch of the congestion charge).

Finally we make an attempt at drawing a road map both to identify the issues which need to be addressed in further studies and also to set out a sensible and politically logical order in which to sequence future work.

First, we examine briefly the key features which make individual carbon trading an attractive concept in theory – and two key characteristics which demonstrate why it is not the policy panacea sometimes claimed.

1.2 What makes individual carbon trading attractive: Guaranteed emission controls through 'enforced' personal responsibility

At a theoretical level, individual carbon trading – variously described as personal carbon allowances, domestic tradable quotas, personal carbon rations, carbon credits – is an attractively simple idea.

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1 HM Government (2006, *The Energy Challenge: Report of the Energy Review*, DTI, July 2006 (see www.dti.gov.uk/energy/review/page31995.html)

2 Speech by David Miliband at the Audit Commission, 19 July 2006, at www.defra.gov.uk/corporate/ministers/speeches/david-miliband/dm060719.htm)

3 Readers should note that this briefing was not commissioned to answer the question of whether individual carbon trading has practical merit; its intent is to identify the issues which need to be thought about, found out about and decided upon to reach an answer.

By giving everyone (or at least every adult) a limited allowance to cause carbon dioxide emissions, total emissions from the population can be limited. Those who need or want to emit more than their allowance will have to buy allowances from those who can emit less than their allowance.

It is an attractive idea because it has the potential to constrain carbon dioxide emissions in an economically efficient, fiscally progressive, and morally egalitarian manner.

If the total allocation of allowances is lower than the existing total carbon dioxide emissions, then emissions will have to reduce to fit within that 'cap'. The cap could therefore be set and tightened over time to reduce emissions in line with international agreements, or nationally adopted targets or community or organisationally determined ambitions. Carbon emission reductions could potentially thereby be guaranteed in the half of UK emissions caused directly by individuals.

Such theoretical certainty in a 'cap-and-trade' system is generally not available from carbon tax-based systems which may not set prices at the right level to change behaviour enough to avoid emissions. It is also not available from restrictive regulation which tends not to pre-empt new ways the population finds to use (and waste) energy or the new and additional journeys it chooses to make. Cap-and-trade neatly side-steps debates about the extent to which energy efficiency initiatives will deliver reductions in carbon dioxide emissions.

Because allowances can be traded, economic theory suggests enticingly that the system should result in carbon emission reductions at lowest cost across the population compared with approaches which rely more on regulation or government intervention. Why, the theory asks, would anyone buy allowances to emit carbon dioxide from someone else if it were cheaper for them to reduce their own emissions?[4]

Individual carbon trading can potentially be fiscally progressive. If allowances are allocated on an equal per capita basis, those who emit more carbon than average (who tend to be richer) will be buying allowances from those who emit less than average (who tend to be poorer).

Individual carbon trading is also attractive because it appears to reach aspects of human behaviour which seem to be immune to other policies and programmes. It can both enforce and incentivise individual responsibility amongst a population which has so far appeared unable and/or unwilling to constrain its collective urge to drive, fly, and consume more electricity[5]. And by explicitly involving the entire population in reducing carbon emissions, it maximises the collective intelligence and imagination applied to the task.

1.3 What individual carbon trading cannot do: Cap-setting and enabling individual action

However, the simplicity and apparent effectiveness of individual carbon trading as a policy tool can lead to an impression that it will inevitably deliver carbon emission reductions. Even if it proves to be a practicable proposition – which, as this report examines, is by no means yet demonstrated – it is no such panacea.

The carbon emission reductions delivered by individual carbon trading will depend on the cap set for total individual allowances. This cap will be set not by climate scientists or by proponents of

4 To sustain this theoretically pure conception of humans as economically rational beings – rather than habit-driven and subject to advertising and cultural norms – economists argue that if anyone does pay more to emit rather than reduce their emissions, it is because they are taking account of 'hidden transaction costs' which haven't been costed properly into external assessments of the price of emission reduction.

5 What Tadj Oreszczyn has described as "our innate ability to think of new ways to use energy"

'contraction and convergence' but by politicians or their appointees. The policy tool has the theoretical capacity to deliver significant emission reductions, but only if it is wielded effectively by politicians to cap emissions.

Similarly, the introduction of a system of individual carbon allowances will not make it immediately any easier for people to take action. It may motivate them to take action but it will not enable them to do so. At the outset, it is unlikely to change quickly the availability or cost of low energy products, public transport, or microgeneration installations or to make it safer to cycle in a city.

Individual carbon trading is not therefore a substitute for other policies to stimulate emission reductions. It may, by motivating individuals to act, serve to amplify the effectiveness and reduce the costs of other policies. But it will not remove the need for those other policies.

These are important considerations because public acceptability and positive response to individual carbon trading is likely to be related to the ease with which the public can source information, select products, access services and change behaviour to cut their carbon emissions.

Individual carbon trading will not therefore avoid the need for tough political decisions about emission reduction targets or about the proportion of emission reductions which will be expected from individuals (as opposed to organisations).

And it does not avoid the need for other policy action to stimulate and sustain action by individuals and organisations – to create a market and society in which carbon cutting action is straightforward, signalled and supported.

1.4 Our starting point

We do not start this study from a position that individual carbon trading is a 'good and feasible idea', or a 'good but unworkable idea', or even 'just a bad idea'. We do not believe there is currently enough evidence and pragmatic consideration of the concept to form any such opinion.

We see a range of quite proprietorial interests debating the relative merits and details of different trading schemes (or a carbon tax alternative) without recognising that they all share some basic assumptions, particularly about public responses and political feasibility.

These assumptions remain largely untested even though they are probably far more important to the overall credibility and practicality of trading or tax schemes than either the operational minutiae or the minor theological differences between schemes.[6]

We also see a range of arguments made against individual carbon trading schemes which make equally untested assumptions about public acceptance, operational problems, scheme costs and political feasibility.

We perceive in this debate a risk that individual carbon trading attains the same 'panacea or poison' status amongst policy-makers and policy-shapers that carbon taxes did in the late 1980s. The simple, shiny beauty of the pure idea blinds protagonists to the need to realise it in the real world of political decision-making and public reaction. That emerging 'panacea' status also

6 For example, detailed study appears to have been undertaken (Starkey & Anderson 2005) into the length of time that people would have to queue in a petrol station to pay for their petrol with their carbon allowance either on the same swipe card as their money or using a different one. While this may be a relevant impact to consider in due course, little study (if any) appears to have been devoted to exploring more fundamental questions such as the basis on which the public might judge the acceptability of such a scheme (which may or may not include the length of time taken to make carbon-based transactions).

encourages sceptics to take up strong positions against the proposition. The result is a confrontational debate in which practical understanding and analysis take second place to the preservation of increasingly entrenched positions. We believe it is important at this early stage to ground the debate quickly in considerations of political and practical feasibility.

We do start from a position that meeting the Government's stated ambitions to reduce emissions by 60% by 2050[7] will require the adoption of policies and programmes which are significantly more effective than current activities in stimulating deep and lasting cuts in emissions.

If "something must be done", the questions we need to be asking are: (a) whether individual carbon trading *could* be part of that something (is it technically, economically and politically feasible and effective?) and (b) whether individual carbon trading *should* be part of that something, bearing in mind the possibility that there may be other more effective alternative policy tools.

We start from the perspective that individual carbon trading will have to be considered politically acceptable if it is to be adopted as a policy tool. Without political acceptability, individual carbon trading will not be introduced. Yet none of the literature has examined explicitly what may determine its political acceptability.

In Section 4 we endeavour to describe the various questions we believe will need to be answered for politicians to consider it acceptable. Central to this will be public reaction and engagement. As with political acceptability, the public's likely reaction to individual carbon trading has hardly been examined within the academic literature. Initial discussions for this project with various experts point to the likelihood that public acceptability will be heavily influenced by:

- the design of the scheme (efficiency and ease of use)
- the extent to which it ensures that there are no special privileges or 'free-riders' (both within the population but also organisations and possibly other countries)
- the perceived ease of action and anticipated cost of inaction (i.e. carbon)

7 Or any greater emission reduction target adopted to reflect latest scientific evidence of the risks of climate change

2 Existing Proposals for Individual Carbon Trading

This section examines the body of academic work that has been carried out in the area of individual carbon trading to date. It identifies the different 'schemes' put forward as well some specific areas of debate and dispute between proponents. In addition, because there is also a debate about the effectiveness of 'cap-and-trade' versus carbon taxes as a more practicable alternative, we examine the relative merits of taxes and trading.

In the time available for this study, this cannot be an exhaustive examination of the academic literature. It was also not possible in the time to make contact with all of the proponents to explore uncertainties in more depth. However, we believe it can provide enough detail to enable informed decisions about the next steps required. Section 4 examines in more depth what is known, and more importantly, what isn't known about individual carbon trading.

2.1 Individual or 'Downstream' carbon trading schemes

All proposals for downstream carbon trading in the literature involve an authority setting allowable community-wide carbon emissions for a given period. Known as the emissions cap, this quantity is distributed according to certain principles among the community's population in the form of emissions permits for the accounting period, which is generally 12 months.

The permits are a tradable commodity. Over the accounting period, participants who emit less than their allowance can sell their surplus permits to others who have emitted more than their allowance. At the end of the accounting period all participants must have surrendered permits in proportion to their carbon emissions. In theory the effect is to limit emissions to the level of the cap while distributing carbon savings in the most efficient way possible.

From this starting point, a number of primary design choices differentiate the possible implementations of downstream carbon trading in the UK, including:

Participation

- Who participates in the system: individuals, organisations, or both?

Some of the schemes propose individual carbon trading as a component of a larger trading system covering all UK emissions. Others focus on systems which cap individual (rather than organisational) carbon emissions through allowances tradable between individuals, leaving organisational emissions to be managed by other mechanisms.

Allocation of permits

- What proportion of the emissions cap is allocated to individuals versus organisations, and on what basis (auctioning, rationing or grandfathering?)
- Do children receive an allowance, and if so what size?
- Are permits issued free of charge, and if not, how are they distributed?

These choices represent some of the key areas of difference/debate between various schemes and their proponents. A common characteristic across all proposals is that individuals are issued their initial allowances on an equal per capita basis, free of charge. On the other hand, where organisations participate they are expected to pay for their initial allocation, typically via an auction (usually along the lines of a Government Debt Tender) rather than by an allocation plan.

Scope

- Which fuels or activities are included in the scheme?

A complete scheme covering all carbon emissions from UK energy consumption would include gas, electricity, oil, coal, private road fuel, public transport, and domestic and international aviation.

2.2 Typology of existing proposals

2.2.1. Tradable Energy Quotas (TEQs)[8]

This proposal is for a domestic carbon trading system involving all individuals and organisations. It is advocated by its author as a solution to both climate change and future fossil fuel shortage.

Overall carbon cap:

- Independent 'energy policy committee' sets overall carbon budget (ie cap), based on national emissions reduction target.
- 20 year rolling budget set at start of scheme. Yrs 1-5 binding, yrs 5-10 firm, yrs 10-20 forecast. 1 week's worth of permits added every week, so minimum of 51 weeks on market at all times.

Participation

- Participation is compulsory for all individuals and organisations including the government.

Allocation

- 40% of overall ration allocated to adults free of charge. 60% issued via tender to 'primary dealers' who sell on to organisations in secondary market (based on domestic/non domestic proportions of UK emissions).
- Weekly tender of quotas for organisations. Market makers (eg banks) participate and sell on to organisations (eg their clients).
- All adults given equal units, children given none.

Scope

- Gas, electricity, coal, oil, road fuels (aviation is not mentioned).

System management

- Individuals can opt out of the process by immediately selling their units (bank account required), and then buying back from the market alongside energy (carbon) purchases. Those without a registry account (eg tourists) buy this way too (effectively 'pay as you go').
- Register of accounts maintained by separate specialised entity.
- All permits are identical, and all individuals and organisations have access to the market. Traders earn their income via buy/sell price spread.
- Permits are surrendered in proportion to carbon 'usage', and passed up the transaction chain from final users (individuals and organisations), via retailers, wholesalers, and producers, before finally being surrendered back to the registry which issued them.
- The system generates revenue via a weekly tender of rations for organisations (equal to 1/52*60% = 1.15% of overall ration for the current year).

8 Fleming (2006) *Energy and the common purpose.* David Fleming. 2006. www.teqs.net

2.2.2 Domestic Tradable Quotas (DTQs)[9]

Described as a cap-and-trade scheme for end users of energy, the DTQs proposal is a detailed technical analysis by Tyndall Centre in support of Fleming's proposal (see above) for a domestic carbon trading system involving all individuals and organisations. Initial allowances are free to individuals but auctioned to organisations. The key difference with Fleming's proposal is that the DTQs scheme includes aviation. A diagram of how the system is expected to operate can be found in Appendix 1.

2.2.3 Personal Carbon Rationing [or 'Personal Carbon Allowances' (PCAs)]

Introduced by Mayer Hillman and Tina Fawcett (Policy Studies Institute) in 'How to save the planet' (Penguin 2004), this is a proposal for domestic carbon rationing and trading for individuals only.

Overall carbon cap:

- Covering about 40% of all UK emissions, with another mechanism needed for the remaining 60%.
- Phased annual reductions in the overall cap correspond to the national emissions reduction target, and are signalled well in advance.

Allocation of permits

- The system is compulsory – it is assumed that free-riding would derail a voluntary scheme.
- There are equal annual rations for all adults, and smaller rations for children.

Scope of emissions

- All household energy use and personal travel including all aviation (this appears to rule out public transport).

System management

- Based on a carbon credit card debited whenever carbon is consumed.

There is an assumption built into this scheme that organisational emissions will be addressed through other cap-and-trade schemes or policy instruments.

2.2.4 Rate All Products and Services

Qualified as unfeasible in its description by Starkey and Anderson (2005 – see footnote 9), the proposal is to allocate 100% of all UK emissions permits to individuals, but then rate all products and services available in the economy according to their associated/embodied carbon emissions, deducting the appropriate amount from allowances when individuals purchase goods and services.

2.2.5 Ayres Scheme

This proposal is similar to Domestic Tradable Quotas, but differs in that 100% of the total allowance is initially allocated free of charge to individuals (as opposed to 60% being auctioned to organisations). Organisations then have to buy permits from individuals (via market makers), so that the revenue from the sale of permits to organisations goes directly to individual permit sellers rather than to the government. This avoids a grandfather-based assumption about the proportion

9 Starkey and Anderson (2005), *Investigating Domestic Tradable Quotas: a policy instrument for reducing greenhouse gas emissions from energy use*, Tyndall Centre, TR29, 2005 at www.tyndall.ac.uk/research/theme2/final_reports/t3_22.pdf

of carbon allocated to organisations, by assuming that only individuals have an intrinsic right to emit carbon, and that organisations must effectively lease this right from individuals. However, it creates the need for a potentially far more complex auction involving millions of individual sellers, rather than one which involves only organisations, market makers and the Government.

2.2.6 Sky Trust[10]

The Sky Trust concept involves an upstream trading system within which permits are auctioned to fossil fuel suppliers. The revenues from the auction are invested into a trust which pays equal dividends to all citizens. As a result the cost of carbon is factored into fossil fuel prices, and the system will tend to appear to downstream entities (individuals and organisations) as a (variable) carbon tax, with revenue recycled on an equal per capita basis via the trust fund.

2.3 Voluntary trading systems

Voluntary trading systems could take the form of any of the schemes discussed above, but with the modification that participation would not be mandatory. Alternatively a mandatory system could be envisaged in which there were rewards for staying within a given carbon allowance, but no penalties for exceeding it. These rewards could be delivered in the form of direct financial benefits, or virtual currencies (such as the Nectar points scheme). Neither approach can hope to have the same impact as a compulsory scheme.

In the first case there would be no way of controlling either overall emissions, or the proportion of overall emissions covered by the scheme. Indeed, as carbon within the system became constrained and the price of permits increased, participants in a voluntary system could be expected to withdraw in inverse proportion to their commitment to the issue. The system could quickly become meaningless as the total emissions covered by it got smaller and smaller, and participants perceived those outside the system as free-riders. In effect one would have the effort and the expense of setting up and running a downstream trading system, but with none of the benefits in terms of the guaranteed emissions controls and market efficiencies of a universally mandatory cap and trade system.

In the second case carbon emissions would not be constrained either. The system would reward carbon reducing behaviour relative to a theoretical personal allowance. Effectively, this would be a carbon reduction subsidy, as opposed to a carbon consumption tax, although the two could be run in parallel, possibly leading to revenue neutrality. However, the weaknesses of tax based instruments relative to permit based instruments would apply (see Section 2.8 below), in that there would be no certainty over total emissions, because the costs of compliance and the cost of damages are unknown, and the price elasticity of energy demand is low.

Such voluntary schemes might prove an interesting way to engage people who have so far been uninterested in taking action to reduce their carbon emissions (which appears to be most of the population). In addition, a voluntary scheme might provide some useful data on how people managed their carbon allowances. However, by definition, a voluntary scheme will not include people reluctant to participate or incapable of understanding such a scheme.

10 See www.usskytrust.org

2.4 Offsetting at the point of purchase

There are two possible approaches to carbon offsetting. The first is through third-party offset companies which offer carbon audits followed by emissions offsetting through a range of projects, often dominated by tree planting, but also including actual carbon reduction projects. There are significant problems with this approach because: (i) the long term value and security of carbon sinks created through afforestation is uncertain, and; (ii) there is a danger of double (or more) counting carbon offset from international energy projects, where these are not regulated under the Joint Implementation or Clean Development Mechanism systems of the Kyoto Agreement. Overall this approach to carbon offsetting risks discouraging real emissions reductions while offering a potentially false sense that the emissions have been nullified by the offsetting activity.

The alternative approach to carbon offsetting is to purchase and retire emissions permits from an existing carbon market, such as the EU ETS. With small volumes of carbon relative to the overall EU emissions cap, offsetting via buying and retiring permits from the EU ETS would appear a simple and attractive prospect. Indeed, it is preferable to using unregulated third party offset companies, in that the retiring of permits genuinely reduces the overall size of the cap on the EU market – the retired permit can no longer be used, so the saving is truly additional to that envisaged within the EU market, as defined by the cap.

However with significant volumes of carbon, using the EU market to offset emissions by non-participants would create problems. The power of an emissions trading system lies in its ability to distribute carbon savings across participants efficiently, but this can only work when all participants are fully within the trading system, so they have an initial allowance within the cap and can both buy and sell permits. If non-participants were to purchase and retire large numbers of permits, they would both raise the price of carbon and force market participants to achieve collective emissions reductions over and above the cap.

However there is no reason to assume that these carbon savings would be occurring in the most appropriate (ie cost efficient) places: an implicit and arbitrary assumption would have been made, such that the participants in the EU ETS have the most economically efficient set of carbon reduction opportunities in the economy. Coupled with a genuine shortage of permits, the increased price of carbon would have implications for the competitiveness of the participants in the EU ETS, because there really is no reason to assume that the participants in the EU ETS can *efficiently* reduce their CO_2 emissions sufficiently to offset an arbitrary proportion of UK carbon emissions, whatever the price of carbon.

A mandatory offset system would also unpredictably increase energy costs in the UK, although because of the price inelasticity of energy demand, this would not necessarily lead to reduced emissions in the UK.

Overall therefore, the idea of mandatory offsetting of UK carbon emissions in the EU ETS at the point of purchase could well represent the worst of both worlds: it works but is not meaningful until hot air in EU ETS is used up, at which point the price of EU carbon is driven upwards, carbon savings are no longer distributed based on cost or efficiency, the competitiveness of EU ETS participants is harmed, and UK energy costs are directly increased by a trading system the UK Government does not control.

2.5 Upstream trading systems

As a general management principle it is efficient to distribute responsibilities to parties (people and organisations) according to the degree to which they are equipped to discharge them. This is a sign of a well designed contract – or a 'compact' in political science terms. However it leads to a criticism of the principle of upstream carbon trading: suppliers of fuels and energy services are not directly responsible for demand, and they start with no commercial interest in reducing it.

As a result, while it is appropriate to require carbon intensity reductions from, for example, electricity generators, it is illogical to either penalise them for increases in electricity demand, or to reward them for reductions. The ability to manage end-use electricity demand rests principally with the end users of electricity. The same applies to the aviation, gas and road fuel supply sectors. While suppliers clearly have some influence (through advertising and direct customer relationships) they do not have control over the marketing of plasma screen televisions, patio heaters or high performance SUVs, or over the demographic changes which are driving up energy demand.

Of course, this does not mean that, if the government did impose such a scheme on upstream companies like energy suppliers, that these players would not take actions to control their customers' energy demand. This may include: partnerships with retailers and manufacturers to restrict energy use in equipment; tariffs which increase in price as usage increases; increasing the rate of deployment of low carbon technologies etc.

The main attraction of upstream carbon trading is its simplicity. There is a small and limited number of potential players, so administrative costs and complexities are low. On the other hand, an upstream market focuses the creative thinking of a tiny number of people on reducing emissions, most of which are not in their control, compared with a downstream system. In this respect the comparison is analogous to one between a centrally planned versus a market economy.[11]

However, energy suppliers may prove difficult to persuade to take on such responsibilities in the absence of other Government action to tackle consumer energy demand. Moreover, it is undoubtedly true that Government is potentially better placed than energy suppliers – in terms of policy levers and influence – to deliver actions which manage consumer demand, particularly in terms of regulatory moves to improve efficiency and curb wasteful applications.

It should also be noted that an upstream carbon trading system will appear principally as a (variable) carbon tax from a downstream perspective. As discussed in Section 2.8 below, taxes do not lead to efficient carbon reductions overall, when the marginal cost of damage is unknown. The price inelasticity of energy demand also means that one cannot rely on efficient downstream responses to upstream price signals.

In the end, the choice between upstream and downstream carbon trading must involve a comparison of the relative administrative costs per tonne of carbon saved from each option. In such an analysis a premium should be placed upon the certainty with which such savings are made, given the importance of managing emissions overall. We have not undertaken this analysis, but *suspect* that over the long term, greater and more efficient carbon savings would be available through a downstream system, particularly if carbon savings are weighted according to the certainty with which they can be achieved.

[11] In addition, downstream trading will create a market in which energy suppliers will have to adjust their business activities as a result of real consumer behaviour, rather than as a result of the imposition of quotas by government which would be the case in an upstream system such as a supplier cap-and-trade.

2.6 Other options

Two other options present themselves. The first is an already-mooted extension of the EU ETS to include a larger number of smaller energy-using organisations. This is not an alternative to individual carbon trading, but could be used to cover a proportion of UK organisations, potentially even all organisations, depending on the energy use threshold set for participation. Coupled with upstream carbon trading in the fossil fuel sector, such a system would cover carbon emissions from all UK energy use including from the domestic sector.

The disadvantages of this approach include those associated with upstream carbon trading in general – ie domestic end users would experience an effective carbon tax, which would not have predictable or manageable effects on demand/emissions, and would also be regressive relative to an individual trading system. Another problem would be the difficulty of extending the National Allocation Planning process to cover a much larger number of organisations, although this issue could potentially be handled by auctioning the UK portion of EU ETS permits to all UK organisations.

Alternatively, the expanded ETS for organisations could sit alongside an individual carbon trading system to cover domestic sector emissions, avoiding the problem of only creating price signals with an upstream system.

The second option is a hybrid of a tax and a permit based instrument. This is discussed in more detail in Section 2.8 below, but would comprise a cap and trade system within which the minimum (floor) and maximum (ceiling) prices of carbon permits were set by the Government. If the market price fell to the level of the floor, the system would behave as a subsidy, while conversely if prices rose to the level of the ceiling the system would behave as a tax. In theory such hybrid systems are economically more efficient than either a pure tax or a pure permit based instrument, and have the advantage of containing the economic impacts of the instrument, although this comes at the cost of reduced certainty over emissions reductions.

2.7 Main areas of debate and dispute

2.7.1 Feasibility and fraud prevention

The Tyndall study (Starkey and Anderson 2005) has examined technical and operational feasibility of DTQs in some depth. Their conclusions are transferable to other schemes.

Debate over feasibility tends to focus on the difficulty of creating a fraud-proof allocation system in the absence of a fraud-proof national population registry. There appears to be general acceptance of the feasibility of creating a system for carbon allowance transactions alongside the financial transaction. However, there is debate over whether the need for fraud prevention requires any allocation system to be linked in some way to biometric ID cards (a debate driven principally by a wish not to tar individual carbon trading with the disputes around ID cards). As discussed further in Section 4.2.1, the perceived need for a link to ID cards is largely dependent on the presumed level of resilience to fraud required in the system rather than any intrinsic quality of individual carbon trading.

2.7.2 Allocations to children

Scheme proponents differ over whether children should be allocated allowances. Those against children receiving an allowance (eg Boardman, pers comm.; Fleming, Starkey and Anderson)

justify this on the basis that children are not ‘players’ in the energy market in that they do not work, earn money or purchase energy.

However, this argument would apply equally to one of every pensioner couple since the energy bills tend to be in one person’s name and many pensioners no longer drive.

Those who are in favour of providing children with carbon allowances (Hillman and Fawcett) tend to provide them with half of an allowance. This appears to reflect a compromise between the ‘not-a-player’ argument and the egalitarian “equal rights to emit” argument. It also reflects a sense that children do contribute in some way to their household’s carbon emissions, both through increased energy use in the home as a result of children’s presence and purchase and use of appliances, and increased need and demand for travel.

The importance of this issue relates to the fact that the more individuals allocated carbon allowances the smaller the allocation per person. Clearly this has a distributional effect of moving benefit from childless households (eg pensioners) to households with children, which will tend to favour families at the expense of pensioners and single person households. Dresner and Ekins (2004) have explored this issue in some depth. Their analysis reveals that both pensioners and households with children will gain on average if children each receive half an allowance (see Table in Section 4.2.4) while households with children lose out (and pensioners gain significantly) if children are excluded from the allocation scheme.

As we shall examine in Section 4, the question of allocation to children is an important issue to explore with the public and to model in more depth.

2.7.3 Inclusion of personal air travel

While there has not been considerable debate, a clear difference between proposed schemes is the extent to which they include personal air travel. It is omitted from Fleming’s TEQs scheme but included in Starkey and Anderson’s version of this. This is an integral part of PCAs and justified on the basis that this is the fastest growing source of carbon emissions from individuals (Fawcett 2005). Indeed, if UK air travel were included in national emissions data for the UK, there would have been no reduction in carbon emissions from the UK since 1990. Its inclusion in PCAs is also justified to ensure individuals are considering not only their ‘essential carbon emissions’ (achieving adequate warmth, basic travel etc) with more ‘discretionary’ driven emissions (short-break holidays in Europe, patio heaters etc).

The ‘insulate your cavity walls if you want to fly abroad’ trade-off is intrinsically attractive to those who have been trying to persuade people to take up energy saving measures for the last 20 years!

However the data on the use of personal air travel and the carbon emissions it causes is somewhat unrefined at present (eg Dresner and Ekins 2004).

2.8 Taxation and Trading[12]

Taxation versus permits: trading certainties over price and quantity

Tax and permit instruments can both be used to achieve environmental policy goals. Price based instruments allow certainty about the cost of compliance with the policy, but with uncertainty about the resulting level of pollution. Conversely, quantity (ie permit) based instruments give certainty about the level of pollution, but with uncertainty as to the cost of compliance.[13]

Where the cost of compliance is known, economic theory sees tax and permit based instruments as equivalent. However in most real world circumstances the cost of compliance is not known, and the relationship between the level of pollution and the resulting damage dictates whether taxes or permits lead to economically more optimal outcomes – ie outcomes in which aggregate welfare (wealth) is maximised. This relationship is referred to as the marginal damage curve. In general:

- taxes are favoured when the marginal damage curve is flatter
- permits are favoured when the marginal damage curve is steeper

A theoretically ideal (ie economically perfectly efficient) system would create an environment within which the penalty for non-compliance (whether it was through a tax, or the need to buy permits) closely matched the marginal damage cost, leading participants to accurately internalise the environmental externality. [14]

There are two further permutations of price and quantity based instruments. The first is a hybrid in which a ceiling is placed on the price of a permit. If market conditions lead to permit prices exceeding this level, the system behaves like a tax. This approach is essentially a permit trading system with a safety valve: the maximum possible cost of compliance is defined by the permit price at which the tax kicks in. The UK Renewables Obligation is an example of such a hybrid – electricity suppliers are expected to purchase buy-out certificates if they are cheaper than the cost of compliance with the renewable electricity target. In effect some price certainty is obtained at the cost of some quantity uncertainty.

In addition, a minimum permit price can be set, which is effectively a subsidy to a seller or a tax to a buyer. The effect of this is to encourage pollution reduction when the permit price would otherwise be too low to achieve this end. Combining these two options gives a system in which minimum and maximum values for the price of a permit are known. The theoretical benefit is that the permit price curve more accurately resembles the marginal damage curve, leading to higher aggregate welfare (aka wealth)[15]. Of course, for this benefit to be verified, the real shape of the marginal damage curve would have to be known.

The case of climate change

There are significant complexities and uncertainties around climate change and its impacts. The problem is international. We do not know the cost of compliance with a given emissions reduction target, and because of the long atmospheric lifetime of carbon dioxide and nonlinearity of the climate system, we also won't know what the marginal damage curve looks like until it's too late to

12 Oxera 2003 paper. Pizer 1999 and 1999.

13 In the cases of both price based instruments (eg taxes) and permits (eg allowances within caps), the 'certainty' of the theory here is entirely dependent in practice on the resolution of the politicians or regulators who set the taxes or cap the allowances in maintaining the required levels throughout the period.

14 Though in the real world, real people may still not act appropriately, since their purchasing decisions and energy-related behaviours may be driven as much by habit and other factors as by price and rational economic analysis.

15 Oxera 2003, page 7.

do anything about it. Furthermore there is no basis for assuming a linear relationship between greenhouse gas emissions and the cost of damages from climate change. Indeed climate science suggests that there is a number of potential 'positive feedback' mechanisms, such as disruption of the Atlantic Conveyor, or disruption of methane hydrates on the ocean floors, which if triggered would lead to highly non-linear effects.

As the Archbishop of Canterbury said recently, "the economy is a wholly-owned subsidiary of the environment". The potential costs of climate change are so high as to be unquantifiable in anything other than economically theoretical terms, and much of the damage from climate change will be irreversible. This means that a premium should be placed on the certainty with which policy instruments can deliver greenhouse gas emissions reductions, leading to the conclusion that permits are more appropriate instruments than taxes for delivering climate policy objectives.

However political considerations are as important if not more so than theoretical ones. The perfect system may be exist in theory, but is of little benefit if it cannot be implemented in practice. In political terms a hybrid system may well be more palatable than a pure permit trading system, since it would be inherently more predictable in terms of its economic impacts. A hybrid system would also offer more 'fine-tuneable' controls, since in addition to the overall cap, the floor and ceiling permit prices could be used to adjust the behaviour of the system.

3 Relevant work in other fields

We could not find or imagine analogues in other fields of human activity for individual carbon trading beyond rationing during and after World War 2. However, we could find some areas of service development, system management and research which could prove useful to consideration of the feasibility of individual carbon trading. These are supermarket loyalty cards (for speed of development and take-up and operational systems), the introduction of the Euro (ditto plus adaptability of the population to new currency systems), and recent financial literacy research (for understanding the population's capacity to manage money and therefore, by analogy, a carbon allowance).

These are not examined in depth here since that is beyond the scope of this briefing. However, we can draw out possible implications for individual carbon trading from the financial literacy research. We can also expose the scale and sophistication of systems developed for Tesco's Clubcard to demonstrate that the underlying systems for an individual carbon trading scheme are likely to be well within the technical limits existing operations of UK retail customer databasing and transaction tracking.

3.1 Financial literacy research

Recent research for the Financial Services Authority by the Personal Finance Research Centre at the University of Bristol[16] (Atkinson et al 2006) provides a detailed insight into the financial capabilities of the UK population, based on a large sample size and sophisticated statistical analysis.

Through earlier research work the research team had identified 4 areas or 'domains' which together could be considered as representing financial capability: 'managing money', 'planning ahead', 'choosing products' and 'staying informed'.

As explored below, these domains may well have some relevance to the ability of the population to manage a 'carbon budget', to keep track of their allowance, to plan actions to prepare for future tighter constrains on their carbon emissions, and to take advantage of favourable market conditions (eg cutting emissions to selling allowance when carbon prices were high and/or buying when prices were low).

The FSA research examined both how the population rated on each of the domains. They also analysed the factors which were underlying the range of overall financial capability scores to see if different groups of people achieved their scores through different combinations of ability on the domains.[17]

'managing money': how well people live within their means and keep track of their finances.

The research found that many were good at living within means but some were a way below the average. Nevertheless, most people were average at keeping track, implying that even those finding it difficult to manage their money, still knew how much money they had (or hadn't).

16 Atkinson, A, S McKay, E Kempson & S Collard (2006) Levels of Financial Capability in the UK: Results *of a baseline survey*, Consumer Research Paper 47, Financial Services Authority, March 2006 (see http://www.fsa.gov.uk/pages/library/other_publications/consumer/index.shmtl)

17 For example, an average overall financial capability score could be a combination of average scores across all four domains or two good scores and two poor scores.

'planning ahead': how well people prepared for likely future significant changes in income or expenditure, such as retirement, making provision for 'the unexpected' etc

The research found significant variation, with it being nearly as common for people to show no evidence of planning ahead as it is for people to have made careful plans.

'choosing products': how well people make decisions about financial products, their suitability for their circumstances, the information they seek.

Most people score poorly on this one, bar a few exceptional cases.

'staying informed': how well people keep in touch with economic trends, developments in financial products and services, and sources of advice and help.

As with 'choosing products', most people score poorly on this domain.

Through cluster analysis, Atkinson *et al* found that more than a third of the population (36%) were good across all four domains, and that these comprised mainly well-off older couples. A further 13% (older, lower income, mainly women) were very good at making ends meet and planning ahead but did not stay informed.

16% of the population were very poor at everything except keeping track of their money which they were particularly good at. There are a disproportionate number of younger low income women and parents with children in this group. With few financial products, they would probably be considered financially excluded.

Overall, about 24% were not good at making ends meet and keeping track (as opposed to poor on other factors). More than a third of these (9% of the total) have high incomes and many financial products (indicating that their failure to keep track may not be a problem). However 3% of the total were disorganised financially and struggling, often with children, on low incomes (though not necessarily lower than others who are coping).

Atkinson et al's financial literacy factors map quite well onto what might be considered relevant for the capacity of the population to manage its individual carbon allowances.[18]

'Making ends meet' is obvious in a carbon allowance context.

'Planning ahead' would relate, for example, to ability to factor future emission reductions into investment decisions on buying energy-using equipment, building improvements, and plans to travel long distances by plane or car .

'Choosing products' aligns with the extent to which people understand the options, seek appropriate advice and make effective decisions.

'Staying informed' would relate to the extent to which people keep track of what is happening to carbon targets and carbon prices, what is happening in other sectors, what new technologies and techniques are emerging etc.

If the findings of this FSA study read across to how well people would manage their carbon allowances, there may be less than 20% of the population who would find it difficult and

18 Though, since carbon would have a price in such a system, it may anyway become closely associated with money in people's minds

problematic to keep track and 'make ends meet'. The main difference is the potential for individuals to trade allowances, either to buy[19] or sell, which is not easily analogous to money management (since most people do not regularly buy or sell shares).

As identified in Section 5, there are a number of questions regarding the population's ability to understand and manage a carbon allowance which need to be researched further. The analysis undertaken by Atkinson et al in relation to financial literacy may provide a useful way to approach such research.

3.2 The scale of UK loyalty cards

There are now some 12 million Tesco Clubcards, 11 million Nectar cards and 15 million Boots Advantage cards in regular use in the UK. Estimates vary between 65% and 85% for the proportion of households which have at least one loyalty card.

However, the scale and rate of take up of loyalty cards is probably less relevant to individual carbon trading systems than the findings that: (a) people seem perfectly prepared to buy things using more than one card per transaction, and; (b) these companies have established enormous databases which securely store personal data and vast amounts of transaction data.

For example, if the average Tesco Clubcard holder buys an average of 20 items per week and the Clubcard database captures the details of the item, how much it cost and when and where it was bought (i.e. 80 data points per week per Clubcard), the Clubcard database is collecting some **50 billion pieces of data per year**.[20]

This is all happening 'live on line' as part of the customer's financial transaction (in some cases with companies other than Tesco). Tesco then provides monthly written feedback to customers detailing their expenditure and the current state of their Clubcard account (in terms of points earned and redeemed in the month). Clearly, Tesco believes that there is a strong commercial case for the investment in the databasing, transaction systems, and customer communications which Clubcard represents.

Clubcard shows the scale at which such systems can be developed to operate with little inconvenience to the consumer. In addition, in Tesco's use of the data, we see how large volumes of customer specific data can be useful to understand patterns of behaviour and develop or adjust services and 'offerings' to make the consumer experience easier or more rewarding or simply more profitable for the store.

3.3 Other fields of potential relevance to individual carbon trading

A number of other fields can be identified which may be fruitful to explore in further studies to help understand how the public might interact with the introduction and operation of individual carbon trading.

The first is the introduction of the Euro – in which the populations and banking systems and retail transaction systems of 9 countries in the EU simultaneously switched overnight from their own currency to the Euro. This required a major exercise in system development and a major consumer education programme. It should be noted that the Euro was not formally piloted with the

19 Buying allowances would clearly engage with an individual's financial literacy.

20 By way of contrast, Starkey & Anderson (2005) estimate 60 transactions per year per personal carbon allowance holder. With a maximum 60 million carbon allowance holders and perhaps a similar 4 data items to be recorded per transaction, this totals less than 15 billion pieces of data per year.

public ‘to see if it would work’. Instead, the banking systems were tested extensively in parallel with existing systems. And public reaction and understanding was exhaustively assessed in opinion polls, focus groups and (in some countries) referenda (and thoroughly courted by both protagonists and antagonists in the debate).

The second area, as discussed in section 4.2.1, is the operation of the UK banking system itself. What is the potential to use (for individual carbon accounting and trading) the financial systems used to manage accounts, register, ‘clear’ and settle transactions, prevent fraudulent acquisition of money, and sustain consumer confidence?

A third area for study is the introduction of the Congestion Charge in London. This was technically complicated and publicly – apparently – unpopular in advance of its introduction.

It would also be instructive to consider public reaction in the past to attempts to introduce or increase possible alternatives to individual carbon trading – such as household energy carbon taxes (or its proxy ‘VAT on fuel’ in the early 1990s) and road fuel duty increases (in the early 2000s).

4 What do we need to know about individual carbon trading?

4.1 The questions that need answers

This section provides a critical examination of the state of knowledge about individual carbon trading required to make a reasonable assessment of its credibility as a future policy tool. As such it endeavours to cover the full range of issues relevant to the practicalities of introducing individual carbon trading in the UK. These include providing answers either now or in the future to the following interconnected questions.

Political acceptability

- Are there adequate and credible answers to all the other questions here?
- Will politicians be able to believe the public will wear it (whatever the polls & focus groups say)?
- What constituency of support needs to be in place to make this credible?
- Can all the conditions for success be put in place simultaneously and the down-side risks covered? (or 'how much of a gamble is this?')
- Is there an alternative – particularly one with greater benefit and/or less political risk?
- How fraud-proof does it have to be (i.e. is there a linkage to biometric ID cards?)
- What are the stories the objectors will use to attack the proposals and can these be convincingly countered?

Political/institutional viability

- Can we commit to it beyond our term of office and/or on a sufficiently long lead time to enable it to happen?
- Is cross-party agreement a necessary condition for public acceptance (and is it feasible)?
- Does its control and the 'cap-setting' need to sit outside the political process to protect it from any short-term instability in political commitment if, for example, carbon prices rose dramatically (à la Monetary Policy Committee)?
- How would carbon accounting for individual carbon trading interact with other carbon trading systems (eg energy supplier cap-and-trade or EUETS etc) – i.e. who ultimately owns and 'cashes in' the carbon savings?

Public reaction and 'acceptability'

- On what basis would the public consider individual carbon trading 'acceptable'? How would they conceive it (eg rationing?) and what might shape that conception?
- Would they understand it and react appropriately to it (or can it be designed so that they will with some education and support?)?
- How will the public react [in terms of their energy using and travelling behaviour, carbon-related purchasing habits (eg appliances and vehicles), and home energy performance]? Will they trade?
- What factors will influence their opinions and determine their willing involvement (or stimulate their active rejection)?
- What are the important differences between different segments of the population?
- How could the issue be 'framed' in communication terms to maximise acceptance and effective reaction?

Market reaction

- How would the markets in energy, housing, energy using equipment, micro-renewables, vehicles, public transport and aviation markets react to such a scheme?
- What secondary financial products might emerge to take advantage of the new carbon currency (eg carbon allowance loans, futures in carbon allowances, etc)?
- Do we know (or can we guess) all the games, scams and rip-offs the less scrupulous will design to take advantage of an individual carbon trading system? (the carbon allowance loan shark?)

Technical and operational feasibility

- Will it work and be sufficiently stable and meet politically acceptable standards of resilience to fraud?
- How long will it take to set up systems to work?
- Who would set up, control the process and run the systems?
- What accounting period would be most suitable?

Set up and operational cost

- What will it cost to set up and run?
- How reliable are these estimates?
- Who will pay?

Economic impact

- What is the economic impact of introducing such a scheme (cf constraining carbon emissions in other ways)?[21]
- What do the Marginal Abatement Cost Curves for carbon emissions look like for different segments of the domestic sector?
- What level of trading is likely to take place and what factors will influence this and the price of carbon?

Equity, justice and distributional impacts – both socially and geographically

- Who will win and who will lose financially (depending on cost of carbon)? (household income, rural vs urban, housing condition etc)
- Beyond financial impacts, what other issues are there in terms of access to opportunities to reduce emissions (information and advice, products, services, capital etc)?
- Are there 'crunch points' where, after some emission reductions, the cost of cutting carbon emissions increases dramatically for certain types of people (eg with particularly housing types or travel needs etc) which may alter the distributional impacts?
- What are the implications of extreme weather conditions (eg particularly cold winter) on overall demand for carbon (and how might the system handle these)?
- Are there mechanisms for avoiding or correcting these inequities within or outside the system?
- How do these impacts compare with those caused by other ways of curbing carbon emissions?

There are clearly many important relationships between these questions. Many of them have a direct influence on each other. For example, feasibility and cost is likely to be partly dependent on the tolerable level of risk of fraud – which is a political question (and possibly also a public acceptability question). If the starting point is that system needs to be extremely resilient to fraud, it will probably have to be linked with biometric ID cards or the like (thus conflating this approach with a completely different objective and system – and raising different issues for public acceptability and system cost and feasibility). However, if the tolerable level of fraud is more in line with that for benefits and tax allowances, it may be technically feasible to use existing benefits and tax registers (eg national insurance and child benefit) to manage the allocation of carbon allowances.

Similarly, modelling may demonstrate that individual carbon trading is fiscally progressive (i.e. the poor do better out of it on average than the rich). But that doesn't mean that the public will understand this or 'think it through' and not draw their own conclusions from a mistaken

21 Individual carbon trading will constrain the carbon emissions of the economy. However, the economic impact of this constraint (be it positive or negative) should not be confused with the economic impact of the particular policy tool(s) used to establish the constraint.

assumption that any scheme in which 'the rich can simply pay to carry on polluting' is inherently unfair or ineffective.[22]

In Section 5 we consider the relationships between these questions and propose a sequence in which it makes sense to develop answers to them. As mentioned in Section 1, the over-riding question is one of political acceptability, since without that being achieved, individual carbon trading will not be introduced.

4.2 The limited knowledge to date

It is reasonable to say that, beyond some detailed assessment of the technical feasibility of individual carbon trading and some analysis of distributional impacts, most of these questions remain unanswered (and, in much of the literature, unasked). The following section analyses what we do know from the literature and identifies some of the key areas for further examination in future. There are some significant and surprising gaps.

4.2.1 Technical and operational feasibility

Starkey and Anderson (2005) underpin the generally held view that it would be feasible to set up and operate an individual carbon trading system, irrespective of the exact typology. Their Tyndall centre briefing sums up virtually all of the work which has been undertaken on technical feasibility.

Their detailed investigation concludes that the know-how exists to establish a database system to hold and manage securely the carbon 'accounts' of the population an enable over-the-counter and remote trading. And the existing infrastructure for credit and debit card transactions (including Chip and PIN) could be used to surrender these in payments for energy, fuel and other qualifying uses (eg air travel).

Starkey and Anderson started from a presumption that the system would need to be highly resilient to fraud and abuse. They therefore explore in detail the extent to which the system would need to be aligned with a national population registry established for an ID card system. They also recognise that it may be possible to use similar systems to verify identity as used by the financial services sector. This would increase the risk of fraud but not beyond levels found within the banking system.

This distinction between the allocation system (which ensures each individual receives only their allowance), the accounting system (which holds the information about each individual's carbon allowances at any given time), and the transaction and trading systems is helpful.

The issues need to be teased out. Starkey and Anderson appear to assume that the banking system can only provide a transaction system and that a new system would need to be developed for managing accounts and verifying allocation. We believe this underplays the potential for the banking system to also manage accounts. Our own knowledge of the banking system[23] upholds the view that both the accounting and transaction systems could be integrated with the existing banking system. Carbon allowances can be treated as bank accounts (with units of carbon as the 'currency').

22 A number of responses to David Milibland's blog certainly took a vehement stance in opposition to individual carbon trading on the grounds that "if you're rich you just buy as many carbon credits as you want and if you're poor its just tough" – without stopping to think who the rich might be paying for the credits.

23 One of the authors was Commercial Manager and then Head of Personal Banking at Triodos Bank for 4.5 years

Banks are familiar with reporting systems (such as those used for ISAs) to enable a regulator to monitor overall monetary holdings, detect fraud etc. They also have existing identity verification systems (principally designed for anti-money laundering and fraud prevention purposes) which (as Starkey and Anderson acknowledge) could be used for ID verification as people set up carbon accounts (either individually or jointly). The regulations governing ISAs already require banks to have systems to ensure individuals can only hold one of these tax-free savings accounts each in the banking system and can only subscribe a limited amount of money during any tax year (irrespective of withdrawals).

This assumed potential for creating a 'carbon currency' system within the existing banking system needs to be examined further. If feasible as assumed here, it would greatly reduce the complexity and cost of establishing both the accounting and transaction system since they would simply sit within existing systems with new reporting requirements to the trading scheme's regulatory body.

The allocation system – which ensures that each eligible individual gets their allowance (and only once in the relevant period) – may also be more straightforward than Starkey and Anderson have assumed. There are national registers for national insurance (all adults) and child benefit (all children) which could be used to check eligibility and trigger 'carbon payments' into the carbon accounts which have been set up by individuals and their banks. It is only if a particularly high level of resilience to fraud is considered necessary (a political question) that more robust (and as yet non-existent) ID verification systems would be required.

Bearing in mind that the likely market value of allowances, at least initially, will be rather lower than many existing benefits and tax allowances, a rather lower level of fraud-proofing may be appropriate than Starkey and Anderson assumed with their examination of the need to link allocation to ID cards.

This approach would avoid the need for major and costly new IT infrastructure, with the focus being on allocation of payments and then reporting, monitoring and control systems. It would also avoid conflating individual carbon trading and ID cards which have completely different political and public acceptability and feasibility issues. We believe this option should be explored as a first step in the road map (see Section 5).

4.2.2 System costs

The problems identified above in the literature relating to technical feasibility also cascade into assessments of the cost of setting up and operating an individual carbon trading system. The main work undertaken, by Starkey and Anderson (2005), acknowledges that it has not attempted to cost the system since it has not yet specified it. However, they believe it would be simpler and therefore cheaper than a national biometric ID card system. They also conclude that, since the government seems keen on the latter, they would also be prepared to pay the cost of a system for individual carbon trading.

This is a false comparison and conclusion. The two systems (individual carbon trading and ID cards) have completely different purposes so the justifiable cost for one has no bearing on the justifiable cost for the other.

The appropriate cost analysis for the system set up and operating costs for individual carbon trading is the cost per tonne of carbon saving which it delivers compared with the policy costs (in tonne per carbon saved) of other policy instruments designed to reduce carbon emissions from the domestic sector.

On these grounds there have been arguments (eg Dresner 2005) against the need to set up a new system for individual carbon trading since it would be simpler and cheaper to use existing systems (tax and benefit) to achieve the same effect with a carbon tax. For reasons outlined in section 2.8, this assumed symmetry between cap-and-trade and taxation is not valid. If the impact on carbon emissions is both greater and more certain as a result of cap-and-trade, this may justify the cost of setting up a new system.

4.2.3 Economic impacts

We have not found any attempts to model the economic impact of introducing individual carbon trading. We perceive confusion within the literature between the economic impacts (either positive or negative) which result from constraining carbon emissions in the economy with the economic impacts resulting from using a particular policy tool or set of policy tools to do it rather than another. This is a failure to distinguish between the impact of the target and the impact of the instrument used to deliver it.

There is a significant need for more detailed and effective modelling of the drivers, constraints and patterns of individual carbon emissions within economic models used to analyse overall impacts, costs and benefits of carbon emission reduction policies across all sectors. This will need to be built on a better understanding of: the marginal cost of carbon abatement in different energy end uses and different population segments; the potential role of behavioural change; the 'pinch points' at which costs rise steeply for some segments and end uses.

4.2.4 Distributional impacts, equity and justice

Individual carbon trading based on equal per capita allocation of allowances would be fiscally progressive. This is because, in general, "the poor" emit less carbon dioxide than average (particularly if personal air travel is included) and "the rich" emit more than average. The rich will therefore need, on average, to buy allowances from the poor if they wish to sustain their more carbon-intensive lifestyles.

This is the conclusion of detailed analysis by Dresner and Ekins (2004).[24] However, there are still some poor households who lose out and some rich households who 'win'. This is because there are more significant differences in expenditure on energy and travel within income deciles than between income deciles. Thus, while most poorer households emit less than average, many emit more (and vice versa with richer households)

However, as the table below from Dresner and Ekins (2004) shows, even with this taken into account, fewer than 1 in 5 of households in the lowest equivalent income decile would be worse off, and most of those would be worse off by only a small amount (depending on the price of carbon – assumed at £10 per tonne in the table below).

24 Dresner S and P Ekins (2004) *The distributional impacts of economic instruments to limit greenhouse gas emissions from transport*, Policy Studies Institute, London, 2004

Table 12: Effect of DTQs including aviation with a quota for each adult and half a quota for each child				
Deciles	average net change £/year	per cent losers	per cent gainers	per cent losing > £1pw
1	36.31	18	82	3
2	23.55	27	73	2
3	23.10	27	73	4
4	14.48	34	66	7
5	7.32	43	57	8
6	-3.58	47	53	10
7	-7.32	54	46	13
8	-20.23	68	32	21
9	-29.60	75	25	27
10	-42.95	78	22	31
All	0.00	48	52	13
Households with children	+11.14	41	59	13
Households with pensioners	+12.33	32	68	2

Dresner and Ekins also found that individual carbon trading would be more fiscally progressive than a carbon tax, even if the revenues of the carbon tax were all recycled as effectively as possible through optimally targeted increases in benefits and other payments to low income households to address its direct regressive impact. In this optimised case, 30% of households in the lowest decile were still worse off (cf 19% for individual carbon trading)

However, the research has not considered fuel poverty by taking account of housing energy performance and costs. By only looking at actual expenditure on fuel as opposed to required expenditure on fuel, the research may be missing significant negative impacts on fuel poor households.

For example, some households, in the absence of significant improvements to the energy performance of their homes, may need to be spending more on energy (and therefore need more carbon allowances) in order to be warm.

Thus, while only small numbers of low income households lose out financially from individual carbon trading, the introduction of individual carbon trading may exacerbate fuel poverty by making it even harder/more expensive to buy energy for heating. This needs to be modelled and tested (using national house condition data relating to building energy performance) to refine the findings of Dresner and Ekins.

In addition, financial impacts are not the only distributional impacts to consider. It is also essential to understand geographical distribution, including rural/urban and north/south. And, as outlined in the road map, assessment of access to opportunities to reduce emissions (information and advice,

services, products and capital) is also relevant since it is unlikely that provision is evenly spread by income or geography. This needs to be understood to shape future programmes to enable individual action in response to individual carbon trading.

4.2.5 Political acceptability

As we have identified above, political acceptability is fundamental to the feasibility of downstream carbon trading (whether the system includes organisations' emissions or not). To date, there has been very little systematic assessment of this. In Section 5, we have identified a number of questions which need to be addressed, starting with the most basic: "Do we understand properly the basis on which politicians will find this acceptable and make the decision to proceed?"

4.2.6 Public acceptability and response

Bearing in mind the importance in political acceptability terms of public reaction to individual carbon trading (both in reaction to the idea and then in response to the market signal it creates), it is surprising that virtually no work appears to have been done in this field. Almost no one has asked the public in any meaningful or systematic way what they think about the idea or tried to examine how they would respond to the system.

Fawcett (2005)[25] reports on some unpublished research (unavailable to us) by Ragne Low at University of Edinburgh based on focus group discussions of individual carbon trading and carbon taxation. She reported that focus group members identified issues of equity (are they really fair?), feasibility and costs, potential for fraud, and civil liberties implications (perhaps because of the presumed link up with ID cards) as their key concerns.

Other work for the EU looking at public attitudes to environmental taxation[26] indicates that there are also significant concerns regarding carbon taxes with members of the public considering them a 'trick' to raise more taxes (and a lack of trust in promises to 'recycle'), and having no concept of price elasticity (that people might cut use if prices rose).

One of the first steps in the road map must address this lack of understanding of public reaction to the idea.

There is also no evidence of how the public will respond to the market signals created by individual carbon trading. There is a widespread assumption that it will trigger significant change in behaviour – that a scheme would 'reach the parts other policy tools can't reach' but no evidence of this. This appears to be based on the assumption that the introduction of the scheme would focus people on their carbon emissions and that they would be willing and able to act. More work needs to be done on likely public responses – with a potential role for both focus group research and simulation games and exercises.

25 Fawcett T (2005) Presentation to UKERC meeting place workshop on Personal Carbon Trading, Oxford, 2005

26 Eg Dresner S (2002) '*Environmental Tax Reform: What Does Europe Think?*' paper presented at the conference 'The Czech Republic and the European Union', Charles University, Prague, 31 October - 2 November, 2002.

4.2.7 Effect of downstream instruments on upstream investment (and vice- versa)

The effectiveness of upstream trading systems relative to downstream systems depends on the availability and cost of carbon savings upstream and downstream. Another influence in this equation is the way in which upstream signals influence downstream decision making, and vice versa. We have not undertaken research into these questions, but some observations occur:

- The same carbon cannot be counted in two overlapping trading systems simultaneously – if it is, the size of the cap is effectively increased by the degree of overlap.
- Several cap-and-trade systems could potentially co-exist within a national or international cap – but any carbon reductions achieved in one system can only be 'counted' towards that national cap once, and a decision would be needed as to which trading system the carbon savings ultimately had to belong and how they would 'get there'.
- From a downstream perspective, upstream carbon trading appears principally as a variable carbon tax (though, as discussed in Section 2.5 upstream companies may also respond in other ways to try to change downstream consumer behaviour if they can 'count' the resulting savings)
- A large proportion of the low cost carbon savings available in the UK are from downstream energy efficiency improvements
- Carbon taxes do not guarantee emission reductions since consumer reaction to a given price increase is difficult to predict. Because the compliance and damage cost curves of climate change are unknown, carbon taxes can not lead to optimally efficient decisions on carbon abatement. Price signals emanating from upstream carbon trading cannot therefore be relied upon to deliver efficient levels of carbon savings downstream, where a large proportion of the cost effective reduction opportunities lie.
- Downstream carbon trading appears from an upstream perspective as changes in market demand for products (ie fuels and energy services), based on their carbon content and the price of carbon. The effectiveness with which these changes occur depends on how well the downstream market functions – access to information, availability of alternative products etc.

In the UK at present we have a number of supply side and upstream policy instruments in place, but few downstream or demand side measures.

4.2.8 Interaction with post EEC3 cap and trade

If a cap has been set on individual carbon emissions, there is an argument to say that there is no need to also put a cap on energy suppliers, as proposed post EEC3. Indeed, to do so would effectively be providing two caps for the same emissions.

However, as noted in Section 1, there would remain a strong argument for retaining an obligation on energy suppliers to make energy saving measures available to individuals, as has been the case with EEC 1 and 2. This is to ensure that individuals, who have been motivated by the trading system to act, can easily do so because energy suppliers have remained in their role as high profile purveyors of energy saving.

There is also an argument that a cap on energy suppliers would require them to control individual energy demand for which they are not wholly responsible. It is not, for example, obvious that energy suppliers are actively marketing plasma screen TVs, patio heaters, or domestic air conditioning. Introducing instead a cap on each individual's emissions alongside a continuing measures-based obligation on energy suppliers would both restrain emissions at the point of the demand which causes them and it retain the stimulus within energy saving markets to sustain opportunities to act.

This said, it would be possible to establish a cap-and-trade system for domestic energy suppliers in which the cap placed on them for domestic electricity and gas related carbon emissions was an appropriate proportion of the total cap placed on individuals (which would also include petrol and aviation). There needs to be some thinking applied to how the reconciliation system would operate. In any individual carbon trading system, individuals are 'using up' carbon allowances when they pay for gas or electricity. The question to resolve is how energy suppliers get to count that carbon allowance towards their 'cap' whilst retaining the individual's capacity to trade his or her allowance.

For example, by delineating the cap specifically on electricity and gas use within the individual carbon trading system, the approach could be pre-judging how individuals may wish to respond to their allowance. Individuals may, for example, decide that they would rather install domestic air-conditioning and give up leisure flights abroad. Understanding the interaction between such schemes is a subject for further examination in future (see Section 5).

4.2.9 Compatibility/Interaction with existing UKCCP instruments

Regulatory

Planning, Building regulations, Appliance Standards, the Energy Efficiency Commitment
Downstream carbon trading would be entirely complimentary to the existing regulatory climate change policy instruments: at present these are all supply side measures, while downstream carbon trading is a demand side measure.

In contrast, no regulatory instruments are currently being used to directly constrain individual (or organisational) carbon emissions. In all the examples above, the introduction of downstream carbon trading would add a missing ingredient, by creating end-user demand for the supply-side approaches mandated in the regulations. The relationship between downstream carbon trading and the Energy Efficiency Commitment is discussed in more detail in 4.2.8, above.

Climate Change Agreements
The relationship between downstream carbon trading and Climate Change Agreements would depend on whether organisational emissions were included in the scheme. If they were, then those organisations subject to Climate Change Agreements would find themselves under two different carbon management regimes. Given that the whole point of downstream carbon trading would be to use a market instrument to identify and exploit the most efficient carbon savings, it is likely that Climate Change Agreements would be rendered obsolete by such a system.

Taxation

Climate Change Levy (CCL)
The CCL is the only carbon tax currently in use in the UK. Because it applies only to energy used for lighting, heating and power in non-domestic sectors, it would not interact with a personal carbon allowance system that involved individuals only. However, if organisations were included in the system, the CCL would be rendered obsolete: the Government would have the ability to set overall emissions with certainty, so there would be no need to impose additional taxes on carbon emissions.

Trading

EU Emissions Trading System

It has previously been noted that the same carbon cannot be simultaneously counted on two overlapping systems – if this happens, the effect is to double the impact of changes in emissions from the overlapping activities on the collective emissions (ie the sum of the emissions from the two overlapping systems). Our initial analysis indicates that increases in carbon emissions from doubly-traded activities lead to an overall decrease in the collective cap by the same amount, with the converse also being true. This occurs where both markets respond predictably, in the same way, and by the same amount to the creation (or removal) of excess carbon credits. The assumption behind this is that the caps on the two markets are independent and fixed, market participants behave rationally, using the relative costs of carbon credits versus carbon abatement to decided whether to purchase credits or reduce their emissions.

The implication of this is that serious consideration must be given to the relationship between downstream carbon trading in the UK, and the EU ETS. If a UK system covered only individuals, with organisations addressed in other schemes, the only problem area would be emissions from the UK electricity supply industry, which are already constrained within the EU ETS.

Simply establishing the UK system in parallel would mean that any reduction in UK emissions resulting from domestic carbon trading would introduce 'hot air' into the European market, by creating surplus credits for UK electricity generators (see Appendix 1 for diagram showing this). This hot air would be taken up by other emitters, leading to no net reduction in emissions. Meanwhile, surplus credits would also have been created in the downstream domestic market. Assuming (as above) that these are not retired, but are used to cover additional emissions, the overall result would be an increase in the total emissions from both systems by the precise amount of the reduction in UK electricity emissions. The converse is that if UK electricity emissions were to increase, this would have to be offset completely in both markets, leading to a net decrease in emissions by the precise amount of the increase in electricity emissions.

If the downstream system covered organisations as well as individuals, the overlap with the EU ETS would be extended to include all UK participants in the EU ETS. Two obvious solutions present themselves: either UK participants in the EU ETS are excluded from the UK downstream system and the markets kept separate (as happens, by and large, at present), or the EU ETS cap is set to include downstream emissions and downstream trading systems provide carbon savings which EU ETS participants can buy to trade within the EU ETS. As identified above, further work needs to be done to trace the carbon allowances and to establish the interaction between such various caps and trading systems.

Renewables Obligation (RO)

The RO is a 'base and trade' as opposed to a cap-and-trade system, in that it attempts to maximise the production of a 'good', rather than minimise the production of a 'bad'. As a result, it is not directly incompatible with the introduction of downstream carbon trading: the quantity being traded in the RO market is not carbon, but megawatt-hours of renewable electricity, the indirect effect of which is a reduction in the carbon intensity of electricity. Nevertheless in a pure domestic carbon market, where carbon intensity informed choices of electricity supplier, a Renewables Obligation might not be necessary.

5 Developing a road map

Starting from the questions identified at the start of Section 4 and reflecting on the lack of answers to most of these, we have considered which questions would be usefully answered early to refine understanding and improve the quality of information upon which a decision about the future potential value of individual carbon trading can be made.

We have focused here on systems of individual carbon trading rather than systems which also include organisational carbon trading. This is principally due to time constraints and also to respond to the focus of the brief for this work. It does not reflect any judgement on the feasibility or desirability of a full downstream trading system compared with a system involving only individual emissions.

The Road Map is divided into five one year steps, with steps identified associated with politics, public reaction, modelling and system design. These are sequenced in an order which we believe will build up knowledge and understanding in a logical fashion. Readers should reference back to the questions at the start of Section 4 for a fuller explanation of some of the 'shorthand' in the table in Section 5.2.

The first year 'next steps' focus on:

Political acceptability:	Understanding the basis on which politicians would decide to do this
Institutional feasibility:	Exploring how our political system (electoral cycles, oppositional politics, need for independent authority) could handle this
Public reaction:	Understanding the basis on which people will judge a system 'acceptable'
Modelling:	Improve models of individual carbon emissions and improve understanding of abatement opportunities and costs to create 'testing rig' for systems and model distributional impacts (particularly fuel poverty)
Systems design:	Examine potential for full alignment with banking system and simple allocation system based on existing registries

First, we explain our view that it is not good idea to initiate pilots of individual carbon trading.

5.1 Why pilots are not a good idea

There is a significant temptation to rush to pilot an individual carbon trading scheme. However, we would caution against this bearing in mind the poor state of current knowledge exposed in Section 4. We believe that there would be considerable risk attached to a pilot that it would fail for reasons which have nothing to do with the effectiveness or acceptability of individual carbon trading. Similarly, pilot success may not tell us much about larger scale compulsory scheme.

The questions to ask are: What would we be trying to achieve with a pilot or trial? Which questions will it answer?

If the objective is a real-world test of systems, then it is far too early to do this. In addition, while this might be interesting it is almost certainly not necessary; there is potential for extensive simulation testing 'behind the scenes' (as with the London Congestion Charge which was never piloted in public). The risk of testing in public is that systems are unrefined and fault-ridden (because they will inevitably be cheaper and simpler than the final version), leading to failure and subsequent public distrust and ridicule (eg SDI 'Star Wars' initiative in US).

If the objective is to test public reaction, there needs to be a much better understanding first of what that might be so that it can be reflected in the system design. A pilot would probably miss the

most important public reaction of all, which is to the mandatory and national nature of the scheme (with no ‘free-riders’); that cannot be piloted. In addition, using a pilot to ‘see how people respond’ assumes you can create a pilot with no leakage (by annexing the Isle of Wight as some have suggested!), with decent transaction systems and with no sense of ‘free riders’. This is unlikely, making a pilot unrepresentative of the real world.

However, it may be possible to explore likely individual responses by developing and testing simulation games and trading systems games for groups. What individual and collective strategies emerge? Do people bother to trade? What gaming takes place? This would help identify possible weaknesses and frustrations in a system which could subsequently be ironed out. It would also enable the collection of carbon emission figures for different individuals and households to create a more ‘real world’ data set to test in the modelling work.

5.2 A Road Map for a UK System of Individual Carbon Trading

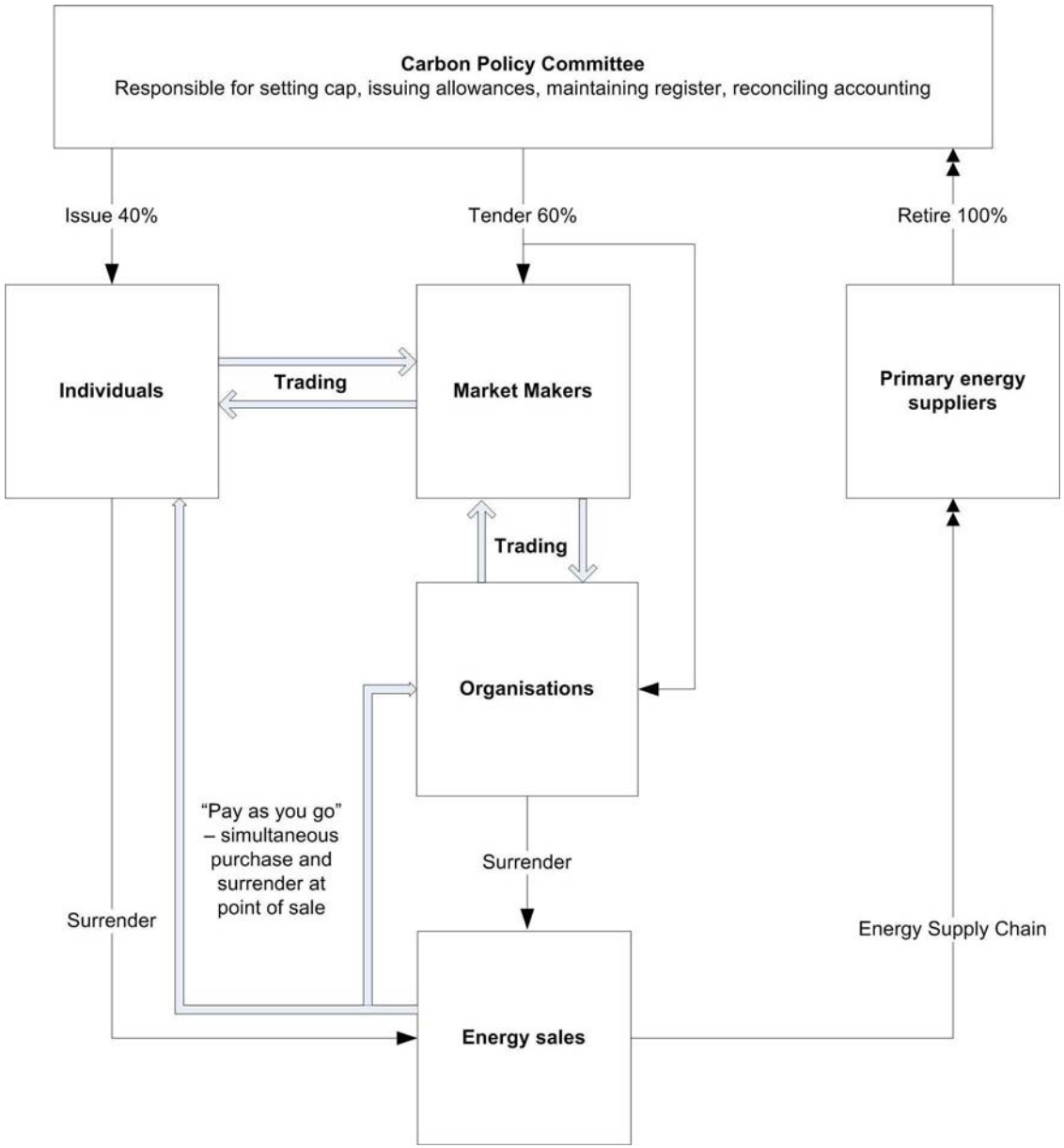
	Politics		Public reaction	Modelling		Technical & costs
	Political acceptability	**Institutional feasibility**	**Public reaction**	**Modelling**	**Equity/ distributional impacts**	**System design and costing**
First 'next-step' questions **Year 1**	• Do we understand the basis on which politicians will make the decision? **Method:** Ask politicians (cross party?) and establish core 'political acceptability' tests to apply to rest of road map steps	• Beyond term of office? • Cross-party support? • Independent authority? **Method:** Ask political scientists (and politicians?) to review conditions historically in which significant long-term changes have been introduced and compare with this situation	• On what basis would the public consider it 'acceptable'? **Method:** Focus groups of different population 'segments' – testing likely opinions and reactions to proposals and exploring perspectives of 'fairness' and 'free riders' (incl. international dimension), tightness of cap, feasibility, cost, fraud, allocations for children etc *Feed results into modelling, system design and institutional feasibility activities*	Prepare tools for modelling impacts and costs/benefits. • Model UK individual carbon emissions and relationship with housing energy performance and actual household income (therefore fuel poverty), travel (incl. aviation) • Reflect housing energy performance & actual household income (fuel poverty) in model to enable key impacts to be assessed • Develop marginal abatement cost curves for domestic sector • Improve data on personal air travel and emissions impacts • Assess economic and distributional implications of different cap levels and emissions reduction trajectory and allocations (eg incl. children) **Method:** Examine existing energy modelling activities within UKERC and Tyndall work programmes to refine methods for achieving above	• Review output of modelling of fuel poverty and distributional impacts Consider rural/urban and other geographical distributional implications of trading scheme	• Is there a simpler and cheaper way to establish individual carbon trading system [eg within the banking system (carbon rather than £ accounts) with allocation via existing registers of individuals (eg NI, child benefit etc)]? • What would it cost and how secure would it be? **Method:** Explore with banks, APACS and LINK. Ask banking system expert to cost set up, operation and estimate fraud risk *Feed costs into modelling strand* • Develop simulation games for step 2 public reaction

	Political acceptability	Institutional feasibility	Public reaction	Modelling	Equity / distributional impacts	System design and costing
Second step **end Year 1**	• Re-test progress against acceptability tests from Step 1 • Answer political questions emerging from other strands (particularly public reaction and equity strands) • Consider constituency of support required	• Feed conclusions into political process and follow through on steps required (eg establishment of cross-party support). • Review in detail relationships and potential operational links with proposed energy supplier cap-and-trade, EU ETS etc	• How will the public respond to individual carbon trading? (eg changes in behaviour, equipment purchasing, building improvements, travel choices) • What factors determine these responses? (eg cost of carbon, access to opportunities and resources to act, socio-economic factors like income, education) **Methods:** Simulation games in organisations or communities Focus groups of different household 'segments' to explore likely responses to trading systems	• Refine model in light of public acceptability results • Explore likely trading and costs of carbon and economic impacts for different caps in different energy price and public response scenarios (eg mainly behavioural change and 'sacrifice' cf investment in lower carbon equipment, vehicles and buildings). Are there 'crunch' points? **Method:** Use refined model as above to test different trading system designs (incl. hybrid with floor and ceiling carbon prices)	• Assessment of access to opportunities to reduce emissions and identify measures to alleviate Identify key "problems" to identify individual circumstances which will be politically sensitive	• Extract system requirements from modelling and other strands and develop appropriate system architecture to deliver (eg transaction networks, trading system access, monitoring, reporting and regulatory requirements) • What will make it easiest for public to understand and participate [eg units of transaction as tonnes (mostly fractions) or kg (lots)] **Method:** Ask experts in public understanding of maths and financial literacy what we already know, then actually test on groups of public • What are all the games, scams, and rip-offs? Can they be designed or regulated out of the system? • What potentially useful secondary financial products would emerge (eg carbon loans/mortgages etc)? **Method**: Ask loan 'sharks', stock market traders, financial security experts.

	Political acceptability	Institutional feasibility	Public reaction	Modelling	Equity / distributional impacts	System design and costing
Third step **Year 2**	• Re-test progress against acceptability tests from Step 1 • Answer political questions emerging from other strands (particularly modelling strands) **Reject or go ahead?** • Build necessary constituency of support and establish manifesto commitment • Develop communications strategy informed by results of step 3 public reaction work • Finalise decisions for operational and strategic control (to feed into tender in system design)	• Consolidate necessary institutional endorsement with manifesto commitments (all parties?) etc • Establish legal framework required to deliver	• What is public reaction to different approaches to communicating and 'framing' of introduction and operation of individual carbon trading? **Method:** Develop and test in focus groups various 'treatments' and communication approaches to the likely scheme	Conclude economic impacts and distributional analysis.		Draw up specification for system design, operation and regulation. Discuss with banking industry, FSA
Fourth Step **Year 3**	• Re-test progress against acceptability tests from Step 1 **Give go ahead?**	• Establish and appoint regulatory authority	• Ongoing tests of public reaction to communications approaches being developed • Develop information campaigns and educational materials to enable people to participate (a la decimalisation, Euro	• Review system testing against modelling		• Tender system design and operation • Test system extensively in simulation
Penultimate step late Year 4	Launch **dry-run** version (available for public involvement but not with trading – to help people establish sense of their emissions relative to likely future cap and to set up joint accounts etc)	• Authority announce cap levels in next X years	• Monitor and evaluate participation in dry-run version	• Review dry-run data against modelling		Launch **dry-run** version
Go Live	**Go Live (cap enforced with trading) late Year 5**					

Appendix 1: Diagrammatic Representations

a. DTQs proposed system (adapted from Tyndall Centre 2005 Technical Report 39, Starkey and Anderson)



b. Possible interaction between a UK DTQs scheme and the EU ETS