



Domestic Tradable Quotas:
A policy instrument for reducing
greenhouse gas emissions from energy use

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This is the final report from Tyndall research project *T3.22* (Domestic Tradable Quotas: A policy instrument for reducing greenhouse gas emissions from energy use). The following researchers worked on this project:

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Abstract

Domestic Tradable Quotas (DTQs) are a “cap and trade” scheme for the reduction of greenhouse gas emissions from energy use. The scheme was proposed by Dr David Fleming, a London-based policy analyst, who first published the idea in 1996. Under DTQs, emissions rights (“carbon units”) are allocated to and surrendered by all end-purchasers of fuel and electricity i.e. adult individuals and organizations. Carbon units are allocated to adult individuals free and on an equal per capita basis whilst organizations purchase the units they require on a national market for carbon units. Individuals with surplus units can sell them on the national carbon market and individuals who require additional units can purchase them on the market.

Project T3.22 set out to evaluate the feasibility of DTQs and their appropriateness as an instrument of public policy. The three evaluation criteria used were equity, effectiveness and efficiency. Key findings are as follows:

Equity

- Strong arguments exist within the philosophical literature on distributive justice that the equal per capita allocation of carbon units under DTQs is equitable.
- DTQs should be implemented in conjunction with policies that build on existing approaches to tackling fuel poverty.

Effectiveness

- It is technically feasible to build a DTQs scheme around the existing infrastructure for credit and debit cards.
- Enrolling 45 million plus individuals into a DTQs scheme might be challenging in the absence of an ID scheme but should be feasible using an approach known as “electronic verification (see Section 5.2 of Technical Report)
- The equal per capita allocation of carbon units to individuals under DTQs may promote public acceptability of the scheme, and the scheme should be sufficiently easy and convenient for the public to use.

Efficiency

- Whilst DTQs might be seen by some as controversial and costly, the scheme is likely to be less costly than current and somewhat controversial government schemes such as ID cards and road user charging and, hence, DTQs are, arguably, affordable in public policy terms.
- DTQs are likely to have greater set-up and running costs than other proposed instruments for emissions reduction but these additional costs may be justified by additional benefits relating to equity, public acceptability and the efficiency of emissions reduction.

Keywords

Domestic Tradable Quotas; DTQs; emissions trading; equity; information technology

Objectives

Prior to the commencement of the project, David Fleming had published a preliminary specification and evaluation of DTQs but there was an absence of other research into the scheme. Given the advantages claimed for the scheme, Project T3.22 therefore aimed

to contribute to the policy debate on climate change mitigation by providing a detailed academic evaluation of the appropriateness of DTQs as an instrument for reducing greenhouse gas emissions arising from energy use.

To provide such an evaluation, three criteria were chosen that are recognized in the literature as appropriate for evaluating environmental policy instruments. These were the “3Es” of equity, effectiveness and efficiency.

Work undertaken

Equity

In much writing advocating the equal per capita allocation of emissions rights, the fairness of such an allocation is asserted rather than argued for. Hence, from an academic perspective, it was felt to be important to ascertain what arguments existed within the philosophical literature to support the equal per capita allocation. Part way through the project, the Policy Studies Institute published significant work on the feasibility of a domestic carbon tax and it was felt to be important to integrate this work into an assessment of DTQs. Equity issues were addressed mainly through a survey of the relevant literature, with some interviews and correspondence with relevant experts.

Effectiveness

Under DTQs, all adult individuals are provided with a “carbon account” in a central database and with a “carbon card” to surrender units from this account when purchasing motor fuel. Various technical and administrative issues were addressed such as (1) the size of the central database that would be required to hold carbon accounts and track carbon unit transactions (2) the potential for carbon card fraud (3) whether the existing infrastructure in place for credit and debit cards could be used for surrendering carbon units and (4) how 45 million plus individuals eligible for carbon units could initially be enrolled into a DTQs scheme. Such issues were addressed both by surveying the relevant literature and by interviewing relevant experts.

To be effective, DTQs would, in addition to being technically and administratively feasible, have to be acceptable to the public. Hence consideration was given to whether the scheme would be sufficiently easy for the public to use and understand and the impact of the equal per capita allocation of carbon units on public support for the scheme.

Efficiency

No detailed assessment of the set-up and running costs of DTQs was attempted but rough order-of-magnitude estimates were made. The potential benefits of DTQs in terms of efficient emissions reduction were also considered. The relative costs and benefits of DTQs were (qualitatively) contrasted with those of other instruments proposed for emissions reduction.

In addition to research relating to the 3Es, an assessment was made of the potential for a smooth transition from the current EU Emissions Trading Scheme (EU ETS) to a DTQs scheme.

Results

In our view, the project has successfully initiated the process of evaluating DTQs as a policy option. However, given the very wide range of issues that need to be addressed, there is significant potential for further work (see below). The main findings of the research are set out below.

Equity

Research to date has established that there are strong arguments within the philosophical literature on distributive justice that an equal per capita allocation of carbon units is equitable. However, in order to ensure equity in the broader sense and protect those on low incomes, it is important that a DTQs scheme should be implemented in conjunction with policies that build on existing approaches to tackling fuel poverty. In our view, individuals should not receive carbon units from birth but should become eligible for units at an age between 16 and 18 and parents should not be allocated additional units as doing so would not appear to be an effective strategy for tackling fuel poverty.

Effectiveness

Our research indicates that it is technologically feasible to build a DTQs scheme around the existing infrastructure for credit and debit cards. Whilst enrolling 45million plus individuals into a DTQs scheme might be challenging in the absence of a successfully implemented personal ID scheme, it should be feasible using an approach known as “electronic verification”.

Those individuals who are not able or do not wish to understand the scheme can sell their carbon units immediately upon receipt and buy all the units they require at the point of sale. In this way, they can

dispense with transacting in carbon units and stick with the familiar practice of transacting in money, thus converting their experience of DTQs into that of a carbon tax. And for those individuals who do wish to transact in carbon units, the processes for surrendering units (plastic cards and direct debit) and trading units (online, phone, over-the-counter) are convenient and familiar.

Allocating carbon units on an equal per capita basis quite literally and explicitly makes individuals equal environmental stakeholders by awarding them an equal stake or share of the atmospheric sink. If the public perceives this equal share to be fair, and if fairness is a condition for public acceptability, then DTQs may promote greater public buy-in to the task of substantially reducing emissions.

Efficiency

It may be objected that DTQs are likely to be both controversial and costly. However, the cost is likely to be less than that of current and, arguably, controversial government schemes such as ID cards and road user charging and in our view is therefore affordable from the point of view of public policy. However, DTQs is likely to have greater set-up and running costs than other instruments but these additional costs may be justified by additional benefits relating to equity, public acceptability and the efficiency of emissions reduction. A more detailed assessment of both the additional administrative costs and potential additional benefits of DTQs is an important area for future research.

DTQs and EU ETS

Our initial research indicates that an evolution of EU ETS into a DTQs scheme is possible but more detailed work is required in this area.

There have been a very considerable number of dissemination outputs from this project (see “Communication highlights” below) and a number of academic papers are in preparation.

Relevance to Tyndall Centre research strategy and objectives

The interdisciplinary nature of this project (see below) means that it fully accords with the overall Tyndall research objectives and, in particular, with the objective of Research Theme 2: “to undertake trans-disciplinary research and assessment of options for reducing atmospheric greenhouse gas concentrations through national and international initiatives”. The innovative nature of the DTQs proposal and its impact upon the policy process means that this project clearly meets the Main Tyndall Task of “innovative agenda setting”.

Potential for further work

Researching DTQs is a decidedly interdisciplinary undertaking, requiring an integrated knowledge of issues relating to climate change, carbon accounting, political philosophy, environmental economics, financial economics, public finance, public administration, information and communications technology, data security and fraud. The wide range of issues to be addressed and the limited research capacity available on this project has necessarily placed constraints on the depth to which we have been able to explore these various issues and hence there is very considerable potential for future work. This includes:

- further work grounding DTQs in the literature on distributive justice
- further study of the relationship between DTQs and policies for addressing fuel poverty
- a detailed assessment of the various information technology issues involved
- a detailed assessment of how to implement “electronic verification” to achieve enrolment in DTQs in the absence of ID cards
- a detailed assessment of the appropriate type of auction arrangement for the sale of carbon units by government
- a detailed assessment of the potential for and consequences of price volatility in the carbon unit market
- a detailed assessment of regulatory structure for carbon market e.g. measures necessary to prevent possible gaming of the market
- a detailed assessment of a system for carbon rating electricity
- survey work assessing public attitudes

- macro-economic modelling of the impacts of DTQs

Communication highlights

At the beginning of the project, DTQs were not widely known within the policy community. However, the project has stimulated a very considerable interest in DTQs and at the end of the project, DTQs are much more widely known and is being taken increasingly seriously as a potential instrument of public policy. Various communication highlights are listed below:

- Presentation by Kevin Anderson (KA) on DTQs to House of Commons' Environmental Audit Committee (Mar 2004).
- Article on DTQs by Richard Starkey (RS) and KA in Guardian (Apr).
- Colin Challen MP presents 10-minute rule bill on DTQs to House of Commons. RS and KA played significant role in drafting of bill (Jul).
- RS gives oral evidence on DTQs to subcommittee of House of Lords Committee on Science and Technology (Dec).
- RS and KA and Colin Challen MP present DTQs to Elliot Morley, Minister of State for the Environment (Jan 2005).
- President of Royal Institute of British Architects (RIBA), George Ferguson, hosts a dinner at RIBA to discuss DTQs with around a dozen invited guests including Stephen Byers and Polly Toynbee. RS gives a 10-minute presentation on DTQs prior to dinner and discussion (Mar).
- DTQs workshop held in London (30 participants) using funds awarded by NERC (Jun).
- Following request from DEFRA, paper on DTQs submitted to Climate Change Programme Review (Jul).
- The Royal Society for the encouragement of Arts, Manufactures & Commerce (RSA) announces launch of half-a-million pound project on DTQs. Decision to launch project in large part due to influence of Tyndall project work on DTQs (Aug)
- RS speaks on DTQs at fringe meeting of Green Party conference. Same day, Green Party adopts principle of personal carbon trading as party policy (Sep)
- RS presents on DTQs at a joint Tyndall/UKERC expert workshop entitled *Taxing and Trading: Debating options for carbon reduction* (Nov). RS also played a role in organizing the workshop, which brought together experts to discuss and debate alternative approaches to reducing carbon emissions from UK energy use.

TECHNICAL REPORT – PROJECT T3:22

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1. Introduction

Domestic Tradable Quotas (DTQs) are a proposed policy instrument for reducing greenhouse gas emissions from energy use. The instrument was proposed by Dr David Fleming, a London-based policy analyst who first published the idea in 1996.¹ Since July 2003, a project at the University of Manchester, funded by the Tyndall Centre for Climate Change Research, has been assessing the feasibility and appropriateness of DTQs as an instrument of public policy.

Section 2 of this paper sets out Fleming's description of the DTQs scheme whilst the remainder of the paper sets out a number of the findings from Tyndall's assessment of the scheme to date. Tyndall's assessment uses three criteria widely recognized as appropriate for the assessment of environmental policy instrument: the "3Es" of equity, effectiveness and efficiency (Gunningham and Grabosky, 1998). Equity is addressed in Section 3, effectiveness in Sections 4-7 and efficiency in Section 8. Section 9 looks at DTQs in the context of the EU Emissions Trading Scheme and Section 10 concludes. Selected communication highlights of the project are set out above and Appendix 1 contains further details.

2. Description of DTQs

2.1 DTQs in brief

DTQs are a "cap and trade" scheme for the reduction of greenhouse gas emissions from energy use, under which emissions rights are allocated to and surrendered by end-purchasers of fuel and electricity. Emissions rights are allocated to adult individuals free and on an equal per capita basis whilst organizations purchase the units they require on a national carbon market. Individuals who surrender less emissions rights than they are allocated can sell their surplus onto the national market and individuals who require rights additional to those they were allocated must purchase them on the market.²

2.2 A slightly longer description

The DTQs scheme can be divided into three elements: (1) setting the carbon budget (2) surrender of carbon units and (3) acquiring units for surrender.

1. Setting the carbon budget

The *carbon budget* is the maximum quantity of greenhouse gases that may be emitted from energy use in a given year by a nation implementing a DTQs scheme. Under DTQs, the carbon budget is reduced year on year in line with national and international emissions reduction targets. Fleming has proposed that, in any given year of the scheme, carbon budgets should be set 20 years ahead, providing a long-term emissions reduction signal to society. He further proposes that carbon budgets are set by an expert independent Carbon Policy Committee, a proposal designed to de-politicize budget setting in same the way that the Bank of England's Monetary Policy Committee is intended to de-politicize the setting of interest rates.

2. Surrendering carbon units

Each carbon budget is divided into *carbon units*, with 1 carbon unit representing 1 kg of carbon dioxide equivalent. All fuels and electricity are assigned a *carbon rating* based on the quantity of greenhouse gases (measured in carbon units) emitted by the combustion of a unit of each fuel and by the generation of a unit of electricity.³ Whenever individuals and organizations purchase fuel or electricity, they are required to surrender to the retailer carbon units to cover the quantity of fuel or

¹ Fleming's published work on DTQs includes Fleming (1996, 1997a, 1997b, 1998, 2005a) and his DTQs website www.dtqs.org. Fleming (2005b) has recently begun referring to his proposed instrument as Tradable Energy Quotas (TEQs) – see his website www.teqs.net.

² DTQs are one variant on the idea of individual emissions trading. Other variants have been proposed by Hillman (1991, 2004), Mayer (1992) and Ayres (1997, 1998). The variant proposed by Ayres is discussed in Section 3.2.

³ The carbon rating of electricity will depend upon the generation mix (see 5.9)

electricity purchased.⁴ For accounting purposes, these units are surrendered up the supply chain and, on reaching the primary energy producer or the energy importer, are passed back to government.

3. Acquiring units for surrender

Carbon units are allocated to eligible individuals by government on a free and equal per capita basis.⁵ (Fleming refers to this allocation as the *Entitlement*.) The proportion of total carbon units allocated to individuals under the Entitlement is equal to the proportion of total energy emissions arising from individuals' purchase of fuel and electricity over a given period prior to the introduction of a DTQs scheme. (In the UK, the proportion is currently around 40%.)

Whilst individuals acquire units free from government, organizations must acquire units for surrender on the national *carbon market*. Units enter onto the market from two sources. First, government auctions onto the market those units not included in the Entitlement (a process referred to by Fleming as the *Tender*). Second, individuals who emit at a below-allocation level ("below-allocation emitters") can sell their surplus units onto the market. Conversely individuals who require additional units ("above-allocation emitters") can, along with organizations, buy on the carbon market. Visitors to the UK (foreign nationals or UK citizens living abroad) are not allocated units and so along with organizations and above-allocation individuals, must purchase them on the market. The following section gives further detail on the carbon market.

2.3 The carbon market

The participants in the carbon market consist of (1) primary sellers (2) final buyers (3) speculators and (4) intermediaries who facilitate trading between primary sellers, speculators and final buyers.

Primary sellers

Primary sellers are those who initially sell units onto the carbon market and, as noted above, they consist of (i) the government and (ii) below-allocation emitters.⁶

Final buyers

Final buyers are those who buy units in order to surrender them and, as noted above, they consist of (i) organizations (ii) above-allocation emitters⁷ and (iii) visitors to the UK.

Speculators

As in other markets, one would expect to see speculation within the regard to carbon units.⁸ Unlike final buyers, speculators would not buy units for surrender but in the hope they could later sell them at a profit.⁹ The role of speculation within the carbon market is an important issue and a topic for further research.

Intermediaries

These are (i) market makers and (ii) energy retailers

⁴ Hence, the number of carbon units surrendered = [Number of units of fuel or electricity purchased] x [carbon rating of unit fuel or electricity].

⁵ The term "eligible individuals" rather than less precise "adult individuals" is henceforth used to describe those individuals who receive an allocation of carbon units – see 3.3.

⁶ As explained in 2.5, below-allocation emitters may also *buy* units for surrender. However, as they are potential *net sellers* of units (see 2.6) they are included in this category.

⁷ As explained in 2.5 and 2.6, above-allocation emitters and organizations may also *sell* units into the market. However, as they are *net buyers* of units (see 2.6) they are included in this category.

⁸ Fleming does not explicitly mention speculators in his description of DTQs, but their participation in the market is implied by/consistent with his description.

⁹ "In a world of uncertainty, most transactions are capable of being interpreted as speculative, but the term speculation is reserved for transactions where expected capital gains provide a major motive. Speculators may buy goods or assets they do not want but whose prices they expect to rise..." (Black, 1997, pp438-9).

i. Market makers: A market maker is

[a] broker-dealer who is prepared to quote buy and sell (bid and offer) prices and to buy and sell specified securities at all times at these prices and is thus ‘making a market’ in them [Bannock et al, 1998, p263].

Market makers facilitate trading within the carbon market by buying units from those participants who wish to sell and selling units to those who wish to buy.¹⁰ As noted above, government is the largest seller of units, auctioning at the Tender all units not included within the Entitlement.¹¹ Fleming has proposed that the Tender is modelled on that for UK Treasury bills and should involve a limited number of participants - primarily market makers - bidding for units (though energy retailers and high-emitting organizations could also participate – see below).¹²

It is anticipated that high street banks and post offices would act as market makers, offering the trading of units as an additional service to customers. However, it could be open to any organization that wished to make a market in carbon units and that satisfied the relevant regulatory requirements to do so. Market makers would buy units at a lower price and sell at a higher price, making their profit from this bid and offer spread and from charging commission on trades. It is anticipated that market makers would make markets not just for the immediate trading of units (a “spot market”) but for the trading of carbon unit options and futures.¹³

ii. Energy retailers: Under DTQs, customers may purchase carbon units from energy retailers (utilities and petrol stations) at the point of sale.¹⁴ To offer this facility, energy retailers will purchase carbon units from market makers, or, if purchasing in very large quantities, may bid for units at the Tender.¹⁵ Those who will use this facility will include eligible individuals who have previously surrendered all their units and visitors to the UK. Take, for example, a customer without units at a petrol station. When the customer buys petrol, the retailer sells the customer the number of units needed to cover the petrol purchase (see 2.4 for a fuller explanation). Hence, the customer’s bill would be the sum of the cost of petrol and cost of carbon units.

Note that although most organizations will buy units from market makers and/or at the point of sale, organizations requiring very large quantities of units may purchase them directly at the Tender.

2.4 Carbon accounts

Who has an account?

All carbon unit transactions involve the movement of carbon units between *carbon accounts* held within a database (registry). All eligible individuals have a carbon account into which the government periodically deposits carbon units (see 5.2). Those organizations that wish to buy carbon units from market makers will require a registry account. However, organizations may choose to buy *all* units at the point of sale, and those that do so will not require an account.

Boxes 1 and 2 below illustrate the difference between (1) an organization (or eligible individual) buying energy and surrendering units previously purchased from a market maker and (2) an organization (or individual) buying units at the point of sale.

¹⁰ Market makers can trade with any person or organization that has a carbon account. This precludes them from trading with overseas visitors (see 2.4).

¹¹ If DTQs was implemented today, approximately 60% of units would be auctioned off in the Tender

¹² For details on the operation of the tender for UK Treasury bills see DMO (2003).

¹³ Spot and futures markets exist currently exist under the European Union Emissions Trading Scheme (EU ETS) and an options market is expected to develop before the end of 2005 (Climate Corporation, 2005).

¹⁴ The exceptions to this are gas and electricity pre-payment customers – see 5.4.

¹⁵ Fleming does not explicitly specify the option of fuel retailers participating in the Tender but such participation would not seem inconsistent with his description.

In Box 1 the customer purchases units from a market maker. Money passes from the customer to the market maker and the units pass from the market maker's registry account to that of the customer. The customer subsequently surrenders units when they purchase energy and the units pass from the customer's registry account to that of the energy retailer.

In Box 2 the customer purchases units at the point of sale. Here, the customer pays the energy retailer for units required to cover their purchase of energy and this money covers the cost of the energy retailer purchasing the required units from the market maker.

In both cases the market maker is paid for the units and the units end up in the energy retailer's account. However, in the latter case, units pass directly from the market maker's account to that of the energy retailer allowing the customer to purchase units without having a carbon account (or using the one they have).

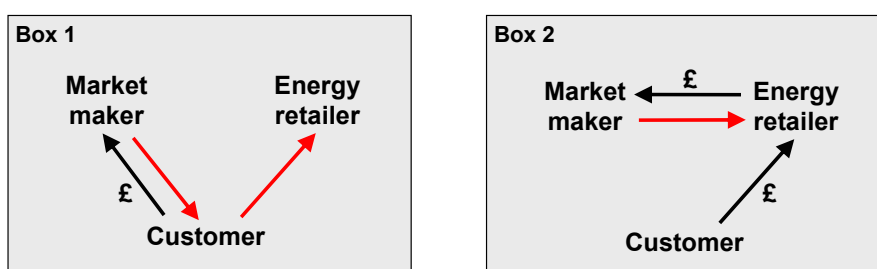


Figure 1: Surrendering units – two routes compared

Whilst eligible individuals necessarily have an account and organizations may choose whether to have one, visitors to the UK are not eligible for an account and hence must purchase at the point of sale.

Surrendering from an account

Units can be surrendered from a customer's registry account in one of two ways. When paying utility bills, units are surrendered by direct debit and pass to the account of the utility. And when paying for motor fuel at garages, units are surrendered by means of a *carbon card* – similar in function to a credit/debit card - which is inserted into a card reader and enables units to be debited from a carbon account.

2.5 From transacting in carbon to transacting in cash

Just as some organizations may choose to purchase *all* units at the point of sale, so too may some individuals. Individuals who do not feel able to manage a carbon account or do not wish to do so can simply arrange with a market maker (for instance, their bank) to automatically purchase their units as soon as they receive them from the government. They can then buy any units they require at the point of sale (as in Box 2). Therefore they do not have to transact in carbon units but can transact purely in cash, and will have transformed their experience of DTQs into one of a carbon tax. There is however a cost to buying all units at the point of sale as the individual's allocation of units will be sold to the market maker at the lower bid price and units subsequently purchased at the higher offer price at the point of sale.¹⁶

2.6 Net buyers and sellers

Below-allocation emitters

Although listed as primary sellers in 2.3, below-allocation emitters may also buy units. For instance, they may choose to have their bank purchase all their units immediately upon receipt and then buy all units at the point of sale. Or they may choose to keep units in their account with the intention of surrendering them but forget to take their carbon card to the petrol station. On such an occasion they would not be able to surrender from their account and so would have to buy units at the point of sale.

¹⁶ See also 6.3 on price volatility.

However, as below-allocation emitters, they have the potential to sell more units than they buy (i.e. to be *net* sellers) and hence their inclusion under the primary seller category. But whilst below-allocation emitters may have the *potential* to be net sellers, it is important to note that they may not be so, for instead of selling surplus units, they may choose to save them to surrender at a point in the future when the carbon budget and their annual allowance of units has shrunk. Although selling or saving units are the only two options explicitly set out by Fleming, it would be possible to design a DTQs scheme so that individuals were also able to (a) gift surplus units to other individuals or to organizations, or (b) retire them. The gifting and retiring of units are explored below.

Gifting units depends on there being a mechanism for the *transfer* of units between accounts. All carbon unit transactions involve a flow of units between accounts. However, the term *transfer* is used here specifically to denote a movement of units that does not also involve the movement of (1) money – as in the trading of units or (2) both energy and money – as in the purchase of energy.

In essence, a retirement mechanism is simply a transfer mechanism between individuals and organizations on the one hand and the government on the other. A retirement mechanism would also require the government not to include in future carbon budgets the quantity of units previously retired by individuals.

It might be argued that, if carbon budgets are reduced in line with what climate science indicates is necessary to prevent (further) dangerous climate change, then there is no need to put systems in place that enable units to be retired. However, conceivably, some individuals might disagree with the emissions reduction trajectory set and therefore wish to retire units. Of course any one individual retiring units would make no real difference to overall emissions, but, it is perhaps possible that large groups of individuals might retire units as the result of a political campaign. More generally, it might be argued that if individuals have rights to emit then they should be able to do with those rights what they see fit - including retiring them - and that unless a retirement mechanism is prohibitively expensive, it should be put in place. (It is probable that the additional cost of including a transfer function within DTQs would not be prohibitively expensive and any transfer mechanism could be designed to incorporate a retirement function.¹⁷)

Above-allocation emitters

Although listed as final buyers, above-allocation emitters may also sell units. This can occur if they choose to sell all their units immediately upon receipt and then buy all units at the point of sale. However, as they will buy more units than they sell, i.e. as they are *net* buyers, they are included under the final buyer category.

Organizations

Organizations that buy units from market makers or at the Tender may at a point in the future have occasion to sell (back) to market makers units that are surplus to requirements. However, as net buyers they are also included in the final buyer category.

Retailers

Although energy retailers will be net (intermediate) buyers of units, like organizations, they may have occasion to sell (back) to market makers units purchased that are surplus to requirements.

Fig 2 represents the flows of carbon units between carbon unit accounts. The solid black lines denote the flows of carbon units that are traded with the thicker lines representing greater flows of units and

¹⁷ In the absence of a formal retirement function units could be retired by individuals simply deciding never to use them, though some might eventually be tempted to do so at a future date when carbon units have become scarcer!

the thinner lines, lesser flows.¹⁸ The dotted red lines represent the surrender of carbon units and the blue lines represent money paid for units at the point of sale.¹⁹

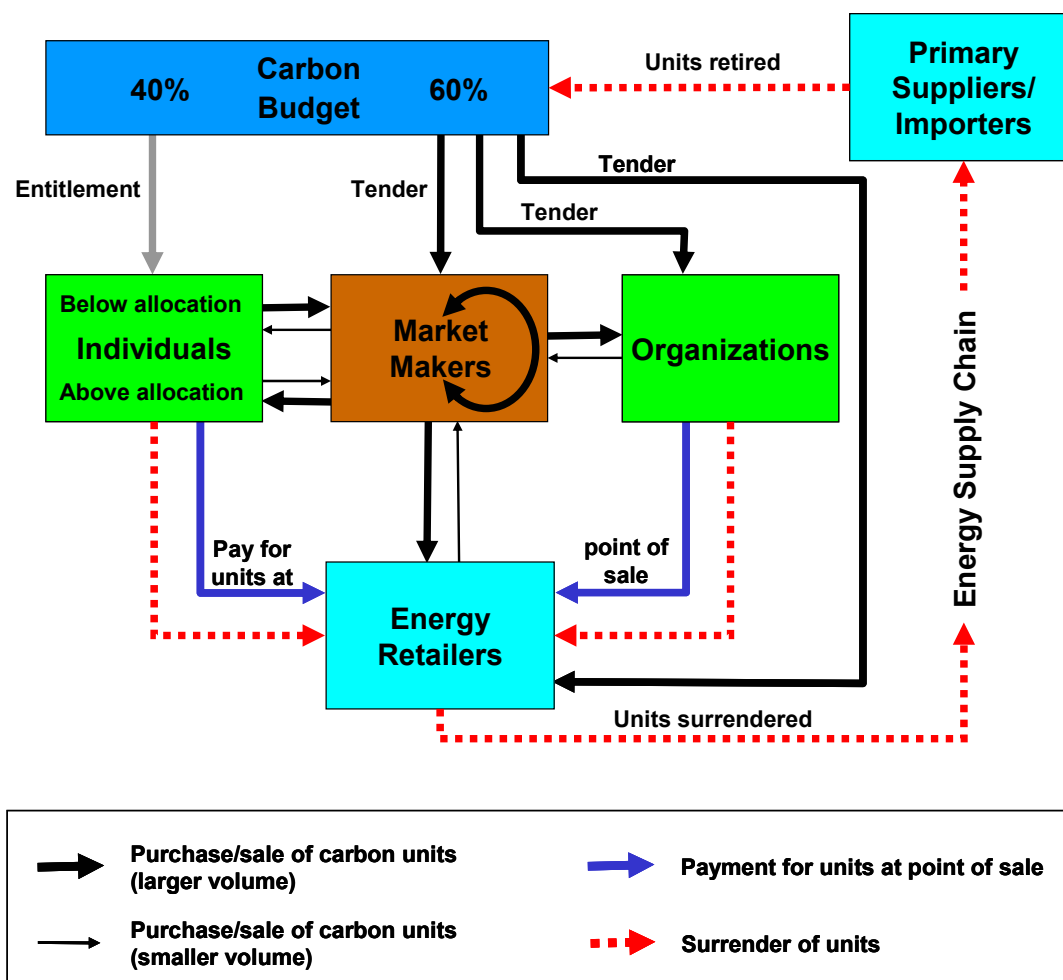


Figure 2: DTQs schema

2.7 Individuals and organizations: who emits what?

Under the Entitlement, individuals are collectively allocated 40% of carbon units which entitles them to release 40% of emissions permitted under the carbon budget. However, it is not the case that individuals will necessarily release this 40% of emissions, with organizations necessarily purchasing the 60% of units sold in the Tender and releasing the other 60% of emissions. In fact, collective individual emissions will equal 40% only if above-allocation emitters purchase a quantity of units exactly equal to the sum of units that below-allocation emitters (1) sell onto the market (2) gift to organizations and (3) retire.

Under DTQs, it is possible for organizations to buy a greater quantity of units than those sold at the Tender, raising their emissions above 60%, and thus bringing individual emissions below 40%. Conversely, it is possible for above-allocation emitters to purchase a quantity of units greater than the sum of units sold onto the market and gifted to organizations by below-allocation emitters. This would raise individual emissions above 40%, and thus bring organization's emissions below 60%.

¹⁸ Speculators are not shown separately on the diagram, but are included within the individuals and organizations buying units from and selling units to market makers. In making a market, market makers will trade amongst themselves, as indicated by the circular arrow within the market maker box.

¹⁹ Other money flows – not shown in Fig 2 – are in the opposite direction to carbon units flows.

3. Equity – Are DTQs fair?

3.1 DTQs and distributive justice

There is increasing political support for allocating emissions rights on an equal per capita basis. For instance, the Royal Commission for Environmental Pollution in its 2000 report on energy, advocated that

every human is entitled to release into the atmosphere the same quantity of greenhouse gases (RCEP, 2000, p2).

However, rarely is a justification for this equal per capita principle offered by its supporters. The Royal Commission, for example, offers no justification at all, and the Global Commons Institute simply asserts that everyone possesses

equal rights to the use of the limited amount of resources of the global commons that is consistent with sustainability (Meyer, 2000, p17).

If one wishes to seek a justification for the equal per capita principle, there is a substantial philosophical literature upon which to draw. This is the literature on distributive justice, that branch of political philosophy specifically concerned to provide a description and justification of what constitutes a fair distribution of wealth and resources within society.²⁰ However, justice is an essentially contested concept and as Miller notes

[t]he situation we are in is one of...fairly radical disagreement as to which theory of justice is actually correct (Miller, 2002, p6).²¹

Whilst it would be convenient if support for an equal per capita allocation were to be found within the various contested approaches to justice, from our reading of the literature, this would not appear to be the case. Whilst there is, for instance, considerable support for this allocation from *liberal egalitarian* and from *left libertarian* approaches, support would not appear to be forthcoming from the *right libertarian* approach.²² Hence, to justify an equal per capita allocation one has ultimately to justify an approach to distributive justice that supports such an allocation.²³

3.2 Proportion of emission rights allocated on an equal per capita basis?

Under DTQs, only those emissions rights corresponding to emissions from individuals' purchase of fuel and electricity (currently around 40% of total energy emissions in the UK) are allocated on an equal per capita basis. However, if the equal per capita principle is the fair way of allocating emissions rights, then it can be argued that fully 100% of available rights should be allocated on an equal per capita basis. Five options for doing so are discussed below. Two involve the actual allocation of emissions rights on an equal per capita basis, and following two involve the allocation on an equal per capita basis of the revenue from the auction of emissions rights and a carbon tax respectively. The fifth option – a variant of DTQs – involves allocating the Tender revenue to eligible individuals on an equal per capita basis.

²⁰ This absence of a justification from supporters of the equal per capita principle may arise from a lack of familiarity with this literature or, alternatively, from a belief that the principle is self-evidently fair and therefore requires no justification (philosophical or otherwise). In a recent report, the House of Commons' Environmental Audit Committee appears to take the view that the principle is self-evidently fair when it states: "it is difficult to argue with the fundamental principle of equal per capita emissions" (HoC-EAC, 2005, p32).

²¹ The existence of competing philosophical accounts is perhaps not surprising, given that such accounts can, in Jeremy Waldron's words, be thought of as "just tidied-up versions of views that compete in the political market place" (Waldron, 1999, p22).

²² At least from that branch of right-libertarianism that describes itself as "self-ownership libertarianism" (Mack, 2002).

²³ A more detailed review of the distributive justice literature will form part of future work.

In describing these options, we refer to *direct* and *indirect* emissions. Direct emissions are those that arise from the purchase of fossil fuel and electricity by individuals and organizations. Organizations' *direct* emissions can also be regarded as individual *indirect* emissions as the former are produced to satisfy individuals' demand for goods and services. Hence

$$\begin{aligned} & \text{Total energy emissions} \\ &= (\text{individuals' } \textit{direct} \text{ emissions} + \text{organizations' } \textit{direct} \text{ emissions}) \\ &= (\text{individuals' } \textit{direct} \text{ emissions} + \text{individuals' } \textit{indirect} \text{ emissions}) \end{aligned}$$

1. RAPS scheme

100% of emissions rights (henceforth *carbon units*) could be allocated to individuals if it were possible to carbon rate not just fuel and electricity but all products and services (hence RAPS – rate all products and services).²⁴ Then, whenever an individual purchased any product under this scheme - from a car to a tin-opener - units would be surrendered corresponding to the greenhouse gas emissions produced in the manufacture of the product and its transportation to the consumer. Similarly, whenever an individual purchased any service – from a stay in a hotel to a hair cut - then units would be surrendered which covered the emissions arising from the provision of such a service. In other words, under RAPS, individuals would surrender carbon units for both their direct and indirect emissions. However, clearly a RAPS scheme is not currently feasible and an easy-to-use, cost-effective scheme of this type is unlikely to be so in the short to medium term.

2. Ayres scheme

Although a RAPS scheme is not currently feasible, there is an alternative scheme for allocating 100% of units to individuals which does appear to be so. This scheme, proposed by Ayres (1997, 1998), is similar to DTQs in that (1) only fuel and electricity that are carbon-rated and (2) all end-purchasers of fuel and electricity (both individuals and organizations) are required to surrender carbon units. However, the schemes differ in how carbon units are allocated. Under DTQs, 40% of units are allocated to individuals on an equal per capita basis and 60% auctioned by government at the Tender. In contrast, under the Ayres proposal, fully 100% of units are allocated to individuals on an equal per capita basis. Under DTQs, market makers obtain the majority of units from one source, the Tender (and, in addition, obtain some from below-allocation emitters). However, under the Ayres scheme, market makers must buy units solely from the tens of millions of individuals holding a surplus in order to sell them on to organizations.²⁵

Note that under RAPS only individuals surrender/trade carbon units, whereas under the Ayres scheme and DTQs both individuals and organizations surrender/trade (see Table 1 below).

3. Sky Trust

The *Sky Trust* proposal (Barnes, 2001)²⁶, consists of an upstream auction of units, the revenue from which is shared equally amongst eligible individuals (i.e. lump-sum recycling). So whilst under the Ayres' proposal carbon units themselves are allocated to individuals on an equal per capita basis, under the *Sky Trust* proposal it is the revenue from the sale of units that is allocated in this way.

Note that under DTQs and the Ayres proposal, both individuals and organizations surrender/trade units, whereas under Sky Trust only those organizations involved in the upstream auction do so (see Table 1).

²⁴ For reasons of taste, we refrain from referring to the scheme by the more precise title “carbon rate all products and services”!

²⁵ And also to those above-allocation emitters whose direct emissions are greater than the average individual's combined direct and indirect emissions.

²⁶ See also the Sky Trust website at www.usskytrust.org.

4. Carbon tax and equal per capita recycling

It is possible to cap emissions indirectly using a tax as opposed to doing so directly by emissions trading. Under certain theoretical assumptions and for a given emissions reduction, the revenue raised from a tax should be equivalent to that raised by an auction, and hence lump-sum recycling of carbon tax can be regarded the theoretical equivalent of the Sky Trust proposal.²⁷

The Swiss Federal Law on the reduction of CO₂ emissions (“CO₂ law”) passed in 1999 makes provision for the implementation of a carbon tax under which revenue is recycled on a lump-sum basis.

The CO₂ Law is being implemented in a two-stage process. Only if voluntary and other CO₂-related measures turn out to be insufficient to achieve the reduction targets will a CO₂ tax be introduced (SAEFL, 2005a).

Article 10 of the CO₂ law states that, if the tax is introduced

10(2) The tax revenue shall be redistributed to the general population and the business community in proportion to their regular payments.

10(3) The proportion returned to the general population shall be distributed uniformly to all natural persons. The Federal Council shall regulate the distribution procedure. It may commission the cantons, public corporations or private individuals to carry out the distribution for appropriate remuneration (SAEFL, 2005b).

5. DTQs and equal per capita recycling

Fleming has proposed that the revenue from the Tender is hypothecated for use in assisting individuals and organizations to stay within the carbon budget. Alternatively, the revenue could be recycled on a lump sum basis.²⁸ In this case, individuals would be allocated both 40% of units and the revenue from the sale of 60% of units on an equal per capita basis. Hence, this version of DTQs can be viewed as falling between the Ayres and Sky Trust proposals.

Scheme	Carbon rated	Initial % allocation of units		Trading/ surrender of units		Auction revenue recycled?
		Ind	Org	Ind	Org	
RAPS	Products/services	100	✗	✓	✗	No auction
Ayres	Fuel/electricity	100	✗	✓	✓	No auction
Sky Trust	Fuel	✗	100% - firms in auction	✗	Only firms in auction	Equal per capita
Carbon tax (EPC)	Fuel	?	?	✗	✗	Equal per capita
DTQs (Fleming)	Fuel/electricity	40	?	✓	✓	Hypothecated
DTQs (EPC)	Fuel/electricity	40	?	✓	✓	Equal per capita

Table 1: Scenarios for allocating units on equal per capita (EPC) basis

²⁷ Pezzey (1992) sets out the theoretical conditions under which taxes and emissions trading are equivalent.

²⁸ As well as equity arguments, there are political arguments for recycling. In a briefing note on DTQs, the Sustainable Development Commission has suggested that “[a]s with the CCL [Climate Change Levy], it would probably be politically important for the revenue raised through the business auction to be recycled to business through tax cuts or other incentives...DTQs would need to be portrayed as a signalling tool to guide good practice rather than a punitive tool that would hit business with excessive costs” (SDC, 2005). (Note that the briefing document “does not represent the Sustainable Development Commission’s position on DTQs”.)

Awarding rights versus awarding revenue from rights

From the point of view of equity, is it preferable to allocate emissions rights directly to individuals (as under the Ayres proposal) rather than allocating them the revenue from the sale of those emissions rights (as under Sky Trust or a carbon tax)? As a point of departure, it can be argued that, if individuals have equal rights to emit, then - as under the Ayres proposal - they should actually receive these rights directly and themselves decide how they are used. Under Sky Trust, by contrast, it is government that decides how they are used (auctioned upstream) and individuals instead get to decide how to use the revenue from their auction. What difference does this make?

Under Sky Trust, the below-average emitter will end up with *additional money* to that which they had prior to the scheme.²⁹ By contrast, under the Ayres scheme a below-average (i.e. below-allocation) emitter will have *surplus units*.³⁰ However, if these surplus units are sold then the below-average emitter ends up with *additional money*, just as under Sky Trust. And just as surplus units can be saved or gifted under the Ayres scheme, so the addition money be saved or gifted under Sky Trust.

Nevertheless, there is a difference between allocating units to individuals and allocating them revenue. In contrast to Sky Trust, individuals under the Ayres scheme can choose to whom they sell their units. For instance, it is conceivable that “ethical” market makers might emerge that would not sell units to organizations in a particular sector and hence, at the extreme, particular organizations/sectors might not be able to obtain units. In addition, individuals do not have the option of retiring units under Sky Trust as they would under the Ayres scheme.³¹ How significant these differences are is open to debate and will be further discussed in future work.³²

Awarding rights directly: the Ayres scheme and DTQs

If one holds that *all* emissions rights should be allocated *directly* on an equal per capita basis then *ceteris paribus* the Ayres scheme should be chosen in preference to a DTQs scheme with lump-sum recycling. However, transaction costs may be (significantly) higher under the Ayres scheme for, as noted above, under DTQs market makers obtain the majority of units from one source, the Tender, whereas, under the Ayres scheme, market makers must buy units from tens of millions of individuals.

Under the Ayres scheme, individuals are awarded units to cover both their direct and indirect emissions. They surrender units to cover their direct emissions and can sell - via market makers - the remainder. It is possible that individuals may find the workings of this scheme less easy to understand than DTQs where units are simply awarded to cover direct emissions. These issues will be considered further in future work.

3.3 Defining eligible individuals

If carbon units are to be allocated on an equal per capita basis under DTQs, to whom should they be allocated? Two key issues are age and residential status.

1. Age

The equal per capita principle states that

every *human* is entitled to release into the atmosphere the same quantity of greenhouse emissions.

²⁹ The lump sum received will be greater than the additional amount spent on goods and services as a result of the auction (see 3.4 for a fuller explanation).

³⁰ As there is no direct allocation of emissions rights to individuals under Sky Trust, the terms “below-average” has been used rather than “below allocation”.

³¹ This assumes a retirement mechanism is in place –see 2.6. Although individuals cannot retire units under Sky Trust organizations could be given the opportunity to do so.

³² In addition to the arguments here, we argue in 7.1 that allocating rights directly to individuals may have advantages over revenue allocation in relation to the public acceptability of large emissions reductions.

However, under Fleming's proposal, carbon units are not allocated to children, and hence the DTQs principle is, roughly speaking, that

every *adult* is entitled to release into the atmosphere the same quantity of greenhouse emissions.

Is it equitable for only adults to receive units? In his discussion of children's rights, Archard (2005) argues that

it seems reasonable to think that there are things children may not do that adults are permitted to do. In the majority of jurisdictions, for instance, children are not allowed to vote, to marry, to buy alcohol, to have sex, or to engage in paid employment. What makes children a special case for philosophical consideration is this combination of their humanity and their youth, or, more exactly, what is thought to be associated with their youth.

Following Archard, the issue in relation to DTQs is whether children have a right to units simply because they are human or whether, even though they are human, they should not have right to units because of their youth. In our view the latter alternative is the correct one. Children, generally speaking, do not work, earn money or purchase energy. Given that carbon units are required specifically to purchase energy, it seems reasonable that units be awarded only to that group of people who, generally speaking, work and purchase energy i.e. adults.³³ (If units are not to be allocated to children, this raises the question of whether parents should receive an additional quantity of units. This is addressed in 3.4).

Although we argue that only adults should receive units, the term "adult" has not been used in the legal sense, for the age at which individuals become eligible for units is not straightforwardly 18, the age of legal adulthood in the UK. Allocating units to those aged 18 and over would disadvantage those 16 and 17 year-olds living independently. However making 16 the threshold age would provide a windfall for the large number of 16 year-olds who live with their parents home and don't buy energy. This is an area which requires further analysis.³⁴

2. Residential status

British citizens and others permanently resident in the UK should clearly receive units whilst those visiting the UK for short periods (say, six months or less) should not. A decision on eligibility for units would need to be made with regard to those individuals who fall between these extremes (for example the foreign partner of a UK citizen resident in the UK on a two-year probationary visa). A related issue is whether eligibility for units should be withdrawn for individuals who are long-term residents in an institution (e.g. care home, prison) with an adult allowance going instead to the institution itself or whether rights to units are absolute.

3.4 Protecting those on low income

Whilst equity may demand that carbon units are allocated to eligible individuals on an equal per capita basis, it also demands that allocating units in this manner does not make those on low income worse off. Whether or not those on low income are worse off following the implementation of a DTQs scheme will depend upon four factors:

³³ Hence, it is not, in our view, inconsistent to calculate the allocation of emissions rights *between* nations under Contraction and Convergence on the basis of the entire population of nations (i.e. adults plus children), but to include only adults in the allocation of emissions rights *within* nations under DTQs.

³⁴ For example, is there a case in principle (even if it were not feasible in practice) for (a) awarding units to a 17 year old living with their parents, who works, drives and uses their earnings to buy petrol and to contribute to household fuel bills but (b) not awarding units to a 17 year old living with their parents, who drives their parents' cars but does not buy petrol or contribute to household fuel bills?

1. their level of direct emissions
2. any change in the price of fossil fuel and of electricity generated from fossil fuel that results from the implementation of the scheme
3. any change in the price of other goods and of services that results from the implementation of the scheme
4. what is done with the revenue from the Tender

These factors are examined below.

1. Direct emissions

If direct emissions were directly proportional to income, then allocating emissions rights on an equal per capita basis would, *ceteris paribus*, make all those on low incomes better off for, as below-allocation emitters, they would have surplus units that they could sell onto the carbon market, earning themselves additional income.

However, whilst it is true that emissions rise on average across the income deciles, not everyone within the deciles emits at the decile average. Work by the Policy Studies Institute (Ekins and Dresner, 2004; Dresner and Ekins, 2004a, 2004b) indicates that there is a wide variation in energy use and direct emissions within deciles and that some 30% of households in the lowest two income deciles currently emit at an above-average level.³⁵ Hence, if DTQs were implemented today, these households would, *ceteris paribus*, be worse off as they would have to buy additional units on the market.

There are two ways of ensuring such households would not be disadvantaged by a DTQs scheme. The first is to provide these households with additional income to buy carbon units to cover their emissions that are above the average and the second is to implement measures to bring their emissions down to an average or below-average level.

The work of the Policy Studies Institute referenced above illustrates the current impossibility of cost-effectively recycling revenue raised from a domestic carbon tax in such a way as to leave no-one in the lowest income deciles worse off. This suggests that it may be less than straightforward under a DTQs scheme to provide sufficient additional income to *all* low-income households that emit above average - especially when the price of units can change over time. Given this, it is preferable to work towards a situation where all low-income households emit at an average or below-average level and below we briefly discuss how this might be achieved.

Direct household emissions arise from fuel and electricity use for *residential services* and for *private transport*. The majority of the 30% of households in the lowest two deciles with above-average direct emissions are in this position because their *residential* emissions are above average.³⁶ Of these households, the vast majority are in fuel poverty and hence, by building on existing government programmes to tackle fuel poverty (such as Warm Front and the Energy Efficiency Commitment) it should be possible to bring the emissions of these households down to average or below-average levels.³⁷

By contrast, a minority of the households in the lowest two deciles with above-average direct emissions are in this position because their emissions from *private transport* are above-average. The majority of such households are rural households. To bring the emissions of these households down

³⁵ Whilst DTQs deals in individuals, the PSI analysis is in terms of households hence the change in terminology.

³⁶ This is due to a combination of factors such as (1) poor thermal efficiency of dwellings, (2) carbon intensive heating systems (electricity generated from fossil fuels) and (3) heating of dwellings for long periods (if occupants, for whatever reason, are at home for long periods or permanently).

³⁷ Further and more detailed work is required in this area.

to an average or below-average level would require measures such as improving rural public transport, locating facilities nearer to households, putting in place rural car clubs and so forth.³⁸

2. Fuel and electricity

Under DTQs, the demand for fossil fuel is reduced and theory suggests that, *ceteris paribus*, the price of both fossil fuel and of electricity generated from fossil fuel should therefore fall, thus benefiting those on low income. Whilst the reduction in demand from one country is unlikely to make much difference to the price on world energy markets, a reduction in demand resulting from a concerted effort amongst nations to reduce emissions might do so. However, this needs to be set against the current backdrop of high oil and gas prices which many predict will continue to rise.³⁹

3. Consumer prices and the Tender revenue

Under DTQs, organizations are required to purchase carbon units on the national market. The effect this has on those on low income will depend upon (1) the impact on the price of consumer goods and services and (2) what is done with the Tender revenue. To date we have done limited work in this area and so the following discussion proceeds at a general level.

Whilst firms face the additional cost of buying carbon units, two factors may, to some degree, offset this. The first is that the cost of fossil fuel and fossil-fuel generated electricity may fall and the second is that firms may be incentivized to seek, and may discover and pick, the “low hanging fruit” of cost-effective carbon reduction measures.

If such offsets failed to materialize or only partially offset the cost of carbon units, then the cost of production would rise. However, this rise could be offset by recycling some or all of the Tender revenue by a reduction in business tax, in which case there would be no increase (at least on average) in the price of consumer goods and services. Alternatively, the Tender revenue could be recycled to individuals on lump sum basis. If individuals’ indirect emissions are assumed to be proportional to income, then, even if firms pass on the full cost of carbon units, those on low incomes would, *ceteris paribus*, be better off.

Passing on the full cost of units means that the market price (P) of units purchased by firms in the production of goods and services is included in the cost of those goods and services. If indirect emissions are proportional to income, then the market price of a *below-average* quantity of carbon units ($<A$) is included in the cost of goods and services purchased by those on *below-average* income.⁴⁰ However, the revenue recycled to each individual is equivalent to the market price paid by firms for an *average* quantity of carbon units (A). Hence, those on low incomes are better off by $P(A) - P(<A)$ whereas those on above-average income would be worse off by $P(>A) - P(A)$.⁴¹ And if firms do not pass on the full cost of units then the sum by which those on low incomes are better off increases to $P(A) - <P(<A)$.⁴²

However, just as individuals’ direct emissions are not proportional to income, so it is likely that neither are their indirect emissions. However, it is reasonable to hypothesize that there will be very few households in the two lowest income deciles which will have both direct and indirect emissions above the average. Hence, if measures can be taken to bring the direct emissions of all household in the lowest income deciles to an average or below-average level and Tender revenue is recycled on a

³⁸ Again, further and more detailed work is required in this area.

³⁹ Some commentators suggest that oil prices are rising as a result of the world imminently approaching peak oil production. See, amongst many others, Bentley (2002) and Roberts (2004).

⁴⁰ An average quantity of carbon units in this context is the number of units purchased by firms divided by the number of eligible individuals.

⁴¹ The higher price P rises, the better/worse off those on low/high income are.

⁴² Under conditions of perfect competition, firms cannot pass on the full cost of an input tax. See for example Begg et al (2000, p46)

lump-sum basis then it would seem likely that very few in these deciles would be disadvantaged by DTQs.⁴³

3.5 Additional units for parents?

If one holds that children themselves are not entitled to carbon units, the question arises as to whether parents should universally be allocated additional units because they have children. Two possible justifications for allocating additional units to all parents might be as follows. (1) Given the intrinsic moral worth of children, the state has a duty to (financially) assist all parents.⁴⁴ (2) Allocating units to all parents is an appropriate way to help families who live in (fuel) poverty. These are discussed briefly below.

There does not appear to be a presumption in public policy that, in recognition of the intrinsic value of children, the state has a duty to financially assist *all* parents. The universal nature of child benefit may suggest otherwise but such a presumption did not lie behind Beveridge's advocacy of universal family allowances (the precursor of child benefit). Rather he advocated universal family allowances because he believed it to be the best way to help families in *poverty*.⁴⁵ Assisting those on low income is also the purpose of child tax credits and working tax credits, with credits reducing with income and families over a certain income becoming ineligible. And the new Child Trust Fund, despite its name, is designed not for the benefit of children, but for young adults.

So is awarding units to parents an effective way of tackling poverty? The work of the Policy Studies Institute (Ekins and Dresner, 2004; Dresner and Ekins, 2004b) compared (1) a DTQs scheme implemented today under which parents were awarded half of an adult allowance of carbon units for each child with (2) a DTQs scheme under which parents received no additional units. Under the scheme where parents received additional units, the number of households with children who were made worse off by the scheme was smaller, but, the total number of households made worse off (i.e. households with and without children) was almost the same under both schemes. This occurred because awarding extra units to parents reduced the size of the adult allowance. Whilst, for parents, this reduction was more than offset by the child allowance thus taking some households with children into the better-off group, it was not offset for those individuals without children, taking some households without children into the worse-off group.

Furthermore, if, as noted in 3.4, (1) measure are taken to reduce emissions in low income households to average or below and (2) the Tender revenue is recycled on a lump-sum basis, then the vast majority of low-income households with children are likely to be better off or no worse off *even in the absence* of awarding extra units to parents. Given this outcome, there would seem to be no case for awarding extra to parents. However, if, for political reasons, it was decided that parents should be able to obtain additional units, then awarding them additional cash (perhaps in the form of increased child benefit) would allow them to do so without reducing the adult allowance of units.

3.6 Civil liberties

It has been suggested that the carbon card may infringe upon civil liberties. If this were the case, it would clearly have implications for the fairness of the scheme, and hence a discussion of the civil liberties issue is included under the section on equity.

⁴³ This argument assumes that all goods and services purchased are provided by UK firms. The situation becomes more complex when UK goods are exported and imported goods are purchased by individuals. This can be illustrated by considering the fantastical scenario in which UK firms export all their goods and services and UK individuals purchase only imported goods! Under this scenario, those on above-average income as well as those on below-average income would benefit from lump-sum recycling. Further work is required to assess the effects of imports and exports.

⁴⁴ Carbon units have financial value and so an extra quantity to parents equates to financial assistance.

⁴⁵ It avoided the desperately unpopular means testing of the 1930s, and also preserved the incentive to work (Timmins, 2001).

Those who suggest that the carbon card may infringe civil liberties do not generally present specific arguments as to how exactly such an infringement might occur. Here we present a specific argument which could be made. This argument is a useful starting point for exploring the civil liberties issue and, perhaps, distils some of the general concerns that have been expressed regarding civil liberties. The argument goes as follows: (1) carbon cards would be like ID cards and (2) ID cards infringe civil liberties, therefore (3) carbon cards would infringe civil liberties. Whilst the argument's conclusion is certainly entailed by the premises, the argument does not appear to be valid for, as discussed below, the first premise does not hold and the second does not necessarily hold.

Carbon cards would be like ID cards?

A carbon card would be very different from the proposed ID card. First, holding a carbon card could be made voluntary, whereas it is the government's intention that holding an ID card will be compulsory. Given that the carbon budget under DTQs would be legally binding, the emissions cap would hold whether or not eligible individuals chose to enrol in the scheme and claim their share of the Entitlement. The only consequence of individuals choosing not to enrol would be that they were financially disadvantaged, as they would have to purchase all the units they required on the national market instead of receiving their share of the Entitlement for free.⁴⁶ Given that non-enrolment would not compromise the carbon budget, there seems no reason to compound the economic penalty to which non-enrolling individuals would be subject with a legal penalty that would presumably exist for non-enrolment under a compulsory scheme.

Of course, it might be argued that the distinction between a legally voluntary and a legally compulsory scheme is illusory as the financial consequences of non-enrolment make a legally voluntary scheme de facto compulsory. However, even if enrolment were to be made legally rather than de facto compulsory, this would not necessarily imply any infringement of civil liberties. Giving evidence on ID cards to the Home Affairs Committee (HoC-HAC, 2004b, Ev 20), the Director of the civil liberties and human rights organization, Liberty, described ID cards as a "single identifier that is used for multi-purposes". The extent to which their use would be multi-purpose was set out in a recent Home Office document (Home Office, 2005a) in which it was forecast that, if ID cards are introduced, they would be a single identifier used by 265 government departments and 44,000 private sector organizations.

In her evidence, the Director of Liberty contrasted "single identifier that is used for multi-purposes" with "purpose specific identity material" and the carbon card would be an example of the latter, as it would be used to verify identity only for the specific purpose of surrendering and trading carbon units. Whilst opposition to the use of single identifiers for multiple purposes is one of the reasons that Liberty is opposed to the introduction of ID, cards, in her evidence (HoC-HAC, 2004b, Ev 20), the Director noted that Liberty has

no problem with purpose-specific identity material that is used for a specific purpose. We have for example NHS cards already and we have National Insurance cards. Of course, they do not in themselves appear to be magic solutions. Making those more secure and more sophisticated is not something that we necessarily have problem with.

ID cards infringe civil liberties?

Those opposed to the UK's proposed ID card scheme, do not take the view that ID cards *per se* infringe civil liberties. For example, in his evidence on ID cards to the Home Affairs Committee, the Director of Privacy International, another organization actively campaigning against the proposed UK scheme, argued that the government's proposals breach the right to privacy set out in Article 8 of the

⁴⁶ If enrolment was optional, then the government would need to ensure that everyone knew that they could enrol and encourage them to do so, on the grounds that that it would be financial disadvantageous for them not to. In this way, non-enrolment would be the result of genuinely informed choice.

European Convention on Human Rights (ECHR). However, he also made clear (HoC-HaC, 2004b, Ev 25) that he was

not suggesting that a simple identity card with specific stated purposes would not be lawful, it may very well be.

A similar point was made by the House of Commons and House of Lords Joint Committee on Human Rights which noted in a recent report (JCHR, 2005, p18) that

[a] requirement to have or to carry some form of identity card does not of itself raise human rights issues, as has been established by the European Court of Human Rights.

The committee explains (p18) that

[i]t is the retention and storage of personal information on a database such as the National Identity Register, and the disclosure of information from it, that engages the ECHR right to respect of private life (Article 8 ECHR)...To be permissible, gathering, storage or disclosure of personal information that falls within the protection of Article 8 must be justified under Article 8.2 as in accordance with the law; as serving a legitimate aim, and as necessary for and proportionate to that aim.

The government has argued (HoC-HaC, 2004b, Ev 204) that its proposals

are compatible with the European Convention on Human Rights...and with the Data Protection Act 1998.

However, with regard to the ECHR, the Committee argues (p20) that

the Bill's provision for the retention of extensive personal information relating to all or large sections of the populations may be insufficiently targeted to be justified as proportionate to the statutory aims and may lead to disproportionate interference with Article 8 rights.

And with regard to data protection, the Information Commissioner⁴⁷ has stated (ICO, 2005, pp3-4) that

[t]he measures in the Bill go well beyond establishing a secure, reliable and trustworthy ID card. The measures in relation to the National Identity Register and data trail of identity checks on individuals risk an unnecessary and disproportionate intrusion into individuals' privacy. They are not easily reconciled with fundamental data protection safeguards such as fair processing and deleting unnecessary personal information. An effective ID card can be established avoiding these unwarranted consequences for individuals as research has shown.

However, whatever the views of particular parties with regard to the proposed ID scheme, all hold that it would be possible to have an ID card scheme that did not impact adversely on civil liberties. Similarly, it should be possible to establish a DTQs scheme that is compatible with civil liberties, by, for instance, ensuring that the information held in the central database is necessary and proportionate to the aims of the scheme.

⁴⁷ The Information Commissioner is an independent official appointed by the Crown to oversee the Data Protection Act 1998, the Freedom of Information Act 2000 and the Environmental Information Regulations 2004. The Commissioner reports annually to Parliament.

4. Effectiveness – can DTQs meet emissions reduction targets?

In theory, emissions trading schemes such as DTQs are effective, as they set the level of emissions *directly*. By contrast, taxes seek to influence emissions *indirectly* through price and therefore under a tax regime it is likely that an emissions target will only be achieved “following a long, iterative procedure” (Tietenberg, 2001, pxviii). However, in order to be effective in practice, DTQs (1) need to be technologically and administratively feasible (2) require an orderly national carbon market and (3) need to be acceptable to the public. These issues are discussed below.

5. Technological and administrative feasibility

Fleming’s work on DTQs does not address technological and administrative issues in any detail. Hence, we have been keen to establish whether DTQs are technologically and administratively feasible.

The technical and administrative requirements of a DTQs scheme include:

- building and maintaining a secure carbon database capable of holding a carbon account for all eligible individuals and those organizations who purchase units from market makers (2.4)
- enrolling individuals into the scheme and setting up and managing of carbon accounts (e.g. closing accounts when individuals cease to become eligible through emigration or death)
- issuing and re-issuing carbon cards to individuals and organizations
- developing, installing and maintaining systems that
 - enable the surrender of carbon units by carbon card and by direct debit
 - allow both remote and over-the-counter trading of carbon units⁴⁸
 - enable *carbon statements* to be obtained
 - allow both the remote and over-the-counter transfer of carbon units between accounts
- developing systems to accurately carbon-rate various electricity mixes

These requirements are discussed below.

5.1 Carbon database

The size and complexity of the database required for DTQs would not, even by present-day standards, be anything like approaching leading-edge. Furthermore, hardware costs of such a database would be relatively low and it would be possible for individuals and organization to access their account balance in real time using landlines, mobile phones and the internet.⁴⁹

5.2 Enrolment and multiple application fraud

The enrolment process must ensure that eligible individuals cannot fraudulently open more than one account and that non-eligible individuals cannot fraudulently open one or more accounts. This will require verifying individuals’ identity to an appropriate level of assurance and three options for doing so are discussed below.

The ID card scheme

The planned ID card scheme aims to verify individuals’ identity to a very high level of assurance. Hence basing DTQs on a successfully implemented ID card scheme would eliminate the possibility of individuals making multiple applications for carbon accounts.

However, as the House of Commons Home Affairs Committee report on ID cards notes (HoC-HAC, 2004a) the proposed scheme is “unprecedentedly large and complex” (p23) and “the Government’s

⁴⁸ Remote trading is trading over the phone or the internet.

⁴⁹ This information was provided by an expert from Oracle on the design and implementation of large databases.

record on large-scale IT projects is not encouraging” (p55). And a recent well-publicized assessment of the scheme carried out by the London School of Economics (LSE, 2005a, p5) concluded that

the establishment of a secure national identity system has the potential to create significant, though limited, benefits for society. However, the proposals currently being considered by Parliament are neither safe nor appropriate. There was an overwhelming view expressed by stakeholders involved in this Report that the proposals are *too complex, technically unsafe, overly prescriptive and lack a foundation of public trust and confidence*. The current proposals miss key opportunities to establish a secure, trusted and cost-effective identity system and the Report therefore considers alternative models for an identity card scheme that may achieve the goals of the legislation more effectively. The concept of a national identity system is supportable, but the current proposals are not feasible.

Given the concerns in some quarters over technology and cost and given claims of a falling levels of public support,⁵⁰ it is prudent to consider how a DTQs scheme could be implemented if the ID card scheme did not proceed.

Electronic verification

In a recent report, the Financial Standards Authority (FSA, 2005, p10-11) notes that

[h]istorically, ID has relied on the customer providing documents. In the case of personal customers, these are passports, driving and other licences, utility bills, letters from care home managers etc. This documentary approach will continue for some customers. However, the industry now makes increasing use of ‘electronic verification’, particularly for UK-based personal customers. This involves confirming identity - either alone or in conjunction with documentary methods - via a credit reference agency (CRA) (or one of the non-CRA service providers that are now also entering the market).

The report continues (p11) by noting that

[t]here is...general agreement that electronic verification is a valid approach to ID, and indeed that in many cases it is likely to have greater authority and be more convenient for both firm and customer than using paper documents.

Hence, it may well be possible to put in place a cost-effective system where the majority of individuals can conveniently enrol in the scheme over the phone or online by having their identity verified against existing databases (e.g. passport, driving licence). This would dispense with the need to produce relevant documents at, say, a local post office or to send documents by post to a relevant authority.⁵¹

Electoral registration

It has been suggested that as an alternative to electronic verification, enrolment in DTQs scheme could be combined with, or operate along similar lines to, the annual electoral registration canvass. Households would be posted out a form that occupants would be required to complete stating their eligibility for carbon units. As under the present system of electoral registration, individuals could be fined if they failed to provide accurate information. We have not examined this suggestion in detail and further work is needed. However, a key question is whether the threat of a fine would be sufficient to prevent identity fraud in a system where individuals effectively verify their own identity.

⁵⁰ See for instance Branigan (2005) and Sheriff (2005)

⁵¹ We have had useful discussions on electronic verification with the GB Group – “one of the non-CRA service providers that are now also entering the market”. The GB Group has, in conjunction with BT, developed an electronic verification tool called *URU* – see www.gb.co.uk.

Certainly, the threat of fine (seldom if ever levied) has not prevented instances of fraudulent electoral registration or non-registration. A report by The Electoral Commission on the electoral registration process (2003, pp27-8) notes that

discussions with a minority of electoral administrators in some urban areas do reveal concerns about fraudulent registration, in that there are a small number of instances where fictitious voters are entered on the register or false addresses used. There are two main reasons for this. One is entirely unrelated to electoral fraud: attempts to register fraudulently are aimed at, for example, fraudulently claiming housing benefit or credit or opening bank accounts. In other words, registration fraud is one part of identity fraud. In the small number of cases where electoral fraud itself has been perpetrated, this has been mainly linked to fraudulent applications for proxy and postal votes.

Electoral registration officers do report concerns that the present system of electoral registration carries with it the potential for fraud, even though there is no real evidence of fraud being on the increase, and that increasing the accessibility of the process would increase that potential. For example, the Association of Electoral Administrators stated: ‘The existing legislation for the rolling registration process does provide potential for registration fraud and any simplification of the processes is likely to enhance this potential.

5.3 Cards and card fraud

Card fraud under DTQs would consist of an individual using a lost or stolen card to surrender or sell – either in person or remotely - someone else’s carbon units. A DTQs scheme would need to be designed so as to keep such fraud within clearly defined limits.

Chip and PIN has recently been introduced for credit, debit and charge cards to prevent use in person of a lost or stolen card where the PIN is unknown and could be used to prevent in-person fraud with a carbon card.⁵² Chip and PIN cannot currently be used online or over the phone, but according to the Association for Payment Clearing Services (APACS, 2004), this may soon be possible through the development of pocket-sized devices that can be used with phones and computers. Hence, by the time a DTQs scheme was implemented, it may be possible to protect all transactions through chip and PIN.

5.4 Surrender

As noted in 2.4, carbon units can be surrendered from a carbon account using either a carbon card or by direct debit. Surrender by direct debit should not present any major technical challenges and therefore this section focuses on surrender by carbon card.⁵³ From the point of view of cost-effectiveness and ease of use, carbon unit surrender at garages should ideally

1. be able to make use of existing point-of-sale (POS) terminals and card readers
2. be able to take place using existing communication (“comms”) capacity
3. not (unduly) increase transaction times for the purchase of fuel

1. Using existing POS terminals and readers

Our initial research indicates that existing card readers and POS terminals in garages could be used for the surrender of carbon units. POS terminals could be loaded with the relevant software and, if carbon cards were manufactured to comply with the relevant standards, they could be inserted into existing card readers.

⁵² Chip and PIN is also designed to prevent “skimming” – the fraudulent copying of the information held on a card’s magnetic stripe.

⁵³ Our findings in parts 1-3 of this section are based on interviews with experts at Barclaycard and at TNS (Transaction Network Services), a leading provider of data communication services.

2. Comms capacity

The majority of credit card transactions at garages are conducted offline (i.e. without the credit card contacting the central database holding credit card accounts). However, as explained below, it would seem that *all* carbon card transactions would need to be conducted online (i.e. with the carbon card contacting the central database holding carbon accounts). Nevertheless, it is likely that for a substantial number of garages the existing comms capacity would be capable of dealing with the additional transactions.

3. Transaction times

To date, we have assumed, in line with Fleming, that individuals and organizations should not be able to go overdrawn at any time on their carbon account.⁵⁴ It is in order both to prevent overdrafts and to allow surrender of units by direct debit when paying utility bills, that online carbon card transactions would appear to be necessary in all cases.

Uploading carbon units to a carbon card does not appear to be a viable alternative. Assume, for instance, that government allocates carbon units to individual carbon accounts on the first day of each calendar month (see 6.2). Given this system of allocation, an individual's carbon card would only need to go online the first time it was used in any calendar month in order to upload the allocated units from their account. With the units uploaded, they could then be surrendered offline (i.e. straight from the card) whenever the card was subsequently used during the month. However, whilst such a system would work for surrender at garages, it would not allow the surrender by direct debit, as there would be no units left in the individual's carbon account.

Alternatively, the card could go online the first time it was used each month, simply note the number of units in the account and surrender units at garages up to this amount over the course of the month. This way the units would remain in the account thus allowing direct debit to take place. However, if units were debited from the account between petrol purchases, then the number of units noted by the carbon card as being available would be too high and could allow a purchase of petrol without sufficient units to cover the purchase. This would result in the account going overdrawn.

Thus it would appear that the only way for the card to know with certainty how many units exist in a carbon account at any particular time is to go online each time it is used. However, given the comms capacity of most garages is adequate to allow such transactions, and given that online transactions take approximately the same time as those performed offline, online transactions should not present increased difficulties for surrender when compared with offline.

Assuming that the carbon card is PIN-protected, the carbon card element of the payment for fuel at a garage would consist of the customer

- removing their carbon card from their wallet/purse/holder/pocket
- placing the card in the reader
- entering their PIN
- waiting for the card to complete its online transaction
- removing the card from the reader
- placing the card back in their wallet/purse/holder/pocket

We estimate that it would add an average time of approximately 15-20 seconds to the total transaction time at the till (see Table 2).⁵⁵ However, given that on average there is more than one person queuing at a till, the average time a customer spends queuing and paying will increase by more than this amount. If it is assumed that, on average, a customer finds two other customers in front of them when they come to pay, then their queuing and paying (and therefore total visit) time would increase by

⁵⁴ It is worth exploring whether DTQs could operate effectively if this assumption was relaxed somewhat.

⁵⁵ In this, and in the following estimates, the lower figure quoted is from Table 2. So as to introduce some conservatism to our estimates, we have included an upper figure by adding 5 seconds to the lower.

around 45-60 seconds.⁵⁶ Given, the average time spent by a customer at a petrol station is approximately five-and-a-half minutes, carbon card transactions would increase visit time by 13.5-18%.⁵⁷

There are two ways in which this increase in visit time could be reduced. The first would be to conduct the carbon card transaction at the pump. In this way, customers could carry out transactions in parallel at the pump rather than in series at the till. Hence visit time per customer would be increased to 15-20 seconds, an increase of 4.5-6%. Installing card readers on all petrol pumps would incur a cost, though less so if DTQs coincided with a switch to pay-at-the-pump.⁵⁸

The second way to limit the increase in visit time would be to place the carbon card function on credit/debit cards. With a separate carbon card, fuel purchased using a credit/debit card (rather than cash) would require a credit/debit card transaction similar to that with the carbon card. This would involve the customer

- removing their credit/debit card from their wallet/purse/holder/pocket
- placing the card in the reader
- entering their PIN
- waiting for the card to transact online or offline
- removing the card from the reader
- Collecting receipt and any additional products purchased
- placing the card back in their wallet/purse/holder/pocket

Using only one card to both surrender units and pay for fuel would mean that only one PIN would need to be entered and would mean one rather than two cards being removed from and replaced in a wallet/purse/holder/pocket. We estimate that a combined card might increase visit times by only 5-10 seconds or 1.5-3%.⁵⁹

Giving oral evidence on ID cards to the Home Affairs Committee, Professor Ross Anderson (HoC-HAC, 2004b, Ev51) made some interesting observations on multi-function cards.

The smart card industry has had over the last 15 years a number of projects to persuade people that a multi-function smart card might be a good thing. I have been involved peripherally in one or two of these, for example, trying to design a system that was simultaneously a banking card and a card for prepayment of electricity meters. The experience of these attempts and pilots was almost uniformly negative. **Technically it is usually not a big deal to have a card with two applications on it but from the administrative point of view and the point of view of legal liability and issues such as whose logo is on the card, who is liable when something breaks, things are very much more difficult.** If you are a banker the last thing you want to do is to be held liable for a power cut or for somebody being unable to get electricity if they suffer as a result. For these reasons the experience of industry is that everybody wants their own card, they want their own customer database and they want control of their own mechanisms to access that database (emphasis added).

⁵⁶ Further work is needed on gathering actual data on petrol station queues.

⁵⁷ Approximately three minutes is spent by a customer on the forecourt and approximately two-and-a-half minutes is spent within the shop/payment area. This data was kindly provided by BP and the research and design consultancy, ID Magasin (www.idmagasin.com).

⁵⁸ In terms of making the link between behaviour, technology and emissions, the point at which fuel is actually flowing into a vehicle's tank is perhaps the ideal location for surrender of units!

⁵⁹ The lower figure quoted rounds up the increase in time over a credit card transaction from 4 to 5 seconds.

Components of till transaction	Credit card		Carbon card		Credit + carbon		All-in-one card	
	Min	Max	Min	Max	Min	Max	Min	Max
Customer tells assistant which pump used	2	2			2	2	2	2
Assistant swipes any non-petrol items	3	3			3	3	3	3
Customer removes carbon card from wallet/purse prior to reaching till			0		0		0	
Customer removes carbon card from wallet/purse at till [1]				6		6		6
Customer places carbon card in reader [1]			2		2		2	
Customer enters PIN and PIN verified			3	3	3	3	3	3
Online connection and transaction [2]			4	4	4	4	4	4
Customer removes card and holds in hand			2		2			
Customer removes card and replaces in wallet/purse				6		6		
Customer removes credit card from wallet/purse prior to reaching till	0		0		0		0	
Customer removes credit card from wallet/purse at till [1]		6				6		
Customer places credit card in reader [1]	2				2			
Customer enters PIN and PIN verified	3	3			3	3		
Online connection and transaction [2]	4	4			4	4	4	4
Customer removes card, collects receipt and non-petrol items, and replaces carbon and credit card in wallet/purse away from till [1]	2				2		2	
Customer removes card and replaces in wallet/purse at till, collects receipt and non-petrol items [1]		6				6		6
Total time at till	16	24	11	19	27	43	20	28
Average time	20		15		35		24	

Notes

1. A transaction time will be shortened if a customer removes their carbon and credits card from their wallet/purse/holder/pocket prior to reaching the till and replaces them after leaving the till. In contrast, the transaction time will be lengthened if the carbon and credit/debit cards are removed and replaced in series at the till.
2. There are 2 main comms methods used to service points of sale: (i) dial terminals using standard a telephone line – average connection time 6-10 secs and (ii) leased lines/IP which is used by all the large forecourt operators and has a connection time of sub 2 seconds. The 4 sec figure quoted here is an average of these two methods. This information was provided by Malcolm Cahill of TNSI (personal communication, 28 Nov 2005). All other figures are estimates by the authors.

Table 2: Estimates for the length of carbon and credit/debit transactions at petrol station tills (seconds)

Professor Anderson's evidence would suggest that placing a carbon card application on every credit, debit and fuel card issued is unlikely to be administratively straightforward or inexpensive. Hence with regard to this option and the option of pay at the pump, the additional costs would need to be weighed against reductions in additional transaction times.

4. DTQs and pre-pay customers

Pre-payment customers constitute approximately 15% of electricity customers and 10% of gas customers (NEA, 2004). For pre-payment customers to be able to surrender units at the point of pre-payment, all pre-pay outlets would need to be able to establish the quantity of gas, and the quantity and carbon rating of the particular mix of electricity being purchased in order to determine the number of carbon units to be surrendered. In addition, outlets would require the equipment necessary to allow surrender by carbon card (i.e. card readers, terminals capable of running relevant software and sufficient comms capacity).⁶⁰ They would also require the facility to sell units to those customers who did not have units at the point of pre-payment. Further work is required to determine whether such requirements might be met in such a way as to be affordable for the smaller outlets such as newsagents that currently offer pre-payment.

Alternatively, as utility companies know the identity of their pre-payment customers, they could debit a customer's carbon account after pre-payment has occurred. If a pre-payment customer did not have carbon units in their account, the utility would have to buy units on the market to cover the customer's purchase (see 2.4) and recoup the money from the customer. This may be possible through adjustment of their meter tariff.

5.5 Trading

Five possible options for trading carbon units are:

1. trading online
2. trading over the phone - call centres or interactive voice recognition (IVR)
3. trading over the counter
4. trading via ATMs
5. automated trading

The trading of consumer goods online and by phone are well established practices and no technological barriers are envisaged using these channels for trading carbon units. 99% of households have a landline and/or mobile phone and so trading by phone would be open to virtually everyone. In May 2005, 13.1 million UK households had access to the internet (ONS, 2005) and this figure will continue to rise. Hence, by the time a DTQs scheme was introduced, online trading would be open to a significant proportion of the population. As well as access to a phone or internet, remote trading would require individuals to have a bank account (or post office cash account) into/from which funds could be paid or withdrawn. Currently 93% of the population have a bank account and this is set to rise with the recent introduction of basic bank accounts (BBA, 2004). In addition, there are people without a bank account who have a Post Office Cash Account (POCA), which it may be possible to use to trade.⁶¹

However, alternative trading options are required for those individuals who do not have the facilities to trade remotely or who do not feel competent/do not wish to do so. Over-the counter trading at banks and post offices are the obvious alternatives.⁶² Like carbon unit surrender, over-the-counter

⁶⁰ For outlets currently using pre-pay terminals provided by the company PayPoint, sufficient comms capacity is required to enable the data to be polled overnight - see www.paypoint.co.uk/retailerprocessoverview.htm. It would need to be determined whether this comms capacity would be sufficient for real-time transactions under DTQs.

⁶¹ We have not been able to establish the percentage of the population that has a bank account and/or a POCA.

⁶² The UK currently has approximately 11,500 bank branches and 16,000 post office branches.

trading would require appropriate terminals, comms capacity and card readers.⁶³ Given that mobile phones can now be topped-up at ATMs, it may also be possible to use ATMs to trade but this has yet to be established.

Rather than contacting a market maker each time units are required for purchase, an organization could set up an automated trading arrangement whereby a set number of carbon units are deposited by the market maker in its account every month and the cost paid by direct debit. Similarly, individuals can make arrangements with their market makers to automatically sell their units immediately upon receipt and have the money paid into a cash account (see 2.5).

5.6 Statements

As noted in 5.1, current technology would allow carbon account holders (both individuals and organizations) real-time access to their account balance via the internet, landlines, and mobile phones. In addition, current technology would allow account holders to obtain a *carbon statement* that listed all transactions involving movements of units into and out of their carbon accounts.

Those transactions that involve the movement of units *out of* an account holder's account are their surrender, sale, transfer and retirement of units, and the transaction involving movements of units *into* their account is their purchase of units from market makers.⁶⁴ By contrast, an account holder's purchase of units at the point of sale does not result in a flow of units into their account, but from the account of the market maker to the retailer (see 2.4).⁶⁵ Hence, if an individual chose to sell all their units immediately upon receipt and then purchased all units at the point of sale, their initial sale of units would appear on their carbon statement but the subsequent purchase of units would not.

Providing individuals and organizations with carbon statements may involve a not insignificant expense. However, even though individuals and organizations could track their carbon unit transactions in the absence of statements, it is likely that this would involve too great a "hassle factor" for most individuals and organizations and therefore statements would be a necessary expense.

Life without statements

Under DTQs, below-allocation individuals who surrender from their account will be left with surplus units in their account that they can save, sell, transfer or retire. Those below-allocation individuals who, instead, sell their units immediately on receipt will, given a stable market price for carbon units (see 6.3), generate additional revenue from their surplus units. Given these benefits, and, conversely, the costs involved in emitting above allocation, individuals will wish to establish whether (and why) they are emitting below, at, or above allocation.

Under DTQs, the quantity of units allocated to individuals each allocation period (see 6.2) will be widely publicized and known. In the absence of a carbon statement, individuals who surrender from their account could track their emissions using bills and statements from utilities and petrol station receipts. Utility bills and statements would show the number of carbon units surrendered to cover the purchase of gas and electricity and, similarly, petrol station receipts would show the number of carbon units surrendered to cover the purchase of petrol or diesel. By combining the information in these various documents, units surrendered could be compared with units allocated to establish whether emissions were below, at or above average.

For those individuals who sell their units immediately upon receipt and who buy all units at the point of sale, their utility bills or statements and their petrol station receipts would show the number of units purchased and this could be compared with the number sold upon receipt to calculate whether

⁶³ It is likely that the first two are already present in both banks and post offices and the third is present in post-offices since the introduction of electronic benefit payments.

⁶⁴ Organizations with very large emissions may purchase units at the Tender (see 2.3).

⁶⁵ If the retailer buys units directly at the Tender, then units will pass from the account of the government to that of the retailer.

emissions were below, at or above allocation. (The number of units sold upon receipt will be equal to number of units allocated and so will be known and, as discussed below, the number of units sold will also appear on the receipt provided by the market maker to whom the units are sold.)

Units may also be purchased at the point of sale by both organizations and above-allocation individuals who surrender from their account. If they do, then, in the absence of carbon statements, they too can use their utility bills or statements and their petrol station receipts to track the number of units purchased. In addition to purchasing units at the point of sale, organizations and above-allocation individuals who surrender from their account may also purchase units from market makers. And market makers will, as mentioned above, be used by those individuals who sell all units immediately upon receipt, and also by those below-average emitters who surrender from their account and who chose to sell their surplus units.

This trading with market makers could take place over the counter, online or over the phone. For individual or organizational account holders, trading over the counter with a market maker, then the transaction receipt would show the number of units debited from or credited to their account. If account holders traded units online, then they could print off a receipt and in addition it would be straightforward for the market maker to provide an online facility that logged account holders' trades. Unlike with trading over the counter or online, there is no way of providing a paper receipt at the point of trade when trading over the *phone*. A receipt could be posted out by the market maker, though whether this would be cost-effective for relatively small value trades would require further analysis. Alternatively, it might be possible for those trading by phone to be sent an e-mail receipt or to be able to access records of their previous trades by phone using IVR.

How many carbon unit transactions?

It is likely that number of carbon unit transactions per month would be small. Below we discuss the number of transactions that various groups of individuals who surrender from their account might make in a month (see Table 3).

Gas and electricity: The majority of individuals pay their gas and electricity bills quarterly and, for those that do, this would mean two transactions each quarter if purchasing both fuels and one if just purchasing electricity. It is assumed that pre-payment customers on average make payments more frequently than quarterly and so their carbon unit transactions would be more frequent (we assume here 1-2 times per month for electricity and 0-2 times for gas).

Motor fuel: For those who purchase motor fuel we assume that the majority do so between twice a month and twice a week.

Trading: A few individuals may speculate on the carbon market and therefore trade very frequently but we assume that the vast majority of individuals will buy and sell units once or twice a month.

Transfer: It is assumed that most individuals transfer units a maximum of once a month.

Category	Transactions per month					
	Surrender			Trades	Transfers	Total
	Gas	Elec	Motor			
Utility quarterly, no motor fuel	0-0.33	0.33	0	1-2	0-1	1.33-3.66
Utility quarterly, motor fuel	0-0.33	0.33	2-8	1-2	0-1	3.33-11.66
Utility pre-pay, no motor fuel	0-2	1-2	0	1-2	0-1	3-7
Utility pre-pay, motor fuel	0-2	1-2	2-8	1-2	0-1	4-15

Table 3: Estimated monthly transactions for individuals surrendering from accounts

For individuals that sell all units immediately upon receipt, all their transactions will be trades (see Table 4). The number of trades for these individuals will be equal to the number of surrenders made

by individuals surrendering from their account plus an additional trade comprising their initial sale of units (assuming units allocated once per month).

Category	Trades per month				Total
	Sale on receipt	Purchases			
		Gas	Elec	Motor	
Utility quarterly, no motor fuel	1	0-0.33	0.33	0	1.33-1.66
Utility quarterly, motor fuel	1	0-0.33	0.33	2-8	3.33-9.66
Utility pre-pay, no motor fuel	1	0-2	1-2	0	2-5
Utility pre-pay, motor fuel	1	0-2	1-2	2-8	4-13

Table 4: Estimated monthly trades for individuals who sell units immediately upon receipt

Even though the total number of carbon unit transactions is likely to be small, using information on bills, statements and receipts or accessed by phone in order to establish whether emissions are below, at or above allocation is not without its “hassle factor”. Even with statements, individuals who sell their units immediately upon receipt would be stuck with this hassle factor as using this information would be the only means available for establishing their level of emissions. However, for individuals that chose to surrender units from their account, a statement would remove the hassle factor of managing a carbon account and, arguably, without access to a statement, DTQs may be deemed too troublesome to implement.

Providing statements

It would, of course, be straightforward to provide access to online statements and it assumed that the vast majority of organizations would access statements online. However, whilst the number of individual able and willing to access online statements will increase over time (see 5.5), there will always be those unable or unwilling to do so and alternative channels for obtaining statements will be necessary.

Individuals are used to having bank statements and phone, credit card, gas, electricity and other bills/statements posted to their home. Therefore, one option would be for the government to send out paper statements to all eligible individuals. To do this, government would require the current addresses of all eligible individuals. The Identity Cards Bill makes provision for recording individuals’ addresses in the National Identity Register at the time of enrolment and for requiring individuals to subsequently notify the government of a change of address. In the absence of an ID card scheme, address data could be captured when eligible individuals enrolled into the DTQs scheme. Once enrolled, it would then be the responsibility of the account holder to notify government of any change of address (though notification would not have to be a legal requirement).

If individuals became eligible for units at age 16, then around 48 million individuals would be enrolled into the scheme.⁶⁶ If the cost of government producing and posting a carbon statement was between £0.20 and £0.40, then a set of statements for this number of individuals would cost approximately £10-20 million and if statements were sent out each month the annual cost would be £120-240m.

In reality this sum is likely to be smaller as some couples will opt for joint carbon accounts thus reducing the number of statements.⁶⁷ This smaller sum could be reduced if paper statements were made “opt-in” on enrolment and the government ran a campaign strongly encouraging individuals not to request a paper statement unless they could not obtain one online. And if it was felt that a quarterly rather than a monthly statement was sufficient, costs would fall by a factor of three.

⁶⁶ There are currently approximately 46.5 million people in the UK aged 18 and over and approximately 48 million people aged 16 and over. (National Statistics, 2005).

⁶⁷ It is assumed that, as will bank accounts, joint accounts will be available for couples under DTQs.

Costs might also be reduced if a customer's carbon statements could be posted out with their monthly bank statement or telephone bill, or their quarterly utility bill/statement. This would be the so if it proved cheaper for the government to pay the companies issuing these bills/statements to print a carbon statement and insert it into a letter that was going to be posted anyway than to pay the cost of printing and then posting out dedicated statements itself. Such a service would require (1) customers of participating companies to contact them to set up the service and (2) participating companies to have access to the database holding carbon accounts and to take the necessary steps to incorporate the printing of carbon statements with the printing of their own bills and statements.⁶⁸

If it was judged that those individuals not willing or able to access a statement online would accept alternative methods of accessing statement to them being posted out, then, if such methods were cheaper, they could be considered. One alternative to posting out statements would be for account holders to have to obtain statements over the counter at banks and post-offices. Whilst this should be technologically straightforward, it may require investment in appropriate printing facilities. Another alternative would be to introduce dedicated "carbon terminals" that printed off carbon statements on the insertion of a carbon card. These could be installed in banks, post offices, garages, supermarkets and other convenient locations.

The majority of ATMs are capable of printing some form of statement or receipt and the complexities of getting information from a central account holding point to an individual ATM are minor.⁶⁹ The limiting factor with ATMs is the size of the paper slip issued, which is unlikely to be large enough to hold the details required on a full statement.

5.7 Transfer

As noted in 2.6, a transfer mechanism would be necessary to allow gifting and retirement of units. Such a mechanism would also provide one solution to the payment of shared bills. For instance, in a shared house where one person had paid a utility bill and surrendered units on behalf of the others in the house, the other members of the household would be able to transfer their share of units to that person's account. Of course the other people could pay the financial value of their share of units to this person as an alternative to transferring units. And, rather than surrendering units, the person paying the bill could buy them at the point of sale so their entire transaction was in cash. This would enable easy cash repayment to this person by other members of the household.

People are used to bid and offer spreads and the payment of commission as part of foreign exchange transactions and they may well therefore be predisposed to accept these features when trading carbon units. However, it is likely that they would expect to be able to transfer units without incurring a specific charge. If market makers were to offer free transfer facilities to customers alongside their trading facilities then the cost of this transfer facility would need to be incorporated within their charging structure for carbon unit trades.

5.8 Lump-sum recycling

Section 3.2 discusses the case for lump-sum recycling of Tender revenue. If it were decided to recycle in this manner, the lump sum could be deducted from the tax bill of tax payers and added to the benefits of non-tax payers.⁷⁰ However, the lump sum would be more visible, and may be more closely associated with the national effort to reduce emissions, if it were paid as a discrete "carbon bonus". Such a method payment might be considered if there was evidence that this might have benefits in terms of public acceptance of DTQs. For such a method to be feasible, all eligible individuals would require a bank account or Post Office Cash Account into which the lump sum could be paid and government would require details of these accounts. If this information was gathered as

⁶⁸ Further research is required to see whether such an arrangement would be feasible in practice.

⁶⁹ This information was provided by LINK Interchange Network Ltd, the company responsible for the UK's LINK network of ATMs.

⁷⁰ In Switzerland, lump-sum recycling to individuals under the CO₂ law would, for administrative simplicity, be implemented through a reduction in health insurance payments.

part of the process by which individuals were enrolled in the DTQs scheme (see 5.6), it could probably be captured at a low additional cost.

5.9 Rating system

The ability to accurately carbon rate electricity depends upon having a system that can adequately account for the different types of generation sources used to produce a particular electricity mix. The electricity disclosure component of the European Directive on liberalisation of the European electricity market (2003/54/EC) provides the basis for such a rating system with its requirements that electricity suppliers provide their customers with reliable information on the carbon emissions produced by their overall fuel mix.

5.10 Procurement

Given the government's record on procurement of large IT systems is, in the words of the Home Affairs Committee, "not encouraging" (HoC-HaC, 2004a, p55), it would be essential that the best possible procedures were in place for procuring a DTQs system. The Home Affairs Committee report on ID cards levelled various criticisms at the government's approach to procurement of an ID card system and it is encouraging to note in the Home Office's response (Home Office, 2004), the various steps that the government is taking to ensure success in this area.

6. The carbon market

Fleming's proposal that carbon budgets be set well into the future seems sensible as it gives the markets and the economy a long-term signal. Fleming's proposal that carbon budgets be set by an independent committee also seems sensible as does his proposal that the Tender is based on that for UK Treasury bills.⁷¹

Fleming has proposed a detailed structure for the setting of carbon budgets and has also proposed a schedule for issuing carbon units to individuals and for the Tender. We have not analyzed these proposals in detail but set them out below for completeness.

6.1 Carbon budgets

Fleming has proposed that the 20 year period over which carbon budgets are set should be divided into three periods (see Fig 3)

Period 1 is a 5-year binding Commitment, which cannot be revised except by *force majeure*. Period 2, the 5-year Intention, is inflexible; the presumption is "no change", but it can be revised for stated reasons at an annual review. Period 3 is a 10-year Forecast, which is indicative only (Fleming, 2005a, p5).

6.2 Issuing carbon units

Fleming has proposed that on day one of a DTQs scheme

a full twelve months-worth of carbon units is issued. After that, they are topped up a monthly basis so that, on the first day of the second month, a further one-month's supply is placed on the market. In other words, between 11 and 12 months supply of carbon units will be on the market at all times. In practice the normal frequency for such Government tenders is weekly, and there is good argument for preserving this in the case of DTQs (2005a, p14).

⁷¹ An anonymous expert on auction theory we consulted confirmed that basing the Tender on that for Treasury bills is a sensible starting assumption.

6.3 Price and price volatility

Prices will be determined by the reduction trajectory of the carbon budget and the market’s estimation of society’s response to this trajectory. Fleming has argued that the carbon unit price under DTQs will be self-stabilizing in that an increase in the price of units will incentivize individuals and organizations to seek to reduce their use of fossil fuels and fossil-fuel electricity which will lead to a reduction in the price of units. It is important to assess in detail the likely volatility of carbon unit prices (including the potential for price-spiking) and the effect that increased volatility would have on the scheme.

For example one could imagine a scenario where low-income individuals with surplus units were disadvantaged by the scheme due to price volatility. An individual on a low-income who emits at, say, a little below allocation may decide to sell their units immediately upon receipt and buy all units at the point of sale. *If* the price was volatile, this individual may sell at one price but end up buying units at a (significantly) higher price. Even though, as a below-allocation emitter, they would be buying less units than they had sold, the higher price at which they bought them may nevertheless mean that they spent more on the purchase of units than the amount received for the sale of their allocation. The likelihood and significance of such an occurrence will be the subject of future work.

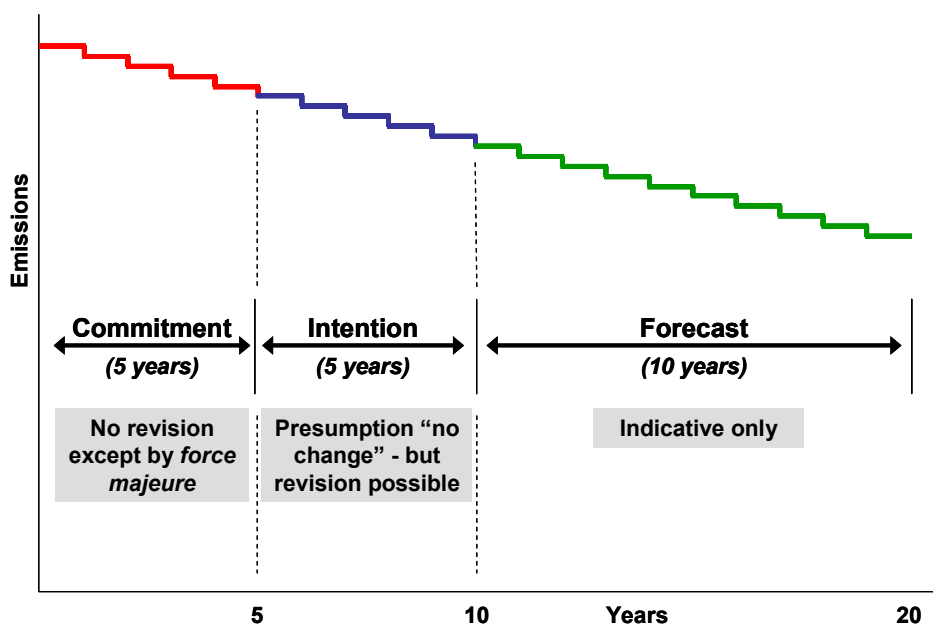


Figure 3: The three periods of carbon budgets

7. Public acceptability

It is presumed that the public support for the proposed introduction of DTQs would relate to (1) the degree to which the scheme was perceived as fair (2) the degree to which it could be understood and (3) how easy the public believed it would be to use. These three issues are addressed below.

7.1 Fairness

The fuel protests of 2000 illustrated the public antipathy that can arise in response to even small rises in the price of fuel. Of course, it may be that lump-sum recycling to individuals of the revenue from a carbon tax or from an auction of units to organizations may make rises in the price of fuel more acceptable to the public – especially if recycled in the form of a “carbon bonus”. However it may also be the case that awarding emissions rights directly to individuals, such as under DTQs, makes emissions reduction more acceptable than any sort of lump-sum recycling of tax/auction revenue.

Allocating units directly and on an equal per capita basis quite literally makes individuals equal environmental stakeholders by awarding them an equal stake or share of the atmospheric sink. Arguably, the lump-sum recycling of auction or tax revenue does not make it as explicit to individuals that they have these equal shares in the atmosphere. If awarding units directly to the public means that they more clearly perceive they have such equal shares, if the public perceives this equal share to be fair, and if fairness is a condition for public acceptability, then DTQs may promote greater public buy-in to the task of substantially reducing emissions.

Indeed, is it possible that a sense of common purpose with regard to emissions reduction could be built around DTQs? It is perhaps not inconceivable that the Prime Minister could address the nation along the following lines:

Making deep cuts in our emission is a great challenge one which must be met for the sake of our children and children's children. As a nation, we've really got to pull together on this and it is only right that the burden of emissions reduction is shared out fairly. The government takes the view that the fairest way of doing this is for all citizens to be given, as of right, an equal share of the nation's permitted greenhouse gas emissions...

Simon Dresner (2005, pp4-5) makes the opposite case, arguing that

[t]here is...a danger that people would regard the practical demands of the [DTQs] scheme as part of a sinister plot to control their lives, and that whenever something went wrong it would become an easy political target precisely because it was so visible. There's a danger that the whole idea of limiting carbon could become discredited for populist reasons.

He therefore argues (pp5-6) for a less visible scheme.

Personally, I think the best option politically is upstream emissions trading. Its abstruseness is a political strength. The Renewables Obligation and the Energy Efficiency Commitment are rather similar instruments and they've been remarkably uncontroversial, probably because few people are aware of them and only nerds like us begin to understand them. It is also likely to be harder to get the public angry about the idea that there is a national emissions quota which they are indirectly paying for than about a tax or having to produce ID to buy petrol and pay extra when they go over their quota.

The extent to which DTQs might generate common purpose or discredit the idea of limiting carbon, and whether it is better to adopt an approach to emissions reduction that is more or less visible to individuals are clearly important issues for future work.

7.2 Understanding the scheme

Given that DTQs would take a significant time to implement, then once a decision had been taken to do so, there would be a substantial period in which government could explain the various facets of the forthcoming scheme. Over time it is likely that, as a result of learning-by-doing, most people would come to understand the scheme. However understanding the scheme is not a pre-requisite of using it. As noted in 2.5, those individuals who cannot understand or simply do not wish to transact in carbon, can sell all their units immediately upon receipt, buy all units at the point of sale and transact in money only.

7.3 Using the scheme

For those individuals and firms who wish to transact in carbon, the process of surrendering units (plastic card or direct debit) is convenient and familiar. And so too are the various proposed options (online, phone, over-the-counter) for trading units. Utility bills would contain information on the

carbon units used over the billing period and could contain historical data on carbon unit use to enable comparisons over time. There is a considerable amount of information available to consumers relating to energy efficiency and conservation matters and it is likely that a DTQs scheme will incentivize consumers to engage with and make use of this information more fully than at present.

8. Efficiency – can DTQs reduce emissions cost-effectively?

8.1 DTQs and other large IT projects

Given that DTQs require further technical specification, and given that our research expertise does not extend to the costing of large IT systems, no cost estimates have been attempted. However, given that DTQs shares common elements with the proposed ID card scheme, we have conducted a brief and preliminary comparison of the two schemes in order to get some sense of relative costs. It is our sense that DTQs may be cheaper and would be unlikely to be any more expensive than ID cards. Furthermore, it could reasonably be argued that the benefits of DTQs (i.e. comprehensively tackling climate change) are comparable if not greater than those claimed for ID cards. Hence, if it is objected that DTQs will be controversial and expensive, then it can be replied that, whilst the cost would be not inconsiderable, DTQs is affordable in public policy terms as it would be cheaper/no more expensive than a comparable and controversial scheme to which the government has already committed itself.⁷²

To begin, we provide some background information on the cost of the ID card scheme and in doing so describe elements of the scheme relevant to a comparison with DTQs. As a starting point, it is worth noting that there is very considerable disagreement over what the cost of the proposed ID card scheme is likely to be. The government's estimate for the cost of the scheme was initially £1.3–3.1 billion and has since risen to £5.8 billion (Lettice, 2005). However, a report on the ID card scheme by a team from the London School of Economics (LSE) and published in June 2005, placed the cost of the scheme between £10.6bn and £19.2bn (LSE, 2005a). A meeting between the Home Office and the LSE in November 2005 clarified the reasons for the very differing cost estimates. According to the LSE team (LSE, 2005b)

the current government cost estimates have been ring-fenced around the Home Office and include no connections, implementation or interaction with other departments...Therefore, the projected costs as stated in the Bill's regulatory impact assessment (RIA) relate only to the costs incurred by the Home Office to develop the National Identity Register and registering and issuing cards from the new national identity agency.

By contrast the approach taken by the LSE team in its report

focused on the rollout cost of the system in accordance with the stated policy goals of combating crime, terrorism, identity theft, and benefits fraud. This difference of approach explains in part the difference in respective cost figures.

However, the LSE team also note that its estimates

were conservative on the costs to the government as a whole, as [they] did not include the costs to all government departments, agencies and local authorities.

The Home Office (2005b, p2) has indicated that government departments, agencies and local authorities will make use of the ID card scheme on an “opt-in” basis.

⁷² A similar argument can be made in relation to the proposed road charging which has set-up costs estimated at between £10-62 billion and annual running costs estimated at £5bn (HoC-TC, 2005, p10). It is likely that the administrative costs of DTQs would be low but would bring comparable or greater benefits.

Decisions of whether, when and how particular public services will make use of the ID cards scheme will be made by those services – individually or collectively as appropriate depending on how services are managed.

However, in its recent *Procurement Strategy Market Soundings* document, the Home Office (2005a) forecast that the number of government departments opting in would be 265. With regard to the costs of integrating these 265 government departments into the ID card scheme, the Home Office (2005b, p3) has argued that

This higher degree of integration can be delivered for new systems without additional cost as the requirements will be designed from the outset. Given that the rollout of ID cards will take place over some years, many systems will fall into this category. For a lot of others, integration costs will be absorbed in the usual cycle of system upgrades and technology refresh. Rather than having to incur the costs of a specific project to “ID-enable” their systems they will wait and plan it into their upgrade and maintenance cycles.

In contrast, the LSE team (LSE, 2005b) argues that whilst

[t]he government seems to take the view that additional functionality covering connections to the National Data Register can be built into new or replacement IT systems at little additional cost progressively over the next decade...the cost of system implementation and integration across the public sector may be substantial.

However, despite the LSE team’s initial cost estimates not including the cost of integrating 265 government departments - a cost which it argues “may be substantial”, the report authors (LSE, 2005b) have recently stated that

[g]iven the government’s assurances on a number of points (for example, that registration will involve a significant degree of automation)...it is likely that their original median cost projection will **at first** be reduced (emphasis added).

With regard to the detailed biographical check to be carried out on individuals during registration into the ID card scheme, the LSE’s original cost estimates were based on the assumption that this would be largely manual and that each check would cost £10-20. However, in response to the LSE’s report, the government stated that the biographical check will in fact be “largely automated” and “thus will be a fraction of this cost” (LSE, 2005c, p7). A reduction in the LSE team’s cost estimate for biographical check to take account of the fact that these checks will be largely automated explains why the team’s overall cost projection will *at first* fall. However, the team takes the view that the additional cost for integrating the 265 government departments which will *subsequently* be factored in could well be greater than the reduction in cost to account for automated checks. In other words, whilst the overall cost estimate may *at first* fall, it is possible that it will *subsequently* rise to a higher level than at present.⁷³

Having outlined the contested estimates for the cost of the ID card scheme, we now compare the various elements of two schemes. Figure 4 shows both the elements that the schemes have in common and those specific to each scheme and these various elements are discussed below.

⁷³ We are grateful to the LSE team for clarifying this issue (personal communication, 5 December 2005).

Common elements

- *Database:* Both schemes will require a secure central database, though a higher level of security may be required for the National Identity Register and this may entail additional expense.⁷⁴
- *Cards:* Both schemes involve the issues and reissue of cards, though the purchase cost of blank ID cards and the cost of processing these blanks may be higher than the purchase and processing of blank carbon cards.⁷⁵
- *Verification:* If the “largely automated” biographical check under ID cards is similar to the electronic verification that has been proposed as a possible means of enrolment under DTQs in the absence of an ID card scheme (see 5.2), then the costs of verification could be comparable for both schemes.

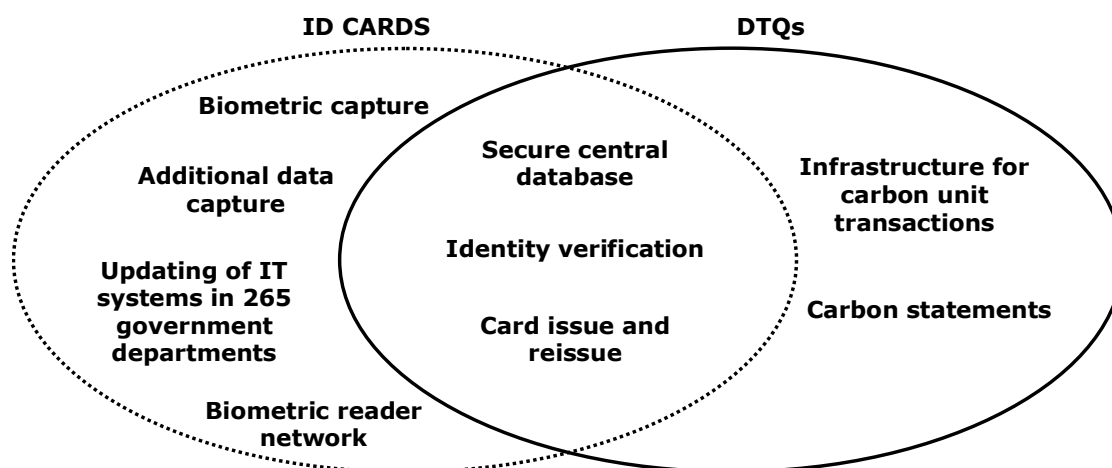


Figure 4 – ID cards and DTQs: common and specific elements

Elements specific to ID cards

- *Biometric capture:* Individuals enrolling in the ID card scheme will be required to attend a dedicated secure facility containing devices to read the various biometrics captured and those biometrics being compared with those already held in the National Identity Register.
- *Additional data:* Schedule 1 of the draft ID cards bill sets out the various types of information that may be stored on the National Identity Register. This is considerably more than would be required for enrolment under DTQs and its capture may incur an additional cost.
- *Biometric readers:* A network of biometric readers will be required around the country so as to be able to compare an individual’s biometric with the template stored on their card and/or in the National Identity Register. There is currently a considerable disagreement between the government and the LSE team on the appropriate cost to attach to biometric readers (see LSE 2005c, p6).
- *Systems update:* The cost issues surrounding the possible update of IT systems in 265 government departments are mentioned above.

Elements specific to DTQs

- *Transaction infrastructure:* As noted in Section 5, the existing credit card network could be used for surrender of carbon units at garages. However, there would be equipment and staff costs associated with any modifications and additions required to this network and with the setting up of online, phone and over-the-counter trading and transfer systems.
- *Statements:* The various options for providing individuals and organizations with statements are set out in 5.6.

⁷⁴ Further research is required into relative costs.

⁷⁵ Again, further research is required into relative costs.

It is our sense that the cost of the elements specific to DTQs may be less than the cost of those specific to ID cards, and it would seem unlikely that they would be higher. However, detailed work is clearly needed in this area.

8.2 DTQs and other emissions reduction instruments

Of course it may be objected that the correct comparison is not between DTQs and other large IT projects but between DTQs and other ways of equitably reducing greenhouse gas emissions from energy use.

DTQs will certainly provide opportunities for cost saving. Implementing a DTQs scheme should allow the removal of certain existing policy instruments (e.g. Climate Change Levy and Climate Change Agreements) which would result in certain administrative cost savings. And if DTQs can reduce the UK's emissions then (assuming other nations play their part in emissions reduction) the avoided damage costs of climate change will dwarf the cost of the scheme. However, such cost savings could also be realized using other instruments and it may be that, for example, an upstream auction or a carbon tax with lump sum recycling would be less expensive means of achieving these cost savings.

This argument has emerged from a number of quarters. For instance, James Graham (2004), reviewing DTQs on the Green Liberal Democrats website in April 2004 site wrote

The question I am forced to ask myself is whether much the same could be achieved simply by putting the country's entire carbon allocation up for [upstream] tender, with the government passing the income onto citizens on a per capita basis and businesses obviously passing their costs onto consumers. It would surely create the same financial incentive for both companies and private individuals to go green, while removing the need for such a complex system? And wouldn't people be able to see the benefits of a 'citizen's income' (for want of a better term) more readily than some abstract carbon allowance?

A similar point was made by a Ravi, an individual posting during a discussion of DTQs on the *WorldChanging.com* website in October 2005 (WorldChanging, 2005).

What a top-down, centralized way to accomplish carbon reductions... Wouldn't it be much simpler to TAX carbon products with a hefty sales tax, then apply those revenues to a per-capita credit to every resident of the country? Those who use more, pay more; those who use less, earn money; it's revenue neutral; and it has ZERO privacy/big-brother problems. I can't see the advantage of DTQs over a simple "feebate" system.

And in November 2005, Simon Dresner (2005, pp3-4) argued as follows:

Distributionally speaking, auctioned upstream emissions trading is the same as an upstream carbon tax...and you can use the same compensation mechanisms...

Do you remember the ecobonus...it's a payment of equal size given to each individual to redistribute the revenue from an ecotax (say a carbon tax). Its distributional effect is the same as the distributional effect of a personal quota, it's just that the individual is given money rather than a personal quota they can trade.

However, there's a huge difference administratively. Now we have a largely integrated tax and benefits system, administering an ecobonus is just a matter of increasing the personal tax allowance, benefits and tax credits by a certain amount. The marginal administrative costs are basically zero. And because the tax is collected

upstream, the administrative costs of tax collection are very low, actually much less than those of the Climate Change Levy, which could be abolished. Much the same is also true for an auctioned upstream tradable quotas system.

By contrast, a downstream personal quota system has large administrative costs. You're looking at having to give every resident a secure card...

The only reason I can think of for wanting to create all this additional expense and complexity is to get the public to think about the environmental impact of heating, using electricity and travelling.

Given the additional set up and running cost for DTQs, any argument in favour of the scheme needs to make the case that this additional cost is justified by additional benefits that would arise from the scheme. This point was made by the government (Defra, 2005 p7) in its response to the Environment Audit Committee report *The International Challenge of Climate Change: UK Leadership in the G8 and EU*.

Domestic Tradable Quotas (DTQs) are an interesting idea and one that would raise awareness amongst people of their own impact on greenhouse gas emissions and depending on the level of the emissions cap, should have an impact on a nation's emissions. There are, however, a number of issues that need to be researched and considered before coming to a conclusion on its feasibility, **such as whether the benefits of introducing DTQs were proportionate to the costs of administering it** as well as the public acceptability of such a scheme (emphasis added).

Two potential additional benefits arising from DTQs have been outlined above. In Section 3.2 it was argued that allocating emissions rights directly to individuals would allow them to control the disposition of those rights in a way that they cannot do under an upstream trading scheme or under a tax. And in 7.1 it was argued that the explicit allocation to individuals of their equal share of the limited environmental sink through an equal share of carbon units might increase buy-in to the task of large emissions reduction, and even generate a sense of common purpose in relation to this task.

In terms of efficiency, it may be the case that if individuals are confronted with an explicit ration of carbon units, they will become more aware of their emissions, and more engaged with and focused upon the task of emissions reductions than they would under other instruments. And if individuals spend more time and effort considering ways to reduce their emissions,⁷⁶ then emissions reduction may be more efficient under DTQs than under other instruments. This is clearly an important issue that will be the subject of future research.

9. DTQs and EU ETS

Even if we agreed that DTQs constitute the ideal "cap and trade" scheme, the scheme could not simply be parachuted complete into an empty policy space. Since January 2005, the European Union Emissions Trading Scheme (EU ETS) has been in operation and hence, if a DTQs scheme is to be implemented, it is important to explore ways in which EU ETS might evolve into DTQs.

Table 5 compares and contrasts the two schemes and notes that, under EU ETS, emissions rights are currently surrendered by *emitters*, whereas, under DTQs, emissions rights are surrendered by *energy end-purchasers*. However, there is a considerable overlap between these two groups as it is only in the electricity sector that end-purchasers are not emitters.

⁷⁶ Emissions reduction could come from choosing low carbon *supply* options and implementing energy efficiency and conservation measure on the *demand* side.

	EU ETS	DTQs
Geographical scope	EU	National
Emissions categories	Energy and industrial processes	Energy
Gases covered	CO ₂	CO ₂ , CH ₄ , N ₂ O
% GHG emissions covered	30%	87% (UK) ¹
% CO₂ emissions covered	45%	97% (UK) ¹
% energy emissions covered	?	100%
Emissions rights surrendered by	High-emitting energy and industrial installations	All energy end-purchasers
Allocation of rights	Mainly grandfathered – increased auctioning over time	40% individuals – EPC 60% auctioned (UK)

1. The emissions percentages for DTQs are calculated on the basis of the national emissions inventory which does not include emissions for international aviation or marine. Tyndall has produced emissions scenarios that include these emissions (Tyndall, Centre 2005).

Table 5: EU ETS and DTQs compared

DTQs include all emitters other than those in the electricity sector (see the DTQs column of Table 6).⁷⁷ By contrast, EU ETS includes only emitters from the electricity sector and large industrial emitters (see the EU ETS column of Table 6). Hence, if EU ETS were to be expanded by gradually including more and more emitting organizations and then by including individuals, the participants in the two schemes would, excluding the electricity sector, be identical (see “electricity” row in Table 6). Then, to complete the transformation from EU ETS to DTQs it would be necessary to change the entities that surrender emissions rights in the electricity sector from the power stations (emitters) to the electricity customers (end purchasers). Hence if DTQs is a sufficiently powerful idea, then there is an evolutionary route that could be taken to realize the scheme.⁷⁸

Scheme	EU ETS		DTQs	
	<i>Emitters</i>		<i>End purchasers</i>	
Units surrendered by	Organizations	Individuals	Organizations	Individuals
Emissions source				
<i>Stationary emitters</i>				
Electricity	(Power stations)	X	NE	NE
High-emitting industrial	(Cement, lime etc)	n/a	E	n/a
Other emitters	X	X	E	E
<i>Mobile emitters</i>				
Road	X	X	E	E
Air	X	X	E	E
Other	X	X	E	E
Key: E = Emitter NE = non-emitters				

Table 6: From EU ETS to DTQs?

⁷⁷ Or to put it another way, DTQs includes all end-purchasers and all end purchasers other than those in the electricity sector are emitters.

⁷⁸ Of course, a transition from EU ETS to DTQs becomes less straightforward if EU ETS develops into a hybrid scheme including fuel suppliers as well as emitters. This issue will be examined in future work.

10. Conclusion

Tyndall's research to date indicates that DTQs fare well when assessed against the 3Es of equity, effectiveness and efficiency.

Equity

A key feature of DTQs is the allocation of emissions rights on an equal per capita basis. There are certainly arguments within the philosophical literature to support the claim that this is an equitable allocation and there is increasing political support for allocating rights in this way. For example, the principle has been endorsed by the Royal Commission on Environmental Pollution, the House of Commons Environmental Audit Committee, the Green Party⁷⁹ and the Liberal Democrats.⁸⁰

If implemented on the back of policies to tackle fuel poverty and rural transport issues, and, if the revenue raised at the Tender is used appropriately, then it should be possible to implement DTQs in a way that does not disadvantage those on low income.⁸¹

Effectiveness

DTQs should not be regarded as simply a "blue sky" proposal as the scheme is technologically feasible and could be built around credit card technologies that are well understood and that have been in place for a number of years. The initial enrolment of 45 million or more adults into a DTQs scheme would, in the absence of a successfully implemented ID card scheme, be challenging, but should be both feasible and convenient using electronic verification.

Efficiency

Whilst there would be a not insignificant set-up cost attached to DTQs, the cost could be less than, and is certainly unlikely to exceed the cost of other large government IT projects. Given that the benefits from DTQs would be at least comparable, it can be argued that DTQs is affordable in public policy terms.

However, though DTQs may fare well when assessed against the 3Es on its own terms, it is important to consider how DTQs compare with other emissions reduction instruments. Section 3.2 outlines the various approaches that can be taken to allocating emissions rights on an equal per capita basis, and Sections 9.2 sets out the arguments that claim that other instruments could reduce emissions equitably and effectively but at a lower cost. In response to these arguments, 9.2 set out three potential additional benefits to DTQs relating to the 3Es. These are summarized below along with a fourth.

Equity

In Section 3.2 it is argued that allocating emissions rights to individuals gives them additional control over those emissions rights compared to the lump-sum recycling of tax or auction revenue. Under DTQs, individuals could potentially choose to whom they sold units and also retire units, something that would not be possible under these other instruments.

Effectiveness

The government's chief scientist, Sir David King, indicated in December 2004 that a reduction in UK emissions of not just of 60% but of 80% may be required by 2050 (HoC-EFRACOM, 2005). And in a paper prepared by the IPPR (Retallack, 2005) for the International Climate Change Task Force and published in February 2005, it was suggested that cuts of 90% may be required. Section 7.1 argues that by making individual's equal share of the carbon budget explicit, DTQs may engender greater

⁷⁹ The Green Party adopted "[t]radeable quotas for carbon dioxide emissions" as party policy at its Autumn 2005 conference (Green Party, 2005)

⁸⁰ It is Liberal Democrat policy to "[p]romote a new Europe-South initiative for a long-term global framework to cap CO₂ emissions through contraction of greenhouse gases emissions to the level needed to stabilise the climate, and convergence to equal emission quotas, with common institutions to ensure and support compliance under democratic control ('contraction and convergence')" (Liberal Democrats, 2005).

⁸¹ However, more work is needed on the consequences of possible volatility of carbon unit prices (6.3).

public buy-in to, and generate a sense of common purpose around the task of making these substantial reductions in emissions.

Efficiency

In Section 8.2 it is argued that, when faced with a personal carbon ration/allowance, individuals may respond by engaging more fully in the task of identifying emissions reduction opportunities, thus leading to more efficient emissions reduction than under other instruments.

DTQs and peak oil and gas

Fleming (2005b, p28) has argued that setting up systems that allow individual emissions trading would be an effective way not only of tackling climate change, but also shortages in oil and gas supply.

[A]lthough climate change is itself a supremely urgent issue, it is becoming likely that the most immediate shock affecting fuel will in fact be the very high prices and supply interruptions which can be expected in the near future. The policy instrument required in response to fuel shortages is not taxation: that would only increase the price of already expensive fuel. Instead it will be necessary to impose some form of rationing system to ensure fair access to fuel among the population as a whole. The existence of the two problems – climate change and oil/gas depletion – is not a conceptual problem for TEQs; on the contrary, they are complementary; they are two sides of the same story, and TEQs are well designed to tackle either – or both at the same time.⁸²

Whilst Tyndall's research on DTQs has not addressed extending the instrument to cover the rationing of oil and gas, further work into this area is potentially important.

A key element of future research is to make a much more detailed assessment of the costs of implementing DTQs and also to make a more detailed assessment as to what are the additional benefits and whether they justify the administrative costs of the scheme.

Researching DTQs is a decidedly interdisciplinary undertaking, demanding an integrated knowledge of issues relating to climate change, carbon accounting, political philosophy, environmental economics, financial economics, public finance, public administration, information and communications technology, data security and fraud. The wide range of issues to be addressed and the limited research capacity available on this project has necessarily placed constraints on the depth to which we have been able to explore these various issues. Given (1) the urgent need to address climate change (2) that our initial research indicates that DTQs is a feasible policy option and (3) the broad range of issues that require further research, we hope that the research community will be motivated to build on work to date.

⁸² Fleming now refers to DTQs as TEQs – see footnote 1.

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Appendix 1 – Communication highlights

- 10 Jan 2004 Kevin Anderson (KA) interviewed about DTQs on Radio 4's *Today* programme. DTQs also subject of feature on BBC Online.⁸³ Colin Challen MP (Labour, Morley and Rothwell) contacts KA having heard *Today* interview and invites him to present DTQs at a meeting in House of Commons on 10 Feb.
- 10 Feb Colin Challen mentions DTQs during debate in the House and requests a meeting on the subject with Elliot Morley, Minister of State for Environment. Minister agrees. KA presents DTQs at evening meeting in House of Commons chaired by Colin Challen.
- 29 Mar Richard Starkey (RS) speaks on DTQs at Dana Centre (www.danacentre.org.uk) as part of a debate on radical solutions to climate change. Five speakers put forward their solution, audience adopts two preferred options and then chooses a "winner". DTQs one of the two options chosen by audience along with Contraction and Convergence (C&C). C&C eventual winner.
- 31 Mar KA and RS present DTQs to Environmental Audit Committee.
- 29 Apr Article on DTQs by RS and KA published in Guardian.⁸⁴
- 7 Jul Colin Challen presents 10-minute rule bill on DTQs to the House.
- Sep Short piece on DTQs in NERC Annual Report.⁸⁵
- 9 Sep RS and KA awarded 15.5K by NERC under its knowledge transfer programme to run workshops on DTQs
- 13 Sep DTQs featured in an article in the *Times*.⁸⁶
- 15 Sep Colin Challen interviewed about DTQs on Radio 4's *Today* programme and on Radio 5's *Morning Reports*. Colin hosts event at House of Commons to mark publication of his 10-minute rule bill. RS give presentation on DTQs. Peter Jones, chair of the environment committee of the Royal Society for the encouragement of Arts, Manufactures & Commerce (RSA) invites RS and KA to make a presentation of DTQs to the committee.
- 20 Sep Each year NERC select one project of interest to feature in a widely circulated press release. In 2004 NERC decides to select two, so it can feature DTQs alongside its previously chosen project.
- Oct Article on DTQs by RS and KA in NERC's autumn edition of *Planet Earth*.⁸⁷
- Oct Launch of Policy Studies Institute (PSI) report *Green Taxes and Charges*.⁸⁸ DTQs included in the various environmental policy instruments modelled by the project.

⁸³ <http://news.bbc.co.uk/1/hi/sci/tech/3385035.stm>

⁸⁴ <http://www.guardian.co.uk/life/opinion/story/0,12981,1205166,00.html>

⁸⁵ http://www.nerc.ac.uk/publications/annualreport2004/03_climatechange.pdf

⁸⁶ <http://www.timesonline.co.uk/newspaper/0,,170-1259154,00.html>

⁸⁷ <http://www.nerc.ac.uk/publications/documents/pe-aut04/share-air.pdf>

⁸⁸ <http://www.jrf.org.uk/bookshop/eBooks/1859352472.pdf>

- 25 Nov Colin Challen hosts meeting at House of Commons on DTQs sponsored by npower. Over 60 people in attendance. Speakers are Colin Challen, RS, Michael Meacher MP and Matt Thomas of npower.
- 26 Nov RS presents DTQs to environment committee of the RSA. Committee keen to support further research into DTQs.
- Dec Feature article on DTQs in *Green Futures* magazine. RS interviewed by author during preparation of article.
- 1 Dec RS gives oral evidence on DTQs to subcommittee of House of Lords Committee on Science and Technology investigating energy efficiency.
- 19 Jan Colin Challen, KA and RS present DTQs to Elliot Morley, Minister of State for the Environment.
- 7 Feb Following a request from the Energy Efficiency Innovation Review, KA and RS give evidence to Review staff on DTQs.
- 10 Feb Following a request from the Low Carbon Vehicle Partnership, RS presents DTQs at LCVP's annual conference.
- 21 Feb Following a request from Greenpeace, RS presents DTQs to selected staff at head office in London..
- 22 Mar RIBA president, George Ferguson, host a dinner at RIBA building to discuss DTQs. Around a dozen invited guests including Stephen Byers and Polly Toynbee. RS gives a 10-minute presentation on DTQs before dinner.
- 7 Apr RS presents DTQs at a lunchtime meeting at the Treasury organized by the NGO CarbonSense.
- May Sustainable Development Commission endorses DTQs in its submission to Climate Change Programme Review and calls for further research.⁸⁹
- 13 Jun Letter on DTQs by RS and KA published in the Independent.⁹⁰
- 20 Jun DTQs subject of major feature in Manchester Evening News.
- 28 Jun DTQs workshop held in London using money awarded by NERC. Around 30 participants.
- 29 Jun RS and KA have meeting with Norman Baker, Liberal-Democrat spokesperson on the environment at his Westminster office to brief him on DTQs.
- 30 Jun RS interviewed by BBC3 news on DTQs. Item due to be broadcast on 7/7 but was pulled as a result of London bombings.
- 2 Jul DTQs featured on front page of Daily Telegraph⁹¹ and in leader.⁹²

⁸⁹ www.sd-commission.org.uk/news/resource_download.php?attach_id=9GN6R2H-I16LWY2-OZQV6OW-LSRIPC�

⁹⁰ <http://comment.independent.co.uk/letters/article225577.ece>

⁹¹ www.telegraph.co.uk/news/main.jhtml?xml=/news/2005/07/02/nrg02.xml&sSheet=/portal/2005/07/02/ixportaltop.html

⁹² www.telegraph.co.uk/news/main.jhtml?xml=/news/2005/07/02/nrg02.xml&sSheet=/portal/2005/07/02/ixportaltop.html

- 5 Jul Letter by RS published in Daily Telegraph responding to leader article of 1 July.⁹³
- 11 July Following request from DEFRA, RS and KA submit paper on DTQs to Climate Change Programme Review.
- Aug RSA announce launch of half-a-million pound project on DTQs. RSA project in large part due to influence of Tyndall's work on DTQs.
- Sep Long article on personal carbon trading appears in ENDS. RS and KA provided extensive briefing to author as part of his research.⁹⁴
- Sep/Oct Sustainable Development Commission run a forum on its website debating DTQs. RS posts a response on 4 October. Subsequently, the SDC home page carries the sentence: "*Have your say in our online forum and read the response of Dr Richard Starkey of the Tyndall Centre to your comments*".
- 9 Sep RS speaks on DTQs at fringe meeting of Green Party conference. Green Party adopts principle of personal carbon trading as party policy.
- 14 Sep RS give presentation on DTQs at an innovation workshop organized by the DVLA at their innovation centre outside Swansea.
- 21 Sep RS gives presentation on DTQs at the Tyndall Theme 2 launch in London. He also appears on the BBC TV programme, *Working Lunch* discussing DTQs.
- 22 Sep RS presents paper on DTQs at British Institute for Energy Economics (BIEE) conference in Oxford.
- 3-4 Nov RS presents on DTQs at a joint Tyndall/UKERC expert workshop entitled *Taxing and Trading: Debating options for carbon reduction*. RS also played a role in organizing the workshop, which brought together experts to discuss and debate alternative approaches to reducing carbon emissions from UK energy use.⁹⁵
- 22 Nov RS gives presentation on DTQs at a meeting of the All Party Parliamentary Group on Climate Change on personal carbon trading, held at House of Commons.
- 29 Nov Article on DTQs by BBC journalist Richard Black, who attended meeting on 22 Nov, is published on science page of BBC News website with link from News homepage.⁹⁶

⁹³ www.opinion.telegraph.co.uk/opinion/main.jhtml?xml=/opinion/2005/07/05/dt0501.xml

⁹⁴ www.endsreport.com/index.cfm?action=report.article&articleID=14103&q=personal%20carbon%20allowances&boolean_mode=all

⁹⁵ www.ukerc.ac.uk/content/view/110/57

⁹⁶ <http://news.bbc.co.uk/1/hi/sci/tech/4479226.stm>

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