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An introduction to personal carbon trading

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Mitigating climate change poses many challenges for policy-makers. Sustained cuts in carbon emissions are required from all sectors of the economy, and they must be delivered quickly. Some countries have committed to reducing emissions to the levels needed to keep global average temperature rises below 2°C, implying very major reductions from current emission levels in developed countries. The UK, for example, has adopted a legally binding target of an 80% reduction in national greenhouse gas (GHG) emissions by 2050. This implies a reduction in emissions of around 4% per annum to 2050 a rate of change far greater than anything achieved so far (Defra, 2008a), despite many years of UK and EU policy to reduce energy use and carbon emissions. It is likely that new policies are required in order to help governments achieve their very challenging reduction targets. Personal carbon trading (PCT) is a forward-looking policy idea, which arguably could provide the national and international framework for delivering emissions reductions over the mid-to-long term.

PCT is a general term used to describe a variety of downstream cap-and-trade policies, which locate rights and responsibilities for the carbon emissions from household energy use and/or personal travel at the individual level. PCT could cover a significant proportion of national carbon emissions. A PCT policy including household energy use and personal travel (excluding international aviation) would cover an average of 45% of national emissions of CO₂ from energy use in major developed countries – half of which come from household energy and half from personal transport (IEA, 2007). PCT is markedly different from current policies covering individual energy use and carbon emissions, which often operate at a distance from individuals (e.g. obligations on energy suppliers), do not require their direct involvement (e.g. minimum efficiency standards for products), and fail to communicate the significance of different decisions on personal carbon emissions. PCT is not envisaged as replacing most current policy, but rather as an enabling policy which encourages individuals to make the most of existing schemes such as product and building standards, energy labels, and taxation and financial incentives. The challenge of integrating PCT with existing policies is evident, and this is considered by several authors in this Special Issue.

Different PCT schemes vary in their inclusiveness, the scope of emissions covered, the level of individual engagement, and the rules and procedures for allocating, surrendering and trading carbon units. They also vary in their level of development – some are outline ideas, for example, a proposal for a scheme covering household energy only (Niemeier et al., 2008), while others have been developed and investigated in more detail, e.g. tradable energy quotas, TEQs (Fleming, 2007) and personal carbon allowances, PCA (Hillman and Fawcett, 2004). At the moment, however, none of the versions of PCT is a fully developed policy proposal. Table 1 summarizes the main PCT schemes. There are also other personal carbon capping mechanisms, e.g. cap and dividend

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TABLE 1 Personal carbon trading scheme options

Scheme	Scope	Features and comments
'Cap and share' (FEASTA, 2008)	Whole economy	An independent committee sets a national carbon cap. All adults periodically receive certificates entitling them to an equal share of national emissions. Certificates are sold by individuals via banks or post offices to companies that import or extract fossil fuels. These suppliers require surrendering certificates equal to emissions from the use of the fossil fuels that they introduce into the economy. The price of emissions flows through the economy. C&S is one of the more detailed and developed proposals.
Tradable energy quotas (TEQs) (Fleming, 2007)	Whole economy	C&S was proposed and developed in Ireland for the Irish economy. It has been examined by the Irish government. Previously known as 'DTQs' (domestic tradable quotas), TEQs aim to tackle climate change and peak oil. A TEQ budget sets a limit on annual carbon emissions over the next 20 years, which then rolls forward week by week. 40% of the allowances are distributed free to individuals on an equal per capita basis. Personal emissions allocations cover household energy use and personal travel, but not air travel. The remaining 60% are sold by tender to all other energy users. All fuels have a carbon rating and purchasers must surrender carbon units to cover related emissions. Transactions are carried out electronically and all carbon units are tradable.
Tradable consumption quota (Ayres, 1997)	Whole economy	TEQs is one of the more detailed and developed proposals. TEQs was proposed and developed in the UK for the UK economy. It has been partially examined by the UK government in a 'pre-feasibility' study: the individual side of the scheme was considered, but not the 60% of allowances which are auctioned.
Personal carbon allowances (PCA) (Hillman and Fawcett, 2004)	Household energy and personal transport	A national cap is set on carbon emissions. All national emissions are allocated for free to individuals on equal per capita basis. All products would be carbon labelled. Quotas are surrendered by individuals to cover the emissions related to the non-manufacturing-related carbon content of purchased goods and their own direct use of energy. Manufacturing organizations buy emissions quotas from individuals in a carbon market to cover their carbon emissions related to the process of manufacturing. The details of this scheme are not particularly well developed.
Household carbon trading (Niemeier et al., 2008)	Household energy	A national cap is set for emissions from household energy use and personal travel, including air travel. Allowances are allocated periodically on an equal per capita basis to individuals for free to cover these emissions. For every purchase of electricity, gas, transport fuels and services, allowances are surrendered. Transactions are carried out electronically and allowances are tradable in the personal carbon market. PCA is one of the more detailed and developed proposals.
		PCA was proposed and developed in the UK. It has been examined by the UK government in a 'pre-feasibility' study. A yearly carbon emissions cap is set for residential energy use based on emissions reduction targets. Allowances are allocated to each household on an equal per household allocation basis via utility service providers who place the allowances in each user's account. These are deducted periodically by the utility according to energy use, and additional allowances must be purchased if the account is in deficit. The carbon allowances are fully tradable. At the

end of a compliance period, the state collects the permits from the utilities and determines compliance with the cap. Household carbon trading was proposed in California and examined against its emission targets.

Tradable transport carbon permits (Raux and Marlot, 2005) Private road transport A cap is set for emissions from private transport. Allowances are allocated to all individuals for free (not necessarily on an equal basis). For every purchase of fuel, allowances are transferred to the regulating authority to cover the CO₂ equivalent of a litre of fuel and cancelled. Transactions and trading are carried out electronically. Participants buy and sell permits through intermediaries like banks or buy them at the petrol pump.

Tradable transport carbon permits were originally suggested in France and the scheme was examined for emissions generated by French private transport. It has also been applied to the UK (Harwatt, 2008).

(AEA Environment and Energy, 2008), but these do not involve personal trading and therefore are outside the scope of PCT.

Despite the variation, the objective of all PCT schemes is to limit the overall carbon emissions within a society by engaging individuals in a process of managing their allowance. All PCT schemes share common features: the scheme is mandatory, with no opt-outs; individuals periodically receive a carbon quota for free; for every activity that involves carbon use within the scope of the scheme, allowances are surrendered; the allowances are tradable, enabling a market in allowances to deal with the different surrender requirements of above-average and below-average carbon consumers; allowances are reduced over time in line with national carbon reduction commitments.

This Special Issue brings together, for the first time, the most recent academic research findings, empirical evidence and new thinking around PCT. Most PCT research to date has been undertaken in the UK, with some contributions from other European and American researchers. This could be explained partly in historical terms – the idea was initiated in the UK and has continued to be developed here. There may also be factors, including the percentage of national emissions potentially covered by PCT, the distribution of personal carbon emissions, and ease of enforcement, which mean that PCT, as it is currently envisaged, seems a more salient policy in the UK than in some other countries (see Fawcett, 2010, for further discussion). The UK leadership on PCT research is reflected in the selection of articles for this issue. Without doubt, this idea would greatly benefit from more international interest, and it is hoped that this Special Issue will encourage readers outside the UK to engage with PCT.

In addition, much PCT research to date has been published via reports and not in academic journals. Consequently, the academic community has not significantly engaged with this idea. The concept of PCT would benefit from further exposure and debate. By bringing PCT to a largely new audience we hope to generate constructive examination and critical thinking around the potential role of this policy option in climate change mitigation. The guest editors believe that readers – both academic and non-academic – will be excited and challenged by PCT. Readers may find some of the findings and insights presented here relevant to their own research, thinking and policy-making.

PCT in research and politics

Of various research into PCT in recent years, most has investigated various ‘practical’ aspects of the policy, with the aim of understanding whether there are fundamental barriers to its introduction. Academic and non-academic studies have examined the technology for implementation and costs of operation (RSA, 2007; Lane et al., 2008; Bird and Lockwood, 2009); interactions with existing policy landscape (Kerr and Battye, 2008); the public’s ability to deal with a parallel currency (Seyfang, 2007); and social acceptability (Bristow et al., 2008; Owen et al., 2008). In addition, there has been research on the impacts of the policy, both in terms of individual psychology (Capstick and Lewis, 2009; Parag et al., 2009) and distributional effects (Ekins and Dresner, 2004; Thumim and White, 2008). The underlying principles of PCT, in particular the case for equal per capita allowances, have been interrogated from philosophical perspectives (Starkey, 2008; Hyams, 2009). In addition, two reports have identified the broad range of research still required across many disciplines (Roberts and Thumim, 2006; Keay-Bright, 2009). While there are undoubtedly many detailed aspects of the policy still to be debated and developed, there is a good basis for future investigations.

PCT has been generally regarded as a radical policy idea, outside the mainstream of policy-making. Nevertheless it has attracted high-level political and policy attention in the UK. In 2006/2007,

a debate about PCT was initiated by the then Secretary of State for the Environment, David Miliband, in the context of all parts of society needing to make a contribution to reducing carbon emissions (Miliband, 2006). This led to a programme of pre-feasibility research work being commissioned by the Department for Environment, Food and Rural Affairs (Defra). Defra examined different aspects of PCT: social acceptability (Owen et al., 2008), economic and technical feasibility (Lane et al., 2008), equity and distributional impacts (Thumim and White, 2008), and effectiveness in the context of the existing policy landscape (Defra, 2008b). These studies were summarized in a synthesis report (Defra, 2008c). The distributional analysis found PCT to be a progressive policy in which the poorer members of society are mostly 'winners', as their levels of emissions are generally lower. Technology was not found to be a barrier for the introduction of PCT: the technology to enable an electronic card PCT system already exists. The real issue around the technology is the cost of setting up a PCT registration and banking system, and likely annual running costs. Defra estimated that the costs of the scheme would considerably outweigh the benefits – by 15 times in the central case assumptions – with a running cost per individual of around £30 (€34) per year. The benefits were calculated based on responses both to the carbon price and to the added carbon visibility that PCT would entail. The research on public acceptability showed that PCT and comparison policies (carbon taxation and upstream cap-and-trade) gained more negative than positive responses. In comparison with the other policies, PCT attracted both more 'very negative' and 'quite positive' ratings – strongly dividing opinion, with key concerns around fairness, administration and the practicalities of the scheme. Based on this research, Defra declared PCT to be 'ahead of its time' (Defra, 2008c: 4), with the issues of most concern being economic feasibility and public acceptability. Defra concluded that the government should remain engaged in the debate around PCT, but that further work should be taken forward by academics and research organizations and not by the government itself.

Defra's findings and conclusions as regards costs versus benefits can be challenged. Bird and Lockwood (2009) and The Lean Economy Connection (2008) questioned some of the underlying assumptions about the cost of the scheme and the price of carbon, and suggested that the costs, while still high, might only be half those suggested by Defra. Others have suggested benefits beyond those recognized by Defra. For example, a number of studies have identified normative and psychological motivations provided by PCT (beyond the price signal and increased carbon visibility that were studied by Defra) by which PCT might encourage and sustain the kind of behavioural change that leads to emissions reduction (Capstick and Lewis, 2008; Parag and Strickland, 2009; Parag et al., 2009). Taken together, this evidence, does not wholly counter Defra's concerns, but it does indicate that the costs may well be lower, and the benefits higher, than their study suggested.

Defra's interpretation of the evidence on public acceptability can be challenged too. The public/social acceptability of PCT has been the most widely researched aspect of the policy (Low, 2005; Howell, 2007; Bristow et al., 2008; Harwatt, 2008; IPPR, 2008; von Knobelsdorff, 2008). Most studies, like Defra's, compared PCT with policy alternatives. Despite wide variation in methods and sample types, the results of these studies are remarkably similar: when PCT is compared with carbon taxation (or other policies) it is usually preferred. For those who prefer PCT, its key benefits are seen as fairness and effectiveness. For those against, their main concerns are about implementation and unfairness. It is also true that, if asked, the majority were often opposed to all of the policies suggested. These wider findings largely mirror Defra's. What can be contested is the interpretation of the results. While there is no great public demand for any policy constraining personal emissions, PCT is not special in this regard and indeed may be less unacceptable than the alternatives.

The UK House of Commons Environmental Audit Committee (EAC) has also shown interest in PCT and conducted its own inquiry, which was published a month after Defra's study (Environmental Audit Committee, 2008). The EAC report was more supportive of PCT, and 'regretted' Defra's decision to wind down further research work (Environmental Audit Committee, 2008: 4). Their inquiry concluded that PCT could be essential in reducing the UK's emissions and that urgent further work was needed, exploring whether PCT could be a viable policy option. While Defra decided not to fund further PCT research, or to revise this decision in the light of EAC's report, they recognized that 'personal carbon trading remains a potentially important way to engage individuals' (Defra, 2008c: 4) and indicated the government's continuing interest in the results of PCT research.

Personal carbon trading has also attracted wider interest beyond government circles. It has been debated by a range of environmental and social thinkers (Porritt, 2005; Monbiot, 2006; Giddens, 2009); has inspired the formation of a network of grass-roots action groups – Carbon Reduction Action Groups (Howell, 2009); has been nominated as a 'breakthrough idea for the 21st century' by the Sustainable Development Commission (the UK's independent watchdog on sustainable development) (SDC, 2009); and has been highlighted by the Chair of the UK Environment Agency as a possible future development (Smith, 2009).

Policy and the role of the individual

Critics of PCT could fairly argue that it would be more administratively complex and expensive than taxation or upstream cap-and-trade alternatives; that it is not currently popular politically; and that PCT has no major interest groups lobbying in its favour. Given this, why should PCT still be of interest to academics, researchers, policy-makers and the wider world?

One answer is that it might provide a framework for delivering long-term, sustainable cuts in carbon emissions in a way that other policies cannot. PCT involves a radical change in the use of market-based climate instruments: one that seeks the direct involvement of the entire population and involves a widespread distribution of environmental property rights. Despite their central role in climate policy, most existing market-based instruments do not seek to engage the public. For example, the EU Emissions Trading Scheme (EU ETS) does not currently cover most emissions by individuals and is invisible to energy end-users. Empowered publics, empowering government, and shared responsibility between government and the public have been identified by two UK prime ministers as the way to tackle the environmental challenges ahead (Brown, 2007). Indeed, effective citizen engagement may prove critical to delivering high levels of carbon emission reduction, as behavioural barriers currently result in cost-effective carbon emissions opportunities not being taken up (Stern, 2006, Dietz et al., 2009). Likewise, lifestyle choices have a major effect on personal emissions (UKERC, 2009; Gram-Hanssen, 2010; Lomas, 2010). Greater engagement of citizens may be a necessary condition for delivering the systemic change required to achieve a low-carbon society.

Another answer is that studying PCT raises many important issues whose recognition may be vital in developing effective future policies regardless of the actual implementation of PCT. It imagines a different relationship between citizens and the state in terms of who is responsible for reducing personal carbon emissions. It embodies specific and explicit ideas about equity – the issue at the heart of international carbon negotiations. It requires better information about the distribution of personal carbon emissions within society, to enable analysis of the impacts of a lower-carbon society. It encourages open discussion about who the 'winners' and 'losers' in a lower-carbon society would be, under what circumstances, and who might be compensated for

their losses. It opens debates about how policies work, how we can test novel policies prior to introduction, and what new sorts of policy may be needed to meet the unprecedented challenge of climate change. It questions the capabilities of the current policy toolkit to deliver the radical changes needed. While PCT may not have all the right answers, it is a policy idea which raises many of the right questions for climate change mitigation.

There is a strong case for continuing to think about and debate PCT, even if there is (as yet) no compelling case for its immediate introduction in the UK or anywhere else.

Articles in this Special Issue

The articles in this Special Issue come from a range of different disciplinary and multidisciplinary perspectives and critically present different scales of investigation: from the effects of different PCT schemes on the individual, communities and organizations, to PCT's place in national, EU and global policy landscapes. None of the contributors to this Special Issue are uncritical of PCT. Most recognize a range of potential problems and unanswered questions. Authors do not always agree with each other, and some see a more positive future for PCT than others. However, together these articles present new empirical evidence, synthesize earlier work, develop our understanding of PCT and its interaction with other policies, investigate previously unexplored aspects of the policy, locate it within wider academic and policy contexts, suggest research agendas, and provide a nuanced, critical analysis of this rich policy idea.

A key set of questions about PCT is how it would fit within the existing policy landscape, with particular concerns around its relationship with the EU ETS. Arnaud Brohé considers the interaction of PCT with the EU ETS, emphasizing a number of issues including: double counting and double regulation of emissions already included in the EU ETS; leakage between personal and non-personal emissions; accounting for cross-border emissions; costs; political acceptability; and the (un)fairness of equal per capita allowances. Steve Sorrell assumes that PCT cannot fit well with the EU ETS and therefore proposes a hybrid upstream trading scheme that could operate alongside the EU ETS.

The prospects for the introduction of PCT are addressed, in terms of its costs and benefits in comparison with alternatives, the political barriers that PCT faces, and its applicability beyond the UK. Matthew Lockwood discusses the potential costs and benefits of a PCT system in comparison with a policy of upstream cap-and-trade. The politics of PCT is further developed by Yael Parag and Nick Eyre. They apply policy theories to identify different types of obstacles and opportunities for PCT schemes in the policy process. Tina Fawcett examines whether PCT is an idea which could flourish outside the UK, with particular focus on the salience of various national energy- and carbon-related characteristics.

The effectiveness of PCT as a policy will be strongly determined by both behavioural responses to, and public support for, the idea. Both of these topics are difficult to investigate in the absence any PCT schemes being in place. Stuart Capstick and Alan Lewis present experimental results from a computer-based simulation which examined the effects of personal carbon allowances on individuals' energy-related decision-making. Andrew Wallace and colleagues present data from an empirical investigation into the social acceptability of PCT. Both these studies considered the influence of personal carbon footprints on responses and attitudes. Sverker Jagers and colleagues provide a Swedish perspective and investigation on public acceptability. Their study focuses on the relations between attitudes towards a PCT scheme and trust in politicians, perceived fairness and ideology in Sweden. Laurence Matthews considers the psychological framing of carbon emission reduction policies and how this influences public and political debate and support for these policies, in ways which may not be apparent to those involved.

No scheme can be effective unless it can be enforced. Nick Eyre tackles the previously neglected topic of enforcement of PCT. He contemplates options for upstream, midstream and downstream enforcement, and the administrative and political challenges involved.

This issue covers a wide range of PCT topics, but there are many more challenges for researchers and policy-makers which are yet to be fully explored. While reading this Special Issue, you might like to bear in mind the following questions:

- What should the balance of responsibility for delivering emissions reductions in the personal sectors be between national and local governments, organizations, communities and individuals? Does current policy get the balance right? Does PCT?
- Are there elements in the different PCT proposals that could be adopted to improve existing demand/emission reduction policies? What insights does PCT provide to challenge the conventional wisdom of emission reduction policies?
- Can some features of PCT be implemented without adopting the whole scheme? For example, would a voluntary scheme or a comprehensive carbon labelling and personal feedback policy deliver significant benefits?
- Would PCT work best as a transport- or household energy-only scheme? It is usually assumed to be a national policy, but could it work at different scales – e.g. international, regional, city?
- Does PCT offer any additional benefits in terms of societal resilience to climate change, for example through improving energy security?

We hope you enjoy this Special Issue, and look forward to receiving feedback and advancing the debate around PCT.

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References

- AEA Environment and Energy, 2008, *Cap and Share: Phase 1 – Policy Options for Reducing Greenhouse Gas Emissions*, AEA Environment and Energy, Harwell, UK.
- Ayres, R., 1997, 'Environmental market failures: are there any local market-based corrective mechanisms for global problems?', *Mitigation and Adaptation Strategies for Global Change* 1, 289–309.
- Bird, J., Lockwood, M., 2009, *Plan B? The Prospects for Personal Carbon Trading*, Institute for Public Policy Research, London, UK.
- Bristow, A.L., Zanni, A.M., Wardman, M., Chinatakayala, P.K., 2008, *Personal Carbon Trading: Using Stated Preference to Investigate Behavioural Response*, Loughborough University and University of Leeds, UK.
- Brown, G., 2007, *Speech by the Chancellor of the Exchequer*, the Rt Hon Gordon Brown MP, to the Green Alliance, 13 March, HM Treasury, London, UK.
- Capstick, S., Lewis, A., 2008, *Personal Carbon Trading: Perspectives from Psychology and Behavioural Economics*, Institute for Public Policy Research, London, UK.

- Capstick, S., Lewis, A., 2009, *Personal Carbon Allowances: A Pilot Simulation and Questionnaire*, UKERC Research Report, Environmental Change Institute, University of Oxford, Oxford.
- Defra, 2008a, *2007 UK Greenhouse Gas Emissions, Provisional Figures*, 27 March 2008, statistical release, e-Digest statistics about climate change, Department for Environment, Food and Rural Affairs, London.
- Defra, 2008b, *An Assessment of the Potential Effectiveness and Strategic Fit of Personal Carbon Trading*, Department for Environment, Food and Rural Affairs, London.
- Defra, 2008c, *Synthesis Report on the Findings from Defra's Pre-feasibility Study into Personal Carbon Trading*, Department for Environment, Food and Rural Affairs, London.
- Dietz, T., Gilligan, T., Stern, P., Vandenbergh, P., 2009, 'Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions', *Proceedings of the National Academy of Sciences of the USA* 106, 18452–18456.
- Ekins, P., Dresner, S., 2004, *Green Taxes and Charges: Reducing their Impact on Low-income Households*, Joseph Rowntree Foundation, York, UK.
- Environmental Audit Committee, 2008, *Personal Carbon Trading*, The Stationery Office, London.
- Fawcett, T., 2010, 'Personal carbon trading in different national contexts', *Climate Policy* 10(4), 339–352.
- FEASTA, 2008, *Cap and Share: A Fair Way to Cut Greenhouse Gas Emissions*, The Foundation for the Economics of Sustainability [available at www.feasta.org/documents/energy/Cap-and-Share-May08.pdf].
- Fleming, D., 2007, *Energy and the Common Purpose: Descending the Energy Staircase with Tradable Energy Quotas (TEQs)*, The Lean Economy Connection, London.
- Giddens, A., 2009, *The Politics of Climate Change*, Polity Press, Cambridge, UK.
- Gram-Hanssen, K., 2010, 'Residential heat comfort practices: understanding users', *Building Research and Information* 38(2), 175–186.
- Harwatt, H., 2008, *Reducing Carbon Emissions from Personal Road Transport through the Application of a Tradable Carbon Permit Scheme: Empirical Findings and Policy Implications from the UK*, International Transport Forum, Leipzig, May 2008.
- Hillman, M., Fawcett, T., 2004, *How We Can Save the Planet*, Penguin, London.
- Howell, R., 2007, 'Would personal carbon allowances be acceptable to the UK public as a means of reducing individuals' carbon dioxide emissions', MSc thesis, University of Edinburgh, Edinburgh.
- Howell, R., 2009, *The Experience of Carbon Rationing Action Groups: Implications for Personal Carbon Allowances Policy*, UK Energy Research Centre Research Report, Environmental Change Institute, University of Oxford, Oxford.
- Hyams, K., 2009, 'A just response to climate change: personal carbon allowances and the normal-functioning approach', *Journal of Social Philosophy* 40, 237–256.
- IEA, 2007, *Energy Use in the New Millennium: Trends in IEA Countries*, International Energy Agency, Paris.
- IPPR, 2008, *IPPR says Public More Receptive to Personal Carbon Trading than Policy-makers Believe*, Institute for Public Policy Research [available at www.ippr.org.uk/pressreleases/?id=3208].
- Keay-Bright, S. (ed.), 2009, *Personal Carbon Trading (PCT): Bringing Together the Research Community*, Workshop Report, 27–28 November 2008, UK Energy Research Centre, London.
- Kerr, A., Batty, W., 2008, *Personal Carbon Trading: Economic Efficiency and Interaction with Other Policies*, RSA, London.
- Lane, C., Harris, B., Roberts, S., 2008, *An Analysis of the Technical Feasibility and Potential Cost of a Personal Carbon Trading Scheme*, Report to the Department for Environment, Food and Rural Affairs, Accenture, with the Centre for Sustainable Energy (CSE), Defra, London.
- Lomas, K., 2010, 'Carbon reduction in existing buildings: a transdisciplinary approach', *Building Research and Information* 38(1), 1–11.
- Low, R., 2005, *An Investigation into the Public Acceptability of the Personal Carbon Allowances Proposal for Reducing Personal Greenhouse Gas Emissions*, Edinburgh University, Edinburgh.
- Miliband, D., 2006, *Environment, Food and Rural Affairs: House of Commons Debate 14 December 2006*, Hansard, London.
- Monbiot, G., 2006, *Heat: How to Stop the Planet Burning*, Penguin, London.
- Niemeier, D., Gould, G., Karner, A., Hixson, M., Bachmann, B., Okma, C., Lang, Z., Heres del Valle, D., 2008, 'Rethinking downstream regulation: California's opportunity to engage households in reducing greenhouse gases', *Energy Policy* 36, 3436–3447.
- Owen, L., Edgar, L., Prince, S., Doble, C., 2008, *Personal Carbon Trading: Public Acceptability*, Report to the Department for Environment, Food and Rural Affairs, Opinion Leader and Enviro Consulting, Defra, London.

- Parag, Y., Strickland, S., 2009, *Personal Carbon Budgeting: What People Need to Know, Learn and Have in Order to Manage and Live Within a Carbon Budget, and the Policies that Could Support Them*, UKERC research report, UK Energy Research Centre, London.
- Parag, Y., Strickland, D., Capstick, S., 2009, 'Judge a book by its cover: the impact of policy framing on the willingness to reduce energy consumption', in: *First European Conference on Energy Efficiency and Behaviour*, Maastricht, The Netherlands, 18–20 October 2009.
- Porritt, J., 2005, *Capitalism As If the World Matters*, Earthscan, London.
- Raux, C., Marlot, G., 2005, 'A system of tradable CO₂ permits applied to fuel consumption by motorists', *Transport Policy* 12, 255–265.
- Roberts, S., Thumim, J., 2006, *A Rough Guide to Individual Carbon Trading: The Ideas, the Issues and the Next Steps*, Centre for Sustainable Energy, Bristol, UK, and Defra, London.
- RSA, 2007, *Technical Requirements for Personal Carbon Trading*, RSA, London.
- SDC, 2009, *Breakthroughs for the 21st Century*, Sustainable Development Commission, London.
- Seyfang, G., 2007, *Personal Carbon Trading: Lessons from Complementary Currencies*, CSERGE Working Paper ECM 07-01, University of East Anglia, Norwich, UK.
- Smith, C., 2009, *Speech to the Environment Agency Conference*, 9 November 2009.
- Starkey, R., 2008, *Allocating Emissions Rights: Are Equal Shares Fair Shares?*, Tyndall Centre for Climate Change Research, Norwich, UK.
- Stern, N., 2006, *Stern Review: The Economics of Climate Change*, HM Treasury, London.
- The Lean Economy Connection, 2008, *DEFRA's Pre-feasibility Study into Personal Carbon Trading: A Missed Opportunity* [available at www.teqs.net/DEFRAPPSresponse.pdf].
- Thumim, J., White, V., 2008, *Distributional Impacts of Personal Carbon Trading*, Report to the Department for Environment, Food and Rural Affairs, Defra, London.
- UKERC, 2009, *Energy 2050: Making the Transition to a Secure and Low-Carbon Energy System: Synthesis Report*, UK Energy Research Centre, London.
- von Knobelsdorff, M., 2008, 'Public acceptability of personal carbon trading', MSc thesis, Department of Land Economy, University of Cambridge, Cambridge, UK.