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BACKGROUND

The Government's 60% reduction in carbon dioxide emissions by 2050 (over 1990) is taken as a given. In reality, a faster rate of reduction may be needed.

Even though this is about the long-term, the policies to achieve this have to start now. Stable, long-term policy frameworks are essential in inspiring investor confidence and encouraging targeted growth.

The long-term 60% emissions reduction target, for example, could be usefully supplemented by interim targets aligned with the investment planning timescales of energy companies. Such targets should be backed with policies which provide assurance to businesses looking to develop longer-term business plans in the understanding that targets will be met. An example would be the extension of the Renewables Obligation to at least 2015.

It is assumed that UK policy does include aviation and shipping, ie it is beyond the present Kyoto boundaries, because of the real effect these have on world carbon dioxide concentrations.

It is vital that energy is considered as a whole – heat, electricity and transport - rather than just electricity. Issues such as nuclear power generation, though relevant to the debate, should remain part of a wider discussion. For instance, peak oil supply will occur during the next 45 years, so planning has to begin immediately to wean the UK off oil consumption. We regret the strong focus on electricity in this review.

Industry and business like clear trajectories and targets that cover their planning horizons. Certainty is important to the delivery of good policy. This is known to apply, for instance, to the manufacturers of domestic appliances and household equipment. Clear strategies enable the solutions to be delivered more cheaply.

SUMMARY

Demand reductions are quick and cheap and could start tomorrow. The potential is substantial and could, with sufficient political will, parallel the closure of nuclear and coal-fired plant so that no 'gap' develops. This would require a focus on reducing electricity demand, for instance by making appliances more efficient, and restricting the installation of electric space and water heating. Enlisting the support of consumers would prevent the proliferation of unnecessary or profligate electrical equipment (eg plasma TVs). This support would result from an extension of carbon trading to personal transactions. As a minimum, a pilot personal carbon trading scheme should be started within a year, as recommended by the Sustainable Development Commission.

New supply, such as additional nuclear power plants, carbon capture and storage, the marine renewables of tidal and wave, or the hydrogen economy cannot contribute significantly before 2020.

Curbing the growth in carbon emissions cannot be achieved through technology alone. All sectors of the economy have to contribute, partly through changing behaviour. The concept of 'sufficiency' – having adequate levels of energy services – needs to be promoted amongst the majority of the population, whilst enabling the disadvantaged (fuel poor, travel poor) to obtain a higher standard.

Largely because of oil supply problems (combined with growth in the developing world) fuel prices can be expected to continue rising. Pressure from other policies (RO, etc) will have a similar effect in the UK. This means the focus must be on efficient products, rather than taxation (see Q5).

QUESTION 1
What more could the government do on the demand or supply side for energy to ensure that the UK's long-term goal of reducing carbon emissions is met?

DEMAND
All energy users need a clear framework from Government that identifies the importance of reducing carbon dioxide emissions (this may or may not mean using less energy, depending on its source). This requires a bold, coherent, unified approach by Government with long-term targets, for instance, the type of combined housing and energy policy recommended in *40% house*[1]. As this study showed, the 60% reduction in carbon emissions from all energy use in the whole housing stock is possible, as a result of both demand reduction and changed behaviour (two-thirds) and the use of building-integrated low and zero carbon technologies (LZC – one third). This scenario gives a 60% reduction despite a 33% increase in households. Comparably detailed studies of other sectors have not yet been undertaken, but major savings are achievable, particularly if combined with LZCs.

The reduction in grid-electricity demand in the *40% house* is sufficient to offset the drop in supply created by the removal of ageing nuclear reactors and of non-complying coal-fired generation plant, from the residential sector alone. This is true during peak demand (as well as over the whole year) and is achieved through a strong focus on more efficient appliances (particularly refrigeration and lighting), the use of combined heat and power (which provides a disproportionate amount of peak electricity) and a switch out of electricity for space and water heating. All of the technologies modelled are commercial or near-to-market.

Changing behaviour (consuming less energy services) is a major part of all demand reduction strategies (Table 1). This includes flying less, flying shorter distances, having smaller homes, driving within the speed limit. Increasingly, 'sufficiency' should become a cornerstone of policy – many of us do not need more equipment. We would have a better quality of life (QOL) with a lower standard of living (less cars, less congestion, less equipment to maintain). Healthy living is part of this higher QOL – eg walking more, better (local) food, less obesity, less asthma, safer roads.

More efficient supply of those energy services is the next biggest contributor to carbon savings overall, and the largest component with housing. For transport, this means hybrid cars. Tough product standards are required (Qi), enforcement of existing regulations (eg for buildings), generally confirming to society that climate change is important.

Fuel switching includes changing over to low and zero carbon technologies (LZC) in the home (eg heat pumps, combined heat and power, solar thermal) and to diesel and biofuels for cars.

[1] Boardman et al 2005 *40% house* ECI, University of Oxford

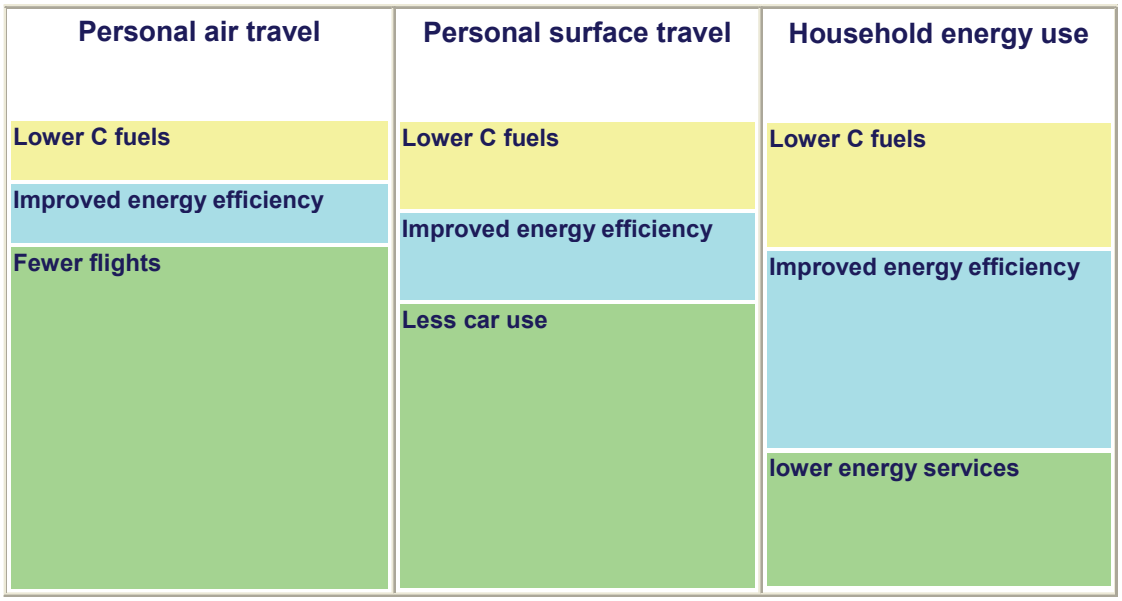

Figure 1 : Schematic diagram showing relative contribution to achieving 60% carbon savings by 2050

Source: Based on Hillman and Fawcett 2005 on http://www.eci.ox.ac.uk/lowercf/demandreduction.html

Carbon trading (EU ETS) is encouraging carbon management within industry[2], though there are questions[3] about whether the scheme should be downstream, rather than upstream. The introduction of auctions would have no effect on consumer prices, as industry is already making windfall profits from passing through the 'costs'[4]. An auction would raise substantial funds for the Government to invest in energy efficiency elsewhere (eg the fuel poor) and would enable SMEs to be included.

It is the aim of the European Commission, supported by the British Government, that the EU ETS scheme will be extended to cover aviation and, perhaps, methane in 2008 or soon after. The extension of EU ETS to aviation will be insufficient to curb demand[5]. There may be no, or limited, fuel switching opportunities with aviation, so that policies to affect behaviour are paramount.

Carbon trading for the whole of society would include personal carbon allowances (pcas) for individuals. These are an example of the overarching framework needed to incorporate the public into the challenge of reducing the climate change threat. Pcas are more certain and equitable than taxing fuel.

More informative billing and display monitors attached to meters are important components in providing users with feedback on their levels of consumption and carbon emissions and, therefore, of encouraging changed behaviour. This applies in the house and for travel. Reductions of around 10% have been achieved in other countries. This again is a relatively quick transformation to bring about.

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[2] Pfeifer, S (2005) MSc dissertation, ECI, University of Oxford
[3] Sustainable Development Commission (2006), *The role of nuclear power in a low carbon economy*. March. P11
[4] Hepburn, C and Neuhoff, K (2006) pers comm., at Meeting Place event, Oxford
[5] Cairns, S and Newsom, C (2006) submission to the Stern Review by TRL and UKERC, Demand Reduction theme

The actual delivery of carbon targets probably depends upon giving local authorities devolved carbon targets (and additional money), to bring together policy on demolitions, density of new build, standards in planning permission (Merton etc), action on energy islands (Woking and GLA).

Fiscal incentives have a role, particularly in encouraging refurbishment of buildings (eg enhanced capital allowances for householders installing micro-generation, stamp duty rebates, green mortgages). The effect of rising fuel prices may still not trigger higher income users into demand reduction, but will force low-income people (on a fixed income) into greater fuel poverty (Q5).

SUPPLY

One important component of reducing carbon emissions, from the supply perspective, is to make it easier for individual householders and companies to obtain micro-generation (the same as low and zero carbon technologies), which produce heat or electricity at the site. This means:

- the provision of helpful forms of finance (perhaps through ESCOs);
- fair payment for exported electricity (not less than the rate paid for imports);
- guaranteed access to the distribution network;
- more supportive planning framework.

QUESTION 2

With the UK becoming a net energy importer and with big investments to be made over the next twenty years in generating capacity and networks, what further steps, if any, should the government take to develop our market framework for delivering reliable energy supplies? In particular, we invite views on the implications of increased dependency on gas imports.

Minimisation of gas imports by both supply and demand side measures would have the combined effect of improved security of supply and a reduction in CO_2 emissions. This would also reduce the UK's exposure to balance of payments problems. Major reductions in demand are possible by 2050: improved building fabric measures could reduce heat demand in the domestic sector by 148 TWh (42%)[6], and other reductions are possible – but not yet quantified[7] - across the entire building stock. Secondly, it is important to source this heat from low or zero carbon technologies. Combined heat and power (CHP) will be the most viable technology for the UK, either centralised (utilising gas, waste or biomass) or micro-CHP (initially utilising gas) and should be actively and immediately promoted. Use of CHP for heat provision will make any imported gas go further by offsetting the thermal losses of centralised plant (Q4).

In order to maximise the potential of CHP, agreements for electrical connection to the distribution grid must be simplified. If investment is to be made in network infrastructure, shifting to a microgrids approach should be encouraged. Microgrids are an enabling technology, which create the technical conditions required to support the use of low and zero carbon technologies including CHP and other micro-generators (solar PV, micro-wind turbines, small hydro). There are additional benefits of microgrids, including reduced transmission losses, increased reliability by allowing the system to ride out faults (security of supply), and reduced costs to consumers by minimising transmission and distribution payments (equity)[8]. Furthermore, the widespread use of CHP will reduce peak load[6], minimising the requirement for investment in new centralised electricity generating capacity

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[6] B. Boardman, S. Darby, G. Killip, M. Hinnells, C. Jardine, J. Palmer, G. Sinden (2005) "40% house", ECI, University of Oxford, Report 31

[7] The ECI is undertaking *Building Market Transformation* as part of the Carbon Vision Buildings programme.

[8] J.A. Peças Lopes, J. Tomé Saraiva, N. Hatziargyriou, N. Jenkins, "Management of MicroGrids", cited from http://www.cogenportugal.com/pdf/Microgrids.pdf

(determined by peak demand). By contrast, the building of baseload-generating nuclear plants will neither reduce required capacity, nor will they be built within the required timeframe.

Investment in capital equipment therefore should be directed towards decentralised micro-generators and microgrid requirements. This will require long-term policy support and financial incentives in the short to medium term. Furthermore, this process will be achieved more readily by the creation of a level playing field and the removal of perverse subsidies to fossil and nuclear plant (e.g. guarantees to industry for the costs of decommissioning, waste and terrorism liabilities). Government support for the formation of energy service companies would also help redirect investment away from centralised generation towards distributed low and zero carbon technologies.

Increased reliance on gas imports also encourages a shift to microgeneration as higher prices will have direct impacts on consumers. The government might incorporate this issue into its review in two ways. First, government documents across all departments should at least explore the impacts of higher than inflation rises in fuel prices. For example, the Treasury's 2005 Pre-Budget Report assumes oil will be $56 per barrel for 2006 and then constant in real terms going forward. Since fuel prices have risen nearly 10% per year since 2002 and peak oil is a growing concern of many in the industry, the assumption of constant real terms fuel prices is short-sighted. These assumptions have significant implications for the investment decisions today; consider for example the ODPM's recent review of microgeneration technologies which concluded that none of these technologies are sufficiently cost-effective to include in building regulations and yet assumed electricity prices will stay at 7p/kWh for up to 25 years[9]. This creates a danger of locking consumers into infrastructures that increase their exposure to price rises, putting government progress on fuel poverty at risk (Q5).

As noted above, microgrids can deliver significant advantages for energy networks. However for these benefits to be realised consumers have to be actively involved. Therefore the second role for government is to ensure that the technical and institutional arrangements are in place to facilitate consumer involvement. On the technical side, this means encouraging the installation of innovative metering systems and monitoring devices, which show potential for demand management at the household level[10]. Accurate metering of micro-generation forms the basis of a fair payment system, giving micro-generators the same chance as central generators to be paid for their exported energy, the low carbon benefits of their generation, and for ancillary services benefits that they bring to the network (reductions in peak demand, power quality, voltage control and so on). To encourage the uptake of these domestic-scale technologies, personal carbon allowances might be a valuable policy option as it encourages households to take responsibility for their emissions. It should be noted that nearly 70 councils throughout the UK are already moving towards micro-generation by requiring these technologies in new developments; central government could similarly introduce such a strong policy, given the precedent of the Renewables Obligation and Energy Efficiency Commitment.

[9] ODPM (2005) Low or Zero Carbon Energy Sources: Final Report http://www.odpm.gov.uk/index.asp?id=1162802

[10] Behavioural responses to PV in the UK, http://www.ouce.ox.ac.uk/~jkeirst. S Darby (2001) *Making it obvious: designing feedback into energy consumption*. ECI.

Question 3
The Energy White Paper left open the option of nuclear new build. Are there particular considerations that should apply to nuclear as the government re-examines the issues bearing on new build, including long-term liabilities and waste management? If so, what are these, and how should the government address them?

Nuclear power provides electricity only, yet the majority of energy demand is for thermal energy (heating and cooling) or transportation. There are numerous alternative sources of electrical power (eg new and existing renewables) for when additional sources of electrical power are needed. In the immediate future, the demise of nuclear power sources (and coal-fired) can be matched by positive policies to reduce the demand for electricity (Q1). Therefore, there is no clear need for nuclear power.

Whatever decision is made on new nuclear power stations, it is important to ensure that:

- the public understand the size and importance of the climate change challenge and do not believe that it has been tackled adequately. There will still be a need for major demand reduction programmes and behavioural adaptation, particularly before 2020.
- The psychological effect of a nuclear decision on the general population is recognized. The public could believe that the Government is in control, there is nothing to worry about and that, as consumers, they do not have to change. Nothing could be further from the truth.
- Any upgrading and changes to the transmission and distribution network should encourage the adoption of micro-generation. There is a risk that this decentralised approach will be overshadowed by decisions to reinforce the existing system and make micro-generation less able to contribute, thus locking the country into a continuing programme of large, remote power stations. This would also penalise the sensible development of chp.
- Any financial inducements required by the nuclear industry (a well established technology) must be reflected in comparable support for the non-nuclear electricity industry and for demand reduction.
- Any electrical generating company that undertakes to provide new nuclear power stations also gives a commitment to invest comparable sums of money in both renewables and demand reduction. If there is a shortage of capital for investment, it should not necessarily be devoted primarily to nuclear power.
- There is no categorical assumption that nuclear power has the primary right to provide base load electricity – this automatically disadvantages the development of those renewable technologies whose variable power has to be taken when it is generated, for instance the new marine technologies.
- The substantial problem of high oil prices and the approaching ‘peak oil’ should receive more attention, as there are only limited alternative sources of transportation fuel.

Question 4
Are there particular considerations that should apply to carbon abatement and other low-carbon technologies?

Carbon capture and storage is one new technology that is receiving much attention as a possible route to reducing emissions from fossil fuel power generation and providing export potential. However, as it adds to the costs of conventional generation, it would have negative impacts on other UK objectives (competitiveness and affordable energy supplies).

Recovering *heat* is more important than recovering *carbon* from power generation in terms of delivering on white paper objectives, particularly for the UK and in the short term. CHP contributes to environmental goals and results in lower overall costs. Its energy efficiency benefits contribute to security and reliability and competitiveness; communal heating systems served by CHP reduce costs for households. The extent of this saving appears to have been downplayed - the carbon savings using emissions factors in the EU CHP Directive are a factor of 2 or 3 higher than the 0.25 MtC per GW installed implied in para 4.17 of the Energy White Paper.

Each manifesto since 1997, and the Energy White Paper, has reaffirmed the 10 GW target for CHP, yet capacity has remained at around 5 GW for the last 5 years[11]. A key element is that renewables are seen as certain generation by companies because of the RO, whereas CHP has been penalised by new trading arrangements because it is (inappropriately) viewed by the system as uncertain.

The Government could still achieve the 10 GW target by 2010, if a small number of large industrial sites were to develop schemes. Specific, strong and targeted support would be needed.

At the community heating level, successive studies have identified CHP as having an important role. More than 20% of UK homes could be served by Community Heating with 27% of the potential for CHP in London, and 66% in half a dozen major cities[12]. There is nothing new in the potential for district heating in large UK cities, as several Government reports have shown[13]. So whilst Denmark changed its planning regime in the mid-1970s to stimulate CHP and now supplies around half of homes with CHP (Sweden and Finland also supply more than half of homes this way) the UK merely discussed the option. And just as the Government trumpets its major investment in microgeneration, a £10m extension to the Community Energy programme, announced a year ago, has been withdrawn in the last month.

Not only has CHP output been flat over the last five years, but renewable heat output has also not increased over this time[14]. The twin failures to develop the CHP market and the market for renewable heat are linked. Energy policy and regulation by both DTI and Ofgem is dominated by electricity at the expense of heat. Electricity is after all, only 30% of the energy economy.

The failure to provide a secure investment environment and the consequent shortfall against the 10GW target has contributed significantly to the perception of a generation gap. Addressing this could go a long way to closing the perceived gap, and in a much shorter timeframe than new nuclear. New CHP build would not imply increased gas burn because it would displace a good deal of gas burn in heat only boilers, and could utilise a range of fuels including biomass, and gases produced in pyrolysis and anaerobic digestion of waste.

Three conclusions follow from this analysis:

- The UK needs a heat policy to support development of heat recovery from power generation, from industrial processes and from using renewable fuels.
- It would be appropriate for new power plants, to prioritise recovery of heat produced in power generation over recovery of carbon dioxide emissions. Thus, power station consents policy needs to ensure that plants are located and sized so as to make use of the heat, either in industrial processes or in district heating. The location of any new power stations near to heat loads would have the added benefit of reducing the need for network reinforcement.
- It would be appropriate to ensure CHP benefits from fiscal measures, to an equivalent extent to CCS and renewables.

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[11] DUKES 2005 Chapter 6

[12] EST (2003) The UK Potential for Community Combined Heat & Power. *http://www.est.org.uk/download.cfm?p=15&pid=570*

[13] The Department of Energy papers 20 (District heating combined with electricity generation in the United Kingdom), number 35 (1979 Energy Paper series, London HMSO) and number 53 (Combined Heat and Power District Heating Feasibility Programme: stage 1) together identified significant potential in 9 major conurbations.

[14] (http://www.dti.gov.uk/energy/inform/dukes/dukes2005/07longterm.pdf)

QUESTION 5

What further steps should be taken towards meeting the government's goals for ensuring that every home is adequately and affordably heated?

It is assumed that this question covers all energy use in the home, not just heat, as in the definition of fuel poverty. The recent substantial rise in domestic fuel prices (eg gas increased 70% over 2002-6) means that the problem of fuel poverty has got worse: the number of vulnerable households in fuel poverty in England has doubled[15]. As prices rise, this trend will continue. The only way for a household on a fixed income to respond to a price rise is to use less and, in this case, be colder.

Previous policies had achieved major reductions in the fuel poor particularly through lower prices and higher incomes: only 17% of the decline 1996-2003 came from improved energy efficiency. The houses of the fuel poor still have a low SAP (standard assessment procedure: used to measure efficiency, with high numbers being good), and are both energy inefficient and carbon intensive.

New policies need to focus strongly on energy efficient capital stocks (housing and equipment) rather than on income, otherwise the Government has a recurring and growing expenditure. The necessary level of expenditure is substantially more than at present – how much more will depend upon expected price rises – if the legal obligation to eradicate fuel poverty is to be met by 2016/8.

Most of this investment should be public money, coming out of direct taxation. Policies that are funded through the utilities, such as the Energy Efficiency Commitment (EEC), raise the price of gas and electricity even further. The switch to direct taxation would help the poor, as many of them do not pay tax.

The present programmes, eg Warm Front and EEC, undertake quite similar, low-cost interventions. As a result, they are tackling the homes that are the easiest to reach and identify. The hard-to-identify (eg rural) and the hard-to-heat (solid walled, not on gas) are avoided by all groups. Even so, few of those visited are lifted out of fuel poverty.

A new, more comprehensive approach is required. When a household is identified as being in fuel poverty, it should be lifted out of fuel poverty. The addition of low and zero carbon technologies (heat pumps, solar thermal, combined heat and power, etc) are required for future proofing, to protect the residents from the effect of continuing price rises. These are essential with hard-to-heat properties.

The problem of identifying the fuel poor requires information on both the people and the property: it is the combination of low incomes and inefficient homes that causes fuel poverty. The best way to be confident about 'eradicating' fuel poverty is to establish an address-specific database, within each local authority, so that the least energy efficient homes are identified. Action on these can be financed through methods appropriate to the income of the occupant.

Better individual house energy auditing is needed (beyond SAP) to cover all energy use in this home, ie not just space and water heating, and based on actual consumption, not modelled expectations. The data already gathered for past HECA (Home Energy Conservation Act) reports would form the starting point. The new address-specific database would provide the local authority with the detail to comply with its carbon targets as well as find the fuel poor. The present HECA are not providing useful information.

New, household-specific data will be obtained from the Home Improvement Packs. These could provide the basis for defined standards that landlords and owner-occupiers have to meet before the premises are re-occupied. Investment is currently taking place to bring local authority properties up to a 'decent' standard. In energy efficiency terms, this standard was too low and since the price increases it should be raised significantly.

[15] Fuel Poverty Advisory Group, Fourth Report

Policies need to focus on moving the poorest people out of the worst houses (and possibly then demolishing them) and on making more affordable, appropriate housing is available. New construction should focus on providing more small (in terms of floor area) homes, some in sheltered accommodation, to provide a good choice for elderly people and encourage them out of the family home; under-occupation is a contributory cause of fuel poverty. The legacy of an old, inefficient housing stock is inextricably linked to the problem of fuel poverty.

Personal carbon allowances (pcas) are the over-arching framework for households, proposed[1]. Pcas could provide extra income for under-consumers, so that the fuel poor could use this extra money to be warmer. Two of the real benefits of pcas are that they are both equitable and certain.

Regulation to reduce the cost of fuel for the poorest consumers would consider the level of the standing charge, tariff tiling, the cost of prepayment meters. At the moment, the poorest people pay the highest unit price

The development of a Fuel Poverty Research Centre would enable coherent R&D to take place, across the broad range of disciplines involved in fuel poverty.

QUESTION i
The long-term potential of energy efficiency measures in the transport, residential, business and public sectors, and how best to achieve that potential.

The potential to reduce both energy demand and carbon emissions is substantial through the combined effect of both energy efficiency and low and zero carbon technologies (LZCs). This potential would be realised over different time periods, because some technologies are already available. For those technologies that are to be commercial and widely available in the longer term (eg beyond 2020), the planning has to start now.

The 60% carbon dioxide reduction could be met in the residential sector (40% House report) and probably with car usage, but not through technology alone if it is accompanied by present levels of ever-growing demand for new energy services. There has to be an acknowledgement by society that lower levels of energy service could be acceptable (see Q1). Some technological developments should be primarily aimed at supporting consumer awareness, providing feedback and incorporating users into the role of carbon managers.

There has to be a commitment by manufacturers to constrain the production of energy profligate and unnecessary equipment (eg patio heaters, plasma TVs, fuel effect fires) so that they do not come on the market. This could be achieved by a scheme that gives them ‘permission to manufacture’ or by putting an energy label on all equipment before it enters the retail sector. This might require EU action on traded goods: there are limitations on the effectiveness of policy if the UK acts unilaterally.

Personal carbon trading (Q5) would also help to promote feelings of ‘sufficiency’ amongst consumers and reduce the likelihood of them buying additional, discretionary purchases that are high-energy users. The recent growth in residential electricity demand is an indicator of run-away demands for miscellaneous equipment by unwitting householders.

The best way to promote energy efficient products is through a market transformation approach – a strategic interaction of policies over a 10-15 year period. Some policies (eg labels and standards) are the responsibility of the European Commission, others (eg procurement and financial incentives) are up to each individual member state. Most market transformation policy is aimed at individual products. Setting tough minimum standards of energy consumption for products by specified dates provides a clear signal for manufacturers and brings forward innovative technology. At present, the EU has minimum standards for just three product groups (refrigerators, boilers and lighting ballasts). This compares with 17 product groups in Mexico and 43 product groups in the US and Canada. Historically, major

[1] op cit

improvements in efficiency have been achieved at nil cost (and major benefit) to consumers through clear, relative tough minimum standards (Boardman 2004). Many of these products will be purchased anyway, as replacements, the objective is to make sure that only efficient equipment is available.

Voluntary agreements with manufacturers are a poor alternative to mandatory minimum standards and should only be used on this basis. Voluntary agreements deliver savings more slowly, in practice, as they are often marginal improvements on expected trends.

Future product policy should be framed in terms of total consumption (kWh pa) not energy efficiency (kWh / litre or wash cycle). The latter approach, for instance on energy labels, has encouraged the manufacture and purchase of larger equipment (fridges, washing machines, cars, houses).

Many of the technologies required are already in existence and are either on the market or are near to market. The challenge is to get them both fully commercial and widely purchased, eg combined heat and power, solar thermal, photovoltaics.

Some technologies, for instance light emitting diodes and vacuum insulated panels in refrigeration need further development to make them commercial, but the technology is known.

There are a few problems, such as solid wall insulation, where new materials could be found to overcome problems with existing solutions (too thick, unsightly). These could involve some basic research.

Most development of new technologies should involve consumer groups and practitioners from the start to make sure that the users needs are understood and incorporated. The present debate about smart meters is a clear example.

The UK Government should focus on influential technologies (eg LZC, lighting) through procurement and financial incentives. Green procurement is already required in the public sector, but appears not to be influential. For instance, Government departments, PFI projects and all public housing should be installing the most efficient products, combined heat and power, micro-generation, etc. They do not appear to be.

New buildings should be built to high standards of energy efficiency and lower carbon impact. This would require the standards in the Building Regulations and conditions in planning permission (eg the Merton example of on-site generation) to be brought together, to avoid either corrupting the other. The Government should give clear signals about future levels of Building Regulations, for instance zero heating demand by 2016, so that industry can prepare the correct skills. The Code for Sustainable Buildings should support this process and clearly include LZCs.

For personal transport, the medium-term technological solution is to bring down fuel consumption, for instance by a focus on hybrid cars. The longer term trajectory appears to be unclear.