Reducing energy use in UK transport

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Abstract

Transport is making a very limited contribution to carbon emissions reduction targets in the UK, and this paper argues the case for a substantial shift in thinking away from the concentration on technological alternatives to one that combines technological efficiency with behavioural change. It presents a critique of the UK approach to energy and transport, commenting on the approach and measures used, and their effectiveness. The focus here is on the 2007 Energy White Paper, the Climate Change Programme and the Environmental Audit Committee report on carbon emissions from transport. The necessary policy measures are available, but at present there is not sufficient political and public support for effective action. Technology on its own will not be enough.

1. Introduction

There is a lively debate on the need to address the challenges of climate change, and of the role that transport should play, as it now (2005) accounts about a quarter of UK energy consumption and for 27% of greenhouse gases (and 29% of CO_2 emissions – Defra, 2006a, p61). The UK government has been very positive about being able to meet its share of the EU Kyoto Protocol set targets for CO_2 reductions (12.5%), and it has gone further to commit itself to a self imposed 20% target reduction (1990-2010). There are no explicit targets for the transport sector, but it is expected to make a major contribution to the national reduction targets (Table 1). But from the data, it is clear that transport's contribution to carbon dioxide emissions is expected to increase, both in relative terms (from 24.3% to 31.0%) and in absolute terms (+14.3%) over the period 1990-2010 (Defra, 2006a)[1].

Two main market based measures have been discussed within the transport sector to change behaviour. The fuel duty escalator, introduced in 1993, was an annual increase in

[1] 1990 Transport emissions of CO_2 was 39.2MtC and the total was 161.5MtC = 24.3%. In 2010 transport emissions of CO_2 will be 44.8MtC and the total will be 144.3MtC = 31.0% - this is the relative increase. The absolute increase is from 39.2MtC to 44.8MtC or 14.3%. Note that this paper uses CO_2 instead of energy as almost all fuel in transport is oil and there is an almost perfect correlation between energy use and CO_2 emissions in transport.

fuel duty above the rate of inflation, initially set at 3% and raised to 5% (later in 1993) and to 7% (July, 1997). The price of a litre of fuel was increased from 56 pence to 85 pence (1994-2000), of which about 64 pence was tax and duty. The escalator was removed in 2000, after pressure from industry and other interests, particularly those in rural areas, just when it seemed to be having an effect on new vehicle purchasing patterns. Real increases in fuel duty will again be introduced in October 2007 (+2 pence), again in 2008 (+2 pence) and in 2009 (+1.84 pence) – these are the first increases since April 2004.

Table 1: Carbon Dioxide Emissions Baseline Projection by End User in the UK

End User Category	**1990**	**2000**	**2004**	**2010**	**2020**	**2030**
Road transport	35	38	40	42	43	49
Railways	2	2	1	1	1	1
Civil aircraft (domestic)	0	1	1	1	1	1
Shipping (domestic)	2	1	1	1	1	1
All transport	38.6	40.9	43.1	44.8	45.3	52.0
All emissions - MtC	161.5	149.0	152.5	144.3	146.6	166.0
Levels of road traffic – B Veh kms	410.8	467.1	498.6	556.6	635.5	696.9
Percentage change on 2004	-17%	-6%	0	+12%	+27%	+40%

Source: Defra (2006a) Units: million tonnes of carbon (MtC), National Road Traffic Forecasts 1997 (DETR, 1997) and Transport Statistics GB (DfT, 2006a).
Note: The figures to 2004 are actual and the others are estimates based on National Road Traffic Forecasts and Defra forecasts (2006a) for CO_2 emissions – they seem to assume a 24% improvement in the energy/CO_2 profile from 1990 to 2020 and a 18% improvement from 2004-2020.

There have also been several documents produced by government and think tanks about the necessity for a national system for road pricing in the UK (DfT, 2004 and 2006b), but the only schemes that have been implemented have been in London and Durham. Even here, the motivation has not been to reduce CO_2 emissions, but to reduce traffic congestion[2]. There has however been a substantial improvement in local air quality in central London resulting from the congestion charge, and CO_2 emissions levels are down by 15%, mainly due to fewer cars, higher speeds and less stop-start driving (Banister, 2006). The 2007 Energy White Paper (2007 EWP) (DTI, 2007) only makes one mention of pricing, and this in the context of the demand management and the Transport Innovation Fund (TIF).

In this paper the recent evidence is summarised on the potential for transport to contribute substantially to the reductions in carbon based energy use, and questions are asked about

[2] Note that within the Congestion Charging zone the CO_2 levels are calculated from vehicle-km driven and fuel consumed. The traffic and speed changes observed in the charging zone are estimated to have led to 15.7% savings, half from reduced traffic and half from more efficient driving conditions (less congestion).

the robustness of many of the assumptions used. The conclusions reached are that the overriding emphasis on technology is misplaced and that more fundamental societal changes are also needed if transport is to make any real contribution.

2. The Options Discussed in the 2007 EWP

2.1 Mandatory Standards for Fuel Efficiency: Voluntary agreements with the car manufacturers have already been established, and a target agreed that by 2008 all new vehicles in the EU would average 140 g CO_2/km[3]. In the UK, the current level for new cars is 167.2 g CO_2/km (2006) with about 20% reaching the 140 g/km target. Industry is now complaining that the targets are too difficult and the only real change has been a switch to diesel, with diesel now accounting for 38% of the new car market (SMMT, 2007). But the scale of the challenge is illustrated by the fact that for every hybrid[4] sold in the UK (6538 in 2006), there are 27 4x4 SUVs sold (175,805 in 2006). The real problems have been that there are only a few vehicles that are available with the low emissions profile, and consumer purchasing patterns still favour the larger cars. Recent changes in the taxation system for company cars and the Vehicle Excise Duty (VED) mean that there are some incentives to use low emission vehicles, but these changes are seen as being fairly marginal when set against the higher purchase costs of hybrid vehicles.

The UK government is now heavily in favour of mandatory agreements for fuel efficiency in new cars beyond 2012 pushing the average down to under 100 g CO_2/km. The use of mandatory standards is welcome and gives clear incentives to car manufacturers to produce a wider range of fuel efficient vehicles. This initiative is being supported by the low carbon innovation strategy (LCIS) and the Julie King 2007 review of low carbon cars, both highlighted in the 2007 EWP.

2.2 Biofuels: Biofuels[5] are making a limited impact with some diesel fuel now having 5% biodiesel added to it. The EU Biofuels Directive means that 5% of all fuel sold in the UK will have to come from renewables by 2010/11. This has taken the form of a Renewable Transport Fuel Obligation (RTFO) and it will become operational in 2008. It is now the main mechanism to achieve carbon reductions in the transport sector (1.7 MtC by 2010 – Table 2). The UK Climate Change Programme (Defra, 2006a) has maintained a high level of optimism about the overall UK targets being achieved and exceeded.

[3] g CO_2/km is the average emissions figure allocated to all new cars in the UK since 1997. Independent tests are carried out on vehicles over a standard test routes to assess fuel consumption and emissions profiles.

[4] The two best selling hybrids are the Toyota Prius II (104 g CO_2/km) and the new Honda Civic (106 g CO_2/km), both with fuel efficiency around 58 mpg (4.9 l/100km).

[5] Biofuels are assumed to be carbon neutral as they "fix" carbon in their growth stage and "release" the stored carbon when they are used as fuel. However, there are transport and other energy costs associated with production, processing and distribution.

2.3 EU Emissions Trading Scheme: The UK has been very active in trying to build consensus and move forwards from the current Kyoto Protocol as seen in the G8 Summit at Gleneagles (July, 2005) and the Montreal Climate Change Conference (December, 2005). This has involved the possible extension of the EU Emissions Trading Scheme (ETS) to include aviation and land transport (from 2008 or more likely 2010), the Clean Development Mechanism (including carbon offsets), the clean energy investment framework, and the application of the best available technologies.

Table 2: Summary of CO_2 Reduction Measures being taken in the UK Transport Sector

2000 Climate Change Programme – 1990-2010	Total savings = 5MtC
a) Voluntary agreements with industry (including reform of company car taxation and graduated VED)	2.3MtC
b) Wider transport policies (Transport 2010)	0.8MtC
c) Fuel duty escalator (ended 2000, but still in estimates)	1.9MtC
2006 Climate Change Programme – additional measures	New savings = 1.8MtC
a) Renewable transport fuel obligation (RTFO)	1.7MtC
b) Further improvements in vehicle fuel efficiency after 2008	0.1MtC
2007 Energy White Paper – 2005-2020	Total savings = 3.0-7.5 MtC
a) Increased fuel efficiency – mandatory targets for new cars	1.8-4.1 MtC
b) RTFO – higher levels after 2010	1.0 MtC
c) Domestic aviation – ETS being extended to aviation	0.2-0.4 MtC
d) Behavioural change – unspecified but ETS for land transport central to this proposal	1.0-2.0 MtC

Source: Based on Defra (2006a) pp61-67 and DTI (2007) pp 251-252.

2.4 Comments on Proposals: Very little seems to be actually happening, even if the headline figures in Table 2 suggest that transport is making a contribution. The 2000 UK Climate Change Programme targeted a 5MtC saving from transport (-12.8% as compared with 1990 levels), and additional savings of 1.8MtC were identified in the 2006 Review (-17.4% in total – Defra, 2006a). The voluntary agreement with the motor industry will not be reached in 2008, and the more likely figure is 160 g CO_2/km (Transport and Environment, 2006), so the figure in Table 2 should be halved. At the current rate of progress, the 140 g CO_2/km emission target will only be reached in 2022 (EAC, 2006, para 22), which is the same time that the 2007 EWP target for 100 g CO_2/km is being sought.

The wider transport policies outlined in the Transport 2010 document said very little about carbon reductions (6 mentions in the whole document, DfT, 2000), but two arguments were introduced. One suggested that reductions in congestion from the proposed investment programme would lead to more efficient use of fuel, and the other was the proposition that a national system of road pricing could be introduced. But even this possibility was only mentioned once in the document at the end in the future directions section. The fuel duty escalator was the main pricing measure introduced (1993-2000), but it is still included in the calculations when it is no longer in operation. The justification is that "carbon savings have been estimated by comparing the level of emissions with the fuel duty escalator in place with what would have happened had the fuel duty been increased annually in line with inflation" (Defra, 2006b, para 1.198, p69).

This was a one off saving and its impact has been eroded since as fuel duties have only been raised twice (2000 and 2003), and then only in line with inflation (EAC, 2006, para 69). The savings given in Table 2 are the maximum figures, and the more likely contribution is 61% of this maximum.

The additional measures (Table 2) look to further improvements in vehicle fuel efficiency and the use of renewable fuels. Bioethanol and biodiesel have substantial potential (Banister and Hickman, 2007), but even here there are questions over whether these fuels will be sourced from the UK or overseas. At present, it seems that about 1MtC will be UK based and the rest will be sourced from overseas (Defra, 2006a, para 17, p64). The optimistic view is to accept the figures in Table 2 and expect a 6.8MtC contribution from the transport sector by 2010, which would mean that there will be a 1% reduction in the transport related carbon emissions over the Kyoto Protocol period. The realistic view is that the voluntary agreement may achieve half its target and that if the fuel prices increase with the global price of oil, then there would be a net saving of 2.3MtC from the existing measures. With contributions from the RTFO, this figure may increase to 4MtC, but this means a 4% increase in carbon emissions from transport.

The Energy White Paper (DTI, 2007) seems to have moderated some of the expected savings in the transport sector and changed the timeline from 1990-2010 to 2005-2020. The overall target figure is similar or even less than that identified in the Defra (2006a) estimates only a year earlier. The figure is now about 5MtC, but even these estimates seem high and are dependent on stringent new mandatory targets for new vehicles being achieved. The contribution from the RTFO have been moderated, and success seems to depend on an effective ETS being introduced for both land and air transport.

The empirical evidence in Table 1 shows an increase in carbon emissions from transport in the UK from 39.2 MtC to 43.1 MtC (1990-2004). This is an increase of 10%, not a reduction as itemised in Table 2. But the UK is not alone in finding it difficult to achieve the Kyoto targets. In all major EU countries there has been an increase in energy consumption in transport and in greenhouse gas emissions from transport (DfT, 2006a). In addition, the expected reductions in carbon are built into the forecasts (Table 1) with substantial efficient gains that do not as yet seem to be supported by the evidence from the recent past. There is an 18% increase in fuel (energy) efficiency over the period 2004-2020.

2.5 Conclusions: The role of transport is an uneasy one in terms of whether it should take its "fair" share or any share of the reduction. The initiatives taken in the transport sector have depended on the fuel duty escalator (abolished in 2000), voluntary schemes (ineffective), and the outcomes of policy interventions (unspecified). The only effective measure could be the RTFO, and even here there may be problems in achieving the production levels required and there are doubts over their real contribution to reductions in carbon emissions if life cycle analysis is undertaken. Much of the biofuels will have to be imported and should not be counted in the UK's renewables balance sheet.

Secondly, the net effect is that transport's emissions will continue to increase and that the figures given in Table 1 may be an accurate estimate (+14.3% 1990-2010). This is substantially less than the expected growth in traffic (over 35%), and it is difficult to see where the savings are coming from. After 2010 it is assumed that CO_2 emissions will decrease, even though levels of traffic continue to increase (traffic growth 2010-2030 +25%).

Thirdly, the initiatives all seem to be coming from the EU through mandatory targets, the biofuels directive, and the EU ETS. Much of the innovative thinking and action is international, but it also transfers the difficult decisions away from national governments, which have to the implement the EU actions. Even so, the limitations of the debate are clear in that the solutions to CO_2 reductions in transport are seen only in technological terms. The nature and scale of the problem facing the transport sector has been totally underestimated and there is a naïve belief that we can substantially reduce energy use by travelling more in a slightly more efficient way. As commented on by the Environmental Audit Committee (EAC, 2006), the emissions targets for transport for 2010 are now projected to be some 0.5MtC below the lower end of the DfT's original proposals (2000), hence the new time horizon of 2020 and lower ambitions. But more fundamentally, there is a concern that the DfT seems to have "a fatalistic attitude which sees carbon-intensive activities and economic growth as going hand in hand" (EAC, 2006, para 10, p4).

3. The Way Forward

Transport can have and must have an instrumental role in achieving sustainable development in the UK (Banister, 2005). To achieve such a change requires a fundamental shift in policy thinking on transport, as both the measures being proposed and the scale of the problem to be overcome have not been addressed. For transport to achieve the levels of savings in the other sectors within a market that is rapidly expanding and one that is becoming less efficient rather than more efficient requires radical surgery. There are four basic ways in which to reduce energy consumption in transport and all four approaches must be used.

Traditionally, the transport activity has been considered as a series of logical steps about the decision to make a trip, where to go, what mode to take and which route to follow. This is the classic four stage procedure of trip generation, trip distribution, modal split and trips assignment, and this sequence in a variety of forms has provided the basic structure of our understanding and analysis of travel patterns. The starting point for a major change that embraces reduced energy use, sustainable development and transport should question each of these components of the travel decision process, by looking for opportunities for making fewer trips, by encouraging modal shift away from the car, by reducing trip lengths, and by encouraging greater efficiency in the transport system (Banister, 2007.

Single measures as outlined in the 2007 EWP need to be combined into a set of mutually supporting measures that between them begin to have a real impact. Most of the current

thinking revolves around the greater efficiency of the transport system through technological measures. Behavioural change must be seen as central to the debate and some of the options have been tested in the VIBAT project (Hickman and Banister, 2006 and 2007).

The initial aim of the research was to establish whether a 60% CO_2 reduction target in the UK transport sector could be achieved by 2030. The analysis has concentrated on the domestic UK travel modes, which means that the actual target for 2030 is 15.4 MtC, or a 60% reduction on the 1990 level of 38.6 MtC. This target needs to be set against the expected increases in travel, with levels of carbon emissions increasing to 52 MtC by 2030 (Table 1). The two images developed generate less travel than the business as usual: with Image 1 (New Market Economy) increasing travel by 35%; and Image 2 (Smart Social Policy) having slightly less travel than now (-10%). In addition, there will be a population increase of 9% in both images, and this adds to the levels of travel and carbon emissions. The study identified 122 individual policy measures that were then combined into eleven packages to tackle both the scale of the task and the complex requirements of combining mutually supporting measures. These packages were again clustered together to provide the necessary reductions in energy use in transport (Banister and Hickman, 2007).

The overall conclusion reached is that the 60% CO_2 reduction target (in 2030) can be achieved by a combination of strong behavioural change and strong technological innovation, but only for Image 1 (Smart Social Policy) where there is no overall increase in UK travel (to 2030). But it is in travel behaviour that the real change must take place, and this should be implemented now. Changes in the built environment will become effective in the medium term (over 10-15 years), whilst the major contribution of technological innovation will only be effective in the period after 2020. However, it is not possible to achieve the 60% CO_2 reduction target (in 2030) with the expected growth in travel (Image 1 +35%, which is still substantially less than business as usual +46%), as the increase in CO_2 emissions from this growth outweighs many of the possible savings from behavioural change and technological innovation. To achieve substantial reductions in energy and carbon use in transport, we must travel less (Banister, 1997).

It is important to open up the debate about the issues raised in the 2007 EWP with all stakeholders, as this begins to create an understanding about the scale and importance of the CO_2 reduction issues, and it would begin to remove some of the barriers to effective implementation. Included here would be questions relating to the concept of sector based targets, and how CO_2 reduction targets can become central in transport decision making.

In addition there is a clear necessity to raise public awareness and to get the public's active involvement in seeking solutions, and how to encourage behavioural change that can be maintained and continued over time. The old debate of relying on technological improvements to help maintain our current CO_2-intensive lifestyles now seems to be obsolete. A clear lead on this issue has been taken in the 2007 EWP through the Low Carbon Transport Innovation Strategy (LCTIS), the King Review, and the communications campaign on smarter driving.

The issue of air transport has not been addressed here, as the figures used and the complementary research referred to have been based on UK domestic travel (including air). But the same messages also apply, namely that in markets where there continues to be substantial growth, it is extremely difficult to present a convincing case for carbon reduction based on technology alone. Behavioural change must lead the debate and the actions needed. Reducing energy use in transport requires strong political will and public support (Banister et al, 2007). A radical shift in thinking is not required, but a rebalancing of priorities away from an overriding concern with economic growth towards one that gives much greater prominence to social and environmental priorities. The climate change imperative provides the necessary impetus for change, yet this paper has shown that at present the political commitment is not sufficiently strong, even in the UK which has traditionally led on the climate change debate. Both the science (IPCC, 2007) and the economics (Stern, 2006) are now strongly promoting immediate and substantial action to address global climate change, even in the transport sector. Technology on its own cannot succeed and it needs to be reinforced by major behavioural change.

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