UKERC

TRANSPORT AND CO_2

Working Paper, September 2005

By Dr Jillian Anable, Transport Topic Leader and Dr Brenda Boardman, Co-Director, Demand Reduction, UKERC

UK Energy Research Centre
58 Prince's Gate
Exhibition Road
London
SW7 2PG

+44 (0) 207 594 1574
admin@ukerc.ac.uk
www.ukerc.ac.uk

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EXECUTIVE SUMMARY

The following six main topic areas/ questions emerged from the seminar, interviews and literature review exercise:

1. Are the figures for current and projected transport and CO_2 emissions consistent between government departments?

- *There are some **differences between the departments** as to how much and how fast emissions may grow from the transport sector. This is primarily due to different modelling methods and the inclusion of different policies and assumptions. Nevertheless, the picture can be confusing.*
- ***Data is needed which can be disaggregated** to show to what extent the different forms of transport including HGVs, buses, aviation and rail are currently and forecast to be responsible for carbon and other greenhouse gas emissions. This would help to pick out particular problem areas and aid policy making. NETCEN produce this for historical data, but future projections of emissions for each mode are not routinely published.*
- *An assessment of the **absolute and relative scale of the emissions savings expected from individual transport policy measures** is needed.*
- ***It is important that these projections are clarified and the contribution of each sector, mode and policy stated**. If we understand the causes of rising transport emissions more clearly, we will be better able to assess whether policies are tough enough to make a difference.*
- *Therefore, **research could be carried out to understand the composition of the official figures, to create a standard breakdown in the various end use sources of transport emissions and to clarify the assumptions used to derive them.***

2. How confident are we in the projections?

- *The confusion that can arise from any lack of clarity creates a can create **difficulties for policy design, evaluation and research**.*
- *Data and projections need to be presented, at least occasionally, alongside **sensitivity and scenario analysis** addressing key assumptions such as traffic growth, the price of oil and vehicle efficiency expectations as well as the potential synergistic effects of policies.*
- *It should be transparent whether changes to the expected outcomes of the 10YP are the result of different models, changes to the model since the last projections or from changes to the inputs and assumptions. The data used and the **underlying assumptions made must be clear** and well communicated throughout published data.*
- *There is a need to **develop long term thinking on transport and to establish appropriate CO_2 targets for the UK transport sector** – not just to 2010 but right up to 2050.*
- ***Specific targets for emissions reductions in each sector** would allow an assessment of the degree to which transport is on track to reduce emissions.*

3. Is the transport sector pulling its weight towards the achievement of UK emissions reductions targets in relation to other sectors in the economy?

[1] UKERC Transport and Aviation Topic Leader, The Centre for Transport Policy, Aberdeen
[2] Co Director, UKERC Demand Reduction Team, Environmental Change Institute, University of Oxford

- ***Whether or not transport is 'pulling its weight' depends on the target being pursued**. If the shorter term Kyoto targets are in sight, the Voluntary Agreement (VA) between motor manufacturers may do enough to offset traffic growth and curb energy use from transport. However, the crucial question is at what rate and for how long traffic growth is going to be allowed to continue – **current growth projections are unrealistic in terms of climate change objectives and yet there are few policies in place to control traffic growth**. In addition, there is an urgent need to place more importance on the implications of freight transport in the climate change debate – something which the VA does not yet address. **With a 60% target in focus, interventionist policies will be required for individual, freight transport as well as air travel**.*
- ***Policy seems to be able to go a long way with tackling vehicle efficiency, but have limited effect on the other 3 aspects of transport energy demand – alternative fuels, travel demand and mode choice.***
- *Since the abolition of the fuel duty escalator, there are few, if any, policy levers on travel and car purchasing behaviour. Yet **it is crucial that attitudes and behaviour are changed**.*
- ***Recent transport policy has focussed on congestion not traffic or CO_2 reduction. How can CO_2 targets be reached while traffic continues to grow?** The extent to **which the focus on congestion reduction is in conflict with emission reduction targets** needs to be assessed.*
- *The few fiscal levers currently being considered such as Road User Charging are only considered on a revenue neutral basis. This instrument will have little or no effect on carbon reduction other than to possibly incentivise the purchase of more efficient, cost effective vehicles. In this context**, scenarios of substantial price increases, personal carbon allowances (rationing) and packages of measures which raise the elasticities and raise the carbon abatement effects of policies such as RUC need to be considered**.*
- *There was little time to discuss local transport policy in detail at the seminar. However, there was a clear feeling that the **tough decisions are being deferred to the local level**. At the same time, however, **not enough recognition or support is being given to the potential for local, 'softer' policies to have a dramatic effect on travel behaviour**. The recent government study on 'Smarter Choices' which assessed current evidence to suggest that a such measures have the potential to cut urban traffic by up to 14% overall and up to 21% in the peak period, was mentioned several times[3]. Department for Transport funding appears to still be focussed on long-distance, heavy infrastructure solutions.*
- ***Transport solutions need to be related to car dependence and the cause of this**. Primarily this involves **more attention being paid to land use changes** and also wider trends such as teleworking and other lifestyle effects. **The National Transport Model and policy appraisal techniques are not yet able to consider all these effects**.*

4. Given that transport solutions are potentially more expensive than those from other sectors, should transport be expected to pull equal weight with respect to emissions reduction? How can we evaluate cost effectiveness and political deliverability of policies in order to identify the optimum policy packages across sectors?

- **A cost effectiveness measure, with clear criteria on which to compare policies within the transport sector and between sectors needs to be developed**.
- **An indicative value for carbon** as an externality needs to be set to aid broad assessment of policies within and between sectors and policies need to be assessed according to the resources required to save an equal amount of carbon.
- There may be **differences in the ways in which cost effectiveness is measured across sectors** – i.e. the way in which welfare gains, environmental effects and other effects are included – this needs to be assessed.

[3] Cairns, S; Sloman, L; Newson, C; Anable, J; Kirkbride, A and Goodwin, P (2004) *Smarter Choices – Changing the way we travel* report for the UK Department for Transport July 2004

- There is **no way of assessing the cost-benefits of non infrastructure, fiscal or softer traffic reduction measures** vis a vis harder infrastructural measures whether this assessment is based on cost effectiveness, carbon abatement or any other measures. Also, in cost benefit analysis, **congestion externalities and air quality benefits** are not captured and there are many externalities that cannot be measured.
- **Transport policies have not yet been systematically assessed in terms of their value for money in relation to the cost per gram of carbon saved**. This is being done as part of the Climate Change Review and is expected to be published at the end of 2005. In such an assessment, low tech measures such as speed management and smart measures may materialise as the best value for money. Hence, strategy to optimise the transport system and secure emissions reductions should not be dominated by high-cost infrastructure projects at the expense of smaller but equally effective measures. There can be a higher rate of return on local pedestrian and safety schemes, for instance.
- **The balance must be redressed in 'official' modelling procedures which simply compare the costs of mature, market ready energy technologies, like wind turbines, with some of low carbon vehicle technologies that still need a lot more research** and development and may still be some way off.

5. What is the optimum balance between technological and behavioural solutions in the transport sector?

- It is **theoretically possible to achieve the reduction within the transport from technology**, probably even earlier than 2050, **but** this would (i) be expensive (ii) be very difficult (iii) not solve other externalities from the transport sector and (iv) itself involve behaviour shifts and 'taking the people with you'. The overriding conclusion is, therefore, that **policies to affect behaviour change and change travel habits were as important if not more important than technological solutions**.
- Although technological improvements bring about emissions reductions, **recent improvements in efficiency have been offset by a range of factors** such as increased vehicle size. These trends are likely to continue.
- In the longer term, there is some possibility that radical changes in technology could significantly reduce the real cost of travel. If this were to occur, then **rebound effects** such as increases in distance travelled might result. This means that **measures to 'lock in' the benefits of alternative technology** will be required such as national congestion charging, demand management and car restraint policies.

6. Are there any polices that could be relatively easily and quickly implemented to effect early emissions savings from the transport sector?

- Speed management
- Car labelling
- Using the transport network more efficiently
- Telecommunications
- Low tech- non motorised modes
- Gaining Public Acceptability

CONTENTS

1.0 INTRODUCTION

The aim of this paper is to provide a comprehensive overview of the current and potential future contribution that the transport sector makes to the UK's emissions of Carbon Dioxide (CO_2). The aim is to develop an understanding of:

- The scale, composition and security of official baseline and projected figures for CO_2 emissions from the transport sector to 2010 and beyond.
- The source of the official emissions projections, the assumptions currently used to calculate these figures and the uncertainty associated with them.
- The research needed to identify appropriate policy packages and CO_2 emission targets for the UK transport sector for 2050.

The focus of this paper is on UK surface transport, although the discussion on emissions projections includes aviation. Aviation has also been discussed in a previous UKERC seminar[4].

The information presented is a combination of three sources:

1. A one day seminar to investigate the above issues was held on 7th December 2004 as part of the UKERC *Meeting Place* entitled *Transport and CO_2*. The seminar consisted of short presentations by representatives of the Department for Transport (DfT), The Department for Trade and Industry (DTI) and the Treasury, followed by discussion structured using the above questions (under the Chatham House Rule[5]) with around 20 participants from academia and government. The presentations and list of participants are available on line at (http://www.ukerc.ac.uk/content/view/102/57). The presentations were as follows:
   1. DfT (1): *Transport and CO_2*
   2. DfT (2*): DfT's projections of CO_2 emissions from road transport* (from the National Transport Model)
   3. DTI: *UK Transport Policy and CO_2 Emissions Projections*
   4. HM Treasury: *Transport, Taxation and Environmental Objectives*

2. A literature review of government White papers, technical annexes, consultation documents and other literature on transport and climate change. References are included as footnotes where appropriate.

3. Face to face meetings with representatives of DfT and DTI to clarify some of the figures and their derivation.

Consequently, the conclusions presented in this paper are *not* the consensus views of the workshop or the civil servants consulted, but those of the authors who have taken a combination of sources of evidence into account and reached their own conclusions.

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[4] Workable Metrics for the EU emissions trading scheme, UKERC Meeting Place seminar, 23rd and 24th November, Oxford available online at http://www.ukerc.ac.uk/content/view/91/57

[5]

2.0 STRUCTURE OF THIS REPORT

This report is presented as a series of questions for which answers were sought in the seminar and through the literature review.

- **Are the figures for current and projected transport and CO_2 emissions consistent between government departments? (s3.0)**
- **How confident are we in the projections? (s4.0)**
- **Is the transport sector pulling its weight towards the achievement of UK emissions reductions targets in relation to other sectors in the economy? (s5.0)**
- **How can we evaluate cost effectiveness and political deliverability of policies in order to identify the optimum policy packages across sectors? If transport solutions are more expensive than those from other sectors, should transport be expected to pull equal weight with respect to emissions reduction? (s6.0)**
- **What is the optimum balance between technological and behavioural solutions in the transport sector? (s7.0)**
- **Are there any polices that could be relatively easily and quickly implemented to effect early emissions savings from the transport sector? (s8.0)**

These questions will be discussed in turn.

3.0 ARE THE FIGURES FOR CURRENT AND PROJECTED TRANSPORT AND CO_2 EMISSIONS CONSISTENT BETWEEN DEPARTMENTS?

Projecting CO_2 emissions from sector to sector is beset with difficulties and uncertainties, especially over long time periods. However, this uncertainty can be compounded by the fact that figures for energy use and emissions are presented differently according to the publication source (i.e. between government departments) and are sometimes not easily comparable. This is primarily due to the different models used , the different purposes of the models and the different dates of publication of the figures.

Research undertaken prior to the meeting place seminar had revealed some apparent inconsistencies in the figures relating to the transport sector both within and between government departments. The seminar[6] was used as an opportunity to clarify the picture. The following tables compare emissions data provided during the seminar and additional examination of the most up to date official reports from DEFRA, DfT and DTI in order to assess the contribution of the transport sector to the reduction of energy use and emissions in the UK.

3.1 UK emissions projections by sector – DTI and DEFRA

DTI and DEFRA use the same model to derive emissions projections (The DTI Energy Model). The DTI Energy Model is a 'top down' partial equilibrium model of the UK energy market. The demand side comprises over 150 econometric relationships of historic fuel demand and the supply side comprises data on every major power producer, plant efficiencies, operating costs and fuels and assumptions on future plants. The model began in the 1970s and has been developed and improved by academics and specialists over the years. It requires a number of assumptions principally on fossil fuel prices, economic growth and demographics. The DTI model provides projected energy use and associated carbon dioxide emissions for the whole UK economy, of which transport is only one sector.
In addition, DTI use the 'MARKAL' model to analyse the UK energy sector for specific pieces of analysis. MARKAL has been developed under International Energy Agency (IEA) auspices and has

[6] And follow up meeting with DfT and DTI June 2005.

been operated for the DTI by Future Energy Solutions (FES) in connection with specific projects. MARKAL is a multi time period, cost-minimising linear programme model. The model specifically looks at ways in which a specified energy demand can be met by specific technologies. It has a variety of uses, one of which is looking at various options for meeting long-term energy demand under various carbon emissions constraints, e.g. to 2050 and beyond.

As both the DTI and DEFRA use the DTI Energy Model, the figures are essentially identical. Any apparent inconsistencies, although sometimes confusing, mainly arise due to issues of *presentation*, rather than substance. The main presentational issues include:

- The difference between 'end-user' and 'source' emissions'. For estimates of CO_2 by end user, a pro-rata method is used to re-allocate estimated emissions from power stations and other fuel processing industries to final users or delivered energy. Emissions by end user are subject to more uncertainty than emissions by source and therefore only give a broad indication of emissions by sector of the economy (transport, business etc)[7] (and are therefore not used in this paper unless otherwise stated). However, the difference between the two sets of figures is not insignificant. For the transport sector, end user allocation adds around 17% to the total CO_2 produced. In 2002, for example, transport accounted for 41 million tonnes of carbon (MtC) on an end user basis, but 35 MtC by source categorisation[8].
- Different dates of analysis – The projections may have been derived at different times thereby using more up-to date figures, assumptions and developments in methodology. Models are updated when necessary in order to ensure the estimates are as accurate as possible.
- Different categorisations of broad sectors. For example, the DTI use 'Power Stations' whereas DEFRA use 'Energy Supply'. These differences can arise due to DTI's focus on *energy* and DEFRA's focus on *emissions*.
- Different definitions of emissions: two categorical breakdowns are used:
    1. The United Nations Economic Commission for Europe (UNECE/ CORINAIR) categorisation is the basis on which summary emission actuals and projections are supplied to the EC[9]. This excludes land use change and also international shipping in UK ports. It also includes *domestic* aviation emissions at both cruise level and below 1000 metres to cover take off and landing cycles. The DEFRA Climate Change Programme Review (CCPR) figures are based on these categories.
    2. The IPCC format is used for reporting UK greenhouse gas emissions to the Framework Convention on Climate Change. The IPCC has proceeded on the basis that socio-economic sources are the easiest and most appropriate groupings for describing emissions, which in turn will facilitate the use of inventories for policy analysis. IPCC includes land use change and all emissions from domestic aviation and shipping but excludes international marine and aviation bunker fuels (although these latter two items are often reported 'below the line'. This categorisation is the basis for the DTI projections[10] and is, in essence, a condensed/ summarised version indented to try and offer interested parties a broad-brush overview of emissions by key sector.

[7] This method, for example, does not take into account higher emissions from increased coal and oil-fired generation used to meet peak domestic demand for electricity. Emissions by end user are therefore subject to more uncertainty than those by source and should only be used to give a broad indication by sector.
[8] Department for Transport (DfT) 2004 *Transport Statistics Great Britain* Table 3.8
[9] The UNECE requirement to establish a much more detailed understanding of the physical source and geographic distribution of emissions has led to source categories based on the physical characteristics of the sources of pollutants. The CORINAIR/UNECE system uses type of physical plant or vehicle, as the fundamental basis for emission estimation. This allows high accuracy in description of individual point or mobile sources and in use of appropriate emission factors for conventional pollutants. From the resulting detailed emissions inventory, the methodology can be used to aggregate, allocate and report emission estimates for different reporting purposes.
[10] E.g. DTI (2004) *Updated Emissions Projections- Final Projections to inform the National Allocation Plan* 11 November 2004 and DTI (2004) *UEP November 2004 Addendum* (Projections beyond 2010)

The most up to date sources of emissions from the DTI and DEFRA projections by sector are presented in Tables 1 and 2 below[11].

DTI

The DTI published projections of carbon dioxide alongside the Climate Change Review Programme (CCP) in November 2000[12]. These figures also serve to inform the United Nations Framework Convention on Climate Change and the EU Emissions Trading Scheme (National Allocation Plan). Updates to these figures are published annually[13] (as presented at the seminar) and the most up to date figures are used below (from November 2004).

The projections are based on an analysis of historical trends in energy use and its relationship to factors such as economic growth and fuel prices. They also reflect the impact of existing Government policies on energy and the environment. The updated figures take into account environmental and other policy developments since the previous exercise. They also revisit and adjust the assumptions used.

Table 1: DTI emissions projections by sector (UK; MtC by source) November 2004

	2000*	**% total**	**2010**	**% total**	**2020**	**% total**
Power Stations	43.1	28%	37.4	26%	35.9	25%
Refineries	4.4	3%	5.5	4%	5.5	4%
Residential	23	15%	20.5	15%	21.8	15%
Services (incl Agriculture)	8.1	5%	7.5	5%	7.9	6%
Industry	33.8	22%	31.6	22%	30.1	21%
Road Transport	**31.7**	**21%**	**34.5**	**24%**	**38.2**	**27%**
Off-road	**1.5**	**1%**	**1.5**	**1%**	**1.5**	**1%**
Other Transport	**2.8**	**2%**	**2.5**	**2%**	**2.7**	**2%**
Sub-total transport	***36.0***	***24%***	***38.5***	***27%***	***42.4***	***30%***
Afforestation since 1990	-0.35	0%	-0.65	0%	-1.1	-1%
Unallocated Measures		0%	-1.34	-1%	-1.34	-1%
Land Use Changes	4.17	3%	2.43	2%	1.9	1%
TOTAL (all measures baseline)	**152.7**		**141.3**		**143.1**	

Source: Adapted from DTI 2004b (Table 3)
Based on IPCC definition of emissions.
** Actual figures for 2000*

These figures are derived on the basis of the following:

- The figures assume the full impact of the Climate Change Programme (CCP) in 2010[14].
- Beyond 2008 or 2010, the impact of a policy is anticipated at an estimated level dependent on the nature of the policy and how savings are derived. For example, the fuel duty escalator was stopped in 1999 but the level of saving is assumed to persist beyond 2010. In addition, the current VA will continue to contribute to emissions saving beyond 2008 as car stock is replaced (assuming that the more efficient vehicles are still available for purchase) and as more of the efficient vehicles form a greater proportion of the total car stock so that carbon savings will increase with time as older vehicles are replaced. Therefore, should there be a second voluntary agreement, carbon emissions from the transport sector beyond 2008 could be lower than shown.

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[11] The figures presented for DTI based on those presented at the seminar. DEFRA did not present any figures at the seminar but use DTI's Energy Model.
[12] Energy Paper 68: Energy Projections for the UK November 2000 The Stationary Office
[13] DTI (2004) *Updated Emissions Projections- Final Projections to inform the National Allocation Plan* 11 November 2004 and DTI (2004) *UEP November 2004 Addendum* (Projections beyond 2010)
[14] The Climate Change Programme Review (CCPE) is a review of the current policies and where estimates have been revised, so too will the impact within the baseline UEP. The CCPR is also evaluating additional measures but it will not be possible to assume that these are firm measures until they do become adopted Government policy.

- Military, railway, shipping and civil aircraft emissions are included in 'Other Transport'.
- Only policies that are 'firm and funded' are included in the baseline because they are firm Government policy. A policy that is not yet firm (i.e. a second Voluntary Agreement (VA) which improves the efficiency of new vehicles beyond 2008) is not included in the Updated Emissions Projections (UEP) baseline. The UEP projections (Nov 2004) include a 1.1 MtC saving allocated to the 10 Year Plan for Transport, though it is unclear exactly which policy developments are assumed. The most recent projections paper suggests the following savings from transport and the other sectors is shown in **Fig 1**:

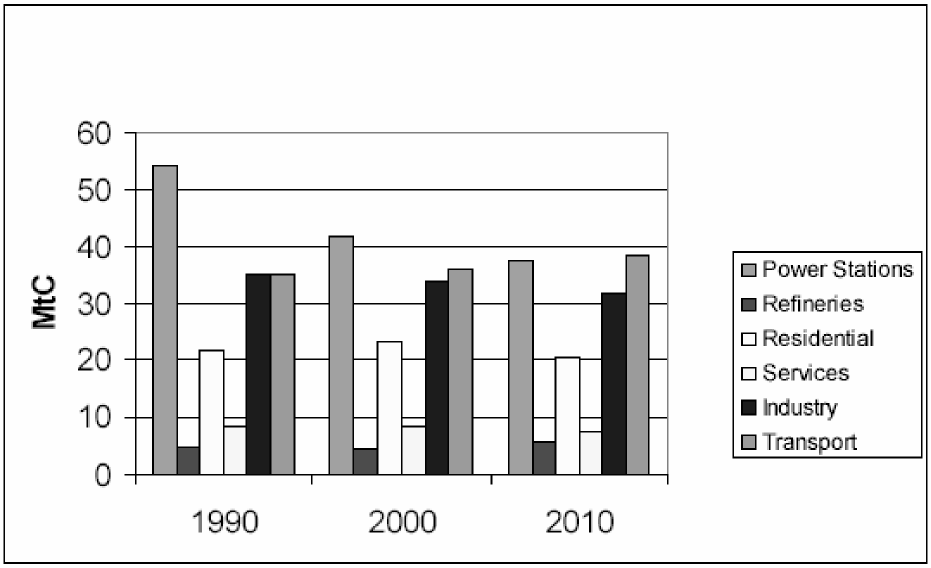
ANNEX 1

Climate Change Programme Measures included in latest projection	Total carbon savings (MtC)	
	2005	2010
DOMESTIC	1.02	3.01
Policies include EEC, Warm Front, Building Regulations (2002) and Community Energy		
INDUSTRY	3.28	4.89
Policies include CCAs, UK ETS, Carbon Trust programmes and Building Regulations (2002)		
SERVICES	0.49	0.89
Policies include Building Regulations (2002), UK ETS, Carbon Trust programmes, UK ETS and public sector programmes		
TRANSPORT	3.02	4.42
Policies include Voluntary Agreements, the 10 Year Plan, Sustainable Distribution, and Off Road programmes		
AGRICULTURE	0.46	0.65
From afforestation since 1990		
TOTAL	8.26	13.86
Total CCP savings including "unallocated" measures	8.26	15.20
"Unallocated" measures	0	1.34
Policies include additional CCAs, Building Regulations (2005), minimum product standards.		

Source: Annex 1 of the Updated Emissions Projections, DTI, Nov. 2004

Fig 1: Climate Change measures included in the latest DTI projection

Despite the fact that some of the largest savings are due to come from the transport sector, **Fig 2** shows that transport is the only sector apart from refineries whose share of emissions is set to be larger in 2020 than in 2000. Transport currently accounts for around 24% of carbon emissions and this will rise to 30% in 2020. To illustrate this, the following graph was presented at the seminar:



Source: DTI Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, December 2004[15]

Fig 2: Broad Sector Emissions (source) – historic and projected 1990-2010

DEFRA

The DEFRA figures are taken from the December 2004 Climate Change Programme Review (CCPR) consultation document.[16] [17]

Table 2: DEFRA emissions projections by sector (UK; MtC by source)

	2000	% total	2010	% total	2020	% total
Energy Supply	55.0	35.0%	48.7	34.3%	44.0	30.6%
Business	24.8	15.8%	23.8	16.8%	25.6	17.8%
Industrial Processes	6.5	4.1%	6.7	4.7%	7.0	4.9%
Transport	**34.6**	**22.0%**	**37.1**	**26.1%**	**41.1**	**28.6%**
Residential	23.1	14.7%	19.6	13.8%	20.9	14.5%
Public	3.7	2.4%	3.0	2.1%	3.1	2.2%
Agriculture	0.6	0.4%	0.5	0.4%	0.5	0.3%
Land Use Change	4.2	2.7%	2.4	1.7%	1.7	1.2%
Waste Management	0.1	0.1%	0.1	0.1%	0.1	0.1%
Total	**152.7**		**142.0**		**143.9**	

*Source: adapted from Table 5 on p 27 DEFRA's 2004 Climate Change Review (CCR)***.**
This analysis by 'end user' allocates emissions from power stations to those using the electricity generated.
Based on UNECE definition of emissions.

The same assumptions about 'firm and funded' policies are assumed in these figures as for the DTI Emissions projections.

It can be seen from the two tables above that the transport figures are different – DEFRA's projections are slightly lower (A difference of 1.4MtC for 2010 and 1.3MtC for 2020). As a result, transport is projected to account for 28.6% of carbon in 2020 compared to DTI's 30%. The reason for this difference is down to the inclusion or not of 'off road' transport emissions and what is included under

[15] Note that this graph is different to the one included in the 2005 DfT paper to the Motorists Forum. In addition to including projections to 2025 as opposed to only 2015, it may be that some of the figures are also different. This is testimony once again to the need for clarity on this issue.

[16] DEFRA 2004 Review of the Climate Change Programme: Consultation Paper December 2004 available at http://www.defra.gov.uk/corporate/consult/ukccp-review/ccpreview-consult.pdf

[17] Unlike DTI and DfT, DEFRA did not present these or any other figures at the seminar.

the various transport subdivisions. For example, in the DTI UEP projections, transport is subdivided into:

- *Road Transport* **-** passenger cars, light duty vehicles, buses, HGVs, Mopeds and Motorcycles
- *Off-Road* –construction sites, fuel use in house and garden, aircraft support and agricultural mobile machinery
- *Other Transport* – Civil aviation, Railways, National Navigation

The DEFRA CCPR figures do not include 'Off Road' transport emissions (they are included under business'), but do include 'Stationary Railway Emissions' [18]. This accounts for the difference between the two departments as in **Table 3:**

Table 3: Projections for Transport for 2010 – DTI and DEFRA (UK; MtC source)

	DTI (UEP)	**DEFRA (CCPR)**
Road Transport	34.5	34.5
Off Road	1.5	
Other Transport	2.5	2.5
Stationary railway	0	0.1
Total Transport	**38.5**	**37.1**

Source: extracted from Tables 1 and 2 above and figures provided by DTI June 2005.

A finer breakdown is provided by DEFRA in the following **Table 4**:

Table 4: Breakdown of Transport CO_2 emissions 2003 (UK, MtC by source)

	2003 (MtC)	**% of total Transport**
Road Transport		
Passenger cars	19.8	57.7%
Light duty vehicles	4.4	12.8%
Buses	1.0	2.9%
HGVs	7.2	21.0%
Mopeds & motorcycles	0.1	0.3%
Road Transport TOTAL	***32.6***	
Other Transport		
Civil aviation (Domestic, Landing and take off)	0.2	0.6%
Civil aviation (Domestic, Cruise)	0.4	1.2%
Railways	0.3	0.9%
National navigation	0.9	2.6%
Other mobile sources and machinery*	0	0%
Other Transport Total	***1.8***	
TOTAL TRANSPORT	**34.3**	

Source: taken from DEFRA 2003 e-Digest of Environmental Statistics Table 5[19]*.*
Based on UNECE definition.
** includes emissions from military, agricultural, domestic and industrial sources*

As DEFRA are the guardian of the official figures, this breakdown of the source of emissions from the transport sector was more readily available from DEFRA than DfT[20]. This data is vitally important to show to what extent different forms of road transport, including HGVs, buses and the other transport sectors are responsible for carbon and other greenhouse gas emissions.

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[18] Note that 'stationary railway emissions' were not separately identified in the DTI UEP exercise but were included in the 'services' category. In the DEFRA CCPR, such emissions were included in 'transport'. However, these emissions account for only 0.1MtC.

[19] available at http://www.defra.gov.uk/environment/statistics/globatmos/gaemunece.htm#gatb5

[20] A similar set of figures in Transport Statistics Great Britain, a DfT publication (DfT 2004), are also from the National Atmospheric Emissions Inventory maintained by NETCEN for DEFRA and are based on the latest compilation of equations derived by the Transport Research Laboratory (TRL) relating emission factors to average vehicle speed.

Overall, the tables show that DEFRA expects savings of 10.7MtC in total from the CCPR between 2000 and 2010, and DTI 11.4MtC. Both expect total emissions to rise between 2010 and 2020 (by 1.8MtC or 1.9MtC). The difference is due to the inclusion of afforestation (-0.65MtC) in the UEP estimates which were not included in the CCPR.

Overall, the figures are comparable. However, due to the differences presented above it can be a confusing picture when a clear breakdown of official projections for the transport sector and the various sub-sectors within transport are needed.

It is however clear from both sets of figures that the projections show that whilst we shall have made some progress by 2020 in terms of carbon dioxide emissions reduction towards the 60% reduction target, without additional policies, emissions will be about 22% above the linear target path. These figures have been updated again as of March 2005 to show that the government is not on path to reach its 20% target by 2010.

3.2. UK Transport Emissions Projections – DfT, DTI and DEFRA

A main purpose of this exercise was to understand the emissions projections specifically within the transport sector. It was around this topic that much discussion took place in order to understand the main drivers of transport emissions and the potential for policy to mitigate the trends.

The DfT and the DTI presented transport emissions projections derived from their own modelling exercises. Due to different remits for forecasts, the Department for Transport uses a different model for traffic forecasting and emissions figures – the National Transport Model (NTM). The National Transport Model (NTM) is a highly disaggregated 'bottom up' forecasting model which can test a wide range of different policy options and illustrate the main drivers of transport demand. It is based on a variety of sources of data and can test a wide range of transport policies. The DTI Energy Model (Markal), on the other hand, can be categorised as a partial equilibrium model of the UK energy market. The demand side comprises over 150 econometric relationships of historic fuel demand and the supply side comprises data on every major power producer, plant efficiencies, operating costs and fuels and assumptions on future plants. It requires a number of assumptions principally on fossil fuel prices, economic growth and demographics[21]. It provides for a constant whole economy modelling of energy use and associated emissions, of which transport is only a part. These models complement each other but do not necessarily provide the same forecasts. In addition, the different focus of the two models is also reflected in the different coverage – DTI publishes emissions at a UK level and the DfT at an England level.

Based on the DTI model, the DEFRA Climate Change Review consultation document provides the following projections on transport and greenhouse gas emissions:

- Transport (excluding *international* aviation) accounted for 24% of UK greenhouse gas (GHG) emissions in 2002, almost the same as the domestic sector on an end-user basis. These are the second largest sources of UK end-user emissions, after the business sector at about 28%[22].
- Carbon Dioxide (CO_2) accounts for about 80% of emissions from the transport sector[23].
- CO_2 emissions from *road* transport grew by 10% 1990-2000 and they are expected to grow further by another 9% or so between 2000 and 2010[24].

[21] Assumptions are sourced, circulated and approved by OGD and, in the case of EU Emissions Trading Scheme, by public consultation (see http://www.dti.gov.uk/energy/sepn/index.shtml).
[22] This is stated in the text of the CCR on p56 although this is confused by the figures presented on p20 showing transport's share (incl. domestic aviation) as more like 22.4% and the business sector as more like 29%.
[23] P56, CCPR
[24] p56, CCPR

1990-2000

In the text of the DEFRA CCPR report on p.56, CO_2 from *road* transport (end user) is said to have increased by **10%** between 1990 and 2000. It is important to make the distinction between forecasts for *road* transport and *all* transport. Table 6 on p29 of the CCPR shows emissions from *all* transport as having increased by only **5.4%** over this period (from 39.2MtC to 41.3MtC)[25]. The corresponding figure for source emissions for all transport over this period is a **3%** increase (**Table 5**).

A recent informal internal publication by the DfT to the Motorists Forum on Climate Change and Air Quality[26] presents different figures. This observes that carbon emissions from *road* transport grew at about 0.5% per annum between 1990 and 2003[27] (i.e. **5%** over the decade). This is despite a rise in 20% of road traffic in the 1990s, showing that CO_2 emissions from increases in road traffic have been largely offset by improvements in vehicle efficiency.

2000-2010

According to the CCPR, end user emissions from *road* transport are expected to grow further by another **9%** or so between 2000 and 2010**.** As above, it is important to make the distinction between *road* transport and *all* transport. The corresponding end user figure for *all* transport is **4.8%** (41.3MtC to 43.3MtC). The corresponding figure for 'source' emissions (Table 5, p27) is **7%** (*all* transport).

NETCEN data suggests that emissions from *road* transport have levelled off over recent years (**Fig. 3**). This mirrors recent traffic growth which has been relatively slow since 2000, coincident with. It is as yet unclear whether this slow traffic growth is anomalous or start of a new trend. This flattening off has was coincident with static fuel prices, although followed fuel pump prices. It is also coupled with a slowdown in economic and traffic growth. The first two years of this decade may be explained to some degree by the fuel protests in September 2000 which had a marked effect on traffic growth in the last quarter of that year and foot and mouth disease in 2001. The minimal traffic growth might also be explained by the fuel duty escalator which, although removed in November 2000, meant significant increases in the fuel price in the latter years of the previous decade and has a longer run elasticity effect on demand (section 5.1). Reasons for the slow**-**down in 2003 and 2004 are less clear.

In the next half of this decade, however, traffic is expected to increase more rapidly due to a pick up in the economy. An increase in GDP but falling income elasticities have been assumed in the modelling. There may also be continued changes in the composition of the car market as the purchase of large vehicles continues to grow apace. Combined with the absence of the fuel duty escalator potentially leading to the falling cost of travel per kilometre (global oil price rises notwithstanding), these developments may mean that average fuel economy improvements in the car fleet will no longer be able to compensate for traffic growth as they were able to in the previous decade and emissions will grow. However, recent oil price increases may, if sustained, help to restrain emissions growth.

DfT's most recent traffic forecasts were published in The Future of Transport White Paper in July 2004[28]. These suggest traffic growth of around 25% between 2000 and 2010. In light of these projections, together with the realisation of lower than originally predicted fuel efficiency savings (discussed in sections 4.2 and 5.2 below), carbon emissions are expected to grow at about 0.6% per annum from 2000 to 2010 (i.e. about 6% over the decade). Oil prices account for only around 20% of

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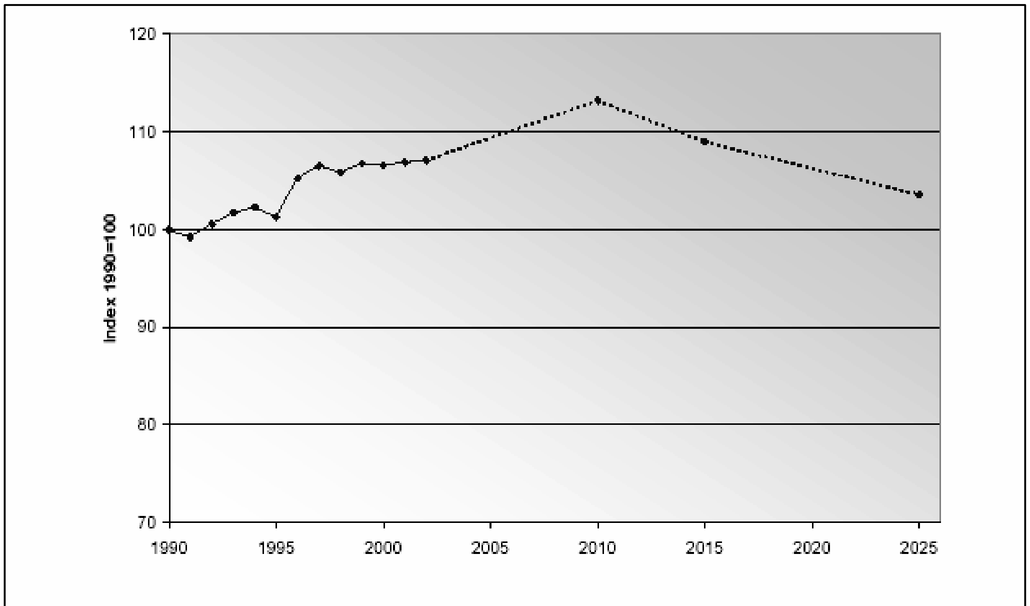
[25] This begs an interesting question about the difference in the projections between *road* and *other* transport emissions. If road transport accounts for ca. 92% of end user domestic transport emissions (calculated from DEFRA 2003 e-Digest of Environmental Statistics Table 5), then for *all* transport to only increase by 5.4% (39.2MtC to 41.3MtC), but *road* transport to increase 10% over this period, the *other* transport component has to have fallen by ca. 48%! Seeing as *other* transport includes aviation, this is unconvincing.

[26] DfT (Cleaner Fuels and Vehicles Division) 2005 Climate Change and Air Quality paper to Motorists Forum (January 2005) MF(22)5

[27] DfT 2005

[28] [3]DfT 2004 *The Future of Transport* (White Paper)

final pump prices. If crude oil prices were to end up about US$5 per barrel higher in 2010 in real terms than DfT current assumptions, they expect traffic forecasts would fall by about 1%.



Source: DfT Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, December 2004[29]

Fig 3: Department for Transport projections for CO_2 from *road* transport 1990-2025

A few points of clarification may be helpful regarding this graph:

- The points before 2004 are actual/ historical figure supplied by NETCEN.
- NETCEN data is based on fuel sales. Forecasts are based on our forecasts of speeds in NTM and a speed-emission curve produced for the DfT by NETCEN based on vehicle testing.
- These are *end user* emissions.
- The graph applies to England only.

Forecast traffic growth, however, does not quite mirror this trend as traffic will increase faster than CO2 due to efficiency savings. The following graph (**Fig. 4**) appears in the Future of Transport White Paper published in 2004 (p44).

[29] Note that this graph is slightly different to the one included in the 2005 DfT paper to the Motorists Forum. In addition to including projections to 2025 as opposed to only 2015, it may be that some of the figures are also different. This is testimony once again to the need for greater clarity on this issue.

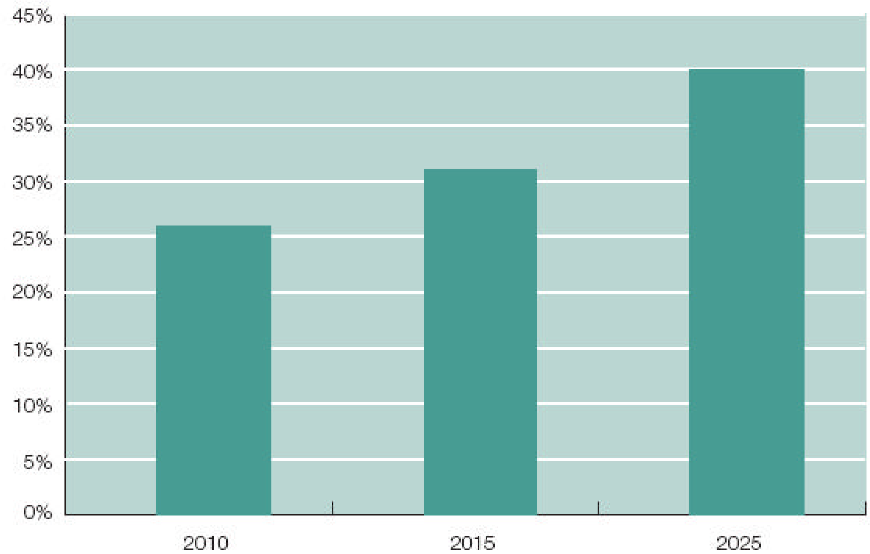
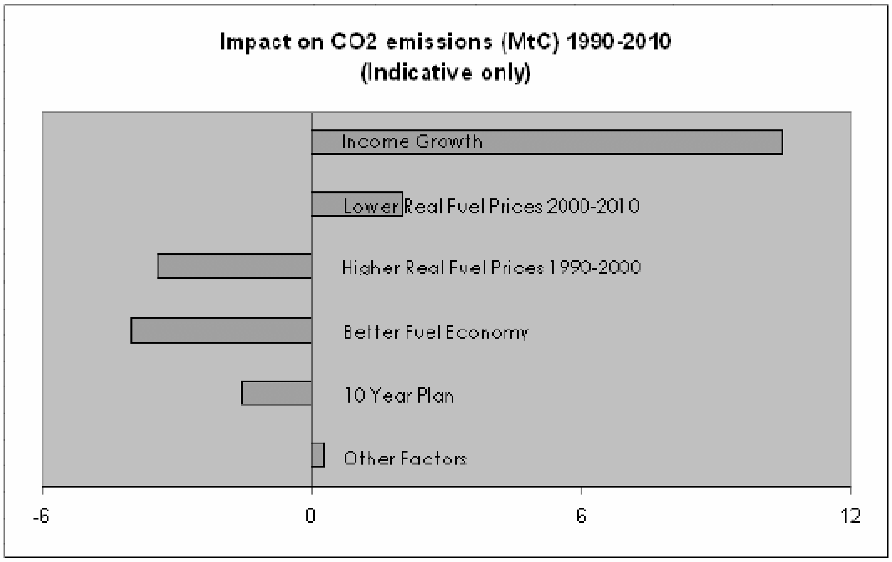


Fig. 4: Increase in traffic from 2000 levels (all roads, England)
Source: The Future of Transport White Paper, DfT 2004, p44

Hence, the key drivers of change in carbon dioxide emissions from road transport through to 2010 are expected to be real reductions in fuel prices combined with economic and income growth, which would more than offset the impact of policies to improve the fuel economy of vehicles. It must be remembered, however, that this graph does not include emissions from aviation. Aviation is the most significant feature in increasing emissions from transport. Despite the fact that the DEFRA emissions inventory shows that *fuel consumption* from aviation has stabilised at 11 Million tonnes of fuel per annum since 2000[30] , another government source shows that recent increases in aviation demand have been adding around 0.5 MT oil equivalent per annum to overall transport use (including international flights – take off only) [31].[32]

The following graph (**Fig. 5**) was presented at the seminar to identify the factors affecting carbon emissions from road transport between 1990 and 2010. Some of the policy assumptions inherent in this graph will be discussed in the appropriate sections below.

[30] http://www.defra.gov.uk/environment/statistics/airqual/aqemissions.htm
[31] DTI EP68 Final at http://www.dti.gov.uk/energy/inform/energy_projections/ep68_final.pdf
[32] This same source shows that motor spirit fuel consumption from road transport has been falling since 1999 (although gas oil has been rising) and we know emissions have increased over the same period (as shown above).



Source: DfT Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, December 2004

Fig 5: Factors affecting carbon emissions from road transport 1990 - 2010

2010-2020

The evidence presented from DfT and DTI, together with DEFRA's CCPR shows that as emissions from most other sectors are forecast to fall, transport's share of total emissions is likely to increase. As shown in **Table 2** above, with the exception of a small increase in the business sector (<3%) and the industrial process sector (<1%), transport is the only sector with higher emissions in 2020 compared to 2000[33]. DEFRA's forecasts of carbon dioxide emissions suggest that transport's share (including domestic aviation) of carbon dioxide emissions (by source) could rise by 4MtC from 26% of total emissions in 2010 to almost 29% by 2020. This amounts to an 11% increase in emissions from transport between 2010 and 2020, while total CO_2 emissions are forecast to increase by only 1% (1.9MtC) over this period.

However, unlike DEFRA, DfT claim the trend changes after 2010 as slower traffic growth and continued fuel efficiency improvements are expected to produce a *fall* in road traffic CO_2 emissions of around 5% between 2010 and 2015 and beyond. **Fig. 3** above illustrates a 'knick point' in 2010 to this effect, whereas the DTI/DEFRA figures have no peak – they continue to rise. After 2010, traffic growth, whilst still growing, is projected to grow at a significantly lower rate than it will to 2010.

Hence the projected fall in CO_2 after 2010 is assumed to come from:

- A slowdown in the fall in motoring costs as fuel prices start rising slowly and fuel consumption rates continue to fall but at a lower rate than to 2010[34], with further falls thereafter[35].
- An ageing population causing:
    - average trip lengths to fall;
    - a corresponding shrinkage in the workforce **-** the proportion of the total population that is of working age is forecast to peak at just under 65%, prior to 2010, before falling to 61% in 2025[36]
- Slower GDP growth;
- Some degree of saturation in car ownership;

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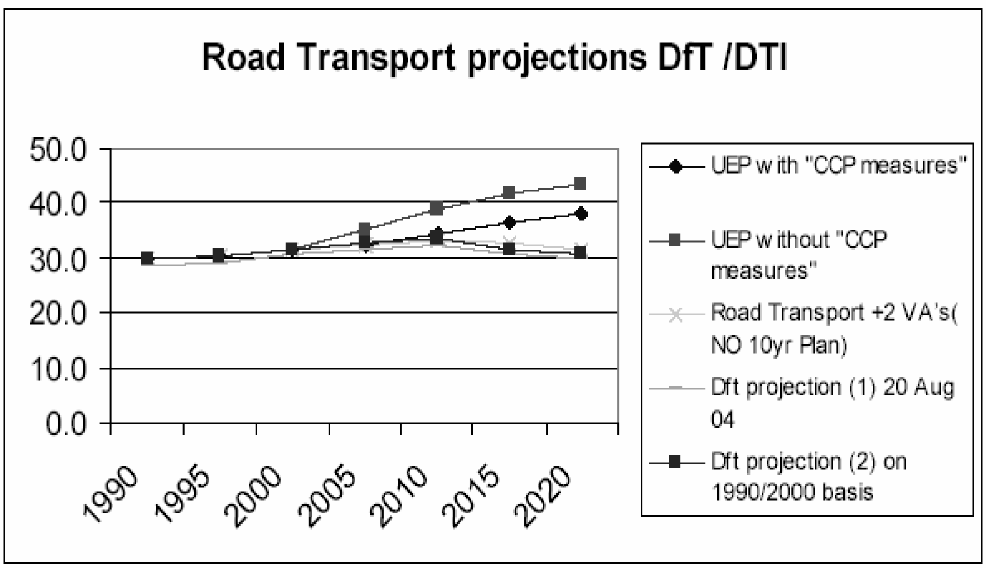
[33] Derived from Table 5, p27. On an end user basis, transport is the only sector expected to have higher emissions in 2020 compared to 2000 (Table 6 p. 27).
[34] DfT 2005
[35] Dft 2004 The Future of Transport (White Paper) DfT available at http://www.dft.gov.uk/stellent/groups/dft_about/documents/divisionhomepage/031259.hcsp
[36] DfT 2005

- Continued fuel efficiency improvements – the fuel efficiency of all vehicles is expected to improve by much more over the latter period (2003-2015) compared to the former (1990-2002)[37]. The estimate is for a 14.5% reduction in average new car fuel consumption between 2003 and 2010 and for a 21% reduction between 2003 and 2015.

The DfT and the DTI have different purposes for their models and therefore make different assumptions. Essentially, the DfT are trying to best represent future transport demand – ie business as usual, and the DTI model is used as basis for comparing the impacts of policies from a baseline. These can be viewed as different scenarios. As a result, a fundamental difference is whether or not policies are included in the models that are assumed to be 'firm and funded'. The DfT modelling assumes, for example, that there will be a second voluntary agreement with car manufacturers after the current one expires in 2008 and that this will have the same effect as the first agreement – although figures have been revised in the light of the slower than expected progress in the average fuel economy improvements of new cars brought to the market in the UK (from 140g/km to 162g/km). By contrast, the DTI energy model only includes policies that are 'firm and funded' and hence does not incorporate further efficiency gains resulting from another agreement after 2008. **Fig 6** below illustrates the difference that including non firm and funded measures can make to the DTI Energy model results for road transport. This difference was said to explain the difference in the results between the DTI and DfT forecasts. As discussed below, however, these results would benefit from some inclusion of sensitivity parameters in order that the importance of certain factors such as the voluntary agreement or fuel price can be understood in relation to the forecasts.



Source: DTI Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, December 2004

Fig 6: 'What if' comparison DTI/DfT – alternative policy assumptions of a second VA (UK)

[37] DfT 2005

Table 5: Summary of the transport emissions projections for each decade (and department) (UK):

	1990- 2000		2000-2010		2010-2020	
	source	end-user	source	end-user	source	end-user
			DEFRA[1]			
Road Transport		+ 10%		+9% or so		
ALL Transport	+3.2%	+5.4%	+7.2%	+4.8%	+10.8%	+6.0%
			DTI[2]			
Road Transport			+9%		+11%	
ALL Transport			+7.2%		+ 10.1%	
			DFT[3]			
Road Transport		+5%		+6%		-5%[4]
ALL Transport						

[1.] *DEFRA 2004 Climate Change Programme Review Consultation Document p29 and p56*
[2.] *DTI 2004 Updated Emissions Projections*
[3] *DfT 2004 The Future of Transport (White Paper)*
[4] *to 2015 at least*

4.0 HOW CONFIDENT ARE WE IN THE PROJECTIONS?

In the seminar and the literature review, a number of queries emerged in the attempt to assess to what extent the projections for transport and CO_2 can be relied upon:

1. **What is transport's contribution to the overall UK emission targets?**
2. **What contribution can specific measures make towards these emission reduction targets?**
3. **What levels of uncertainty exist in the data and should scenario based analysis be used more often in the transport sector?**
4. **What assumptions have been used to derive the emission projections?**
5. **Should there be specific targets for the transport sector?**
6. **What are the projections beyond 2010?**
7. **To what extent is government policy 'joined up?'**

4.1 Transport's contribution to the overall UK emission targets

Longer term projections are naturally beset with uncertainties. Nevertheless, despite the attempts during the seminar and subsequent literature reviews to clarify the situation, the contribution of transport to the overall UK emission figures is still - to some extent - unclear.

For example, it is not clear the extent to which the rising emissions in the transport sector will be responsible for the lack of progress towards the UK domestic target to reduce carbon dioxide emissions by 20% by 2010. Likewise, the figures suggest that the continued increase in emissions from the transport sector could start to raise total emissions again by 2020. If technological developments are not brought on stream, there is a risk that road transport, but definitely air transport, could begin to erode the projected carbon savings expected from energy efficiency savings and increased renewable electricity use. As a result, the consequence of rising transport emissions could be to jeopardize the achievement of a 60% cut in CO_2 emissions by 2050.

It is important that these projections are clarified and the contribution of each sector stated. If we understand the effects of rising transport emissions more clearly, we will be better able to assess whether policies are tough enough to make a difference.

4.2 The contribution of specific transport measures

It is difficult to ascertain from current government policy documents (i) the exact basis of the calculations (ii) what is expected to drive the forecasts and (iii) the absolute and relative scale of the emissions savings expected from individual transport policy measures.

As confirmed in **Fig. 3**, we know that the projected fall off in carbon emissions after 2010 is expected to come from efficiency gains as well as an assumed large fall off in traffic due to an ageing population and a fall in the *rate* of decrease in the cost of motoring[38]. Graphs such as **Fig. 5** and single issue feasibility studies such as that into Road Pricing[39] provide some assessment of the extent to which economic growth, motoring taxes, road charging etc have and could contribute to changes in transport sector emissions. More often, however, transport measures are 'lumped' together to give an aggregated assessment of the savings to be expected from the sector. For example, the Climate Change review (p24) and the most recent DTI figures project 4.42MtC from policies including 'voluntary agreements, the 10YP, sustainable distribution and off road programmes'. There does not appear to have been a systematic assessment of drivers and policy options. This is happening as part of the Climate Change Programme Review and results should be made public at the end of 2005.

An assessment of the absolute and relative scale of the emissions savings expected from individual transport policy measures is needed.

4.3 Uncertainty in the data – lack of sensitivity analysis

The balance between average fuel efficiency and traffic levels in future years is critical to predictions of future road transport and energy use. Yet, there are real uncertainties surrounding both of these elements. Although the individual government departments do publish ranges around traffic and CO_2 forecasts and they stress there will be some inevitable uncertainty in the forecasts, the considerable range of uncertainty surrounding the assumptions used to derive the transport projections is not always acknowledged. This seems particularly relevant at the moment as global oil prices are rising beyond the figures assumed in the forecasts.

Fuel costs fuel efficiency and demographics seem to be the main drivers of change in traffic forecasts. The forecast for traffic growth is largely based on the assumption that car fuel costs will fall by 29% by the end of the decade due to a combination of improvements in fuel efficiency as well as a reduction in real fuel price from the peak in 2000. However, the oil price may prove to be higher throughout this decade than forecast – it is currently forecast to be between $20 and $23 dollars a barrel between 2010 and 2020 in the DTI model[40], although DTI are using oil price projections considerably above this for the current Climate Change Progamme Review work. Brent averaged $42 for the 6 quarters from Q1 2004 to Q2 2005 and some commentators believe the barrel price will not come down much below its price in 2004/05 of around $50 a barrel. Indeed, some commentators are predicting at least $100 a barrel in the next couple of years. However, questions asked during the research for this paper have clarified, as mentioned earlier, oil prices account for only around 20% of final pump prices and a US$5 increase in per barrel price above that assumed in the forecast for 2010 in real terms would see traffic forecasts fall by about 1%.

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[38] DfT 2005
[39] DfT 2004 Feasibility study of road pricing in the UK http://www.dft.gov.uk/stellent/groups/dft_roads/documents/divisionhomepage/029798.hcsp
[40] DTI 2004 – UEP November 2004 Addendum Projections beyond 2010 Annex 2a

The differences between the departments with respect to the inclusion or not of 'firm and funded' policies has been highlighted. However, why something is or is not considered to be firm and funded by the DfT is not clear. For example, a secondary Voluntary Agreement beyond 2008 is regarded as highly likely and is therefore included, even though this is not guaranteed and is out of the DfT's direct control. In addition, it is assumed that some policy measures outlined in the 10YP will be implemented, despite the fact that there is little evidence to suggest that this is the case. One example of this is local congestion/ cordon charging. It was clear from the seminar, that even though the importance of congestion charging has been scaled down to some extent in the DfT traffic modelling exercises, an optimistic outlook (8 cordon charges by 2010) is still being used. Conversely, a recent report outlining the potential for 'smart measures' which set out the evidence base for a potential reduction in national traffic of up to 11% over the next decade through softer, voluntary travel behaviour change measures[41], has not been incorporated with the same level of optimism.

When queried on these points, the following explanations were given:

- DfT are forecasting a 'best view' of the future on a 'business as usual' basis. DTI needs to establish a baseline for the purposes of the Climate Change Review.
- Local cordon charging schemes as modelled have only a very small impact on traffic and emissions.
- With regard to 'soft' measures, policies to 'lock in' the benefits of smart measures at a societal level (so as to avoid the induced traffic effects generated by freeing up road space) could not be guaranteed. In addition, because DfT are forecasting business as usual based on current funding levels they need to take a conservative approach to whether smarter choices can be scaled up and the traffic savings really achieved. In addition, not all types of smart polices (such as teleworking) can yet be modelled.

One of the key elements in the forecast for future road transport CO_2 *emissions* concerns the assumptions about future vehicle fuel efficiency. These estimates have also been revised downwards as slower than expected progress with the Voluntary Agreement mean that fuel efficiency gains assumed in the forecasts may not materialise by 2008. The improvements in fuel efficiency and reduction in CO_2 emissions may still prove inaccurate even though they have been revised downwards. The problems with the VA projections are discussed in section 5.2 below.

The effect of the VA and the policies in the 10YP are combined to provide one overall indication of potential emissions savings (4.42MtC by 2010[42]). However, the sensitivity of the forecasts to balances between the price of oil, fuel efficiency, fuel duty and other motoring costs need to be made explicit in order to have confidence in these projections. These forecasts include rebound effects from improvements in car fuel economy. Other second order effects such as the longer term locational choices made if the real cost of motoring declines, are possibly greater in transport than any other sector. Where sensitivity tests are carried out, these are not made explicit in the published data.

In addition, there is insufficient use of scenario based analysis in transport and climate change policy. The DTI have carried out some scenario based projections for the longer term forecasts to 2050 (using Inter-departmental Analysts Group (IAG) scenarios) and there is currently some work being undertaken within the UKERC (Paul Ekins) to review scenario analysis in energy studies. Some studies have used future scenarios for the UK with a focus on carbon emissions and an attempt to simultaneously evaluate innovative packages of policies. The role that transport was expected to play in achieving the 60% reduction varied among the various studies and scenarios evaluated[43]. There were differences in both the magnitude of the expected role and the combination of the different measures used to achieve the reduction. However, very little work appears to have been done within

[41] Cairns, S; Sloman, L; Newson, C; Anable, J; Kirkbride, A and Goodwin, P (2004) Smarter Choices – Changing the way we travel report for the UK Department for Transport July 2004
[42] DTI 2004 – UEP November 2004 Addendum Projections beyond 2010 Annex 2a
[43] Foley,J and Fergusson,M 2003 Putting the Brakes on Climate Change: A policy report on road transport and climate change. IPPR, London; Pridmore,A,, Bristow,A, May,T and Tight,M 2003 Climate Change, Impacts, Future Scenarios and the Role of Transport. Tyndell Centre for Climate Change Research Working Paper 33.

the DfT in particular to include a range of scenarios of future policies. This may be addressed by current work taking place as part of the DfT Horizons project by Prof Banister *et al* at University College London. Likewise, the synergies between policies have been poorly addressed. Given the instability in the projections, policy development may benefit from being able to draw upon official scenario analysis.

Data and projections need to be presented, at least occasionally, alongside sensitivity and scenario analysis identifying key assumptions such as traffic growth, the price of oil and vehicle efficiency expectations as well as the potential synergistic effects of policies.

4.4 Clarity of the assumptions used

Although this is a complex area, the underlying assumptions underpinning the forecasts are not transparent and can therefore lead to confusion. Linked to the above point, the figures give no idea of a range of error or attempt to offer a range of forecasts based on scenario analysis. As assumptions and the modelling outputs are under constant review, making the assumptions more explicit would help to clarify the reasons for the differences between forecasts from year to year and from department to department.

It should be transparent whether changes to the expected outcomes of the 10 YP are the result of changes to the model or from changes to the inputs and assumptions. The data used and the underlying assumptions made must be clear and well communicated throughout published data.

4.5 Specific targets for transport emission reductions

Within the overall targets for reductions in greenhouse gas emissions, there are no specific targets for transport. In addition, there are no interim targets between now and 2010 and up to 2050 in order to get away from the linearity suggested by the Kyoto and domestic 60% targets and to be aware of the 'points of no return' figures (Global Commons Institute) to avoid locking ourselves out of higher targets.

Specific targets for emissions reductions in each sector could be considered. These would allow an assessment of the degree to which transport is on track to reduce emissions. In addition, interim targets will sharpen awareness of 'points of no return' with respect to GHG atmospheric concentrations. On the downside, however, sector-specific targets could involve a movement away from abating carbon in a least-cost way if transport policies are proven to be less cost effective.

4.6 Insufficient focus on longer term projections beyond 2010

Although the DTI produce projections beyond 2010[44] and DfT to 2025, there is limited discussion of projections beyond 2010 in the published data. However, any discussion on which policies to develop and their potential effectiveness is dependent on the target being pursued. The more demanding the target, the more substantive the reduction in emissions required. For example, in the period to 2010, technological advances in fuel efficiency may be enough to secure savings from the transport sector with little behavioural adaptation. However, if the 60% reduction target by 2050 is being evaluated, it may be less likely that technology can be relied upon on its own (discussed in S.7.0).

[44] DTI 2004 – UEP November 2004 Addendum Projections beyond 2010

This is especially important given the time that it takes to change policies and affect outcomes. In addition, the more targeted the reduction, the more defined, costly and time consuming the transport policy changes may need to be.

There is a need to develop long term thinking on transport – not just to 2010 but right up to 2050.

4.7 Conflicting objectives

The 10YP emphasised government targets/ projections for the reduction of *congestion*. It is not yet clear what the relationship is between emissions projections and those for congestion. As congestion reduction does not necessarily involve traffic reduction, this could suggest that the government believes it can let traffic grow whilst still being able to hit all other targets. Therefore the government should clarify how important the CO_2 targets are in relation to other environmental priorities and in relation to other policy objectives such as safety and accessibility. For example, industry is faced with conflicting objectives such as measures to clean exhaust emissions which work against measures to improve CO_2, as do vehicle design standards (e.g. safety enhancements) which add to vehicle weight and emissions. Also, there is little evidence as to the implications of pollution standards and safety requirements for public transport operating costs and fares – and therefore patronage. In addition, increases in average HGV loadings, whilst potentially positive in terms of congestion and air quality, are potentially negative in terms of road maintenance.

The degree to which the explicit aim of transport policy to reduce congestion is in conflict with emission reduction targets needs to be assessed. In addition, there are some counterproductive policies at work in the transport sector and between sectors which are in need of further evaluation.

5.0 IS THE TRANSPORT SECTOR PULLING ITS WEIGHT?

There was much discussion in the seminar relating to the extent to which the transport sector should employ traffic reduction strategies in proportion to its share of energy and greenhouse gas emissions. At the moment, in the absence of sectoral targets, those interpreting the emissions forecasts and targets might assume that the 60% target applies to all sectors equally. If this is the case, the consequence of transport 'not pulling its weight' in the climate change programme could be to jeopardize the achievement of an overall 60% cut in CO_2 emissions by 2050. For the transport sector to 'pull its weight' in this context, it would mean that it was making progress towards the 60% reduction target from the 1990 baseline. It is not taken to mean reducing transport emissions with respect to a business as usual projection.

Perhaps understandably, DfT representatives feel that it is unfair to describe transport as not pulling its weight. The Department cites the fact that projected carbon savings from the transport sector are higher than many other sectors (due mainly to the Voluntary Agreement) (**Fig. 1**). In addition, the fact that carbon abatement may be more expensive in the transport sector is said to be evidence that it is more than pulling its weight.

However, as stated above, although the DfT are predicting a fall in road transport emissions of 5% between 2010 and 2015, projections beyond this date are unclear. If technological developments do not materialise, there is a risk that road transport, but definitely air transport, could begin to erode the projected carbon savings expected from energy efficiency in other sectors and increased renewable electricity use.

Given the magnitude of the forecast increases in international air travel and the fact that there are few, if any, compensatory technological developments in this sector, the credibility and the degree of challenge embedded in the targets for transport CO_2 reduction are especially dependent on the extent to which aviation is included in the figures. Given the fact that air travel is the fastest growth area of energy demand and this growth could wipe out savings from all other sectors of demand, leaving it out of the official emissions projections renders all other emissions targets almost meaningless. In addition, omitting aviation makes it more likely that the implications of the resulting rise in energy demand may simply be overlooked. However, to include international aviation in a 60% transport emissions target will mean that the road transport sector may have to take on an even bigger share of transports emission reductions – such as a 90% reduction in energy use.

The 60% target may itself be inadequate to prevent climate change. The current atmospheric concentration of CO_2 is about 371ppm[45] or more[46]. A stabilisation target of around 550ppm has come to be seen as the upper bound. Climate models suggest that even if stabilisation at this level were to be achieved, global temperatures could still rise by around 2^{o}C by 2100, leading others to support stabilisation at 450ppm or even lower, implying an 80% reduction[47]. In addition, the stabilisation target only refers to CO_2. If other greenhouse gases are included then the 'safe target' for CO_2 alone would be below 550ppm. What is more, the Global Commons Institute proposes that the reduction will have to be achieved according to an agreed framework which it has called Contraction and Convergence which aims to distribute emissions reduction on an equitable basis[48]. Under this framework, emissions from developed countries would decrease most, while those from some developing countries would be allowed to rise.

So what policy instruments are either in place or on the horizon in the UK to effect a reduction in energy use from surface transport?

A DfT presentation at the seminar classified the most important policy levers currently influencing energy use from transport into the following sources of energy demand from road transport:

1. Traffic levels (activity/ the amount of travel) – including switching to less intensive modes.
2. Fuel economy
3. Fuel Carbon Content

The following policies were presented and came out of the discussion as the main levers currently in place for reducing energy and emissions from transport. This is not a comprehensive overview of all the available policy options, but the following list represents those that the government believe to be the most effective in their current 'toolkit' and those which generated some debate at the seminar:

5.1 Fuel Duty

In the latter years of the previous Government and the early years of this Labour Government, the fuel duty escalator was employed as a price signal for helping to reduce traffic and CO_2 emissions. The Fuel Duty Escalator was introduced in 1993 when fuel duty was increased by 10% with a subsequent 3% annual increase above inflation, rising to 5% in 1995. This was increased to 6% in 1997 by the new Labour Government. The fuel duty escalator was removed in November 2001 with no duty rise beyond the automatic inflation rise of 2p per litre. In 2002, all road fuel duty was frozen (no inflation rise); in 2003 it rose in line with inflation and in 2004 and 2005 road fuel duty has been frozen.

The policy of increasing fuel tax counteracted falls in the underlying price of oil and apparently contributed to a significant slowing of traffic growth over about two years, despite strong economic

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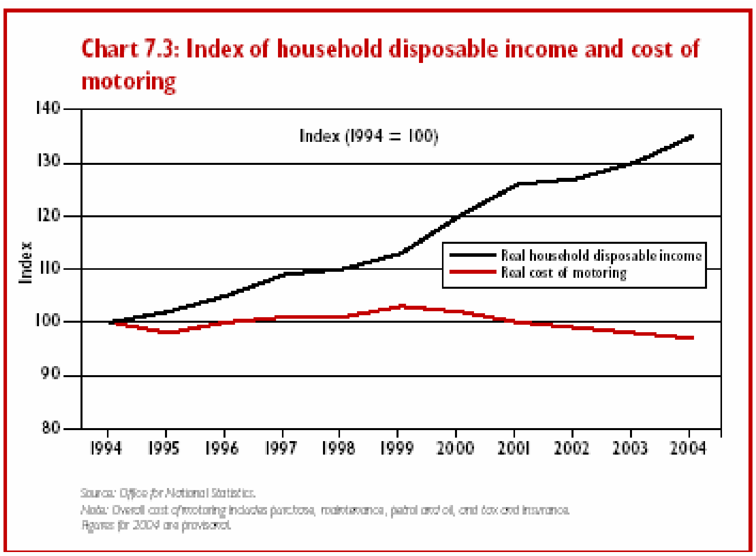
[45] DEFRA 2003 The Scientific case for setting a long term emissions reduction target available at http://www.defra.gov.uk/environment/climatechange/ewpscience/ewp_targetscience.pdf
[46] Global Warming Spirals Upwards The Independent 28th March 2004
[47] Bristow,A et al 2004 Low Carbon Transport Futures: How acceptable are they? Paper presented at World Conference on Transport Research 4-6 July 2004, Istanbul
[48] Global Commons Institute GCI Briefing: Contraction and Convergence available at http://www.gci.org.uk/

growth during this period. Between January 1998 and July 2000 the fuel price rose by 23% above inflation. The increases in duties between 1996 and 1999 are estimated to have produced significant annual carbon savings of between 1 and 2.5 MtC[49]. Analysis by Professor Stephen Glaister at Imperial College, London (2001) shows that assuming a longer term traffic price elasticity of -0.3, this rise would be expected to reduce traffic by about 7 % over the two and half years or an average of 2.8% per year. This is of the same order as the increase that would be expected as a result of economic growth[50].

There was, however, some debate at the seminar as to the effectiveness of increases in fuel prices. In particular, it was pointed out that the rate of growth in traffic has declined *since* the fuel duty escalator was *removed*. For example, in 2001, pump prices fell by around 20% but the underlying growth in traffic fell to 1.2%[51]. The distinction must be made, however, between short term and long term effects. In addition, it is clear that underlying factors such as economic growth, the barrel price of oil and total real costs of motoring (also compared to the costs of other forms of travel) are as important as the fuel duty itself. In addition, road capacity did not increase during this time. Glaister's research found that the demand for fuel is affected not only by its price but also by disposable income. In the long run a 10% increase in income will increase fuel demand by 11%.

The presentation by the HM Treasury representative at the seminar showed that the whole cost of motoring has remained broadly constant over the past decade, declining in recent years as shown in **Fig. 7.** Since 2000, duty on main road fuels used in the UK has fallen in real terms by nearly 12%, a saving equivalent to nearly 6 pence per litre for motorists, while the cost of motoring overall has also fallen to below 1994 levels, in part owing to increasing fuel efficiency[52]. Over the same period, household disposable income has steadily increased, with average motoring costs therefore accounting for a smaller share of disposable income.



Source: *Source: HM Treasury Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, Dec 2004*

Fig 7: Index of household disposable income and cost of motoring

[49] DETR 2000 Climate Change Draft UK Programme Chapt.5 Transport

[50] Glaister S (2001) UK Transport Policy 1997-2001. Paper delivered to the Economics Section of the British Association for Science, Glasgow, 4th September 2001

[51] Quoted from the DTLR's Transport Statistics bulletin - Traffic in Great Britain Q4 2001 "The rate of motor vehicle traffic growth has varied in recent years. Between 1985 and 1990 it grew rapidly, by over 6% per year on average. Traffic growth then slowed to less than 1% per year between 1990 and 1994, before rising to about 2% per year between 1994 and 2000. Between 2000 and 2001 it increased by 1.2%. It is estimated that this is also the underlying rate, after the effects of special factors, such as the September fuel protests and foot and mouth disease in 2001 are removed" – cited on the Association of British Manufacturers website http://www.abd.org.uk/pr/319.htm

[52] Budget 2005 Chapter 7: Protecting the Environment

Glaister's research also concluded that both long and short term effects of petrol prices on traffic levels tend to be less than their effects on the volume of fuel burned. A 10% increase in the price of fuel will cause the volume of traffic to fall by 1.5% in the short run and by 3% in the long run but the equivalent long run fuel consumption saving figure is 7%. To hold traffic constant against 2.5% pa underlying growth, fuel price must increase by 8% pa above inflation and to hold emissions constant, fuel price must increase by 3.5% pa above inflation. Raising fuel prices is therefore more effective in reducing the quantity of fuel used than in reducing the volume of traffic. Therefore, increasing fuel price could provide an incentive for the purchase and therefore the production of more fuel efficient vehicles. This analysis, however, emphasises the price of fuel and neglects the importance of information provision and retailing as discussed in section 9.2.

In any case, the negative publicity from the UK 'Fuel Protests' in September 2000 means that it is highly unlikely that any government will use (fossil) fuel duty as a price mechanism for reducing traffic and CO_2 emissions for the foreseeable future. The political sensitivity of not increasing fuel taxation is present in the Government's policy which is committed to keeping fuel duty levels roughly the same in real terms in the period to 2010[53]. Nevertheless, in the 1993 Pre Budget Report, the Chancellor announced a three-year rolling horizon on duty *differentials* for alternative fuels. This included biofuels as well as road fuel gases (RFGs). RFGs currently benefit from very low duty rates making them around half the price of petrol and diesel. The three year certainty in the Alternative Fuels Framework aimed to provide market stability for alternative fuels. This could be compared to Germany, however, where a 20 year certainty has been granted.

A frequent assertion made in the seminar was that proper carbon pricing is clearly central to both developing and deploying technology and clear price signals to travellers can be an effective measure in behaviour change. However, there is much work to be done and the following areas were discussed as requiring further consideration:

- Research shows the impossibility of sustainable mobility without efficient price signals[54]. Subsidies for the so called clean alternatives will have little effect unless the 'dirty' status quo is clearly marked with taxation.
- Even a stiff carbon tax would still leave the price of road fuels relatively unchanged because it is already heavily taxed.
- Rapid introduction of low CO_2 vehicles and fuels will require grants and or tax incentives on a major scale and will erode the large tax base in road transport – the effects of this require further research[55], particularly in the context of assessments for the feasibility of a national congestion charging scheme.
- Such a measure could have disproportionate effect on lowest income groups who are least likely to be able to afford to purchase these vehicles.

5.2 The Voluntary Agreement

In 1998 the European and the European car industry represented by the European Automobile Manufacturers Association (ACEA), together with the Japanese (JAMA) and Korean (KAMA) manufacturers associations, reached a non-legally binding agreement on the reduction of tailpipe CO_2 from new passenger cars sold in the EU. Alongside fiscal frameworks in each member state and a fuel economy labelling scheme, the VA is the main mechanism for encouraging the design of cleaner cars. It commits ACEA to:

- achieve a European Fleet average CO_2 emissions figure of 140g/km by 2008 for all new passengers cars sold in the EU.

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[53] In the 2005 Budget, even the inflation-only increase of main road fuel duties was deferred until September 2005 and in July 2005 the government announced that it will not even go ahead with the planned inflation increase in fuel duties on 1 September - including for rebated oils, biofuels and road fuel gases. The position will be reviewed again at the time of the Pre-Budget Report.

[54] Potter *et. al.* (2004) *Taxation Futures for Sustainable Mobility Final Report* available at: http://www.psi.org.uk/ehb/projectspotter.html

[55] ibid.

- bring to the market individual car models with CO_2 emissions of 120g/km or less by 2000.

Given that cars sold in Europe in 1995 emitted on average 186g/km, a reduction to 140g/km means cutting emissions by 46g or 25%. The achievement of this target would contribute about 15% of the total emissions reductions required from the EU under the Kyoto protocol[56] assuming that car mileage would grow by 2% p.a. and that, without the agreement, average new passenger car CO_2 emissions would have stayed at the 1998 level[57].

However, others argue that the target of 140g/km falls short of the emission reductions necessary in the transport sector and is not even likely to stabilise CO_2 emissions from passenger cars at the 1990 level by 2010[58]. For example, analysis carried out by the Dutch government demonstrated that most of the VA's impacts had already been assumed in the official business as usual projections and as a benchmark, the contribution of the VA to the specific Dutch CO_2 reduction target will be just over the contribution of measures for raising tyre pressure of Dutch cars[59].

By contrast, in the seminar, it was pointed out that the VA *package*, which includes company car tax and graduated VED changes, was the largest single contributor to the CCP 2000.

Advocates of the VA claim that it has demonstrated that soft intervention, and the threat of regulation, can play an important role in encouraging car manufacturers to invest in more fuel efficiency technologies and lighter weight designs[60]. The European Commissions 5th annual monitoring report on the VA[61] showed that average new car CO_2 emissions fell by over 20g/km between 1995 and 2003.

Regardless of whether these improvements would have happened anyway, there is some doubt that car manufacturers are on track to meet the 2008 target and in the final period of the commitment may have to accelerate their efforts. For example, provisional figures for 2004 show the European industry produced an average efficiency of 160g/km, down only 1.8% on the previous year. This is only half the annual rate of improvement needed to meet the 140g/km target[62].

The growth in sales of diesels have made it easier for companies to meet their intermediate targets and is likely to contribute greatly towards reaching the 2008 final target. Diesel has grown from 14% of European vehicles in 1990 to 44% in 2003 and is expected to grow to 52% of market share by 2007[63]. There is some political expectation that a new VA after 2008 with a target of 120 g/km of CO_2 could be reached for the average new car fleet early in the next decade and a more ambitious target for new car fleet average in 2020 of 100g/km. While diesel sales have allowed companies to make progress toward the 2008 target of 140g/km however it will not be possible for the sale of these vehicles alone to advance them to the proposed 2012 target of 120g/km.

Moreover, the target and these figures are for a European fleet average. There are no specific targets for individual European states, and individual member states are performing differently. There has been some suggestion, including in the seminar, that the UK is the 'dirty man of Europe'. **Table 6** shows the success to date in reducing carbon dioxide emissions from new cars in the UK.

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56 Kageson,P (2005) *Reducing CO_2 Emissions from New Cars* European Federation for Transport and the Environment Position paper for European Federation for Transport and Environment

57 European Commission and ACEA 1998 *CO_2 emissions from cars. The EU Implementing the Kyoto Protocol* Brussels (pamphlet)

58 World Wildlife Fund (WWF) (undated) *Will voluntary agreements at EU level deliver on environmental objectives?*

59 The Dutch Ministry of Environment (1999) *The Netherlands' Climate Policy Implementation Plan* The Hague

60 Foley,J and Fergusson,M (2003)

61 European Commission (2005) *Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Fifth annual Communication on the effectiveness of the strategy* Brussels, 22.6.2005 COM(2005) 269 available at: http://europa.eu.int/comm/environment/co2/report/com_05_269.pdf

62 European Federation for Transport and Environment News Release 11th May 2005

63 An,F and Sauer,A (2004) *Comparison of passenger vehicle fuel economy and greenhouse gas emission standards around the world* prepared for the Pew Centre on Global Climate Change

Table 6: Average new car carbon dioxide emissions in the UK 1997-2004

Year	Average carbon dioxide g/km (figures for EU-15)	y/y % change	% Change on 1997
1997	189.8 (182)	-	-
1998	188.4 (180)	-0.70%	-0.70%
1999	185 (176)	-1.80%	-2.50%
2000	181 (172)	-2.20%	-4.60%
2001	177.6 (167)	-1.90%	-6.40%
2002	174.2 (166)	-1.90%	-8.20%
2003	172.1 (164)	-1.20%	-9.30%
2004	171.4 (n/a)	-0.40%	-9.70%

Source: SMMT UK New Car Registrations by CO_2 performance (2004), European Commission (2005) an d Guardian 14th April 2005

In the UK, it has taken six years to reduce carbon dioxide emissions by 17.7g/km. As a result, only four years remain to reduce carbon dioxide by a further 32g/km to fulfil the agreement of 140g/km – although it must be remembered that the 140g/km target is at the EU level and is not country specific. Nevertheless, translates into an average fuel efficiency improvement of almost 8g/km in each of the next 4 years – a rate of improvement 11 times faster than in 2004[64]. It is looking very unlikely that the UK will achieve this.

To give an indication, in 2003, just 15.5% of new cars in the UK had already reached 140g/km, up from 14.9% in 2003 and a new car on average emitted 172g/km[65] compared to the EU(15) average of 164g/km[66]. Emissions of CO_2 had fallen steadily for six successive years up to 2003 – but the improvement ground to a near standstill in 2004 due to the increase in sales of larger cars. Although average emissions from new company cars, which accounted for 53% of sales fell by 1% to 169g/km, (suggesting that reforms to the company car tax regime are having some success (section5.4)), average emissions from new private cars actually increased by 0.3% to 174.2g/km. One of the main reasons is the growing demand for 'people carriers', four wheel drive vehicles and sports cars. Together these accounted for 14.8% of sales in 2004, up from 13% in the previous year. At the same time, after years of growth, sales of 'super minis' fell slightly. The CO_2 figures would have been worse still had diesel vehicles not captured 32.5% of the market in 2004, up from 27.3% in 2003 and 16.7% in 1997. Sales of electric petrol hybrids such as the Toyota Prius more than doubled, but still totalled less than 2500 cars in 2004.

The original expectations for savings in the UK were overoptimistic. The Transport Select Committee[67] was told that the original expectations were for a reduction of between 2.6 and 5.9MtC and a figure in the Transport White Paper and the Energy White Paper [68], was given as 4MtC by 2010. Savings of closer to 2.6 MtC are now expected[69]. This is echoed in DEFRA's CCR which claims a total saving from all transport policies (Voluntary Agreements, 10YP, Sustainable Distribution and Off Road Programmes) of 4.42 MtC[70]. Further improvements are forecast in the UK average figure by 2008, although on current progress it is unlikely that the UK itself will reach the 140g/km figure by that date nor the UK Powering Future Vehicles target that by 2012, 10% of all new car sales will be cars emitting 100g/km carbon dioxide or less at the tailpipe[71].

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64 ENDS report 363, April 2005, p10
65 Society of Motor Manufacturers and Traders Ltd (SMMT) (2004) *Annual Report: UK New Car Registrations by CO_2 Performance*
66 European Commission 2005
67 House of Commons Transport Committee 2004 Cars of the Future 17th Report of Sessions 2003-04
68 DTI (2003). Our Energy Future . Creating a Low Carbon Economy. Energy White Paper Department of Trade and Industry available at http://www.dti.gov.uk/energy/whitepaper/index.shtml
69 House of Commons Transport Committee 2004 Cars of the Future 17th Report of Sessions 2003-04
70 p24
71 DfT (2002) Powering Future Vehicles Strategy available at http://www.dft.gov.uk/stellent/groups/dft_roads/documents/pdf/dft_roads_pdf_506885.pdf

Apart from Sweden, where emissions from new registrations have continued to stay far above those of all other Member States and have not declined since 2000 (Sweden's figure for 2003 was 198g/km[72]), progress in the UK has been slightly slower than the EU average for a number of reasons. These include:

- the UK car market has traditionally been weighted towards larger vehicles
- the UK baseline figure for 1995 was higher than the EU average
- in the intervening period, the UK has experienced considerable economic growth, as a result of which consumers have been able to afford generally larger, less efficient vehicles.

Progress at the European level is also stalling. There has been a recent upward trend in several EU member states (including Austria, Luxemburg, Ireland and Germany). This prompted Jos Dings, Director of European Federation for Transport and Environment to say *...the car industry has been putting most of its effort into marketing bigger, heavier, more powerful cars – this strategy is incompatible with the Commission's stated target of 120g / km [for 2012] and these new figures appear to prove that*[73].

In addition, vehicle manufacturers warn that the Commission's political goal of achieving average new passenger car CO_2 emissions of 120g/km by 2012 is unsustainable. They argue that it would require a rapid increase in reductions between 2008 and 2012 which would have a negative impact on the industry leading to lower employment levels and higher vehicle cost.

Therefore, a long term framework and effective mechanism post-2008 is needed that can drive standards down further. This means, among other things, an even more ambitious target for a second VA beyond the current 2008 target. Quantitative targets must be ambitious enough to have an impact on the sectors' behaviour. They should go beyond business as usual so they can affect future investment decisions and spurt technological development. As the WWF stated: 'The starting point for negotiations should be how great the GHGs emissions reductions needs to be delivered by the agreement, and not how much industry thinks it can or wants to deliver'[74].

The following factors emerged out of the discussion as needing to be considered when evaluating the extent to which the VA is an effective way of ensuring that the transport sector pulls its weight in energy and emissions reduction strategy:

- The VA only refers to *average* emissions from new cars in the EU car fleet. The target only refers to new cars entering the fleet, whereas the overall composition of the car fleet and the rate of replacement of old cars determine the fleet average so that the fleet average is slow to reflect new improvements.
- There are no **targets set at a national level** for individual member states.
- Car manufacturers are under **no legal obligation** to adhere to the emissions standards. The agreement does not contain sanctions for non-compliance and measures to address the issue of free-riders although Motor manufacturer associations (ACEA, JAMA and KAMA) may have their own burden sharing agreement to stop free-riding.
- The VA could be **combined with further fiscal measures** to stimulate greater consumer demand for very fuel efficient car technologies such as hybrid-electric cars.
- There have been calls for a European wide carbon dioxide trading scheme aimed at bringing average new car emissions down to 100 g/km. This would be achieved through tradeable permits for fleet average emissions
- There are particular reservations about the fuel efficiency projections for goods vehicles. Unlike cars, **there is currently no standard measure for quantifying the CO_2 emissions from light goods vehicles (LGVs) and heavy goods vehicles (HGVs) (and buses)** and there are no targets for these. A major stumbling block is that there has been no requirement to even

[72] Kageson (2005)
[73] European Federation for Transport and Environment News Release 11th May 2005
[74] WWF (undated) Will voluntary agreements at EU level deliver on environmental objectives?

measure the CO_2 emissions from vans in the same way there is for cars. However, there is an adopted amendment to the EC Directive - requiring the CO_2 of cars to be tested and reported and that extends this Directive to vans.

- Environmental groups strongly argue that target levels of an extended VA should be set at a level which helps Member States and the EU to meet their **overall GHG reduction targets.**
- The agreements objective is not sufficiently ambitious to **support a technological shift from the current internal combustion engine to new technologies**, such as methanol or hydrogen-based fuel cells.
- With a future increase in market penetration of biomass based fuels and hydrogen, there is a strong case for considering reformatting future agreements on the basis of **well-to-wheel (W-T-W) emissions**. A target based on tailpipe emissions could risk providing perverse incentives to increase W-T-W emissions (for example if Hydrogen was produced using carbon intensive 'upstream' sources). Future agreements could incentivise and account upstream for the use of alternative fuels. This could be reflected in subsequent agreements in the carbon content of the fuels.
- Improvements in fuel efficiency are expressed in terms of test cycle results whereas it is well known that real on-road emissions differ significantly from these because the test cycle poorly reflects real driving conditions. The predicted increases in congestion is one reason to suppose that they may diverge further and that anticipated improvements in average emissions may not fully happen. In addition, the specific fuel consumption measured according to European Directive (93/116/EC) does not include fuel used for powering electric equipment such as headlights, electrically warmed seats or air conditioners. The direct effect on fuel consumption of using an air conditioner, for example, is between 10 and 15%.[75]. Hence, the robustness of the agreements as climate change policy instruments is seen at risk if numerous accessories curb increasing vehicle efficiency. **If the European drive cycle is to reflect as closely as possible actual use on the road, it will need to include the use of mobile air conditioning and other equipment.**
- Achieving a target of 120g/km of CO_2 would require a greater proportion of new car sales to be smaller, lighter weight diesel models. It may also require greater uptake of very fuel efficient, new car technologies such as hybrid-electric cars. However, low carbon cars are already available on the market but people are generally not choosing to buy them. Encouraging the development and manufacture of further niche vehicles which are low carbon but only purchased by a small minority will not generate a mass move to low carbon cars across the market. There is not enough understanding of how to motivate consumers and stimulate the purchasing of alternative/ lower carbon vehicles. Therefore, there is a need to **understand consumer choice and encourage purchasing of these vehicles** through measures such as **consumer information and education,** tax incentives and purchase grants, car labelling (section9.2) and the development of mass market hybrid-electric cars.

5.3 Sustainable Distribution

Relatively little attention was afforded in the seminar to 'true' issues of sustainable distribution with respect to improved logistics, regional distribution centres and efficiency gains. Likewise, there was little time to discuss the switch from road to rail freight. Instead, some mention was made to Lorry Road User Charging as a fiscal government instrument which at the time of the seminar was still government policy, but has subsequently been cancelled. As an example fiscal instrument, however, it is still worth discussing.

Lorry Road User Charging (LRUC)

In April 2002 the Treasury and the DFT announced that a UK wide road user charging scheme for all lorries (including foreign ones) would be introduced. The aim is to ensure that all those using HGVs on UK roads should contribute at a level that reflects the costs they impose on the UK. However, in

[75] Kageson,P 2005 Reducing CO2 Emissions from New Cars European Federation for Transport and Environment

July 2005, the Transport secretary announced that plans for this charge were being scrapped[76]. Despite originally being seen as a test-bed for a national road user charging scheme, the tax is now seen as unnecessary in the context of possible plans for national road pricing covering all vehicles. The scheme was going to be run as a joint programme between HM Treasury, HM Customs & Excise and the Department for Transport and the Government with the first payment of the charge due 1st January 2008[77]. The procurement exercise has now been cancelled.

Plans for the LRUC emerged in response to the road fuel duty protests of 2000. Road hauliers argued that they were losing business to foreign drivers that could fill up on cheaper fuel overseas. The charge was to be distance based and applied to all roads in the UK. Therefore, unlike a congestion charge, the amount lorry operators would pay would be related to the distance they travel and not to levels of congestion. Satellite or microwave tracking technology would be used to determine the distances travelled by individual vehicles, and it would use an automated charging process. The charge would be revenue neutral for all UK haulage operators achieved by a reduction in fuel duty for all lorries over 3.5 tonnes. However, because it opted to reduce fuel duty rather than annual VED it missed the opportunity to use the charge to reduce CO2 emissions unless the heaviest and most polluting vehicles were to be charged more[78]. There would also be the potential to vary the charge by time of day and for those vehicles travelling on motorways.

There has been some disappointment expressed at the scrapping of the scheme by the UK Freight Transport Association. To them, the distance based charge was seen as a way of separating the taxation system of lorries from cars, thereby allowing the taxation on lorries to be cut. It also allowed parity between domestic and foreign operators.

A distance-based charge could provide a financial incentive for lorry operators to reduce their mileage and plan shorter delivery trips which should in turn help to reduce fuel consumption and hence CO_2 emissions. However, given the revenue 'neutrality' of the proposed UK scheme, there was likely to be little change in the number of kilometres travelled by UK registered lorries. In addition, it was unlikely to have a significant impact on reducing HGV traffic and the congestion they create particularly on motorways. Nevertheless, as there would have been financial benefits for operating less polluting vehicles, some operators may have upgraded their vehicles and these changes may lead to small reductions in emissions. However, on a national scale these were not expected to be significant.

In contrast, modelling by Foley and Fergusson revealed that in 2010 a revenue raising congestion charge could reduce traffic growth from articulated lorries by about 9% and also reduce their CO_2 emissions by about 9%. This is compared to a slight increase in lorry traffic and CO_2 emissions seen under a revenue neutral scheme in 2010.

At the same time, it is emerging that proposals are under consideration for a significant increase in the maximum permitted weight and length of lorries in the UK[79]. From these two developments it can appear that UK policy on freight transport is still rooted in the ethos of 'predict and provide' and is far from joined up with targets on emissions and climate change.

5.4 Company Car Tax

Companies buy about half of the new cars sold each year and because a significant proportion of the second-hand car market consists of ex-company cars there is potential for significant long-term environmental benefits from company car tax. In April 2002 the Government reformed company car tax and began to calculate it on the basis of carbon dioxide emissions. The reformed system is

[76] DfT News release 5th July 2005 http://www.dft.gov.uk/pns/displaypn.cgi?pn_id=2005_0076
[77] announced in "*Modernising the Taxation of the Haulage Industry Progress Report 3*" published on Budget Day 2004
[78] ENDS Report 340, pp.53-54)
[79] [79] Local Transport Today 421, 7th July 2005

designed to provide financial incentives for employers and company car drivers to choose cars which emit lower levels of carbon dioxide.

The Inland Revenue has been carrying out an evaluation of these reforms[80] with Phase 1 of this evaluation published in 2004. This found:

- In 2003 alone the reforms saved 0.15 to 0.2 MtC, equivalent to around 0.5% of total CO_2 emissions from all road transport.
- These savings are due to the increased uptake of cleaner conventional vehicles, and in particular a switch to diesel cars, rather than increased use of alternative fuel vehicles. Also, 300 - 400 million fewer vehicle miles were driven from April 2002 to March 2003
- Diesel vehicles tend to produce lower carbon dioxide emissions and there has been a significant increase in the sales of diesel cars since the details of the company car tax reform were first announced. It is estimated that the proportion of company cars running on diesel is around 40-45 per cent; and that this will increase to about 50-60 per cent by 2005.
- Over half of employers who provide company cars have changed their policies towards carbon dioxide emissions and are actively encouraging their employees to switch to cars with lower carbon dioxide emissions.
- The cost of the company car tax reform in income tax and National Insurance revenues was estimated to be around £10 million in 2002-03, and around £120 million in 2003-04. Although significantly higher than the Inland Revenue anticipated, the additional costs are modest in the context of overall revenue receipts from company car tax accounts, which totalled £2,660 million in 2000-01.
- It could be concluded that large, corporate fleet buyers are more sensitive to actual as opposed to perceived price signals and would respond to further such changes.
- Phase II of the evaluation will look closely at the effect on Exchequer revenues – the scheme was designed as revenue neutral but a reduction of £150m per year has been the result so far.

The reform of company car tax policy has had a number of unintended effects. The reform has been the catalyst for structured ‘cash for car’ schemes and employees have opted out of traditional company car policies and into such schemes. ‘Cash for car’ schemes remove the focus on carbon dioxide emission levels and allow employees to choose their own model of car. The average carbon dioxide emission level of the vehicles delivered by one personal leasing company was 11% higher than those delivered to customers with traditional company car policies. Hence, the increasing popularity of ‘cash for car’ schemes could undermine the progress made within the company car market[81]. However, it was also noted at the seminar that this aspect of the scheme also has the potential to allow employees to opt not to travel by car at all, although there is not evidence that this has happened.

The House of Commons Transport Committee recommended: ‘*The reformed company car tax regime has been most effective in encouraging cleaner cars. The challenge is to* ***transfer this policy success to the private car market****. At present, there are no incentives in place capable of achieving this. Moreover, people are now opting out of the company car regime and choosing higher emitting cars in the private market. The Department for Transport and the Treasury need to create effective mechanisms in the private market to relate motoring charges to pollution more directly*.’[82]

5.5 Vehicle Excise Duty (VED)

The UK was the first country in Europe to introduce an explicit CO_2 basis for taxation on vehicle ownership. The Graduated Vehicle Excise Duty (VED) was introduced in 2001. Since then, new cars with CO_2 emissions below pre-defined levels have benefited from a reduced VED tariff. Motorists

[80] Details of the evaluation are available at www.inlandrevenue.gov.uk
[81] House of Commons Transport Committee 2004 Cars of the Future 17th Report of Sessions 2003-04
[82] ibid

under the new system can save around £110 in VED each year by choosing the most efficient and least polluting cars.

However, the evidence suggests that graduated VED was not influencing customer choice[83]. Research by MORI for the Department for Transport has shown that new car purchasing is dependent on a number of key factors (price, fuel consumption, size, reliability and comfort) but road tax is not among the most significant and environmental considerations are given least consideration. Nearly four in five car buyers did not look at the vehicle's emission rating before purchase and the majority of drivers are still not aware that VED is now calculated on the basis of emissions and still believe that road tax is calculated using the size of a car's engine.

Nevertheless, the Government believes that graduated CO_2-linked VED is an important tool for providing signals to consumers about the environmental impact of their vehicles. The following points were mentioned in the seminar and have been advocated in the literature:

- The current graduated scheme does not offer a large enough incentive to encourage changes in behaviour. The difference in duty for the most polluting and the cleanest vehicles is small, and the difference between neighbouring bands is minimal. The maximum VED amount currently payable is £165 per annum for a Band D diesel car[84]. This is only £100 more than the rate payable for a Band AAA petrol vehicle[85]. Compared to the overall cost of buying a car and running a car, this charge is insignificant. Therefore, gradations could be finer so that tax rates between low and high carbon vehicles will get steeper.
- The MORI research suggests that a higher differential would change purchasing behaviour. If the differential between bands was £50, a third of people surveyed said they would change to a less polluting vehicle; if this differential were raised to £150, over half would change; and if it were £300, 72 per cent of private car buyers say they would change to a lower emission model. Such price differentials may also affect car purchasing behaviour for the more marginal second and third vehicles in a household.
- The Transport Select Committee[86] recommended: '*The difference in the level of carbon emitted from various vehicles is significant: a 4x4 can produce up to four times more carbon dioxide per mile than the most fuel efficient small cars. The way we pay for road use may change radically in the future. However, whilst Vehicle Excise Duty continues to be part of that charge, the way it is structured should be made responsive to evolving policies. The differentials between Vehicle Excise Duty bands must be widened to ensure that the graduated system influences car purchasing decisions. Owners of cars which produce high levels of carbon should be made to pay for the environmental damage they cause.*'[87]
- Consumers need to understand the cost implications of poor fuel economy. Likewise, car buyers are unlikely to be influenced by graduated Vehicle Excise Duty levels if they are not aware of how the system operates. The publicity strategy for this policy needs to be reviewed to ensure that awareness of such initiatives is improved. The introduction of car labelling (discussed below) may support this policy initiative. In addition, the Department could take the opportunity to reinforce the message of how VED is now calculated when issuing the renewal note or through simple measures such as colour-coding the disk.
- VED is largely a 'deadweight' tax and a purchase tax or 'fee-bate'[88] may be more effective.

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[83] MORI 2003 Assessing the Impact of the Graduated Vehicle Excise Duty research study conducted for the DfT

[84] This was altered slightly in Budget 2005 as a VED rates were frozen for the lowest four bands of graduated VED for cars, and the standard increase of £5 was applied to the two most polluting bands and for the over 1549cc band for pre-March 2001 vehicles.

[85] Budget 2005 also announced that the six VED bands will be re-named A-F, from the current lettering of AAA to D, while retaining their current carbon dioxide emission levels. This will align VED lettering with the new energy efficiency labelling scheme to be introduced by industry into car showrooms later this year, ahead of EU proposals for such labels.

[86] House of Commons Transport Committee 2004 Cars of the Future 17th Report of Sessions 2003-04

[87] (ibid)

[88] Inefficient vehicles would be socked with large "inefficiency-penalty" fees while efficient vehicles are rewarded with a rebate.

5.6 Alternative Fuels

There was some debate in the seminar as to how much there is to gain from the development of alternative fuels and over what timescale we can realistically expect developments.

In particular, the issue of Biofuels generated discussion on efficiency and land take requirements. Biofuels are one of the few options for producing liquid (or indeed gaseous) fuel for conventional motor vehicles from non fossil sources. In principle they offer diversification away from oil dependence and a substantial reduction in CO_2 emissions. The carbon savings of biofuels can vary considerably according to the processes and feedstocks used, as can the impact on biodiversity. Imports could come from unsustainable sources. Future technologies could offer the prospects for better carbon savings than todays.

For the UK, the most immediately promising primary crop source of domestically produced biofuel is biodiesel or rape methyl from rape seed oil. There is already a significant level of commercial production from rapeseed in a number of other countries with the encouragement of substantial fuel duty reductions and other incentives.

Eyre *et al*[89] suggest that a substantial share of UK road fuels could be produced from short rotation coppice crops if combined with highly efficient engines. In the short term, production of bioethanol from wheat or sugar beet suffers from many of the same limitations as biodiesel (growing and processing specific crops requires a high level of energy use and other inputs). In the longer term, however, new technologies may make it possible to produce ethanol commercially from vegetable waste materials, at more cost-effective prices.

The 2003 EU Biofuels Directive requires Member States to set indicative targets for biofuels sales for 2005 and 2010, and to introduce a specific labelling requirement at sales points for biofuel blends in excess of 5%. The directive aims for biofuels to make up 2% of the energy content of all fuels used for transport by end 2005, 5.75% by 2010 and 8% towards 2020.

According to the UK Public Consultation on Biofuels[90], the UK biofuels sector is confident that, given sufficient support, it could readily produce enough biofuel to achieve a 5% sales target by 2010 and deliver significant carbon savings. This in turn could mean carbon savings of close to 1MtC a year, which equates to some 3 percent of total road transport emissions. However, the Energy White Paper estimate that even with such support it would take biodiesel and bioethanol until 2020 to account for up to 5% of total fuel use. The official target therefore remains at 0.3% by 2005 (a best estimate of biofuels sales). However, although sales of biodiesel have increased since the introduction of the incentive from 150,000 litres a month in August 2002 to about 12 million litres per month in 2005, this currently only amounts to 0.03% of sales and is therefore short of the EU and the UK target[91], and prompting legal action from the EU.

Hybrid-electric passenger cars use small diesel or petrol engine in conjunction with an electric motor and battery. Only three hybrid passenger cars are on sale in the UK: the Toyota Prius and the Honda Civic IMA and Insight. Others are reported to be 'production ready'. Efficiency gains of up to 90% reduction in NOX, CO and hydrocarbons is claimed for the Toyota Prius and reductions in fuel consumption mean that there are also CO_2 emissions benefits to be achieved from hybrid vehicles of at least 20 or 30 percent and possibly as much as 50%. These higher gains are possible as the technology will soon be applied to diesel engines. Since they run on conventional fuels, hybrids do not require a dedicated infrastructure and could therefore be introduced quickly and at no infrastructure cost.

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[89] Eyre,N; Fergusson,, M and Mills, R 2002 Fuelling Road Transport: Implications for Energy Policy Energy Savings Trust, Institute for European Environmental Policy, National Society for Clear Air, London

[90] Consultation Biofuels: summary of consultation responses DFT 2004 available at (http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_033085.hcsp)

[91] ENDS Report 637, August 2005, p38

The UK has already taken a number of steps to promote the uptake of biofuels and hybrids and to stimulate the market:

- A 20 pence per litre duty incentive on biofuel has been in place since July 2002 and a similar duty incentive for bioethanol was introduced on 1st January 2005. The 2005 Budget report claims that since 2002, 43 million litres of biodiesel have been sold. A similar duty differential for bioethanol was introduced in January 2005.
- The Government has also committed to a rolling three-year period of certainty on the levels of the incentives for both biodiesel and bioethanol.
- Budget 2004 also confirmed the Government's intention to explore new taxation methods that could enable the direct processing of biomass into mainstream conventional refinery processes.
- Hybrid cars currently (2004/05) attract a standard £700 grant from the Energy Saving Trust (EST) PowerShift scheme, which partially offsets purchase costs. (these grants were suspended in 2005)[92]

However, uptake of biofuel and hybrid technology is dependent to a large part on vehicle manufactures supporting the technology. In recent years manufacturers have been withdrawing from this technology due to anticipation that hydrogen fuel cell technology will be the power source of choice in the medium to long term. Many motor manufacturers do not warrant their vehicles to run on biofuel blends higher than 5% and the scope for increasing the uptake of hybrid technology is for the moment limited firstly by a lack of available vehicles causing waiting lists for consumers.

Despite these prospects, biofuels and hybrid technology do not appear to be enjoying the same degree of focus and support as the Liquefied Petroleum Gas sector or the fuel cell industry.

It would be possible to address this discrepancy with the following actions:

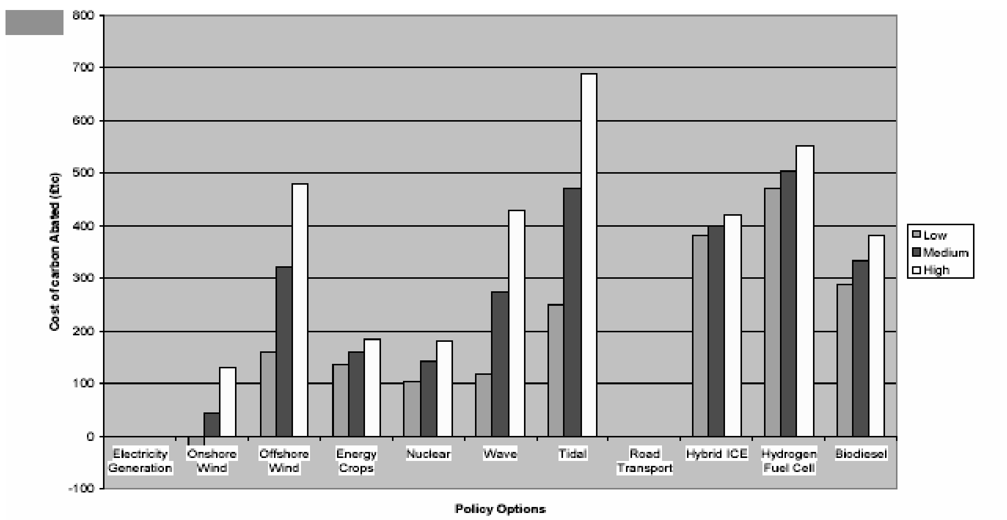
- Greater fuel duty differentials could be used to help the UK meet its targets. This will send a long term price signal of the Government's commitment to low carbon transport by rewarding lower carbon forms of fuel. Duty incentives are considered quick, simple and easy to implement and can be targeted at specific fuels. However, there is scope to complement these with some kind of renewable transport fuels obligation and enhanced capital allowances on conversion costs and even a voluntary agreement with the road fuels industry.
- The DfT are making progress towards a biofuels obligation. A Renewable Transport Fuel Obligation (RTFO) drawing on the experience of the Renewables Obligation (RO) that applies to licensed electricity suppliers would present long term prospects for delivering all low carbon fuels. In essence, an obligation would require specified sections of the road transport fuel industry to demonstrate that a specified proportion of their aggregate fuel sales were 'renewable transport fuels' to ensure the gradual substitution of fossil fuels renewable fuels over the long term, or else pay a 'buyout' fine. The Government is evaluating how such an obligation might work and whether it would be the most effective and even more politically palatable mechanism.
- Enhanced capital allowances as a measure to support investment in biofuels production facilities could support investment in conversion and the most environmentally beneficial biofuel processing plants.
- One method of promoting the use of this technology would be to encourage local authorities and central government to purchase vehicles of this type. Central Government is already doing this and incentives are in place for local authorities (see below).

[92] The PowerShift and CleanUp grant programmes are now closed. The autogas+ programme in Scotland is currently still running but is due to close on 30th August 2005. As a result, outside of Scotland, there are currently no grants available for people wishing to purchase new vehicles or convert existing vehicles to LPG. For an update on new grant programmes visit http://www.est.org.uk/fleet/funding/

6.0 COST EFFECTIVENESS

An important element of national and EU climate-change policy is the cost effectiveness of different policies and measures. The long term climate change objectives are an enormous undertaking that could, if carried out in an inefficient way, have a significant negative impact on economic growth and domestic/ European competitiveness. It is thus essential to focus on cost efficiency and to make use of policy instruments that encourage the use of low cost abatement measures.

However, a (if not *the*) key constraining factor in delivery is the cost of reduction of CO_2 emissions in the road transport technology in comparison with reductions available in other sectors. One of the outcomes from the UK Energy White Paper analysis was that over the next twenty years, carbon savings are likely to be more cost effectively achieved within the power supply sector than the transport sector (**Fig. 8**). If this is the case, it is efficient use of public money to allow the energy sector to be the main beneficiary of government support and spending on low carbon technologies and allow these sectors to achieve the greatest carbon savings.



Source: HM Treasury Presentation, UKERC Meeting Place Seminar: Transport and Climate Change, December 2004
High, medium, low' refers to the cost scenarios used

Fig 8: Cost of Carbon Savings from Different Routes in 2020

As presented in the seminar, the White Paper (Annex 1) – estimates the cost and potential for various low carbon options using the Markal Energy Model[93]. The transport options include road transport hybrids, road transport biofuels and hydrogen fuel cells (**Fig 8**). Energy efficiency is generally low cost – but transport carbon savings are among the higher cost options as modelled in this selection of polices by Markal.

Biofuels and hybrids are some of the technology routes assessed in this exercise. The DfT carried out a public consultation on biofuels and in its consultation document[94] suggested:

- With the exception of biodiesel from Waste Vegetable Oil (WVO), our analysis suggests that the costs of saving a tonne of carbon from biofuels in 2010 would be between £350 and £750. By contrast, the cost of carbon saving from offshore wind is estimated at between £240 and £380. Energy crops for power generation is estimated at between £220 and £480
- This means that there are opportunity costs associated with government support for biofuels – similar investment in carbon saving options in other sectors could yield greater results, but

[93] Markal is an economic optimising technology model of the energy system. As such it consists of a menu of energy technologies characterising the production, transmission and use of energy, with associated information on the costs of these technologies.

[94] DfT 2004 Towards a UK consultation on Biofuels Consultation Document available at http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_028393.hcsp

there may be limitations to achieving sufficient carbon savings by the use of cheaper carbon savings alone. It may be that that carbon savings from hybrid cars are more cost effective than savings from biodiesel. Also, new energy sources may save much more CO_2 if they are used to substitute fossil fuel in heat and power needs rather than being converted into transport fuel.

Approaches to costing are a key to the evaluation of different alternative energy policy options – it may be reasonable to deem one source of energy uneconomic relative to another when the differences in cost between the two are very large, no matter what methods of accounting are used. But great care needs to be taken as the outcome depends on how the costs are attributed, whether the costs of environmental damage are included and on the magnitude and form of discount rate employed[95]. Sustainable development demands fundamental changes in the way environmental costs and benefits are included in comparisons of alternative policies.

Given the importance attached to this issue, the seminar discussion raised a number of reasons why the presentations in the seminar relating to cost effectiveness was either misleading or in urgent need of research and debate:

- It is misleading to simply compare the costs of mature, market ready energy technologies, like wind turbines, with some of low carbon vehicle technologies that still need a lot more research and development and may still be some way off[96].
- We have no cost effectiveness measures on which to compare policies within the transport sector and between sectors. An indicative value for carbon needs to be set to aid broad assessment of policies within and between sectors and policies need to be assessed according to the resources required to save an equal amount of carbon. There may be differences in the ways in which cost effectiveness is measured across sectors – i.e. the way in which welfare gains, environmental effects and other effects are included
- Up until the recent climate change review, there has been little attempt to assess the cost-benefits of non infrastructure, fiscal or softer traffic reduction measures vis a vis harder infrastructural measures whether this assessment is based on cost effectiveness, carbon abatement or any other measures.
- Transport policies have not yet been systematically assessed in terms of their value for money in relation to the cost per gram of carbon saved[97]. If such an assessment were carried out, low tech measures such as speed management and smart measures may materialise as the best value for money. Hence, strategy to optimise the transport system and secure emissions reductions should not be dominated by high-cost infrastructure projects at the expense of smaller but equally effective measures. There can be a higher rate of return on local pedestrian and safety schemes, for instance.
- In the DfT 'Smarter Choices' study[98], the cost of facilitating choices by individuals to reduce their car use by the different soft measures in most cases ranged from about 0.1 pence to 10 pence per vehicle kilometre saved. Thus, on average, every £1 spent on well-designed soft measures could bring about £10 of benefit in reduced congestion alone, more in the most congested conditions.
- Given current life styles and land use patterns, cycling and walking can only account for a small proportion of total travel but they can play a vital role in reducing the need for short car journeys. These are neglected modes in policy and they require empirical assessments to provide robust 'harder' figures to support claims of value for money.

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[95] Office Science and Technology Chief Scientific Adviser's Energy Research Review Group (undated) Report of the Group: Recommendations to Inform the Performance and Innovation Unit Energy and Policy Review available at http://www.ost.gov.uk/policy/issues/csa_errg/index.htm

[96] Foley and Fergusson 2003

[97] This is being done as part of the Climate Change Review. Results are expected end 2005.

[98] Cairns, S; Sloman, L; Newson, C; Anable, J; Kirkbride, A and Goodwin, P (2004) Smarter Choices – Changing the way we travel report for the UK Department for Transport July 2004

The Markal modelling process is being re-run in the light of the climate change review and new results can be expected towards the end of 2005. It is hoped that the assumptions and methodology are transparent in order that counter-intuitive results like those presented above can be evaluated.

7.0 TECHNOLOGICAL VERSUS BEHAVIOURAL SOLUTIONS

There are several potential routes to achieving a 60% carbon reduction both in terms of the balance of emphasis between sectors and the packages of policies pursued within sectors. It is clear that technological solutions (currently in the form of the VA and emphasis on alternative fuels in the long term) dominate the policy agenda for transport and climate change. Recent government policy has shied away from managing growth in car traffic, an original aim of the 10YP, leaving many of the harder choices on demand management and congestion charging to local authorities. The recent Energy White Paper made no mention of any need to reduce traffic levels – in fact it acknowledges that traffic will grow and says that the aim must be to 'reduce the negative impacts of traffic growth'.

However, given the relationship between car use and vehicle emissions, there is a fear that an unwillingness to address demand for road use could jeopardise the UK's ability to meet its targets. As we are already witnessing, technology will achieve efficiency gains but these are likely to be offset by traffic growth. In addition, there is uncertainty as to the level of reduction that can be delivered in terms of vehicle technology and securing carbon neutral sources of hydrogen. Hence, it is likely that changes in technology will go some way towards achieving the targets, but it is questionable whether this alone will be enough in the short or the long term.

The feeling at the seminar was that it is theoretically possible to achieve the reduction within the transport sector from technology, probably even earlier than 2050, but this would (i) be expensive (ii) be very difficult (iii) not solve other externalities from the transport sector and (iv) itself involve behaviour shifts and 'taking the people with you'. The overriding conclusion, was, therefore that policies to affect behaviour change and change travel habits were as important if not more important than technological solutions.

This implies renewed and consistent support for the need to manage demand for road transport. The scale of such changes are likely to be large and to require considerable lifestyle adaptation, though the advantage of such changes is that they could, at least theoretically, be implemented on a quicker timescale than technological change. Even in the UK significant technological change will take some time and given the residence times of GHGs in the atmosphere it is imperative that reductions in carbon emissions are achieved sooner rather than later.

As mentioned above, recent evidence on smart measures[99] has highlighted the travel, emissions and cost benefits to be gained from packages of smart measures in a supportive local and national policy context. 'Smart measures' is a collective term for a range of transport initiatives aimed at encouraging more informed travel choices and voluntary behaviour change. Smart measures are therefore key to striking the balance between technological and behavioural solutions. However, the recent evidence has also highlighted that smart measures are far from enjoying 'mainstream' policy status. This results in a 'chicken and egg' type situation – significant behaviour shifts are perceived not to be too difficult to attain and therefore smart policies are still regarded as less important in policy and resource terms – and without these resources, real behavioural shifts are less likely to occur.

There is, however, a plethora of evidence to indicate that there is a significant willingness amongst the general population to become less dependent on the car. The results in the smart measures study are consistent with other evidence from transport practice and research showing that around a 20% reduction in individual car journeys can be encouraged in a supportive policy environment. For example:

[99] The term 'soft' and 'smart' are used interchangeably in this report.

- a study of car dependence in the UK showed that around 20% of trips are not locked in to car use[100].
- A comprehensive study of what happens when road space is reallocated reported an average 18% of traffic went 'missing' from the road network[101].
- the London Congestion Charge has shown a reduction in traffic levels of at least 15%.
- Studies of attitudes to travel and different modes of transport have consistently shown that around 30% of people are willing to reduce their car use if good quality alternatives existed[102].

This is a poorly understood and under-resourced area of research and policy. The following factors emerged out of the discussion as worthy of future debate:

- Even if we wanted it to be, we do not know whether 'clean' Hydrogen could be brought on stream by 2030-50. In a backcasting exercise, the conclusion may be that we need to put a huge amount of resources into Hydrogen *now*. But even with the most favourable assumptions it may be that it is not possible to bring Hydrogen on stream in time.
- Behaviour change means looking at the whole ethos of behaviour as to why we travel and are locked into car dependent lifestyles. This understanding is still poor and we do not understand enough of what motivates certain segments of the population to change behaviour.
- Given current poor energy efficiency of most public transport alternatives, emphasis on mode switching to public transport could be a 'Red Herring' with respect to carbon abatement.
- In order to tap into any willingness to change behaviour, the price signals must be right and land use planning must also be considered.

8.0 QUICK FIXES IN TRANSPORT

If technological fixes cannot deliver carbon savings fast enough, what are the actions that are available now to make a difference to behaviour and to use the current transport system more efficiently? The following areas were mentioned (sometimes only in passing) at the seminar:

8.1 Speed Management

There appears to be some consensus emerging at the potential for speed enforcement to achieve quick, cheap and significant carbon savings from the transport sector – with added benefits such as safety and traffic management,

The role of speed control in reducing emissions and fuel consumption and managing demand needs serious attention. As far back as 1994, the RCEP[103] supplied a figure of 3% reduction in CO_2 if the 70mph motorway/ duel carriageway and 60mph single carriageway limits were enforced. A further 3% could be added if the speed limit was reduced to 55mph for all types of road and effectively enforced. RCEP says that 10-15% of fuel could be saved if drivers moderated their speeds, avoided rapid acceleration and made more appropriate use of their cars[104] . These behavioural changes would have accounted for most of the 34MtC of the reduction required to limit CO_2 emissions form cars to the 1990 level in 2000.

More recent preliminary work looking at petrol driven cars and data from Netcen has shown that enforcing 70mph would give a 9.4% reduction from petrol driven cars[105]. These were 66% of the

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[100] Goodwin, P. (ed) *et al.*, (1995) *Car Dependence*. RAC Foundation for Motoring and the Environment, London
[101] Cairns, S., Atkins, S. and Goodwin,P (2002) Disappearing Traffic, the story so far *Municipal Engineer* 151, pp.13-22
[102] See for example Anable, J. (2005) Complacent Car Addicts or Aspiring Environmentalists? Identifying Travel Behaviour Segments Using Attitude Theory *Transport Policy* 12 (1) pp.65-78 and Stradling, S,.G. (2002) Levels of travel awareness in Scotland paper presented to *34th Universities Transport Studies Group annual conference*, Edinburgh
[103] RCEP (1994) *Transport and the Environment* 18th Report
[104] ibid para 8.38
[105] Slower Speeds Initiative, personal communication, November 2004

traffic on motorways in 2001 which gives a 6% reduction of total motorway emissions of CO_2. A new speed limit of 65mph gives a reduction of 10%.

This order of reduction is very worth while, especially when all the additional benefits of enforced speed limits are considered. Speed management should therefore be considered as a serious policy option for transport and climate change.

8.2 Car Labelling

A fuel economy label is a means to influence consumer behaviour, as well as to induce a market transformation by encouraging car manufacturers to produce vehicles that are more efficient. Labels enable consumers to make an informed choice and when used in conjunction with other market measures, help move the market towards better performing models. The effect of such a label, combined with other policies, in the domestic appliance sector has been dramatic.

In November 2001, EU regulations came into force to require all new cars displayed or offered for sale or lease to bear a label detailing the vehicle's fuel efficiency and CO_2 emissions[106]. Posters detailing this information for all new cars had to be displayed in a prominent position at all points of sale and an annual guide produced detailing the fuel efficiency and CO_2 emissions of all new car makes and models. This label was an 'absolute' label, bearing fuel consumption figures without any comparison in the label.

The European Commission is currently reviewing the success of its existing car labelling Directive introduced in 1999, with a view to improving its effectiveness. A UK pilot study in 2003 and research by MORI for the DfT suggested that the basic label introduced in 2001 was not informing or influencing customers.

The MORI research concluded that some form of comparative label is necessary as it forms a real added value for the consumer. A comparative label can take two forms (i) the comparison of a model to the average consumption of cars that are somehow equal (relative comparison) or (ii) to the average consumption of all new cars sold (absolute comparison). In the research, the relative comparison was preferred to the absolute comparison since car buyers have a certain idea of the car they want to purchase and prefer a comparison of cars that are similar e.g. with respect to size or segment.

The European Commission is working to a timetable that should see a revised labelling Directive in force by 2008. In the interim, the UK has introduced a new voluntary colour-coded fuel economy label for all new passenger cars to be comprehensively adopted in the market for the start of new registrations in September 2005[107] (**Fig 9**). This uses six bands (A-F) linking it to the European Energy Efficiency label format for fridges, freezers and other electrical items (which use bands A-G). This format was trialled by the DfT with positive response[108]. It was announced in Budget 2005 that the VED bands are now renamed A-F in order to link to the new labels and increase transparency for customers. The label also displays typical fuel costs calculated using estimated costs of a year's petrol based on an average 12000 miles and the cars official fuel consumption rate. There are, however, no specific comparisons made with similar cars or with the average consumption of all cars sold

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106 European Communities (Consumer Information on Fuel Economy and CO_2 Emissions of New Passenger Cars) Regulations, 2001

107 Passenger Car Working Group (2004) *Colour Coded fuel car label – update* 10 December 2004 PCWG-04-021

108 DfT (2003) *Comparative colour coded labels for passenger cars* Department for Transport October 2003 DfT 2003 available at http://www.dft.gov.uk/stellent/groups/dft_roads/documents/pdf/dft_roads_pdf_024519.pdf

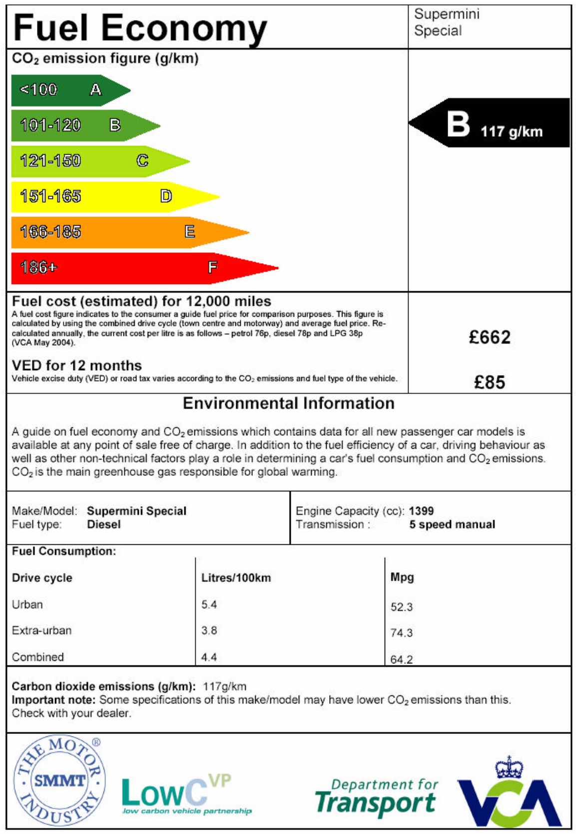

Fig 9: Voluntary UK Car Label launched July 2005

The label has been introduced at a crucial stage in the car market when efficiency standards for private cars are moving in the wrong direction (section 5.2). It is clear that there is considerable potential for a shift to more fuel efficient vehicles within most vehicle model ranges. A fuel economy label is a means to influence consumer behaviour as well as to induce a market transformation by encouraging car manufacturers to produce vehicles that are more efficient. A well communicated label results in a market pull effect from the consumer side.

Hence, the introduction of the interim voluntary car label this year should be accompanied by appropriate publicity to ensure that consumers realise that a more helpful scheme has been introduced, and to ensure that dealers know how to explain it. This last point is crucial. Research on household appliance labels[109] shows that information on fuel consumption is greatly enhanced if salesmen refer and use it in the sales situation. To date, however, there is little evidence of attempts by sales staff to highlight carbon emissions when people are in showrooms looking at cars[110]. Whilst staff are happy to have the (pre 2005) labels on hand, they do not tend to discuss them with customer because the labels do not reflect the customers' main interests. Therefore training in the use of the label for showroom or sales staff should be provided.

The label, however, is just one element of an information strategy to make consumers aware of fuel efficiency, to influence their purchasing behaviour and to stimulate car manufacturers to put more emphasis on fuel efficiency. There also needs to be a strategy of accompanying measures such as fuel economy guides, posters and fuel consumption data in promotional literature.

[109] ECU (1997) *Transforming the UK Cold Market* DECADE report, Environmental Change Unit, University of Oxford
[110] DfT (2003) *Comparative colour coded labels for passenger cars* Department for Transport October 2003 DfT 2003 available at http://www.dft.gov.uk/stellent/groups/dft_roads/documents/pdf/dft_roads_pdf_024519.pdf

8.3 Using the Transport Network more efficiently

Transport is a large and growing sector of energy demand – thus even if alternative and renewable fuel sources prove technically and commercially feasible on a large scale, there may be insufficient total supply available to meet all needs and transport will have to continue to compete in commercial terms for the available energy supplies. Thus the efficiency as well as the environmental impacts of the transport system will need to be addressed.

Getting the most from the transport system requires the system to be used efficiently. In the domestic and industrial sectors this is termed energy efficiency and generally involves an element of reducing waste and lowering demand. This is akin to reducing the need to travel in transport policy. It is unclear whether this is an explicit UK government goal. This implies behavioural change beyond modal shift between motorised modes, including reductions in trip making and reduced lengths of journeys that will facilitate the use of non-motorised modes. Improvements to passenger transport, cycling and walking facilities, the siting of facilities closer to home and the increased use of telecommunications will also be required if change is to occur on a sufficient scale.

In addition to reducing the need to travel, energy efficiency in transport sector means improving the occupancy of existing modes of transport. In addition to policies to encourage mode shift, this will include improving car occupancy through car sharing, workplace travel plans and other measures such as car parking management.

8.4 Telecommunications

Existing knowledge on the effects of transport policies on carbon emissions is stronger on technology and pricing effects than on measures relating to telecommunications, service quality, walking, cycling and land use. An extensive research project on critical issues in transport and climate change[111] identified intelligent transport systems and Information and Communication Technologies (ICT) as critical technologies in need of further research as their potential for carbon reductions is unclear after the literature review.

8.5 Low Tech – Non Motorised Modes

Strategy to optimise the transport system and secure emissions reductions should not be dominated by high-cost infrastructure projects at the expense of smaller but equally effective measures. There can be a higher rate of return on local pedestrian and safety schemes. Cycling and walking can only account for a small proportion of total travel but they can play a vital role in reducing the need for short car journeys. These are neglected modes in policy and they require empirical assessments to provide robust ‘harder’ figures to support claims of value for money.

8.6 Gaining Public Acceptability

Scenarios to reduce the environmental impact of mobility have been constrained by political and social acceptability. As a consequence, getting the most out of the transport system requires tackling the perception of political risk within transport and energy policy. This may not so much be a ‘quick fix’. However, informing the public of the nature of the problem and of their need to change behaviour thus creating a desire to change is a critical step. This could focus on the promotion of lifestyle change linked to improved quality of life.

In order to do this, more research is needed on how to gain public acceptability for more radical solutions such as congestion charging and even carbon rationing. In particular, a better understanding of how this acceptance can be encouraged and galvanised over longer time horizons is urgently required in order to develop effective transport and climate change programmes.

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[111] ; Pridmore,A,, Bristow,A, May,T and Tight,M 2003 Climate Change, Impacts, Future Scenarios and the Role of Transport. Tyndell Centre for Climate Change Research Working Paper 33.