Looking over the horizon

Bartlett School of Planning, University College London and Halcrow Group for Department for Transport

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UCL Halcrow

Executive Summary

Looking over the horizon

Visioning and Backcasting for UK Transport Policy

Department for Transport – Horizons Research Programme 2004/05

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1. Towards a 60% reduction in transport emissions

The issues relating to climate change have risen dramatically to the top of the political agenda, and the importance of transport in contributing to reducing levels of CO_2 is clearly evident: yet the problem remains that traffic levels continue to rise. All the projections suggest that significantly reducing emissions from current levels is likely to be very difficult. As urban and transport planners, policy makers and the public, we need to start to think very differently about tackling the global emissions problem.

The VIBAT project (Visioning and Backcasting for UK Transport Policy) has examined the possibility of reducing transport CO_2 emissions by 60 per cent by 2030. It has examined a range of policy measures (i.e. pricing, regulation and technological), and assessed how they can be effectively combined to achieve this level of CO_2 emissions reduction. The intention has been to assess whether such an ambitious target is feasible, to identify the main problems, and to comment on the main decision points. The study is based on the innovative research technique of backcasting, which has been used for the first time in the transport planning field in the UK.

This executive summary is mainly targeted at policy recommendations. Those interested in more details of the research carried out during the DfT Horizons Research Project 2004/05 should refer to the three extended working papers and presentations produced during the research (September 2004 – November 2005) and to a sister document on methodological issues.

All are available at: **www.bartlett.ucl.ac.uk/research/planning/vibat/index.htm.**

The two main objectives for the VIBAT project are:

1. To test the visioning and backcasting methodologies as a means to assess challenging new environmental targets for UK transport policy – this is the methodological objective;

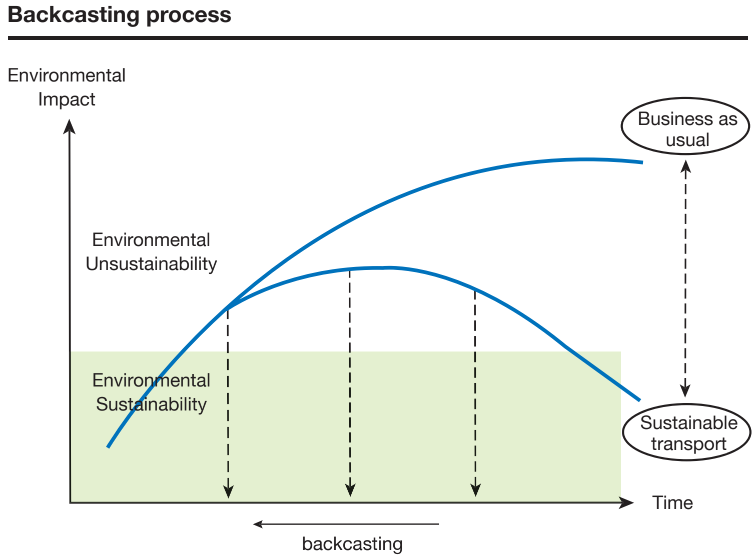
2. To produce a set of images of the future that represent different alternative visions for the year 2030, and to determine alternative policy packages that it would be necessary to introduce to achieve these images, together with the policy paths that highlight when change has to take place – this is the policy objective.

We need to start to think very differently in tackling the global emissions problem - the transport sector needs to make a significant contribution to reductions in carbon emissions.

Low emission vehicles are critical to the lower carbon future, but are reliant on technological improvements and changes in consumer buying patterns (Toyota Prius).

There have been three main stages in this innovative research project. The first was to set targets for 2030 and to forecast the business as usual situation for all forms of transport in the UK over that period, so that the scale of change can be assessed in terms of achieving the emissions reductions. The second was the description of the transport system in 2030 that will meet the reduction target. This has taken the form of two alternative visions of the future, that will push both the technological and the behavioural options, separately and in combination. The third stage was the backcasting process, where alternative policy packages were assembled to lead to the images of the future. The benefits of scenario building are that packages of policy measures can be developed to address ambitious CO_2 emissions reduction targets. This allows trend-breaking analysis, by highlighting the policy and planning choices to be made, by identifying the key stakeholders that should be included in the process, and by making an assessment of the main decision points that have to be made (the step changes). It also provides a longer-term background against which more detailed analysis can take place.

Figure 1: The backcasting process



“Scenario building and backcasting allows trend-breaking analysis - ideally suited to the sustainability field - with innovative packages of policy measures developed to address ambitious CO_2 emissions reduction targets”

2. Visioning and backcasting for the future

The scenario building process used in the VIBAT project has three separate stages (see Figure 2).
These are baseline and target setting, the development of alternative images of the future, and policy packages and pathways that can take us towards our target.

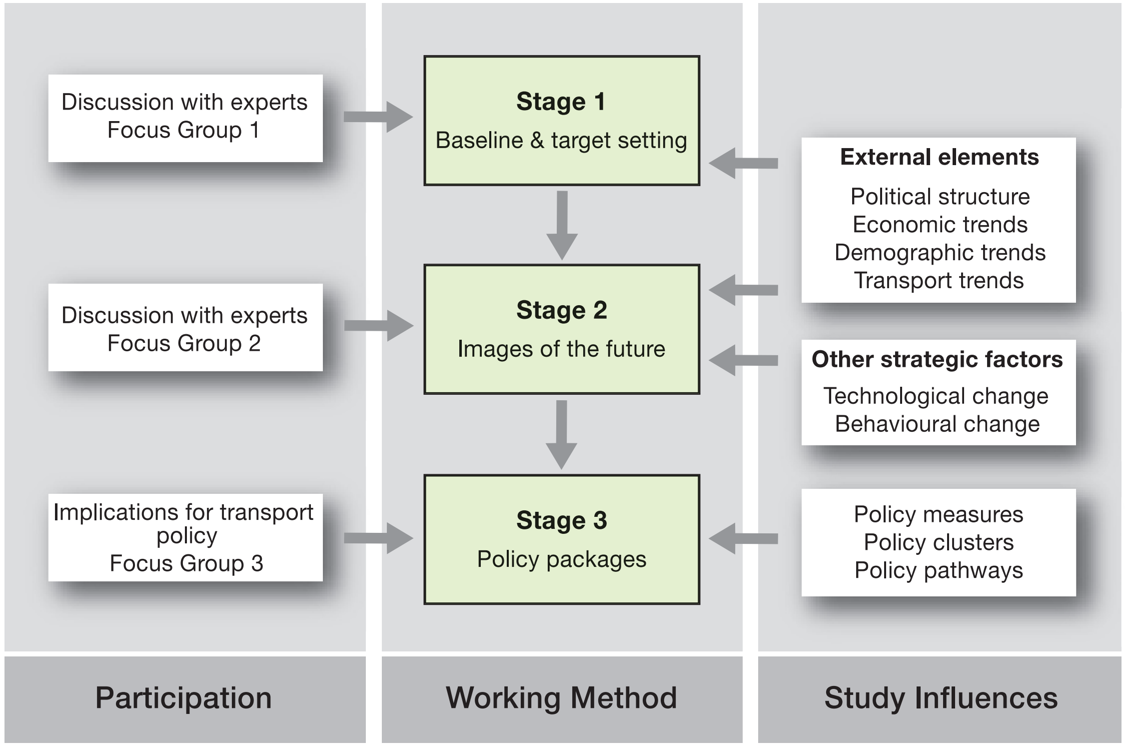
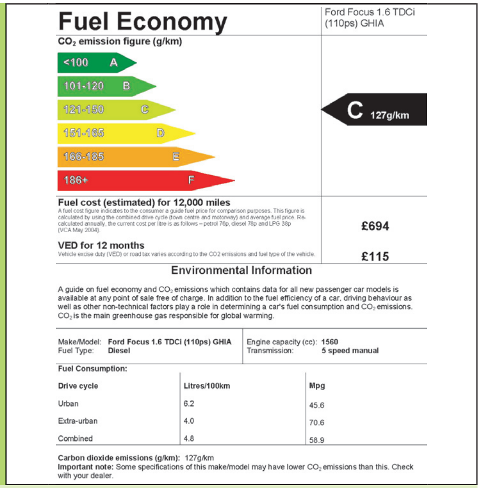


Figure 2: The structure of the VIBAT scenario building approach

Fuel cells are currently being trialled in the bus fleet (Fuel cell bus on Tower Bridge, London).

3. The VIBAT baseline and projections



New car labelling: improved information is the first step towards changed consumer choices.

In deriving a baseline and projections for CO_2 emissions we have used historical data from NETCEN and the published projections made available in Transport Statistics Great Britain (DfT), and Energy Paper 68 (DTI). Extrapolations of these projections (see Table 1) indicate a large increase in expected CO_2 emissions over time. All transport emissions rise by 35% from 38.6 MtC in 1990 to 52 MtC in 2030. This compares to all emissions of greenhouse gases in the UK, where an increase of 3% is expected over the same period.

DfT projections using the National Traffic Model, based on the assumptions in the 2004 Transport White Paper and reflecting the current UK transport policy approach including the ACEA voluntary agreement, mean that the projection of 52 MtC for 2030 is reduced to 37.5 MtC (see Figure 3). This is less than 1990 levels and current emissions levels.

Table 1: Carbon dioxide emissions baseline projection by end user in UK

End user category	1985	1990	2000	2015	2030
Road transport	28	35	38	42	49
Railways	1	2	2	1	1
Civil aircraft (domestic)	0	0	1	1	1
Shipping (domestic)	2	2	1	1	1
All transport	31	39	41	47	52
All emissions	156	161	149	153	166

Units: million tonnes of carbon (MtC)
End user emissions for transport: include a share of the emissions from combustion of fossil fuels at power stations and other fuel processing industries, but exclude activities emissions.
Projections are based on Transport Statistics Great Britain (2004) low fuel price scenario.
A high fuel price scenario is also available, but the differences are not substantial.

Our VIBAT target aims to reduce all transport end user CO_2 emissions by 60% from a 1990 base - this results in an emissions level of 15.4 MtC in 2030. This level of target is ambitious, but around the level required to achieve a future CO_2 atmospheric concentration of 500 ppm, depending obviously on what reductions are made in other carbon emitting sectors. Further research is required to assess the actual targets required in the transport sector and how they are likely to work alongside industrial, commercial and household reductions.

Public transport orientated development: a development form that can enable sustainable transport; high densities around public transport interchanges (Freiburg).

A number of CO_2 targets are available as a comparison to the VIBAT research. For example:

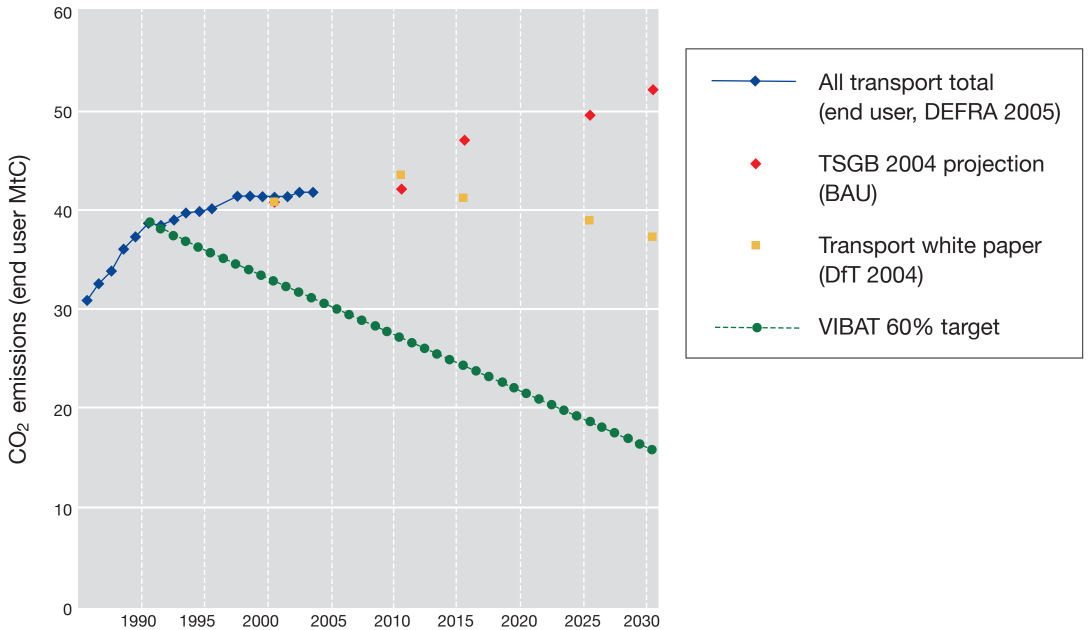
- The UK Kyoto commitment is a 12.5% reduction in six greenhouse gases below 1990 levels over the period 2008-2012;
- The UK domestic target is for a 20% reduction in CO_2 emissions below 1990 levels by 2010 (DETR, 2000);
- A path towards a 60% reduction in CO_2 emissions by 2050 has been adopted by the UK Government (DTI Energy White Paper, 2003), following the recommendation of the Royal Commission on Environmental Pollution (RCEP, 1994).

The striking feature of all these targets, particularly the more ambitious ones, is the huge gap between the business as usual projection and each of the emissions reduction targets. Achieving this scale of change is not likely to be easy (Figure 3).

Increasing the cost of carbon intensive travel: moving from city-based charging to a national scheme based on emissions (London congestion charge).

Figure 3: Carbon dioxide emissions target by end user in the UK

A 60% CO_2 emissions target from a 1990 base - 15.4 MtC by 2030 - a hugely ambitious target.



A further critical issue relates to UK international air emissions, which currently amount to 8 MtC (9 MtC including domestic emissions) and they are expected to rise to some 14-16 MtC by 2020 (and, if extrapolated, to 20 MtC by 2030).

This is despite an improvement in the fuel efficiency of aircraft of around 1.7% p.a. (DTI, 2003). International shipping is also not accounted for in the domestic projections. In the VIBAT research, only domestic UK travel data is used, but it is acknowledged that the much harder problem of reducing international carbon emissions (particularly by air) should be a priority for international study and action.

"Reducing carbon emissions from international air travel should be a priority for research and action"

4. The VIBAT images of the future

The second part of the VIBAT methodology develops two images of the future for the transport sector in the UK - set within the context of broader demographic and socio-economic changes (such as globalisation) - each provides an alternative, qualitatively different future. They reflect a potential move in a certain policy direction: towards a new market economy or a smart social policy (Table 2).

Table 2: Images of the future – external elements

	New market economy	Smart social policy
Key drivers	Economic growth	Quality of life
Values	Individualism, economic efficiency	Community and social welfare, environmental quality
Globalisation	Continuous production in low cost locations	Slightly more localised production, with specialisation, clusters and agglomeration
Economic growth	+2.5% pa = +110% (2000-2030)	+2.2% pa = +92% (2000-2030)
Population change	+9%	+9%
Role of ICT	High levels of take up and maximum use by individuals	Substantial take up, but concerns over those unable to use the technology (affordability and knowledge)
World oil prices	$60 a barrel	$80 a barrel and $100 a barrel sensivity
Governance	Central and top down	Multi level and partly bottom up

Urban design in cities must be radically improved, so that urban living becomes the primary choice for all age groups (Manchester).

Within the **New Market Economy** the main aim of transport policy is to achieve the required CO_2 emissions target with a minimum of change in terms of behaviour. Car traffic still grows (by 35% on 2000 levels) and dominates in terms of modal share, with trip lengths increasing and occupancy levels increasing. The main changes are in pushing hard on hybrid technologies so that the overall average emissions profile of the total car fleet reduces to 90 g/km in 2030 (down from 171 g/km for the new car fleet and 184 g/km for the total car fleet in 2004). This is achieved through the phasing in of the hybrid technology over the next 25 years so that by 2030 all new vehicles are hybrid. There is also considerable investment in alternative fuels to reduce the carbon content of existing internal combustion engines and the non-electric parts of hybrids. There is less effort made in terms of behavioural change - this image of the future relies on technology to deliver our lower carbon future.

"The overall average emissions profile of the total vehicle stock will reduce to below 100g/km in 2030"

State of the art walking and cycling facilities are required - so think Delft, Amsterdam and Grenoble - and replicate this throughout the UK, not just in Cambridge or York.

Within the **Smart Social Policy** behavioural change plays a central role, with less reliance on technological change. The expectation in this image is that there will be a slight reduction in the amount of car travel per person in 2030 (-10% from 2000 levels), but the overall levels of travel will be higher as population will have increased by 9%. The main reduction is not in the number of trips made but in the length of trips. The distribution has changed, with some growth in long distance trips. These are more than compensated for by the increase in shorter, more local trips. The desire for less travel (and distance for freight distribution) links in with the greater social awareness of the population, and the importance of community and welfare objectives. The lock-in to car dependency (experienced under image 1) is broken with social priorities pushing for greater use of public transport and other clean modes of transport. Reducing carbon emissions is placed at the centre of policy making - investment in national, regional urban planning and transport strategies and local transport plans is targeted at achieving a lower carbon future.

> "There is a strong shift to public transport, walking and cycling and to the greater use of local facilities. The use of walking and cycling both increase to European best practice levels"

There is less dependence on technological solutions, but cars become cleaner over the period (125 g/km for new cars and a total fleet level of 140 g/km in 2030) through new taxation and pricing incentives to use more efficient and cleaner technologies, with tax reductions for not owning a car or for participating in car sharing schemes. It is expected that real fuel prices increase by 40% over the period.

There is a strong shift to public transport, walking and cycling and to the greater use of local facilities. The use of walking and cycling both increase to European best practice levels – the number of walking trips per person doubles; cycling trips increase fivefold. Land use planning favours compactness (or polynuclear urban form), public transport orientated development patterns with mixed use and high quality local environments. Traffic demand management is accepted by the public as being necessary to achieve environmental targets, and it is perceived as helping to reduce the impact of the car and in improving the quality of life in cities. Road pricing (based on environmental emissions), ICT developments, soft factors, ecological driving including lower speeds, long distance travel substitution and freight transport subsidiarity all make major contributions to this image of the future.

5. Policy packages

Our third stage of the VIBAT study develops policy packages that are targeted at the alternative images of the future. The pre-requisite to this is the consideration of a range of measures available to help achieve the CO_2 emissions reduction target. There is huge potential on offer - we identify at least 122 individual policy measures that can be used to reduce emissions in the transport sector. Most of these measures are well known, and many have been implemented on an ad-hoc basis in recent years in the UK. A key message that follows during the policy packaging stage is that the roll out of many of the measures needs to be prioritised, with a 'step change' in resources used. 'Tinkering' around the edge of the business as usual policy direction will not deliver our ambitious CO_2 reduction target. An important area for future research is to develop an exhaustive list of policy measures available to practitioners, one that can be developed over time, with an indication of current best practice, likely travel reduction and CO_2 emission reduction effects. Such a resource would be of great use for practitioners in the UK.

"We identify at least 122 individual policy measures that can be used to reduce emissions in the transport sector. However, 'tinkering' around the edge of the business as usual policy thrust will not deliver our ambitious CO_2 reduction target. We need major change"

Policy packages are developed by combining sets of individual measures that are likely to work well together, concentrating on those that might create positive synergies. Eleven policy packages are developed - some of the policy packages are technologically based, some rely on pricing to drive them, whilst others depend more on regulation and control or behavioural change. They cover all modes of transport, including freight and passenger movement, and they also relate to land use and spatial change. Some of the packages are more directed at the policy level, whilst others involve primarily industry and individual actions.

Investing in walking and cycling so that they are much more attractive to use (Cycle parking, with bike hire and café at Freiburg railway station).

Let's raise our collective game - Strasbourg, Freiburg and Zurich show the quality in public transport provision required.

Our summary findings - including initial estimates of carbon reduction potential - are outlined below. All have ranges of values that reflect different levels of intensity of application as all of the policy packages have variants:

PP1 Low Emission Vehicles:

The take up of low emission vehicles, based largely on hybrid technology is very important. Full introduction of the 90 g/km car in the total fleet by 2030 requires massive investment by car manufacturers. The current best generations of vehicles have emissions levels of around 100 g/km (the Toyota Prius emits 104 g/km). Relying on this option may be high risk, and further work is required to establish the costs and feasibility of converting the whole of the UK car fleet to hybrids by 2030. There is a major role here for the motor industry. The full potential of hybrids for the freight and public transport sectors also needs further investigation.
Carbon reduction potential = 18.3 MtC - 9.1 MtC.

PP2 Alternative Fuels:

Additional benefits can be obtained if alternative fuels are used in conjunction with petrol and diesel hybrids. There are many possible alternative fuels on the market - including compressed natural gas, liquid petroleum gas, methanol, ethanol, biodiesel, hydrogen and electricity. Many alternative fuels can be used on their own, others can be blended with existing fuels and used in vehicles without any major modifications to the engines. The International Energy Agency suggest that by 2030, some 20-40% of all fuels in transport could come from alternative sources. Much further work is however required to investigate the potential of alternative fuels - this should include the necessary infrastructure required to make them work effectively.
Carbon reduction potential = 9.1 MtC - 1.8 MtC.

PP3 Pricing Regimes:

Road pricing can also make a substantial difference, whether it is operated nationally or just within cities and on the motorways. In combination with other policies, road pricing on an environmental basis (i.e. the charging relates to the carbon emissions profile of the vehicle and the number of passengers), can give clear signals to consumers to switch to more efficient cars or to other modes of transport.
Carbon reduction potential = 2.3 MtC - 1.1 MtC.

PP4 Liveable Cities:

This package focuses on using urban form to support sustainable transport, with higher density development clustered around an upgraded public transport system, and urban areas masterplanned to vastly improve their urban design quality and attractiveness for living and working. There is complementary heavy investment in walking and cycling facilities and public transport. Extensive application of this package has a major impact, but largely over the medium term, as decisions on the location of new housing and other development take place gradually over time. These decisions have a substantial effect on both distances travelled and modes used.
Carbon reduction potential = 2.4 MtC - 0.5 MtC.

PP5 Information and Communictions Technology (ICT):

This option explores the potential for carbon reduction, but the levels seem limited, and there may be rebound effects as ICT encourages more, not less travel. The measures are targeted at personal and freight travel, and include advanced route and parking guidance, car sharing, public transport information systems, freight logistics, local traffic regulation and teleactivities.
Carbon reduction potential = 1.2 MtC - 0.3 MtC.

PP6 Soft Measures:

Including workplace and school travel plans, future changes in car ownership (including leasing and car clubs), car sharing, travel awareness and personalised travel planning programmes. These are important supporting measures to other packages, but they also have an important impact on carbon emissions in their own right.
Carbon reduction potential = 2.4 MtC - 0.9 MtC.

PP7 Ecological Driving:

This has substantial immediate benefits, particularly if combined with lower national speed limits. Slower speeds provide extensive savings, with potential for some 15-20% reduction in carbon emissions if a maximum speed limit of 80 km/hr is introduced on motorways and trunk roads, with lower speeds on other roads. Although the fuel use and speed value curves for new cars are flatter than those for older cars, there are considerable fuel savings from lower speeds. These speed limits need to be combined with awareness programmes and better driving techniques to reduce fuel use.
Carbon reduction potential = 4.6 MtC - 2.5 MtC.

Innovative forms of public transport, including demand responsive modes, will form part of the future transport package (Ultra light rail module).

The new Sustainable Communities, Growth Areas and Housing Pathfinder Areas provide a unique opportunity to 'get things right' from the start. Sustainable transport should be at the heart of new development in the Thames Gateway, Ashford, Milton Keynes, Harlow, Stoke-on-Trent, Liverpool and Newcastle, etc. We need a quantum leap in our thinking.

PP8 Long Distance Travel Substitution:

There is some limited potential for long distance travel substitution of rail for air, and coach for rail, but the savings here are not substantial.
Carbon reduction potential =
0.7 MtC - 0.5 MtC.

PP9 Freight Transport:

Freight transport is covered in several of the packages, but subsidiarity (local production and knowledge transfer) and dematerialisation (miniaturisation, advanced logistics and distribution networks, load matching and material consumption) can all lead to savings, some substantial.
Carbon reduction potential =
2.5 MtC – 0.7 MtC.

Two more policy packages are also very relevant - carbon rationing (PP10) and increased oil prices (PP11). Under a carbon rationing package, individuals are given a yearly CO_2 budget, on an equitable basis - where heavy CO_2 users can buy rations from less intensive users. The overall usage on a national and regional scale is reduced over time to meet carbon reduction targets. Both carbon rationing and increased oil prices are seen as supporting or enabling packages - ensuring the take up of the earlier measures and policy packages. Much more research is required on the likely implementation pathways on both of these supporting packages. There are potential difficulties in implementation with both.

Although this research takes us a huge way forward in terms of estimating the likely contribution of the transport sector to carbon emissions reductions - it is based on limited analysis, using a range of secondary sources on travel, fuel and emissions savings. Much further work is required to further understand this critical topic and to test the assumptions made during this (very small scale) VIBAT project.

A summary of the packages and variants is shown below, including separation by passenger and freight where necessary. The table can be used to develop a range of different packages, or clusters, to see how far we achieve the target set for each image of the future.

Table 3: Summary of the policy packages

Package	Variants	Comments	Potential carbon saving
PP1: Low emission vehicles	1A High (90g/km) and 50% freight emissions reduction	Passenger: -11.8 MtC Freight: -6.5 MtC	-18.3 MtC
	1B Low (140g/km) and 25% freight emissions reduction	Passenger: - 5.9 MtC Freight: -3.2 MtC	-9.1 MtC
PP2: Alternative fuels	2A (50%)	With 1A (passenger + freight) With 1B (passenger + freight)	-9.1 MtC -4.6 MtC
	2B (20%)	With 1A (passenger + freight) With 1B (passenger + freight)	-3.7 MtC -1.8 MtC
PP3: Pricing regimes	3A City and motorway 3B National		-1.1 MtC -2.3 MtC
PP4: Liveable cities	4A Limited application 4B Extensive application		-0.5 MtC -2.4 MtC
PP5: ICT and travel	5A ICT in transport - passenger and freight 5B Teleactivities - passenger and freight		-1.8 MtC -0.8 MtC
PP6: Soft measures	6A Travel plans		-2.4 MtC
	6B Car ownership		
	6C Travel awareness		
	6D Improved car occupancy		-0.9 MtC
PP7: Ecological driving	7A National system 7B National and local system		-2.5 MtC -4.6 MtC
PP8: Long distance travel Substitution	8A Air travel and some substitution 8B High speed train and coach		-0.5 MtC -0.7 MtC
PP9: Freight	9A Freight transport subsidiarity 9B Freight dematerialisation		-0.7 MtC -2.5 MtC
PP10: Carbon rationing	10A 550ppm 10B 450ppm	This is an enabling mechanism	25.7 MtC 34.1 MtC
PP11: Oil Pricing	11A $60 a barrel (100p a litre) 11B $80 a barrel (130p a litre) 11C $100 a barrel (170p a litre)	This is an enabling mechanism	-1.3 MtC -6.4 MtC -10.7 MtC

Building the public transport network before the development: a lesson for new development in the UK (The Hague, the Netherlands).

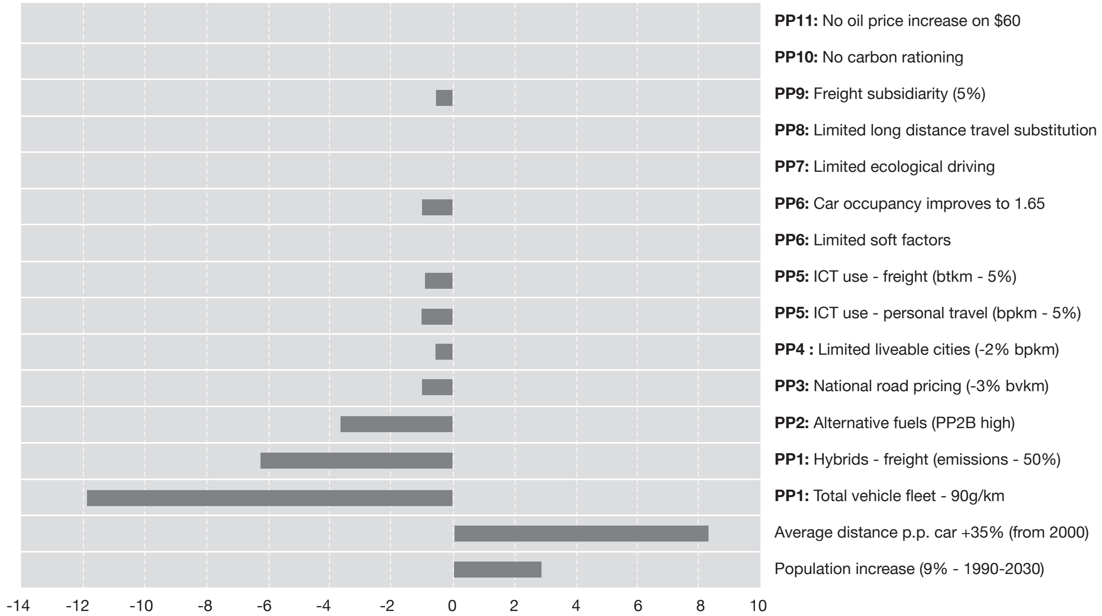
ICT developments may mean the 'death of distance' - the 'meaning of flows may supersede the meaning of space' - and lead to the reduction in travel for some activities. Other activities are however likely to increase in terms of their travel intensity - hence the net gain may be small in terms of carbon reduction.

6. Package clustering and policy pathways

The final task within the VIBAT project is to cluster the packages together so that the target levels of reduction can be achieved within each of the two images of the future. The intention here is not to be prescriptive or comprehensive to show every possible combination of packages that can be used to achieve the image targets, but to illustrate the ways in which package clustering can be undertaken.

Figures 4 and 5 illustrate the most likely policy clusters under image 1 (New Market Economy) and image 2 (Smart Social Policy). Image 1 relies heavily on technological developments to achieve the 60% emissions reduction target. However it only takes us two thirds of the way towards the target.

Figure 4: New market economy - package contributions (MtC)



Reliance on technological means is additionally risky - the package is dependent on only a small number of measures. If hybridisation of the fleet does not occur to tkae fleet averages below 100g/km - perhaps based on a continuation of current consumer choice trends for larger and heavier cars - then our progress towards the 60% target will be very limited.

Table 4: New market economy core package

Image 1: New market economy		
Target reduction of -25.7 MtC (2000-2030)		
Basic assumptions	• Oil price $60 • Average distance by car +35% • Trip lengths by car +10% and trip frequency stable	
Core policy cluster 1.1		
Policy package	**Target contribution**	
Population increase (9% - 1990-2030)	+2.8 MtC	+10.7%
Average distance per person car increases by 35% from 2000	+8.4 MtC	+32.5%
PP1A: Total vehicle fleet - 90 g/km	-11.8 MtC	-46.0%
PP1A: Hybrids used for freight (emissions - 50%)	-6.5 MtC	-25.1%
PP2B: Alternative fuels passenger and freight (PP2B 20%)	-3.7 MtC	-14.2%
PP3A: Road pricing (congestion basis -3% bvkm)	-1.1 MtC	-4.4%
PP4A: Limited PTOD/liveable cities (-2% bpkm)	-0.5 MtC	-1.9%
PP5A: ICT use for personal travel (bpkm -5%)	-1.2 MtC	-4.6%
PP5A: ICT use for freight (btkm -5%)	-0.6 MtC	-2.5%
PP6: Limited Soft factors	0 MtC	-0.0%
PP6: Car occupancy improves to 1.65	-0.9 MtC	-3.5%
PP7: Limited ecological driving	0 MtC	0%
PP8: Limited long distance travel substitution	0 MtC	0%
PP9A: Freight subsidiarity and dematerialisation (5%)	-0.7 MtC	-2.5%
PP10: No carbon rationing	0 MtC	0%
PP11: No oil price increase on $60	0 MtC	0%
Total approx change	-15.8 MtC	61.6%
VIBAT target	-25.7 MtC	100%
MtC short	9.9 MtC	38.4%

NB. Because of the expected increase in travel and population, the target under image 1 effectively increases to 36.8 MtC

Giving greater priority to walking, cycling and public transport - it should be quicker and cheaper travelling into town by the "low carbon modes" than by car (Freiburg).

Travel planning, car clubs and travel blending - the way forward for car ownership in the UK. 'Owning' a car can be by different means in the future.

Image 2 is more balanced, relies less on technological improvements, and is premised on major behavioural change. It allows full achievement of the 60% emissions reduction target.

Figure 5: Smart social policy - package contributions (MtC)

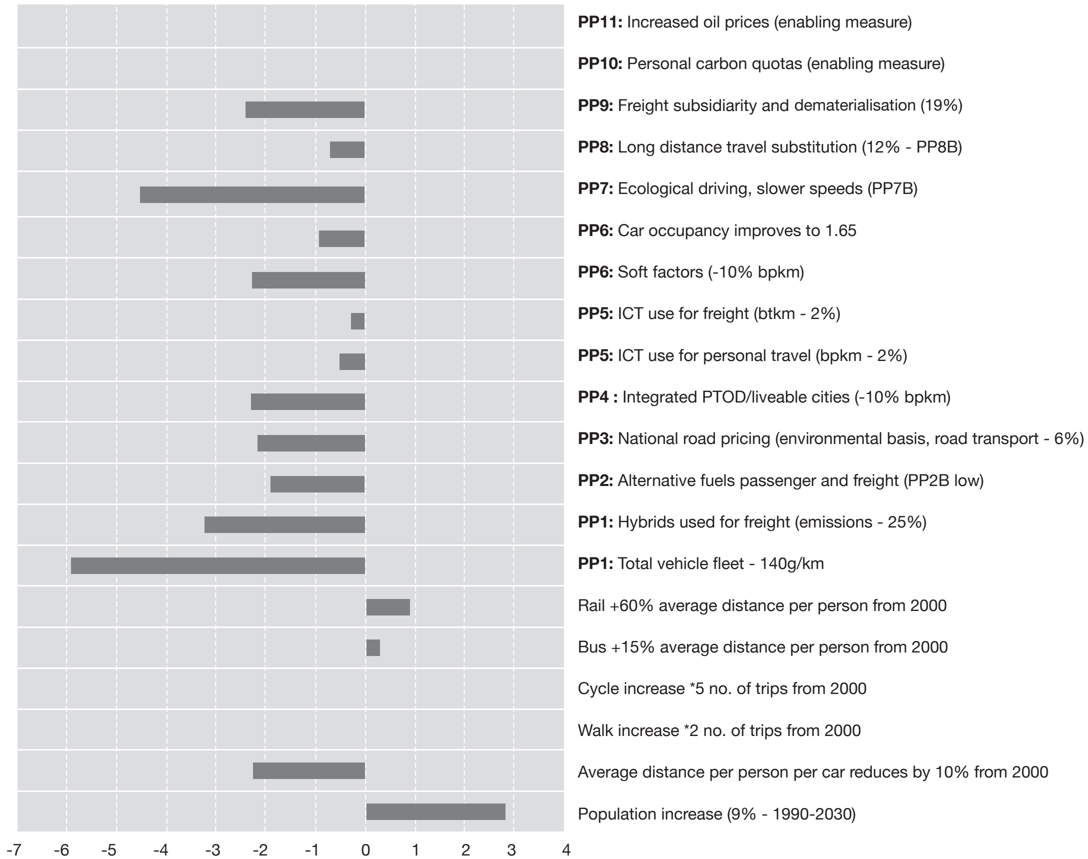


Table 5: Smart social policy core package

Image 2: Smart social policy		
Target reduction of -25.7 MtC (2000-2030)		
Basic assumptions	• Oil price $80 or $100 • Car mobility reduces, average distance by car reduces by 10% from 2000, car trip lengths reduce by 10%, trip frequency stable • Aggregate multi-modal mobility similar to 2000 • Walk *2 number of trips; cycle *5 number of trips, bus +15% in distance, rail +60% in distance	
Core policy cluster 2.1		
Policy package	**Target contribution**	
Population increase (9% - 1990-2030)	+2.8 MtC	+10.7%
Average distance per person car increases by 10% from 2000	-2.4 MtC	-9.3%
Walk *2 number of trips from 2000	0 MtC	0%
Cycle *5 number of trips from 2000	0 MtC	0%
Bus +15% in distance from 2000	+0.2 MtC	+0.8%
Rail +60% in distance from 2000	+0.9 MtC	+3.5%
PP1B: Total vehicle fleet - 140 g/km	-5.9 MtC	-22.8%
PP1B: Hybrids used for freight (emissions - 25%)	-3.2 MtC	-12.5%
PP2B: Alternative fuels passenger and freight (PP2B low)	-1.8 MtC	-7.1%
PP3B: National road pricing (environmental, road transport -6%)	-2.3 MtC	-8.9%
PP4B: Integrated PTOD/liveable cities (-10% bpkm)	-2.4 MtC	-9.3%
PP5B: ICT use for personal travel (bpkm -2%)	-0.5 MtC	-1.9%
PP5B: ICT use for freight (btkm -2%)	-0.3 MtC	-1.0%
PP6: Soft factors	-2.4 MtC	-9.3%
PP6: Car occupancy improves to 1.65	-0.9 MtC	-3.5%
PP7B: Ecological driving, slower speeds	-4.6 MtC	-17.8%
PP8B: Long distance travel substitution (12% - PP8B)	-0.7 MtC	-2.6%
PP9B: Freight subsidiarity and dematerialisation (19%)	-2.5 MtC	-9.7%
PP10: Personal carbon quotas (potential enabling measure)	25.7 MtC	100%
PP11: Increased oil prices (potential enabling measure)	25.7 MtC	100%
Total approx change	-25.9 MtC	-100.7%
VIBAT target	-25.7 MtC	100%
MtC short	-0.2 MtC	-0.7%

NB. The projected reduction in car travel offsets the increase in carbon consumption resulting from increases in bus and train usage and population growth. The effective target under image 2 is hence 27.2 MtC

Car parking provision - we need a refined approach here. Residential and office parking standards can be tightened in areas of good public transport accessibility, combined with car free developments wherever possible, and designed in an attractive manner (The Hague, the Netherlands). Much too much space, which could otherwise be developed, is currently given over to car parking in the UK.

Our main policy conclusions are therefore as follows:

- The 60% target reduction under image 1 is not possible over the timescale envisaged. This is because the additional car-based travel (+35%) that is expected in this vision of the future increases the target to 34.1 MtC. Technological innovation on its own cannot bridge that gap, even if there is a very strong push on efficient vehicles and alternative fuels.
- The 60% target reduction (25.7 MtC) can be achieved under image 2 (no additional car travel), through a variety of policy packages that are well known now, but even here major change is required that combines behavioural change with technological innovation.

Reduced travel speeds and ecological driving skills, together with wider technologies such as speed delimiters, stopping distance enablers, electronic vehicle identification and 'black boxes' can make a major contribution to lower carbon emissions.

7. The way forward for policy makers

The VIBAT project has produced a methodology that has now been tested, and this in turn has produced a series of important policy conclusions. In this final section we set out our conclusions and recommendations for policy makers.

The initial aim of VIBAT was to establish whether a 60% CO_2 reduction target in the UK transport sector could be achieved by 2030. The analysis has concentrated on the domestic UK travel modes, which means that the actual target for 2030 is 15.4 MtC, or a 60% reduction on the 1990 level of 38.6 MtC. This target needs to be set against the expected increases in travel, with levels of carbon emissions increasing to 52 MtC by 2030.

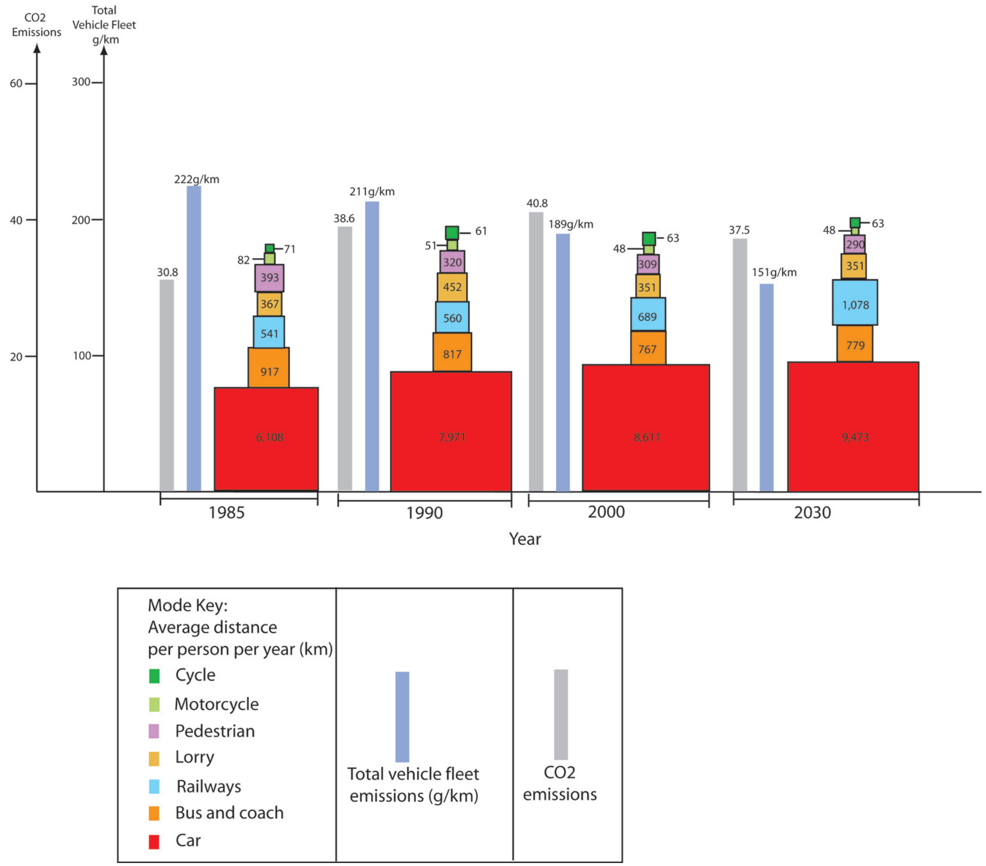
The two images developed generate less travel than the business as usual: with image 1 (New Market Economy) increasing car-based travel by 35%; and image 2 (Smart Social Policy) having slightly less car-based travel than now (-10%). In addition, there will be a population increase of 9% in both images, and this adds to the levels of travel and carbon emissions.

The overall conclusion reached is that the 60% CO_2 reduction target (in 2030) can be achieved by a combination of strong behavioural change and strong technological innovation. But it is in travel behaviour that the real change must take place, and this should be implemented at the earliest possible occasion. Changes in the built environment will become effective in the medium term (over 10-15 years), whilst the major contribution of technological innovation will only be effective in the period after 2020. However, it is not possible to achieve the 60% CO_2 reduction target (in 2030), with the expected growth in travel (image 1 or business as usual), as the increase in CO_2 emissions from this growth outweighs many of the possible savings from behavioural change and technological innovation.

We really need to start working differently in the transport sector - we can't solve problems using the same thinking we used when we created them.

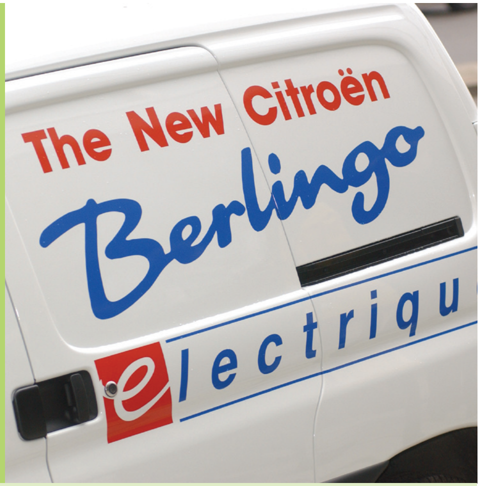
"The 60% target reduction can be achieved through a variety of policy packages that are well known now, but even here major change is required that combines behavioural change with technological innovation. Little increase in travel on 2000 levels is possible"

The key trade off individuals are likely to have to make is in fleet vehicle efficiency and distance travelled by mode. The historical trends are illustrated below, together with projections to 2030 (consistent with the 2004 Transport White Paper) and projections for the two images of the future - New Market Economy and Smart Social Policy. More efficient vehicles mean increased travel becomes more acceptable – in all likelihood we will have to deliver on the technology side and keep travel at or under present levels.



A lower carbon future necessitates that long distance travel is no longer quicker and cheaper by air or car. High speed train and public transport becomes the favoured option.

The 'skyscraper' diagrams illustrate all transport CO_2 emissions and average vehicle fleet emissions with vertical bars, and mode shares in terms of average distance per person per year (km) by area of the 'skyscraper' blocks.



Lower carbon freight travel can be achieved with hybrid technology, regional consumer markets, logistics planning and ecological taxation (The electric Citroën Berlingo).

A series of recommendations are also made to reflect the needs for further research in this important area (Objective 2 of the VIBAT project):

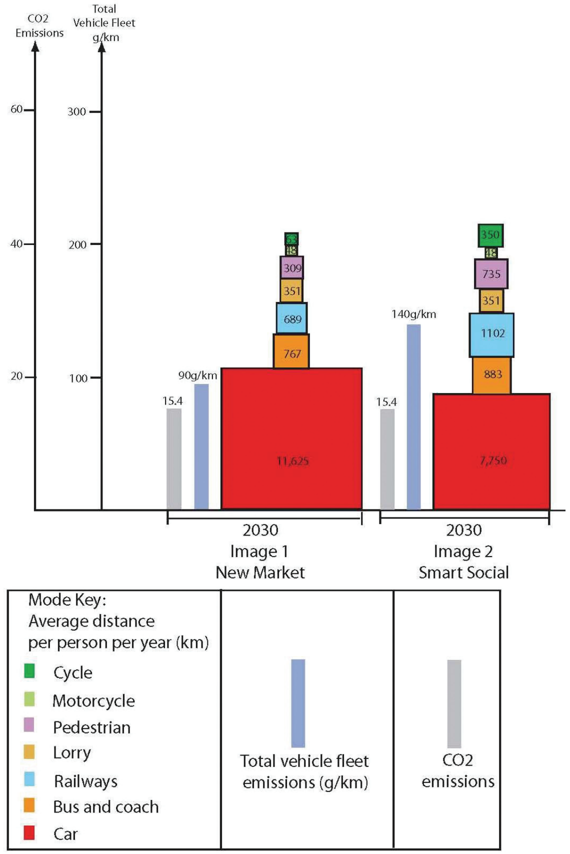
1. There should be a reliable baseline data source that brings together DfT, Defra and DTI interests in a consistent way to at least 2030, if not 2050. This database can be regularly updated and used to monitor progress towards transport and environmental targets.

2. An inventory of measures and packages, together with their carbon reduction potential would help establish where most effort needs to be placed. This inventory should also have details on costs, benefits, responsibilities for implementation and the risks entailed.

3. Good practice guides on the introduction of transport demand management schemes, including savings (or increases) in travel and the associated carbon savings (or costs) should be introduced.

4. The VIBAT research has assumed that each package adds to the overall savings potential, but this needs further analysis to see whether this is a valid assumption. Issues relating to synergies, to critical points where "real change happens", to unintended and rebound effects, and to monitoring the effects of change all need further investigation.

5. It is important to open up the debate about the issues raised in this research with all stakeholders as this begins to create an understanding about the scale and importance of the CO_2 reduction issues, and it would



begin to remove some of the barriers to effective implementation. Included here would be questions relating to the concept of sector based targets; how CO_2 reduction targets can become central in transport decision making; how to raise public awareness and to get the public's active involvement in seeking solutions; and how to encourage behavioural change that can be maintained over time.

Although 2030 seems a long way ahead, action must be taken now if the target for CO_2 reduction is to be met. This project has not relied on unknown technologies or new behavioural changes, but on creatively packaging the full range of existing opportunities, so that the feasibility (and possibilities) of target achievement can be estimated for the two alternative images of the future. All of the measures embedded in the policy packages are well established, and only in a few limited cases is the technology not available for immediate implementation (e.g. speed or road pricing controls through GPS systems). But all the technology (including hybrid cars and lean burn engines) will be fully operational within the next five years (to 2010).

There will be a major role for a wide range of policy packages – including more efficient vehicles, alternative fuels, more walking and cycling, better quality and more public transport, lower speed limits, integrated land use and transport planning, reduced car occupancy, new ICT developments, national road pricing (based on environmental impacts rather than congestion), long distance travel substitution, reduced emissions from freight and 'softer' factors such as personalised travel planning and travel blending.
Vehicle technologies and individual travel behaviour are likely to change very markedly in the future. Carbon rationing and higher oil prices may be required to facilitate the level of change required.

Enabling Measures

To achieve this ambitious level of carbon reduction we might require radical enabling measures. Higher oil prices are already with us and are likely to stay if 'peak oil' occurs in the next few years. This, however, should act as a catalyst in the switch to lower carbon travel behaviour. Critically, carbon rationing may prove to be the only way to an equitable lower carbon future.

"The old debate in terms of relying on technological improvements to help maintain our current CO_2 intensive lifestyles seems to be obsolete"

The VIBAT project has demonstrated through the use of a sound and innovative methodology that the targets set are achievable provided that there is not a substantial increase in travel between 2000 and 2030.

The old debate in terms of relying on technological improvements to help maintain our current CO_2 intensive lifestyles seems to be obsolete. We need a renewed emphasis over a very wide range of fields. Multi-disciplinary thinking is critical.

We will need to achieve excellence in practice in all these fields. We really should see this as a new age for integrated transport and urban planning - a huge opportunity - with the global environmental imperative as the catalyst for a major improvement in the way we live our lives. There is no time for delay, as looking over the horizon, we can see that concerted action is required now, and not tomorrow.

The VIBAT study has been carried out by the Bartlett School of Planning, University College London and the Halcrow Group Ltd. For more information visit the study website on www.bartlett.ucl.ac.uk/research/planning/vibat/index.htm.

This executive summary has been produced by Robin Hickman and David Banister as part of the VIBAT project under a contract with the Department for Transport. Any views expressed are not necessarily those of the Department for Transport. Comments on the study are welcome: hickmanro@halcrow.com and d.banister@ucl.ac.uk

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