Visioning and Backcasting for UK Transport Policy (VIBAT)

The Bartlett School of Planning and Halcrow Group Ltd

Stage 2 Working Paper

Images of the Future: New Market or Smart Social

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1 Introduction

1.1 Towards Likely Images of the Future

The issues relating to climate change have come to the top of the political agenda, and the importance of transport in contributing to reducing levels of CO_2 is now clear, with all the predictions suggesting that more emissions rather than less are likely to 2030. One of the main aims of the VIBAT project is to test alternative visions of the future to see whether there are other ways in which the organisation, the priorities and the management of the transport system can be structured so as to reach the challenging target of a 60% reduction in CO_2 emissions target by 2030. The main aim of Stage 2 of the VIBAT study is to construct scenarios – or "images of the future" - that seek to achieve the objectives of sustainable transport. These scenarios are used to illustrate what a sustainable transport system might look like under different sets of external and strategic constraints. The rationale behind the development of scenarios is that they are used to add clarity and detail to what is often an unclear or vague concept of sustainable transport.

The projective time horizon used is to 2030, with a mid-point of 2015. Retrospective data is available for 2000, 1990 and 1985. The target for 2030 is set against a baseline of 1990 to ensure comparability against other headline environmental targets.

Extensive changes are required to the transport system and travel behaviour to achieve the 60% target reduction for sustainable transport by 2030. The main focus of the scenario building is on elements that can be influenced through transport policy changes. External elements are however also of critical importance if radical change is to be achieved, hence the transport images of the future are set within the context of likely wider demographic and economic changes.

An important point to note is that many technologies and behavioural change strategies are available today that can significantly reduce transport CO_2 emissions over the short to medium term. These include technologies which make vehicles more technically efficient than they are today and lessen their fuel consumption per km travelled; technologies to make transport systems and infrastructure more efficient, better in-vehicle fuel efficiency, new lower carbon fuels and fuels lower in greenhouse gas emissions on a 'well-to-wheels' basis[1] (IEA, 2004). There are also behavioural measures such as pricing, speed reduction, reducing the need for motorised travel, more efficient vehicle routeing, and mode switching.

These strategies are all key to our transport images of the future and, critically, they need to be implemented quickly, on a UK-wide basis, as part of integrated technological and behavioural change packages.

[1] For a fair comparison of the emissions associated with different energy carriers, the total well-to-wheels fuel chain should be considered. The use of fuel in vehicles is only the last stage in this chain. The total fuel chain consists of feedstock production (the well), feedstock transport, fuel production, fuel distribution, and fuel use in vehicles (the wheels).

1.2 Structure of the Report

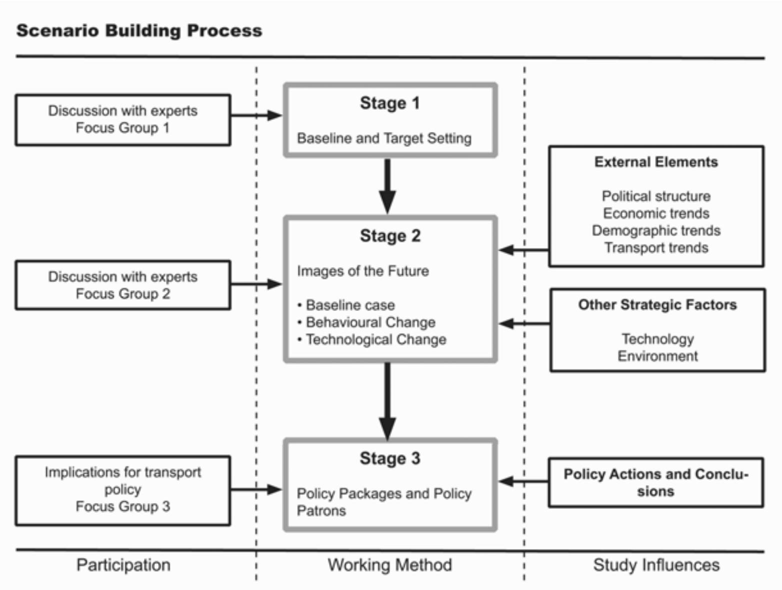
The remainder of this second stage study report is kept purposively short, and has two main sections as follows:

- Section 2: Images of the Future
- Section 3: Conclusions and Next Steps

As can be seen from Figure 1.1, this part of the VIBAT project focuses on Stage 2 where the external elements and the strategic elements are seen to influence the images of the future, the former in a more contextual manner and the latter to give clear differences in the two contrasting Images.

The Annex provides the VIBAT work programme, a list of the expert panel contributors for Stage 2 (held on 22nd June 2005) and selected references.

Figure 1.1: *The Study Process*



2 Images of the Future

2.1 Introduction

In this main section of the report we develop two images of the future: one with a technological change focus, the second with a behavioural change focus. The construction of these images is the second step in the backcasting methodology, the final being the elaboration of pathways and milestones backwards from the future images to the present.

2.2 The Impetus for Change

From the baseline and target setting, we have the following key quantitative information on the scale of the necessary change in the transport sector (see Table 2.1). The business as usual (BAU) projection gives the UK transport sector annual emissions as 52 million tonnes carbon (MtC) of carbon dioxide by 2030. Our 60% reduction target seeks to reduce emissions to 15.4 MtC from 38.6 MtC in 1990. Our target reduction from 1990 levels is thus 23.2 MtC. The National Transport Model (DfT, 2005) suggests that likely emissions in 2030 - based on the policy approach in the Transport White Paper (2004) - are 37.5 MtC. This includes the effects of the voluntary car agreement and the investment levels in the White Paper.

To give an idea as to the scale of change required, in relation to global warming stabilisation levels, we perceive this level of target in the transport sector as providing a likely contribution [only] to a 550 ppm CO_2 concentration future by 2030, dependent obviously on what other sectors achieve.

The working is as follows: current total CO_2 emissions in the UK are around 150 MtC (which equates to around 2.5 tC per capita[2]). Our Stage 1 VIBAT report noted that per capita total annual carbon emissions need to reduce to around 0.3 tC per capita (to meet a global stabilisation level of 450 ppm) or 0.7 tC per capita (for 550 ppm) to meet globally equitable emission shares under a contraction and convergence future. Our 60% reduction target seeks to reduce transport emissions to 15 MtC (equating to 0.25 tC per capita): hence 36% of total CO_2 target emissions for a globally equitable 550 ppm future, or 83% of a 450 ppm future. With other sectors - such as power stations, domestic, industrial and commercial - still likely to be carbon emitters in 2030, it looks like even a 60% reduction in the transport sector is not likely to be enough to contribute to a 450 ppm contraction and convergence vision.

The UK Government's pathway towards a 60% reduction in emissions is of course a little less demanding. By 2050 we are looking for emissions of around 1 tC per capita. Our 60% target in the transport sector (0.25 tC per capita) would make up a quarter of allowable per capita emissions.

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[2] Using a UK population of 60 million. Hillman and Fawcett (2004) note that, in terms of annual emissions of carbon dioxide per capita, the world average in 2000 was just over one tonne carbon per capita (1tC per capita), but varied dramatically country by country. For the UK emissions were at an average of 2.5tC per capita, in the US they are 5.5tC per capita, developed countries and transitional economy countries an average of around 2.8tC per capita. The developing nations contribute much less: China's emissions average 0.6tC per capita, India 0.3 tC per capita. Afghanistan is currently the bottom (or top) of the emissions league at 0.01tC per capita.

Whatever the target, huge change is required in the future: Houghton (2004) suggests atmospheric concentrations of 450 ppm are more acceptable than 550 ppm, especially when taking into account feedback effect problems. The Global Commons Institute (2001) suggest even lower levels should be sought, down to 350 ppm. Current levels of atmospheric carbon concentration are at 379 ppm (2004) and rising at over 2 ppm per annum.

Our 60% target - although hugely ambitious - may therefore need to be revised *upwards* if CO_2 emissions are not radically reduced in other sectors. Global contraction and convergence in particular is a very demanding objective for the UK.

Table 2.1: *UK CO_2 Emissions 1990-2030*

Emissions (MtC)	1990	2000	2030	% Change
All CO_2 emissions	158	148	166	+5%
All transport emissions	38.6	40.7	52.0	+35%
Transport % of all emissions	24%	28%	31%	+7%
All transport 60% target reduction	38.6	32.8	15.4	-60%

Unit: million tonnes of carbon (MtC)

NB. These figures cover all UK transport for all modes, including domestic air and domestic shipping. International travel is excluded from all the analysis.

The VIBAT baseline target hence gives a clear direction in terms of the time period and scale of reduction required for CO_2 emissions in the transport sector. Two other important constraints came out of the stage 1 expert workshop (23rd February 2005). The role for technological change may be more limited than expected, as compensating behavioural changes could weaken its impact. The argument here is that as travel becomes more efficient through the use of more economical vehicles, and as CO_2 emissions are reduced through alternative fuels, this might encourage more travel - a classic rebound effect. The potential technological benefits are reduced. There is some evidence that this has occurred in the recent past (see VIBAT Stage 1 report). This means that in all images of the future, technological change needs to be combined with measures to reinforce behavioural change, i.e. we need to “lock-in” the benefits. The second conclusion reached by the expert group was that a hydrogen future using fuel cells would not be possible by 2030 in terms of its general availability. Technology would still be experimental and mass production of “clean” vehicles was highly unlikely. It was also stressed that the efficiency of the hydrogen technology was no better than that provided by the hybrid (diesel/petrol and electric) technology that is already available in 2005.

Scenario building is thus very relevant here: this type of approach helps develop relevant, plausible and challenging futures that can be used by decision-makers. The scenarios should enable a better understanding of possible futures and allow decisions to be taken now that will address the longer term challenges, such as those that relate to the environment. They also allow rebound effects to be explored within the “*space of possibilities*” (Banister et al., 2005).

2.3 Broad Socio-Economic and Technological Trends

As part of our images of the future (which are focused on transport and urban planning issues) we need to consider the role of external factors which may influence future travel behaviour, such as political, economic and demographic trends.

The globalisation of the world's economy will continue, with more, longer distance travel required for the movement of goods, services and people (for meetings). But changes in the nature of work (from manufacturing to service and information) and the components of the labour force (more female employees and part time labour) may reduce travel frequency as work patterns become more flexible, with some substitution (home working) and longer distances (extended commuting areas).

Globally, production is likely to become ever more dispersed, as firms relocate plants to low labour cost economies, provided that the necessary skills are available. Agglomeration economies and clustering of related businesses will continue, with shorter supply chains to balance the global relocation of manufacturing and services. Trends in longer distance travel will continue, but they will also be mitigated by some compensatory shorter distance travel, more remote working and the need for face to face contact.

The 24-hour economy will reinforce these trends as continuous activity (through shift working) takes place within countries and as global markets take advantage of the time differences to remain in operation throughout the day and night. New production methods will be required to permit full advantage to be taken of these opportunities, through networking, outsourcing, flexible specialisation, and the customisation of products. These changes reflect the decoupling of space (as opposed to the more common decoupling of the economy). The importance of space is still accepted as there are arguments for both dispersal and agglomeration - both of these are likely to occur in terms of future spatial change.

Over the thirty year time horizon, it is expected that the UK economy will grow at between 2-3% per annum in line with Treasury projections (DfT, 2005), resulting in a total percentage increase of about 100% (an average of 2.4% p.a. for 2000-2030). The population will also change as the expected total increase amounts by about 9% (2000-2030), and there will be an increase in the median age of the population. Projections suggest that the number of people aged 65 and over will exceed the numbers aged under 16 by 2014 (Social Trends, ONS 2004). These underlying trends mean that income levels will increase substantially over this period, and that leisure time will also increase (at least for the retired), even though the retirement age may also be raised as participation in paid work continues beyond the age of 65. Generally, the trend towards individualism, changes in lifestyles and consumer preferences will all continue, as the growing need for instant satisfaction (through consumption and participation) continues. But there is also a heightened concern over the quality of the environment, both in terms of global climate change issues (closely linked to CO_2 emissions) and the local environment. The local environment covers local emissions, safety and security, the quality of the built environment, neighbourhood design, and the social concerns over crime and going out at night.

Less certain are the trends in technology. The assumption is made in the VIBAT images of the future that there will be no "new" replacement technology in transport implemented by 2030. Common usage is certainly not likely to occur by 2030, due to cost, knowledge and diffusion constraints.

This means that the hydrogen solution will not be available within the transport sector by 2030. However, technology will be available to reduce some of the projected CO_2 emissions and advances will contribute substantially to the images through further increases in the efficiency of existing technologies (e.g. the internal combustion engine[3]), the use of electric and hybrid technologies, and the use of alternative fuels (for example gas, biofuels and renewables).

In addition, there is a considerable role that information and communications technologies (ICT) can play in improving the technological performance of vehicles, increasing the capacity and efficiency of the transport system, and in providing alternative means to carry out activities. ICT plays an instrumental role in traffic and transport management systems, travel information and reservation systems, route guidance systems, smartcards, and many other applications. Dematerialisation, eco-efficient technologies and advances in new materials (particularly plastics and polymers), combined with the trend towards miniaturisation (including smartdust), have considerable potential to reduce freight volumes and weight.

It is also very likely that over the 25-year period (to 2030) that mobile services (mainly provided through the phone) will become far more sophisticated and ubiquitous, as real time information will be available on all transport services, smartcard transactions will be used for bookings and through tickets, as well as the increased provisions of video links and messaging services. The constraints on use would include costs (probably low), and the acceptance, competencies and skills required to use the ICT. New intuitive interfaces are required. More generally, the role of ICT in society needs to be thought about, together with its potential to substitute for (or increase) existing patterns of mobility.

A difficulty remains as to the assumptions to be made on world oil prices. Most of the projections used to provide the baseline here use the DTI's long term forecast for 2010 of $23 a barrel (2003 prices) in real terms, increasing to nearly $28 a barrel by 2025. Prices are however now over $60 a barrel, and it seems likely that they will remain high for at least the next few years as demand has grown at a substantially higher rate than supply. Such a situation reinforces the globalisation process and the switching of production to low cost economies, and also impacts on global growth rates (although less than in the past), and on consumption patterns. In the images of the future, we take high oil prices as a reality and explore the implications for demand and higher prices, as well as the incentive this gives to a move away from total oil dependence in the transport sector. Within our images of the future we take a variety of prices according to the image chosen - ranging from $60 to $80 and $100 a barrel.

2.4 Images of the Future

Within these broad likely future trends, we have developed two images of the future, each providing an alternative, qualitatively different future. They reflect

[3] Note that Exxon forecast that in 2030 ICE will still make up over 95% of the world's vehicle fleet (The Economist 30th April 2005, Survey of Oil, p.18).

a potential move in a certain policy direction: towards a new market economy or a smart social policy. These are elaborated in Table 2.2.

Table 2.2: *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 sensitivity
Governance	Central and top down	Multi level and partly bottom up

2.4.1 New Market Economy

Society at large - this image is driven by the economy making a successful transition to a technology-led new market society[4]. Most manufacturing is carried out overseas and the UK economy depends even more on imports, adding value through its high knowledge base and its continued excellence in financial services. There is a ready acceptance of new technology, both in the home and the workplace, but also in transport with a keen desire to overcome the consequences of CO_2 emission increases through clean technology. This concern is not backed up by major lifestyle changes, only marginal changes using ICT to reduce the need to travel for certain activities (e.g. some use of teleconferencing and home shopping).

Global businesses are still powerful players in determining what computer technology is available – but there is a price to pay for the latest technology. The market is oligopolistic[5] where the main manufacturers continue to develop competing proprietary standards to lock in their customers. Often basic hardware is provided at little or no cost, but more sophisticated applications have a high price attached to them. Intervention by government is at a low level, as there is a strong preference for market forces to operate.

[4] The scale of change involved in moving to a new technological society can be viewed in the same context as the transition to agricultural and industrial societies in the past. The late 20th Century and early to mid-21st Century mark this transition towards new patterns of work, leisure and economic activity.

[5] Economic conditions where there are so few suppliers of a particular product that one supplier's actions can have a significant impact on prices and on its competitors.

Increasingly concerns are apparent over the power exerted by some large multi-national companies - with market valuations in excess of many smaller and medium-sized national economies - and at the high levels of world oil prices, carbon dependency and future oil shortages.

Transport policy – 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 and dominates in terms of modal share, with trip lengths increasing and occupancy levels remaining about the same as in 2000. The main changes are in pushing hard on hybrid technologies and alternative fuels so that the overall average emissions profile of the total car stock reduces to 90 g CO_2/km in 2030 (down from 171 g/km for the new car fleet in 2004). This is achieved through the phasing in of the hybrid technology over the next 25 years so that by 2030 virtually all new vehicles are hybrid. There is also considerable investment in alternative fuels to reduce the carbon content of existing ICEs and the non-electric parts of hybrids. Niche electric vehicles also have a limited role for low speed vehicles in cities, provided that their source of energy is renewable. The cost of fuels rises overall by 20%, but this increase falls increasingly on those car users that continue to consume fossil fuels. As with all vehicles, lean burn ICEs also reduce the fuel needs per km and so the real costs of motoring do not increase by as much as 20%. New materials will be used to make vehicles lighter (-25% from 2000 levels).

To complement these measures, technology is used to ensure maximum efficiency in engine monitoring systems, in route and parking guidance, and in ensuring that vehicles are used efficiently, through measures such as car sharing and demand responsive public transport and taxi services. Freight distance remains constant, but contributions to the CO_2 reduction target are met through load consolidation and the use of smart freight matching services to reduce empty running. Hybrid technology is used for distribution vehicles so that their emissions are halved (LGVs have 2 times the CO_2 emissions of a 1993 pre-cat car), and HGV emissions levels are also halved (HGVs have 6 times the CO_2 emissions of a 1993 pre-cat car). An issue here for debate is the continued use of diesel in urban areas (and elsewhere) as it has benefits in terms of less CO_2 emissions, but costs more in terms of increased emissions of other pollutants.

Domestic air travel is an increasing producer of CO_2 (in 2000 emissions = 1.38 MtC), and this is expected to increase by 31% to 1.81 MtC by 2030. It seems that there are less options for substantial increases in fuel efficiency in the air sector, so savings will be made through the use of larger planes (with less CO_2 emissions per passenger) and higher load factors to reduce the BAU levels to 1.60 MtC (+16% from 2000 levels).

The technological measures therefore concentrate on a very heavy promotion of technological alternatives through a restructuring of the car fleet, through the use of new renewable fuels, and the encouragement of more efficient ICEs, coupled with an extensive use of technology in transport to ensure that the system is working at its maximum efficiency. This means that measures to increase load factors and reduce empty running are very important in both the passenger and freight sectors.

Although behavioural change is also acknowledged as being important, the general view is that little change is required, apart from clear pricing signals to encourage less fuel consumption and a switch to cleaner technologies. Public transport use increases, in particular for long distance travel (by High Speed Train) and air, as leisure-based lifestyles increase and as global networks expand. Cities continue to sprawl, expanding at low densities (at 30 dwellings per hectare and below) with continued modest use of planning controls to locate development in public transport accessible locations, and there is only be a token use of soft measures to raise awareness and involve individuals and firms in travel plans. The main changes here again relate to the use of technology to allow greater flexibility in the use of time and location for work, shopping and other activities.

Congestion will increase, as there is a growth in traffic but not a corresponding growth in the provision of road space. A national system of road charging is introduced in the major cities and on the motorway network, mainly to reallocate the current costs of motoring to take account of the amount and time of use of the road system. This is not a revenue raising pricing system and is not targeted at environmental objectives. The technology is used to regulate speed within urban areas and on the motorways in a demand responsive way and in accordance with the desired use of road space.

This means that priority is given to particular users at specific times of the day - outside schools, in town centres and shopping areas, and in residential locations within cities. On the main roads priority is given to clean (including hybrid) vehicles, those with high load factors (passenger and freight), and other priority users (e.g. public transport). Parking is privately controlled with charges being made for all forms of parking (including commercial and residential), linked to the number of spaces, their function and location.

The new market economy approach argues for pricing of all space and for the use of that space. This means that the costs of travel (including parking) are likely to be substantially raised over this period to help achieve the 60% CO_2 emissions reduction target. The economy will also be growing and the levels of income will rise, but the proportion of expendable income being allocated to transport (and indirectly to the price of goods in shops) is likely to rise to about 25%. This means that pricing will be the main mechanism to achieving behavioural change, and if the measures taken are not sufficient to reach the 33% target, then further price rises are necessary. It should be noted that the price increases are designed to make people and firms create less CO_2, not less travel, so incentives are present to encourage switching to clean technology, and to using the technology in creative ways to reduce levels of CO_2 pollution. In all cases the prices will be substantially higher if the vehicle is producing higher levels of CO_2. Table 2.3 summarises the changes envisaged in the new market economy image of the future.

Table 2.3: *Characteristics of the Transport Sector in Image 1 (New Market Economy)*

Indicator or Measure	Characteristics of Change
Headline indicators	
Transport CO_2 emissions aspiration	▪ 15 MtC for all transport in the UK by 2030
Personal travel	▪ Total mobility is higher than in 2000, higher than the behavioural change image for 2030. People are not willing to dramatically change their travel behaviour, hence all trip type volumes increase (commuting, shopping and leisure travel) ▪ Billion person km by car = + 35% and trip lengths = +10% on 1990 levels ▪ Average distance per person p.a. by car = +35% ▪ More internal air travel ▪ Working hours become more flexible
Car Ownership	▪ Car ownership increases from 2000 levels, car-based lifestyles, saturation of ownership ▪ Car stock = + 70% and cars per person = +50% ▪ Car occupancy levels show improvements on 2000 levels - moving from an average of 1.59 to 1.65 ▪ Lock in to car dependency
Freight travel	▪ Centralized production, long supply chains, companies organised around synergistic constellations of core competencies ▪ High volumes of goods are transported over long distances, freight centres for inter-modal distribution at periphery of cities ▪ Freight travel remain road dominated, but with focus on new vehicle technologies and higher load factors ▪ Lock in – oligopolies, proprietary standards, specialisation – key high value markets ▪ Extensive use of IT, logistics planning and new management strategies
Incomes and GDP	▪ Substantially higher incomes = 110% ▪ Similar increase in GDP (+2.5% p.a.)
Technological change	
Vehicle technology	▪ Niche marketing of cars, global production ▪ All purpose cars are dominant, mainly hybrid vehicles or fuel cells ▪ Battery cars become niche market vehicles

	▪ Cars are 25% lighter than at present ▪ Hybrids market uptake for all new vehicles = 2010 (10%), 2020 (50%), 2030 (100%). Strong shift to hybrids reduces emissions impact of increase in travel
Vehicle fuels	▪ Efficiency gains in vehicles mean that fuel consumption = -40% ▪ Fuel prices = +20% (real terms) ▪ Average total fleet CO_2 emissions = 90 g/km
Use of new technology	▪ Car sharing and mobile technologies are prevalent ▪ Matching for work and social activities ▪ Public transport and taxi is demand responsive ▪ White vans and distribution of goods, tracking and tracing, alarm systems
Behavioural change	
Personal travel behaviour	▪ Limited mode shift to public transport, cycling and walking, increased car dependent lifestyles ▪ Domestic air travel grows in line with global economy, but with larger more fuel efficient planes and higher load factors ▪ Business travel by air and high speed train (HST) is popular, leisure travel by air and car grows rapidly
Land use planning	▪ Little strategic thought behind integration of land use planning and transport, continued urban sprawl ▪ Minimal increase of densities around public transport nodes; urban design and transport planning remain un-coordinated ▪ Some roadspace reallocation, priority to public transport, pedestrianisation, parking supply issues not well resolved
Soft factors	▪ Limited use of green travel plans and safe routes to school; low take up of car clubs and car sharing ▪ Telecottaging, telecentres, flexible working and teleshopping remain fringe activities
Wider traffic demand management measures	▪ Congestion charging in major cities, and a national scheme to cover road pricing on the motorways. ▪ Parking controls and market pricing for all uses related to commercial and residential activities
Traffic management	▪ Higher speed limits introduced, but with variable speed technology ▪ Few area-wide traffic calming schemes introduced in the UK
Grand total for Image 1	Aspiration that 60% emissions reduction target is achieved by 2030

NB. All % changes refer to the period 1990-2030

2.4.2 Smart Social Policy

Society at large - this image is also market driven, but has a much stronger social and environmental emphasis, and is focused on improving quality of life. The transition to the technological society is moderated by greater social intervention. The UK economy still has some manufacturing capability through its knowledge-based economy, producing specialist products for hi-tech businesses. Its role as a financial centre is still substantial, but it has lost out to the growing importance of the European Centres (Frankfurt, Paris and Milan), which form the Eurocore financial cities. Although there is an acceptance of the importance of the technological revolution that has taken place, there is a strong social and environmental policy imperative as the basis for policy. It is accepted that behavioural change is the essential basis needed to address the required CO_2 emissions targets, however technology can help to a certain extent. The UK takes the lead in moving towards less CO_2-intensive lifestyles, through a combination of strategies including a strong contribution from the transport sector. This includes changes to individual travel patterns and the transport element in the goods and services consumed. Supply chain lengths are, for example, targeted for reduction. Excellence in the social, environmental and quality of life spheres leads to economic competitive advantage in the UK.

Global businesses adapt to the changing environment with more local production. The priorities are still in efficient production, but not necessarily in the lowest cost locations, as consumers are prepared to pay slightly more for goods that are produced locally and that have a lower transport cost associated with them. One key to this change is the use of the "open source" (OS) culture for the provision of public goods and information. One current example here is the use of OS in computing, where the operating system Linux allows users to develop the system through their own software enhancements. Another example is the Ebay or Amazon concept that allows trading between individuals in a bidding system that is based on mutual trust in terms of what is offered and the mechanism for payment and delivery.

Such a system allows OS communities to develop that have supportive policies to encourage a commitment to common goals such as social cohesion, environmental quality and human rights. Intervention by government is at a higher level as social welfare objectives are perceived as important, as are the means to ensure that all members of society are included within the technological society. High oil prices are seen as a benefit and one incentive by which the transport sector can switch from high carbon dependency to a lower carbon dependency.

Transport policy – the expectation in this image is that there will be a slight reduction in the total amount of travel distance by each person in 2030 (-10% from 2000 levels), but the effect of this will be offset as population will have increased by 9%. The main reduction has not taken place in the number of trips made, but in the length of trips. The distribution has changed, with some growth in long distance trips, but 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 and conscience of the population, and the importance of community and welfare objectives. The lock-in to car dependency (as found in image 1) is broken with social priorities pushing for greater use of public transport and other clean modes of transport.

There is less dependence on technological solutions, but cars become cleaner over the period (120 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. Real fuel prices increase by 40% over the period.

Most of the technological innovation is in the monitoring of vehicles according to their emissions profiles, and in implementing a national system of road pricing that is based primarily on environmental charging. The costs of motoring relates to the type of vehicle, emissions and distance travelled, with reductions for more people (or goods) carried – it does not relate to the levels of congestion. If a vehicle is trapped in congested conditions, the levels of pollution are likely to increase, thus leading to a higher charge.

Technology is used to restrict access to certain areas in the city and the countryside to maintain local air quality and tranquillity, and is used to maintain and enforce suitable environmental speeds on all roads. The desire for fast travel is moderated through extensive variable speed limits, so that travel is carried out in an optimal way environmentally – this means that maximum speeds on roads are limited to around 80 km/hr or where the engine is working in the most efficient manner.

Smart technology is used in all forms of public transport to provide full information and interactive services for seamless travel between places using a variety of interconnected transport services. Many forms of public transport are demand responsive with the facility to share trips and routes. This results in a renaissance for all forms of public transport, as their characteristics become more comparable to those of the car. In many cases it is only possible to gain access to the city centre and other facilities by public transport, as car parking is severely limited, and priority is given to public transport. All towns and cities have extensive areas set aside for pedestrians, with comprehensive cycle networks (and appropriate safe storage facilities) to encourage the substantial growth in clean travel.

Within towns and cities there is substantial investment in public transport to provide a high quality and dense service network, with competitive prices and higher vehicle occupancy levels. It is now faster to get around the city by public transport and walking and cycling than by the car. The frequency and capacity of services are substantially increased and urban design favours direct routes for low carbon transport. Complementary actions in planning and development permits higher densities, mixed uses and local facilities, with further encouragement of higher density residential (>40 dph and upwards) and office developments around accessible public transport nodes. Social and leisure activities are also concentrated at these accessible interchanges, which in turn develop as shopping, leisure and social meeting places. Their functional use is complemented by high quality design and local environmental standards, as they become new city landmarks. Similar design quality issues are important in residential neighbourhoods and elsewhere, where it is made clear through design what the function and use of space is for. The quality of the public realm is improved dramatically - the city becomes the living room.

Complementary policies also involve all stakeholders in the debate over priorities, as it is important that people and firms “buy into” the need to reduce CO_2 emissions. Travel plans, car clubs and travel blending are all part of that process of change, as people move away from the concept of private ownership towards one that involves shared ownership. It is here that technology is not seen as the master or the solution, but something that can be used to help create a better quality transport system for all users. Hence ICT is used to reduce the need to travel through working, shopping and networking from home, but not in the sense of facilitating additional compensatory travel.

Towards 2030 issues relating to personal tradable emissions are discussed - with a view to moving towards a more stringent contraction and convergence global environmental future in the UK - with those that need to travel more buying credits from those that have spare credits from travelling less. Difficulties relating to the costs and administration and likely equity impacts of such a carbon trading scheme, and whether individuals require (or are entitled to) the same number of credits all need to be resolved in the early years 2005-2010. A shadow carbon trading scheme is commenced in 2010.

There is also potential for less freight traffic through more local sourcing of production, and through companies and individuals purchasing more locally produced goods. Again, greater use is be made of the rail system to transport freight with intermodality actually reducing the total CO_2 profile of journeys. There is extensive use of load matching through internet based freight exchanges and a “spotmarket”. This includes both the trunk haul section to the local distribution centres and the final 'white van' delivery to the customer.

With domestic air travel, the expected business as usual growth does not take place as little new capacity is made available, and as long distance travel is made by HST and hybrid car hire or by bus. Prices for all forms of transport reflect their full environmental costs, and there are limited subsidies available for social reasons. The basic premise is that users of all forms of transport should pay their full environmental costs of travel - the polluter pays.

Overall in the smart social policy image, there is less travel and journey lengths are shorter. Travel time reduction is of less importance, as speeds are related to using less energy. There is a strong shift to public transport and to the greater use of local facilities. 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 is perceived as helping to reduce the impact of the car and improve the quality of life in cities. Available road space is allocated to priority users by time of day and urban planning is fully participatory. Table 2.4 summarises the changes envisaged in the smart social policy image of the future.

Table 2.4: *Characteristics of the Transport Sector in Image 2 (Smart Social Policy)*

Indicator or Measure	Characteristics of Change
Headline indicators	
Transport CO_2 emissions aspiration	▪ 15 MtC for all transport in the UK by 2030
Personal travel	▪ Total mobility is the less than in 1990. People recognise environmental concerns and change their travel behaviour ▪ Billion person km = -10% and trip lengths = -10% on 1990 levels ▪ Average distance per person p.a. = small reduction, but offset by population growth ▪ Long distance internal travel mainly by High Speed Train (HST) ▪ Individuals move away from single mobility to multi-mobility use (from one mode to many modes) ▪ Working hours become more flexible
Car Ownership	▪ Car ownership remains stable ▪ Occupancy levels in all forms of transport increases (car occupancy again increases from 1.59 to 1.65) ▪ Increase in rental and shared ownership ▪ End of lock in to car dependency
Freight travel	▪ Regionalised production, shorter supply chains, glocalisation with regional and local production of goods ▪ Distribution networks more regional and local, public transport bias ▪ Extensive use of IT, logistics planning and new management strategies, load matching and intermodality ▪ Internet-based freight exchanges, spot markets for load matching, load factors increase
Incomes and GDP	▪ Incomes substantially increased = +90% ▪ Some increase in GDP (+2.2% p.a.), but increased focus on improving quality of life
Technological change	
Vehicle technology	▪ Niche marketing of cars remains marginal ▪ Less use of light materials in cars ▪ Low speed city vehicles and use of renewable energy
Vehicle fuels	▪ Efficiency gains in vehicles mean that fuel consumption = -20%

	▪ Fuel prices = +40% (real terms) ▪ Average total fleet CO_2 emissions = 140 g/km
Use of new technology	▪ Car sharing and mobile technologies ▪ Matching for work and social activities ▪ Public transport and taxi are demand responsive ▪ Smart public transport – rail, bus, and clean taxis with seamless, smart payment and information systems
Behavioural change	
Personal travel behaviour	▪ Mode shift to public transport, cycling and walking ▪ Increased investment in public transport, e.g. new LRT schemes ▪ Public transport is competitive in price ▪ Higher vehicle occupancies ▪ Internal air travel growth is slower ▪ Personal tradable emissions quotas
Land use planning	▪ Smart growth, public transport orientated development, concentration of development in cities and urban areas ▪ Increased densities around public transport nodes, mixed uses. Urban mobility centres (highly accessible meeting places at interchanges) ▪ Development and transport generation profiles matched with accessibility profiles ▪ High quality in urban and public realm design ensuring improved quality of life in cities, for all age groups ▪ Less space for cars in cities: roadspace reallocation, priority to public transport, pedestrianisation, shared space, traffic calming, limited car parking provision
Soft factors	▪ Social acceptance of traffic demand management approaches ▪ Participatory approaches, information, debate and labelling ▪ Green travel plans and safe routes to school widely used ▪ Niche vehicle usage, car clubs and car sharing ▪ Rail and rental car is a popular combination ▪ Use of telecottaging, telecentres, flexible working and teleshopping, telephone and video conferencing widespread
Wider traffic demand	▪ National system of road pricing, strong public and political support

management measures	▪ Bus priority on main roads and motorways
Traffic management	▪ Lower speed limits ▪ Area-wide traffic calming ▪ Eco-driving widespread
Grand total for Image 2	Aspiration that full 60% emissions reduction target achieved by 2030

NB. All % changes refer to the period 1990-2030

2.5 The Dual Role of ICT

There is a critical role that information and communications technologies (ICT) can play in influencing each image of the future, and it is worth re-emphasising the importance of pushing hard on ICT development.

In terms of the new market economy, ICT can help improve the technological performance of vehicles, increasing the capacity and efficiency of the transport system, and provide alternative means to carry out activities. ICT plays an instrumental role in traffic and transport management systems, travel information and reservation systems, route guidance systems, smartcards, and many other applications including road pricing (a revenue neutral system based on used of the network). Dematerialisation, eco-efficient technologies and advances in new materials (particularly plastics and polymers), combined with the trend towards miniaturisation (including smartdust), have considerable potential to reduce freight volumes and weight.

It is also very likely that over the 30 year period that mobile services (mainly provided through the phone) will become far more sophisticated and ubiquitous, as real time information will be available on all transport services, smartcard transactions will be used for bookings and through tickets, as well as the increased provisions of video links and messaging services. The constraints on use would include costs (which are probably low), and the acceptance, competencies and skills required to use the ICT. New intuitive interfaces are required.

In terms of influencing the smart social policy, ICT can also have a major influence in reducing the need to travel and in improving travel making decisions based on environmental impacts. This means facilitating flexible working, telecentres and teleshopping; travel blending; limited vehicle access to town and city centres and parts of the countryside; reduced speed limits; improved information and integration between modes; emission profiling and road pricing (this time based on emissions and distance travelled). Carbon trading will be facilitated by ICT developments in the longer term.

3 Conclusions and Next Steps

3.1 External and Internal Change

Our transport images of the future have thus been immersed in the likely broader trends within society, and are used to depict likely futures within the space of possibilities in the transport sector. They are therefore well grounded in likely future demographic and economic trends. A number of summary issues are evident (see Table 3.1). The likely trajectory of the external influences [on transport] is dependent upon a myriad of issues covering people, politics, industry and emergent factors.

Table 3.1: *Summary External Key Issues*

Key Dimensions	Issues
People	Attitudes, acceptance, skills, knowledge, variations between people, access to technology, priorities
Politics and framing conditions	Global priorities, 24 hour society, distribution of costs and benefits
Industry	Production and logistics, maximum efficiency and welfare objectives
Emergent factors	Techno economic regimes, including oil prices, path dependencies and lock in, substitution, dematerialisation, decoupling (economic and spatial), customisation, mobile services, availability and use of ICT

Beyond this, we can determine the key distinguishing factors between the alternative images (Table 3.2). Both aim to achieve the 60% emissions reduction target, but with a marked change of emphasis in terms of broad objectives, likely travel behaviour and social, environmental and economic impacts.

Table 3.2: *Summary Alternative Transport Images*

New Market Economy	Smart Social Policy
Efficiency – economies of scale and scope	Social welfare – wider objectives including environmental
High level of substitution and technology	Multimodality and seamless travel
Lock in to technology	No need to own a car in the city
Oligopoly and competition	Road pricing and slow travel
Value constellations	Tradable permits
Niche markets and targeting of high margin markets – mainly the rich	Skills and knowledge. Clusters and some dispersal
Occupancy and load factors key – longer distances but greater efficiency	Modal split key – shorter distances and extensive substitution

3.2 Moving Beyond Our Tragedy of the Commons

The largest risk to tackling climate change is that individuals continue to act in their own - rather than the common - interest. Policy makers have a hugely important role to play here.

Researchers, urban and transport planners and others are thus provided with a unique opportunity to challenge existing conventional wisdom and to define and develop radical trend-breaking futures. The window of opportunity is however closing – atmospheric concentrations of CO_2 are currently over 370 ppm - their highest level for over 420,000 years - and rising by over 2 ppm per annum. Before industrialisation in western countries they were at 280 ppm. In the 1958 they were at 315 ppm. In a couple of decades they are likely to move beyond the tipping point of 400 ppm. Concerted action is required now.

The next, and final, stage of the VIBAT report is to progress policy packages and pathways which help to achieve our 60% emissions target. An integrated package of technological and behavioural measures will be critical.

This background paper 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.

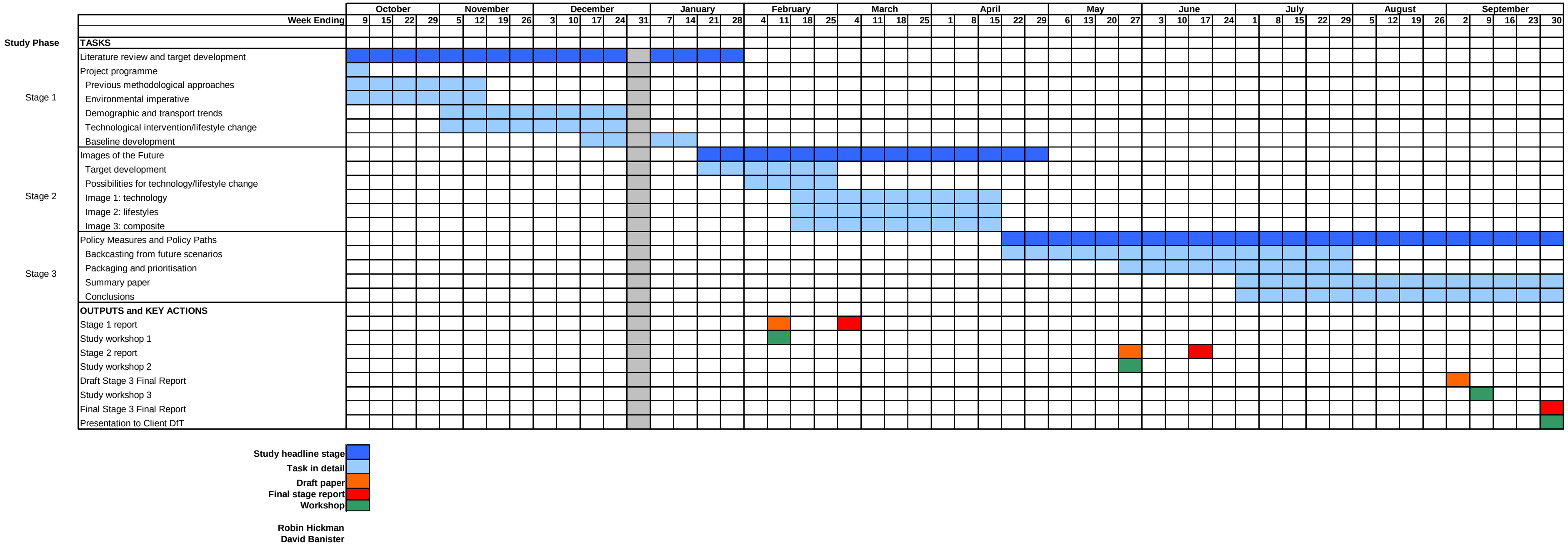
For more information on the project see
http://www.bartlett.ucl.ac.uk/research/planning/vibat

Annexes

Annex 1: VIBAT Work Programme

The VIBAT study is planned in three main work stages as shown below.
Each stage includes a study seminar and draft working paper.

Figure 1: *Work Programme*



Annex 2: Study Workshop 2

Topic: Images of the future

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