

THINKING STRATEGICALLY: PATHWAYS TOWARDS LOW CARBON TRANSPORT

Dr Robin Hickman

Research Fellow, Transport Studies Unit, Oxford University Centre for the Environment,
University of Oxford, South Parks Road, Oxford, UK, OX1 3QY

robin.hickman@ouce.ox.ac.uk

Professor David Banister

Director, Transport Studies Unit, Oxford University Centre for the Environment,
University of Oxford, South Parks Road, Oxford, UK, OX1 3QY

david.banister@ouce.ox.ac.uk

Abstract

This chapter considers the potential for transport CO₂ reductions in Oxfordshire. It examines the CO₂ baseline within the county and elsewhere in the UK, assessing the 'leaders' and 'laggards' in terms of relative transport CO₂ emissions. A target for the county is developed at 1.2 tCO₂ per capita by 2030, and ultimately 0.5 tCO₂ per capita by 2050, and scenario analysis is used to assess the potential interventions, policy packages and different pathways available for CO₂ emission reduction. The Central Oxfordshire Transport Model (COTOM) is used to quantify the likely impacts of different policy areas over the long term to 2030. The contribution made is in setting a potential strategic direction for policy making within transport and in understanding the likely impacts from the options available. The concluding argument is that the current interventions and levels of funding for sustainable transport are not strong enough to significantly reduce transport CO₂ emissions in line with the targets, and there is a need to start thinking and acting differently. There is a major discontinuity between the 'greenwash' of the conjecture at the national governmental level and the level of funding necessary to actual implement effective actions at the local level.

Keywords: transport, climate change, carbon dioxide, equity, public transport, walking and cycling

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1. INTRODUCTION

The first modern motor car was designed and built in 1885, by Karl Benz in Germany. Jump forward 125 years, and there are now over 600 million motor cars worldwide (2010), around one per eleven people. The vast majority are powered by a common technology and power source: the four stroke cycle engine, fuelled by petrol or diesel. The motor car has shaped our cities and urban form, and the use of the car is associated with both instrumental (flexibility and convenience) and affective emotions (a sense of freedom, the thrill of driving, perceived success and enjoyment) (Anable and Gatersleben, 2005). This helps explain the strength of the desire for motorisation and car ownership. The development and 'consumerisation' of the product has been one of the technological and business success stories of the 20th Century, as illustrated by the Toyota Corolla which is the current best-selling vehicle of all time (32 million vehicles and rising, 1966-), closely followed by the VW Golf (25m, 1974-), VW Beetle (22m, 1938-), Ford Model T (16.5m, 1908-1927) and Chrysler Voyager (11.7m, 1984-) (Motortrend Forum, 2010). So we have a very significant momentum in the business model, but also some huge problems. In the words of Heathcote Williams (1991, pp.7-9):

"The first automobile [...] had three wheels, like an invalid car, and ran on alcohol, like many drivers. Since then more than seventeen million people¹ have been killed in an undeclared war. And the rest of the world may be in danger of being run over in a terminal squabble over the oil. Were an alien visitor to hover a few hundred yards above the planet, it could be forgiven for thinking that cars were the dominant life-form, and that human beings were a kind of ambulatory fuel cell, injected when the car wished to move off, and ejected when they were spent."

This chapter examines these issues in terms of the possibilities for a break in the dominant trend of motorisation. A starting point is taken that the potential scarcity of oil, the concerns about climate change, or the health dividend (reduced fatalities from reduced motorisation and health benefits associated with active lifestyles), or the urban fabric dividend (the urban design benefits of reduced car use) will mean that our travel in the future (2030) will by necessity be very different to the extrapolated trajectory. All of these issues however have been well known for years, but little action has been taken in the belief that a technological solution will be found to the problems of peak oil, climate change, adverse health effects and even city structure. It is perhaps the finite nature of oil that will make the difference here (Gilbert and Perl, 2010). Oxfordshire² is used as the case study, with an initial comparison made of the CO₂ baseline within the county and elsewhere in the UK. Scenario analysis is then used to assess the potential interventions, policy packages and different pathways available for CO₂ emission reduction across the county. The context of Oxfordshire means finding solutions for an affluent rural hinterland as well as a compact urban centre (Oxford), and this may lead to contrary priorities. The contribution made is in assessing and quantifying the

¹ The current data estimates that there are over 1.2 million deaths each year on the world's roads, and between 20-50 million suffer non-fatal injuries (World Health Organization 2009. Global Status Report on Road Safety. Washington DC: WHO.). This is a huge cost that seems to be accepted by society.

² The analysis draws on work carried out in the Integrated Transport Appraisal and Simulation for Oxfordshire study (INTRA-SIM Oxfordshire). Hickman, R., Ashiru, O., Seaborn, C., Walters, G. 2010. INTRA-SIM Oxfordshire, Final Report. London: Halcrow.

likely impacts from the potential options available and assessing whether substantial transport CO₂ emission reductions can be achieved. The concluding argument is not new, but needs to be restated: our strategic aspiration in terms of the current application and levels of funding in sustainable transport are not enough to significantly reduce transport CO₂ emissions. There is a major discontinuity between the ‘greenwash’ of the conjecture at the national governmental level and the level of funding necessary to actual implement effective actions at the local level.

2. THE OXFORDSHIRE CONTEXT

Oxfordshire provides an example, with resonance for many other areas, of a relatively sustainable central urban area in urban mobility terms (Oxford), but a car dependent rural hinterland (the remainder of the county of Oxfordshire). These travel behaviours (Table 1) reflect many factors, including income, car ownership levels, the levels and cost of alternative transport provision, a relatively dispersed urban structure beyond Oxford, and also individual aspirations in terms of travel behaviour choices. There is potential for developing a much greater emphasis on walking, cycling and public transport, and also for making significant progress through the introduction of low emission vehicles. The major difficulty for Oxfordshire and many similar locations is in achieving sustainable behaviour across a region or sub-region, in particular the suburban and rural areas beyond central urban areas. Even the more carbon efficient urban centres in European cities – including the classic good practice examples such as Freiburg, Strasbourg, Amsterdam and Zürich – tend to be surrounded by relatively car dependent suburban and rural areas.

The local authorities, Oxfordshire County Council and Oxford City Council, are developing planning strategies and transport investment strategies with a forward look to 2026, and they are generally viewed as progressive authorities in the transport and urban planning field within the UK. The Oxford Local Development Framework (LDF), for example, has been prepared by Oxford City Council (2008, Core Strategy), and there are four other LDFs across the county (Cherwell, South Oxfordshire, Vale of White Horse and West Oxfordshire). Each is prepared within the context of the regional South East Plan (Government Office for the South East, 2009) and national planning policy guidance. The current Oxfordshire Local Transport Plan (LTP3) (Oxfordshire County Council, 2011) has a long term horizon 2011-2030, with a three and five year investment programme that can be updated annually. There are however major limitations in terms of funding, with very low levels of investment being allowed due to constraints imposed by central government through the allocation of strict cash limits. The current Conservative government is less supportive of regional planning efforts, and the land use planning system as a whole, and this has created even greater uncertainty with further reductions in funding for local authorities. There is a policy vacuum, with little strategic direction being offered, and some confusion as to the most effective process for forward planning at the local level.

Within Oxfordshire there are no explicit county-wide or local CO₂ emission reduction targets, or budgets, either across all sectors or for the transport sector. This situation is common across all UK local authorities, and it is clearly at odds with the strong statements from central Government on the importance of achieving the 80 per cent CO₂ reduction target by 2050. Within this debate the targets for transport CO₂ emissions have not yet been set, but they are

likely to lower at about 50 per cent as the costs of reduction are considerably higher than those in other sectors of the economy (DECC, 2009).

There is little understanding of the different baselines, how these might evolve over time, and the means by which significant alternatives might be conceptualised. The nearest perhaps in Oxfordshire is a traffic growth target which seeks to limit the growth in overall traffic levels on Oxfordshire roads. A baseline is used of 10.9 million vehicle kilometres travelled in 2000, with a target of ‘no more than’ 12.2 million vehicle kilometres per day to be travelled in 2010. This equates to an approximate 1% per annum maximum traffic growth target, against a projected 2% per annum (Oxfordshire County Council, 2000). Although the development of sustainable transport initiatives has some history over the last decade or so, the development of low carbon transport strategies that look across a range of technological, network investment and behavioural opportunities are much less well developed. There is a lack of clarity in strategic thinking, insignificant funding, and little understanding of the scale of change required in travel behaviour to contribute to national CO₂ reduction targets. Limited progress may have led to a feeling that change is not possible, and this has created frustration at the local level.

Table 1: Oxfordshire – Some Key Statistics

<i>Issue</i>	<i>Comment</i>		
Population			
Oxfordshire (2001)	605,500		
Oxfordshire (1801)	111,977		
Oxford (2007)	165,000		
Oxford (1801)	12,690		
Area (2007)	2,605 km ²		
Population density	246/km ²		
Commuters	75% of Oxford’s population works within Oxford; only 9% travel outside of the county to work; yet around 50% of Oxford’s workforce lives beyond it (Oxfordshire County Council, 2011)s boundary		
Mode share (2001)	Oxfordshire Main mode for the journey to work: 62% car, 10% walk, 7% bus, 7% bicycle, 10% work at home, 2% rail	Oxford Journey to work: 42% car, 15% walk, 16% bus, 15% bicycle, 8% work at home, 2% rail	West Oxfordshire Journey to work: 67% car, 9% walk, 5% bus, 5% bicycle, 10% work at home, 2% rail
Cars per household (at least one)	82%		
Transport CO ₂ emissions (2008)	3.0 tonnes CO ₂ per person		

(Oxfordshire County Council, 2006; 2007; 2011)

3. BASELINE AND PROJECTIONS

The national UK target of an 80 per cent reduction in transport emissions by 2050 (on 1990 levels) can be applied to Oxfordshire (Table 2)³. There are some data issues, in that 1990 data is not readily available for the county and an end year of 2030 is used to be consistent with the later analysis in this chapter. A 60 per cent reduction in emissions by 2030 can be derived on a

³ Note that the national level has been taken and used locally, and that transport has been allocated its “fair” share rather than taking a lower level as discussed above.

2005 base, which is broadly equivalent to the national UK target. This would mean a target for Oxfordshire at around 1.2 tCO₂ per capita in 2030. An ultimate target for 2050 would however use the UK 1990 baseline, and seek an 80 per cent reduction on this, resulting in a target of around 0.5 tCO₂ per capita for transport in Oxfordshire in 2050. Hence the baselines and timescales used can be very important in target setting.

Table 2: Potential Transport CO₂ Targets for Oxfordshire

Area	Aggregate (Per Capita)
Oxfordshire, total CO ₂ emissions, 2005	5,880 kt CO ₂ (9.4 tonnes CO ₂ per capita)
Oxfordshire, transport, CO ₂ emissions, 2005	1,964 kt CO ₂ (3.1 tCO ₂ per capita)
Oxfordshire, target total CO ₂ emissions, 2030 (60% reduction on 2005 levels by 2030)	2,352 kt CO ₂ (3.8 tCO ₂ per capita)
Oxfordshire, target transport CO ₂ emissions, 2030 (60% reduction on 2005 levels by 2030)	786 kt CO ₂ (1.2 tCO ₂ per capita)
UK-based, target transport CO ₂ emissions, 2050 (80% reduction on 1990 UK levels by 2050)	1990: 120 Mt CO ₂ (2.1 tCO ₂ per capita)
	2010: 120.6 Mt CO ₂ (2.0 tCO ₂ per capita)
	2050: 24.0 Mt CO ₂ (0.42 tCO ₂ per capita)
	<i>Assumed target: 0.5 tCO₂ per capita</i>

The recent historic cross-sector CO₂ emissions are given for the districts in Oxfordshire in Table 3, and they cover both overall emissions and the levels of transport related CO₂ emissions. All areas are reducing in emissions over time, but progress is very slow. Cherwell, South Oxfordshire and Vale of White Horse are associated with the highest emissions in the county, and these represent the affluent, remote rural areas with the highest levels of car use. Cherwell has a total of 11 tCO₂ per capita, and 5 tCO₂ per capita in transport. The urban area of Oxford is by far the lowest emitter, with a total of 6.9 tCO₂ per capita, and just 0.9 tCO₂ per capita in transport. 30-45 per cent of emissions are associated with the transport sector in some districts, which is very high in the UK context. A much more 'appropriate' level is below 15 per cent as found in Oxford. The differences in transport emissions, even in a county as small as Oxfordshire, are thus large, with income levels and accessibility to public transport and central urban areas all playing large contributory parts. It is the difference in transport emissions that largely account for the increase in emissions beyond the urban area of Oxford.

Table 3: CO₂ Emissions by Local Authority in Oxfordshire

Local Authority*	Total	Road Transport	Population ('000s, mid-year estimate)	Total Per Capita Emissions (t)	Transport Per Capita Emissions (t)	% Transport	% Reduction to 0.5 tCO₂ Per Capita
Cherwell	1,632	688	137	11.9	5.0	42.2%	90.0%
Cherwell	1,642	692	138	11.9	5.0	42.1%	90.0%
Cherwell	1,611	695	138	11.7	5.0	43.1%	90.0%
Cherwell	1,548	664	139	11.2	4.8	42.9%	89.6%
Oxford	1,026	147	144	7.1	1.0	14.3%	50.0%
Oxford	1,026	142	144	7.1	1.0	13.8%	50.0%
Oxford	965	146	145	6.6	1.0	15.1%	50.0%
Oxford	1,014	139	147	6.9	0.9	13.7%	44.4%
South Oxfordshire	1,252	460	129	9.7	3.6	36.7%	86.1%

South Oxfordshire	1,277	452	129	9.9	3.5	35.4%	85.7%
South Oxfordshire	1,262	465	129	9.8	3.6	36.8%	86.1%
South Oxfordshire	1,252	445	130	9.6	3.4	35.5%	85.3%
Vale of White Horse	1,165	435	118	9.9	3.7	37.4%	86.5%
Vale of White Horse	1,168	432	118	9.9	3.7	37.0%	86.5%
Vale of White Horse	1,135	432	118	9.6	3.7	38.0%	86.5%
Vale of White Horse	1,148	415	118	9.7	3.5	36.1%	85.7%
West Oxfordshire	805	233	99	8.1	2.3	29.0%	78.3%
West Oxfordshire	797	229	100	8	2.3	28.7%	78.3%
West Oxfordshire	796	233	102	7.8	2.3	29.3%	78.3%
West Oxfordshire	779	223	102	7.6	2.2	28.6%	77.3%
Oxfordshire Total	5,880	1,964	628	9.4	3.1	33.4%	83.9%
Oxfordshire Total	5,911	1,946	630	9.4	3.1	32.9%	83.9%
Oxfordshire Total	5,770	1,970	632	9.1	3.1	34.1%	83.9%
Oxfordshire Total	5,740	1,885	636	9	3.0	32.8%	83.3%

*In local authority order

(Data from Department of Energy and Climate Change, 2010)

There are important issues here in terms of target setting, as the different contexts have very different baselines and opportunities for changing travel behaviour, hence national targets will need to be differentially apportioned by area. Urban and rural areas will provide different opportunities for reductions as well as starting points. Difficult questions hence remain unresolved about whether the high emitting areas should be targeted on the basis of equity, or whether efforts should be concentrated elsewhere in the areas which may be more receptive to low carbon travel behaviours, or where actions might be cheaper to introduce. The above approach for target setting in Oxfordshire draws directly on the current baseline, and this means that it would 'penalise' a location with a low CO₂ emissions by suggesting an even lower future emission level, or conversely it could 'favour' a location with high emissions (as in some parts of rural Oxfordshire). There is no analysis or guidance at the regional and local levels as to the most appropriate reduction targets.

Table 4 provides similar data for selected local authorities in England, and again the variation in emissions is very large. Areas are categorised in terms of the 'laggard' authorities (high emissions) and 'leading' authorities (low emissions) by transport CO₂ emissions per capita. The affluent rural areas (e.g. West Berkshire, Chester, Cambridgeshire, Harrogate) are associated with relatively high per capita emissions, both in cross sector and transport terms. Lower incomes areas and larger urban areas (e.g. London, Liverpool, Manchester), historic university cities (e.g. Cambridge, Oxford, York) and very remote urban areas (e.g. Plymouth, Norwich) have lower per capita emissions. Some of the low income northern towns have surprisingly high per capita emissions because of their relatively high levels of car use (e.g. Warrington and Doncaster). The recent low density developments on the edge of these towns, including out of town retail sheds, leisure complexes and residential areas inaccessible to public transport, may have added substantially to the car dependency in these areas. The contributory factors to travel behaviour and resultant CO₂ emissions are thus wide, covering socio-economic, attitudinal, urban planning and network investments, including the levels of public transport, walking, cycling and highway infrastructure. In future years, the take up of low emission vehicles in different area will also become important. Some areas are 'spending' a very high proportion of their emissions on transport, over 40 per cent in some cases. If a

target of 0.5 tCO₂ in transport CO₂ emissions is to be achieved on an equitable basis then some areas have a very long way to go, with a reduction in transport emissions of up to 90 per cent in some of the high income rural areas. Other areas need to contribute less, but even those with the lowest levels of CO₂ emissions should be seeking at least a 40 per cent reduction in transport CO₂ emissions. Budget allocations for the intervening years (perhaps on a five year basis) would also help in moving towards the end state targets, as this encourages early progress to be made in terms of investing in certain transport options, and a more likely achievement of the targets.

Table 4: CO₂ Emissions by Local Authority in England

<i>Local Authority</i>	<i>Total Emissions</i>	<i>Road Transport</i>	<i>Population ('000s, mid-year estimate)</i>	<i>Total Per Capita Emissions (tCO₂)</i>	<i>Transport Per Capita Emissions (tCO₂)*</i>	<i>% Transport</i>	<i>% Reduction to Target (0.5 tCO₂ Per Capita)</i>
LOW CARBON TRANSPORT, LAGGARDS (>3 tCO₂ Per Capita)							
West Berkshire	1,841	809	151	12.2	5.3	43.9%	90.6%
Richmondshire	537	268	51	10.5	5.2	49.9%	90.4%
Chester	1,291	461	118	10.9	3.9	35.7%	87.2%
Harrogate	1,533	587	156	9.8	3.8	38.3%	86.8%
Warrington	1,934	706	196	9.9	3.6	36.5%	86.1%
St Albans	1,080	491	135	8	3.6	45.5%	86.1%
Doncaster	2,546	897	289	8.8	3.1	35.2%	83.9%
LOW CARBON TRANSPORT, MID-PACK LAGGARDS (2-3 tCO₂ Per Capita)							
Oxfordshire	5,740	1,885	636	9	3.0	32.8%	83.3%
Surrey	8,574	3,252	1,101	7.8	3.0	37.9%	83.3%
Wiltshire	4,694	1,283	454	10.3	2.8	27.3%	82.1%
Hampshire	10,834	3,515	1,284	8.4	2.7	32.4%	81.5%
Milton Keynes	1,920	594	233	8.2	2.6	30.9%	80.8%
Derbyshire	8,945	1,925	758	11.8	2.5	21.5%	80.0%
Shropshire	2,509	732	291	8.6	2.5	29.2%	80.0%
Kent	11,879	3,568	1,402	8.5	2.5	30.0%	80.0%
Devon	6,096	1,834	747	8.2	2.5	30.1%	80.0%
South East	63,773	20,402	8,369	7.6	2.4	32.0%	79.2%
Fenland,	1,036	189	92	11.3	2.1	18.3%	76.2%
Cambridgeshire							
National (England)	506,526	131,045	61,398	8.2	2.1	25.9%	76.2%
Leeds	5,465	1,647	779	7	2.1	30.1%	76.2%
West Sussex	5,368	1,667	789	6.8	2.1	31.0%	76.2%
LOW CARBON TRANSPORT, MID-PACK LEADERS (1-2 tCO₂ Per Capita)							
Cornwall	4,131	1,052	529	7.8	2.0	25.5%	75.0%
Newcastle upon Tyne	1,890	474	278	6.8	1.7	25.1%	70.6%
Stevenage	560	131	81	7	1.6	23.4%	68.8%
Manchester	3,215	687	473	6.8	1.5	21.4%	66.7%
Birmingham	6,534	1,493	1,019	6.4	1.5	22.8%	66.7%
York	1,182	296	195	6.1	1.5	25.1%	66.7%
Stoke-on-Trent	1,647	341	239	6.9	1.4	20.7%	64.3%
Liverpool	2,815	602	441	6.4	1.4	21.4%	64.3%
Harlow, Essex	645	106	80	8.1	1.3	16.5%	61.5%
Sheffield	3,666	682	540	6.8	1.3	18.6%	61.5%
Plymouth	1,414	336	256	5.5	1.3	23.8%	61.5%
Bristol	2,320	536	426	5.4	1.3	23.1%	61.5%
Kingston upon Hull	1,738	319	261	6.7	1.2	18.3%	58.3%

Nottingham	1,806	370	297	6.1	1.2	20.5%	58.3%
Leicester	1,925	341	304	6.3	1.1	17.7%	54.5%
Greater London	46,357	8,736	7,668	6	1.1	18.8%	54.5%
LOW CARBON TRANSPORT, LEADERS (<1 tCO₂ Per Capita)							
Oxford	1,014	139	147	6.9	0.9	13.7%	44.4%
Cambridge	782	109	119	6.6	0.9	13.9%	44.4%
Norwich	794	128	137	5.8	0.9	16.1%	44.4%

*Ranked in descending order by transport per capita emissions (tCO₂)

(Data from Department of Energy and Climate Change, 2010)

4. SCENARIO ANALYSIS

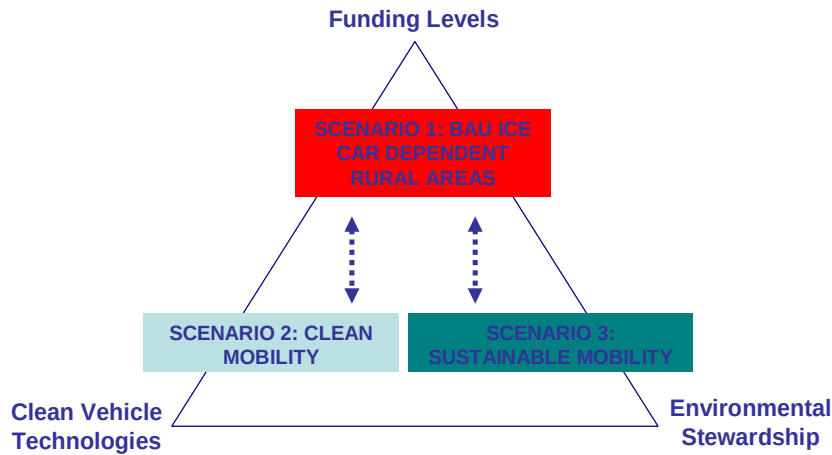
The scale of change required in reducing transport emissions towards the 0.5 tCO₂ per capita target is formidable. The key issues are to examine what can be done in terms of policy interventions and to assess whether this level of emission reduction is possible. To help provide a framework for the thinking, scenario analysis is used as described below. The first stage is to understand the main trends and uncertainties that may be important to transport futures in Oxfordshire (Table 5).

Table 5: Major Trends and Uncertainties Affecting Transport

Trends and Uncertainties	Ranking
<i>Economy and governmental</i>	
Economic growth rate (e.g. GDP or other growth metric)	**1
Funding for transport investment and urban development	
Income levels, income inequality	
Tertiary education sector growth	
<i>Socio-demographics</i>	
Population growth	**2
Age profile (including an ageing population)	
Aspirations and culture – continued ‘western consumption’ model?	
<i>Technologies</i>	
Clean vehicle technologies	**2
Energy and power supply – renewable sources	
<i>Environmental</i>	
Major environmental shocks – changing climate, flooding, water supply	**3
Quality of environment and ecology	
<i>Urban issues and transport planning</i>	
Environmental issues – stewardship, extent of ‘seriousness’ given to them in policy making and implementation	**3
Urban design and built environment quality	
Extent of development and urban sprawl	
Level of sustainability in travel, investment in public transport, walking and cycling	

The three most important issues, in terms of level of uncertainty and likely impact, are used to derive the 'possibility space' for future scenario development. The scenarios are then developed as a 'trilemma'⁴ (Figure 1).

Figure 1: The Possibility Space for Transport Scenarios in Oxfordshire



In Oxfordshire, and indeed much of the UK beyond perhaps London, funding levels are likely to be severely constrained and this will limit the efforts to achieve sustainable travel. The policy intention will still be present, but the implementation programme in terms of schemes and initiatives will be much harder to realise. Funding problems are evident in the short term, but potentially also in the longer term, as local authorities are heavily dependent on central Government support. Transport investment is usually relatively low in the priorities for state spending. There is also a wider problem in practice. There is a major aversion to innovation (and necessarily risk) in transport planning, and efforts to adopt the newer public transport options, or public realm (streetscape design), cycling and walking schemes are not often ambitious. This is evident when a comparison is made between some of the practice in the UK and that in Copenhagen, Delft or Groningen (cycling and walking), or virtually any of the French cities for tram schemes (Strasbourg, Montpellier, Bordeaux), or even Bogotá and Curitiba (bus rapid transit), San Sebastian, Madrid or Barcelona (public realm), and Freiburg or Malmö (urban extensions). UK practice is failing to deliver to the level and the quality on offer elsewhere. The good practice has been around for years, and there are many advocates pushing for improved decision-making and implementation, but internationally leading practice in the UK seems to be not on the same scale as elsewhere.

The scenario analysis for Oxfordshire can be used to examine three major potential futures:

- **Scenario 1 – Business as Usual (BAU):** A continuation of the current policy approach (and levels of implementation), with only ad-hoc progress being made towards sustainable travel behaviour, no real strategic direction, and low funding levels.

⁴ A scenario matrix is also often used in scenario planning, with two dimensions of uncertainty used as the parameters for the future. In theory multiple dimensions can be used to explore possible futures, but the most commonly used approaches tend to keep things simple with limited key dimensions, and variation developed within the scenario portraits.

- **Scenario 2 – Clean Mobility:** There is a marked change in terms of the increased use of low emission vehicles, but levels of mobility continue to rise and there are no coordinated efforts to invest in alternatives to the car.
- **Scenario 3 – Sustainable Mobility:** Here the focus is in developing public transport, walking and cycling options, as well as clean vehicle mobility. Urban structure plays an important role in enabling sustainable travel, and there is a reduction in travel by private motor car. Funding priorities change in terms of much higher investment in the non-car modes and the public realm.

Modelling Approach

The approach to understanding the likely pathways and combination of policy alternatives for each of the three scenarios is to develop an inventory of the range of measures likely to reduce CO₂ emissions in Oxfordshire. This inventory covers the network infrastructure, demand management and pricing measures, low emission vehicle technologies and other policy measures. Individual measures are 'clustered' into policy packages (PPs) as outlined below, and described in more detail later, and the impacts quantified at the policy package level using model runs from the central Oxfordshire multi-modal transport model (COTOM). The results from COTOM are also supplemented with other datasets including vehicle/speed CO₂ emission factors (Department for Transport, 2008), modal CO₂ emission factors (Department for Food and Rural Affairs, 2009) and spatial planning assumptions from the South East Plan (Government Office for the South East, 2009).

- PP1 Rail
- PP2 Bus
- PP3 Walk
- PP4 Cycle
- PP5 Highway Infrastructure
- PP6 Traffic Demand Management
- PP7 Pricing
- PP8 Parking Management
- PP9 Park and Ride
- PP10 Land Use Planning
- PP11 Behavioural Change
- PP12 Low Emissions Vehicles
- PP13 Alternative Fuels
- PP14 Slower Speeds and Ecological Driving
- PP15 Freight
- PP16 Long Distance Travel Substitution

Each package typically has a level of ‘applicability’ – business as usual (BAU), low, medium and high. This notion of applicability may be viewed in terms of the level of investment, the level of policy support or the scale of the initiative, but it should also be remembered that there are also important issues of feasibility and deliverability. A scenario is then developed using a variety of policy packages and different levels of application within each.

Appraisal Framework

Each scenario is compared relative to its CO₂ reduction potential, but also wider multi-criteria impacts; this is an attempt to show that low carbon transport pathways may have differential impacts against other policy goals. A multi-criteria appraisal (MCA) framework is thus developed (Table 6).

Table 6: MCA Framework

<i>Environment (Strategic)</i>	<i>Environment (Local)</i>	<i>Accessibility</i>	<i>Safety</i>	<i>Economy</i>
• Total CO₂ emissions by car, LGV, HGV, bus and rail**	• Population affected by noise • Number of households experiencing noise levels above 68db • Population perceiving a noise nuisance • Population experiencing vibration • Number of households experiencing vibration • Air quality index (by nitrogen dioxide, ozone, sulphur dioxide, particulates)	• Hansen measure of accessibility to town centres (by mode)** • Hansen measure of accessibility to hospitals • Hansen measure of accessibility to workplaces • 2026 households within 30 minutes of town centres • 2026 households within 30 minutes of hospitals • 2026 households within 30 minutes of workplaces	• Number of personal injury accidents (PIAs), based on Stats19 data (2007) • Number of accidents resulting in slight injury • Number of accidents resulting in serious injury • Number of accidents involving fatalities	• Journey time reliability • Junction delays** • Travel time on links, by mode • Access to jobs

NB. For reasons of space, only partial reporting against CO₂ reduction potentials is given in the following analysis.

5. EXPLORING THE SCENARIOS

One of the key scenarios from the Oxfordshire ‘possibility space’ is explored in more detail below. Scenario 3 ‘Sustainable Mobility’ represents a balanced approach to reducing transport CO₂ emissions, covering many of the possible policy packages with the exception of highway infrastructure building. The scenario is illustrated in Figure 2 with details specified in Table 7. The total CO₂ reduction impact is approximately 1.366 MtCO₂ per annum in 2030 (a 48.3 per cent reduction relative to the BAU level in 2030). This would mean 2.0 tCO₂ per capita transport emissions in 2030, relative to a BAU of 3.8 tCO₂ per capita (and relative to a 2005 transport baseline of 3.1 tCO₂ per capita and target of 1.2 tCO₂ per capita in 2030 and ultimately 0.5 tCO₂ per capita in 2050). There are however some important findings and major problems here. The scenario as developed contains a major level of intervention and it is unaffordable under current funding regimes. Further, although it would represent a major contribution to reducing CO₂ emissions in Oxfordshire it is still insufficient against required

targets. This is a story replayed across many authorities in the UK, and internationally perhaps. In the technical analysis and strategy development, very ambitious futures have been identified, but these are currently not financially (and politically) deliverable. In addition, although they are ambitious, they are not likely to help us meet the extremely demanding legally binding strategic CO₂ reduction targets adopted at the UK level under the Climate Change Act (2008)⁵. This discontinuity is a major dilemma for policy makers and not widely appreciated. The adoption of targets is often made in the belief that they are reachable, but the 80 per cent reduction in CO₂ emissions for the UK by 2050 is not likely to be delivered in the UK in the transport sector unless there are immediate and major changes to investment strategies, including the availability of public finance.

Figure 2: Sustainable Mobility

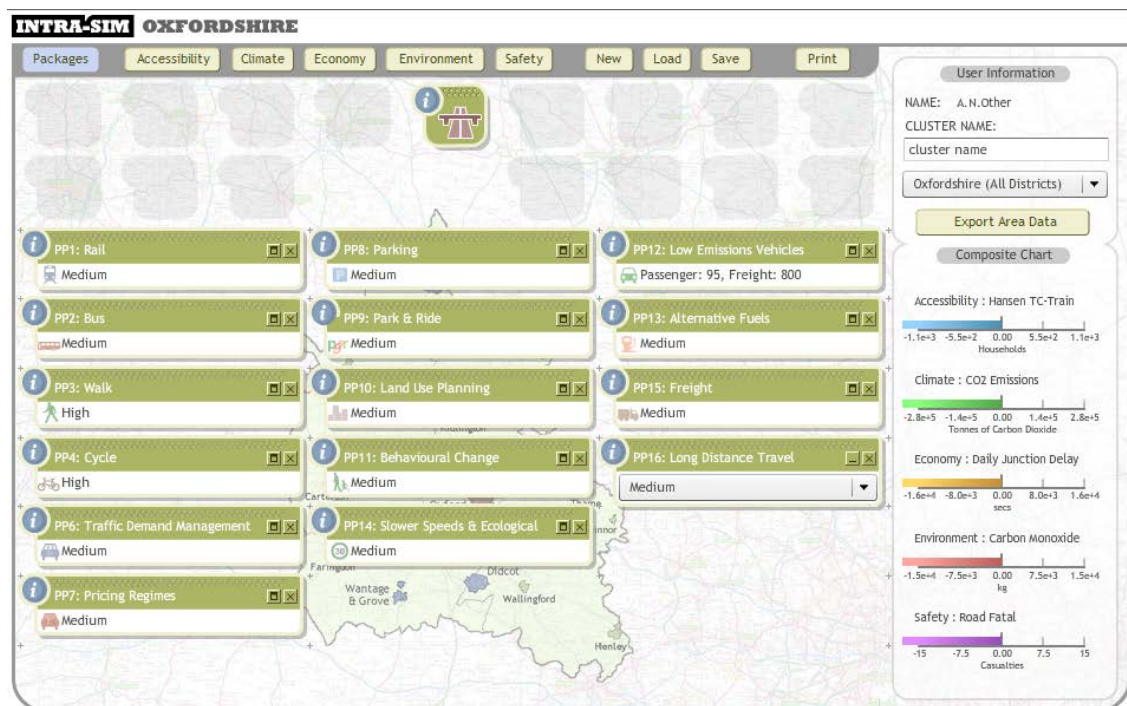


Table 7: Sustainable Mobility

Policy Package	Level of Application	Summary Specification
PP1 Rail	Medium	Interchange improvements, Mainline network frequency upgrades (Reading-Oxford-Midlands) and assumed new networks (Cotswold line upgrade; Evergreen 3, Oxford-Bicester-London Marylebone; and East-West rail, Oxford-Milton Keynes-Cambridge-Felixstowe), new Milton Park station.
PP2 Bus	Medium	Improved Premium Routes to main housing and employment sites; improved bus services between large towns and small towns; electric and hybrid buses in Oxford.

⁵ The UK Climate Change Act (2008) has placed legally binding targets for UK CO₂ reductions of 34% by 2020 and 80% by 2050 on 1990 levels across all sectors of the economy.

PP3 Walk	High	High quality pedestrian environment and streetscape upgrades in Oxford, larger towns, smaller towns and villages, and connections to Rights of Way network.
PP4 Cycle	High	High quality network improvements, integrated cycle parking in Oxford, larger towns, smaller towns and villages, cycle hire schemes in Oxford and large towns. New links from new developments.
PP5 Highway Infrastructure	BAU	None
PP6 TDM/Active Traffic Management	Medium	Access to Oxford programme, including HOV lane on A34; routeing measures from Transport Networks Review (TNR); Traffic Incident Management (TIM) programme; expansion of real-time monitoring systems across the county.
PP7 Pricing	Medium	Road pricing scheme across Oxfordshire and the UK, charging 20p per kilometre for all vehicles.
PP8 Parking Management	Medium	Reduced parking supply in new developments and maximum standards applied, increased use of controlled parking zones.
PP9 Park and Ride	Medium	Increase capacity at existing sites: Seacourt, Redbridge, Thornhill; new remote park and ride sites for Oxford on A34(s), A40(w) and A34(n)/A41 corridors, used for accessing Premium Bus Routes.
PP10 Land Use Planning	Medium	Development located according to South East Plan but better strategic co-ordination and sustainability travel aspirations achieve 25% lower car trip rates in new developments.
PP11 Smarter Choice Behavioural Measures	Medium	Enhanced travel planning (workplace and schools), widespread travel awareness campaign, including increased availability of pre-trip and en-route information, personalised travel planning in new developments, support for car clubs.
PP12 Low Emissions Vehicles	High (Car/LGV) High (HGV)	A total car/LGV fleet at an average of 95 gCO ₂ /km and HGVs (fully loaded) at 800 gCO ₂ /km.
PP13 Alternative Fuels	Medium	Increase in car dieselisation and much greater uptake of biofuels across modes – car 25% diesel (from 15%), 60% petrol, 15% alternative fuels (mix of LPG, electric, biofuel); HGV 75% diesel (from 100%), 25% alternative fuels; bus 60% diesel (from 100%), 40% alternative fuels. No hydrogen in 'medium' level application.
PP14 Slower Speeds and Ecological Driving	Medium	20mph speed limits in all major towns and 50mph speed limits on all rural single-carriageway roads; lower speed limits are supported by variable signage and enforcement. There is also a targeted public education campaign concerning ecological driving skills.
PP15 Freight	Medium	Increase in rail freight capacity between the south coast ports at Southampton and the Midlands and North, together with advisory HGV routing.

PP16 Long Distance Travel Substitution	Medium	Improved coach/rail links to a range of major destinations, including London, Oxford and all London airports, and along major corridors - Birmingham/Manchester, Oxford-Southampton (M40/A34 road/rail corridor), Oxford-Bristol (via Swindon).
SCENARIO RESULTS (relative to BAU 2030)*		
Climate: Carbon dioxide (CO ₂) emission reduction (tonnes CO ₂)	Absolute	Percentage
	-1,365,697	-48.3%
	2.0 tonnes CO ₂ per capita (2030) relative to BAU of 3.8 (assumed aggregate BAU in 2030 is 2,664,849 tonnes CO ₂)	

The major CO₂ reduction impacts in Oxfordshire arise from the following policy packages:

- PP12 Low emission vehicles (high): a high level of application is envisaged, the total car fleet averages 95 gCO₂/km and HGVs (fully loaded) 800 gCO₂/km by 2030. This level of new vehicle technology penetration will be very difficult to achieve across the whole vehicle fleet. The levels (2006) for the current new car fleet are at around 165 gCO₂/km and heavy goods vehicles (HGVs) (fully loaded) at 1100 gCO₂/km.
- PP14 Slower speeds and ecological driving (medium): this has a major impact, representing 20mph speed limits in all major towns and 50mph speed limits on all rural single-carriageway roads; lower speed limits are supported by variable signage and enforcement. There is also a targeted public education campaign concerning ecological driving skills. This package achieves a -5% reduction in CO₂ emissions.
- PP15 Freight (medium): HGV freight movements represent over 20 per cent of traffic on key routes in Oxfordshire, particularly the A34 and M40, and the large and heavy vehicles are high CO₂ emitters. An assumed increase in rail freight capacity between the south coast ports at Southampton and the Midlands and North, together with advisory HGV routing, would reduce heavy goods vehicle traffic through the county. This package also achieves a -5% reduction in CO₂ emissions.

The other selected policy packages also have a direct impact on CO₂ emissions, but the scales of impact are less than the above. PP1 Rail (medium), PP2 Bus (medium), PP3 Walk (high), PP4 Cycle (high), PP6 TDM/Active Traffic Management (medium), PP7 Pricing (medium), PP8 Parking Management (medium), PP9 Park and Ride (medium), PP10 Land Use Planning (medium), PP11 Behavioural Change (medium), and PP16 Long Distance Travel Substitution (medium), for example, all lead to limited CO₂ emission reductions as expected impacts are often masked by other traffic filling up the space gained in network improvements. The major gains are made when car and freight emissions are tackled (the vast majority of emissions). The interpretation of these types of result needs careful consideration. This is not an argument for not investing in the non-car modes, simply a result of the current dominance of car use relative to other travel modes. PPs 1-4, 6-11 and 16 lead to a level of CO₂ reduction and they are also useful for non carbon reduction issues, such as supporting the wider quality of life in urban centres.

6. More Radical Interventions: Towards a 60 per cent and Deeper Reduction

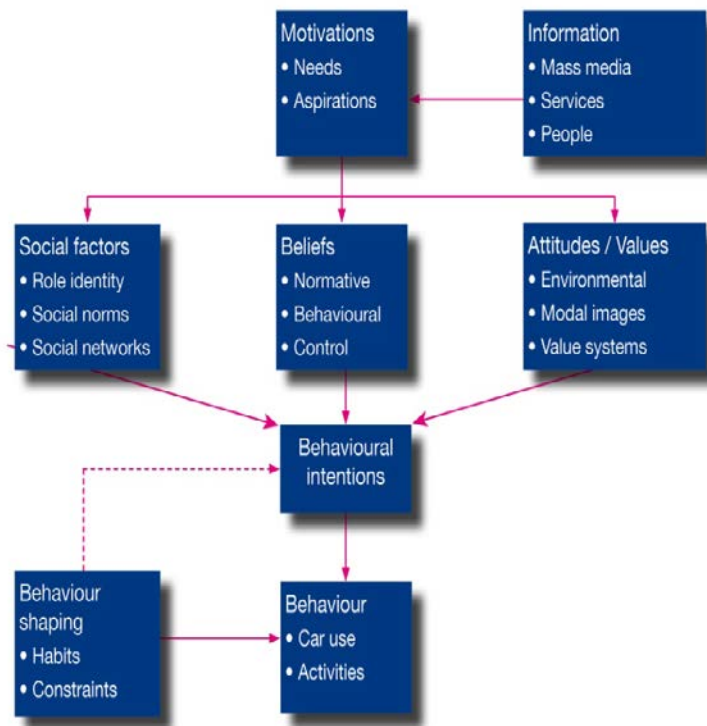
Scenario 3 as examined delivers major gains in CO₂ reduction and wider sustainability benefits. However, it appears that reducing transport CO₂ emissions on an area-wide basis by anything more than 20-30 per cent is likely to be very difficult. The scale of intervention being considered, even in the innovative authorities such as Oxfordshire, is nowhere near enough to deliver the 'fare share' of CO₂ reduction required in the transport sector in contributing towards the national CO₂ reduction target. Greater innovation is required in considering the range of measures available, in making the most of potential application levels, and in packaging and synergies, but too little analysis is considering these issues. This is where scenario analysis can become very useful: in helping to think through what is currently unthinkable (in technical, funding and political terms), with the aim of changing the parameters of the debate.

Very deep reductions in CO₂ emissions, to move towards the 60% reduction in transport CO₂ emissions and beyond on 1990 levels, would require moving towards the 'high level' of application of the policy packages, and beyond, as considered in Oxfordshire. This may mean very radical measures and initiatives (for the present day), including new local rail links, a light rapid transit network for Oxford, tram-train services (e.g. serving Reading-Abingdon-Oxford), fare level changes; much more extensive bus services in rural areas, better network planning and integration, bus rapid transit (e.g. serving Oxford and other key centres), taxi-bus type schemes for rural areas; a much improved public realm for pedestrians; cycle networks and hire facilities across the county; road pricing (at a high charge per kilometre); car free developments, higher parking charges and restrictions in parking supply; much extended park and ride with 'remote' parking sites next to major routes; spatial planning shaped to support public transport usage, walking and cycling to a much greater extent than at present; widespread, mass market smarter choice behavioural measures; and slower speed limits on all roads. International best practice in transport planning, as found in cycling facilities in Groningen or Delft, or public transport in Zürich, Strasbourg or Montpellier, needs to become standard practice. Despite the good intentions of many transport planners over the last 20 years this has not happened. The effective transferability of good practice and transitioning process towards sustainable travel behaviour needs a much more coordinated approach, perhaps through one or two cities becoming examples of what can actually be achieved in terms of minimum carbon use in transport.

There are, of course, wider issues involved in the transition to different travel behaviour. Improved networks, facilities and urban planning are only part of the rationale for travel, as individual motivations are also a critical component. It is here that some of the emerging literature in transport planning sheds some light, as there are important psychological and social and cultural dimensions to people's choice of travel. For example, Lucas and Jones (2009) and Lucas et al. (2011) describe the motivations that may underlie choice processes. These include needs and aspirations, the social factors (identity and norms), beliefs, attitudes and values and behavioural intentions. These factors are also influenced by information and marketing, and they inter-relate with the networks, opportunities and urban form that are more conventionally considered in transport planning (Figure 3). There are also important influences in terms of time-space constraints on travel (Dowling, 2000; Schwanen and Kwan, 2008) and the impact these have on current travel behaviours and future possibilities for changed behaviours. It is these types of factors that tend to be ignored when thinking about

and modelling transport behaviours, and also when shaping policies and strategies for future transport.

Figure 3: The Personal Factors Influencing Car Use Behaviours



(Lucas and Jones, 2009)

The sociology of mobilities take the debate even further as the, perceiving transport or mobility as a defining factor within society (Urry, 2000; Kaufmann, 2002; Sheller and Urry, 2006; Cresswell, 2006; Urry, 2007). There is also the existence of social ‘practices’ (Bourdieu, 1972) within lifestyles and travel. Perhaps surprisingly, the emerging understanding of the rationales behind travel is still embryonic, at all levels from individual motivations to societal representation, and how these might combine, and, critically, the potentialities for change. Furthering these understandings seem central to the transition to sustainable travel behaviours.

7. CONCLUSIONS: INCREASING THE AMBITION

The transport sector needs new thinking and approaches to understanding the scale and immediacy of the carbon reductions necessary over the next twenty years. It must also demonstrate and discuss the potential pathways and examine the feasibility for change. In addition there is an imperative to examine the means by which action can take place, including the responsibilities for both central and local government, so that the necessary powers and funds are available. Any move towards sustainable travel behaviour needs to be area-wide and low carbon targets should also be consistent with wider sustainability objectives.

This chapter has examined the different baselines for districts in Oxfordshire and also for urban areas more generally in the UK. It suggests that the location is of key importance, with the starting points, opportunities and scale of change more varied than imagined, as there is

uniqueness in all situations. The options for Oxfordshire have been examined, with a core scenario outlined in terms of the likely impacts in CO₂ reduction terms. Major CO₂ reductions are possible, but the reality makes any real progress difficult. Many of the measures that would make significant contributions are not possible, as the responsibilities do not reside at the local level and as funding is not available, and even the policy environment has changed away from needing to take immediate action. The INTRA-SIM model allows the exploration of the strategic policy choices in a transparent and participatory manner, with the role playing element allowing the different options to be tested by a range of participants. This makes explicit some of the tensions evident for decision-makers involved in local transport planning. It is this type of decision-making tool and process that can change the parameters of the debate by making the problems of implementation more explicit, and through allowing a wide range of different interested parties to get involved in examining the alternatives. Such an approach allows the ownership of the decisions to be spread as widely as possible, and this in turn means that public and political acceptability will be enhanced.

Creative combinations of policy measures are required to achieve the target reductions in transport CO₂. As noted above, the interventions considered cover the responsibilities of Oxfordshire County Council and other key public and private decision makers, including those at the national and European levels. Reduced national funding levels certainly are causing difficulties in investment programmes. The Sustainable Mobility Scenario (Scenario 3), although representing substantial new investment, which is far beyond the current funding levels available, still only delivers an expected level of 2.0 tCO₂ per capita in 2030. This is only a reduction of a third against 2005 levels and quite a way from an assumed target of 1.2 tCO₂ per capita in 2030 and 0.5 tCO₂ per capita in 2050.

It is well known that achieving a substantial reduction in transport CO₂ emissions is very difficult, and it requires a move towards the 'high level' of application of the policy packages considered in Oxfordshire. It also suggests that such targets may be impossible to achieve, even if there were funds available and the necessary political and public support for effective implementation. This in turn means that combinations of policies need to provide more than their individual contributions (i.e. synergetic effects), that transport options need to be considered with interventions in other sectors, and that reductions in levels of mobility are required. It should also be remembered that carbon reduction is only one policy objective, so impacts across multiple indicators need to be part of any assessment, and this might include multi-criteria or goals achievement assessment (Saxena, 2010; Hickman, 2010). All of these are major issues to be resolved and progressed in the next few years.

The caveat from Thomas More is relevant in this debate (Utopia, 1516, pp. 118):

"There are many features of the Utopian commonwealth that I can more easily wish for in our own societies than hope to see realised."

Thinking strategically, in a similar manner to the 'strategic conversation' (Van der Heijden, 1996), becomes central to transport planning: involving ambitious targets, a range of measures and high levels of application, consistent starting points for assessing change, and understanding the variations between different locations. But it is also in realising the need for substantial change in individual lifestyles, and the practices of behaviour and society. Effective realisation means that all of these barriers must be overcome, and in this sense it is

understandable why so little progress has been made, either at the national or the local level in reducing the levels of carbon emissions in transport.

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Dr Robin Hickman (robin.hickman@ouce.ox.ac.uk) is a Research Fellow at the Transport Studies Unit, University of Oxford and an Associate Director at the Halcrow Group. Professor David Banister is Director of the Transport Studies Unit at the University of Oxford.

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