DERBYSHIRE County Council
Improving life for local people

derbyshire

LOCAL TRANSPORT PLAN

2011 to 2026

carbon reduction strategy: road transport network

April 2011

Maps

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Executive Summary

This document is the CO_2 reduction strategy for the Derbyshire third Local Transport Plan (LTP3) for the period 2011-2016. The overall aim of this Strategy is to quantify the CO_2 emissions from each aspect of the Derbyshire road transport network and assess the possible emission reduction which could be achieved if various measures were implemented through the LTP3. The aim is to provide an indication as to the scale of the emission sources, identify potential measures which could be used to reduce these sources and where possible quantify the CO_2 emission reduction which could be achieved. The intention is that this Strategy can be used as a tool to inform strategies, policies and the decision making processes involved in the development and implementation of the LTP3. It will also provide a vehicle to assess progress in CO_2 reduction within the transport sector, identify gaps in data, support projects which could be implemented to gather further information and to reduce the sources of CO_2 from the transport network.

There are two guiding principles for this Strategy

- To ensure that the current road transport network is used as efficiently as possible. Improving the efficiency with which the current network is being used should allow the transport network to still fulfil the requirements of the user whilst also delivering reductions in CO_2 emissions.
- To provide a vehicle with which plans can be made to decarbonise the current transport network and provide a range of viable sustainable transport options.

The benefits of a more efficient and sustainable transport network are numerous and potentially far reaching. In addition to reducing CO_2 emissions, efficient, sustainable transport networks can also provide financial benefits through reduced use of fuel and improved use of resources, reduced congestion, improved journey times, increased support of the local economy, better air quality, health benefits, reduced congestion and an overall improved environment.

Consideration should also be given to preparing Derbyshire for a future of rising oil prices and the subsequent cost of transport. There are growing concerns regarding the impact that Peak Oil could have on transport in the future. Peak Oil is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline because geological limitations are reached. If demand for oil continues to increase over supply then an increase in oil prices can be expected. There are also concerns regarding the insecurity of supply and price volatility further increasing the price of fuel. Therefore, the principles of this Strategy also guide Derbyshire to prepare for such a future and making sure the transport system is resilient to such pressures.

Figure 1 provides a summary of estimated CO_2 emissions from different aspects of the Derbyshire road transport network. Figure 2 lists potential CO_2 emission reduction measures which could be implemented, their associated CO_2 reduction potential, ability for the LTP3 to influence the measures, estimated timescales and costs. It is recommended that policies should consider all influences on carbon reduction measures when drawing conclusions from this information.

Figure 1: Road Transport CO_2 Emissions per sources (2008)

Transport Sector	Carbon Dioxide Emissions (kt CO_2 pa)	% Total emissions
Total Car Drivers	944.3	56.9
Car driver commuting to work	226.6	13.6
Single occupancy commuting car drivers	206.2	12.4
Derbyshire County Council staff commute	26.6	1.6
Car drivers travelling on business	122.8	7.4
Car drivers travelling/escorting to education	37.8	2.3
Car drivers Shopping	132.2	8.0
Car drivers in other escort and personal business	141.6	8.5
Car drivers visiting friends	151.1	9.1
Car drivers travelling for other leisure purposes	56.7	3.4
Car drivers travelling as part of a holiday	75.5	4.5
Articulated Heavy Goods Vehicles	260.3	15.7
Rigid Heavy Goods Vehicles	178.2	10.7
Light Goods Vehicles	223.4	13.4
Motorbikes	4.9	0.3
Public Transport: buses	33.2	2.0
Derbyshire County Council school transport	0.8	0.05
Derbyshire County Council contracted services	3.3	0.2
Commercial bus services	29.8	1.8
Derbyshire County Council business travel	4.3	0.3
Derbyshire County Council vehicle fleets	4.9	0.3
Derbyshire County Council streetlights/bus shelter lights/signlights	17.1	1.0
Total Traffic	**1644.4**	**99.0**
Total Emissions from Transport Network	**1661.5**	**100.0**

Figure 2: Carbon reduction summary, including level of influence, timescales and costs (2008)

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Replacing all cars with low emission vehicles (=<110g CO_2/km)	National Policy supported by local awareness raising, Personalised Travel Planning	350.2	Positive	Low	Long	High
Replacing petrol fuel cars with hybrid petrol/electric	National Policy supported by local awareness raising, Personalised Travel Planning	255.7	Positive	Low	Long	High
Replacing petrol fuel cars with CNG/LPG	National Policy supported by local awareness raising, Personalised Travel Planning	78.6	Positive	Low	Long	High
Replacing petrol fuel cars with diesel	National Policy supported by local awareness raising, Personalised Travel Planning	74.4	Negative	Low	Long	High
Replacing all current cars with electric vehicles	National Policy supported by local awareness raising, Personalised Travel Planning, provision of charging points	497.4	Positive	Low	Long	High
DCC Estate reductions (including energy use in buildings)	Corporate policy	4.6	Positive	High	Short	Low
Increasing use of car share for commuting journeys	Car Share Derbyshire available, promotion through awareness raising, Personalised Travel Planning	47.6	Positive	High	Short	Low

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Increasing uptake of cycling to work: Those who live <5km from work to cycle in place of driving	Creation of viable cycle networks, awareness raising, Personalised Travel Planning	33.6	Positive	High	Medium	Medium
Increasing uptake of walking to work: Those who live <2km from work to walk in place of driving	Creation of viable walking networks, awareness raising, Personalised Travel Planning	9.1	Positive	High	Medium	Medium
Sustainable Travel Towns Initiative (Eg Chesterfield, Buxton, Long Eaton)	Personalised travel planning project	8.1	Positive	High	Short	Medium
Using low carbon buses for all services	Awareness raising, liaison with Operators	9.9	Positive	Low	Long	High
Using low carbon buses for contracted services only	Awareness raising, liaison with Operators	1.0	Positive	High	Med	TBC
Smarter Driving: Cars	Awareness raising, provision of training, Personalised Travel Planning	68.0	Positive	Medium	Short	Low
Smarter Driving: Buses	Awareness raising, liaison with Operators	2.4	Positive	Medium	Medium	Low

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Smarter Driving: Freight	Awareness raising, liaison with Fleet Operators, Business Travel Plans	47.7	Positive	Medium	Medium	Low
Freight: Selection Policy	Awareness raising, liaison with Fleet Operators, Business Travel Plans	20.1	Positive	Medium	Medium	TBC
Freight: Aerodynamic Styling kits	Awareness raising, liaison with Fleet Operators, Business Travel Plans	26.8	Positive	Medium	Medium	TBC
Freight: Fuel Management	Awareness raising, liaison with Fleet Operators, Business Travel Plans	13.4	Positive	Medium	Medium	TBC
Freight: Route Planning	Awareness raising, liaison with Fleet Operators, Business Travel Plans	10.7	Positive	Medium	Medium	TBC
Freight: Strategic Measures	Awareness raising, liaison with Fleet Operators, Business Travel Plans	13.4	Positive	Medium	Medium	TBC
Increasing access to Derbyshire Tourist Events by sustainable transport	Awareness raising, provision of alternative transport and incentives	TBC	Positive	High	Short	Low
Encouraging and supporting sustainable tourism in Derbyshire	Awareness raising, provision of alternative transport information and incentives	TBC	Positive	Medium	TBC	TBC

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Reduction in energy consumption of DCC signlights, streetlights and bus shelter lighting	Programme of bulb replacement and reduction in burning hours	TBC	Positive	Medium	Long	TBC
Reducing the need to travel	Land-use and accessibility planning	TBC	Positive	High	Short	Low
Reducing business travel mileage	Business Travel Plans	TBC	Positive	High	Short	Low
Reducing travel to school mileage	School Travel Plans	TBC	Positive	High	Short	Low
DCC Corporate Initiative: Changing the Way Derbyshire Works	Corporate policy	TBC	Positive	High	Medium	Low
Transfer freight from road to rail	Awareness raising, liaison with Freight Companies	TBC	Positive	Medium	Long	TBC
Emission standards in conditions of contracted services	Contract Conditions	TBC	Positive	High	Short	TBC

For explanation of the rating criteria, please reference: Explanation of terms

Terminology and Glossary

Fuel Consumption: The amount of fuel consumed per distance travelled. Typical units include litres per 100km (l/100km). Lower values mean better fuel consumption: you use less fuel to travel the same distance.

Fuel economy: The distance traveled per unit of fuel used; most commonly miles per gallon (mpg) or kilometres per litre (km/l). Higher values of mpg means travelling further for the same amount of fuel.

Fuel consumption and CO_2: Emissions are directly correlated for diesel and petrol.

Fuel efficiency and CO_2: Emissions are inversely related.

Tailpipe CO_2 emissions: Refers to CO_2 emissions released directly from the vehicle as a consequence of internal combustion of fuel.

Lifecycle CO_2 emissions: Refers to the 'well to wheel' concept which also considers emission generated from the production and distribution of fuels and the production and disposal of vehicles etc.

BSOG: Bus Service Operators Grant
CO_2: Carbon Dioxide *(Further information can be found in Appendix II)*
CO_2 eq: Carbon Dioxide equivalent (incorporates other greenhouse gases - *further information can be found in Appendix II*)
CNG: Compressed natural gas
DCC: Derbyshire County Council
DECC: Department of Energy and Climate Change
DEFRA: Department of Environment, Food and Rural Affairs
DfT: Department of Transport
EU: European Union
GHG: Greenhouse gases, including CO_2 dioxide
HEV: Hybrid elective vehicle
HGV: Heavy Goods Vehicle >3.5t GVW
Kt: Kilotonnes
Kg: Kilogramme
LDV/LGV: Light Duty Vehicle/Light Goods Vehicle up to 3.5tGVW
LED: Light emitting diode
LEV: Low emission vehicle
LPG: Liquid-petroleum gas
LTP2: Local Transport Plan 2006-2011
LTP3: Local Transport Plan 2011-2016
MCO_2: Megatonnes of CO_2

NAEI: National Atmospheric Emissions Inventory

NI: National Indicator

EPR: Environmental Permitting Regulations

Introduction to the Strategy

The overall aim of this Strategy is to quantify the CO_2 emissions from each aspect of the Derbyshire road transport network and assess the possible emission reduction which could be achieved if various measures were implemented through the Local Transport Plan 3 (LTP3) 2011-2016. The aim is to provide an indication as to the scale of the emission sources, identify potential measures which could be used to reduce these sources and where possible quantify the CO_2 emission reduction which could be achieved. The intention is that this Strategy can be used as a tool to inform strategies, policies and the decision making processes involved in the development and implementation of the LTP3. It will also provide a vehicle to assess progress in CO_2 reduction within the transport sector, identify gaps in data, support projects which could be implemented to gather further information and to reduce the sources of CO_2 from the transport network.

CO_2 Emission Sources Assessed

This Strategy assesses the carbon Dioxide (CO_2) emissions which originate from the road transport network only and compares the results with those published nationally by DECC through National Indicator 186 Per capita CO_2 Dioxide emissions per area in the local authority area. This Strategy only deals with direct 'source' or 'tail-pipe emissions' from the Derbyshire transport network. For a detailed explanation of this term, please reference Appendix II.

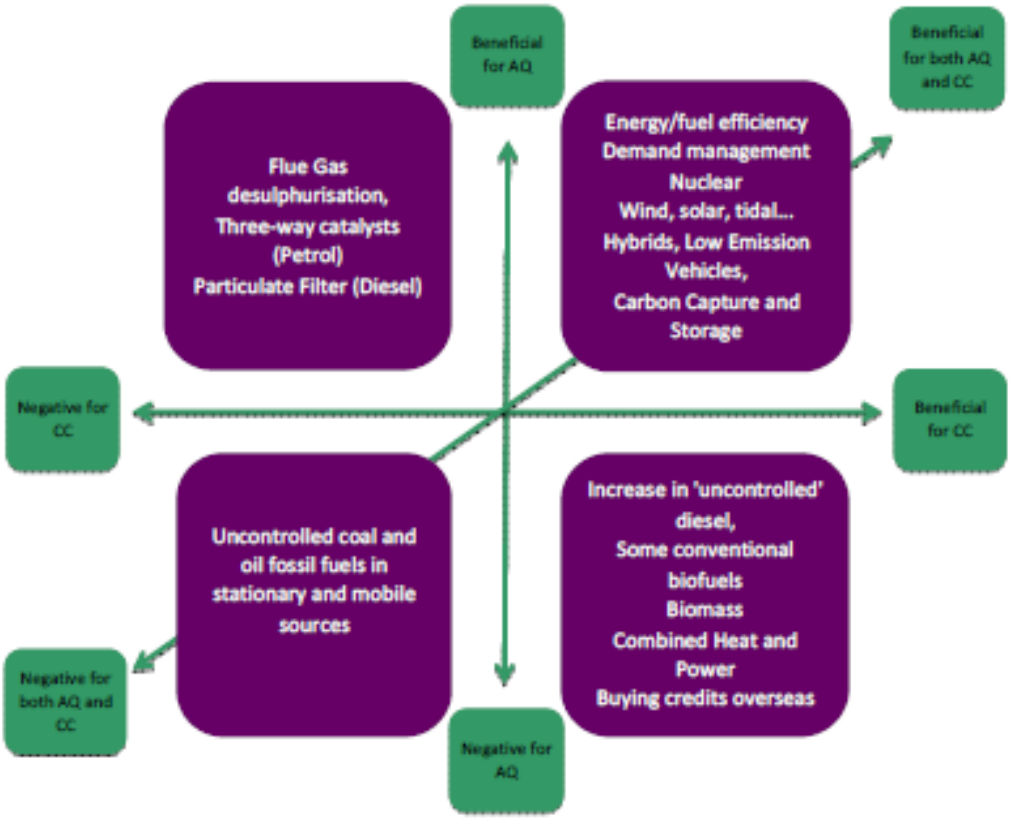
Since the analysis is based on total vehicle km driven, the data will inevitably include residents and non-residents travel in Derbyshire. However some local datasets and surveys are available which has allowed an assessment of Derbyshire resident's travel choices and these are detailed in the appropriate sections of this Strategy.

The emissions from the Derbyshire rail network have not been assessed as part of this Strategy. Currently, the quantified outputs of this Strategy are compared with the results from NI 186, as published by DECC[1] annually. However, since the emissions from rail are not included in the DECC calculations of NI186 due to issues extracting electricity powered rail data from the energy sector, comparison of outputs is not possible at the time of writing this report. Therefore it was felt appropriate to assess these emissions in future phases of this Strategy. The importance of rail is discussed in this Strategy, particularly in the context for potential carbon reductions through modal shift from using the car to train, and also through the transfer of freight from road to rail.

[1] http://www.decc.gov.uk/en/content/cms/statistics/indicators/ni186/ni186.aspx

In developing this carbon reduction strategy, local air quality has also been given careful consideration as recommended in the recently published Defra guidance document 'Air Pollution: Action in a Changing Climate[2]. Since many processes which generate CO_2 emissions also contribute to local air pollution, measures to reduce some of these emission sources for carbon reduction can also have a mutual benefit to improving local air quality. However, there are some areas where there can be a trade-off between the two, where an improvement made to reduce CO_2 emissions may have a negative impact on local air quality and these need to be fully understood and considered in this Strategy. The science is complex surrounding the differing impacts of air pollutants and greenhouse gases and the evidence base is still being collated, however care must be taken where possible to consider both aspects when developing carbon reduction policies. These will be discussed further in the appropriate sections of this Strategy, however a useful summary is depicted in Figure 3 which is featured in the aforementioned Defra report regarding air pollution and climate change.

Figure 3: Policy map displaying air quality and climate change interactions



[2] http://www.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-pollution.PDF

Data Health Warning

At the time of writing this Strategy, modelling software to accurately predict the sources and reductions of CO_2 was not available nor the data which would be required to run such a model. A national tool and methodology were also unavailable therefore the calculations have been made using best available information, using vehicle kilometres, emission factors, vehicle splits, surveys and various estimates and assumptions to allow the calculations to be made.

The national estimates of CO_2 from a local authority area through NI 186 however used more detailed information in computer models which is not available on a local level, namely the mix of warm/cold starts, vehicle speeds, driving styles and fleet mixes. Therefore, in comparison to analysis conducted at a national level, the calculations completed locally involve more simple mathematical functions, the resulting output therefore provides a reliable indication of the scale of CO_2 emissions but not necessarily as absolute quantities. When using the output data, the assumptions used in calculating the emissions should be fully understood and it should be noted that the outputs are not mutually exclusive and therefore cannot be added to assess total emission reduction which could be achieved.

The calculated carbon emissions in this Strategy have been compared with centrally produced statistics Derbyshire, which showed that local calculations resulted in higher estimated CO_2 emissions than those produced centrally, approximately 10% higher. This difference is due to the different methodologies employed in the calculations. However, since the objective of this Strategy is to provide an overview of the relative scales of the different transport CO_2 emission sources and their potential reduction, this difference is not as important as the comparative magnitude of the sources and reductions detailed.

The calculations used in this Strategy can be re-run using improved data and research as this becomes available, and should a national tool to quantify carbon emissions be developed by the DfT, as recommended in the recent report produced by Atkins on behalf of DfT: Local and Regional Climate Change Research[3], all the calculations can be re-run in future phases of this Strategy. This report also highlights the potential benefit of using fuel sales data to calculate area-wide CO_2 emissions, which is discussed further in Part 3: Recommendations for future work.

In order to ensure all local calculations are traceable, transparent and replicable and to allow calculations to be updated should new information and data become available, all emission factors, baseline data, estimates and assumptions used are disclosed in Appendix I. The baseline year for this assessment and that used for the majority of data sources is 2008. A minority of data sources are unavailable for this year, and where this is the case, these will be clearly identified and where appropriate, projections using that dataset will be employed.

[3] http://www.dft.gov.uk/pgr/regional/policy/climatechange/

This Strategy has been prepared on the basis of the best available estimates of CO_2 emissions. If anyone has any comment about methodology used, or ideas for further development of the work, these are welcomed.

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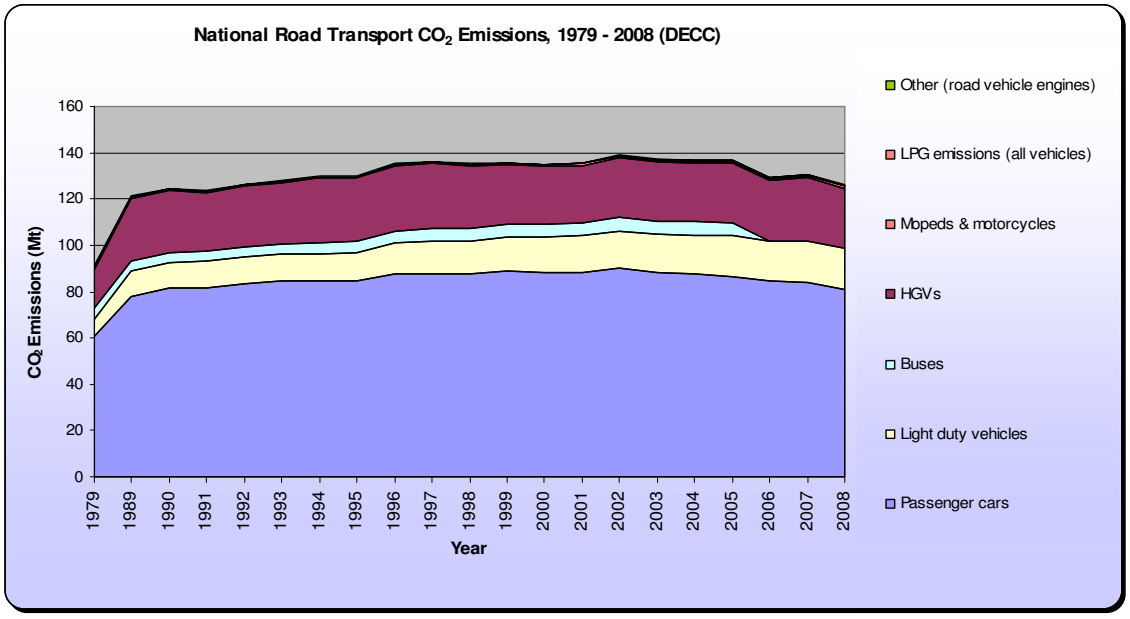
Part 1: Assessing the scale of road transport CO_2 emissions in Derbyshire

Overall Picture: National and Local Trends

Figure 4 provides a national overview of the CO_2 emissions from road transport over the past 30 years. The graph clearly shows that CO_2 emissions from road transport have increased considerably since 1979, although the rate of increase has lessened and reduced in the last decade. This levelling and reduction in domestic road transport emissions over recent years has also been documented in the DfT Transport CO_2 Reduction Delivery Plan[4], published in March 2010. This Strategy states 'the most recent data shows that UK domestic transport greenhouse gas emissions were 131.9Mt CO_2 in 2008, which is 3% lower than in 2007, and the largest reduction in transport emissions since 1990. This was chiefly the result of reductions in road

Figure 4: National CO_2 emissions from road transport, 1970 – 2008, DECC.



transport emissions, which were down 4% compared with 2007. These numbers represent encouraging movement in the right direction, and we will be analysing them in detail to understand what underlies the change'. Figure 1 also shows the proportion each road vehicle type contributes to overall emissions, highlighting that overall, passenger cars are the predominant source of emissions from road transport with mopeds, motorcycles and LPG vehicles representing the least. The proportion of light duty vehicles has gradually increased from 1979 to date, demonstrating this vehicle type to be a growing area within the road transport sector. The DfT CO_2 Pathway Analysis observed

[4] [4]http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/about/strategy/transportstrategy/tasts/tastsCO2pathway/

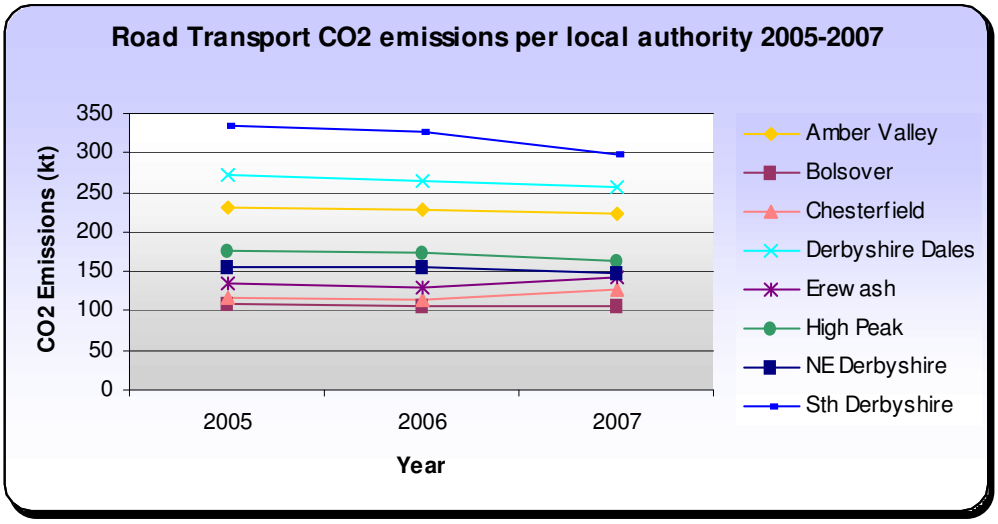
that 'LGV traffic has been increasing fast in recent years, and this is forecast to continue, suggesting growth in CO_2 emissions from LGV traffic of around 30% to 2025.'

It is logical to infer that this national trend in CO_2 emissions over the past thirty years, as depicted in Figure 4, would be mirrored at a local level along the Derbyshire road network, however at the time of writing this Strategy, road traffic data over this 30-year time period is currently unavailable. Local data is available specifically for Derbyshire roads over a shorter time period through reporting on National Indicator 186. The National Performance Framework for local authorities and their public sector partners agreed a national indicator set for Derbyshire which includes two climate change indicators which aim to quantify CO_2 emissions in Derbyshire, these are:

- NI 186: Per capita CO_2 Dioxide emissions per area in the local authority area
- NI 185: CO_2 Dioxide reduction from local authority estate

Information provided through these reporting mechanisms have been used in this Strategy, which provide quantified CO_2 emissions for Derbyshire. NI 186 provides data for all sources of CO_2 within Derbyshire for the years 2005 to 2007 (at the time of writing this Strategy, 2007 is the most recent

Figure 5: Estimated CO_2 emissions for each local authority in Derbyshire from 2005-2007, DECC.



year available). This information is compiled at a national level by AEAT on behalf of DECC[5] and provides data regarding CO_2 emissions from a local authority area including from the road transport sector. This information provides a useful insight into Derbyshire road transport emissions, broken down into the constituent authorities and is shown in Figure 5.

Although three years data is insufficient to assess trends, it provides a useful overview of emissions and also the variation in CO_2 emissions from each authority, which reflects the variable nature of the Derbyshire road network. Figure 5 shows, with the exception of Chesterfield and Erewash, that the

[5] http://www.decc.gov.uk/en/content/cms/statistics/indicators/indicators.aspx

majority of Derbyshire authorities show similar or a slight decreases in CO_2 emissions per year between 2005 and 2007, with overall Derbyshire emissions remaining fairly steady over the three years. This pattern fits with the national perspective of CO_2 emissions from transport and may be due to the effects of the wider UK economy, however further data and analysis is required to substantiate this. Figure 5 also illustrates the differences in the level of CO_2 emissions between authorities, reflecting differences in urban densities, presence of major arterial or trunk roads, relative location of homes, workplaces and shops, public transport infrastructure and network and policy measures. Understanding these differing influences on the road transport network within Derbyshire, will help to devise effective measures, tailored to reflect these local demands and pressures.

The Derbyshire Road Transport Network

In order to quantify emissions and make viable suggestions regarding the CO_2 reduction measures which could be implemented, it is important to fully understand the transport network of Derbyshire; to understand the pressures and requirements which influence it, the types of vehicles that are using the roads and the reasons why. The CO_2 emissions can then be quantified for the various transport users, alternative lower CO_2 emission alternatives suggested and the impacts these alternatives may have on CO_2 emissions assessed.

Figure 6 provides an overview of the Derbyshire road transport network and identifies the main influences exerted on this network, including locations of industrial, urban and rural areas, adjacent cities and the railway network. Derbyshire covers an area of 255,071 hectares of central England. It supports a population of 745,500 and aside from the largest market town, Chesterfield with a population of 99,500, is largely a rural authority dotted with towns and villages. These urban areas are mainly concentrated down the eastern and western edges of the County, which provide areas of employment, leisure and shopping facilities. There is considerable industry in the north-east of Derbyshire and quarrying to the north-west. The majority of the rail network lies to the east of the county, requiring freight to be transported mainly by road in the west.

Derbyshire is also within close proximity of the major cities of Manchester and Sheffield to north-west and north-east and Derby and Nottingham to the south. These cities exert considerable pressure on local road networks on their periphery for those residents accessing the cities for employment, shopping and leisure purposes. To the east of the County, a particularly busy section of the M1 and several trunk roads skirt the county from north to south. The remainder of the transport network mostly comprises A and B roads, with busy east-west movements connecting with the M1 in the east. The central area of Derbyshire is more rural in nature dotted with villages and towns and lying at altitudes of 300m or more. The central and northern areas of Derbyshire also form a major part of the Peak District National Park which draws substantial visitor numbers and tourism every year.

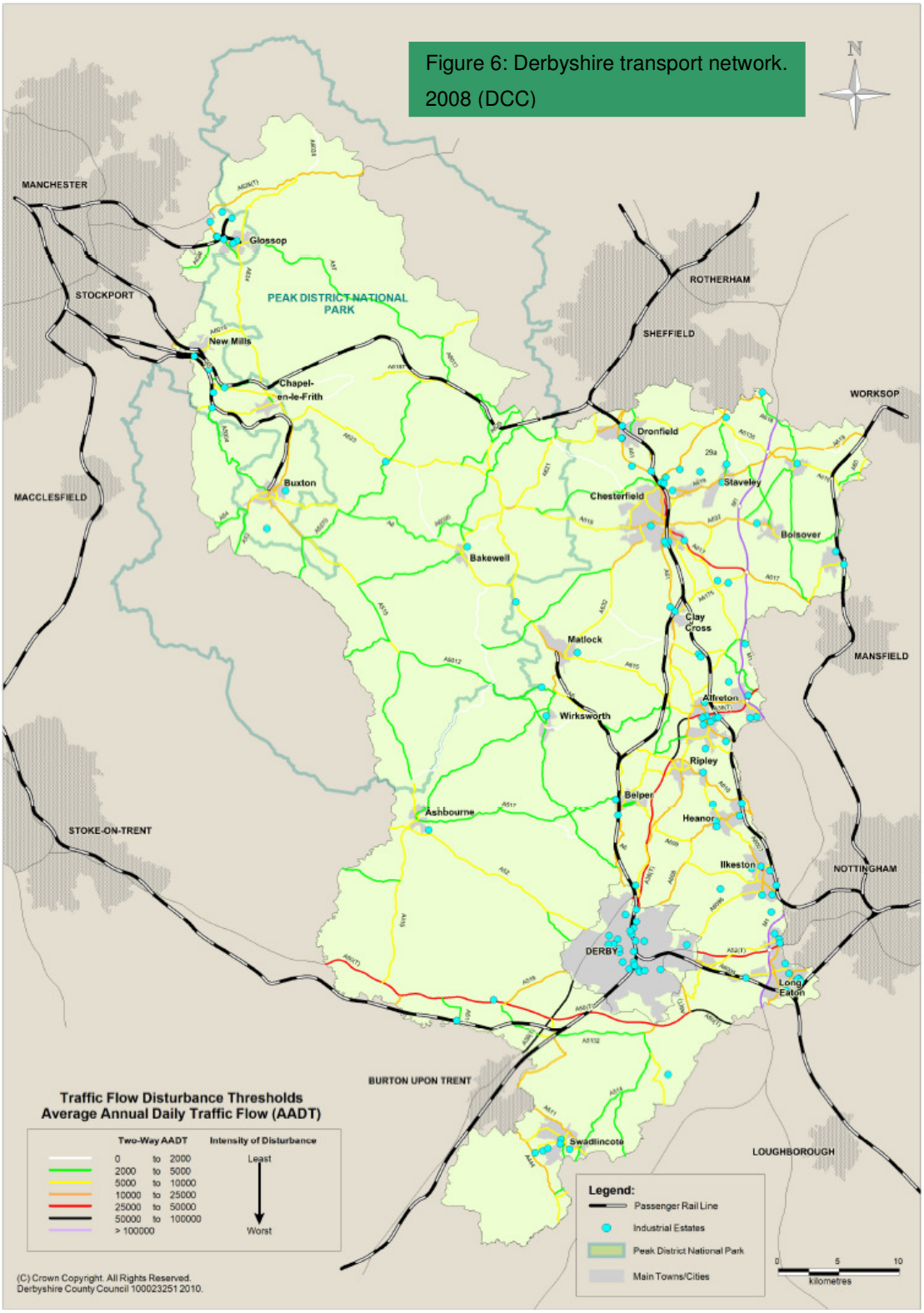


Figure 6: Derbyshire transport network. 2008 (DCC)
N
MANCHESTER
STOCKPORT
MACCLESFIELD
STOKE-ON-TRENT
BURTON UPON TRENT
ROTHERHAM
SHEFFIELD
WORKSOP
MANSFIELD
NOTTINGHAM
LOUGHBOROUGH
PEAK DISTRICT NATIONAL PARK
Glossop
New Mills
Chapel-en-le-Frith
Buxton
Bakewell
Dronfield
Chesterfield
Staveley
Bolsover
Clay Cross
Matlock
Alfreton
Wirksworth
Ripley
Belper
Heanor
Ilkeston
Ashbourne
DERBY
Long Eaton
Swadlincote
Traffic Flow Disturbance Thresholds
Average Annual Daily Traffic Flow (AADT)
Two-Way AADT
Intensity of Disturbance
0 to 2000
2000 to 5000
5000 to 10000
10000 to 25000
25000 to 50000
50000 to 100000
> 100000
Least
Worst
Legend:
Passenger Rail Line
Industrial Estates
Peak District National Park
Main Towns/Cities
0
5
10
kilometres
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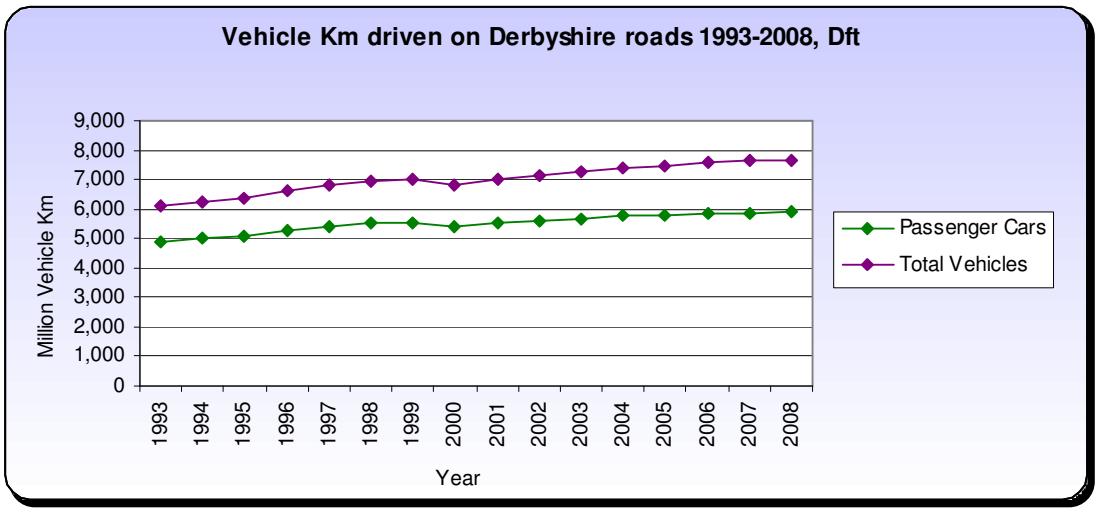
Traffic using Derbyshire Roads

Providing an overview of Derbyshire's road transport network highlights potential pressures and influences on the traffic patterns, which will influence the associated CO_2 emissions. In order to begin to quantify the CO_2 emissions generated, detailed information is required regarding the traffic using the roads, including the type of vehicle and distance travelled. The DfT provide annual statistics[6] regarding the number of vehicle kilometres driven within a local authority area and proportions of passenger cars to other types of vehicles. This data is available from 1993 onwards and provides a useful overview of the trends in vehicular distance travelled over the past 20 years which is shown in Figure 7 below.

Figure 7: Vehicle Km driven on Derbyshire roads 1992-2008, Dft.



The overall trend appears to be an increasing number of vehicle kilometres driven each year on Derbyshire roads, although the graph does appear to level somewhat between 2006 and 2008 however two years data is insufficient to assess whether this is a permanent trend. The number of kilometres driven each year is influenced by a wide range of factors such as employment, fuel prices, disposable income and the wider UK economy. Therefore, it is logical to infer that the recent economic recession will have had an impact on the number of vehicle kilometres driven but at this stage it is too early to assess this impact or know its permanency. Indeed, similar to the DfT findings regarding the reduction in CO_2 emissions, further observation and investigation is required in order to fully understand the cause of these reductions.

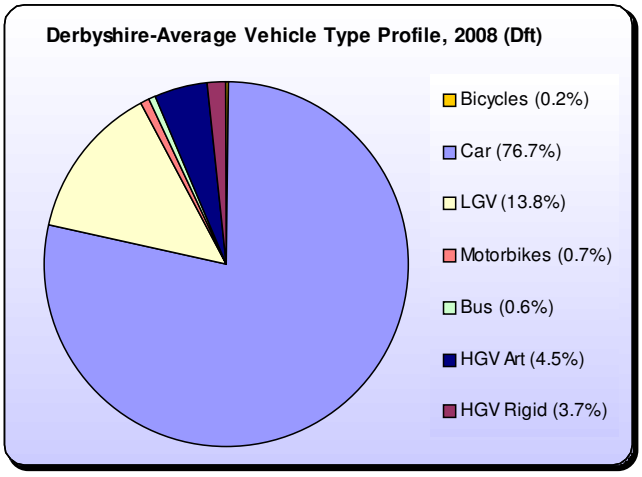
The data provided by the DfT, as shown in Figure 7, is split into two categories, distance travelled along major and minor roads; the former monitored through traffic counters and the latter are

[6] http://www.dft.gov.uk/pgr/statistics/datatablespublications/roadstraffic/traffic/rtstatisticsla/

estimations based on average distances travelled along these types of roads. To provide more accurate information for use in this Strategy, vehicle kilometres driven along Derbyshire roads was assembled from local traffic counters and local information relating to the road link lengths. The resulting data for the major roads showed excellent correlation with the data provided by the DfT, however local data showed considerably higher vehicle kilometres being driven along the minor roads in Derbyshire. When this local data for minor roads was used in the calculations, the resulting CO_2 emissions were approximately 30% higher than those published by DECC. Therefore it was decided to use traffic data provided by DfT and DECC until an understanding as to the cause of the difference in the datasets for minor roads is fully understood. For further information on how the traffic estimates were made, please see Appendix II.

In order to estimate CO_2 emissions, in addition to information regarding the distance travelled along Derbyshire roads, the number of each vehicle type using the roads needs to be estimated in order to apply the appropriate emission factor. For more information on emission factors, please refer to Appendix I. At the time of writing this Strategy, the local network of traffic counters operated by Derbyshire County Council could not provide a standard breakdown of vehicle types as required for these calculations, therefore this information was obtained from the national network of traffic counters employed by the DfT[7]. Figure 8 provides an average vehicle type profile for Derbyshire roads and clearly shows that cars are the predominant vehicle type. A smaller but still significant proportion of the vehicle sector is occupied by LGV's and HGV's, with rigid and articulated HGV's being represented in similar proportions.

Figure 8: Average vehicle type profile for roads in Derbyshire, 2008 (DfT)



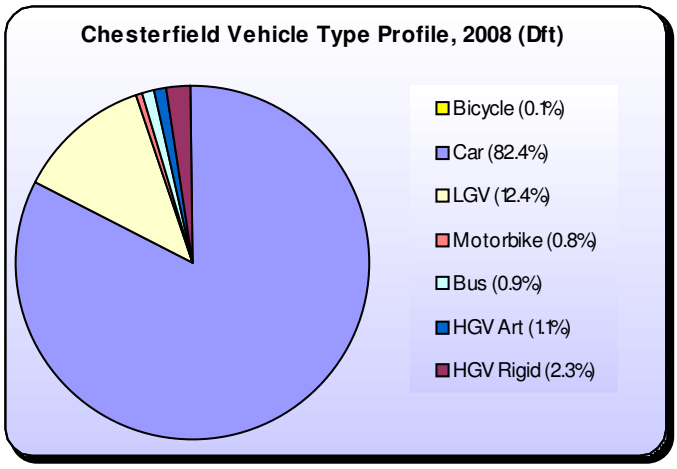
This vehicle profile is very similar to regional and national averages and represents an average vehicle type profile for Derbyshire. However, it is expected to vary slightly depending on which roads and /or locations with Derbyshire being assessed. For example, it is logical to infer that in the north-west and north-east of Derbyshire, where there is a greater concentration of quarries and heavy industry, there will be a higher proportion of HGV's using the roads. Similarly, in the larger urban areas and market towns, such as Chesterfield, Buxton and Long Eaton, there is expected to be a higher proportion of passenger cars due to the draw of shopping facilities, employment and leisure facilities.

[7] http://www.dft.gov.uk/matrix/

Therefore, in order to fully understand these differences in vehicle profiles, it would be useful to have a strategic network of local traffic counters, which provide a consistent breakdown of vehicle types using strategic roads in Derbyshire and potentially traffic speeds and congestion data. It would also be useful to have information regarding the journey purpose of vehicles using these strategic roads, through traffic surveys. The development of a local Derbyshire wide strategic traffic network is one of the recommendations of this Strategy.

In the absence of local information, in order to investigate differences in vehicle type profiles, data has been obtained from DfT traffic counters situated along the major roads around Chesterfield, Buxton and Long Eaton. The resulting profile for Chesterfield is shown in figure 9. As expected, there are slight differences in the traffic profile of roads in Chesterfield compared to the County average. In this large market town, there is a considerably higher proportion of passenger cars using the major road network, and marginally higher number of buses and motorcyclists. The number of HGV's and LGV's using the roads is lower than the Derbyshire average and cyclists represent a fraction of the traffic profile using the major roads. The vehicle type profile for Buxton is very similar to the County average but with a higher proportion of rigid HGV's using the roads, potentially due to the concentration of limestone quarries in the area surrounding Buxton.

Figure 9: Proportion of Vehicles using Chesterfield Roads, 2008 (DfT)



The types of vehicles using the roads have considerable influence on the associated CO_2 emissions, which in turn also informs which CO_2 reduction measures would be most appropriate to help to tackle these sources of CO_2, as discussed in Part II of this Strategy.

CO_2 Emissions from Derbyshire Road Transport Network

As discussed earlier, a useful source of information regarding CO_2 emissions from a local authority area, is available through reporting on National Indicator 186: Per Capita CO_2 Emissions in the Local Authority Area. This reporting provides a useful overview of the contribution that road transport makes to total CO_2 emissions in Derbyshire. Figure 10 shows that the transport sector contributes the smallest but still significant proportion of CO_2 emissions in Derbyshire, accounting for 24% of total CO_2 emissions in 2007.

This data source can be further broken down to show the CO_2 emissions from petrol and diesel vehicles using major roads and minor roads in each Derbyshire District/Borough Authority and is shown in Figure 11.

Figure 10: NI 186 Data showing CO_2 emissions from the three main sectors within Derbyshire, 2007. (DECC)

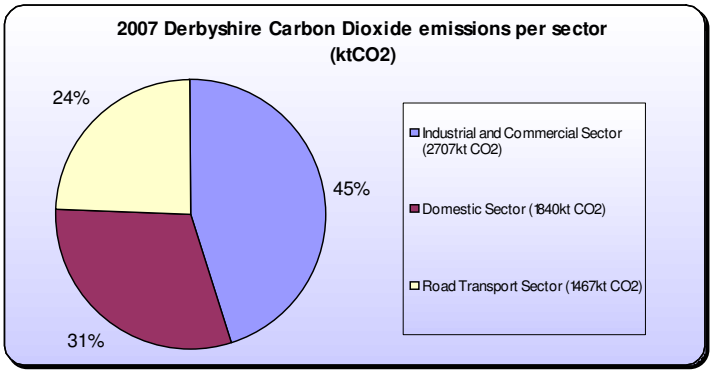
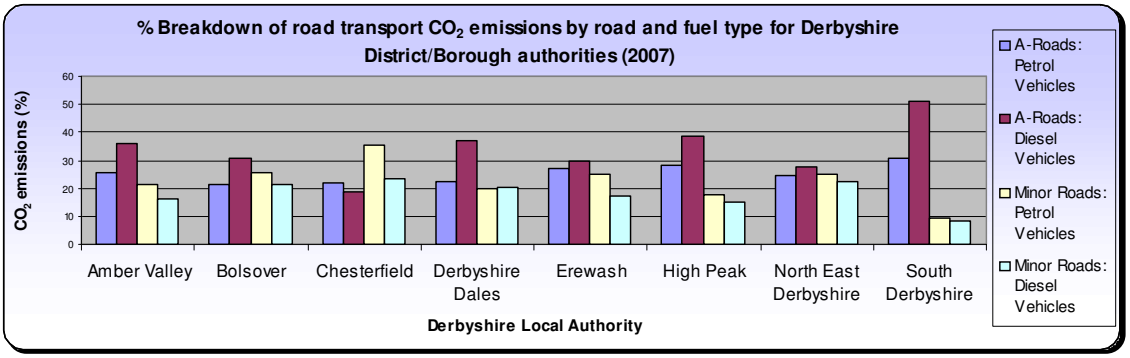


Figure 11 shows the differences in sources of CO_2 emissions in each Derbyshire District/Borough Authority which, similar to the trend graphs seen in figure 5, reflects the variable nature of the Derbyshire road network. In South Derbyshire the dominant source of emissions from the transport sector are diesel vehicles using A roads, whereas in Chesterfield the predominant source are petrol vehicles using minor roads. These differences will be largely due to the existence of trunk roads and main arterial routes within the local authority areas[8]. These emissions will also be influenced by the type and transport requirements of the surrounding area. For example, Chesterfield is a busy market town and as such will attract higher numbers of passenger cars due to the draw of shopping and leisure facilities.

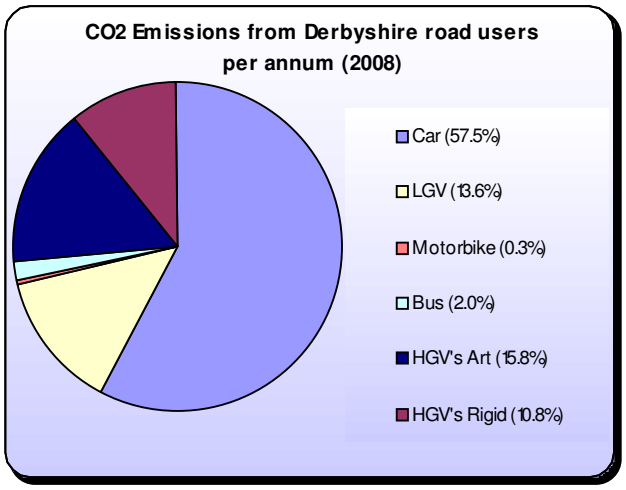
Figure 11: % Breakdown of CO_2 emissions for each District/Borough Authority in Derbyshire according to road type and fuel use, 2007 (DfT)



Therefore, understanding the variations in the transport network and the requirements of the users is important in informing which CO_2 reduction measures are appropriate to an area and therefore which will be most successful. In order to do this, the data provided by NI 186 alone, does not provide sufficient detail and further calculations are required.

To do this, local traffic data, as detailed earlier, and associated emission factors, have been used to quantify the respective CO_2 emissions from each road transport user on the Derbyshire network and can be found in Figure 12. As can be seen from Figure 12, the CO_2 emission profile is different to the vehicle type profile seen in Figure 8. Although passenger cars represent 76.7% of the vehicles using Derbyshire roads, they represent approximately 57.5% of the road transport CO_2 emissions. HGV's and LDV's emit proportionally higher levels of CO_2 per kilometre travelled, so although there are fewer of these vehicles using the roads, they emit proportionally higher levels of CO_2. This is line with finding of the DfT in their CO_2 Pathways Analysis[9], July 2008, which found similar results at a national level.

Figure 12: CO_2 emissions from Derbyshire road transport vehicle types, 2008.



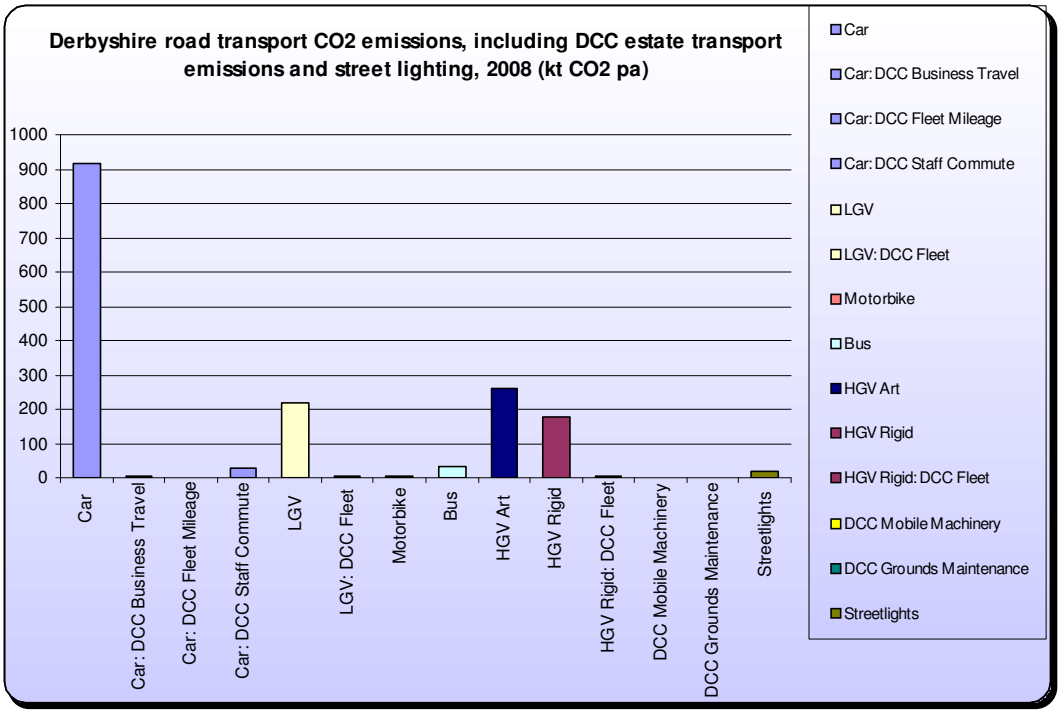
In addition to traffic using Derbyshire roads, a further source of CO_2 emissions associated with the road transport network is from street lighting. Information relating to this has been obtained through reporting for National Indicator 185: Percentage reduction from local authority operations. This reporting mechanism requires each local authority to estimate the CO_2 emissions from its own estate. The baseline for reporting on this indicator is 2008/2009, and it has been estimated that the CO_2 emissions from street lighting is 17.1Kt of CO_2 per year, which represents 0.8% of total emissions from the transport network. Through this reporting mechanism, emissions relating to DCC business and fleet travel have also been estimated. Emissions associated with staff commuting to work were not included in the latest submission of the national indicators, so an estimate has been provided, using a simplistic methodology based on estimated number of DCC employees, average distance travelled to work and average proportion of residents which travel to work. This estimation is expected to be improved following detailed staff surveys which will be conducted as part of the Smarter Travel Programme discussed later in this Strategy. Since Derbyshire County Council should lead by

[8] It should be noted that motorways were not included in the calculations of CO_2 emissions for reporting on NI 186, as it was felt, the emissions arising from those using motorways were largely passing through an area and therefore out of the scope of the local authority.
[9] http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/about/strategy/transportstrategy/tasts/tastsCO2pathway/

example in aiming to reduce CO_2 emissions from its own estate, and to provide context to the overall CO_2 emissions for Derbyshire, these totals have been incorporated into one overall picture. This can be seen in Figure 13.

As can be clearly seen, the dominant source of emissions in Derbyshire is from passenger cars, LGV's and HGV's. Street lighting and DCC staff commute to work represent a very small proportion of the total emissions, and the remaining aspects of the DCC transport estate, contribute fractions of the total amount. Therefore, although it is important that DCC leads by example, as discussed in later section of this Strategy, in order to generate significant reductions in carbon emissions to support Government targets, carbon reduction measures across the whole road transport network is required, which represents a significant challenge.

Figure 13: Derbyshire road transport CO2 emissions, including emissions from the Council transport estate and street lighting, 2008.



Passenger Car

As discussed earlier the predominant source of CO_2 emissions from Derbyshire roads are from passenger cars. This Strategy will now aim to quantify the emission according to journey type, identify appropriate CO_2 reduction measures and quantify their associated reduction in CO_2 emissions.

The passenger car sector represents approximately 57.5% of total CO_2 emissions from the Derbyshire road transport network, therefore in order to suggest possible reduction measures, it is necessary to understand the journey type made using this type of vehicle so recommendations can be made as to how to reduce emissions from this source.

The DfT completed an analysis such as this in their report 'The CO_2 Pathways Analysis[10], 2009, using a detailed model to estimate the relative contribution to CO_2 emissions of different types of journeys, which required the following information:

- Detailed results of the National Travel Survey
- Distance travelled and average speed by journey purpose
- Fuel consumption
- Speed curves and fuel to CO_2 conversion factors
- Fuel types and engine size for a particular journey.

As discussed in the opening section of this Strategy, currently this level of detailed data and associated modelling software is currently unavailable. Therefore, in order to quantify carbon emissions, the national journey purpose proportions have been applied to total CO_2 emissions from the passenger car sector. It is appropriate to conduct the analysis using this more simplified approach as the CO_2 Pathways Analysis study conducted by the DfT found that 'the distribution of CO_2 emissions by journey purpose closely follows the distribution of vehicle km by journey purpose'. Therefore these estimations still provide a useful indication as to the CO_2 emissions associated with journey purpose and is shown in Figure 14.

[10] http://www.dft.gov.uk/pgr/regional/ltp/guidance/localtransportsplans/policies/climatechange#

Figure 14: National average journey purpose for passenger cars, DfT, 2008.

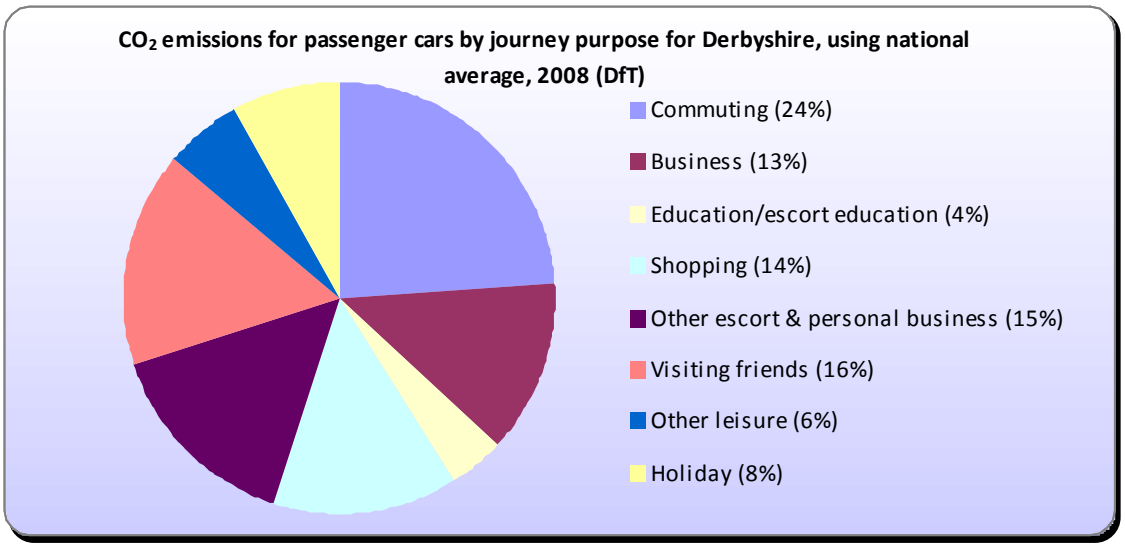
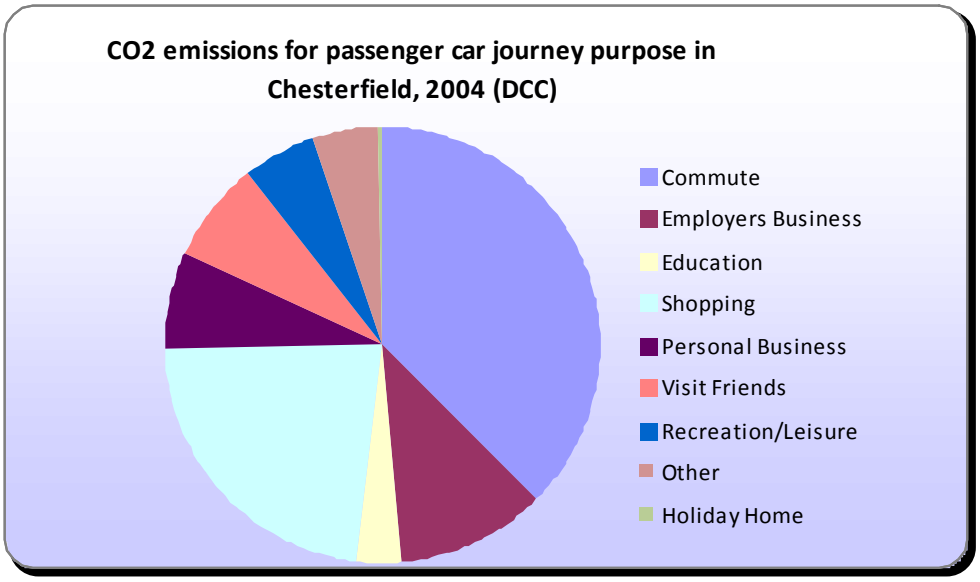


Figure 14 shows that commuting to work is the largest source of CO_2 emissions from passenger cars. According to the CO_2 Pathways Analysis, this journey purpose also has the highest rates of single occupancy vehicles, on average 91%, so this is potentially an area where CO_2 reduction measures could be applied to achieve a reduction in emissions, either through encouraging car share or other sustainable transport measures, as detailed in the later sections. Figure 11 also shows that journeys involving visiting friends, shopping, business and other escort/personal business show similar CO_2 emissions, with journeys to education representing the least. It should be noted that the emissions attributed to travel to education may be underestimated due to the effect of 'combination journeys' where parents drop their children off at school on their way to work, which may not have been captured in the national journey purpose split. Therefore, should travel surveys be conducted as part of future work, care must be taken in the wording of the surveys to allow for 'combination journey' to be accurately recorded.

An understanding of this information is fundamental to informing where CO_2 reduction measures could be effectively applied as it provides a more detailed view of why people are using their cars and what proportions of CO_2 emissions are generated as a result.

Similar to the variations of vehicle type profile along roads and towns in Derbyshire as discussed earlier, it is also expected that the journey purpose will vary across the network of Derbyshire due to its varying nature, particularly between trunk roads crossing the rural areas, market towns and along the roads in the Peak District National Park. Therefore it would be useful to have local information regarding journey purpose at these types of locations, in order to assess appropriate carbon reduction measures, tailored to the requirements of Derbyshire road users. At the time of writing this Strategy, local information from strategic town-wide travel surveys were limited, however, results were available for a traffic survey conducted along the main roads in Chesterfield in 2004. It was thought appropriate

Figure 15: CO2 emissions from passenger cars by journey purpose in Chesterfield, 2004.



to continue to use this data as it would provide a useful indication as to the journey purpose variation for a large Derbyshire market town. The information obtained through this travel survey can be found in Figure 15. Figure 15 shows that in a market town such as Chesterfield, the dominant source of emissions is from commuting vehicles, with approximately 13.5% increase in emissions from this sector on the roads in Chesterfield compared to the national average. Shopping is the second largest CO_2 emission source for passenger cars on Chesterfield's roads and similar to the national average, travel to education is the smallest source.

Household travel surveys are conducted every year to a representative sample of Derbyshire residents regarding their travel behaviour, which although does not capture data on a town-wide basis, does provide valuable information on a district/borough basis. It is recommended that the information contained in these surveys be referenced when designing carbon reduction measures on a district/borough basis. This is a recommendation of this Strategy.

This insight into why people are using their cars shows that the reasons can vary according to location and the user requirements and therefore any suggested reduction measures need to be tailored to reflect this. Therefore in Derbyshire market towns such as Chesterfield, the suggested emphasis would be on reducing emissions from passenger cars used for commuting and shopping. Within the wider Derbyshire road network, primary emphasis should be on reducing commuting emissions but also looking at more general journey purposes such as visiting friends, business, shopping and other escort/personal business. Further survey work, as part of a strategic traffic monitoring network is recommended in order to provide more detailed and robust information which can be used in the carbon reduction process.

Public Transport: Buses

According to the data obtained from the DfT traffic counters, 0.6% of total traffic using the major roads in Derbyshire comprises public service vehicles, which equates to 2.2% of total CO_2 emissions. Due to the carrying capacity of buses, the number of vehicle kilometres driven by this vehicle type is expected to be proportionately lower than other transport modes for example passenger cars. It is important, therefore when assessing CO_2 emissions from buses that an additional calculation is made regarding the CO_2 emissions per passenger km, in order to reflect the carbon reducing potential of public buses. For example: Currently the national average occupancy of a local bus is 9 passengers, with an associated emission factor of 0.115. If the occupancy rates of buses were to be increased this emission factor would decrease per passenger, demonstrating the carbon reduction potential of increasing bus patronage and removing single occupancy cars from the network. For example:

- If 25 people travel the average Derbyshire distance to work of 25km a day in a single occupancy vehicle, in an average car of unknown fuel, the associated CO_2 emissions would be 34, 824kg.

- If the same 25 people chose to use a standard local bus the same distance, the emissions would be 14,953kg, which is a 43% reduction and there would be 24 less vehicles using the roads.

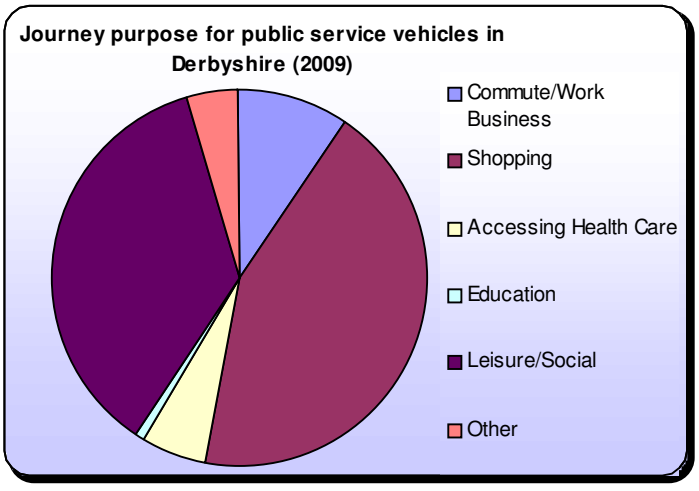
According to the Derbyshire Bus Strategy which was published alongside the LTP2, 90% of buses operating in Derbyshire are commercial vehicles and 10% are contracted services with Derbyshire County Council. Therefore, the total emissions estimated from public service vehicles can be divided between commercial and contracted services, namely 29.8kt CO_2 pa for the former and 3.3kt CO_2 pa for the latter. It should be noted that the emission factor used to calculate the CO_2 from buses was downloaded from the NAEI emission factor database which is based on fleet average gCO_2/km for all UK buses and coaches and as such may well be under or over estimating the emissions from Derbyshire buses dependent on the age of the Derbyshire bus fleet.

EURO standards have been implemented since 1993 for buses and HGV's with increasingly more stringent levels permitted for certain pollutants. However, these emission standards do not apply to CO_2 emissions. A report for the most recent Greenhouse Gas Inventory [11] calculates fuel consumption data for buses and coaches from 1993 to 2008. The principal data source used were figures from DfT on the Bus Service Operators Grant (BSOG), which directly links subsidy to fuel consumed on local services. Interestingly, the BSOG data implies an increase in the average fuel consumption for local buses i.e. a reduction in fuel efficiency, over the period from 1994 to 2000. Buses produced from 2000 onwards having progressively better fuel efficiency, therefore lower fuel consumption and lower CO_2 emissions. Therefore the age of the bus is important not only in terms of the air pollutants controlled by EURO emission factors but also by CO_2 emissions dependent on fuel efficiency.

Overall, the fuel consumption between 1990 and 2008, which has a direct effect on CO_2 emissions, has decreased by 17.4% from pre-euro (1990-1993) to Euro V (2008). Therefore, more accurate predictions of emissions from buses could be calculated if the age of each vehicle, and the distance being driven, is known for the bus fleet in Derbyshire. However, in the absence of this detailed local data, the emission factor provided by NAEI has been used in the calculations. Further discussion regarding bus emissions can be found in the later section called Public Transport: Buses.

A Citizens Panel Questionnaire, circulated to a representative panel of Derbyshire residents in 2009 explored the main journey purpose for residents using the local bus service. The results of this survey can be seen in figure 16. The largest proportion of journeys made by bus are for shopping and leisure purposes, with travel to education representing the least. However, caution should be applied when assessing these responses; the age group of the survey participants may mean some of the journey purposes will be biased E.g. travel to education. However, it does provide a useful overview of the types of journeys currently made by bus and those which could potentially be increased as a carbon reduction measure, this will be explored further in later sections.

Figure 16: Regular journey purpose using public bus, DCC (2008)



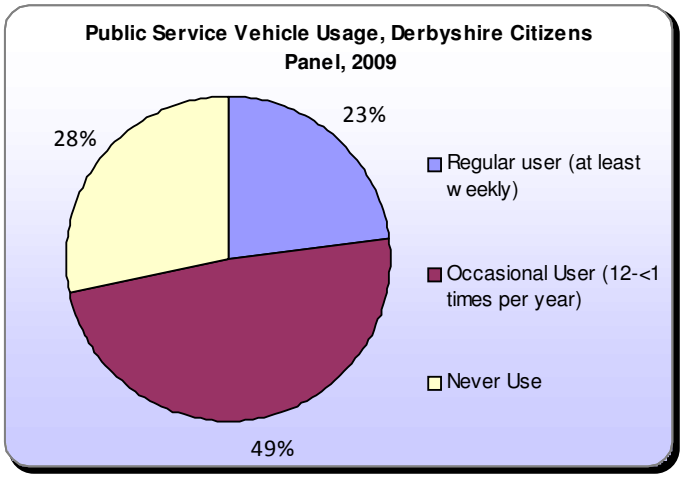
The Citizens Panel also questioned the frequency with which the local bus is used by those residents surveyed, the results of which can

[11] *UK Greenhouse Gas Inventory, 1990 to 2008: Annual Report for submission under the Framework Convention on Climate Change', MacCarthy J, Thomas J, Choudrie S, Passant, N, Thistlethwaite G, Murrells T, Watterson J, Cardenas L, Thomson A. AEAT/ENV/R/2978*

be found in Figure 17. The largest proportion of those surveyed either never use the bus or only occasionally – from once a month to once a year. Less than ¼ of those surveyed use the bus on a regular basis. This information provides a useful insight into bus patronage in Derbyshire. In addition, the survey asked for comments regarding local bus services, which may provide an indication as to the reasons why less than a ¼ of those surveyed use the bus on a regular basis:

- Only use bus if the weather is bad
- Cannot use the bus due to being disabled
- Buses don't go where I need to go
- Only one bus per hour and only until 6pm
- Bus service not regular
- If I have the kids, its easier to use the car
- Only use the bus if the roads are blocked with snow on the road
- Only use if going on holiday i.e. connect with trains, coaches or airports
- Use when not in a rush, will use when I retire
- Only use buses as a last resort
- Cheaper to go by car.

Figure 17: Public Bus use, DCC (2008)



The results of these surveys may help to provide an insight into the public perception of local barriers to using public transport. Additional information regarding public attitude towards public transport can be gleaned through two Best Value Performance Indicators contained in the LTP2, performance against which have been updated annually during the lifetime of the LTP2, these are:

- BVPI103 % of users satisfied with public transport information
- BVPI104 % of users satisfied with local bus services.

In 2008/2009, 57.5% of users felt satisfied with local bus services and 49.3% of users felt satisfied with public transport information. (Unfortunately data from earlier years cannot be compared to 2008/2009 results due to a change in the methodologies employed in their collection). Information such as this requires careful consideration when determining and implementing appropriate carbon reduction measures relating to buses, and can be used to indicate which measures may be most likely to be successful, as discussed in more detail in later sections of this Strategy.

Road Freight

Figure 12 shows the CO_2 emissions from Derbyshire road transport vehicle types, including road freight. The road freight sector and their associated emissions are divided into three categories, namely:

- Articulated Heavy Goods Vehicle (Art HGV's): 260.3kt CO_2 pa.
  These vehicles have a pivotal point between the drivers cab and the actual body of the vehicle
- Rigid Heavy Goods Vehicle (Rig HGV's): 178.2kt CO_2 pa
  Have the cab and body built onto the same chassis unit and unable to pivot.
- Light Goods Vehicles (LGV's) Vans up to 3.5 tonnes: 223.4kt CO_2 pa

The emission factors which have been used to calculate the emissions from these vehicle types are based on a UK average for all articulated HGV's, rigid HGV's and LGV's, and an average load factor of 40% was applied. It should be noted, however that the emissions from these three sources are very sensitive to vehicle load factors, size and vehicle technologies. The complete set of emission factors are detailed in Appendix I.

The 2009 Guidelines to Defra/DECC's GHG Conversion Factors report shows that the percent loading factors are on average mostly between 40-60% in the UK HGV fleet. This report describes the effect of load as "becoming proportionately greater for heavier classes of HGV's, in that the relative difference in fuel consumption between running a HGV completely empty or fully laden is greater for a large >33t HGV than it is for a small <7.5t HGV". The data resulting from their ARTEMIS project shows that "the effect of load is largely independent of the HGV's EURO emission classification and type of drive cycle. For example, a >17t rigid HGV emits 18% more CO_2 per kilometre when fully laden and 18% less CO_2 per kilometre when empty relative to emissions at half load". Therefore, understanding the factors which affect the amount of CO_2 emitted by the freight sector is key to designing and implementing a viable carbon reduction program for the road freight sector.

Recent discussions held by the DfT with freight and logistics operators and customers have demonstrated a need for a consistent carbon measurement and reporting method for the logistics transport supply chain. Following identification of this requirement, in July 2009, the DfT launched an industry-led steering group aimed to develop such a method. A comprehensive review[12], conducted by Ricardo on behalf of the DfT, assessed the CO_2 savings that could be achieved by using a number of lower carbon vehicle technologies and although these are out of the scope of the LTP3, they are discussed in more detail in the freight section, along with other carbon reduction measures which could be applied to the road freight sector.

[12] http://www.dft.gov.uk/pgr/freight/lowcarbontechnologies/lowcarbon.pdf

CO_2 Reduction Targets for UK

The Climate Change Act 2008 created a legal requirement for at least 34% reduction in UK greenhouse gas emissions by 2020 and at least an 80% reduction by 2050 from a 1990 baseline.

To drive progress towards this target, the Act introduced five year 'CO_2 budgets', which define the emissions pathway to the 2050 target by limiting the total greenhouse gas emissions allowed in each five year period, beginning in 2008. The first three CO_2 budgets are as follows:

- In the first CO_2 budget period, 2008-2012, a 22% reduction
- In the second CO_2 budget period, 2013-2018, a 28% reduction
- In the third CO_2 budget period, 2018 – 2022, a 34% reduction.

The UK Low CO_2 Transition Plan[13], published in July 2009, set out a pilot system of departmental CO_2 budgets, designed to ensure clarity over the allocation of responsibility across Government for meeting the UK CO_2 budget for the first 5 year CO_2 budget period. The DfT has been allocated responsibility for a 76% share of transport emissions over 2008-2012.

[13] http://centralcontent.fco.gov.uk/central-content/campaigns/act-on-copenhagen/resources/en/pdf/DECC-Low-Carbon-Transition-Plan

CO_2 Reduction Targets for Derbyshire

As discussed earlier in this Strategy, the National Performance Framework for local authorities and their public sector partners agreed an indicator set for Derbyshire which includes two climate change indicators which aim to quantify CO_2 emissions in Derbyshire, these are:

- NI 186: Per capita CO_2 Dioxide emissions per area in the local authority area
- NI 185: CO_2 Dioxide reduction from local authority estate

National Indicator 186:

National Indicator 186 has an associated target relating to the per capita emissions for each local authority area. The target for Derbyshire, using a baseline year of 2005, is an overall reduction in per capita emissions of 9.06% by 2010/2011.

Figure 18: Derbyshire CO_2 emissions per capita, 2007

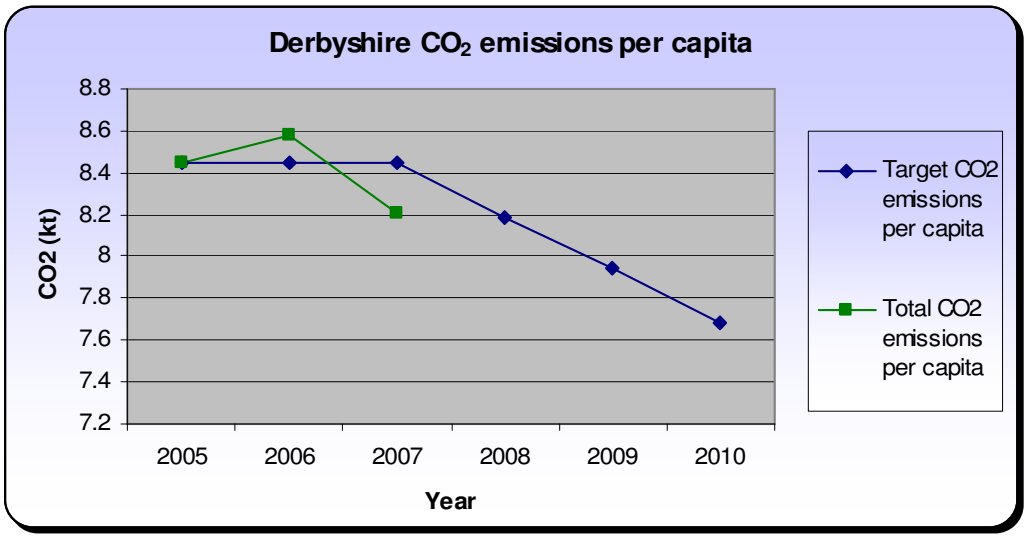
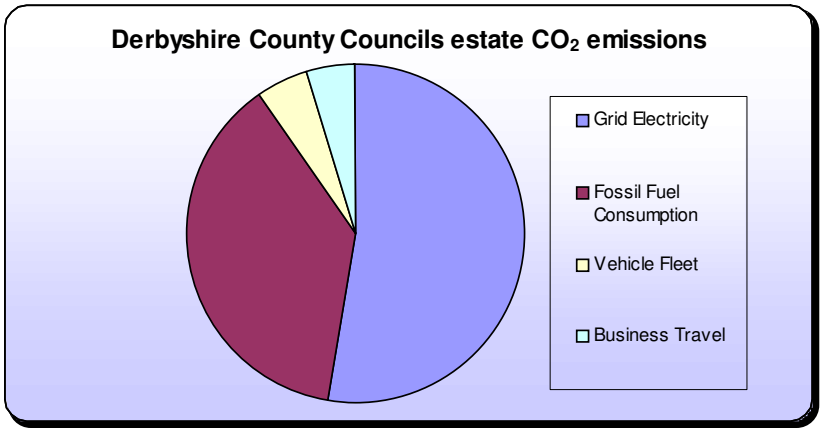


Figure 18 shows the per capita CO_2 emission for Derbyshire for reporting years 2005 to 2007 and the target emission, to demonstrate progress towards the agreed emission reduction.
It appears that Derbyshire is making good progress to achieving this target in 2010/2011, which as alluded to earlier, may be a consequence of national transport policies, fuel prices and the effects of the wider UK economy. Further data and analysis would be required in order to fully understand the cause of the reduction in carbon emissions in Derbyshire.

National Indicator: 185

There are currently no Government targets associated with NI185; however Derbyshire County Council has adopted a reduction of 15% in CO_2 emissions from its estate by 2010 through its CO_2 Management Programme which was adopted on 23 March 2007. Staff business mileage and vehicle fleet procurement have been identified as key areas for reduction, as well as energy consumption from buildings, street lighting and waste generation. The baseline year for this target is 2005/2006, with total CO_2 emissions excluding schools being 32,842 tonnes of CO_2 per annum. Implementing the CO_2 management programme and adopting the 15% reduction target, whilst allowing for expansion of the business, will result in estimated cumulative savings over the five year period 2005/2010 to be 4,600 tonnes of CO_2.

Figure19: Derbyshire County Council Estate CO2 emissions, Baseline year 2008.



Since this CO_2 reduction applies to all Derbyshire County Council operations, this also includes energy use in buildings and so strictly does not apply directly to the transport sector alone. However, the overall impact of the various actions contained within this Programme will contribute to reductions for DCC transport estate and so have been included in this Strategy. Further work is currently underway to collate detailed departmental fleet and business mileage usage, which will be used to review and create departmental reduction targets as part of the Programme, which is discussed in more detail in a later section of this Strategy. Once this baseline data has been collated, the CO_2 emission reduction attributed to DCC corporate policies can be reviewed in future phases of this Strategy.

Part 2: What can we do through the LTP3?

The overall aim of this Strategy is to quantify the emissions sources and potential carbon reduction measures in order to guide policy to develop an efficient, sustainable and integrated transport network for Derbyshire.

Efficient, Integrated and Sustainable Derbyshire Transport Network:

Improving the efficiency with which the current transport network is being used aims to fulfil the requirements of the user whilst also delivering reductions in CO_2 emissions.

Derbyshire County Council shares a similar perspective to transport as the DfT outlined in their Climate Change Adaptation Plan 2010-2012 in that the DfT Strategic aim 'transport that works for everyone' 'means providing a transport system that balances economic, environmental and social considerations.' 'Transport has been fundamental to economic progress and has led to significant improvements in our quality of life. 'Transport growth is both an enabler and a consequence of economic growth and has a vital role to play in increasing world trade'[14]. However, transport is also a significant contributor to the UK atmospheric emissions and therefore a more efficient and sustainable use of transport needs to be employed if the UK is to meet its climate change targets and prepare for a low carbon transport network. Balancing economic growth and climate change is often seen as a complex and often polar undertaking, however this Strategy aims to show that actions can be taken to provide a transport system which supports both agendas, and mirrors the message delivered in the Governments recently published White Paper: Creating Growth, Cutting Carbon[15].

To this end, this Strategy is not simply about stopping people using mechanised forms of transport because for some areas of Derbyshire and for some journey requirements there are no viable alternatives. More so it is about assessing the transport requirements for Derbyshire and then encouraging, where appropriate, more efficient and sustainable alternatives which will yield associated CO_2 emission reductions. For example, in larger towns, where there is a higher concentration of short trips and viable networks for cycling, walking and public transport, carefully selected packages of complementary measures aimed at increasing the uptake of sustainable travel modes will achieve greater and longer-term impacts than through individual initiatives alone and will aim to create sustainable communities with a reduced car dependency. In the more rural areas, where alternatives to using private vehicles may not be viable, the emphasis should be on sustainable use of vehicles, promoting low CO_2 vehicle choices, smarter-driving and car sharing. Throughout Derbyshire there

[14] Eddington Transport Study: http://www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/.

[15] Creating Growth, Cutting Carbon. Making Sustainable Local Transport Happen: http://www.dft.gov.uk/pgr/regional/sustainabletransport/

should be increased emphasis on reducing the need to travel through well planned developments and services, and encouraging increased uptake of tele-working and home shopping for example.

The Strategy acknowledges the fact that, in terms of carbon emissions, transport of freight by rail is a more efficient option. However, it is also acknowledged that in some locations and for a variety of reasons, there is no viable option but to transport freight by road, which is an intrinsic and important element of the Derbyshire economy. Therefore this Strategy also aims to assess where efficiencies can be made in the transportation of freight with associated carbon reductions.

Public transport is a fundamental component of a sustainable transport network, as such, this Strategy aims to assess how the current bus network is being used, how patronage could potentially be increased and how the overall emissions from the bus sector could be reduced.

Greater integration between different modes of transport is key to providing viable alternatives to using the private car. Integration between the different requirements of the network is key to improving the efficiency with which the network is being used.

The benefits of a more efficient and sustainable transport network are numerous and potentially far reaching. In addition to reducing CO_2 emissions, efficient, sustainable transport networks can also provide financial benefits through reduced use of fuel and improved use of resources, reduced congestion, improved journey times, increased support of the local economy, better air quality, health benefits, reduced congestion and an overall improved environment.

The efficiency improvements which could be employed will vary considerably depending on the transport mode choice and the reasons for the journeys being made. Some measures and alternatives with lower CO_2 emissions can apply to the whole transport sector and some are more specific to vehicle type and journey depending on the local situation and transport requirements and therefore need to be tailored to reflect this. It is important, when assessing possible CO_2 reductions that viable alternatives are available and that these take into consideration the needs and circumstances of the transport user. Fully identifying the transport issues and requirements of the user is the only means of providing viable alternatives and to successfully achieve reductions in CO_2 emissions.

In addition, it is important to identify those actions which can be delivered through the LTP3. Some carbon reduction measures relate to vehicle technologies, fuels and tax incentives for example which are outside the scope of the LTP, although they can be influenced by increasing public awareness of the benefits of such vehicle advances. In reporting on NI 186, Defra published a document called 'Analysis to support climate change indicators for local authorities'[16], April 2008, which provides a list of measures which could be applied to reduce CO_2 emissions from all sources across a Local Authority area, including the industrial and commercial sector, domestic and road transport sector. The

[16] http://www.decc.gov.uk/assets/decc/Statistics/nationalindicators/1_20100421135745_e_@@_analysisclimatechangeindicatorslas.pdf

list comprises 57 measures in total, of which only 1/8th of the transport related measures can be delivered at a local level and the remaining to be 'influenced' by the LTP to varying degrees. The measures which relate to transport and can be delivered locally have been included in this Strategy and are as follows:

- Smarter Choices Initiatives; Sustainable Travel Towns and Personalised Travel Planning
- Restrictive measures on transport use
- Public transport measures
- Vehicle maintenance
- Driver training
- Local Authority fleets
- Planning measures to reduce sprawl

The remaining transport measures detailed by the DECC will be led at a national level, but which can be influenced and supported by the Local Authority. It is important to also assess some of these measures as they provide guidance and direction to a local authority in developing a more sustainable transport system.

Lead by Example: Reducing Emissions from DCC Estate

As discussed earlier, it is important that DCC leads by example in trying to reduce the CO_2 emissions from its own transport estate. The quantified carbon emission reductions which have and will be achieved by Derbyshire County Council can also be used as a benchmark for other Derbyshire employers, which could be communicated through business travel plans and the work completed by the sustainable travel team. Considerable work has been carried out over recent years and further actions are proposed to reduce emission from DCC estate. These measures are as follows (listed in alphabetical order):

Bike week:

Bike Week is the biggest nationwide annual cycling event in the UK, which provides an opportunity to promote cycling in everyday life, aiming to demonstrate the social, health and environmental benefits of cycling.

The Sustainable Travel Team and Countryside Services have supported Bike Week over the past 4 years on behalf of Derbyshire County Council. In 2008, the baseline year for this Strategy, DCC supported the Bike Week Campaign by promoting an employee cycling event that spanned the 5 weeks prior to and including Bike Week. Employees were challenged to take part in a virtual tour of the Tour de France, to see how many miles could be collectively cycled, with gift vouchers offered as an incentive. During the final week, Council employees were also able to receive a free breakfast for

cycling to work. Eighty one employees took part in the Challenge and /or Bike Week itself, a 60% increase in the number of participants on the previous year. A family fun day was also held at Poulter Country Park at Langwith, near Shirebrook on Sunday 15 June, which included family bike rides, bike safety checks, skills tests, kite flying and arts & crafts activities. Everyone hiring a bike from Middleton Top during Bike Week was given a free Cycle Derbyshire water bottle.

Bike week also presents an opportunity to survey those DCC employees who took part to identify issues with cycling to work, the results of which produced useful recommendations to be implemented by DCC to improve cycling facilities.

Over the course of the event in 2008, the carbon emission reduction which was achieved through employees cycling to work totalled 1019kg CO_2. In 2009 and 2010, participation in the event has increased and its profile raised throughout the Council. It is a simple and effective carbon reduction measure and although may generate modest savings at present compared to the County totals, the recommendations and outcomes of holding such an event are invaluable in encouraging modal shift for staff commuting to work, they can also be used to lead by example for other external organisations who may want to hold a similar events or increase the number of their employees who are cycling to work through business travel plans.

Changing the way Derbyshire works*:*

Changing the Way Derbyshire Works (CWDW) is a programme of organisational and service enhancements to be implemented across the Derbyshire County Council estate over the next five years, which will improve the efficiency with which the assets are used and the employees operate. It involves improving efficiencies in five areas:

- Better use of accommodation: Disposal, investments and moves in accommodation, the introduction of flexible working styles and more efficient, changing working practices for employees.
- Smarter travel: Reduction in staff and commuting mileage, changing personal car use, reviewing in-house vehicle fleets and examining opportunities for savings from the hire of vehicles.
- Procurement initiatives: Reviewing contract arrangements, identifying possible areas for savings and collaborative procurement.
- Single status implementation: Employee contracts to be reviewed and equalised with consequential implications for staff, structures and working practices
- New core financial and personnel systems: New and more efficient software, training, systems and procedures to be introduced.
- Improving customer experience: increasing the accessibility of services for the public.

- Working jointly with others: Improving working relationship between the Council and other local councils, agencies and the “third” sector

The area specifically relating to transport is the Smarter Travel Project which aims to reduce 12.7million business miles and 8.5million fleet miles that are travelled each year in delivering Council services, leading to associated reductions in carbon emissions. These reductions will be achieved by using more environmentally friendly pool cars, such as electric vehicles, for work journeys instead of using private cars, promotion of walking and cycling, greater use of tele-conferencing facilities and more effective use of fleet vehicles. A trial is currently ongoing involving the use of an electric vehicle as a pool car, the results of which will be evaluated with the potential for the scheme to be rolled out to various departments.

Through this Project, data is currently being collated regarding departmental fleet and business mileage usage, which will be used to review and create departmental reduction targets. In addition, site surveys will be conducted for all future DCC offices to assess their facilities to allow access by sustainable travel modes such as walking, cycling and public transport. Recommendations will then be made on additional facilities which may be required.

A DCC travel survey is also expected to be conducted in the autumn 2010 to assess where and how staff are currently travelling to work. This survey has been designed to allow quantification of employees carbon emissions, which will lead to more detailed commuting emissions to be calculated, potentially replacing the current emissions detailed in this Strategy. In addition, through the Sustainable Travel Team, it may be possible to obtain travel information from those employees who currently work in schools as they are not included in the current survey. Care should be taken when designing the survey forms that the correct questions are posed to allow quantification of carbon emissions.

Once all this baseline data has been collated, the information will be used to inform and update the DCC Corporate Travel Plan.

Cycle to Work Scheme

Derbyshire County Council is currently assessing the implementation of a cycle to work scheme. This is a salary sacrifice scheme for Derbyshire County Council employees to purchase a bicycle and accessories for use to and from work and where appropriate when conducting council business and attending meetings etc. A survey was conducted through the monthly employee magazine ‘Workforce’ to assess interest in such a Cycle to Work Scheme, which will influence the decision to implement such a scheme.

If the Cycle to Work scheme is implemented, in order to calculate the associated carbon emission reduction, the mileage reduction for commuting staff and/or on council business which the scheme achieves would need to be monitored. This could be done through appropriate survey forms circulated to those who are involved in the scheme and updated on an annual basis.

Derbyshire Car Share

Derbyshire Car Share Scheme is a website designed to match those travelling by car with others on the same journey, providing a mechanism to increase car sharing rates. There is a Derbyshire-wide car share website with is available to anyone with access to the internet and under the 'Derbyshire Car Share' umbrella group, Derbyshire County Council also has a private car share group. DCC employees are encouraged to join the car share scheme and designated car parking spaces are reserved in the car park for Car Share members. Membership of the scheme has been increasing annually, there are currently 1080 members and projected annual savings of CO_2 for 2010 is 635.2tonnes.

Derbyshire Tourist Events

Derbyshire County Council hosts an annual Food and Drink Festival in Derbyshire, which encourages local producers and suppliers to take part in order to raise awareness amongst Derbyshire residents of their local producers and encourage more local shopping. The Food Awards form part of the festival and were set up to support the Derbyshire food and drink industry, to encourage establishments to use their local producers and suppliers and to reduce 'food miles'.

The venue used each year for the festival changes, which can have impact on associated traffic generation dependent on how accessible the site is to the public using alternative modes of transport to the private car. In 2009, the event was held at Bolsover Castle, which for those living in the town, was within easy walking distance. In addition, to reduce congestion around the castle, parking was provided approximately a mile away and shuttle buses were available for visitors to travel to the Castle. A visitor survey conducted at Bolsover showed that 87% of visitors accessed the festival by car. Evaluation of the Derbyshire Food Fair 2010 held at Kedleston Hall, showed that over 95% of visitors travelled to the venue by car. The difference in car usage between the two events has been attributed in part to the location of the event and also the low take-up of the shuttle buses which were provided between the venue and Derby city centre. The shuttle buses operate free of charge and complete 4 return trips per day over the course of the festival. Unfortunately, however, only 70 visitors took advantage of this service, with over 12,000 attending the event.

Using the experiences gained from this year's event, it is proposed in future years that the shuttle bus service be more widely promoted, ensuring the service is detailed on all marketing material and radio adverts, as well as improving the transport information available on the Festival website, including providing a link to the East Midlands Journey Planner, which is supported by Derbyshire County

Council. In addition, consideration will be given to the potential for providing discount entry to those visitors arriving at the festival using non-car modes, similar to schemes already in operation at some Derbyshire tourist attractions and for many National Trust sites.

In order to understand where visitors to the festival are travelling from, it is recommended that a detailed study of the evaluation forms be conducted to assess the distances travelled and main destination nodes. In turn this may help to advise where shuttle buses should be provided from in order to encourage more visitors to leave their vehicle at home and support the provision of detailed travel information. The travel statistics would also allow the associated carbon emissions to be calculated, forming a baseline from which any reasonable carbon reduction target associated with the festival could be adopted. This potential project has been highlighted as a recommendation of this Strategy.

Direction Signs

One of Derbyshire County Councils routine area of work in traffic management is the erection and maintenance of direction signs including brown tourist destination signs. There is an indirect but important element of CO_2 emission reduction associated with this area of work as an effective signing network helps drivers reach their destination directly thus reducing the potential for drivers to get lost, minimising unnecessary mileage and therefore CO_2 emissions. It is not possible to quantify the effects of maintaining an efficient network of signs but it was felt appropriate to highlight the contribution that such works have to reducing carbon emissions from the transport network.

Important work is also conducted as part of routine traffic management work in assessing and applying height and weight restrictions to some routes and bridges etc. This work is particularly beneficial to the road freight industry that can use this information to assess the suitability of a route to the size and weight of vehicle being used. In doing so, unnecessary mileage and therefore associated CO_2 emissions are reduced. In addition, as part of a Freight Quality Partnership which was instigated through the LTP2, a freight network map was created which highlighted which roads through Derbyshire were appropriate for use by freight vehicles, which is available to be downloaded for the DCC website at http://www.derbyshire.gov.uk/transport_roads/transport_planning/freight_quality_partnership/default.asp

Vehicle Fleets

Through the reporting requirements of NI185, the CO_2 emissions associated with Derbyshire fleets and mileage were quantified and reported for the year for the first time in 2008/2009 and are detailed in figure 13. This information was used as a provisional baseline for reporting on future years, however it was identified that in order to create viable corporate targets relating to fleets and mileage, improved

data collection of the baseline data would be sought through the Smarter Travel Programme discussed earlier, over the course of 2010/2011. A comprehensive baseline dataset, coupled with viable reduction targets will then follow on to the formation of an updated corporate strategy to tackle carbon emissions from these sources.

Lighting: Streets, signs and bus shelters

Through the reporting requirements of NI 185, the CO_2 emissions associated with Derbyshire's transport lighting network were quantified and reported for the first time in 2008/2009, as detailed in Figure 13. In total 17.1kt CO_2 pa are generated through the lighting requirements of the Derbyshire transport network.
The lighting network can be divided into three categories:

- *Signlights*
- *Streetlights*
- *Bus shelter lighting*

Work is ongoing in all these areas, trialling new light technologies, replacing lights with more efficient bulbs, reducing burning hours, with the cumulative effect of reducing emissions from this source. The following sections provide a brief overview of work which is ongoing in this area.

Signlights

To provide a brief overview of the current signlight assets, there are approximately 11000 illuminated signs, bollards, refuge beacons, flashing amber warning signs etc. within the county with many different lamp/wattage combinations, of which 600 are LED lights.

The current guiding principle applied by DCC regarding signlighting is that unless a signlight is required to illuminate a sign which is legally enforceable, photo-electric controls are fitted which reduces the burning hours from 8760 (24/7) to approx 4200 (nighttime only) hours per year. (Legally enforceable signs such as speed terminal signs need to be illuminated at all times.)

LED signlight lanterns have been installed as part of a rolling program since December 2008, with a total of approximately 225 replacing the current stock of 5500 traditional fluorescent signlights to date. Investigations are currently underway regarding a retro-fit LED gear tray which could replace the existing lamp and reduce fuel consumption further to ¼ of the LED signlights and 90% less than the traditional fluorescent lights. In addition, the lamp life of the new bulbs are 68% longer than most of the fluorescent lamps currently used, which means fewer replacements, lowering CO_2 emissions not only from the energy usage but also the mileage required for maintenance.

Streetlights

Derbyshire maintains approximately 87,000 street lamps in Derbyshire which are visited every three years for routine maintenance work. Currently the majority of streetlights are standard fluorescent lamps, however the use of LED technology for street lights is an emerging area and it is expected that there will be some viable alternatives to the standard fluorescent street lights in 12-18 months available on the market.

Some local authorities are pushing ahead with trials of LED streetlights with promising results, which is being reviewed by DCC. Results from some trials show that LED technologies can reduce energy use by 70% compared to traditional lights and are expected to last up to ten times longer. A trial is being conducted for three LED streetlights which have been installed by the Parish Council in Hayfield. The trial is ongoing and will provide invaluable information in investigating the use of LEDs in streetlights.

Bus Shelter Lighting

In Derbyshire there are approximately 1600 bus shelters, of which approximately 1000 are illuminated; 730 by mains power and the remaining use solar powered low energy bulbs. It should be noted that although the solar shelters do not required mains connection, they require batteries which need replacing every five years.

Where a bus shelter becomes damaged and requires replacement, a low energy bulb is used to replace the existing standard fluorescent lights. New bus shelters are automatically fitted with low energy bulbs as standard and on average approximately 40 new shelters are provided each year, some of which replace existing shelters and some are at new locations where a new demand had been identified.

Trials are underway at Snape Hill, Belper, where existing bulbs are being replaced with energy efficient LED bulbs. These trials are still underway therefore data and the data from this trial is expected to be completed in the winter of 2010.

It would be useful for the various works which are ongoing across the Derbyshire lighting network to allow quantification of the accompanying carbon emission reduction. This would require detailed records of the number and wattage of the bulbs being used and those being replaced, an account of the number of burning hours, records of any reductions in burning hours, and the indirect effect of reduced mileage through reduced maintenance. Careful consideration regarding the energy requirements of solar batteries used in some bus shelters would be required. This project would then provide the baseline data to support the achievements to date, provide evidence for further work and allow appropriate targets to be set should this be required.

Actions Appropriate to the LTP3

There are numerous approaches which could be applied to CO_2 reduction within the road transport sector in Derbyshire, however it is important to highlight those which can be delivered at a local level and therefore can be realistically delivered through the LTP3 or through DCC corporate policies. There is already considerable influence on CO_2 reduction at a national level through improved vehicle technologies, improved fuels, taxation and fuel duties, Government scrappage and ultra-low carbon vehicle schemes and other Government funded mechanisms and policies in addition to the wider influence of the UK economy. Therefore it is important when assessing which carbon reduction measures could be applied to the road transport network that consideration is given to those actions which can be influenced at a local level either through the LTP3 and/or corporate policies or those which are driven at a national level with local support provided by the local authority.

In reporting on NI 186, Defra published a document called 'Analysis to support climate change indicators for local authorities'[17], April 2008, which provides a list of measures which could be applied to reduce CO_2 emissions from all sources across a Local Authority area, including the industrial and commercial sector, domestic and road transport sector. The list comprises 57 measures in total, of which only 1/8th of the transport related measures can be delivered at a local level and the remaining to be 'influenced' by the LTP to varying degrees. The measures which relate to transport, and which have been included in this Strategy are as follows:

- Smarter Choices Initiatives; Sustainable Travel Towns and Personalised Travel Planning
- Restrictive measures on transport use
- Public transport measures
- Vehicle maintenance
- Driver training
- Local Authority fleets
- Planning measures to reduce sprawl

The remaining transport measures detailed by the DECC will be led at a national level, but which can be influenced and supported by the Local Authority. It is important to also assess some of these measures as they provide guidance and direction to a local authority in developing a more sustainable transport system. All local measures have been assessed as part of this Strategy. In addition, some national measures have been assessed in order to provide a context to the level of action which is required/level of reduction which could be achieved if certain measures were successfully implemented. Finally some measures which will be driven at a national level but which will benefit from local support/encouragement have also been identified.

[17] http://www.decc.gov.uk/assets/decc/Statistics/nationalindicators/1_20100421135745_e_@@_analysisclimatechangeindicatorslas.pdf

CO_2 Reduction Summary: Explanation of Terms

Level of Influence

As discussed earlier, it is important to identify those actions which can be implemented at a local level and those which will be led from a national perspective. This will provide a focus as to the actions which could play a larger role locally and could be delivered through the LTP3 and/or DCC corporate policies:

- **High:** Direct influence through a variety of existing channels.
- **Medium:** An influential role, liaising with external organisations and leading by example.
- **Low:** Minimal, reduction measure largely dictated by national policies and strategies. Possible local influence through awareness-raising and promotion.
- **TBC:** To be confirmed, data being collated or under review.

Time-scale

The various measures were assessed to estimate the approximate time-scale to implementation and to generation of resultant reductions in CO_2:

- **Short:** Measure already underway or could be initiated early in LTP3 period, associated CO_2 reductions potentially being achieved relatively quickly (1-3 years).
- **Medium:** Measure could be implemented within the life of LTP3, with CO_2 reductions requiring a slightly longer lead-in time (5 years).
- **Long:** Measure outside scope of LTP3, requires considerable behavioural change, however support towards change to be provided through LTP3 (15 years).
- **TBC:** To be confirmed, data being collated or under review.

Costs:

The cost of implementing a CO_2 reduction measure would require considerable resources to quantify, so a simper evaluation method has been applied:

- **Low:** Existing role with Derbyshire County Council, Corporate Policy and/or awareness raising initiative using existing channels.
- **Medium:** Moderate investment in infrastructure or marketing required.
- **High:** Substantial investment in infrastructure, comparable to a major scheme or requires large buy-in from wider population.
- **TBC:** To be confirmed, data being collated or under review.

Important note: *The methodology used in estimating the potential CO_2 reduction savings means that these measures are not mutually exclusive, therefore it is inappropriate to add them to assess total emission reduction which could be achieved should all the measures be implemented. The estimates are only to provide an indication of the scope of the reduction which could be achieved.*

Figure 20: Carbon reduction summary, including level of influence, timescales and costs (2008)

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Replacing all cars with low emission vehicles (=<110g CO_2/km)	National Policy supported by local awareness raising, Personalised Travel Planning	350.2	Positive	Low	Long	High
Replacing petrol fuel cars with hybrid petrol/electric	National Policy supported by local awareness raising, Personalised Travel Planning	255.7	Positive	Low	Long	High
Replacing petrol fuel cars with CNG/LPG	National Policy supported by local awareness raising, Personalised Travel Planning	78.6	Positive	Low	Long	High
Replacing petrol fuel cars with diesel	National Policy supported by local awareness raising, Personalised Travel Planning	74.4	Negative	Low	Long	High
Replacing all current cars with electric vehicles	National Policy supported by local awareness raising, Personalised Travel Planning, provision of charging points	497.4	Positive	Low	Long	High
DCC Estate reductions (including energy use in buildings)	Corporate policy	4.6	Positive	High	Short	Low
Increasing use of car share for commuting journeys	Car Share Derbyshire available, promotion through awareness raising, Personalised Travel Planning	47.6	Positive	High	Short	Low

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Increasing uptake of cycling to work: Those who live <5km from work to cycle in place of driving	Creation of viable cycle networks, awareness raising, Personalised Travel Planning	33.6	Positive	High	Medium	Medium
Increasing uptake of walking to work: Those who live <2km from work to walk in place of driving	Creation of viable walking networks, awareness raising, Personalised Travel Planning	9.1	Positive	High	Medium	Medium
Sustainable Travel Towns Initiative (Eg Chesterfield, Buxton, Long Eaton)	Personalised travel planning project	8.1	Positive	High	Short	Medium
Using low carbon buses for all services	Awareness raising, liaison with Operators	9.9	Positive	Low	Long	High
Using low carbon buses for contracted services only	Awareness raising, liaison with Operators	1.0	Positive	High	Med	TBC
Smarter Driving: Cars	Awareness raising, provision of training, Personalised Travel Planning	68.0	Positive	Medium	Short	Low
Smarter Driving: Buses	Awareness raising, liaison with Operators	2.4	Positive	Medium	Medium	Low

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Smarter Driving: Freight	Awareness raising, liaison with Fleet Operators, Business Travel Plans	47.7	Positive	Medium	Medium	Low
Freight: Selection Policy	Awareness raising, liaison with Fleet Operators, Business Travel Plans	20.1	Positive	Medium	Medium	TBC
Freight: Aerodynamic Styling kits	Awareness raising, liaison with Fleet Operators, Business Travel Plans	26.8	Positive	Medium	Medium	TBC
Freight: Fuel Management	Awareness raising, liaison with Fleet Operators, Business Travel Plans	13.4	Positive	Medium	Medium	TBC
Freight: Route Planning	Awareness raising, liaison with Fleet Operators, Business Travel Plans	10.7	Positive	Medium	Medium	TBC
Freight: Strategic Measures	Awareness raising, liaison with Fleet Operators, Business Travel Plans	13.4	Positive	Medium	Medium	TBC
Increasing access to Derbyshire Tourist Events by sustainable transport	Awareness raising, provision of alternative transport and incentives	TBC	Positive	High	Short	Low
Encouraging and supporting sustainable tourism in Derbyshire	Awareness raising, provision of alternative transport information and incentives	TBC	Positive	Medium	TBC	TBC

Potential CO_2 Reduction Measure	Actions to implement measures	Potential CO_2 Saving (kt pa)	Potential Impact on AQ	Level of Influence at local level	Timescales to results	Cost to implement Measure
Reduction in energy consumption of DCC signlights, streetlights and bus shelter lighting	Programme of bulb replacement and reduction in burning hours	TBC	Positive	Medium	Long	TBC
Reducing the need to travel	Land-use and accessibility planning	TBC	Positive	High	Short	Low
Reducing business travel mileage	Business Travel Plans	TBC	Positive	High	Short	Low
Reducing travel to school mileage	School Travel Plans	TBC	Positive	High	Short	Low
DCC Corporate Initiative: Changing the Way Derbyshire Works	Corporate policy	TBC	Positive	High	Medium	Low
Transfer freight from road to rail	Awareness raising, liaison with Freight Companies	TBC	Positive	Medium	Long	TBC
Emission standards in conditions of contracted services	Contract Conditions	TBC	Positive	High	Short	TBC

For explanation of the rating criteria, please reference: Explanation of terms

Reducing the need to travel through planning

The land use planning system is a highly powerful tool in ensuring new developments are built to minimise their impact on the environment, contribute to CO_2 emissions reduction and are supportive to the development of a sustainable and low carbon transport system.

The location of a development has a key impact on the numbers of trips, the modes of transport used and the distances travelled. The provision, delivery and location of facilities and infrastructure play a key role in determining the travel patterns of an area. Therefore it is important that developments are located and designed in such a way as to reduce the need to travel and provide the infrastructure required to promote more sustainable travel modes or lower carbon alternatives. Information has been drawn from an article recently published by Town and Country Planning regarding the role spatial planning has in encouraging sustainable travel[18] and it is recommended that consideration should be given to the following aspects of any development:

- The location and type of development is tailored to the needs of the area. Consideration should be given to existing commuting patterns, employment locations, workforce and other developments in order to discourage long-distance commuting.
- Ensure key services are provided through the development or nearby, such as workplaces, healthcare, schools, shops and leisure facilities in order to encourage local journeys. Support should be given to building types which facilitate co-location of businesses and facilities.
- For mixed use developments, ensure the development is well serviced by the existing public transport network, making improvements where necessary and ensuring all infrastructure is in place before the development is occupied i.e. before learned travel behaviour. Ensure travel information is available to occupiers of the site.
- Ensure the development incorporates links to key services, facilities and pedestrian or cycling networks and that appropriate information and signage is provided and that these links are provided prior to occupation of the site (i.e. before learned travel behaviour)
- Timely provision of residential and business travel plans, which are monitored and updated regularly.
- The design of development is key to promoting more ‘shared use’ of the space, providing green spaces or communal areas, allowing roads to accommodate all vehicle types including cyclists etc
- Provision of infrastructure to support lower carbon alternatives such as provision of electric power points, cycling networks, parking controls, car share schemes and car clubs to name a few examples.

[18] http://www.tsu.ox.ac.uk/pubs/rhickman-paper02.pdf

Derbyshire is a two tier local authority, with the planning authorities sitting with the individual district and borough authorities and the transport authority sitting with Derbyshire County Council. Therefore it is imperative that the Planning and Transport Authorities work together on planning applications and hold discussions at early stages in the planning process to agree the appropriate infrastructure that should be provided through a development. It is also important that Derbyshire County Council continues to liaise with the Planning Authorities through the development of their local development framework to ensure strong consideration is given to the type of policies which would require developments to minimise their impact on the environment, contribute to CO_2 dioxide emissions reduction and are supportive to the development of a sustainable and low carbon transport system.

Accessibility Planning

The importance of reducing the need to travel through the provision of local key services is also reflected in the continuing work of the Accessibility Team at Derbyshire County Council, their accessibility vision being:

"To ensure that everyone in Derbyshire has the opportunity to access healthcare, education, employment and food shopping facilities in a reasonable time, and at reasonable cost."

To this end, work is undertaken in improving access to work and key services through accessibility planning and providing additional services such as:

- Community transport services
- Wheels to work
- Independent travel training
- Local and community rail services
- Bringing services to the people

The complete Derbyshire Accessibility Strategy which accompanied the LTP2 is available to view from DCC website[19]. The planning regime and accessibility planning all have key roles to play in contributing to CO_2 reduction from transport through reducing dependency on the car, reducing the distance to access key services and leisure facilities, encouraging the uptake of lower emission vehicles and more sustainable travel modes. However it is difficult to quantify the exact impacts that these services provide, particularly in terms of planning, however their importance should be highlighted in this Strategy.

[19] http://www.derbyshire.gov.uk/images/A3%20Annex.pdf

Passenger Cars

Smarter Driving

Smarter driving, also commonly called 'eco-driving' is a CO_2 reduction measure which is applicable to most vehicular road transport users; having the widest market means that potentially it could have a substantial impact on CO_2 emissions for Derbyshire, subject to some key assumptions which are discussed later in this section. Smarter driving involves a series of techniques which can be applied when driving a vehicle with the overall effect of improving fuel efficiency. Since for a given type of fuel, CO_2 and other greenhouse gases emissions are directly proportional to the quantity of fuel consumed, a decrease in fuel consumption yields an associated decrease in CO_2 emissions. Further information regarding smarter driving techniques is available in Appendix II.

According to Defra/DECC GHG Conversion Factors for Company Reporting Methodology 2009[20], if smarter driving techniques are employed, a 5-15% reduction in fuel consumption can be achieved. The UK Government set up an collective initiative called 'Act on CO_2' which involves various Government Agencies to work together to help tackle UK CO_2 emissions. According to information provided by the 'Act on CO_2'[21] campaign, the average fuel savings which can be achieved when smarter driving techniques are employed equates to an 8% reduction. It is this average reduction which has been used to calculate the associated CO_2 emission reductions.

In order to assess the impact of Derbyshire car drivers employing smarter driving techniques, the following assumptions have been made, in agreement with those contained in the DfT Consultation report 'Increasing the uptake of eco-driving training for drivers of HGV's and PSV's' [22] :

- Currently no passenger car drivers in Derbyshire employ smarter driving techniques
- Once the techniques are learned, they will be applied 90% of the time whilst driving
- All passenger car drivers will undergo all the necessary training.

As indicated, the assumptions involved in this calculation are considerable but the purpose of this exercise is to provide an indication as to the scale this CO_2 reduction measure could have. In reality, some drivers may already employ smarter driving techniques and it is inevitable that despite receiving training, some drivers will not always employ the techniques when using their vehicles. Overall the calculations provide a useful indication as to the scope of this CO_2 reduction measure.

The total reductions which could be achieved if every passenger car driven on Derbyshire roads employed smarter driving techniques would equate to CO_2 emission reductions of 68.0kt of CO_2, this equates to a reduction in 4.1% of total CO_2 emissions across the whole passenger car transport sector.

[20] http://www.defra.gov.uk/environment/business/reporting/pdf/091013-guidelines-ghg-conversion-factors-method-paper.pdf
[21] http://actonco2.direct.gov.uk/actonco2/home/what-you-can-do/driving-your-car.html
[22] http://www.dft.gov.uk/consultations/closed/2010-11/

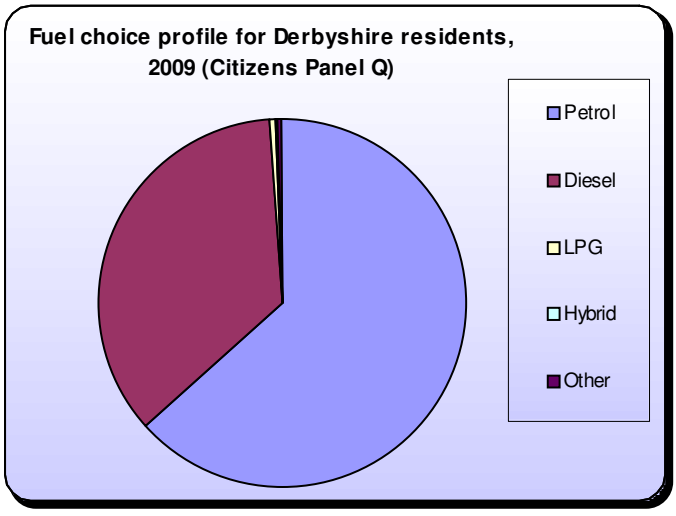
How can LTP3 influence Smarter Driving?

The LTP3 can influence the driving techniques employed by the wider population through increased communication and awareness campaigns. This communication can be through the Council website and publications, potentially reaching a large proportion of the Derbyshire population, working with local Borough and District Authorities to cascade information through their channels; working with businesses through business travel plans and/or personalised travel planning. The latter two options are discussed in more detail in the following chapters. There is an abundance of information and support available to local authorities looking to reduce CO_2 emissions from transport through the Energy Savings Trust[23], including the provision of subsidised smarter driver training, so this resource should be fully explored when designing an awareness raising or communication campaign.

Fuel Choice

The different fuels available for passenger cars vary in their CO_2 emissions and therefore it is appropriate to understand the different fuels available and their associated CO_2 emissions. Information regarding the types of fuels currently available and their relative CO_2 emissions can be found in Appendix III.

Figure 21: Derbyshire Fuel Choice Profile, Citizens Panel Questionnaire, 2009 (DCC)



Detailed information regarding the type of fuel used in the passenger car fleet in Derbyshire is currently unavailable. However, a Citizens Panel Questionnaire completed in 2009, which received over 4,500 responses from Derbyshire residents, queried which of the most common fuels (not including biofuels or electric vehicles) were used in the vehicles of those surveyed. The results showed good correlation with national averages for fuel choice and in the absence of more detailed information, the results of this survey have been used in this Strategy.

[23] http://www.energysavingtrust.org.uk/Travel/Drivers

Figure 21 shows the current fuel choice profile for Derbyshire and as can be seen petrol is the most commonly used fuel, accounting for approximately 63.4% of all fuels. However, there is an increasing awareness and use of alternative fuels, which can be seen by the alternative fuels used by a small proportion of Derbyshire residents; the Government through its program of reducing CO_2 from the transport sector, will be encouraging increased take-up of alternative fuels and technologies which have the potential to offer considerable CO_2 savings, these are discussed in the following section.

It is difficult to assess a CO_2 reduction measure involving alternative fuels in Derbyshire, since fuel choice is influenced by numerous factors, many of which lie at a national level through Government incentives and policies. It is also difficult to predict, and therefore quantify, the types of fuels people will choose in the future as this will be dictated through availability and costs for example. Therefore, the most sensible way to show the impact that the different fuel types have on CO_2 emissions is to compare the emissions associated with each fuel type over the same distance.

Using the average distance driven to work per year of 6713km and the emission factor associated with each fuel, CO_2 emissions per fuel type can be calculated and are shown in Figure 22. Battery electric vehicles have also been included, which applies an emission factor associated with electric vehicles powered by mains electricity. Technically, electric vehicles do not generate any 'tailpipe' emissions, however the majority of UK electricity is generated from burning carbon-intensive fossil fuels, in 2008, the share of carbon-free sources of electricity generation was only 18.5% (13% nuclear and 5.5% renewable sources)[24]. Therefore, although there are zero emissions from the tailpipe of electric vehicles, it is not appropriate to consider them to be zero emission vehicles as the power which is required to fuel them has a predominantly carbon source. If the generated electricity used to power electric vehicles, came from a source that contained increased amounts of renewable energy or 'non-carbon' energy, the emissions from electric vehicles would be reduced further.

Figure 22: CO2 emissions from different fuels used over the same distance.

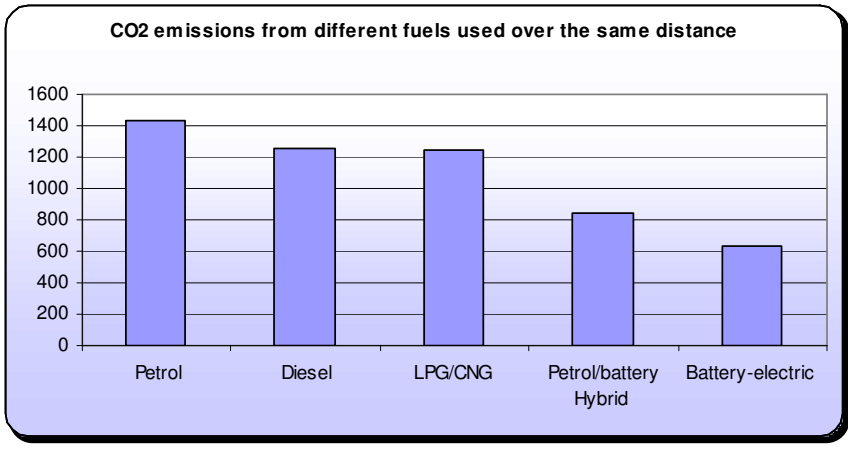


Figure 22 shows that the CO_2 emission reductions associated with using diesel and LPG/CNG vehicles are similar, which is in agreement with the Energy Savings Trust whereby 'LPG and CNG cars result in 10-15% reduction in CO_2 relative to petrol cars, producing emissions similar to diesel vehicles.' Due to the significant size

[24] Driving Down Emissions: The Potential of Low CO2 Vehicle Technology, 2010, RAC Foundation.

and weight of the LPG and CNG fuel tanks it is assumed only medium and large sized vehicles will be available.

It should be noted that although diesel vehicles produce lower CO_2 emissions, their emissions of particulate matter are higher than for their petrol equivalents, which is one of the main local air quality pollutants of concern in the UK. Therefore there is a distinct trade-off between a benefit for climate change and a detriment to air quality. In addition, emerging evidence suggests that black carbon, which is a fraction of particulate matter, once in the atmosphere will contribute to climate change by absorbing heat and depositing on the snow and ice. This in turn will reduce the reflectivity of these areas, possibly speeding up the melting of glaciers and altering weather patterns. This emerging evidence suggests that black carbon may contribute to 20-50% of the warming effect of CO_2 in near-term climate change[25]. Therefore there is strong air quality data and emerging climate change evidence to suggest that this measure should not be actively pursued in developing policies to abate these emission sources.

It is clear from Figure 22 that electric vehicles afford the greatest potential for CO2 emission reduction from vehicle fuels. Therefore, to provide an indication as to the possible reduction which would be achieved by replacing current fuels with lower carbon equivalents, CO_2 emissions have been calculated for the proportion of the passenger car sector which is currently fuelled by petrol, as compared to this sector using different fuels. Emissions have also been calculated regarding the reduction associated with replacing the current car fleet with alternative technologies such as hybrid and electric vehicles. The CO_2 emission reductions which would be achieved are as follows:

- Replacing all cars with low emission vehicles: 350.2kt CO_2 pa
- Replacing petrol fuel cars for diesel: 74.4kt CO_2 pa
- Converting petrol cars to LPG/CNG: 78.6kt CO_2 pa
- Replacing petrol cars for hybrid vehicles: 255.7kt CO_2 pa
- Replacing all cars with electric vehicles: 497.4kt CO_2 pa.

This information should be treated with caution as the assumptions used in their calculation are considerable, however it does provide an indication of the potential scale of reductions which could be achieved by using different fuels.

It should be noted that at the time of writing this report, these were the technologies which were emerging in the passenger car market. This is a fast growing area and as such, new technologies and fuels are being quickly developed which may offer further CO_2 reductions. Therefore care should be taken in future reports to assess any new technologies which may have been developed and to include them in future phases of this Strategy.

[25] http://www.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-pollution.pdf

How can the LTP3 influence Vehicle Fuel Choice?

The main influence for fuel choice in vehicles used by the wider population will come from national policies and strategies. In 2008/2009, the Government supported a national scrappage scheme, which invited motorists to trade in vehicles which were over 10 years old in exchange for a £2000 grant towards the cost of a newer vehicle. The scheme finished in 2010 and the Department for Business Innovation and Skills estimated that there was a 27% reduction in the average CO_2 emission of the old scrapped vehicle and the new one. Total emission reduction data attributed to the Government Scrappage Scheme are currently unavailable.

In order to encourage greater uptake of lower carbon cars, in July 2010, the Government confirmed that motorists will receive up to £5000 towards the purchase of ultra-low carbon cars from January 2011. The aim is 'Consumer incentive will help Britain become one of the leading centres for the design, development and manufacture of ultra-low carbon vehicles.

In addition, the Government is funding the 'Plugged in Places' Initiative, where cities and businesses join together to bid for funding to help with the installation of electric charging points on streets, car parks, and in commercial, retail and leisure facilities. The funding will act as a pilot programme which will inform future development of national charging infrastructure. Derbyshire County Council is currently supporting the 'Plugged in Places' bid currently under development with the Sheffield and Leeds City Regions.

Although direct control of these initiatives through the LTP3 is limited, it can help to support national incentives and policies largely through development control, infrastructure development, and communication and awareness campaigns. The planning regime can be used to ensure that appropriate facilities and infrastructure are provided with new developments to encourage alternative fuel choice. This could be done in a variety of ways, by designing the appropriate infrastructure into a development, influencing parking controls or creating funds to improve the infrastructure over a wider area.

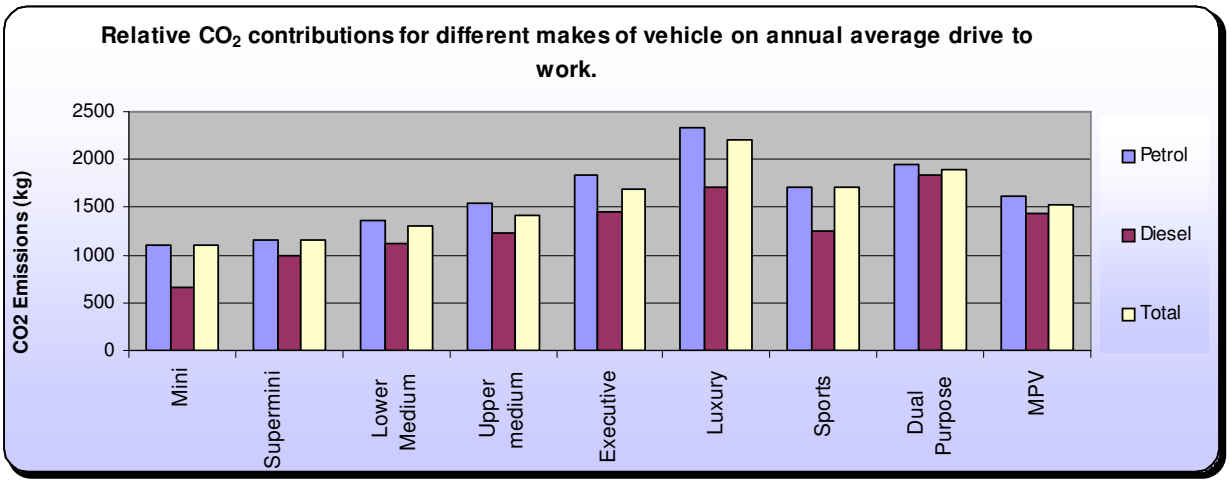
Communication and awareness campaigns are important to ensure the public understand the choices that are available to them, so they can make the right decision for their circumstances. There is a plethora of information available regarding this subject, which can often be a hindrance, therefore an important role for a local authority is to ensure the public are aware of reliable sources of information and to help simplify the messages. This communication can be through the Council website and publications, potentially reaching a large proportion of the Derbyshire population, working with local Borough and District Authorities to cascade information through their channels; working with businesses through business travel plans and/or personalised travel planning. The latter two options are discussed in more detail in the following chapters.

The Citizens Panel Questionnaire produced in 2009, invited comments from the public regarding the use of alternative fuels. The main barriers which were identified in the various responses were that hybrid vehicles were too expensive and there were a lack of outlets selling alternative fuels such as LPG or CNG in Derbyshire. In developing a CO_2 reduction program to increase the use of alternative fuels, consideration should be given to these perceived barriers.

Vehicle Type

Similar to different emissions associated with passenger car fuel choice, the type, age and efficiency of the vehicle which is driven along Derbyshire roads will generate different CO_2 emissions. Since CO_2 emissions are directly associated with fuel consumption, a general rule of thumb is that the smaller, newer and therefore more fuel efficient the vehicle, the lower the associated CO_2 emissions. However, the reasons behind the ownership of a particular vehicle are extremely varied and subject to personal preference, employment requirements, lifestyle choices, level of disposable income, national policies and incentives as well as the general influence of the wider UK economy to name a few examples. Therefore, in order to provide an overview of the variations in the CO_2 emissions that different vehicle types have, the CO_2 emissions associated with a selection of vehicles will be calculated for the same distance driven, which can be seen in Figure 23.

Figure 23: CO2 emissions from different vehicles driven over the same distance.



Examples of the types of car which fall into each category are:

- Mini: Smart Fortwo
- Supermini: VW Polo
- Lower Medium: Ford Focus
- Upper Medium: Toyota Avensis
- Executive: BMW 5 Series
- Luxury: Bentley Continental GT

- Sports: Mercedes SLK
- Dual Purpose: Land Rover Discovery
- MPV: Renault Espace

As can be clearly seen from the graph, the smaller vehicles have considerably lower emissions that those luxury or executive vehicles which are used for the same journey. Since CO_2 emissions are directly related to fuel consumption, the graph also indicates those vehicles which will use more fuel and therefore cost more for the same journey length. This information is important as it may influence people's decisions, not only in the type of vehicle they choose to own, but also the type of vehicle used for a particular journey.

It would be useful therefore to try to quantify the emission reduction which could be achieved, if all those who drive along Derbyshire roads, did so in low emission vehicles. Due to the progress made with improving emissions from vehicles over recent years, a number of models are available on today's market with CO_2 emissions of less than 110gCO_2/km. Using this emission standard as a benchmark, it is therefore possible to estimate the emission reductions which could be achieved should all passenger cars using Derbyshire roads comply with this standard, which will provide a useful overview of the scope of the reduction possible simply though improving vehicle engine efficiency. The VCA website[26] lists all vehicles which are available with CO_2 emissions less than 110g CO_2/km. These include petrol, diesel and hybrid vehicles of a variety of types from Supermini to family medium vehicles. A 15% uplift factor has been applied to the emission factor to simulate 'real-world' conditions (see Appendix I for further information), in agreement with many of the emission factors used in this Strategy.

The overall emission reduction which could be achieved if everyone chose to drive low emission vehicles is 350.2kt CO_2 per annum. Although this appears to be a significant reduction, the results must be treated with caution as the assumptions used in the calculations are considerable and the largest influence to encouraging the uptake of lower emission vehicles lies at a national level. However, it does provide a useful overview of the scale of CO_2 emission reduction which could be achieved through engine technology alone. The CO_2 emissions associated with the use of electric vehicles is discussed in the preceeding section: Vehicle Fuels.

How can the LTP3 influence vehicle type?

Similar to vehicle fuels, the LTP3 can support the Government policies regarding informed vehicle choice through a variety of channels such as development control, communication and awareness campaigns. The planning regime can be used to support a shift to low CO_2 transport through the introduction of infrastructure such as:

[26] http://www.vcacarfueldata.org.uk/information/how-to-use-the-data-tables.asp#petrol

- Provision of electric charging points on local streets and/or car parks which can be integrated into existing street furniture such as lighting columns, bollards and signs to reduce clutter
- Creation of low emission zones on new developments
- Use of parking controls to encourage low emission vehicles.

Communication and awareness campaigns are important to ensure the public understand the choices that are available so they can make the right decision for their circumstances. There is a plethora of information available regarding this subject, which can often be a hindrance, therefore an important role for a local authority is to ensure the public are aware of reliable sources of information and to help simplify the messages. This communication can be through the Council website and publications, potentially reaching a large proportion of the Derbyshire population, working with local Borough and District Authorities to cascade information through their channels; working with businesses through business travel plans and/or personalised travel planning. The latter two options are discussed in more detail in the following chapters.

Commuting Emissions

Passenger cars used for commuting to work account for 24% of total CO_2 emissions from this transport sector, and therefore is the largest single sources of CO_2 emissions from passenger cars. The following section will therefore look at measures which aim to reduce CO_2 emissions from the commuting vehicle sector.

Car Share:

According to the DfT CO_2 Pathways Analysis, single occupancy rates for vehicle journeys are highest for commuter journeys, therefore these journeys afford greater scope to improve car-sharing rates and therefore reducing CO_2 emissions. Figure 24 provides the car occupancy rates for different journey types.

An alternative to single occupancy car use is for employees at the same company or who work in similar locations to car share their journeys to work. According to Liftshare UK[27], the largest car share organisation in the UK, travel surveys show typically 50% of commuters would share if they could find someone suitable to share with. If this were to be put into practice, the average occupancy rate would increase from 1.1 to 1.5, representing a 22% increase in occupancy rates, reducing the percentage of single occupancy vehicles. If this were the case, and following the assumptions listed below, this equates to a CO_2 reduction potential of 45.4kt of CO_2 per year. In addition, if this reduction measure were successfully implemented and the effect locked into the road transport network, there would be the added benefit of alleviating congestion through a reduction in the number of cars with all the associated benefits this would provide.

[27] https://www.liftshare.com/uk/

Figure 24: Vehicle occupancy rates for journeys made by passenger cars.

Journey Type	Vehicle Occupancy	
	Average Occupancy	Single occupancy rate
Commuting	1.1	91%
Business	1.2	87%
Education/escort education	2.0	37%
Other personal business	1.7	49%
Shopping	1.7	51%
Visiting friends	2.1	32%
Holiday	2.1	37%
Other leisure	1.7	57%
All journey purpose	1.6	61%

These estimated potential CO_2 reduction savings rely on the following assumptions:

- Suitable car sharers were found for 50% of single occupancy commuters
- They then consistently shared their journey to work for a full calendar year
- The distance travelled when sharing a car is the same as when driven alone
- The number of cars removed from the road directly relates to the distance travelled i.e. % reduction in commuting vehicles = % reduction in CO_2 emissions.

How can the LTP3 influence car sharing?

Aside from Derbyshire County Council leading by example, which is discussed in an earlier chapter, the LTP3 can influence car sharing among the wider population through communication and awareness raising. This communication can be through the Council website and publications, potentially reaching a large proportion of the Derbyshire population, working with local Borough and District Authorities to cascade information through their channels; working with businesses through business travel plans and/or personalised travel planning. The latter two options are discussed in more detail in the following chapters. The planning regime can also be used to influence car sharing rates, by introducing parking charges based on vehicle occupancy rates.

There is an abundance of information and support available to local authorities looking to reduce CO_2 emissions from transport through the Energy Savings Trust, so this resource should be fully explored when designing an awareness raising/communication campaign.

Walking/Cycling to Work

Information is available from the online National Statistics Database[28] regarding the personal travel choices made by the residents of Derbyshire to travel to their place of work. The most recent data available for Derbyshire is 2001 and the number of people surveyed was 531984. A study of commuting patterns in Great Britain based an Annual Population Survey (APS's) in 2008 concluded that the information available is not sufficient to explore how Travel to Work Areas may have changed since the survey conducted in 2001, nor to create any update to the survey results from 2001[29]. Therefore although the population in Derbyshire may have increased since 2001, since further data is unavailable and projections are not viable, the original data will be used to provide a reliable indication.

Figure 25: Mode of travel to work in Derbyshire, 2001, National Statistics

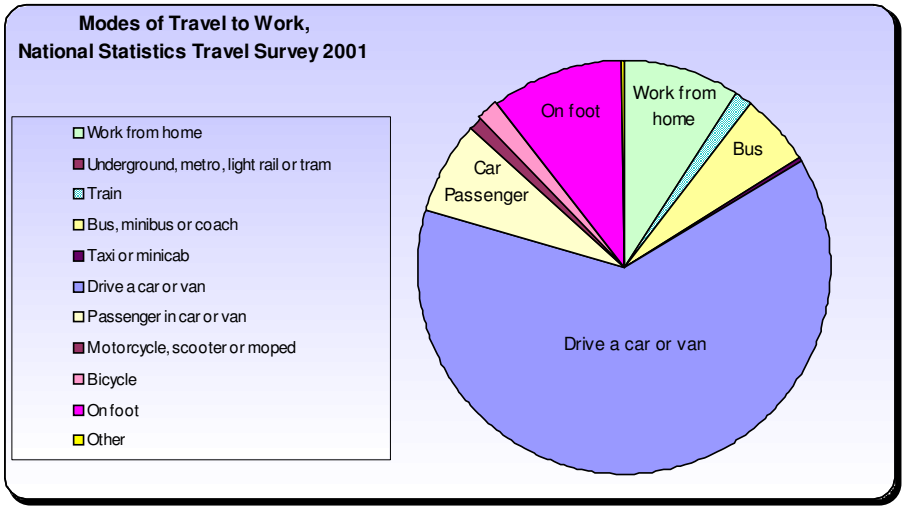


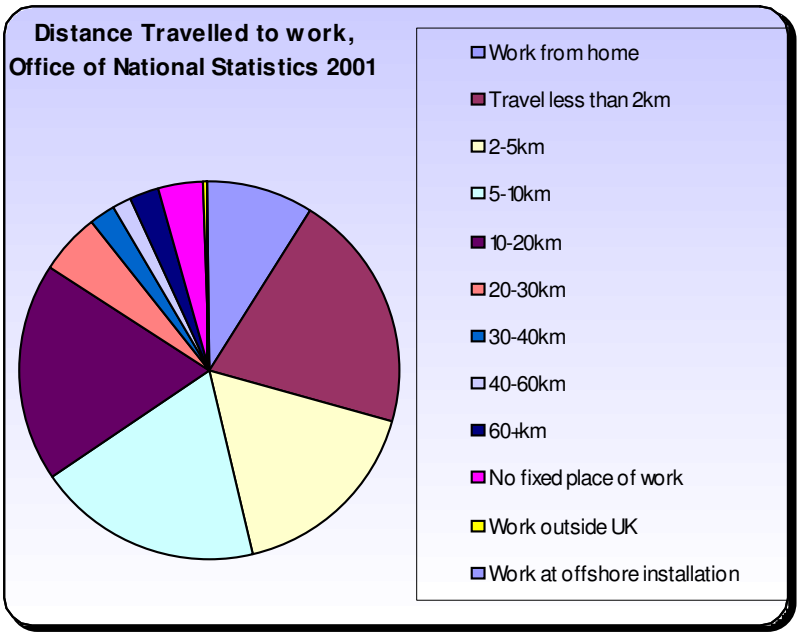
Figure 25 shows the breakdown of mode of travel to work in Derbyshire and it can be clearly seen that the vast majority of journeys are made by driving a car or van, which reflects the source of emissions for this journey type, as discussed in earlier sections. It is noticeable from Figure 25 that one of the least popular modes of travel to work is by bicycle, which is interesting as this form of transport has large CO_2 reduction potential especially for those commuters who cannot access other forms of public transport such as bus, metro or train. Those who travel on foot, by bus and by being a passenger in a vehicle are of similar proportions. This provides an interesting insight into transport mode choice for Derbyshire residents which again will help to inform any CO_2 reduction strategy for this type of journey.

The Office for National Statistics also provides information regarding the distance travelled to work. Figure 26 shows that over 65% of Derbyshire residents travel less than 10km/6miles to work. There is an opportunity to encourage those who drive shorter distances to work to walk or cycle instead. According to Cycling England, it is likely that people who will cycle to work, also tend to live within 5miles/8km (30 min cycle ride) of their place of work. Therefore, calculations have been made to assess the number of journeys to work made by those driving a car or a van who live within 5miles/8km of their place of work. This could represent a CO_2 reduction measure should they choose to cycle to work instead of using their vehicle. Using the data relating to the modal split of journeys to

[28] http://www.statistics.gov.uk/default.asp
[29] http://www.statistics.gov.uk/about/data/methodology/default.asp

work, coupled with the distances residents travel to their place of work, calculations have been made to the approximate number of vehicles which are used to travel to work for distances of less than 5km.

Figure 26: Derbyshire residents distance travelled to work, National Statistics 2001



In order to calculate this potential CO_2 reduction measure, important assumptions have been made regarding the datasets provided by The Office of National Statistics, namely:

- Since the sample year and size are the same it has been assumed that the same people were surveyed regarding both transport mode and distance to work, it is assumed therefore that these datasets are compatible for analysis.
- The same proportion of commuters use their vehicles for all journey lengths
- Those people who do live within 5km of their place of work are able to cycle or walk to work.

If all those who currently drive to work less than 5km cycled to work instead, the potential CO_2 emission saving which could be achieved would be 33.6kt of CO_2 per annum.

A significant proportion of commuters also live within 2km of work, which is approximately a 15-20 min journey on foot and therefore could be considered to be within walking distance. As a result using similar assumptions used to calculate emission reduction for cycling to work, the estimated CO_2 savings if those who currently drive to work walk instead is 9.1kt CO_2 per annum.

How can the LTP3 influence walking and cycling rates?

Figure 25, as discussed earlier, shows that currently a very low proportion of the current vehicle fleet on major roads comprise cyclists. In order to design measures to encourage increased cycling, it is important to understand the potential barriers to more widespread use of this form of transport. It may be the low statistic is due to the nature of the road, in that cyclists may prefer to use quieter minor roads and so is not shown in this dataset. However, it remains that understanding perceived

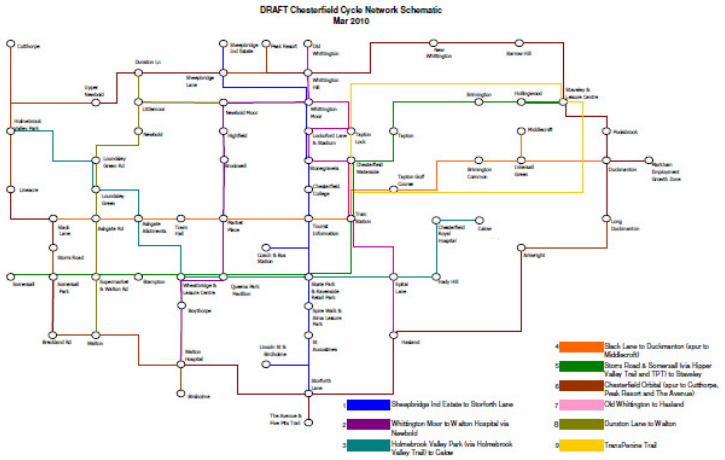
obstacles to cycling will help inform any reduction measure to encourage its use. The Citizens Panel survey conducted in 2009 surveyed Derbyshire residents travel behaviour and attitudes towards cycling and the following comments were received, which provides an insight into these perceived obstacles and included:

- Only cycle if the weather is fine
- Back injury means I can't cycle
- I would cycle to the shops if there was a safe route
- I don't know how to ride a bicycle
- Only children ride bicycles
- The roads are too busy
- Not enough safe cycle parking especially long term
- Cycling is too dangerous/probably suicide, only cycle abroad where proper infrastructure is provided e.g. Germany

Some of these comments cannot be resolved through action delivered by the LTP3 such as poor weather and personal injuries; however the majority of responses are areas which can be reviewed through the LTP3 such as cycle infrastructure and training and the comments received should be considered when designing a measure to increase cycling rates in Derbyshire.

Considerable work has already been conducted through the LTP2 to improve cycling facilities across the County, including the routine maintenance and expansion of the Derbyshire Greenway Network which is being expanded on average by 8km per year, provision of multi-user trails, cycle hire facilities, provision of cycle parking and training, road safety measures and speed reduction schemes. A Derbyshire cycle map has been produced which is available to download and the greenway network continues to expand across Derbyshire.

Figure 27: Chesterfield Cycle Network Schematic



In addition, a pilot project was conducted in 2009/2010 to assess the cycling infrastructure in the largest Derbyshire market town of Chesterfield in order to help tackle congestion and emerging air quality issues. The aim was to map an urban network of complete routes, connecting all the main destinations in the town, using as much existing cycle infrastructure as possible and linking in with the wider network of national cycle routes and Derbyshire

Greenways. The project was conducted having due regard to the 'Hierarchy of Measures' and 'Requirements of Infrastructure' as detailed in 'Guidelines for Cycle Audit and Cycle Review'[30].

The mapped network highlighted missing links and sections which needed to be delivered through land-use development and the Local Transport Plan. A schematic was also produced, based on the London Underground concept, as shown in Figure 27, replicating the routes on the ground, which could be used once the network is complete as a simple guide to routes and destinations. Monitoring of the routes will be conducted before and after implementation of the network and surveys can be used to assess the CO_2 reduction achieved through modal shift from passenger car to bicycle. This project and associated methodology can now be cascaded to other towns in Derbyshire, with the overall aim that eventually all urban and rural cycle networks will connect, creating a viable non-motorised transport network.

A similar design principle can also be applied to pedestrian networks, auditing routes between required destinations and highlighting any missing links in the networks.

Monitoring of cycling across Derbyshire has been carried out during the LTP2 period using DCC traffic counting network, which has shown cycling rates have remained fairly level over the LTP2 period. Therefore there may be further opportunities which can be identified to support and further existing works to encourage more cycling.

The Sustainable Travel Demonstration Towns in the UK[31] aimed to encourage increased cycling, walking and use of public transport, and these towns identified that there is greater opportunity to do so in urban/semi urban areas where there is a higher density of shorter trips and better public transport services. The range of measures which were implemented by the demonstration towns are listed below (in alphabetical order):

- Creating safe and complete cycling and walking networks, with appropriate signage and mapping.
- Encourage cycle loan or cycle hire schemes to be implemented
- High quality, safe and secure cycle parking
- Promotion of 'In Town without my car' and 'Cycle to work guarantees'
- Promotion of the networks through cycling/walking maps and promotional work through marketing campaigns, business and personalised travel planning
- Provision of adult and child cycle training where required.

The result of the various sustainable travel towns was that after five years, on average, cycling rates had increased by 26-30%. If this increase in cycling is a result of modal shift from using the car, the associated CO_2 emission reduction would be achieved through reduced car usage. Therefore it is

[30] Published by the Institution of Higheays and Transportation, September 1998
[31] http://www.dft.gov.uk/pgr/sustainable/demonstrationtowns/

recommended that Derbyshire use the information provided by these demonstration towns when designing the carbon reduction measure to increase cycling in Derbyshire. In addition, surveys should be designed so as to allow any modal shift to be captured and associated CO_2 emission reduction to be quantified.

Public Transport

Figure 25 shows that less than 6% of commuters use public transport to go to work. Currently, due to the complexity of assessing modal shift and limited data and detailed information, the emission reduction possible if more people were to use public transport rather than their private passenger cars cannot be quantified. In the interim, an example of emission reduction which could be achieved has been provided to create a brief overview.

- If 25 people travel the average Derbyshire distance to work of 25km a day in single occupancy vehicle, in an average car of unknown fuel, the associated CO_2 emissions would be 34, 824kg.

- If the same 25 people chose to use a standard local bus, the emissions would be 14,953kg, which is a 43% reduction and there would be 24 less vehicles using the roads.

If you imagine, in 2001, over 200,000 people drove to work each day, this gives an idea of the scope of the CO_2 emission reductions possible if more people were to use public transport.

How can the LTP3 increase bus patronage on the commute?

Modal shift from the car to using the bus is known to be a complex and difficult area to influence and quantify in terms of CO_2 emissions. An understanding of current bus patronage for the commute coupled with an understanding as to perceived obstacles to using the bus would be needed when designing a CO_2 emission reduction measure to reduce this source of emissions. Further discussion regarding public transport can be found in a later section.

Sustainable Travel Towns

As discussed in previous sections, the location and requirements of the transport network in Derbyshire needs to be fully understood in order to be able to suggest viable lower CO_2 alternatives to the current transport decisions being made. However, at this early stage in the process, it may not be feasible to approach the whole transport network as the requirements of the network vary so widely. Instead, an approach which has been tested through the Sustainable Travel Demonstration Towns is to concentrate on urban areas where there is a higher density of shorter trips which are more suitable for encouraging modal shift, making cycling, walking, car clubs and car sharing more realistic alternatives.

The Government provided considerable funding between 2005 and 2009 to fund three Sustainable Travel Demonstration Towns[32] in the UK, namely Darlington, Peterborough and Worcester. The project was commissioned to demonstrate the costs and effectiveness of a sustainable travel town programme, implementing a range of initiatives including travel planning, marketing and improved information; the complete list of measures can be found in Appendix II. The preliminary results regarding the costs of these programmes and the effect the various initiatives had on traffic levels and transport choices are now available and include the following:

- Between 2004 and 2009, the number of car trips was reduced by 7-9% of those targeted[33]
- Estimated out-turn costs of programme is £10pppa, including both capital and revenue expenditure.
- Estimations based on the household surveys suggest that the Sustainable Travel Towns programme resulted in annual per capita CO_2 savings of approximately 50kg of CO_2 dioxide in 2008, compared to 2004
- Grossing this up to town-wide level and accounting for increases in population, there was a combined saving of 17.5kt CO_2 per annum in 2008, across all three towns. The per capita figure only reflects reductions in car driver distance on journeys of less than 50km, but it is equivalent to a reduction in annual per capita emissions from car driving of approximately 4.6% for journeys of all lengths
- Car driver distance fell by 5-7%
- Cycling trips increased by 26-30%
- Walking trips increased by 10-13%
- Bus trips increased by 10-22%.

Using the information, experience and advice provided by the Government Sustainable Travel Towns Initiatives, the same principles could be applied to Derbyshire towns. As can be seen on Figure 6, there are numerous larger market towns surrounded by small villages and hamlets across Derbyshire. Using the results of the Government initiatives, it has been calculated that implementing such a scheme in three large Derbyshire towns, namely Buxton, Chesterfield and Long Eaton, the potential CO_2 emission savings which could be achieved would be 8.1kt CO_2 per annum.

Personalised Travel Planning

Personalised Travel Planning forms a key part of a Sustainable Travel Town Initiative and involves a team of travel advisors trained in all modes of local transport contacting the residents of a town to discuss their current travel arrangements and advise of alternatives which are available to them. The advisors then educate, advise and incentivise the residents to substitute their regular car journey with more sustainable transport modes.

[32] http://www.dft.gov.uk/pgr/sustainable/smarterchoices/smarterchoiceprogrammes/
[33] http://www.dft.gov.uk/pgr/sustainable/guidelocalauth/pdf/lowCO2travel.pdf

The service is able to assess current transport modes and monitor changes; therefore any surveys employed should be designed to allow reductions in CO_2 emission to be quantified. The survey also represents an opportunity to gather information as to any aspects of the transport network which could be improved on in order to encourage fewer journeys to be made by car.

Considerable work has been conducted on behalf of the DfT looking at personalised travel planning and rolling out pilot schemes across the UK[34], the results of which have been very encouraging suggesting this to be a cost-effective method to encourage modal shift. The potential CO_2 emission reduction associated with a personalised travel planning project has been included in the total for implementing Sustainable Travel Town Initiatives.

Business Travel Emissions

As discussed in earlier sections and shown in Figure 14, 13% of total car passenger emissions, equating to 122.8kt CO_2 per annum, are from business travel, These types of journeys have a high single occupancy rate, second to commuting journeys at 87%, therefore there may be scope for further CO_2 emission reduction through increasing car sharing rates and reducing business mileage.

In addition to ensuring the physical infrastructure is available to encourage more sustainable modes of travel such as car share databases, cycling and walking infrastructure, cycling and smarter driving training, an important element of encouraging further use of these methods is through communication and regular monitoring of travel plans.

Business Travel Planning involves liaison with businesses across Derbyshire to provide support and information regarding travel planning and to ensure adequate monitoring is conducted to assess any impacts in terms of reduced vehicle use and CO_2 reduction which is achieved.

Currently the CO_2 reduction emissions specifically associated with business travel planning cannot be quantified but are included in the total CO_2 reduction measures relating to smarter driving, car sharing and walking and cycling to work. Data could be obtained in the future through monitoring of business travel plans which have been developed through liaison with DCC. The surveys should be designed in such a way as to allow quantification of carbon reductions achieved through reduction in business mileage. In addition, reduction in the use of the grey fleet, which is staff using their own vehicles, can be reduced by operating a pool cars, tele-working and tele-conferencing. It important that any travel plans which are implemented are reviewed on a regular basis to ensure they are current and being used as efficiently as possible.

[34] http://www.dft.gov.uk/pgr/sustainable/travelplans/ptp/areviewoftheeffectivenessofp5773?page=3#a1023

Derbyshire County Council operates a travel planning liaison service for those companies wishing to get advice on how to implement a travel plan and for those that have to do so through a planning obligation. Over the coming years, it may be possible to extend this service to work more closely with larger organisations and to regularly review the travel plans to assess their impact in terms of modal shift. It is recommended that the regular monitoring is to also include quantification of CO_2 emissions.

School Travel Emissions

As discussed in earlier section and shown in Figure 14, 4% of total passenger car emissions are generated from trips to education. However, there is considerable anecdotal evidence that during the school holidays, general traffic along roads in the UK is considerably less than during term-time. It may be that the emissions attributed to travel to education has been underestimated due to the effect of 'combination journeys' where parents drop their children off at school on their way to work, which may not have been captured in the national journey purpose split. Therefore, should travel surveys be conducted, care must be taken in the wording to allow for 'combination journey' to be accurately recorded.

In addition, the importance of school travel plans should not be masked by the modest estimated contribution that travel to education makes to total CO_2 emissions. School travel plans and travel choice education may have considerable long-term and indirect impacts on travel behaviour, through influencing travel choice made in later life, influencing travel choices made by children for other journey modes, and the influence the child may have on family travel choices. A "Transport Choices" education pack was designed as part of earlier local transport plans and it is recommended that this information be reviewed to assess its expediency to support the education of children regarding their travel choices. This action is a recommendation of this Strategy.

Considerable work is already undertaken by the School Travel Plan team at Derbyshire County Council , providing a travel plan service for all schools in Derbyshire, 99.1% of all Derbyshire Schools now have a workable travel plan which aim to reduce car mileage to school by increasing more sustainable transport modes. The Government target date for ensuring all schools have implemented a travel plan has now passed, and the focus for the school travel plan team will be to work with certain schools that have a higher car usage, in order to reduce this further. It is recommended that any survey work relating to this work include annual mileage figures so the associated CO_2 emission reduction can be quantified and reported in future phases of this Strategy.

The School Travel Plan team also work with schools to provide road safety educational resources that compliment the national curriculum, such as the Art of Road Safety and Travel Smart programmes which are run annually. This is an important resource as travel behaviour and habits learned as children can often extend into adult life; therefore it is crucial that children understand the benefits and consequences of their travel choices.

School crossing patrols provide additional support for the safety of children and their parents/carers walking to and from school. School crossing patrols are currently provided at around 300 sites throughout the county, making a vital contribution to ensuring that Derbyshire children travel safely to and from school.

School buses are also provided for children in Derbyshire, with a network of services that transport approximately 25,000 pupils to and from school each day, of which approximately 9,000 receive free bus passes. This represents a significant reduction in potential CO_2 emissions if these children where being driven to school in passenger cars. The total emissions generated from the school buses equate to 0.8kt CO_2 pa. This has been calculated using an emission factor based on an average for all UK buses and coaches. It should be noted however, that these emission factors were calculated as an average across all UK buses and coaches and as such may well be under or over estimating the emissions from Derbyshire buses dependent on the age of the fleet. In order to generate more detailed calculations, a survey of the vehicles being used for school buses and their mileage would be required, which is recommended for future phases of this Strategy.

Public Transport: Buses

Similar to passenger vehicles, there are two ways that reductions in CO_2 emissions could be achieved through the public transport network, namely:

- Directly through the emissions generated when the vehicles are using Derbyshire roads i.e. vehicle exhausts and smarter driving.
- Indirectly by increasing patronage and thereby reducing the number of journeys made by passenger cars.

Vehicle Choice

In order to assess the former, it is necessary to fully understand the type, age and distance travelled by public service fleet using Derbyshire roads. The LTP3 has no direct control over the types of vehicles used by commercial operators, however it can influence those used on contracted routes by introducing emissions standards into the contract conditions. Currently conditions relating to vehicle emissions are under review, however in order to be able to introduce effective standards that not only relate to air pollutants through EURO standards but also the CO_2 emissions, an understanding of the current fleet and distance travelled on contracted services needs to be collated. This will require contracted service operators to complete and return carefully worded surveys which can collate this information, taking into consideration the following:

- Contracted services can comprise entire routes or simply links in routes, therefore careful evaluation of distance travelled is required when collating mileage data.

- Buses are sometimes refurbished, where the engine age may be different to chassis age and vice versa, therefore this information should be carefully captured through surveys to ensure the correct emission standard is recorded.
- Contracted vehicles can be used commercially at certain times of day, therefore should fuel consumption figures be collated, data must clearly reflect only fuel consumed on contracted distances.

Following collation of this information, accurate evaluation of the emissions from the current fleet can be conducted which will help to inform any minimum emission standards for public service vehicles. Careful consideration should be given to this as there will be associated financial implications of including emission standards in conditions of contract.

In the absence of the detailed information listed above, the emission factors as supplied by AEAT have been used to approximate the emissions generated by the public service fleet. It should be noted however, that these emission factors were calculated as an average across all UK buses and coaches and as such may well be under or over estimating the emissions from Derbyshire buses dependent on the age of the fleet.

EURO standards have been implemented since 1993 for buses and HGV's with increasingly more stringent levels permitted for certain pollutants. However, these emission standards do not apply to CO_2 emissions. A report for the most recent Greenhouse Gas Inventory [35] calculates fuel consumption data for buses and coaches from 1993 to 2008. The principal data source used was data from the DfT on the Bus Service Operators Grant (BSOG), which directly links subsidy to fuel consumed on local services. Interestingly, the BSOG data implies an increase in the average fuel consumption for local buses i.e. a reduction in fuel efficiency, over the period from 1994 to 2000. Buses produced from 2000 onwards having progressively better fuel efficiency, therefore lower fuel consumption and lower CO_2 emissions. Between 1990 and 2008, the overall fuel consumption, which has a direct effect on CO_2 emissions, has decreased by 17.4% from pre-euro (1990-1993) to Euro V (2008). Care must be taken therefore, in setting minimum standards in contract conditions that both the level of pollutants and CO_2 emitted are taken into consideration. Overall, vehicles that are EURO III (2001) and above represent the most efficient vehicle engines for use with regards both air pollutants and CO_2 emissions.

Part 5 of the Disability Discrimination Act 1995 allowed regulations to be made regarding all new land-based public transport to be accessible to disabled people including wheelchairs. This requires all new buses and coaches weighing up to 7.5 tonnnes to be accessible to wheelchairs since 1st January 2005. All existing full size single deck buses over 7.5 tonnes have to be fully accessible from 1st January 2016 and all double deck buses from 1st January 2017. Since this legislation has been in existence since 1995, over the past 10 years, many public service operators have replaced their older

[35] *UK Greenhouse Gas Inventory, 1990 to 2008: Annual Report for submission under the Framework Convention on Climate Change', MacCarthy J, Thomas J, Choudrie S, Passant, N, Thistlethwaite G, Murrells T, Watterson J, Cardenas L, Thomson A. AEAT/ENV/R/2978*

buses with newer 'low floor' vehicles which comply with this legislation and will also comply with increasingly more stringent EURO standards and improved fuel efficiency. This legislation therefore will result in the eventual replacement of all older non-compliant vehicles by 2017, which will result in indirectly reducing CO_2 emission through operators using newer and more fuel efficient vehicles. Unfortunately due to the absence of any detailed information regarding the current fleet, the impact on emissions that this legislation may have cannot be evaluated, so this impact remains anecdotal at this stage.

Since 2008, the Government has invited bids for funding from private companies and local authorities to purchase 'low carbon buses', which by definition is a bus with 30% less emissions than a standard EURO III bus. In order to provide an indication of the impact should 'low carbon buses' replace the current fleet of buses, this 30% reduction has been applied to the current CO_2 emissions calculated from the bus sector, resulting in a potential CO_2 emission reduction of 9.9k CO_2 pa. However, care must be taken when using this estimation, as the exact nature of the current fleet is unknown. If the Derbyshire bus fleets comprised considerably older vehicles than EURO III, this figure would be considerably higher. It is recommended that further information regarding the current fleet be collated which would allow for more accurate emissions calculated. This would then give a more reliable indication as to the possible emission savings which could be achieved through employing 'low carbon buses'.

Smarter Driving

In addition to the age of the public service vehicles which are being operated along Derbyshire roads, another important reduction measure involves the way the vehicles are being driven. As discussed earlier in relation to smarter driving in passenger cars, smarter driving is a cost effective way to reduce fuel consumption of a vehicle by applying some simple driving techniques when the vehicle is in use. It is estimated that smarter driving can reduce fuel consumption by 8%. Within Low Carbon Transport: A Greener Future[36], the DfT calculated emission reduction which could be achieved if 90% of drivers were smarter-driving trained. Simulating this methodology, local calculations have been completed to assess the CO_2 emission reduction which could be achieved if 90% of bus drivers, which has been transposed to 90% of vehicle kilometres (assuming that the remaining 10% of drivers drive similar distances on Derbyshire roads) implemented smarter driving techniques. Since CO_2 emissions are directly related to fuel consumption, this approximately equates to an 8% reduction across 90% of total CO_2 emissions. The potential CO_2 emission reduction which could be achieved is 2.4kt CO_2 pa.

The Derbyshire Bus Strategy, which accompanied the LTP2, contains policy BS15a which commits that by 2011, Derbyshire County Council will require operators to ensure that all drivers have undertaken customer care and disability awareness training. It may be appropriate therefore for drivers on contracted services, in addition to customer care and disability training to also receive

[36] http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/sustainable/carbonreduction/low-carbon.pdf

training on smarter driving. There are a considerable number of smarter driver training programmes available, including subsidised courses provided by the Energy Savings Trust[37], which should be fully explored when designing this CO_2 emission reduction measure.

It should be noted that a consultation paper was released from the DfT in March 2010, consulting on three approaches to increasing the uptake of smarter-driving training for drivers of Large Goods Vehicles and Passenger Carrying Vehicles. The approaches included:

- Option 1: No Change. This is a baseline against which other options are assessed. Eco-driving training continues to be undertaken on a voluntary basis, and the commercial pressure to reduce fuel costs is the primary driver for change
- Option 2: Maintain current regulations but increase promotion of the benefits of eco-driving training, for example through increased marketing or improved best practice programmes
- Option 3: Regulatory change. Our current thinking is that a cost-effective way of achieving a 90% uptake of eco-driving training across the LGV drivers and increased eco-driving training for PCV drivers is for eco-driving to become a mandatory part of Driver CPC periodic training. The DfT and trade associations already promote the benefits of eco-driving training, and this suggests that promotion in isolation may not achieve the attainable benefits. Mandating eco-driving training is thought to be a cost-effective way to further reduce CO_2 emissions, as it utilises a regulatory framework that is already in place.

It is recommended therefore that any potential CO_2 emission reduction measure relating to smarter-driving in buses be designed following publication of the results of this consultation. It may transpire that the main steer for a smarter-driving reduction measure may be at a national level through one of the approaches outline above.

Increasing Bus Patronage

Similar to encouraging modal shift in the use of the passenger car, encouraging modal shift onto public buses is a large and complex area and is difficult to quantify in terms of CO_2 emission reduction unless directly monitored though personalised/business travel planning surveys and/or through overall CO_2 emissions across the County as reported through NI 186. Nevertheless, it is important to assess in this Strategy to assess what actions are already being employed to increase bus patronage and to identify possible measures which could be implemented to strengthen existing policies.

In 2001, Derbyshire County Council entered into a Public Service Agreement (PSA) with the Government which included a target to increase the number of bus passengers travelling in the County by 14% by 2010, baseline figure being 26.833 million passengers to 28.706 million. Although it is too early to say whether this target has been reached, the data collated to 2009 shows that the

[37] http://www.energysavingtrust.org.uk/business/Business/Transport-advice/Smarter-Driving

County Council is online to meet this target. The Derbyshire Bus Strategy[38] lists the numerous actions which are being employed to improve the quality and use of public transport in order to meet these bus patronage targets and increase patronage further in the future.

As discussed in earlier sections of this Strategy, and as shown in Figure 17, currently only 23% of residents surveyed in the Derbyshire Citizens Panel used a public bus on a regular basis. In the aforementioned Citizens Panel Survey, the question was posed as to why people used the bus and the dominant journey types were for shopping or leisure purposes, with only 8% choosing to use the public bus to travel to work. Included in the survey were the following comments regarding the use of buses which provides an insight into the obstacles which people perceive are related to public transport:

- Only use bus if the weather is bad
- Cannot use the bus due to being disabled
- Buses don't go where I need to go
- Only one bus per hour and only until 6pm
- Bus service not regular
- If I have the kids, its easier to use the car
- Only use the bus if the roads are blocked or if there's snow on the road
- Only use if going on holiday i.e. connect with trains, coaches or airports
- Use when not in a rush, will use when I retire
- Only use buses as a last resort
- Cheaper to go by car.

In addition to using information such as this, the rural nature of Derbyshire and the requirements of the users need to be understood. For example, due to the rural nature of Derbyshire, the availability of an appropriate bus service which is accessible for the daily commute may be more limited than in a busy urban/semi-urban area. A lack of knowledge of local bus services and/or confidence to use the services that are available may also be discouraging factor of using public transport.

The Sustainable Travel Town Initiatives as discussed in an earlier section, through their package of smarter travel measures, increased bus patronage levels by an average of 10-22%, over the course of the project. Therefore, it is recommended that any CO_2 emission reduction measure designed to increase bus patronage should take into consideration the advice and recommendations of the Sustainable Travel Town Initiative as well as local information and surveys and includes personalised travel planning and business travel planning. A combination of methods may not only encourage more people to use public transport but may also highlight actions which could be implemented to encourage greater use such as multi-operator and interchangeable ticketing, smartcard technology, more demand responsive transport services such as 'dial a bus' and/or joined up public transport

[38] http://www.derbyshire.gov.uk/Images/A4%20Annex.pdf

information and branding. In addition, in conjunction with analysis of the Derbyshire Car Share database coupled with maps of the current bus network, travel planning may also help to identify a potential demand for a bus service which is currently unavailable.

Development Control and Planning also have a role to play in increasing bus patronage by ensuring that developments are well serviced by the existing public transport network, making improvements where necessary and ensuring all infrastructure and information is in place before the development is occupied i.e. before learned travel behaviour. Further information regarding the role of planning can be found in 'reducing the need to travel' section.

Road Freight

As discussed in earlier sections of this Strategy, as a consequence of recent discussions between the DfT and freight and logistics operators, a comprehensive review of low carbon technologies for HGV's was conducted by Ricardo[39], which identified a vast range of technologies which are available/due to be available with different CO_2 reduction potentials, applications, costs, limitations and safety considerations. Therefore there is no 'one size fits all' regarding low carbon technologies for HGV's, those that are suitable to be implemented within a fleet are very specific and subject to various considerations. The Ricardo review also concluded that the DfT need to consider the type of framework which would provide incentive for greater uptake of lower carbon technologies i.e. regulatory framework, funding to support investment or best practice programmes. It is recommended therefore that any potential CO_2 emission reduction measure relating to reduction from the freight sector be designed following the response from the DfT to the Ricardo Report. It may transpire that the main steer for a smarter-driving reduction measure may be at a national level.

However, for discussion in this Strategy, a brief overview of the potential CO_2 savings which could be generated through the freight sector have been calculated based on a review of the Freight Best Practice Programme[40] funded by the Dft. This programme offers a range of free publications to help freight operators improve their efficiency. Guides, case studies, software and seminars are available on topics such as fuel saving, developing skills, equipment and performance management. In 2007, a review of the Programme was conducted and it was the findings of this report which were used to make the calculations used in this Strategy. For specific information regarding the technologies discussed, please refer to the Freight Best Practice Review. The main findings included:

The Selection Policy: selecting the right vehicle for the job can make a significant difference to the fuel consumption with the following savings:

- Operators tailor vehicle to demand: 10%
- Operators choose the most fuel efficient vehicle in its class: 5%

[39] http://www.dft.gov.uk/pgr/freight/lowcarbontechnologies/lowcarbon.pdf
[40] http://www.dft.gov.uk/pgr/freight/research/freightbestpracticeprog.pdf

Aerodynamic Styling Kits: Selecting and using the right kit can reduce fuel consumption with the following savings:

- Cab deflector blades: 5%
- Solid cab fairing: 10%
- Full streamlining: 15%

Fuel Management: Using some form of fuel management, with systematic procedures, targets for improvements and/or on or off board loggers can reduce fuel consumption by 5%.

Route Planning: Use of route planning software such as Trafficmaster can reduce fuel consumption by 4%.

Strategic Measures: use of one or more of the following measures can reduce fuel consumption by reducing mileage. In the absence of specific mileage data, an average of 5% reduction is applied.

- Load Consolidation
- Fleet Sharing
- Supplier Collections
- Depot Location Reviews
- Empty running
- Vehicle fill.

The review also identified that 39% of all freight vehicles already use freight best practice, so it already has a high proportion of the market, indeed they found that although large fleets together emitted the highest proportions of CO_2, on average they are also the most active on measures to reduce their emissions. Therefore the potential CO_2 reduction these measures could generate have been applied to 61% of the total emissions from the freight sector to provide a brief overview and are listed in Figure 15.

However, care must be taken when using these estimations as the calculations are based on estimated reductions and general emission factors which when used together, multiply the level of uncertainty associated with this output. As discussed in earlier sections of this Strategy, the emissions from freight are very sensitive to vehicle load factors, size and vehicle technologies, which are reflected in the various emission factors associated with this sector. Therefore, in order to provide more accurate dataset relating to freight, further information is required regarding the size and laden weight of the freight vehicles using Derbyshire road network, so more accurate emission factors can be applied, which in turn will provide more accurate CO_2 emission reductions.

This additional information could be generated by working with Freight Operators through business travel planning, which could not only provide a vehicle to raise awareness of the support provided through Freight Best Practice but would also provide an opportunity to assess current freight fleets

and quantify any CO_2 reductions achieved either through vehicle technologies or reduced mileage. Using the finding of the Freight Best Practice Review, it may be appropriate for business travel planning, which is focussing on freight, to initially concentrate on smaller fleets, which may be less active than the larger fleets on reducing their emissions and may benefit more from additional support.

Another means of reducing CO_2 emissions from the freight sector is by transferring freight from road to rail. Derbyshire County Council has liaised with the freight and rail industry to help support this transfer for numerous years, helping operators take advantage of the Freight Facilities Grants, which offer cash incentives for businesses to take freight off congested roads and move it onto rail or water. In order to quantify the CO_2 emission reduction which has been achieved over the years in achieving this transfer, further information would be required regarding the number of tonnes which have been transferred, as emissions from freight rail are based on emissions per tonne of freight.

To provide an example of the scale of reductions which could be achieved we can compare the CO_2 emissions associated with moving 1 tonne of freight by road and compare this to rail.

- If we move 1 tonne of freight by road 100km, the CO_2 emissions would be 11.86kg CO_2
- If we move 1 tonne of freight by rail 100km, the CO_2 emissions would be 2.85kg
- This is a 76% reduction in CO_2 emissions when transferring freight by rail rather than by road.

Obviously there are practical elements associated with the transfer of freight from road to rail, however, this simple calculation does provide an indication as to the scale of reductions which could be achieved. The potential reductions of moving freight from road to rail, similar to modal shift from using car to rail, and calculations of total CO_2 emissions from the rail network will be discussed in more detail in future phases of this Strategy.

Tourism to Derbyshire and the Peak District National Park

The Peak District National Park is the first national park in the UK, declared in 1951 and covers an area of 1438 square kilometres of countryside, a large proportion of which lies within Derbyshire, as shown in Figure 6. In addition to the presence of the national park, there are also considerable numbers of tourist attractions in Derbyshire which although are outside the national park, do form part of a wider Peak District tourism destination e.g. traditional market towns as well as major family attractions and theme parks.

Tourism is important for the economy of Derbyshire providing almost £1.42 billion in the wider Peak District area, which supports over 24,000 jobs[41]. There are estimated to be 35million day visits per

[41] http://www.derbyshire.gov.uk/transport_roads/transport_planning/freight_quality_partnership/default.asp

year, of which 87% are made by car.[42] Therefore it is important that tourism play its role in reducing CO_2 emissions from Derbyshire roads by encouraging more sustainable transport choices for those visiting Derbyshire and the Peak District.

The number of vehicle kms driven along Derbyshire roads by those on tourist trips will already be captured by the traffic counting network operated by the DfT upon which the CO_2 emissions described in this Strategy have been calculated. However, it is important to note that, in the absence of any detailed local data, the journey made by passenger cars has been broken down into journey purpose using a national breakdown, a national average. It is logical to infer that, due to the presence of the national park and the rural nature of parts of Derbyshire, the number of journeys made for tourism could be much higher than the national average. In addition, similar to the vehicle profile mentioned in Derbyshire Traffic Section, the journey purpose is expected to vary dependent on the road being assessed, i.e. it is expected that those driving along roads in the Peak District may have higher proportion of tourists compared to more urban locations such as Chesterfield and Long Eaton. In the absence of more detailed information for Derbyshire however, this national perspective has been applied to the traffic data.

Although Derbyshire County Council does not have a specific Tourism Strategy, considerable work has been completed over the years to influence the modes of transport used by visitors and the 'green' credentials of accommodation and attractions. The Visit Peak District & Derbyshire Destination Management Partnership (DMP) was created to form one group to represent tourism in the Peak District and Derbyshire and their remit is to help increase occupancy levels for quality accommodation providers and attract more customers to visitor attractions, venues, restaurants shops and events. The partnership is funded by all the local authorities in the Peak District & Derbyshire, together with the East Midlands Development Agency, Derbyshire & Nottinghamshire Chamber of Commerce and Industry and the University of Derby.

Peak Connections[43] sits within this overarching Partnership and aims to 'Get everyone to think about how they travel around the Peak District and National Park in a more sustainable way'. Their website provides travel information, location of tourist information centres, and specific travel guides for some of the more popular tourist destinations such as Chatsworth House, Macclesfield, Buxton and Bakewell, the Hope Valley, Upper Derwent Park & Ride, Sheffield to the Peak District and Hathersage and Kedleston Hall from Derby. These guides also contain vouchers for discounted entry to some of the attractions.

Derbyshire County Council provides up to date public transport information to the East Midlands Journey Planner[44], available online, which is an extremely useful resource available to all those with access to the internet who wish to make a journey across Derbyshire. It is recommended that links to

[42] http://www.peakdistrict.gov.uk/tourism.pdf
[43] http://www.visitpeakdistrict.com/information/peak-connections.aspx
[44] http://www.derbyshire.gov.uk/transport_roads/public_transport/timetables/journey_planner/default.asp

this journey planner be included on the Visit Peak District and Derbyshire Food Festivals websites in order to encourage more visitors to travel by public transport.

The estimated total emissions from Derbyshire roads which has been attributed to tourism equates to 75.5kt CO_2 pa. The CO_2 emissions from passenger cars used for tourist visits could potentially be reduced using similar measures as described for other journey purposes earlier, with an increased emphasis on integrated public transport, ticketing and travel information. In addition, those destinations or links in journeys which are not accessible by public transport or cycling/walking need to be identified so appropriate measures can be put in place.

Therefore although personalised travel planning may have a role to play in educating people and helping them to change their decision making processes which would include travel arrangements for days out, it is arguably more important that DCC Transport/Tourism, The Visit Peak District & Derbyshire Destination Management Partnership (DMP), Peak District National Park and the tourist attractions themselves work together to help improve and encourage the sustainable travel options available to tourists visiting the area.

Some methods which could be employed are as follows:

- Improved information on websites, linking to the East Midlands Journey Planner which is supported by Derbyshire County Council
- Information regarding bus services and train services which directly access a venue
- Directions to venue for non-car modes i.e. directions from nearest train/bus station
- For some accommodation, transport could be provided to collect passengers from nearest bus stop/train station
- Discounts for visitors who have travelled to the venue using public transport or non-car modes – thought should be given as to how to reward those who walk or cycle to the attraction. The Derbyshire Bus Strategy which accompanied the LTP2 describes ‘Some Derbyshire attractions already promote travel by bus and offer discounted entry to those who have used bus services to access their attraction. It will be important to increase the number of attractions doing this.’ An assessment of how this can be implemented across Derbyshire could be conducted.
- Provision of example ‘car-free’ tours of Derbyshire, with appropriate links to timetable information etc
- The creation of ‘Derbyshire and the Peak District Gateway’ to assist tourists who are travelling from other parts of the UK or from abroad to help simplify route planning. E.g. a northern and a southern gateway, to strengthen links into Derbyshire and the Peak District from the wider UK area. There is a potential for overseas tourists to connect with trains from St Pancras International to Derby, connecting with local lines to Matlock for example. Therefore it is important that those tourists arriving in Derbyshire by train are able to connect with other services to visit tourist destinations located outside the rail network.

- Improve integration between rail and bus services to help strengthen the message that using public transport is a feasible way to visit Derbyshire and the Peak District.
- Provision of multi-operator and interchangeable ticketing, smartcard technology and joined up public transport information and branding
- Continue to improve public transport (see earlier section for details)
- Continue to expand the Derbyshire Greenways and urban cycle networks to encourage access to attraction by bicycle.
- Continue to encourage District /Borough Authorities to consider access/connection to public transport and non-car modes in all planning applications.
- Although rail transport is not directly considered in this phase of the Strategy, it has a key role to play in encouraging more visitors to travel by train rather than by car. Consideration of rail will be included in future phases of this strategy.
- Increase tourist information available at gateway train stations and neighbouring city train, bus and coach stations to assist onward travel arrangements into Derbyshire using public transport.
- Support new sustainable and/or low carbon transport initiatives such as guided bus ways, electric charging points along popular tourist routes with electric car hire schemes, road trams, single track rails and town-wide bicycle hire schemes to name a few examples.
- Continue to ensure tourist destinations are clearly signed from the roads so people find their way directly thereby avoiding unnecessary mileage, making improvements where necessary.

This is not a definitive list and has been collated through liaison with various parties involved in Derbyshire tourism and may well change over the course of the LTP3 as further work and research is conducted and new and emerging technologies and initiatives enter the market. The important overall CO_2 emission reduction measure associated with tourism is that all parties work together to reduce emission from this source using a range of measures which due to the availability of data and their wide-ranging natures, currently cannot be quantified. Therefore it is important that any CO_2 emission reduction measure which will be implemented to reduce emissions from tourism be done so in such as way as to allow their quantification.

Part 3: Recommendations for future work

Additional Data Requirements

Recommendations have been developed through this Strategy which will highlight any data gaps which could be developed in the future to further improve calculations.

- Development of a strategic network of traffic surveys which will provide detailed information similar to that used by the DfT in their CO_2 Pathway Analysis Report.
- Development of an emissions database, compiling data on fuel consumption in Derbyshire. This information could be obtained from the Borough/District Authorities as part of the annual EPR environmental inspections of petrol stations.
- More detailed and accurate data regarding the CO_2 emission associated with the DCC staff commute to work.
- Quantification of the CO_2 emission reduction which can be achieved through the Derbyshire transport lighting network.
- Collation of data regarding the age, size and mileage of vehicles used on contracted services.
- Quantification of the CO_2 emissions associated with travel to Derbyshire Tourist Events.
- Quantification of the CO_2 emissions associated with Business, school and personalised travel plans.
- Liaison with the DfT to understand the differences in locally produced traffic data and those produced nationally for minor roads in a local authority area.
- Analysis of the annual household surveys regarding residents travel choices.

Rail Transport

It is recommended in future phases of this Strategy that CO_2 emissions from the rail network in Derbyshire be assessed and quantified. The assessment to include the emissions reduction associated with the transfer of freight from road to rail.

Currently, the quantified outputs of this Strategy are compared with the results from NI 186. However, since the emissions from rail are not included in the DECC calculations of NI186 due to issues extracting electricity powered rail data from the energy sector, comparison of outputs is not possible at the time of writing this report. Therefore it was felt appropriate to assess these emissions in future phases of this Strategy.

Vehicle Speeds and Congestion

Vehicle speeds and congestion have a considerable influence on fuel consumption and associated CO_2 emissions. Free-flowing traffic lowers fuel consumption and therefore reduces CO_2 emissions. It is therefore recommended that the current assessment methodology be assessed to include variations due to speed and congestion, so that calculations can be modified to reflect this variable in future phases of this Strategy.

A National Carbon Tool

The DfT Local and Regional Climate Change Research Report completed on behalf of the DfT by Atkins, May 2010[45], identified a requirement for the DfT to create a carbon tool which can be used by all Local Authorities. Although, through the development of this Strategy, a tool has been created for use internally by Integrated Transport at Derbyshire County Council, the Atkins recommendation is supported in order to provide a consistent means for local authorities to quantify CO_2 and/or GHG emissions in their area and the potential impact of transport interventions. We await a response from the DfT to the findings of the Atkins Report.

Several difficulties and constraints were encountered in quantifying emissions for reporting in this Strategy, which mirror the findings of the Atkins Report, these are listed as follows:

- A national carbon accounting tool should be provided, to ensure consistent carbon accounting methodology is used and to also assist those authorities who do not have access to expensive and/or time-consuming computer models.
- In the absence of a national carbon accounting tool, an appraisal system, similar to that which is already in operation for local air quality management, be implemented so that local calculations can be verified and approved.
- Clear and consistent guidance and methodology for carbon accounting for transport at a local level should be provided, currently information is spread between different Government Departments and Agencies and requires considerable research to compile.
- Information on how national measures will impact at a local authority level should be clarified, carbon reduction measures for the local level often are ‘vague’ and none appear to be quantified.
- Current emission factors should be made clear; there are several guidance documents available online for public and private sector accounting, as well as databases used for National Indicator reporting, which all reference slightly different emission factors.
- The input data used to generate the NI 186 should be made available, so local calculations can be compared easily to national findings.
- The data sources which can be used to calculate carbon emissions lie with different Government Departments, are difficult to locate, access and understand, and due to differing

[45] http://www.dft.gov.uk/pgr/regional/policy/climatechange/

sample sizes, sample years and methodologies used in their generation, means some are incompatible, which is not making the best of current data.

- Information relating to the costs and timescales involved in local carbon reduction measures should be provided so that informed policy and decision making can be made.
- A forum should be provided to allow those in carbon accounting to share information, best practice and to provide support.

CO_2 Reduction Costs

It would be beneficial for the purpose of guiding policy and decision making processes to be able to provide an associated cost for implementing the different potential carbon reduction measures identified by the Government. This would then help to highlight which measures would be more cost-effective in reducing CO_2 emissions from the transport network and would assist the Local Authority to plan for future years spending in light of reductions in levels of funding available.

Carbon holds a fiscal value per tonne, so where a carbon emission is quantifiable so is the fiscal value of that emission. The value of carbon should be based on non-traded values of carbon based on 2002 prices taken from TAG Unit 3.3.5 dated January 2010.

The cost of implementing a carbon reduction measure is more complicated to estimate and would require substantial resources in order to calculate exact values. In order to provide an overview of the estimated costs, the following assessment criteria have been used:

- **Low:** Existing role with Derbyshire County Council, Corporate Policy, awareness raising initiative using existing channels.
- **Medium:** Moderate investment in infrastructure or marketing required.
- **High:** Substantial investment in infrastructure, comparable to a major scheme or requires large buy-in from wider population.

This system provides a general overview, however, it is recommended that further work and research be undertaken in order to provide a robust method for accounting for both the cost of a carbon reduction measure and the resulting savings in its implementation.

CO_2 Reduction Targets

Quantification of the carbon emissions from the transport network is the first stage to being able to assess challenging but realistic carbon reduction targets for the local authority. Using the methodology used in this Strategy, this would require robust predictions of traffic from all vehicle types and predicted/factored emission factors for the target year. Once this information is collated, the emission reduction which will be achieved through national measures should also be predicted which can then be accounted for in future projections of CO_2 emissions in the local authority area. Finally, taking into consideration the timescales involved in implementing the different CO_2 emission reduction measures, the effects can be quantified and a target set. It is important that targets are set using robust and transparent methodologies, based on logic and evidence, to ensure they are not misleading and thereby reducing the potential for expensive and insignificant action.

In the interim, however, while targets are being assessed, it is recommended that policies be developed to support the CO_2 emission reduction measures as suggested at a national level, using the carbon quantification presented in this Strategy to provide some steer on which measures would be most appropriate to be implemented for the Derbyshire road transport network.

Potential CO_2 Reduction Projects

1. Sustainable Travel Town Initiatives include full package of measures to promote and encourage more sustainable transport.
2. Business Travel Planning to include encouraging lower carbon HGV technologies.
3. Encouraging walking and cycling, creation of viable cycle networks which link to the wider greenway network throughout Derbyshire, promotion and marketing of networks, including production of maps. Provision of cycle training for adults if required.
4. Smarter driving campaign, potential for provision of discounted smarter driving training, potentially delivered through Sustainable Travel Towns Initiative.
5. Vehicle type and fuel choice campaign – awareness raising campaign, including providing up-to-date information regarding outlets selling alternative fuels, potentially delivered through Sustainable Travel Towns Initiative and/or business travel planning.
6. ‘Transport Choices’ education resource to be reviewed to assess its expediency to support the education of children regarding their travel choices.
7. Possibility of application of emission standards to be set as condition of contract to be investigated.

Monitoring CO_2 Reduction

As with any project, it is important that the effects be correctly captured and analysed in order to show progress and to advise as to where modifications can be made to generate improvements. The overarching monitoring for carbon reduction work will be in the total CO_2 emissions from the Local Authority area as reported annually by the DECC. However, this data source has a lag-time of 21 months so therefore it is recommended that additional monitoring and indicative monitoring be implemented.

There are several approaches to doing this, which are as follows:

- Ensure that all surveys conducted on any aspect of the transport network, for example as part of travel training and/or travel planning, contracted services, be developed in such a way as to allow CO_2 emissions to be quantified.
- Annual updates to quantified emissions can be generated using the annual vehicle kilometre data provided by the DfT using the methodology created by this Strategy.
- Monitoring fuel consumption on an annual basis provided by the local District and Borough Authorities
- Cycling and walking monitoring statistics, perhaps accompanied by journey purpose survey work
- Modal shift to be captured by carefully designed surveys
- Length of new cycling routes implemented or creation of cycling/walking networks
- Monitoring of Derbyshire Events, careful attention to the design of surveys to ensure data is captured to calculate CO_2 emissions
- Weight of freight moved from road to rail
- Monitoring of Car Share Derbyshire activity
- Number of drivers receiving smarter driver training
- Monitoring of school travel plans
- Monitoring of Bike Week, Bike to Work Schemes
- Monitoring the outcome of ‘Changing the Way Derbyshire Works’ programme
- Monitoring the outcome of business travel planning
- Monitoring the outcome of Sustainable Travel Towns Initiative.

Appendix I: Data and Emission Factors

National and Local Datasets

In collating the data which informs the CO_2 reduction strategy, two approaches have been used with the sources of data available. The first uses national 'top down' data provided by DECC and the DfT, such as NI 186, which provides overall CO_2 emissions for each local authority area which is available to download from Government websites[46]. This information is useful as it provides an overview of the major emission sources within a local authority area and also provides opportunity for comparison between local authorities.

The second approach is creating 'bottom-up' calculations, using local information and statistics to calculate CO_2 emissions which can provide a more detailed local view of CO_2 emission sources. This in turn allows more detailed assessment of where CO_2 reductions can be achieved within a local authority area transport sector. Both of these data sources have been used in developing this Strategy.

It should be noted, however, that due to the different ways data is collected and processed nationally and locally, it is unlikely that the 'bottom-up' local calculations will generate identical CO_2 emissions to the 'top-down' national Government calculations. It is therefore important to clearly identify all emission factors, baseline data and assumptions used in making the local CO_2 emission calculations and for these to be used consistently throughout the assessment. It is also important when making local calculations to mirror where possible, the calculation methodology employed by the Government in producing the 'top down' CO_2 emission assessment. A clear, consistent methodology will ensure all local calculations are traceable, transparent, easily replicated and can be updated as new information becomes available.

The baseline year for this assessment and that used for the majority of data sources is 2008. A minority of data sources are unavailable for this year, and where this is the case, these will be clearly identified and where appropriate projections using that dataset will be employed.

Emission Factors

At the time of writing this Strategy, the most up-to-date transport emission factors available with an accompanying methodology were those contained in Defra/DECC's GHG Conversion Factors for Company Reporting: Methodology Paper for Transport Emission Factors 2009 (using 2008 data)[47] and these have been used in all calculations contained in this Strategy. At the time of writing this Strategy

[46] http://www.defra.gov.uk/corporate/about/what/localgovindicators/ni186.htm
[47] http://www.defra.gov.uk/environment/business/reporting/pdf/091013-guidelines-ghg-conversion-factors-method-paper.pdf

however, several emission factor datasets were available from Government websites dependent on the year they were published and the reporting requirements. For example, the reporting database for NI 185, available to download from the DECC website, which is completed by local authorities when they are reporting on NI 185[48] contains slightly different emission factors and it appears to be due to the regular review and revision of emission factors. This Strategy, however, uses the latest dataset published by Defra and DECC and are listed in the following sections.

Passenger Cars Emission Factors

The emission factors that have been used for passenger cars can be found in Table A1. These factors have been derived from speed emission curves used by the UK National Atmospheric Emissions Inventory (NAEI)/ Green house Gas Inventory (GHGI), developed from actual testing of a selection of different sized and different Euro 3 emission class cars for several 'real world' drive cycles.

These factors were then 'uplifted' to real-world values taking account real-world effects such as the use of accessories (air con, lights, heaters), vehicle payload, poor maintenance, road gradients, weather and driving styles. An uplift factor of +15% was agreed with the DfT in 2007 and have been applied to these factors. The figures have also been calculated from a mileage weighted average of the petrol and diesel averages, using data provided from the DfT on the relative mileage by petrol and diesel cars for 2006.

Table A1: Passenger Car Emission Factors (Defra, DECC 2009) based on 2008 data.

Vehicle Type	Engine Size	Size label	Final 2009 New 'real-world' GHG Conversion Factors				
			gCO_2 per km				MPG
			CO_2	CH_4	N_20	Total	
Petrol car	<1.4	Small	179.8	0.31	1.8	182.0	36.4
	1.4-2.0	Medium	212.8	0.30	1.8	214.9	30.7
	>2.0	Large	295.5	0.28	1.8	297.6	22.1
Av petrol			**205.7**	**0.30**	**1.8**	**207.8**	**31.8**
Diesel car	<1.7	Small	151.0	0.08	1.7	152.8	49.2
	1.7-2.0	Medium	187.6	0.08	1.7	189.4	39.6
	>2.0	Large	255.8	0.08	1.7	257.6	29
Av diesel			**196.5**	**0.08**	**1.7**	**198.3**	**37.8**
Average car (unknown fuel)			**202.8**	**0.23**	**1.8**	**204.9**	**33.1**

The average age of vehicles in the East Midlands is 7 years old and the average size nationally is 1,751cc in 2008. This is the most detailed information available at the time of writing this report. Using

[48] http://www.defra.gov.uk/corporate/about/what/localgovindicators/ni186.htm

this information, the car fuel database on the VCA website[49] has been used to reference the approximate emission standards for vehicles of this age. According to the database, vehicles registered in 2001 are largely EURO 3 vehicles, which became available in October 2001[50]. The emission factors detailed in Table A1 have been generated using different sized EURO 3 emission class cars and so therefore it is reasonable to use these emission factors in the following calculations:

UK Petrol/Diesel Fuelled Passenger Vehicles:

A Citizens Panel questionnaire was conducted in 2009 which surveyed the fuels used in the cars of those who participated in the survey. In the light of no other sources of local information regarding fuel choice in Derbyshire, this fuel split had been used in the calculations. The results of the survey, although representing a small sample number, show good correlation with the national average fuel split, as supplied by the DfT for 2006. The local information regarding fuel data is as follows:

- Petrol: 63.4%
- Diesel: 35.4%
- LPG: 0.5%
- Hybrid: 0.4%
- Other: 0.3%

Number of Vehicle Km Driven in Derbyshire: National Data

The number of vehicle kilometres driven in a local authority area is calculated by the DfT on an annual basis and is available to download at the following website: http://www.dft.gov.uk/pgr/statistics/datatablespublications/roadstraffic/traffic/rtstatisticsla/roadtrafficexcltrunk

The DfT traffic estimates are produced by using a consistent national methodology which is mainly designed to deliver national level estimates. This methodology includes applying the same growth factors for minor roads to all local authorities across the country. The local authority level estimates resulting from this process may therefore differ from estimates produced by local authorities using local data and locally robust methodologies.

[49] http://www.vcacarfueldata.org.uk/search/usedcar/make-model.asp
[50] http://www.dft.gov.uk/foi/responses/2009/dec/euroemisions/foiresponse.pdf

Alternative Fuels:

According to the Energy Savings Trust (EST[51]), LPG and CNG cars result in 10-15% reduction in CO_2 relative to petrol cars, a similar reduction as diesel vehicles. The figures contained in Table A2 were

Table A2: Passenger Car LPG/CNG Emission Factors (Defra/DECC 2009)

Vehicle Type	Size label	Final 2009 New 'real-world' GHG Conversion Factors gCO2 per km			
		CO_2	CH_4	N_20	Total
LPG/CNG	Medium	186.2	0.30	1.84	188.3
	Large	258.6	0.28	1.84	260.7
Average		**222.4**	**0.30**	**1.84**	**224.5**
Hybrid petrol/electric	Medium[1]	126.2	0.18	1.84	128.2
	Large[1]	224.0	0.21	1.84	226.0

calculated based on an average 12.5% reduction in CO_2 emissions relative to the emission factors for petrol cars from the 2009 GHG conversion Factors dataset. Due to the size and weight of the LPG and CNG fuel tanks it is assumed only medium and large vehicles will be available.

Derbyshire Average Trips to Work Per Year

Data from the Labour Force Survey (LFS), as published by the HSE and East Midlands Government Office Region (GOR) shows that the combined estimate of the number of working days lost (full-day equivalent) due to workplace injury and work-related ill health was 2.2 million in the East Midlands. This equates to an average annual loss of an estimated 1.2 days per worker[52]. The average number of days annual leave in the UK, including bank holidays is estimated to be 28 days per year.[53] Table 3 is

Table A3: UK average working days per person per annum 2009.

Number Working Days	Average UK Annual Leave	Average number Sick Days	Daily trips to work	Total trips to work per annum
260	28.0	1.2	2	461.6

an estimate of the number of working days and therefore trips to work per year per worker.

Derbyshire Average Distance to Work

[51] http://www.energysavingtrust.org.uk/fleet/technology/alternativefuels/

[52] http://www.hse.gov.uk/statistics/regions/eastmid/days-lost.htm

[53] http://www.direct.gov.uk/en/Employment/Employees/Timeoffandholidays/DG_10034642

The Office for National Statistics reports that the average distance to a fixed place of work, by all people in Derbyshire aged 16 to 74 in employment at the time of the 2001 Census in Derbyshire is 12.91km[54]. The distance travelled is a calculation of the straight line between the postcode of place of residence and postcode of workplace.

Average Age of Vehicle in East Midlands

Data is available on the DfT website regarding the average age of a vehicle in the East Midlands in 2008. Unfortunately, there is no specific data available for Derbyshire, therefore the East Midland data is used as a local proxy. The average age of vehicle in the East Midlands is 7.0 years.

Average Vehicle Engine Size

National data is available regarding the average engine size of vehicles from the DfT website. There is no local data specific to Derbyshire available, therefore the national average engine size is used as a proxy. The average UK vehicle engine size is 1751cc.

Calculation of Vehicle Kms

The calculation of vehicle kms (Motorway to B road classification) was conducted using the following formula for individual links and then summed by road classification;

(Link Length (km) x AADT) x 365

The link lengths were calculated using a simple query in MapInfo based on DCC's Road User Hierarchy predetermined sections, generally split by intersecting junctions.

The total and HGV AADTs (2008) were obtained from representative counts provided by the DCC Data Team for the respective links, in some instances 12-hour counts were factored accordingly. Data representing the Motorway and Trunk Road networks were obtained directly from the Highways Agency's Annual Monitoring reports.

The Link Road and Local Access Road vehicle kms were calculated using a variation in the above methodology. Instead of obtaining AADTs for each link, a representative sample of counts were obtained and averaged for each classification. The total network length was then multiplied by the averaged sample to provide the vehicle kms.

This analysis was conducted separately for Chesterfield (Borough), Buxton and Long Eaton as well as County to allow a separate analysis of interventions and their effects at a District level.

[54] http://www.statistics.gov.uk/default.asp

Car vehicle km figures were determined by subtracting the HGV values from the totals for each classification. Obviously this is not exact as the resulting values include everything other than HGVs i.e. pedal cycles, motorcycles, vans, bus.

The resulting data for the major roads showed excellent correlation with the data provided by the DfT, however local data showed considerably higher vehicle kilometres being driven along the minor roads in Derbyshire. When this local data for minor roads was used in the calculations, the resulting CO_2 emissions were approximately 30% higher than those calculated by AEAT. Therefore it was decided to use traffic data provided by DfT and DECC until an understanding as to the cause of the difference in the datasets is fully understood.

In order to estimate the potential reduction of a sustainable travel town initiative for three Derbyshire towns, insufficient data was available nationally, therefore local calculated data was used. This may have led to an overestimation of the potential reduction, but in the absence of any other data, it was felt appropriate to provide an estimation using local data. These calculations can be re-run once the cause of the difference in the datasets is fully understood.

Table A4: Assumptions used in the CO_2 emission reduction

CO_2 Emission Reduction Measure	Assumptions
Replacing current fleet with low emission vehicles (=<110g CO_2/km)	All vehicles currently driven along Derbyshire roads which are fuelled by either petrol or diesel will be replaced with vehicles emitting <=110g CO_2 km
Replacing all petrol with 100% hybrid petrol/electric	All petrol fuelled vehicles currently driven along Derbyshire roads will be replaced with petrol/hybrid vehicles
Replacing all petrol vehicles with CNG/LPG	All petrol fuelled vehicles currently driven along Derbyshire roads will be modified to run on CNG/LPG
Replacing all petrol with diesel	All petrol fuelled vehicles currently driven along Derbyshire roads will be replaced with diesel fuel vehicles
Replacing all vehicles with electric vehicles	All vehicles currently driven along Derbyshire roads which are fuelled by either petrol or diesel will be replaced with electric vehicles
DCC Estate reductions	Target reduction through the Local Authority Management Plan - applies to total reduction including energy use in buildings
Car Share:	The surveyed responses would be upheld in reality
	Suitable car sharers were found for all interested parties
	Journeys to work were shared daily for a full year
	The distance travelled during car share is the same as the distance driven alone
	The number of cars removed from the road directly relates to the distance travelled i.e. % reduction in cars = % reduction in CO_2 emissions
Cycling (commute by car or van <5km)	The same proportion of commuters apply to all journey lengths
	Those that live within 5km of work are able to cycle to work

	Those that live within 5km of work no longer use their cars on the commute
Walking (commute by car or van <2km)	The same proportion of commuters apply to all journey lengths
	Those that live within 2km of work are able to walk to work
	Those that live within 2km of work no longer use their cars on the commute
Sustainable Travel in Chesterfield	A 9% reduction in car trips equates to a 9% reduction in CO_2 emissions
Using 'low carbon buses' on all services	The current fleet is currently equivalent to EURO III vehicles
Using 'low carbon buses' for contracted services only	The current fleet is currently equivalent to EURO III vehicles
Freight: employing Best Practice	71% of current freight miles covered by vehicles not employing FBP
	LGV's are not included in the calculations as difficulties were encountered separating LGV's into private and commercial use.
Smarter Driving	Currently no drivers employ smarter driving techniques
	Once the techniques have been learned they will be applied 90% of the time whilst driving
	All drivers will undergo the necessary smarter driving training
	Smarter driving yields an 8% reduction in fuel consumption, equating to an 8% reduction in CO_2 emissions

Appendix II: Background Information

Greenhouse Gases and Carbon Dioxide (CO_2)

A greenhouse gas is one that is present in the atmosphere with the capacity to cause global warming. The most important of these gases which are accumulating in the atmosphere due to human activities are Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Sulphur Hexafluoride (SF_6) and two groups of industrial gases known as hydrofluorocarbons (HFC's) and perfluorocarbons (PFC's). Each greenhouse gas has a different capacity to cause global warming so in order to be able to compare these global warming capacities, an index known as the global warming potential (GWP) has been devised. The global warming potential of each gas is defined as its warming influence over a set time period relative to that of CO_2 dioxide, which by definition has a GWP of 1.

For example, the GWP of the Hydro-fluorocarbon HFC-134 over 100 years is 1,000. This means that 1 tonne of this gas emitted into the atmosphere has 1,000 times the warming potential over 100 years of 1 tonne of CO_2. The main greenhouse gases emitted from combustion and therefore the transport sector are CO_2, CH_4 and N_2O.

When assessing anthropogenic emissions of greenhouse gases from the transport sector, the gases which are commonly assessed are:

- Carbon Dioxide (CO_2) is the most common greenhouse gas, accounting for 85% of all known greenhouse gas emissions in the UK in 2008.
- Methane (CH_4), when weighted by its global warming potential, equates to 8% of UK greenhouse gas emissions in 2007.
- Nitrous Oxide (N_20), when weighted by global warming potential, accounted for about 5% of the UK's man-made greenhouse gas emissions in 2007.

It is emissions of these three gases which will be quantified, where possible, in this reduction strategy. When evaluating CO_2 emissions from the transport sector, it is useful to distinguish between CO_2 emissions, those specifically relating to emissions of carbon dioxide and carbon dioxide equivalent (CO_2 eq), which is the equivalent amount (or weight) of CO_2 that would be emitted into the atmosphere to produce the same estimated radiative forcing[55] of all three greenhouse gases.

However, many reporting systems already in use for monitoring greenhouse gas emissions focus on CO_2 emissions only, for example National Indicator 185 and 186. In order to be able to draw on data which is available from Government Department websites and to allow comparisons between

[55] the extent to which a given concentration of a greenhouse gas raises global average temperature

datasets, this Strategy will predominantly calculate CO_2 emissions in line with other Governmental reporting systems.

Whole Lifecycle v's Tailpipe Calculations

There are two main methods of accounting for CO_2 and the other greenhouse gases (CO_2eq), from any emission source. The first is to assess the direct emissions, such as the exhaust emissions from vehicles; these are often called 'source emissions' or in terms of transport 'tail-pipe' emissions. The second is to reallocate emission from sources to the end user. E.g. emissions from the chimney of a power station (source emission) is reallocated to the user of the electricity, such as a factory or domestic house, these are called 'end-user' emissions.

There are also indirect emissions associated with the use of a vehicle, such as the emissions generated during manufacture and disposal of the vehicle, generating and distributing the fuel used and in maintenance of road infrastructure. These additional indirect emissions are often included when calculating the 'lifecycle' emissions of a vehicle, which although give a much more comprehensive assessment of the emissions associated with the use of a vehicle, are known to be very complex and difficult to quantify.

To clarify, this Strategy only deals with direct 'source' or 'tail-pipe emissions', calculations are only made regarding the CO_2 and CO_2 eq generated in the exhaust emissions of vehicles from different transport sectors.

Passenger Car Fuel Choice

The following fuels have been assessed in this Strategy, however as emerging fuels enter the market, these will be evaluated in future phases of this Strategy.

Diesel Fuel Vehicles

Diesel fuel vehicles represent a growing area within the passenger car sector and currently occupy 35.4% of the market. Diesel fuel emits less CO_2 per kilometre of distance travelled compared to petrol fuel vehicles however they do produce more 'air quality' pollutants such as Nitrogen Oxides (NO_x) and particulates (PM_{10}) which contribute to air quality problems in urban areas. This Strategy quantifies the impact on CO_2 emissions if the current fleet of petrol fuel vehicles were to be replaced by diesel vehicles, simply to provide an overview of the scale of CO_2 emission reduction this could achieve. However, since this Strategy also evaluates the impact of the various measures on local air quality, conversion of petrol to diesel is not a recommendation of this Strategy.

Liquid Petroleum Gas (LPG)

LPG is a relatively common fuel, increasingly available at traditional service stations across the country. It is a blend of propane and butane produced either as a by-product of oil-refining, or from natural gas (methane) fields. Vehicles that use LPG perform just like petrol vehicles but they produce approximately 10% less CO_2 emissions. The added benefit of using LPG as a fuel is the associated reduction in 'air quality' pollutants, delivering up to 80% less Nitrogen Dioxide (NO_2) emissions and zero particulate emissions (PM_{10}), therefore the use of LPG is particularly suited to driving in urban areas. All existing petrol fuel vehicles can be converted to run on LPG and the impact of converting all existing petrol vehicles to using LPG has been quantified in this Strategy.

Hybrid Vehicles

Hybrid vehicles are a new sector within the passenger car market, currently occupying only 0.4% of the fuels used by Derbyshire passenger cars. Hybrid vehicles have a conventional engine in addition to an electrical motor and battery which is recharged while you drive, current models run on petrol and electricity and diesel/electric hybrid models are expected soon. Hybrid vehicles emit less CO_2 per kilometre than petrol or diesel cars driven the same distance, although this only relates to the tailpipe emissions.

Electric Vehicles

Electric vehicles produce no tailpipe emissions and therefore are exempt from road tax. They are recharged by using main supply therefore consideration should be given to the way the electricity is generated which provides this mains supply. Most electric vehicles have a range of about 40-50 miles therefore should this vehicle type become more widespread, the availability of electric charging points is a factor, especially since a large proportion of the Derbyshire transport network is located in largely rural areas. The average top speed of an electric vehicle is about 50mph and so are best suited to urban driving although new designs are being developed that have a far greater range.

Passenger Car Vehicle Choice:

The VCA website provides a useful overview of vehicle CO_2 emissions improvements over the past few decades[56] and a summary of the information provided by them is as follows:

Compared to the reductions in the emissions of air pollutants, specifically regulated through increasingly more stringent EURO emission standards, there has been less progress on reducing CO_2 emissions from cars. For a given type of fuel the CO_2 emissions of a car are directly proportional to the quantity of fuel consumed and it is this fuel consumption which has changed slowly over the years. Despite engines becoming more efficient, the average vehicle mass had increased due to additional

[56] http://www.vcacarfueldata.org.uk/information/cars-and-CO2-dioxide.asp

features to meet crash safety requirements and the widespread addition of features such as power assisted steering and air conditioning.

Following the Kyoto Conference in 1997, most developed countries agreed to legally binding targets to reduce their greenhouse gas emissions in response to warnings over global climate change. Arising from this, the European Commission agreed voluntary targets to reduce the average g/km CO2 dioxide emissions of new cars by over 25% by 2008/2009 to 140g/km. Average fuel consumption has therefore dropped somewhat as a result of these voluntary agreements. However, by 2006 it had become apparent that the targets were unlikely to be met and therefore The Commission, following industry negotiations, agreed a regulation binding on manufacturers which came into force in 2009. The main feature of this is a target emission of an overall average of 130g/km CO_2 from 2012 onwards. This will be allocated by giving each manufacturer an individual target to meet, based on the types of vehicles it sells—rather than exactly 130g/km for each or leaving the industry to decide how to meet it. The 'type' of vehicle is determined by its mass: heavier cars have a higher g/km 'allowance'. The target will be phased in, so that full compliance must be reached by 2015. There is a further target for improvement for 2020, provisionally set at 95g/km.

The VCA website also publishes a list of new cars available in the UK with CO_2 emissions below 110g CO_2/km. The age, size and efficiency of vehicles can have a considerable impact on emissions of CO_2, as generally speaking, newer, smaller vehicles can have considerably less CO_2 emissions per Km than older, less efficient vehicles.

Smarter Driving Techniques

These techniques, as provided by the Energy Savings Trust[57], UK are:

- Modern cars are designed to move straight away. Warming up the engine wastes fuel and actually causes engine wear so drive off from cold.
- Change gears before 2,500rpm (petrol) or 2,000rpm (diesel)
- Anticipate road conditions to drive smoothly and avoid sharp acceleration and heavy braking. This saves fuel and reduces accident rates.
- When slowing down or driving downhill, remain in gear but take your foot off the accelerator early. This reduces fuel flow to the engine to virtually zero.
- Driving within the speed limit is safer as well as being the law, and reduces fuel consumption.
- Switch off the engine when stuck in traffic. Modern cars use virtually no extra fuel when they are re-started without pressing the accelerator. Turn off the engine if you're going to be stationary for more than a minute or two.
- Plan journeys to avoid congestion and road works, and to make sure you don't waste fuel or time getting lost.

[57] http://www.energysavingtrust.org.uk/Travel/Drivers/Smarter-driving

- Use other forms of transport for short journeys, if you can. A cold engine uses almost twice as much fuel and catalytic converters can take five miles to become effective.
- Accessories such as roof racks, bike carriers and roof boxes significantly affect your car's aerodynamics and reduce fuel efficiency, so remove them when not in use.
- Under-inflated tyres are dangerous and increase fuel consumption so ensure tyres are inflated to the correct pressure.

Sustainable Travel Towns

Examples of actions to encourage more sustainable travel include:

- Encourage increased walking and cycling
- Tele-working/tele-conferencing
- Home/remote working
- Encourage greater use of public transport
- Car clubs/car sharing
- Awareness raising and information provision for various forms of transport
- Personalised travel planning
- Smarter-driving
- Choice and use of vehicle
- Fuel Choice
- Parking restrictions
- Travel planning
- Traffic management
- Integrated land-use planning to reduce the need for travel

In addition to the above list, examples of specific actions which can be employed:

- Provision of electric and alternative fuels infrastructure,
- Business cycle facilities and incentives
- Parking restrictions relating to emissions
- Strategic cycle and walking networks
- Cycle hire schemes
- Traffic management
- Improved integration between public transport modes
- Improved infrastructure and information at bus stops
- Cycle to work schemes/cycle loan schemes
- Travel centres in towns with public transport routes, timetables, stops and ticketing information, obtaining tickets, vouchers and incentives, applications for parking permits, car

clubs, cycle hire, cycling and walking maps, school transport options, personalised travel planning service, locations of local businesses, services and amenities.

It is important when implementing a Sustainable Travel Town programme that carefully selected packages of complementary measures based on specific target areas are used which achieve greater and longer-term impacts than through individual initiatives alone.

An obvious danger associated with any sustainable travel town programme is that measures which reduce traffic can release road space which is quickly occupied by more traffic therefore it is important that any behavioural changes are locked in, such as changes to infrastructure, bus/cycle lane prioritisation or lower speed limits. It is also important that the programme is held together by a clear and strong brand with supportive marketing. Data relating to behaviour before and after the programme is implemented should be carefully collated to show any behavioural changes, modal shift or changes in attitude over time. Any survey work should be designed in such a way as to allow for any associated CO_2 emissions to be quantified.

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