Department for Transport

Road Transport Forecasts 2011

Results from the Department for Transport's National Transport Model

January 2012

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Introduction and Key Results

1. Road Transport Forecasts 2011 (RTF11) presents the latest results from the Department for Transport's National Transport Model (NTM), which produces forecasts of road traffic growth, vehicle tailpipe emissions, congestion and journey times up to 2035.

2. Road transport forecasts have been published by the Department since the 1970s, with varying frequency, reflecting both changing demand for forecasts and improved modelling capability. The NTM has contributed to the analytical base of 'The Eddington Transport Study', the Impact Assessment of the Department's Carbon Reduction Strategy (CRS), the Spending Review 2010 and used to inform the Committee for Climate Change (CCC) report on Building a Low Carbon Economy. Chapter 2 gives an overview of the structure of the National Transport Model.

3. Road Transport Forecasts 2011 represents an update of 'Road Transport Forecasts 2009: Results from the Department for Transport's National Transport Model'. The key changes this year have been to revise assumptions on growth in Gross Domestic Product (GDP), fuel prices, and fuel efficiency. This year's forecast incorporates new assumptions that are consistent with meeting the first three carbon budgets – including the EU long-term target on new van CO_2 emissions, complementary measures for reducing new car CO_2 and HGVs, expansion for the use of low carbon buses and reductions in car trips through the Local Sustainable Travel Fund. Chapter 3 explains the key inputs and assumptions that determine the forecasts.

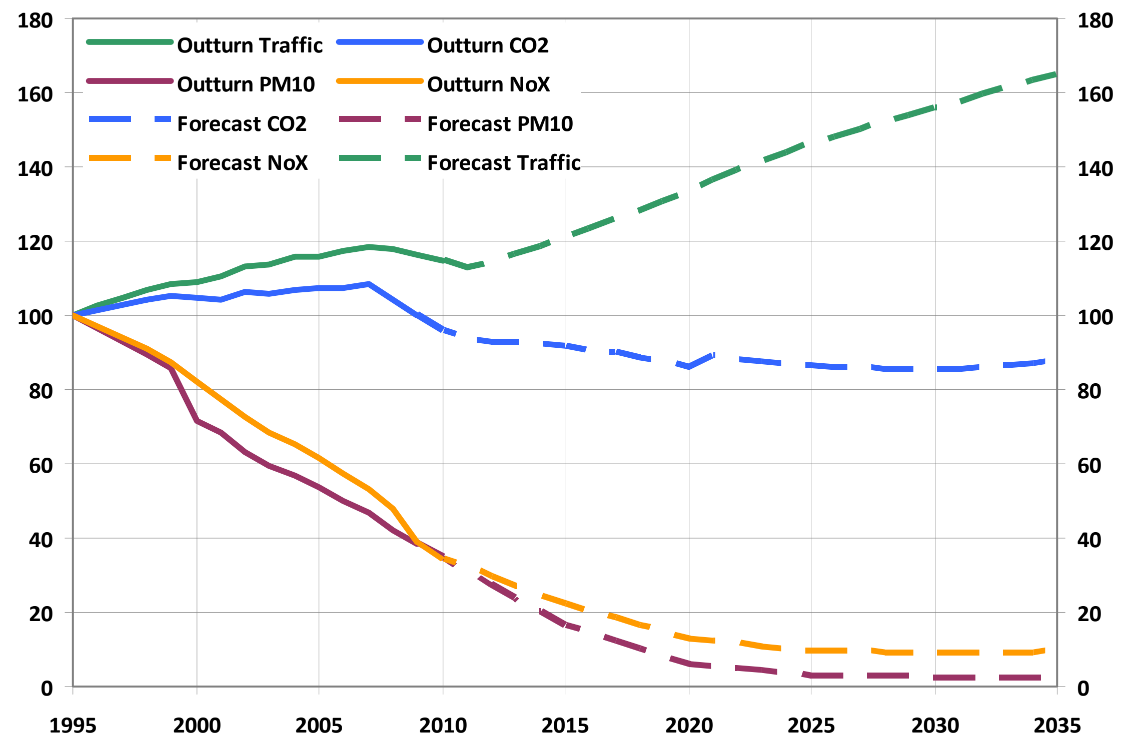
4. The Road Transport Forecasts 2011 central case results are presented in Chapter 4. Figure 1.1 below illustrates the key results for road traffic, CO_2 and air pollutant emissions:

   - The figure illustrates that road traffic is forecast to return to the growth trend evident before the recession. By 2035 road traffic is forecast to be 44% higher than in the level in 2010.

   - Despite this increase in traffic, CO_2 emissions are forecast to decline by around 9% from 2010 levels, reflecting fleet fuel efficiency improvements and use of biofuels.

- PM_{10} and Nox emissions have been falling since 1995 and are projected to fall to significantly lower levels as new low air pollutant emitting vehicles enter the general fleet.

Figure 1: Historic and Forecast Traffic and Emissions, England



Source: NTM 2011, Dft Statistics, NAEI.

5. As with all forecasts, there is uncertainty around the outturn of key input variables, such as projected future GDP growth, fuel prices and population. To account for key uncertainties around the forecasts Chapter 5 of this report includes a range of scenarios, which combine sensitivity tests on key variables. The aim of these scenarios is to show how the forecasts change when the key input variables are varied within reasonable bounds. Chapter 5 presents results from high/low road traffic demand and high/low CO_2 scenarios:

- Compared to the central scenario that projects road traffic in 2035 to be 44% higher than 2010, the low traffic demand scenario forecasts road traffic to be 34% higher, and the high traffic demand scenario around 55% higher.

- Compared to the central scenario that projects CO_2 in 2035 to be 9% lower than 2010, the low CO_2 scenario forecasts emissions to be 23% lower than 2010, and the high CO_2 scenario around 9% higher.

6. The rest of the document is structured as follows:

- Chapter 1 gives an overview of the nature of transport demand, how people make their transport choices and why it matters.
- Chapter 2 gives an overview of the structure of the National Transport Model and describes in detail how the model works.
- Chapter 3 discusses the key drivers for the change in traffic, congestion levels and CO_2 emissions between now and 2035.
- Chapter 4 presents the main forecasts of traffic, congestion, CO_2 and air pollutant emissions and describes the key drivers of the results. The chapter also compares the central CO_2 forecast to DECC's forecast and discusses whether individual car demand has sautrated
- Chapter 5 presents high/low road traffic demand and high/low CO_2 scenarios that have been carried out to take into account uncertainties regarding input variables such as GDP, fuel prices and vehicle fuel efficiency.

1. Introduction to Transport Demand

1.1 An effective and efficient transport system is an important enabler of economic growth and prosperity.[1] In 2010 the average person in Great Britain made 960 trips, travelling a total of 6,726 miles. In terms of time, residents spent an average of 367 hours per year travelling with the average trip lasting 22.9 minutes.[2]

1.2 This chapter sets out a number of questions about peoples' travel choices and how we observe and forecast changes in transport demand. It offers a simple framework to understand the underlying nature of transport demand.

What is Transport Demand?

1.3 Transport demand is derived from the amount of people and goods that society wishes to move around, given the costs and benefits of doing so to the individuals and firms making transport decisions. By and large, people do not demand transport for its own sake – it is a means to an end and dependent on the needs of the economy and preferences of people in society.

1.4 Depending on the question one is trying to address, transport demand can be measured in many different ways: in number of trips, number of passengers, vehicle-miles, passenger miles, freight tonnes or tonne miles. All of these are essentially measures of the outturn quantity or volume of travel we observe.[3]

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[1] DFT&HMT (2006) "The Eddington Transport Study: The case for action", http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/

[2] National Travel Survey 2010: http://assets.dft.gov.uk/statistics/releases/national-travel-survey-2010/nts2010-01.pdf

[3] Note that in some contexts, people sometimes talk about "unconstrained" demand; this can be misleading as demand (at least for individual passenger travel) is always constrained, at a minimum, by the maximum 24 hours in a day, but also in practice by the time and money costs facing individuals or firms making transport decisions. Transport demand is an outcome of the interaction between people's and firms desire to travel or transport and the benefits, prices and costs facing them in doing so (some of which are materially influenced by supply-side factors, such as network capacity).

1.5 The consumption of transport we observe is the result of millions of individual decisions about whether, when and how to travel or transport goods. Demand is therefore not a fixed quantity – it responds to the factors that influence people's decision making and which, in aggregate, determine its size and pattern.

Why does transport demand matter?

1.6 Demand matters to economic growth, emissions and safety. It is an indication of the economic value users of transport place on it. Some of this value can be directly attributed to economic output i.e. Gross Value Added (or Gross Domestic Product). However, concentrated levels of high demand, whether in a particular place or at a particular time, can lead to high levels of congestion or over-crowding. Congestion generates economic costs to society by delaying journeys - an unreliable transport system will obstruct productive activity.

1.7 Transport demand also generates wider negative outcomes, such as climate change emissions, air quality problems, and accidents. Accidents have fallen over the years with CO_2 and air pollutant emissions projected to fall in the future despite rises in road traffic.

1.8 The challenges which transport strategy and policy aim to overcome are strongly influenced by current and future trends in transport demand.

How do people make transport choices?

1.9 Evidence, and calibration of transport models to observed phenomena, suggest that it is useful to think about an individual making travel choices across five dimensions:[4]

- **Whether to travel (generation/frequency)** – the individual decides whether the purpose for the journey is sufficiently worthwhile. The aggregation of all individuals' micro decisions determines the total number of trips.
- **Where to travel to (destination)** – this choice is determined and constrained by the distribution of destinations that are worth the individual travelling to e.g. the location of jobs, schools and shops.

[4] In reality, it is clear that many individual travel decisions are habitual, significantly more complex than this and almost certainly not sequential. However, analysing decisions using these five dimensions does help us explain the aggregate travel patterns observed.

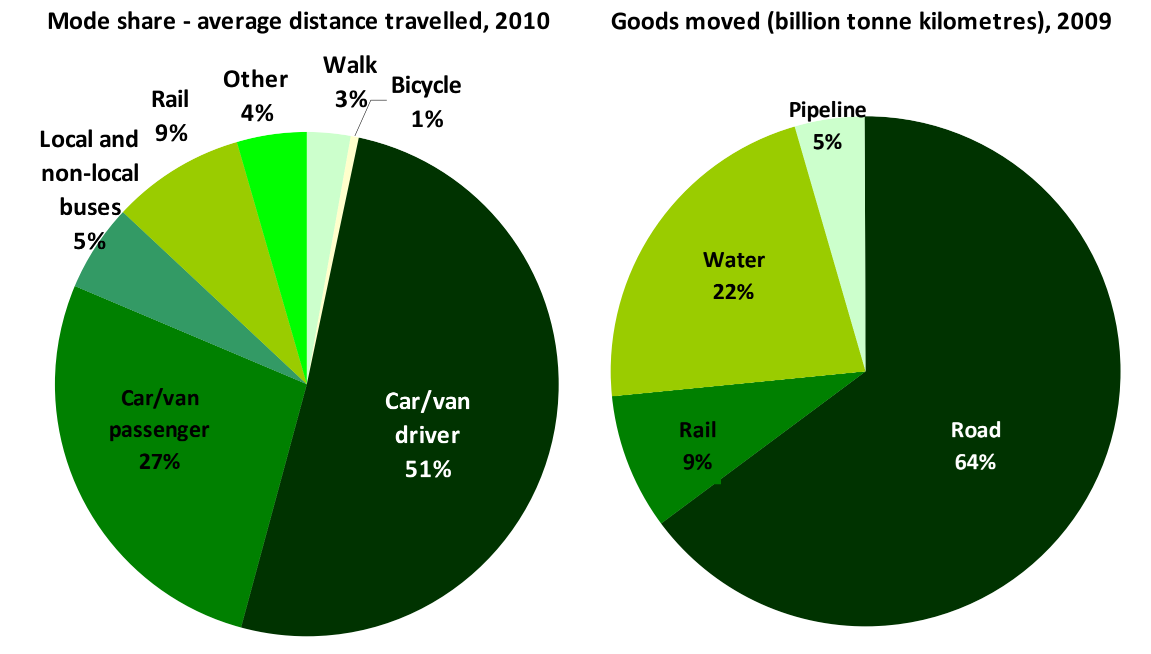
- **Which mode to travel by (mode choice)** – the individual takes into account the feasibility and costs (including time and monetary costs and other preferences) of travelling by different modes.
- **What time to travel** - the individual takes into account the feasibility and costs (including time and monetary costs and other preferences) of travelling at different times of day, particularly during peak and off-peak periods.
- **Which route to take (assignment)** – the individual takes into account the time and monetary cost, and other preferences, relating to the number of different feasible routes.

1.10 All other things equal, people are generally more likely to choose a lower cost mode and route to travel to their destination of choice, and the higher the costs both in time and money, the less likely someone is to choose to travel at all. However, every individual will also have other preferences – for example, about specific modes in general or about their convenience, safety, social acceptability or other characteristics – that influence their choices.

How do people travel and how are goods transported?

1.11 Figure 1.1 illustrates how the GB's individuals and goods are transported by mode. More than four-fifths of personal travel is by road and almost two-thirds of goods movements (in tonne-kilometres) occur on the road network. Road transport is therefore the main transport mode for individuals and businesses.

Figure 1.1: Personal average distance travelled and Freight Carried by mode, Great Britain 2009 & 2010



Source: National Travel Survey, Table NTS0302 & Transport Statistics Great Britain, Table 4.1[5]

1.12 This travel choice framework proves very effective in modelling demand so that it reflects what we observe in reality. Therefore the information we have about how trip demands and transport costs are changing is likely to continue to be a good basis for predicting future demand at an aggregate level.

1.13 Given the relative importance of road traffic, in relation to the overall transport patterns presented above, modelling and forecasting road traffic is an important element of forecasting overall transport demand. The model the DfT uses to aid the development of the forecasts presented in this publication is briefly discussed in the next Chapter.

[5] http://webarchive.nationalarchives.gov.uk/20110218142807/http://www.dft.gov.uk/pgr/statistics/datatablespublications/freight/tsgb0499.xls

2. Introduction to the National Transport Model

2.1 Grounded in the costs and benefits framework presented in chapter 1, this chapter provides a more detailed description of the specific modelling approach used to forecast road traffic demand.

Strategic Transport Modelling and Appraisal

2.2 The National Transport Model (NTM) is a highly disaggregated multi-modal model of land-based transport in Great Britain (GB).[6] It comprises six modes: car driver; car passenger; rail; bus; walk and cycle. The NTM has two main objectives:

- To *produce forecasts* in a future year of the main road transport indicators – traffic, congestion, carbon dioxide and pollutants.
- To provide a *policy and scenario testing tool* by estimating the impact of a transport policy scenario or a change in forecasting assumptions.

2.3 The NTM combines both cross-sectional and time series information. The cross-sectional data allows the model to capture the diversity of factors that, at any time, determine the travel patterns of people in Great Britain. The time series data allows the model to reflect changes over time. Input data is sourced from a range of places:

- **Observed data** – this data is usually measured from surveys, the most important of which are the National Travel Survey, the population census and the road traffic and goods vehicle censuses.
- **Forecast data** – the model requires forecast data or assumptions on future trends, the most important of which are assumptions on population, oil prices, GDP and the road network. This data is often provided by other Government Departments such as the Office for National Statistics (ONS), the Office for Budget Responsibility (OBR) and the Department for Energy and Climate Change (DECC) and,

[6] Although the NTM is a model of land-based transport in Great Britain, in this publication forecasts are generally presented at the England level only. Forecasts for Wales and all English regions are provided in the accompanying Excel worksheets.

therefore, the NTM is based on the same planning assumptions as used elsewhere across Government.

2.4 The NTM outputs can also be described in terms of their time series and cross-sectional elements.

- **Time Series elements** – The model forecasts the change in demand for travel over time in terms of the number of trips. This change in demand for travel depends on changing population and employment patterns, changing levels of income, changing prices, patterns of where people live and work, car ownership and social trends.
- **Cross-sectional elements** – For any point in time, the model projects mode split based on the relative generalised cost[7] of travelling to different destinations by different modes. This is essentially where the supply side of the model, which includes both the time and money costs of making a journey interacts with the demand side to determine journey and mode choices. Congestion, for instance, that increases journey times on a part of the road network, would make a person more likely to choose an alternative destination, or another mode. The NTM models every trip and every vehicle kilometre and the costs associated with these trips. Furthermore, it projects how generalised costs change with the introduction of various transport interventions, including providing additional road capacity, changing public transport fares and frequencies, or change in motoring costs.
- **Economic elements** – The Welfare module summarises the main outputs of the NTM to give the overall cost and benefit implications, including some of the environmental ones, of a policy intervention relative to some base case in a particular future year. The key determinants of overall welfare remain the journey times for trips, which are themselves determined by comparing demand levels with capacity and identifying (any) congestion/crowding.

Overview of the National Transport Model

2.5 The National Transport Model[8] uses what is known as a four stage behavioural modelling approach to forecast the demand for travel. This approach estimates the demand for travel from the bottom up.

- Firstly, it estimates the numbers of trips people make;

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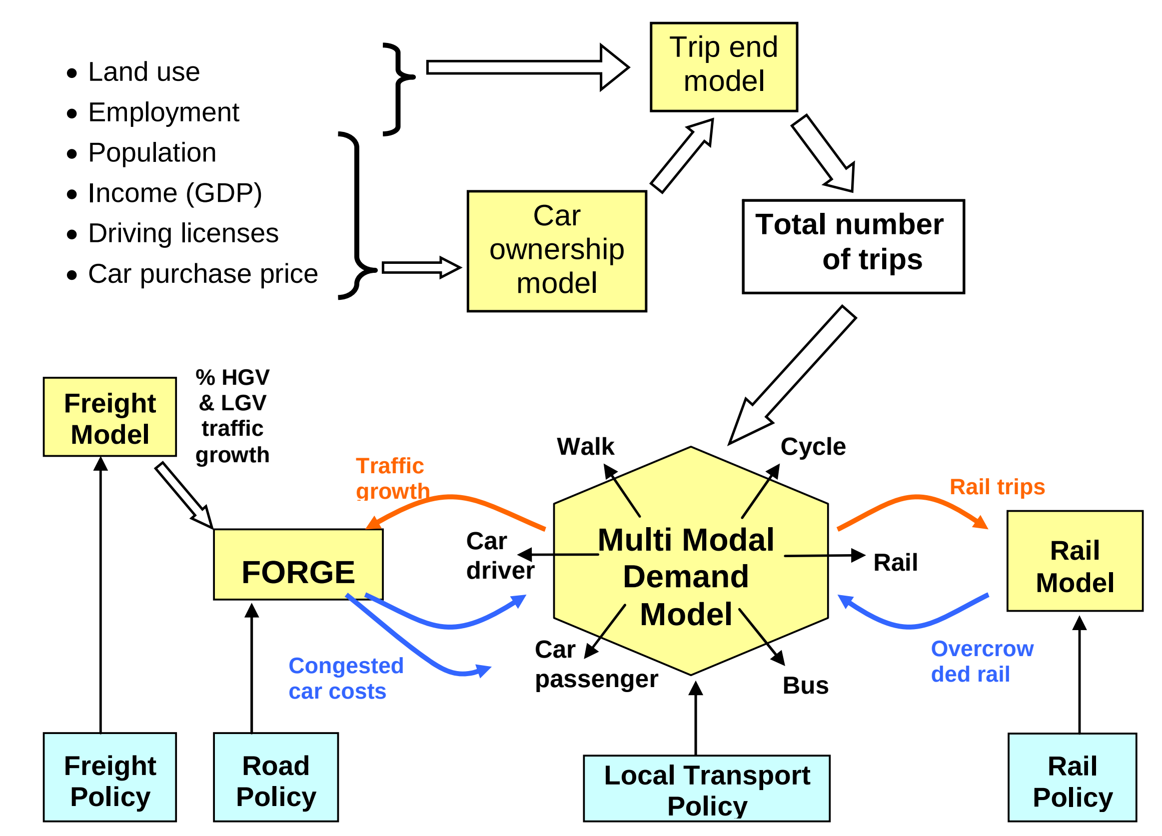
[7] The generalised cost of a journey is a combination of time (multiplied by an individual’s value of time) plus the monetary costs associated with the trip. The NTM works on a 'Generalised Time' basis - the concept is the same as generalised cost but expressed in units of time rather than money.
[8] More details about the model available at: http://www.dft.gov.uk/pgr/economics/ntm/

- Secondly, it allocates those trips to actual journeys made between specific origins and destinations;
- Thirdly, it allocates those journeys to specific modes;
- Finally, it allocates the journeys being made via a particular mode to specific routes across the transport network. The basic structure of the model is illustrated in Figure 2.1.

Figure 2.1: Outline Structure of the National Transport Model



2.6 At the top of the diagram, the **Car Ownership Model**[9] and **Trip End Model** estimate the number of trips made in each future year as a function of demographic and land use inputs and various economic forecasting assumptions. The Car Ownership Model feeds into the National Trip End Model and the demographic/planning input assumptions are collectively known as NTEM. NTEM calculates the number of trips starting in each zone (trip productions) and the number of trips finishing in each zone (trip attractions) for both the base and future year. Trip productions are primarily generated by the location and

[9] http://www.dft.gov.uk/pgr/economics/ntm/carownership

structure of households and trip attractions by the location and structure of employment, schools, shops and leisure facilities.

2.7 In the centre of the system is the main **Demand Model**[10] that first determines the distribution of the trips and then the mode by which they are made. The inputs to the demand model are total numbers of trip ends (which are taken to be largely invariant to cost as shown by the National Travel Survey) as calculated by the National Trip End Model and the generalised costs of travelling between each origin and destination for each mode. For any chosen year, the Demand Model then uses these generalised costs to determine how the trip ends are joined together to form trips between origins and destination area types and the mode they are made by (car driver, car passenger, bus, rail, cycle and walk). The outputs are numbers of trips by each mode segmented by origin, destination area type, trip length, trip purpose and person type. The Demand Model is calibrated to replicate behaviours as observed from the National Travel Survey.[11] It is highly segmented by user class because different user classes are known to have different responses to changes in generalised costs.

2.8 The Demand Model is not geographically detailed but it is highly segmented by trip length, trip purpose, and person type. For road and rail, separate and more detailed geographic models are then used to determine the specific route across the network by which a trip is made.

2.9 On the left of Figure 2.1, a specialist highway model **FORGE**[12] links with the Demand Model to provide a more detailed estimate of highway traffic flows, congestion and pollution. FORGE is not a traditional assignment model; rather it uses observed data on the level of traffic using each link of the road network in 2003 and then applies elasticities derived from the Demand Model to forecast future levels of traffic from its 2003 base year.

2.10 To understand how traffic is currently distributed across the road network, FORGE takes data from the national road traffic database which is populated from count censuses of every major road and a sample of minor road sites across Britain. For each of the road types modelled in FORGE a relationship known as a speed flow curve links the average speed on that section of the road to the level of traffic flow. A similar kind of relationship between speed and vehicle emissions is used to determine pollution.

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[10] http://www.dft.gov.uk/pgr/economics/ntm/demandmodel
[11] http://www.dft.gov.uk/pgr/statistics/datatablespublications/personal/
[12] Fitting On of Regional Growth and Elasticities. See http://www.dft.gov.uk/pgr/economics/ntm/nationaltransportmodelntmsummary

2.11 Although the NTM is essentially a passenger transport model, freight road traffic is modelled for the purpose of assessing the impact of freight vehicles on congestion. Heavy Goods Vehicle (HGV)[13] traffic growth is modelled using the **Great Britain Freight Model** (GBFM). This takes base year data from 2004 on international and domestic freight movements for a range of different commodities. The model then grows this traffic over time by modelling the effect of changes in macroeconomic variables and also changes in generalised cost. Light Goods Vehicle (LGV)[14] traffic is projected by a separate time series model relating LGV miles in a given year to the levels of GDP and fuel price.

2.12 On the opposite side of the diagram, the **National Rail Model**[15] assigns rail passenger trips from the demand model to a detailed geographic network of rail services. The resulting journey time, overcrowding costs, and rail fare outputs are sent back to the demand model so that the interactions between road and rail can be modelled.

2.13 The blue boxes at the bottom of the diagram indicate that the NTM can be used to examine the impact of various policy assumptions, which are fed into the different sub-models. In general, changing policy assumptions changes the relative costs and/or time (generalised cost) of travelling by the various modes. However the forecasting assumptions feeding into the car ownership and trip end models can also be altered to represent the impact of different policies and scenarios.

Updating the National Transport Model

2.14 Peer review and external validation have consistently shown that the National Transport Model (NTM) provides robust results and is fit for purpose. Nevertheless, the assumptions and methodologies used by the NTM are kept under review. For example, many of the main forecasting assumptions, such as forecasts of GDP and oil prices have been updated since the 2009 forecasts were published and the forecasts set out in this paper have made use of these.

2.15 The drivers of road traffic demand, and hence the key inputs into the NTM, are discussed in more detail in the next chapter, along with the assumptions made for how they are likely to change in the future.

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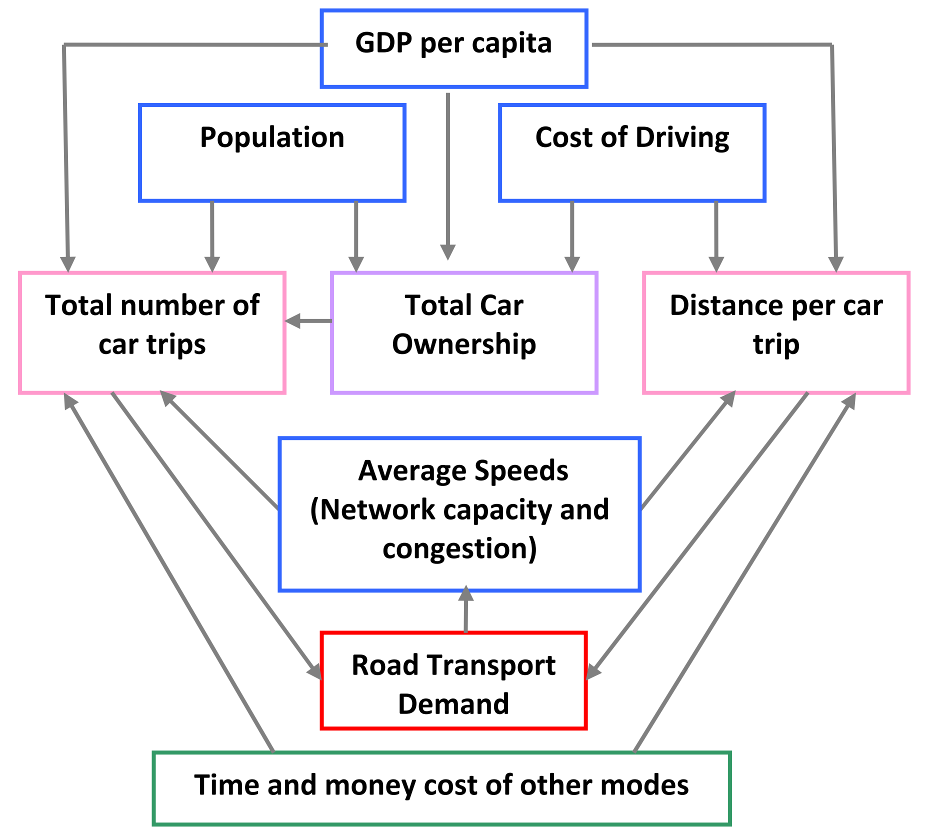
[13] Goods vehicles of over 3.5 tonnes Gross Vehicle Weight
[14] Includes mainly but not exclusively vans not over 3.5 tonnes maximum permissible gross vehicle weight
[15] http://www.dft.gov.uk/pgr/economics/ntm/railmodellingframeworkfullreport

3. Key Drivers of Road Transport Demand

3.1 Chapter 2 discussed the NTM key inputs. This chapter explores those key drivers in a little more detail, and what the latest round of forecasts assumes about their future values. Demand is driven by ‘macro’ factors, like population, demography, economic growth, money cost of travel, and by more ‘micro’ influences on individuals’ decision-making such as time costs and personal circumstances and preferences; but also constrained by network capacities and performance limitations (which put people and businesses off transport they would otherwise have used). Figure 3.1 illustrates how the main key drivers impact road transport demand.

Figure 3.1: Key drivers’ relationship to road transport demand

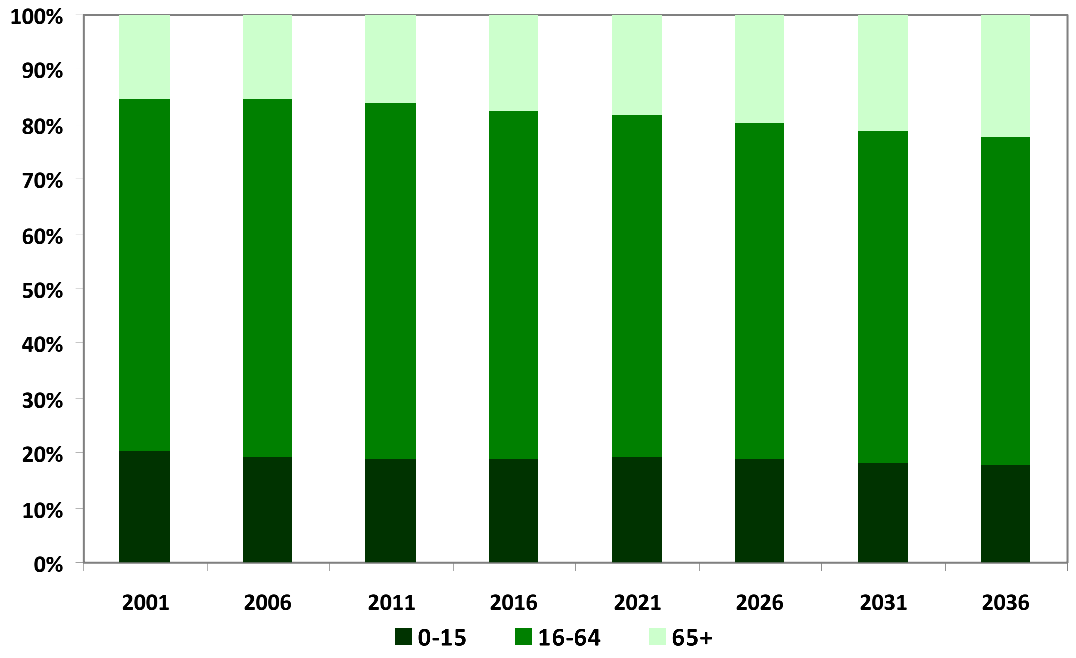


Population

3.2 If population increases then there will be more people choosing to travel for economic and personal needs and more production of goods which will also need to be transported. This will increase car ownership and the total number of trips taken. In the 2011 forecasts, population is assumed to rise by around 18% between 2010 and 2035. Employment in total is also projected to rise around 19%.[16]

3.3 Demographics within a population can also play a significant role in transport demand, in terms of age and household size. One example of this is age: currently, older members of society make fewer trips and generally travel shorter distances than younger generations. As the 'baby boomers' grow older we may find that average number of trips and distance per trip – averaged across the whole population – reduces. In 2011 over 65s make up around 16% of the total population, but by 2020 this is forecast to grow to around 20%.

Figure 3.2: Population Forecasts by Age band, England 2001-2036



Source: NTEM 5.4

[16] Population inputs are provided by NTEM 5.4.

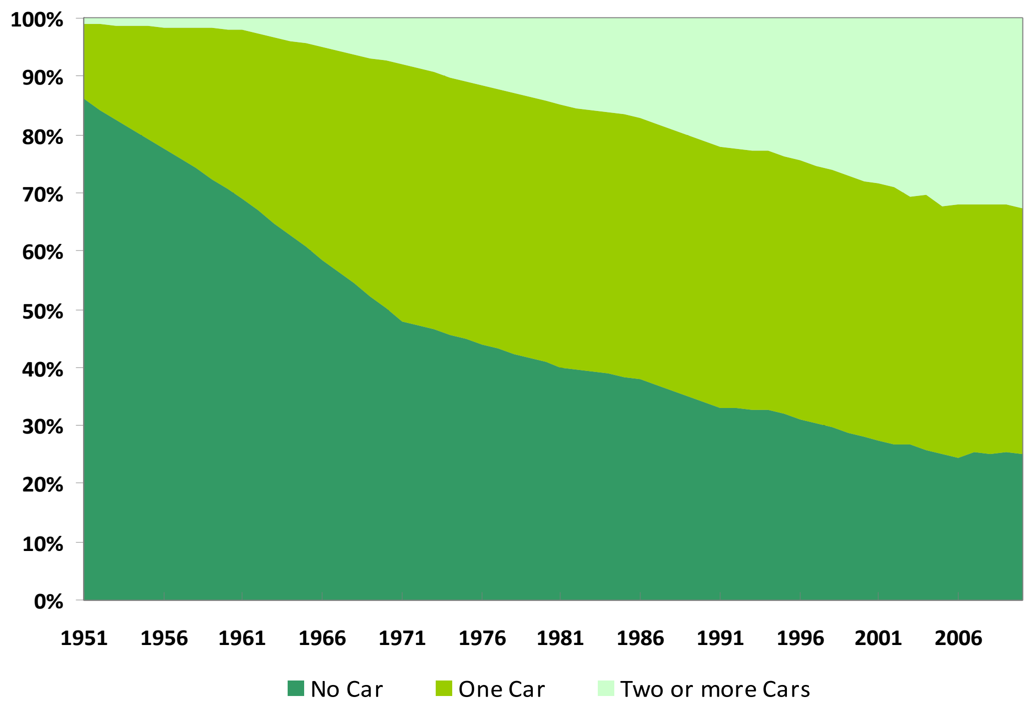
Economic Growth

3.4 Increases in GDP per capita mean individuals will have more disposable income, increasing general demand for goods and services. Increasing general demand may increase use of road transport for the production, distribution and consumption of goods and services. Rising GDP impacts on car traffic growth specifically through two channels:

Car Ownership

3.5 Increases in GDP per capita make car ownership more affordable, and thus increase the availability of using a car as a mode of transport through reducing the relative cost of road transport to individuals. Figure 3.3 presents the expansion of car ownership since 1951.

Figure 3.3: Household car availability: Great Britain, 1951 to 2010



Source: National Travel Survey[17]

[17] http://www.dft.gov.uk/statistics/tables/nts0205 Years for which data is unavailable are estimated by linear interpolation. For example, until 1981 data points are only available for years 1951, 1961, 1971 and 1981. The chart above estimates the intervening years by interpolation. Figures from 1985/86 are from the

Value of Time

3.6 A rise in incomes also increases people's 'value of time' – the opportunity cost of travel becomes higher – the individual could be earning more money or enjoying more leisure. Individuals decide how much time to spend travelling and which mode to take. A car can take you directly to a destination so may be preferable in terms of 'time cost' to a train or bus. However, if there is congestion on the road network causing car trips to take longer then this may not be the case, individuals may travel to a location closer by or not make the journey by car or at all.

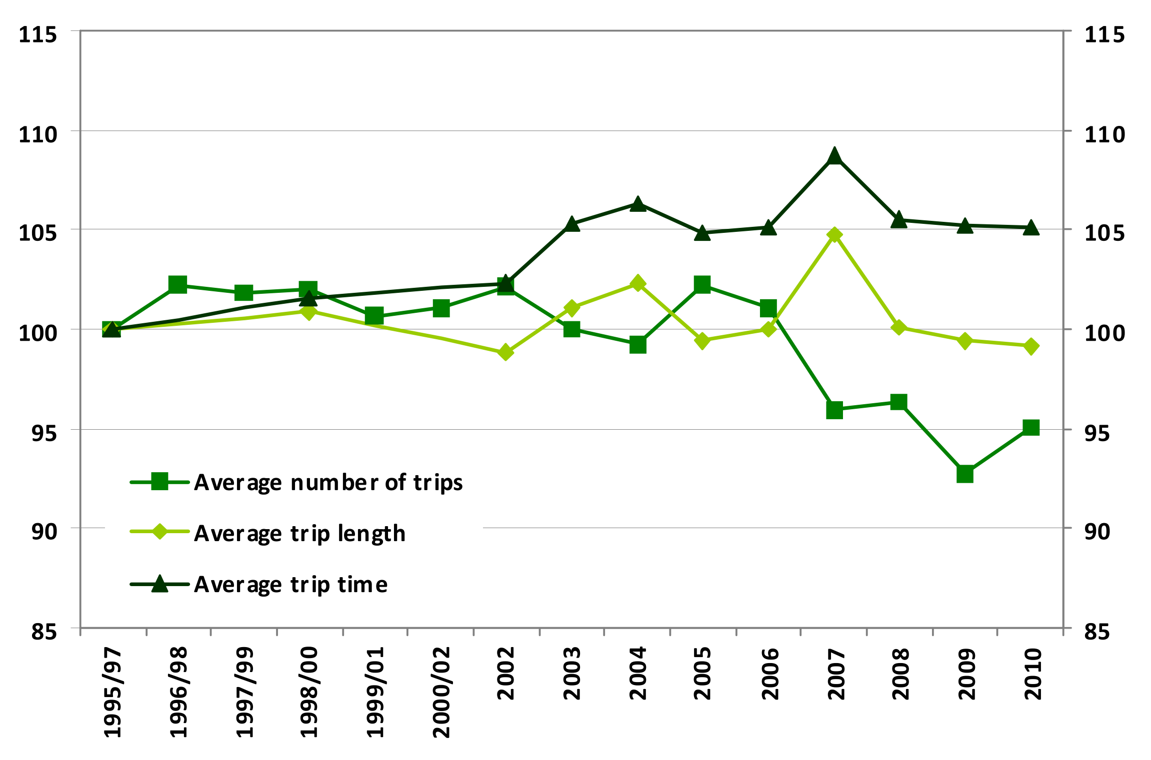
3.7 Figure 3.4 illustrates results from the National Travel Survey (NTS) for car/van drivers between 1995/97-2010. Determining trends through using the NTS can be difficult due to changes in survey methodology over time and idiosyncratic issues in individual years. However, figure 3.5 below suggests that:

- Between 1995/97 and 2006 the average number of trips and length of trip was relatively constant with average trip time increasing by 5%. Although over this period average incomes increase by 28%, fuel prices also rose 25% which with the increase in journey times may assist in explaining why the average distance travelled by car/van drivers was relatively flat over this period.
- The NTS recognises that there was an under-reporting of trips under 5 miles in 2007 which can help explain fall in number of trips and increase in average trip length and time taken.[18]
- From 2008 through we can begin to see the impact of the recession through lower incomes and higher oil prices. Rather than choosing to take shorter car trips due to lower incomes people are choosing to undertake fewer car trips leading to less road transport demand.

National Travel Survey. Earlier years are derived from other household surveys. Figures for 1995 onwards are based on weighted data.

[18] There was also some underreporting of short trips in 2008, although the impact is thought to be to a lesser extent.

Figure 3.4: Car/Van Driver - Average number of trips, trip length and time, Great Britain (indexed 1995/97=100)



Source: National Travel Survey[19]

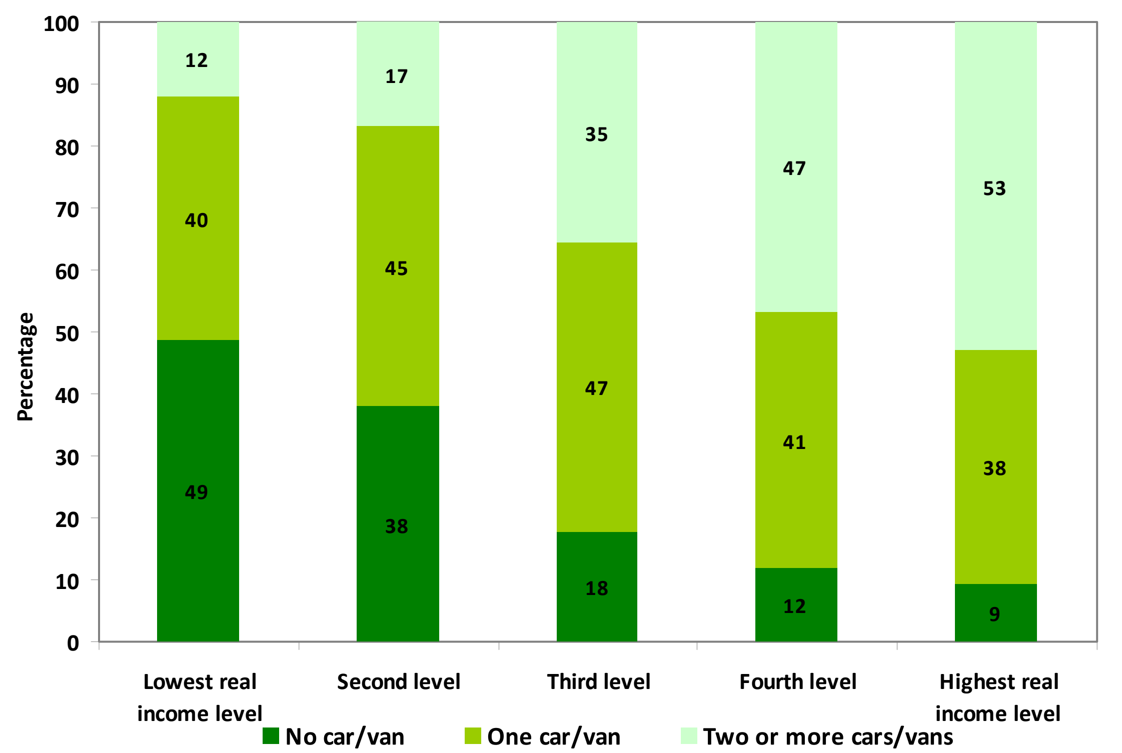
Impact of Income on Car Ownership and Travel Choice across Society

3.8 Figure 3.5 illustrates the current relationship between income and car ownership in Great Britain. While 49% of the lowest real income quintile have no car, only 9 percent of the highest income quintile have no car. In fact, over half the highest quintile group have two or more cars, while only 12 percent of the lowest income quintile have two or more cars.

3.9 There may be a saturation point in car ownership, where rising incomes fail to result in demand for additional cars. However, even if some sections of the market are nearing saturation, there currently appears to be scope for further growth amongst other sections of the population.

[19] Data from http://www.dft.gov.uk/statistics/tables/nts0103, http://www.dft.gov.uk/statistics/tables/nts0306, http://www.dft.gov.uk/statistics/tables/nts0311. Due to sample sizes results for the early years, results for multiple years were combined to produce the estimates.

Figure 3.5: Household car availability by household income quintile, Great Britain, 2010



Source: National Travel Survey, http://assets.dft.gov.uk/statistics/tables/nts0703.xls

3.10 Figures 3.6a-c below shows the number of trips taken per person, distance per trip and total distance per person by mode and by household real income quintile.[20] Figures 3.6a-c illustrate that those households with higher real incomes and thus have greater ownership and access to a private vehicle make more car trips, the car trips are longer and thus the overall distance travelled in cars is longer. Figures 3.6a-c shows that the majority of the higher car driver total distance travelled per person across the income quintiles comes from an increase in car trips rather than length in car trips. Figures 3.6a-c imply that a rise in incomes and car ownership can increase demand for transport.

[20] Households divided into quintiles according to their gross real income. Each quintile represents 20%, or one fifth, of all households.

Figures 3.6a-c: Travel by household income quintile and mode: Great Britain, 2010

Figure 3.6a: Trips per person per year by main mode and household real income quintile

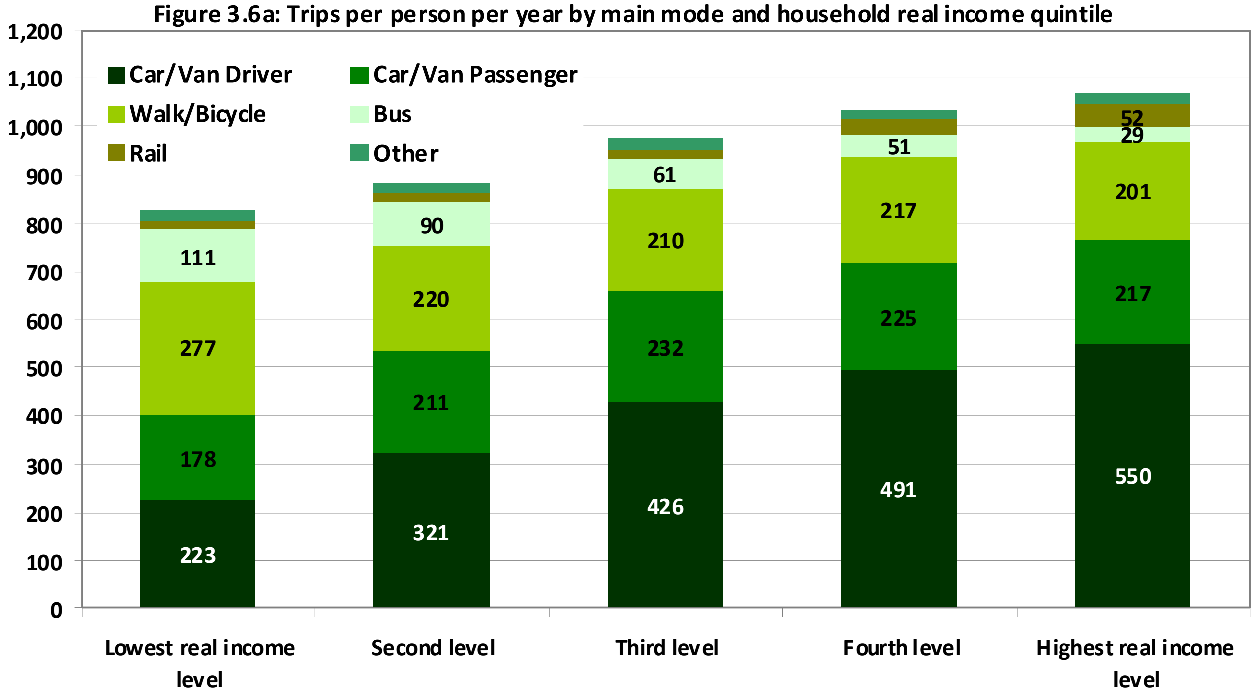
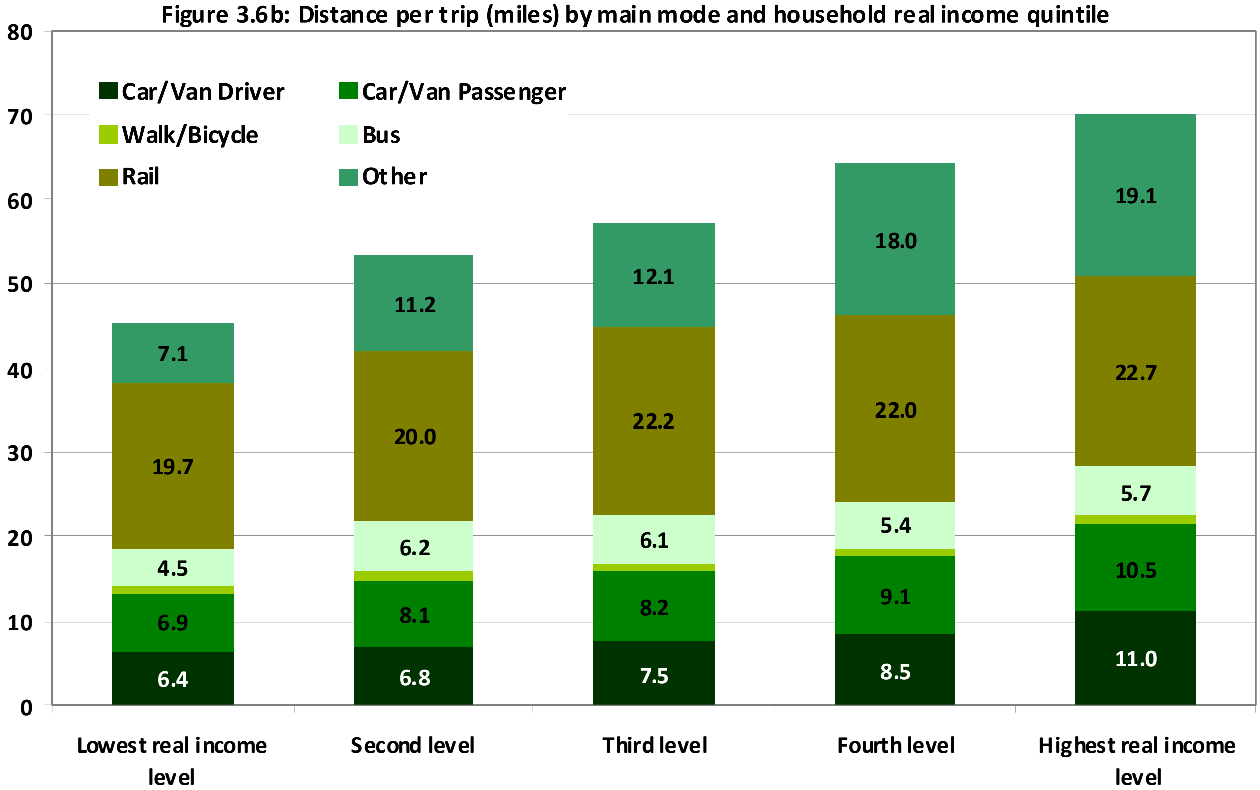
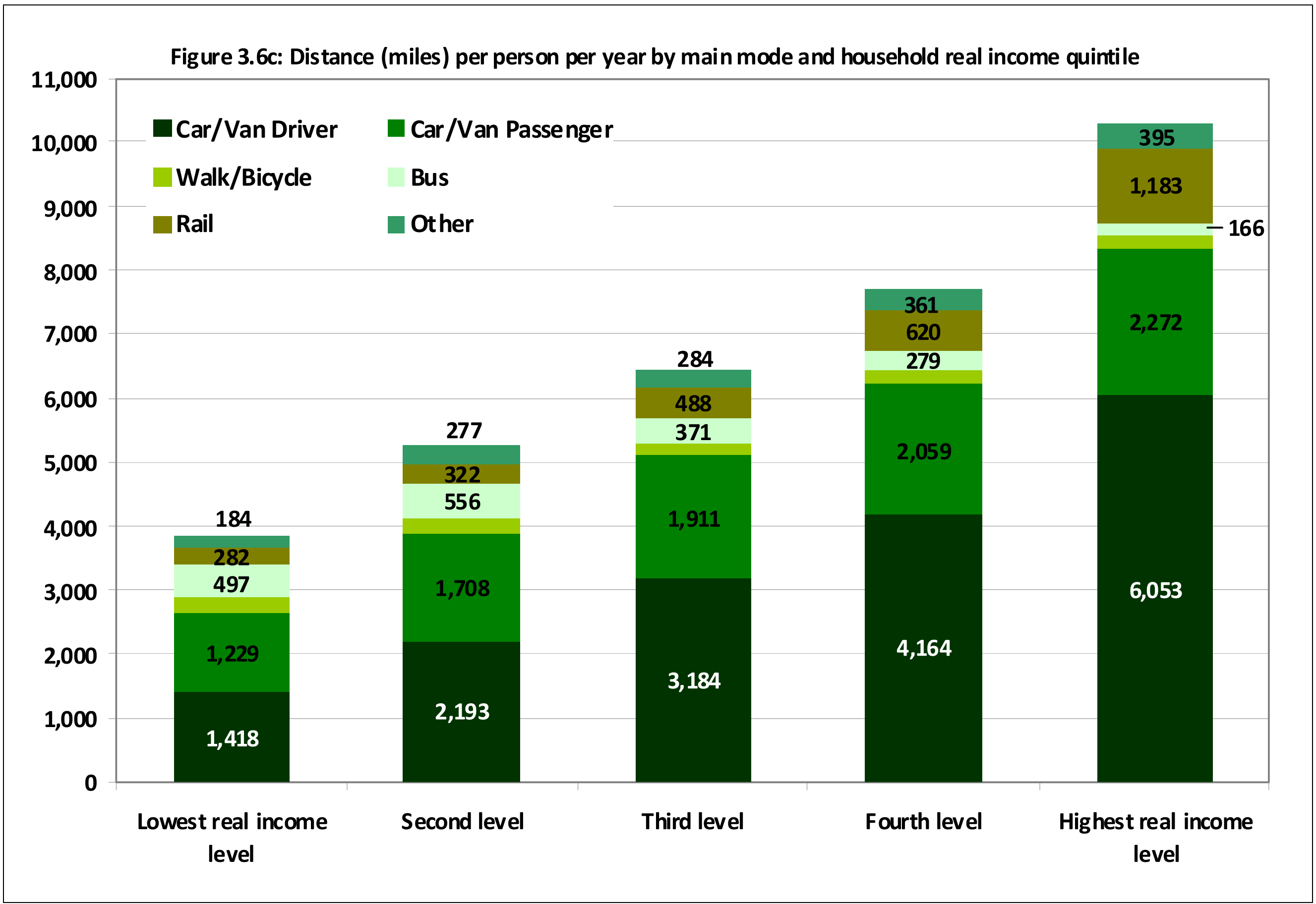


Figure 3.6b: Distance per trip (miles) by main mode and household real income quintile





Source: National Travel Survey, http://www.dft.gov.uk/statistics/tables/nts0705 and DfT analysis. 'Rail' includes surface rail and London Underground. 'Other' transport includes motorcycles, other private (mostly private hire bus), taxi/minicab and other public (air, ferries and light rail).

3.11 From the Budget 2011 OBR Economic Outlook and July 2011 OBR Fiscal Sustainability Report real GDP is forecast to grow as detailed in Table 3.1.

Table 3.1: Projected Real GDP and Real GDP per capita growth

Period	Real GDP	GDP per capita
2010-2015	13.5%	9.5%
2010-2020	27.7%	19.2%
2010-2025	41.8%	28.6%
2010-2030	57.1%	38.8%
2010-2035	74.1%	50.0%

Source: GDP growth rates consistent with Budget 2011 OBR Economic Outlook and July 2011 OBR Fiscal Sustainability Report long-term growth projections. GDP per capita relates to forecast growth in GDP per capita in Great Britain.

Fuel Efficiency and the Costs of Driving

3.12 The money cost of driving will impact on transport demand as the higher the money cost of road transport relative to alternatives (other travel modes or activities) the lower the projected demand will be. The cost of road travel is highly dependent on the oil price, taxation on the marginal use of road transport (fuel duty and VAT) and the fuel efficiency of the vehicle. Reductions in the cost of driving increase car ownership and distance per trip.

Fuel Efficiency

3.13 The rate at which vehicles use fuel is a key determinate of road transport CO_2 emissions, and the cost of driving. The projected impact on fuel use (litres per mile) from fleet fuel economy improvements in cars, light vans and HGVs are set out in table below and discussed in more detailed in Table 3.2.

Table 3.2: Fleet fuel economy improvements in cars, light vans and HGVs (litres per mile)

Vehicle	Policy	Fuel Use Impact 2010-2035
Cars	- EU new car CO_2 target met in 2015 (130gCO_2/km) and 2020 (95gCO_2/km) - EU complementary measures (e.g. low rolling resistance tyres, gear shift indicators etc)	-46%
Light Vans	- EU new van CO_2 target met in 2017 (175gCO_2/km) and in 2020 (147gCO_2/km)	-34%
HGVs	- Industry led action leads to 5% improvement in HGV efficiency over 5 years - Low Rolling Resistance Tyres for HGVs	-11%

3.14 As did the RTF2009, the Road Transport Forecasts 2011 includes the EU new car CO_2 regulation, including the mid-term target of 130 grams of CO_2 per kilometre by 2015 and the long-term target of 95 grams of CO_2 per kilometre by 2020. In addition to this RTF11 also includes the fuel efficiency impacts of EU complementary measures such as low rolling resistance tyres, gear shift indicators, tyre pressure monitoring systems and efficient air conditioning systems.

3.15 There are currently no targets on car fuel economy in place for the period post 2020. In the absence of confirmed policy the NTM assumption is for no further improvement in new car fuel economy post 2020. Therefore these forecasts represent what would happen if no further improvements to new car fuel economy were made after 2020. Total fleet efficiency will continue to improve beyond 2020 due to new vehicles replacing old ones, refreshing the fleet with more economical vehicles. The regulatory framework is therefore projected to deliver increased car fuel efficiency long after the long term CO_2 target is implemented. At present there are no assumptions in the NTM regarding the role electric vehicles (EVs) could play in reducing emissions. This is an area in which we will develop the NTM's capability for future forecasts.

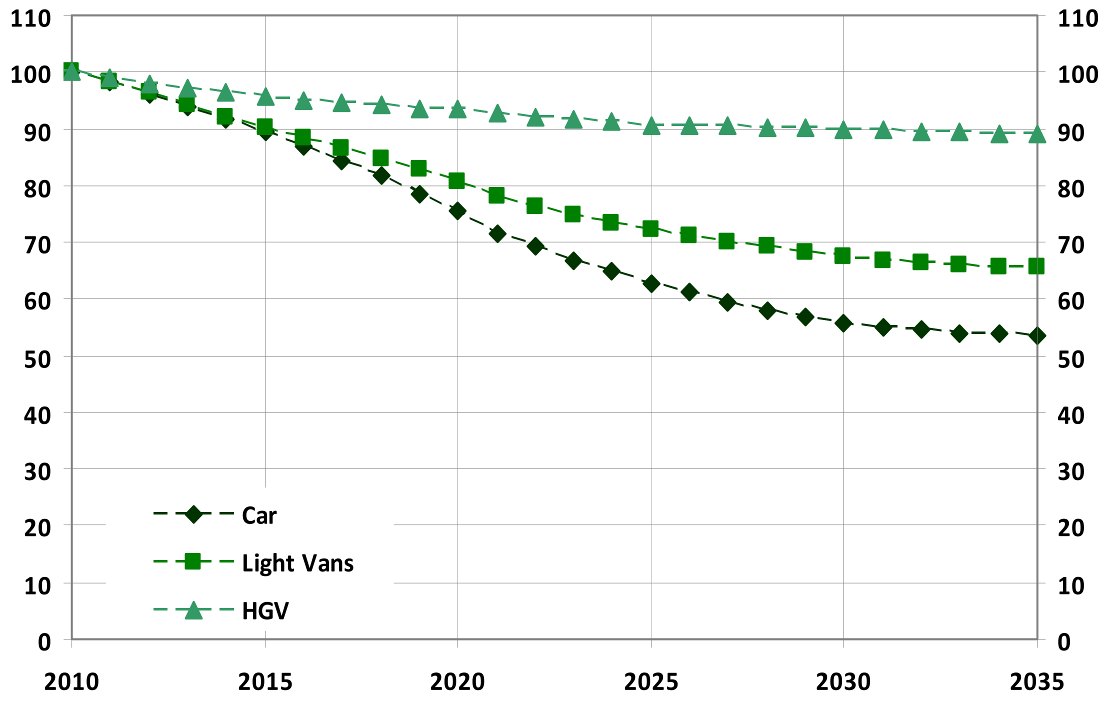
3.16 When modelling fuel economy we have taken into account the biofuels energy penalty. Biofuels have lower energy content so more fuel is needed to drive the same mileage. Despite this energy penalty, car fleet fuel economy is projected to improve by 46% between 2010 and 2035.

3.17 For this year's forecast we have updated our assumptions on light van fuel economy. For light vans the forecasts include the EU new van CO_2 regulation; the mid-term target of 175 grams of CO_2 per kilometre by 2017 and the long-term target of 147 grams of CO_2 per kilometre by 2020. Due to this, van fleet fuel economy is projected to improve by 34% between 2010 and 2035. As with cars, given no confirmed policy on new vans post 2020, these forecasts represent what would happen if no further improvements to new van fuel economy were made after 2020.

3.18 For this year's forecast we have updated our assumptions on HGV fuel economy. For HGVs the forecasts include industry-led action leading to a 5% improvement in HGV efficiency over 5 years and the roll out of Low Rolling Resistance Tyres for HGVs. Due to these, HGV fleet fuel economy is projected to improve by 11% between 2010 and 2035.

3.19 Figure 3.7 below illustrates the improvement in fuel efficiency assumed for cars, light vans and HGVs.

Figure 3.7: DfT Fuel Consumption Projections 2010-2035, litres per 100 miles by vehicle type



Source: DfT projections.

Costs of Driving

3.20 The cost of driving per kilometre is a key determinant of traffic and congestion levels.

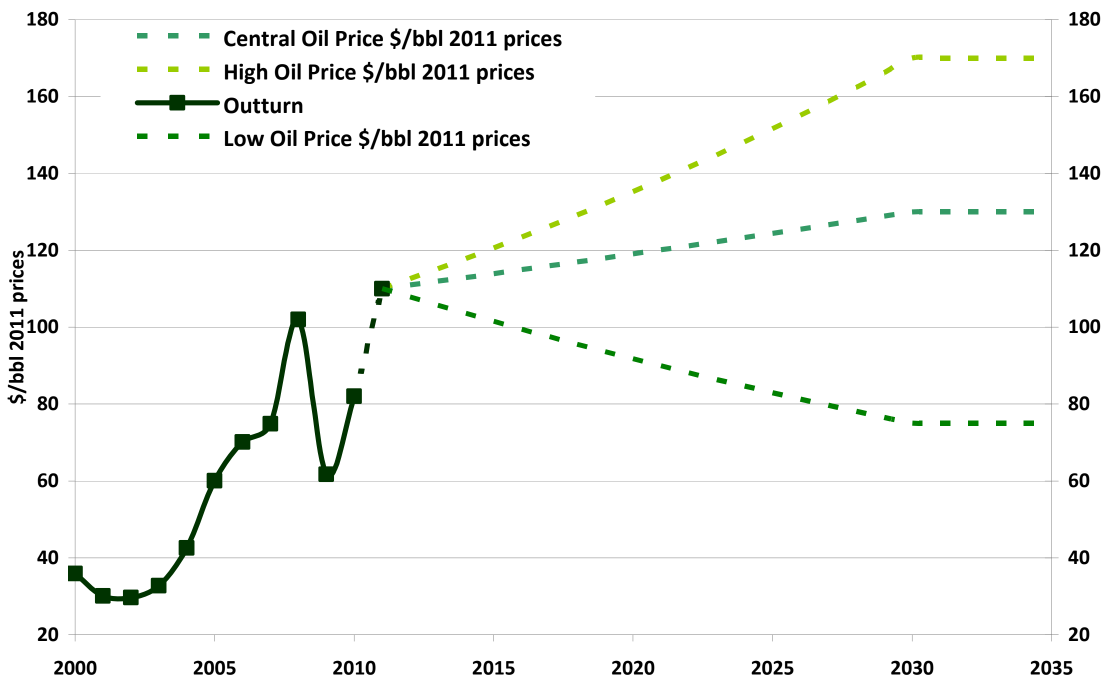
3.21 The cost of driving includes various elements such as the costs of purchasing a vehicle, insurance, fuel costs and servicing costs. Assumptions on non-fuel operating costs are unchanged from last year's forecasts. The assumptions regarding fuel prices and fuel economy are combined to produce car fleet average costs of driving per kilometre for each year.

3.22 The underlying driver for changes to pump fuel prices, in the absence of changes to rates of taxation, is oil prices. Road Transport Forecasts 2011 is based on the latest DECC crude oil price projections, published in October 2011.[21] DECC has produced three oil price scenarios (low, central and high) to 2030, represented in Figure 3.7. DECC project that oil prices will rise to $130bbl by 2030 in 2011 prices. DECC's high and

[21] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/ff_prices/ff_prices.aspx

low scenarios project oil prices to either fall to $70bbl or rise to $130bbl respectively. Post 2030 the prices assumed in the forecasts remain at 2030 prices levels (in real terms). Given the impossibility of forecasting the future oil price with real certainty, the range of outcomes covered is intentionally wide.

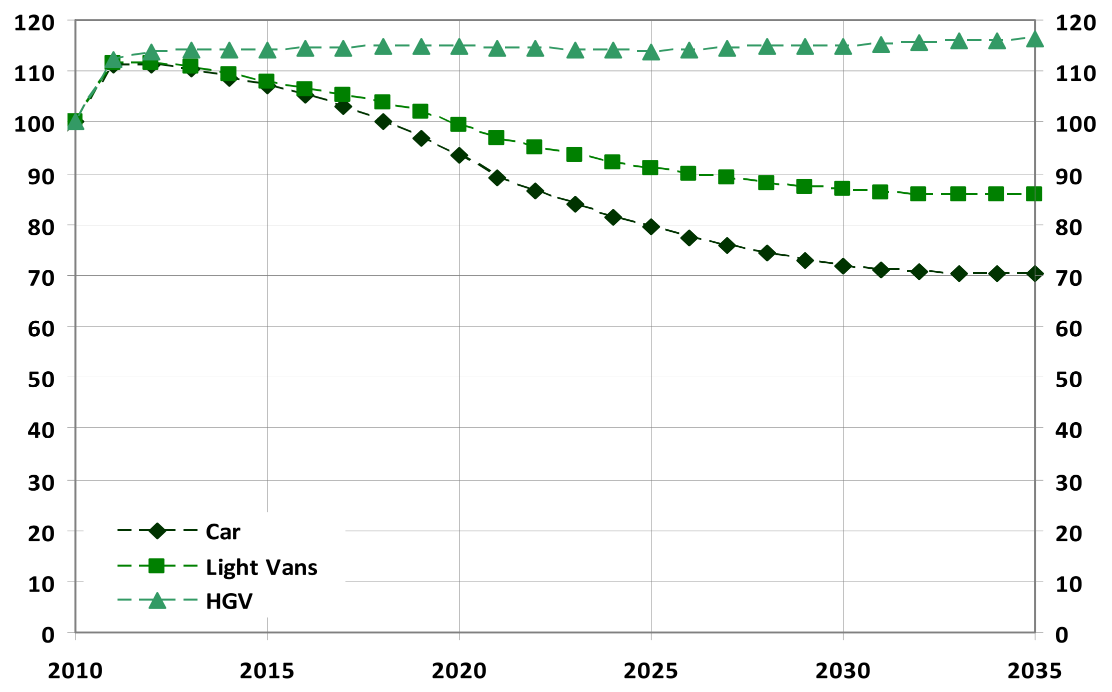
Figure 3.8: DECC Oil Price Projections ($bbl)



Source: DECC, see footnote 20.

3.23 Combining projections of fleet fuel efficiency and fuel cost determines the fuel cost of driving. Figure 3.8 shows these assumptions over time. The fuel cost of driving is projected to increase in 2011 due to the projected increase in the oil price. From 2012 fuel economy improvements begin to reduce the fuel cost of driving for cars and vans. From 2010 to 2035 these fuel costs of driving are projected to fall by 30% and 14% respectively. For HGVs the fuel cost of driving is projected to slightly rise over time as increases in the fuel cost outweigh the improvements in fuel efficiencies. From 2010 to 2035, HGV fuel cost of driving is projected to rise by 16%, the majority of which is projected to occur in 2011.

Figure 3.9: Central Fuel Cost of Driving Projections 2010-2035, pence per mile by vehicle type



Source: based on DECC Oil Price projections and DfT fuel consumption projections.

Network Capacity and Congestion

3.24 The time cost of travel is a key driver of demand at the 'micro' level because it is unique to each individual and situation. However, the time cost of travel by road will also be influenced by some 'macro' factors that affect average speeds, such as network capacity and congestion. An increase in journey time cost of driving will lower demand for road transport.

3.25 The NTM has a representation of the road network that is updated in line with the Highway Agency road programme and agreed local road schemes. The NTM uses Spending Review 2010 (SR 2010) agreed road projects as the basis for future road projects. No further expansions to the road network beyond those agreed during the SR 2010 are assumed.[22]

[22] The Investment in Highways Transport Schemes (2010) sets out the projects assumed in the modelling. http://www.dft.gov.uk/pgr/roads/network/strategic/highwaystransportschemes/?view=Standard

4. Road Transport Forecasts

Summary

4.1 Transport is vital to the economy and the way we live. Taking a long-term view of the likely trends in key metrics such as traffic, congestion and tailpipe emissions is important to enable policy decisions to be made early enough to have an impact.

4.2 This chapter presents the central NTM forecasts of traffic demand growth and associated emissions over the period to 2035 and discusses changes to previous forecasts.

4.3 This report updates Road Transport Forecasts 2009[23]. The major changes to the forecasts since the last publication include updated GDP forecasts by the Office for Budget Responsibility, oil prices by DECC, additional policies to further reduce CO_2 emissions from the transport sector and agreed road projects from the Spending Review 2010.

4.4 The key results this year are an increase in traffic vehicle miles of roughly 44% between 2010 and 2035, with equivalent increases in seconds lost due to congestion and journey times. Despite the increase in traffic, CO_2 and air pollutant tailpipe emissions are projected to fall.

Forecast performance against observed data

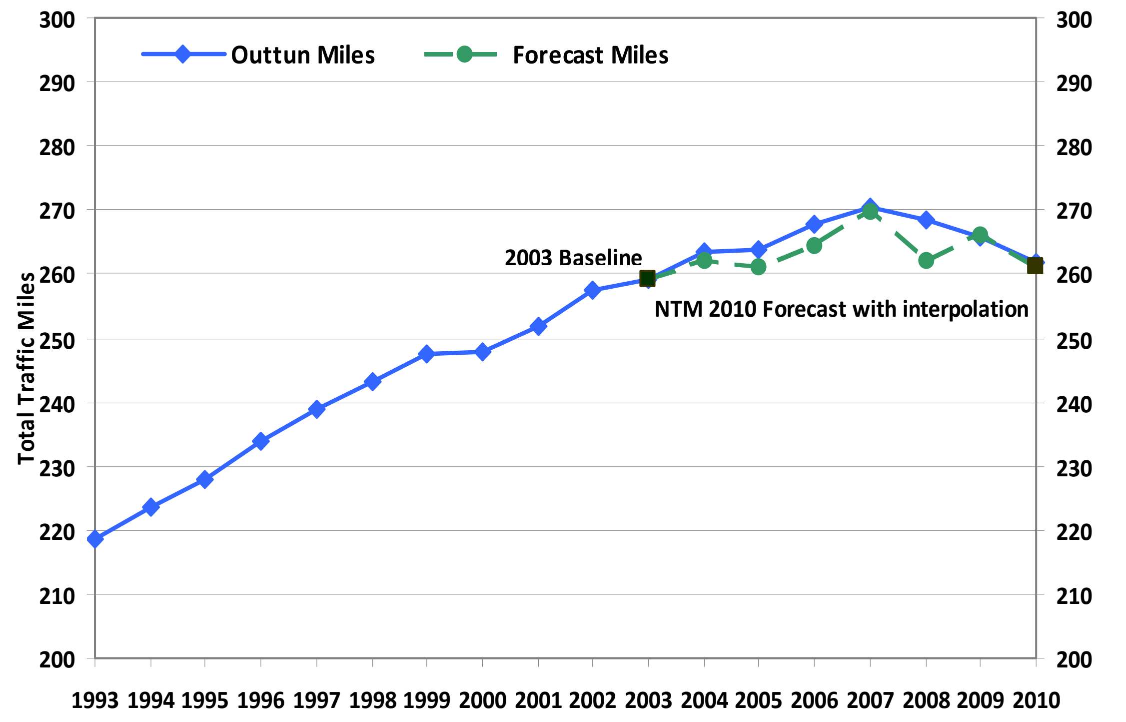
4.5 The NTM is designed to forecast long-term trends (currently 2010 to 2035 in five year intervals) rather than individual years. It therefore does not provide insight into the precise path between the base year and forecast years. However, using our understanding of how the key drivers from the previous chapter impact road transport demand we can interpolate between NTM forecast years. Figure 4.1 compares this year's forecast to 2010 to observed Transport Statistics data on traffic.

4.6 The NTM forecast to 2010 is within 0.2% of observed traffic data. The forecast interpolation (estimated in addition to the NTM forecasts and

[23] http://www.dft.gov.uk/publications/road-transport-forecast-dft-ntm-results-2009

based on changes in population, GDP and fuel costs of driving) follows observed traffic data closely between 2003-2010. The one year in which the interpolation does not follow observed data is in 2008, where we observed volatile oil prices reaching $149bbl in August 2008. Impacts of such short-term volatility in costs of driving are difficult to model.

Figure 4.1: NTM 2010 Forecast and Observed Traffic Data, England



Source: Observed DfT Road Traffic Statistics (2010)[24]; 2003 outturn data, 2010 Traffic forecast from NTM (DfT), intervening years derived through separate model interpolation.

Forecast Limitations

4.7 As with all forecasts, there is uncertainty around the outturn values of key drivers such as future GDP growth, fuel prices and population (discussed in more detail in the previous chapter). The forecasts presented in this chapter should therefore be read as the projected trends for traffic, congestion and emissions, given the most likely path of the input variables. To account for such uncertainty chapter 5 presents a range of scenarios, which combine sensitivity tests on the key variables. The aim

[24] http://www.dft.gov.uk/statistics/tables/tra8901

of these scenarios is to show how the forecasts change when the key input variables are varied within reasonable bounds.

Forecast Status, Inputs and Assumptions

4.8 The forecasts for road transport presented in this document represent the modelling and assumptions used over summer 2011 to update DfT's analysis of CO_2 reducing policies to meet the first three Carbon Budgets.[25] The central forecast analysis include central projections on Real GDP and Oil prices from the Office for Budget Responsibility and Department for Energy and Climate Change respectively, as were available at the time. The central forecasts also only include CO_2 reducing policies and road schemes that have been publically announced and funded. These forecasts should not therefore be interpreted as a statement of policy, but a central projection based on the inputs and assumptions set out in the box below.

Road Transport Forecasts 2011 – Inputs and Assumptions

- Population and employment data - based on NTEM 5.4.
- GDP Forecasts – 2011-2015 from OBR projections post-Budget 2011, and post 2015 growth from OBR's July 2011 Fiscal Sustainability Report.
- Fuel Prices – based on DECC's October 2011 fossil fuel price projections.
- CO_2 Reduction policies – all policies analysed to meet the first three Carbon Budgets.[26]
- The road network includes investment in forthcoming, future and review schemes agreed during the Spending Review 2010.

[25] The modelling over summer 2011 was used to inform the evidence base behind the baseline scenario within the Governments recently 'The Carbon Plan: Delivering our low carbon future'. see http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/carbon-plan/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf

[26] These road transport CO_2 reduction policies were also included in DECC's Updated Energy and Emission Projections 2011. see http://www.decc.gov.uk/publications/basket.aspx?filetype=4&filepath=11%2fabout-us%2feconomics-social-research%2f3134-updated-energy-and-emissions-projections-october.pdf#basket.
Low Carbon Buses were not originally analysed within the NTM in summer 2011, but are for RTF11. Central forecasts include announced and funded CO2 reducing policies and thus do not include the range of additional emissions abatement potential over the fourth carbon budget period covered in the recently published 'The Carbon Plan: Delivering our low carbon future'. See footnote 26 for link to publication.

Summary of Key Forecasts

4.9 Table 4.1 summarises the key forecasts for a selection of forecast years from 2010 to 2035:

- Between 2010 and 2035 English total traffic is forecast to increase by around 44%, from 261.2 bn vehicle miles in 2010 to 375.6 bn in 2035.
- As traffic demand increases, congestion is also forecast to rise, with seconds per mile lost due to congestion rising from 19.2 seconds in 2010 to 32.3 seconds in 2035.
- Journey times are also forecast to increase, with an average mile taking around 1 min 54 seconds in 2010, but 2 mins 6 seconds in 2035.
- Finally, despite the increase in traffic, road traffic emissions are forecast to fall. CO_2 emissions are forecast to fall by around 9% between 2010 and 2035, with PM_{10} and Nox emissions falling too.

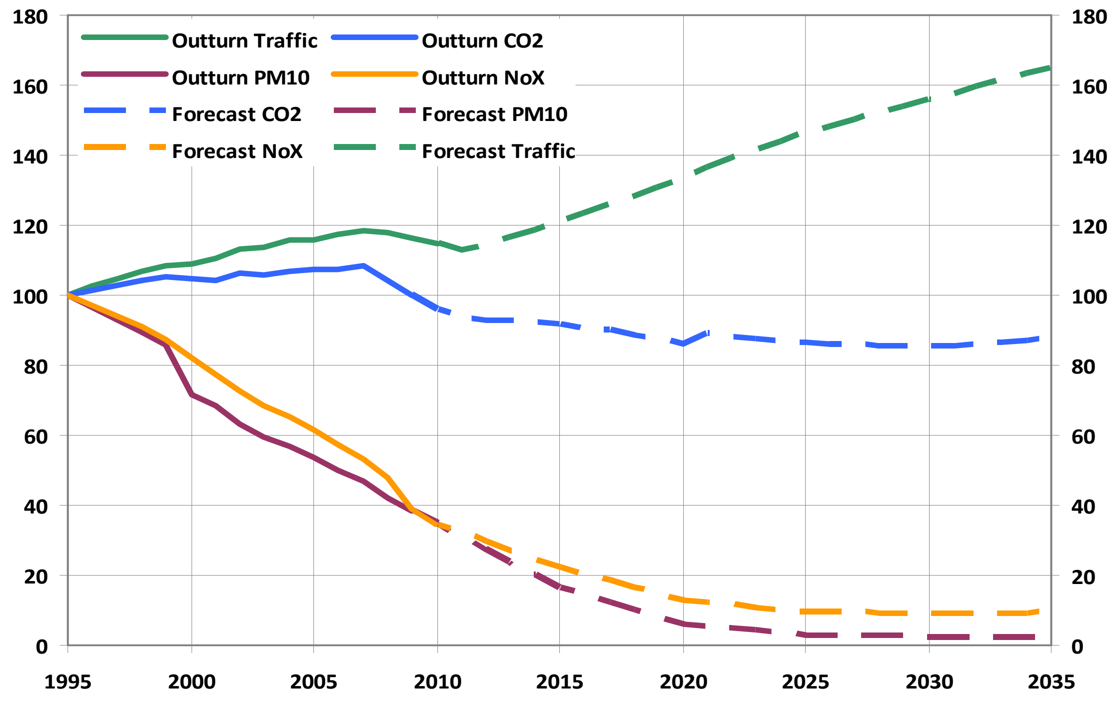
Table 4.1: Summary of Key Forecasts, England

England	Year	Traffic (Bn Vehicle miles)	Congestion (Lost Sec's/mile)	Journey Time (Min/mile)	Road Traffic Total Emissions (M tonnes)		
					CO_2	PM_{10}	NO_X
Central Forecast	2010	261.2	19.2	1.9	88.5	9.8	264.7
	2015	275.9	20.4	1.9	84.4	4.6	168.6
	2020	303.7	23.2	2.0	79.1	1.7	97.7
	2025	333.0	26.4	2.0	79.6	0.8	72.2
	2030	354.7	29.2	2.1	78.4	0.7	69.3
	2035	375.6	32.3	2.1	80.7	0.7	72.9

Source: NTM 2011 - 2010 numbers in table are modelled.

4.10 Figure 4.2 presents the summary traffic and emissions forecasts from Table 4.1 in graphical form, alongside outturn data from 1995. This allows us to compare the forecasts against recent trends.

Figure 4.2: Historic and Forecast Traffic and Emissions, England



Source: NTM 2011, NAEI statistics, Dft statistics

4.11 As Figure 4.2 shows, road traffic and road traffic CO_2 emissions peaked around 2007, after a period of steady growth in both metrics since 1995. After a trough in 2010, road traffic is forecast to return to the growth trend evident before the recession, with steady increases in road traffic to 2035. By 2035 road traffic is forecast to be 44% higher than in the level in 2010. However, despite this increase in traffic, CO_2 emissions are forecast to decline by around 9% from 2010 levels, reflecting the fleet fuel efficiency improvements and use of biofuels. PM_{10} and Nox emissions have been falling since 1995 and this trend is forecast to continue. However, by 2025 declines in these emissions will plateau at significantly lower levels compared to 2010 levels.

Forecast Traffic 2011 by Vehicle Type, Area Type and Road Type

4.12 The NTM can disaggregate its traffic forecasts by the types of vehicles using the road network, as well as area and road types. This allows us to observe where traffic demand is highest, and how this will change over time, and which types of users are using what parts of the road network.

Table 4.2: Forecast Traffic by Vehicle type and Area type, England						
Bn Vehicle Miles	**Year**	**London**	**Large Urban Areas**	**Other Urban Areas**	**Rural Areas**	**All Areas**
Cars	2010	15.1	52.1	42.4	99.0	**208.6**
	2035	20.6	70.2	57.3	137.7	**285.8**
LGV	2010	2.8	8.8	6.4	17.8	**35.9**
	2035	5.1	16.4	12.2	33.7	**67.3**
HGV	2010	0.5	2.9	1.5	9.1	**14.0**
	2035	0.7	4.0	2.1	13.2	**20.1**
Bus & Coach	2010	0.4	0.8	0.6	0.9	**2.7**
	2035	0.4	0.8	0.5	0.8	**2.4**
All Traffic	2010	**18.8**	**64.6**	**50.9**	**126.9**	**261.2**
	2035	**26.8**	**91.4**	**72.0**	**185.4**	**375.6**

Source: NTM 2011 - 2010 numbers in figure are modelled.

4.13 Table 4.2 presents road traffic forecasts by user type and area type for 2010 and 2035.[27] Cars are the dominant road user group across all area types. However, LGVs are forecast to grow at the fastest rate, with LGV traffic forecast to rise by 88% across all area types between 2010 and 2035. Car traffic in contrast is forecast to rise by 37%. HGVs are forecast to increase by 43%, while bus & coach traffic is forecast to fall by around 1%. Total traffic is forecast to rise by roughly the same amount across different area types, with the highest growth (46%) occurring in rural areas, and the lowest (41%) occurring in Other Urban Areas.

4.14 Table 4.3 presents road traffic forecasts by user type and road type.[28] The majority of road traffic takes place on Principal and Other Road types, although the fastest growth in road traffic is forecast to take place on Motorway and Trunk roads, with 49% growth and 46% growth respectively. Across different user types, the distribution of road use differs. The vast majority of Car, LGV and Bus and Coach miles take place on Principal and Other Roads, whilst the majority of HGV miles take place on Motorways.

[27] The London area includes Central, Inner & and Outer London. Large Urban Area includes Inner & Outer conurbations (Birmingham, Manchester, Liverpool, Sheffield, Leeds and Newcastle) and settlements with populations greater than 250,000 individuals. Other Urban Areas includes settlements with populations greater than 10,000 but less than 250,000 individuals.

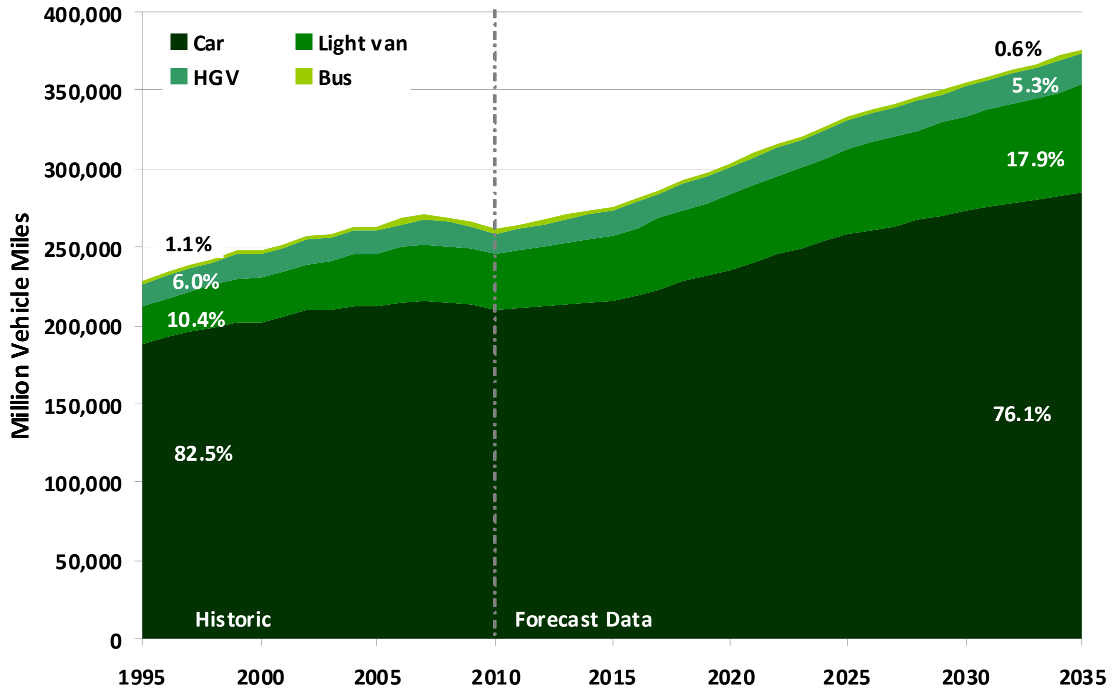
[28] Trunk classification includes Dual & Single A Trunk roads. Principal classification includes Dual & Single A Principal roads. Other Roads includes all B, C and unclassified roads.

Table 4.3: Forecast Traffic by Vehicle type and Road type, England						
Bn Vehicle Miles	**Year**	**Motorway**	**Trunk**	**Principal**	**Other Roads**	**All Roads**
Cars	2010	39.0	24.2	67.8	77.6	**208.6**
	2035	55.6	33.9	91.6	104.7	**285.8**
LGV	2010	6.7	4.1	10.9	14.2	**35.9**
	2035	12.6	7.7	20.4	26.7	**67.3**
HGV	2010	6.0	2.8	3.5	1.8	**14.1**
	2035	8.7	4.0	4.9	2.5	**20.1**
Bus & Coach	2010	0.2	0.2	0.9	1.4	**2.7**
	2035	0.2	0.1	0.8	1.3	**2.4**
All Traffic	2010	**51.9**	**31.3**	**83.1**	**94.9**	**261.2**
	2035	**77.1**	**45.7**	**117.7**	**135.1**	**375.6**

Source: NTM 2011 - 2010 numbers in table are modelled.

4.15 Figure 4.3 presents the vehicle type traffic forecasts alongside outturn data since 1995. The percentage figures on the chart represent the proportion of total traffic in 1995 and 2035 accounted for by Cars, Light Vans, HGVs and Buses. in 1995 Cars accounted for around 83% of total traffic, by 2035 this is forecast to fall to just over 76%. The growth in traffic from 1995 to the onset of the recession, discussed above, is evident, but we can also see that the relative proportions of road users remained relatively constant over this period. In contrast, the forecasts suggest that the growth in LGV traffic will mean that LGVs form a relatively larger proportion of overall road users by 2035.

Figure 4.3: Forecast growth in Traffic by Vehicle Type, England

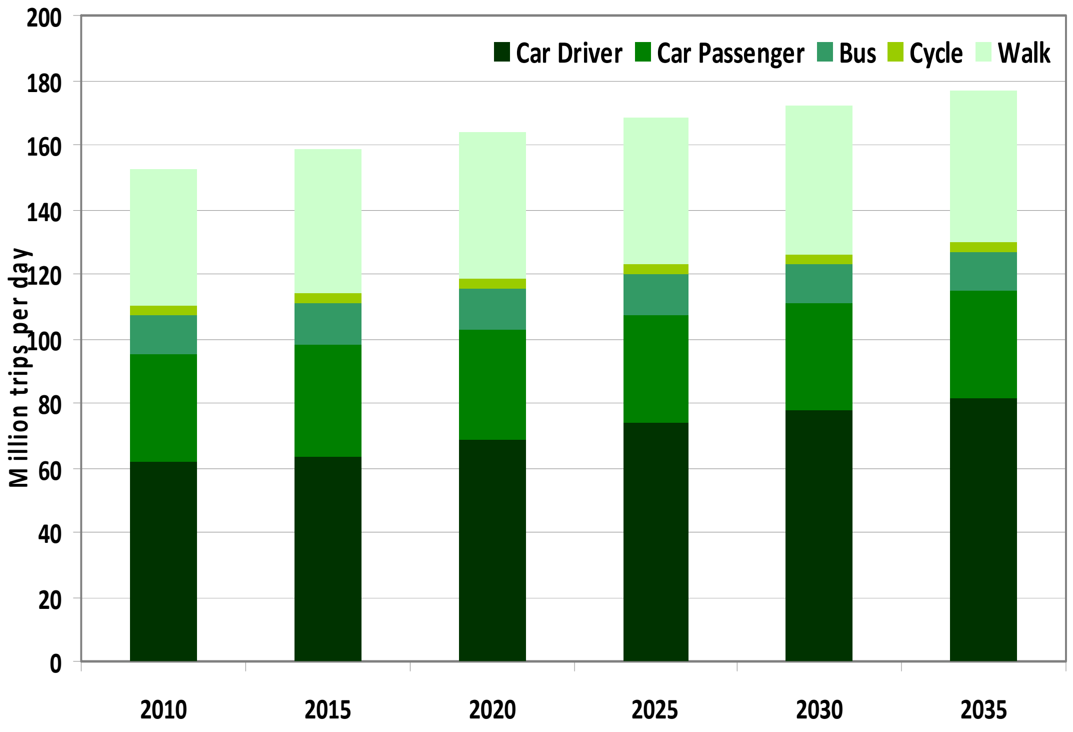


Source: Outturn Traffic Statistics (DfT) and NTM Forecasts

Trip Forecasts by mode and journey purpose

4.16 Figure 4.4 presents the results of trip analysis from the NTM. The number of daily journeys is forecast to grow between 2010 and 2035 by 16%, which is in line with projected increase in population. The growth in car driver journeys is the main driver for this growth with the total number of car trips increasing by around 33% between 2010 and 2035 as the ownership and use of cars rise. The proportion of all daily journeys made by a car driver is forecast to grow from 40% to 46%. Walking journeys are also projected to grow in number.

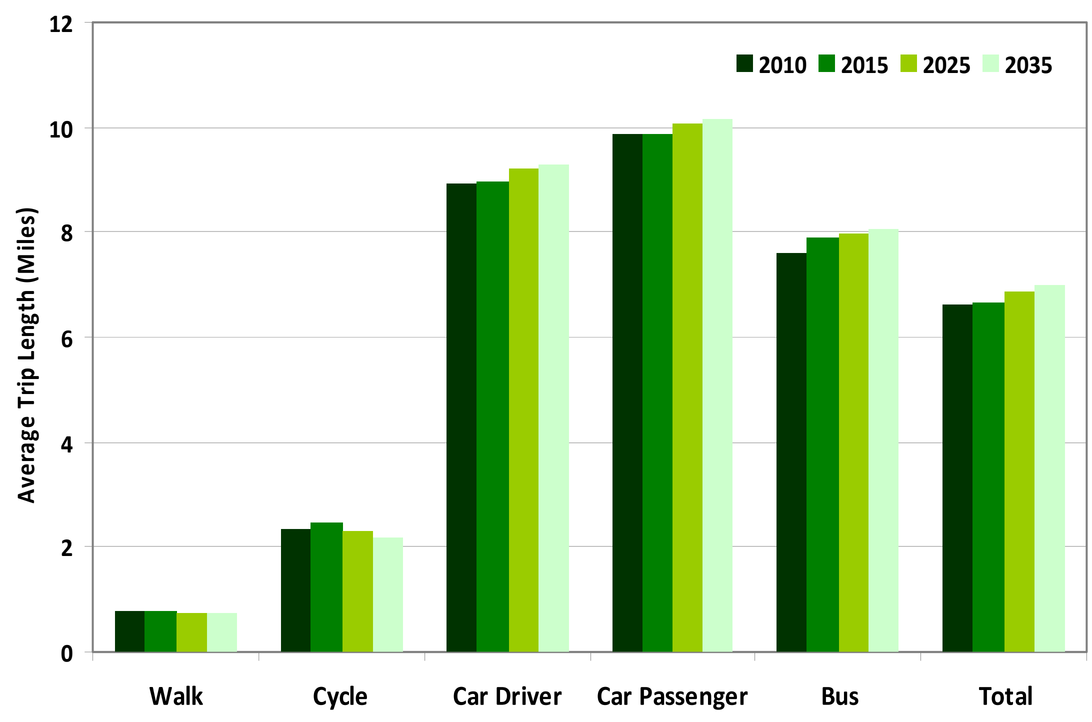
Figure 4.4: Trips per day by mode of travel, England (2010-2035)



Source: NTM 2011 - 2010 numbers in table are modelled.

4.17 Although many daily trips are forecast to be made using non-car modes, in terms of distances travelled, cars are forecast to be the dominant mode. Figure 4.5 illustrates the average distance travelled per trip. On average car trips are much longer than trips using other transport modes, with the average trip length of car passengers longer than the average car driver trips. Walking trips are forecast to be the shortest, as one might expect.

Figure 4.5: Average Trip Length, England (2010-2035)

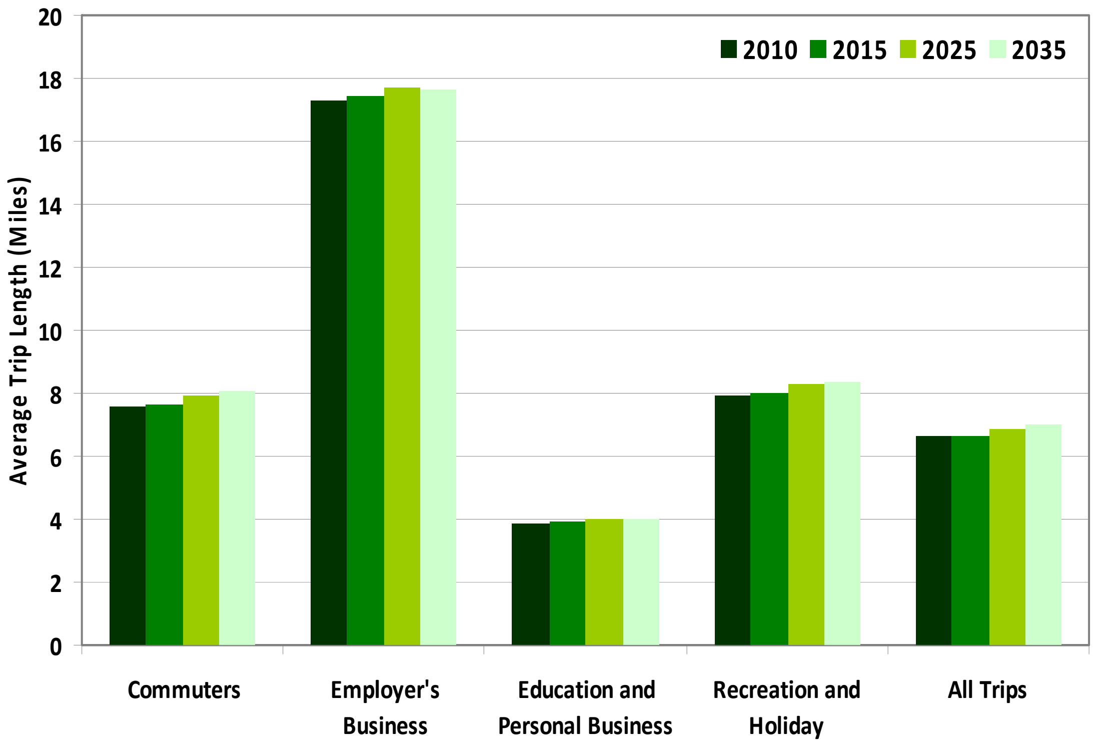


Source: NTM 2011 - 2010 numbers in figure are modelled. Car Passenger average trip distances are longer than Car Driver average trip distances as passenger occupancy rates can be higher than one and average passenger journeys are averaged across total distance and passenger trips.

4.18 In Chapter 3, Figure 3.4 presented National Travel Survey data of car/van driver average number of trips and trip length. This illustrated that when the recession started the average trip length of car journeys remained around the same length but the number of trips fell. Likewise in the forecasts, population is projected to rise by around 18% from 2010 to 2035, but total car trips are projected to rise by 33%. This compares with Figure 3.4 that shows average car driver trip length is forecast to increase by 4% from 2010 to 2035. The majority of the growth in car traffic is therefore expected to come from more car trips rather than increasing trip length.

4.19 Figure 4.6 presents information on average trip length by different journey purposes. There is little change in the average distance travelled over time, although there is a universal trend for trips, of all purpose types, to be slightly longer by 2035 in comparison to 2010. Employer's Business trips are the longest, with Education and Personal Business trips on average being the shortest.

Figure 4.6: Average trip length by journey purpose, England



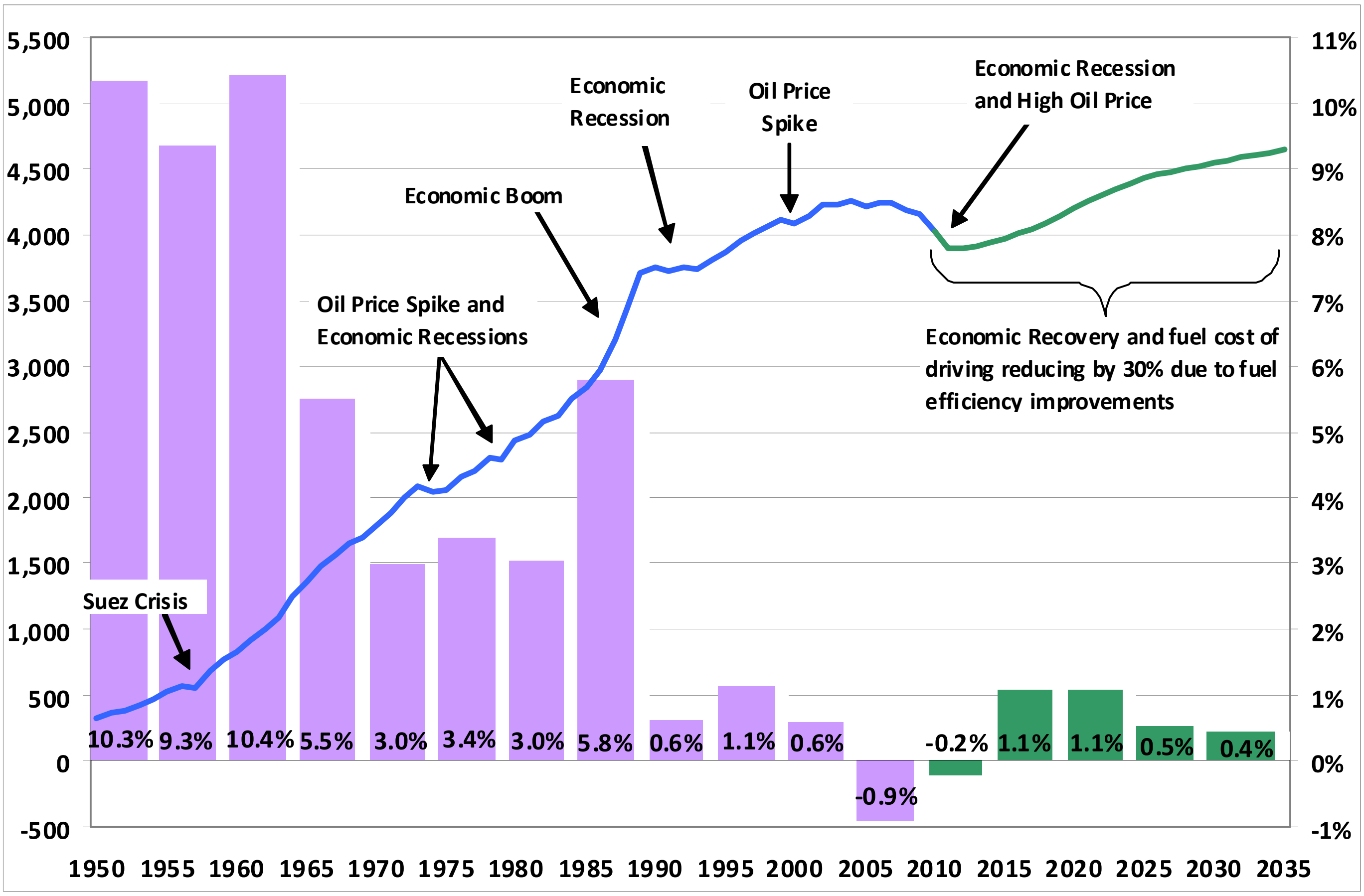
Source: NTM 2011 - 2010 numbers in figure are modelled.

Box 1: Has the Demand for Car Travel Saturated?

Figure 3.4 in chapter 3 illustrated that in the last few years individual's growth in car travel demand in miles per car/van driver has either been static or fallen. Does this suggest that individual's car travel demand has now saturated?

To answer this, we can consider whether the key drivers of road transport demand can explain the recent trends. One approach to this is to look historically at any other times when there has been a fall or no growth in car travel demand and consider what possible outside drivers may have caused this. The figure below illustrates the average miles per person travelled in a car from 1950 to 2010 and compares this with our central forecast to 2035 (represented by the line on the chart). The line represents average miles per person rather than by car/van driver so the rise in vehicle availability and proportion of the population with driving licenses and access to a car will also have a positive impact. The bars in the chart illustrate the average annual growth rate in car demand for each five years over this period - for instance, between 1950 and 1955 the average growth in car miles per person was 10.3%.

Car miles per person (with 5 year annualised growth rates)



Source: DfT analysis

One can see 1950-1965 saw high growth in individual car travel demand of around 10% per year. This can be explained through rises in incomes and car ownership growing at nearly 10% per year. After this period though we can see a general decline in the growth of car travel demand, except during the economic boom of the late 1980s, with periods where the car travel growth was either static or negative.

Historically, static growth or falls in car miles per person correlate with periods of high oil prices or economic contractions. This is specifically seen during fuel rationing of 1957, twice during the 1970s where there were spikes in the oil price and economic recessions, during the recession of the early 1990s and in the year 2000 when fuel prices increased by over 10%.

The trends in travel since 2000 can mainly be explained using the macroeconomic key drivers. The figure shows that there was growth in car miles per person in 2001 and 2002 as fuel prices fell, but then static growth to 2007 as fuel prices rose by 13%. Since 2008 we have experienced high and volatile oil prices combined with either weak growth in GDP or large economic contractions. This is confirmed by a second approach, which is to apply the key drivers, within the NTM, from 2003 to 2010. The result, shown earlier in Figure 4.1 is that the key drivers explain the recent trend in traffic growth.

Looking forward, the central forecast projects that car demand per person will begin to grow once again as the economy recovers, averaging 1.2% from 2015-2025, similar to the late 1990s. However after this, it is projected that travel demand will continue to grow but at a slower rate, on average 0.6% per annum between 2025-2030 and 0.4% per annum between 2030-2035. The projections, therefore, do not suggest that individuals demand will continue to grow to the same degree as the past. The projections show car travel growing but at a declining rate, the income and price impacts on car demand are projected to fall over time as car ownership growth continues to slow and the demographic composition of the population changes.

Congestion

4.20 With constrained road space, increasing traffic creates greater congestion. Congestion here is measured in 'lost time' – the difference in journey time between modelled and 'free flow' speeds. The NTM forecasts where congestion problems may arise by comparing traffic demand with road capacity. The congestion forecasts presented below assume a road network including investment in forthcoming, future and review schemes agreed during the Spending Review 2010. They therefore represent forecasts of what would happen if no further road investments were made beyond those set out during SR 2010 and should not be interpreted as a statement of policy.

Table 4.4: Traffic and Measures of Delay, England

England (2010 modelled)	Year	London	Large Urban Areas	Other Urban Areas	Rural Areas	All
Traffic (Bn Vehicle miles)	2010	18.8	64.6	50.9	126.9	**261.2**
	2035	26.8	91.4	72.0	185.4	**375.6**
Congestion (Lost Sec's/Mile)	2010	83.5	30.3	19.4	4.0	**19.2**
	2035	140.9	51.6	29.5	8.1	**32.3**
Vehicle Speed (Miles/hour)	2010	16.0	25.0	26.3	49.2	**31.6**
	2035	12.8	21.8	24.5	46.8	**28.5**
Proportion of all traffic travelling in very congested conditions[29]	2010	24%	14%	9%	2%	**8%**
	2035	42%	24%	17%	9%	**17%**

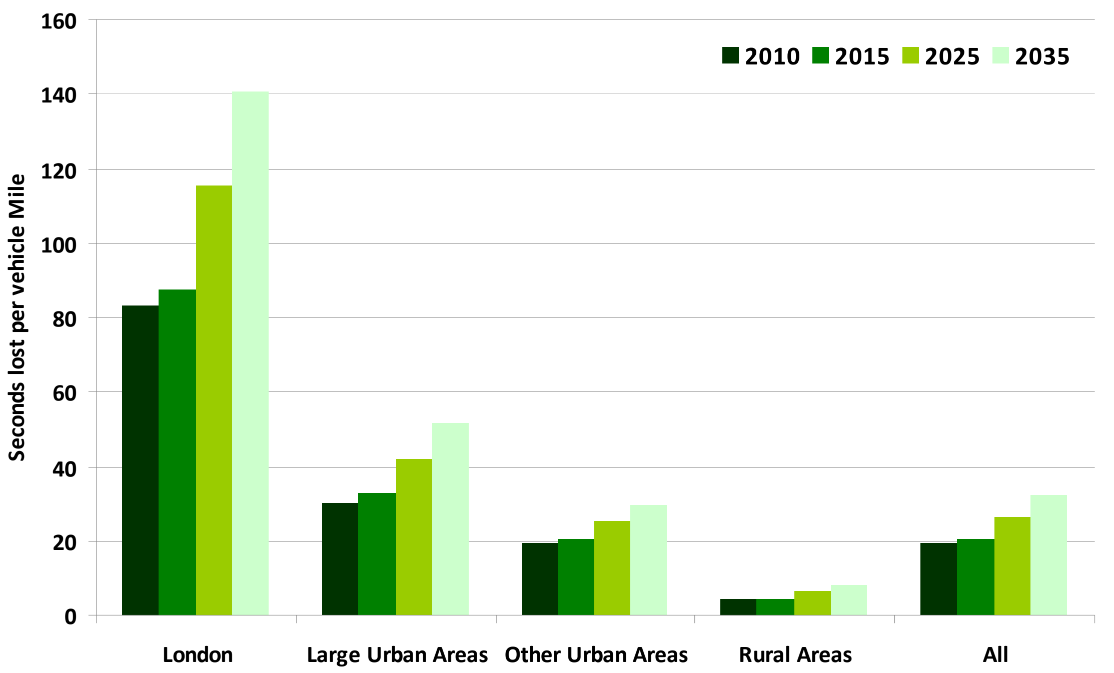
Source: NTM 2011 - 2010 numbers in table are modelled.

4.21 Table 4.4 presents a number of metrics to forecast the congestion impacts across different area types. Congestion is most evident in London, with around 83 seconds per mile lost to congestion in 2010 and 24% of all journeys travelling in very congested conditions. By 2035 42% of all journeys would be in very congested conditions and roughly 151 seconds per mile would be lost to congestion. Across all areas only 17% of all journeys would be in very congested conditions in 2035 and only 33 seconds per mile would be lost to congestion. Congestion is of least concern in rural areas, with only 9% of journeys in very congested conditions in 2035 and only 8 seconds per mile lost. Average speeds in rural areas are also higher than in other areas. Average speeds across all areas are forecast to fall from 2010 levels, reflecting the higher congestion.

[29] Traffic travelling in conditions above 80% of theoretical capacity.

4.22 Figure 4.7 presents the seconds lost per vehicle mile in graphical form. The number of seconds lost to congestion is forecast to rise across all areas between 2010 and 2035, with the fastest growth taking place in rural and large urban areas, although in the former's case, from a relatively low base. Congestion is most evident in London and in absolute terms the increase in seconds lost due to congestion by 2035 is forecast to be largest in London. Despite the growth, seconds lost per mile in Large Urban Areas in 2035 is still forecast to be lower than the seconds lost in London in 2010.

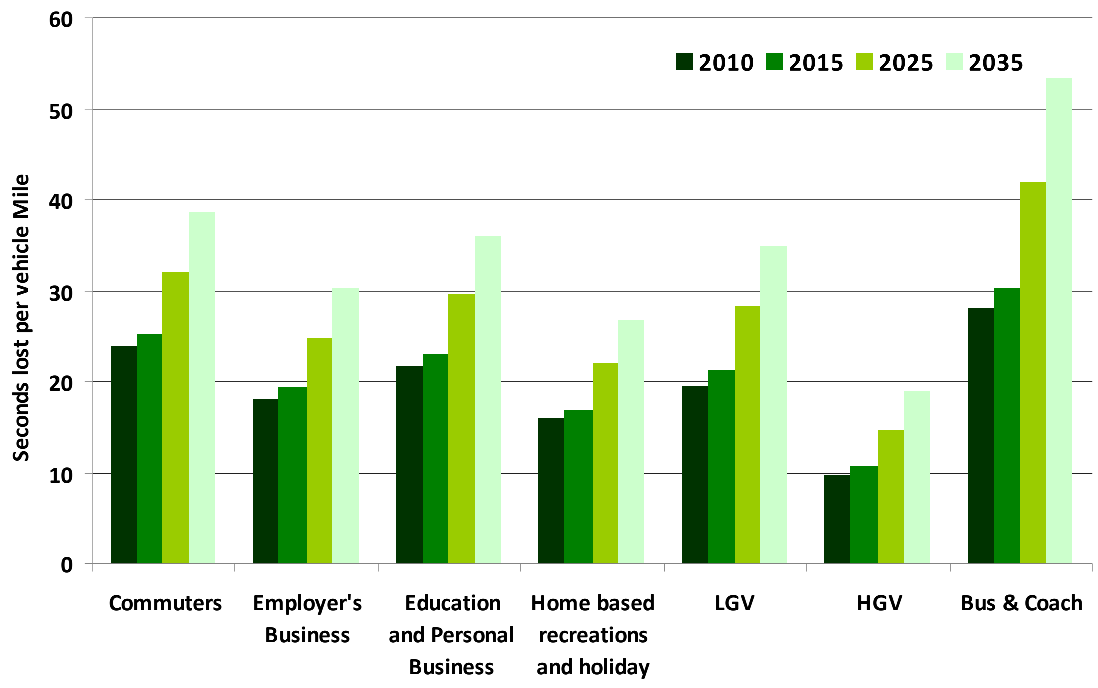
Figure 4.7: Congestion by Area Type, England



Source: NTM 2011 - 2010 numbers in figure are modelled.

4.23 Figure 4.8 presents time lost to congestion by journey purpose. Travel taking place at peak hours, such as Commuter, Education and Personal Business travel, loses the most time to congestion, with recreational travel losing the least. These trends are forecast to continue up to 2035. Congestion to Bus and coach travel appears disproportionately high as the majority of these journeys take place in the London region.

Figure 4.8: Time lost per vehicle mile by journey purpose for freight and car traffic, England



Source: NTM 2011 - 2010 numbers in figure are modelled.

Emissions

4.24 The reduction of CO_2, Nox and PM_{10} emissions is a domestic and international policy aim. The NTM allows us to forecast the impact of changing traffic demand, policy and technological advancement on these emissions. The CO_2 forecasts presented below assume no further CO_2 emission reducing policies for road transport beyond those announced to meet the first three carbon budgets. They therefore represent what would happen if no further CO_2 emission reducing policies were introduced beyond those to meet the first three carbon budgets and should not be interpreted as a statement of policy.

4.25 There has been some significant change to the CO_2 reducing measures included in the central forecast from RTF09 to RTF11. RTF09 assumed improvements in car fleet fuel efficiencies due to EU new car CO_2 regulations for 2015 (130gCO_2/km) and 2020 (95gCO_2/km). RTF11 continues to assume that these regulations will be met but also includes impacts on car fleet fuel efficiency from complementary measures implemented through EU regulations which includes gear shift indicator lights, low rolling resistance tyres, tyre pressure monitoring systems and fuel efficient air conditioning systems.[30]

4.26 In RTF09 it was assumed that there would be some spillover fuel efficiency improvements in the van fleet due to the EU new car CO_2 regulation. In RTF11 we assume improvements in van fleet fuel efficiencies due to EU new van CO_2 target met in 2017 (175g CO_2/km) and in 2020 (147g CO_2/km). [31]

4.27 For HGVs RTF11 assumes that industry led action leads to 5% improvement in HGV efficiency over 5 years in addition to improved efficiencies from the roll out of Low Rolling Resistance Tyres (LRRT) for HGVs due to EU regulation.[32]

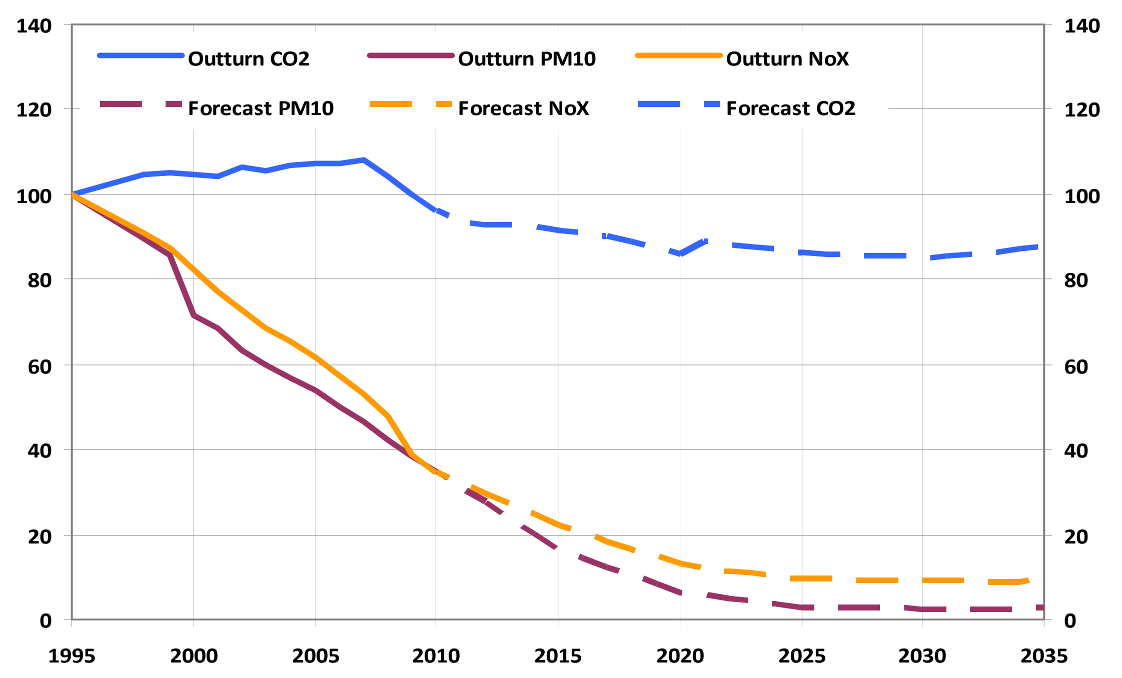
4.28 For RTF09 biofuel use in road transport was assumed to increase to and remain at 10% by energy from 2020 to 2035. RTF11 assumes an achievement of 8% fuel share by energy by 2020 and then from 2021 the use of biofuel reverts back to the Renewable Transport Fuel Obligation level of 5% by volume. This change is for modelling purposes only and does not imply any change in policy or in government commitment to renewables.

4.29 Within RTF11 it is assumed that the Local Sustainable Transport Fund reduces urban car trips by around 2% in 2015 with decay in impact over time. It is also assumed that there is an expanded use of Low Carbon buses within London, further reducing CO2 emissions from road transport.

4.30 Figure 4.9 presents the outturn data and forecasts for CO_2, PM_{10} and Nox. For the latter two the NTM forecasts a continuing downward trend until 2025, in line with historical precedent. After 2025, PM_{10} and Nox emissions are projected to plateau, at significantly lower levels compared to those observed in 2010. Up to 2020 CO_2 emissions are also projected to decline, although at a slower rate. In 2021 there is an increase as the model adjusts for an assumption about the future biofuels fuel mix. After this increase CO_2 emissions are forecast to remain relatively constant. By 2035 this would imply an 8% reduction on 2010 levels, although there would be a 44% increase in traffic across the same period.

[30] See chapter 3 for more details on the fuel efficiency assumptions.
[31] Ibid
[32] Ibid

Figure 4.9: Tailpipe CO_2, NO_X and PM_{10} Transport Emissions: History and Forecast, England (indexed 1995=100)



Source: NTM 2011, NAEI statistics.

Other Government Forecasts of Transport CO_2

4.31 Within Government, forecasts of CO_2 emissions from transport are produced both by the DfT and by the Department of Energy and Climate Change (DECC). These forecasts are produced by two separate models, the DfT's NTM and the DECC UK Energy Model.

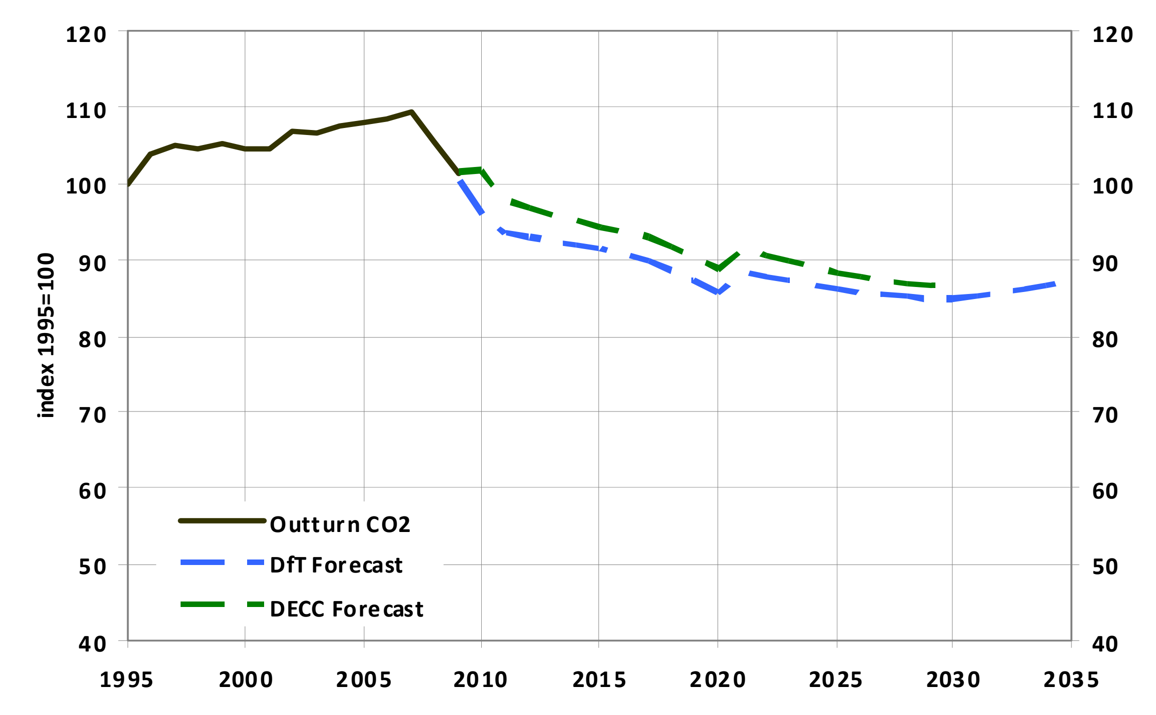
4.32 The DECC Energy Model is a time series top-down model that directly forecasts energy use and emissions for all sectors across the United Kingdom including transport. The DECC model provides for consistent whole economy modelling of energy use and associated emissions, of which transport is a part. Such a model is needed for the purposes of cross-Government strategies.

4.33 The NTM uses a bottom-up approach starting from data on the trips that people make and distinguishing between area, person and household types as well as including a representation of the road network. Emissions are derived from the type of vehicles and the average speed they are forecast to be travelling at. The DfT model allows for a greater level of detail in modelling the transport sector specifically and is better suited to the modelling of a range of transport policies.

4.34 Due to the different nature and purpose of the two models, we would not expect identical forecasts. Nevertheless, there are a number of significant common assumptions between the two models. For example, assumptions on economic growth, fuel prices, vehicle fuel economy, population, cars per household, and the CO_2 impact of biofuels are the same in both models. Also, for the recent October 2011 update in DECC projections there were adjustments to the transport demand equation to align more with DfT's projection methodology.

4.35 The latest projections from the DECC model were published in the updated energy and CO_2 emissions projections in October 2011[33]. NTM forecasts are only available at a Great Britain level, whereas DECC forecasts are published on a UK basis. In order to compare these DECC forecasts both need to be indexed. Figure 4.10 compares these projections along with the trend in actual UK road transport CO_2 emissions from 1995 to 2009. One can see that both models follow a similar path from 2009 through to 2030, but there is just a difference in the starting year estimate.

Figure 4.10: Comparison of DfT (GB) & DECC (UK) Transport CO_2 Forecasts (indexed 1995=100)



Source: NTM 2011 & DECC

[33] Available at http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx

Summary of Changes from Road Transport Forecast 2009

4.36 Updated input values and changing policy environment will mean road traffic forecasts will have changed from the 2009 published figures. Table 4.5 compares the RTF11 forecasts to those published in 2009, to observe how the department's forecasts have changed. The 2009 forecasts presented forecasts in terms of percentage changes from a 2003 baseline. For the purposes of comparison, the RTF11 forecasts have been converted into percentage changes from the 2003 baseline also.

4.37 The updated forecasts imply that traffic would be higher than previously forecast in 2025 and 2035. Congestion and journey times are also projected to be higher. In RTF11, CO_2 emissions are forecast to be lower but do not reduce as far as in RTF09. In contrast however, PM_{10} and NO_x emissions are projected to fall significantly.

Table 4.5: Summary of changes to key forecasts, England from 2003 base

Year	RTF Version	Traffic (Vehicle mile)	Congestion (Lost time/mile)	Journey Time (time/mile)	Road Traffic Total Emissions		
					CO_2	PM_{10}	NO_X
2015	RTF 2009	7%	6%	1%	-11%	-55%	-60%
	RTF 2011	6%	4%	1%	-13%	-72%	-68%
2025	RTF 2009	25%	27%	4%	-22%	-50%	-59%
	RTF 2011	29%	34%	6%	-18%	-95%	-86%
2035	RTF 2009	43%	54%	9%	-22%	-41%	-54%
	RTF 2011	45%	64%	11%	-17%	-96%	-86%

Source: NTM 2011 & NTM 2009

5. Sensitivity Analysis

Summary

5.1 This chapter contains the results of sensitivity and scenario tests on the key input variables.

5.2 Evidence-based forecasting involves making assumptions about the outturn of key drivers of transport activity. Inevitably there are uncertainties around how these drivers will change in the future. As in the 2009 publication, the various sensitivity tests are combined into scenarios resulting in higher and lower overall transport demand. This provides a forecast fan around the central forecast. In a similar way, a forecast fan for road transport CO_2 emissions has been generated.

5.3 Scenarios that combine departures from the central scenarios for several variables are presented in this chapter because the impact of varying several assumptions together will be greater than the impact of varying one at a time i.e. the changes compound each other. Scenarios therefore provide a truer picture of the overall sensitivity of the forecast to a reasonable range in the key drivers.

High and Low Demand

5.4 The central assumed level of growth and the variation in the key measures considered are detailed in Table 5.1.

Table 5.1: Input sensitivities used in forecast sensitivity analysis	
Input	**Sensitivity**
GDP	In the low demand scenario, GDP growth is assumed to grow in line with OBR's low productivity scenario in their July 2011 Fiscal Sustainability Report[34]. In the high demand scenario, GDP growth is assumed to grow in line with OBR's high productivity scenario.
Oil Prices	For the low demand scenario the DECC's high oil price scenario was used. For the high demand scenario the low oil price scenario was used.
Fuel Efficiency	For cars and vans higher/lower efficiency projections have been used that begin post-2020 (after the EU regulations are met) reaching a sensitivity band of +/-12.5 in 2035. For HGVs and buses & coaches these higher/lower fuel efficiency projections begin post 2010. For the low demand scenario the lower fuel efficiency improvement projections are used. For the high demand scenario the higher fuel efficiency improvement projections are used.

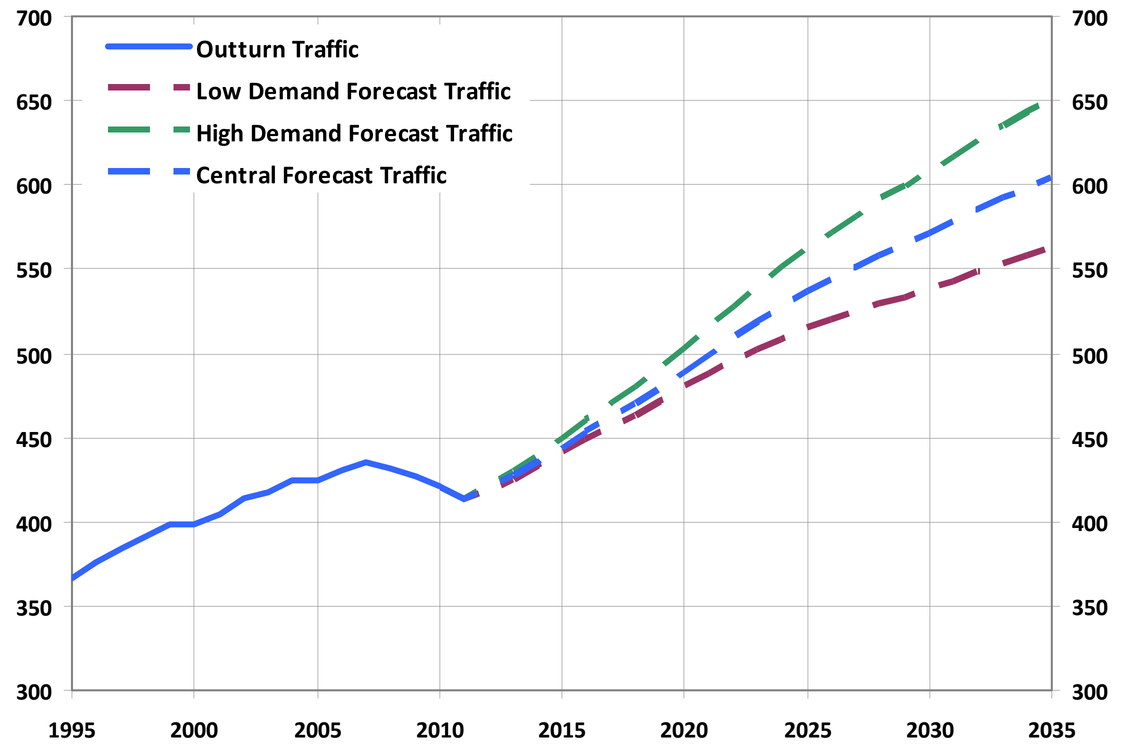
5.5 For the purpose of assessing the maximum variation around the central forecast, we model scenarios based on a combination of these sensitivities. The high demand scenario combines high GDP, low oil prices and high fuel economy improvements. Each of these assumptions cause demand for transport to rise faster than the central case. The low demand case assumes low GDP, the high oil price and a low fuel economy setting.

5.6 Figure 5.1 presents the High and Low traffic demand forecasts up to 2035, alongside the central scenario and outturn traffic data from 1995. Unsurprisingly, the scenarios imply a progressively larger fan around the

[34] http://budgetresponsibility.independent.gov.uk/fiscal-sustainability-report-july-2011/

central traffic scenario, with the low demand forecast around 7% lower than the central forecast in 2035 and the high traffic demand forecast around 8% higher. Relative to 2010, traffic emissions rise by 34% under the low demand scenario by 2035, 44% under the central scenario and 55% under the high demand scenario. Thus even in the low demand scenario road traffic is projected to rise.

Figure 5.1: Central, High and Low 2035 Traffic Forecasts, England



Source: NTM 2011 & Dft Statistics.

5.7 Table 5.2 presents the summary forecasts presented in Chapter 4, for the High and Low demand scenarios. The traffic forecasts are presented in Figure 5.1, but the table also shows the impact of the scenarios on congestion and emission forecasts. Journey times (at the presented level of accuracy) do not vary significantly across the different scenarios. However, seconds lost due to congestion in 2035 are forecast to be 15% higher in the high demand scenario, relative to the central scenario, and 11% lower in the low demand scenario. In terms of emissions the high demand scenario actually implies lower CO_2 emissions relative to the central scenario, and the low demand scenario higher emissions, both by 4% respectively.

Table 5.2: Summary results of high and low demand scenarios, England								
England	Scenario	Traffic (Vehicle Miles)	Congestion (Lost Sec's/Mile)	Journey Time (Min's/Mile)	Road Traffic Total Emissions (m tonnes)		
					CO_2	PM_{10}	NO_X
2010 (modelled)		261.2	19.2	1.9	88.5	9.8	264.7
2015	Low Demand	274.1	20.3	1.9	84.4	4.6	167.7
	Central	275.9	20.4	1.9	84.8	4.6	168.6
	High Demand	279.4	20.7	1.9	84.8	4.7	170.3
2025	Low Demand	319.6	24.8	2.0	80.0	0.8	69.0
	Central	333.0	26.4	2.0	79.6	0.8	72.2
	High Demand	349.2	28.5	2.0	79.5	0.8	76.1
2035	Low Demand	349.8	28.7	2.1	83.8	0.6	67.4
	Central	375.6	32.3	2.1	80.7	0.7	72.9
	High Demand	405.0	37.2	2.2	77.4	0.7	79.9

Source: NTM 2011 - 2010 numbers in table are modelled.

High and Low CO_2

5.8 Those assumptions that reduce the amount of CO_2 have been combined, namely all the settings for the 'low demand' scenario, except for the fuel economy settings, where the high fuel economy setting is used. While high oil prices and low fuel economy both make driving more expensive and, therefore, reduce demand, the lowest CO_2 emissions are achieved when high fuel prices are matched with high fuel economy settings. The reduction in emissions per kilometre more than offsets the higher demand arising from the higher fuel economy improvements.

5.9 The high and low CO_2 scenarios presented here do not represent the maximum potential range around future CO_2 emissions or include all potential CO_2 reducing policies for road transport[35]. The scenarios presented are purely a combination of the input sensitivities outlined in paragraph 5.4 above that create high/low CO_2 projections to give a range around the central forecast.

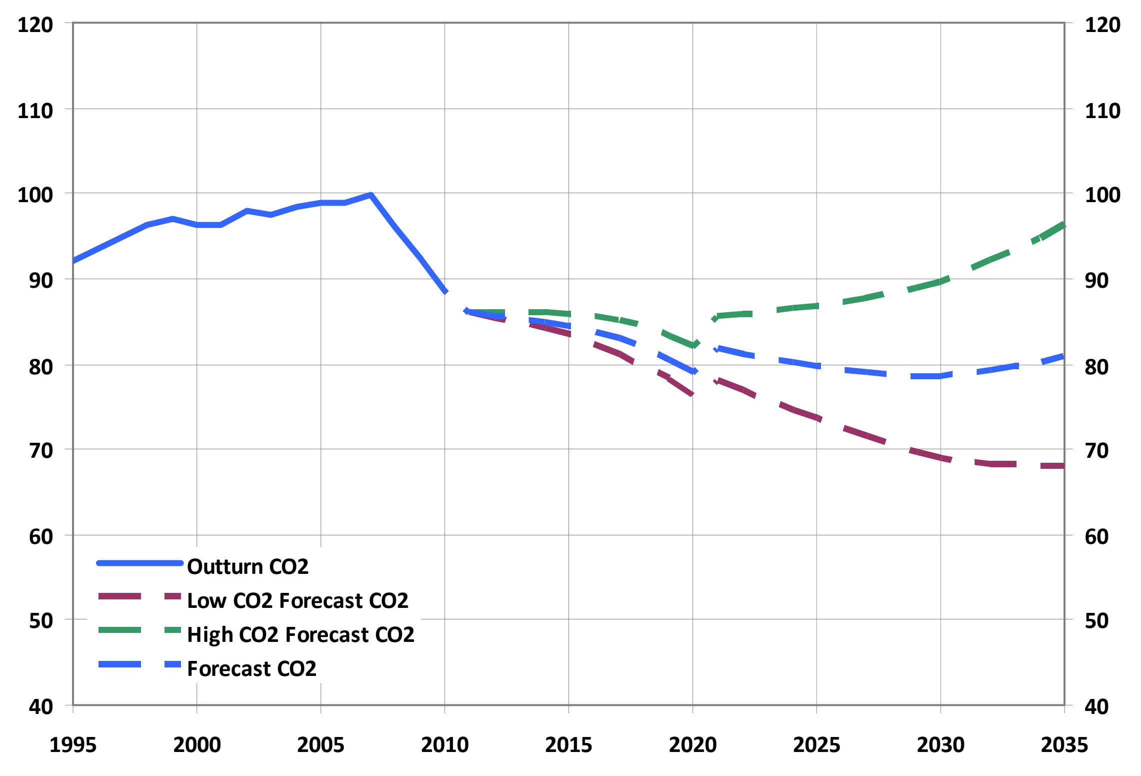
5.10 Figure 5.2 presents the CO_2 forecasts under the different CO_2 scenarios. Again they suggest a fan around the central scenario, with CO_2

[35] A range of additional CO_2 emission abatement over the fourth carbon budget period is covered in the recently published 'The Carbon Plan: Delivering our low carbon future'. See footnote 26 for link to publication.

emissions in 2035 forecast to be 19% higher, relative to the central scenario, under the high CO_2 scenario, and forecast to be 16% lower under the low scenario. Relative to 2010 levels, the low CO_2 scenario implies CO_2 emissions falling 23% by 2035, while they rise by 9% by 2035 in the high CO_2 scenario.

5.11 Table 5.3 presents the summary information for the high and low CO_2 scenarios. Aside from the CO_2 emissions discussed above, the high CO_2 scenario forecasts higher traffic levels than in the central scenario (4% by 2035), and conversely the low CO_2 scenario lower levels (3% by 2035). As a result congestion is forecast to be higher under the high CO_2 scenario and journey times are longer.

Figure 5.2: Central, High and Low CO_2 Forecasts, England



Source: NTM 2011 & NAEI statistics.

Table 5.3: Summary results of high and low CO_2 scenarios, Englan							
England	Scenario	Traffic (Vehicle Miles)	Congestion (Lost Sec's/Mile)	Journey Time (Min's/Mile)	Road Traffic Total Emissions (M tonnes)		
					CO_2	PM_{10}	NO_X
2010 (modelled)		261.2	19.2	1.9	88.5	9.8	264.7
2015	Low CO_2	274.1	20.3	1.9	83.4	4.6	167.9
	Central	275.9	20.4	1.9	84.8	4.6	168.6
	High CO_2	279.4	20.7	1.9	85.8	4.7	170.0
2025	Low CO_2	325.4	25.4	2.0	73.4	0.8	70.2
	Central	333.0	26.4	2.0	76.9	0.8	72.2
	High CO_2	344.5	27.9	2.0	86.7	0.8	74.9
2035	Low CO_2	366.1	30.8	2.1	67.9	0.7	70.4
	Central	375.6	32.3	2.1	80.7	0.7	72.9
	High CO_2	392.4	35.1	2.2	96.3	0.7	77.0

Source: NTM 2011 - 2010 numbers in table are modelled.