Road Transport Forecasts 2013

Results from the Department for Transport's National Transport Model

Executive Summary

Road Transport Forecasts 2013 presents the latest results from the Department for Transport's National Transport Model (NTM) for traffic demand, congestion and emissions in England up to 2040.

The NTM is designed to forecast long-term trends (currently 2010 to 2040 in five year intervals) rather than individual years. The NTM Road Traffic Forecasts should not be viewed as what we think will actually happen in the future, or what we want the future to look like. The forecasts are what may happen, based on:

- Our current understanding of how people make travel choices
- The expected path of key drivers of travel demand
- Assuming no change in government policy beyond that already announced.

The three key drivers for road traffic on the strategic road network are population, income and the fuel costs. Between 2010-2040 the population in England is expected to rise by 20%, GDP per capita is projected to rise by 57% and the fuel cost of driving is projected to fall by 28%.[1]

Road traffic on the SRN is forecast to return to the growth with the recovery of the economy. By 2040 road traffic is forecast to be 46% higher than in 2010, implying an increase in congestion (measured as lost time) of about 114%.

Despite this increase in traffic, CO_2 emissions are forecast to decline by around 15% from 2010 levels, reflecting fleet fuel efficiency improvements and use of bio-fuels.

The rest of the annex is structured as follows:

- Section 1 gives an overview of the nature of transport demand and discusses the key drivers of travel demand.
- Section 2 Explains why there is uncertainty involved in forecasting road traffic, what the sources are and we take these into account.
- Section 4 presents the forecasts of road traffic in England through to 2040 for a number of demand scenarios.
- Section 5 presents the forecasts of road congestion in England through to 2040.
- Section 6 presents forecasts of road transport CO2, NoX and PM10 emissions in England through to 2040.

[1] Source: ONS 2008 Principal Projection, OBR Budget 2013 and DECC/DfT respectively.

1. Key Drivers of travel demand

What is Transport Demand?

1.2 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. 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.

1.3 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's a result of factors that influence people's decision making and which, in aggregate, determine its size and pattern.

Why does transport demand matter?

1.4 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.

1.5 Transport demand also generates wider negative outcomes, such as climate change emissions, air quality problems, noise 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.

1.6 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?

1.7 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:[2]

[2] 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.

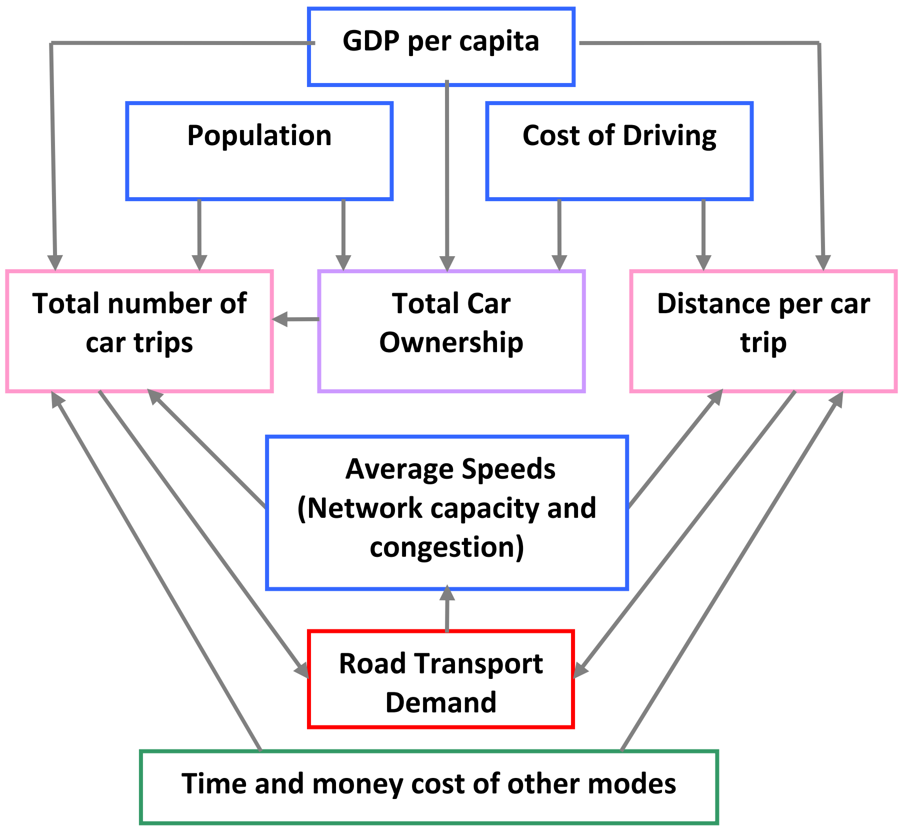
- **Whether to travel (generation/frequency)** – the individual decides whether the purpose for the journey is sufficiently worthwhile. The aggregation of all individuals' micro decisions determines the total number of trips.
- **Where to travel to (destination)** – this choice is determined and constrained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

1.8 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 specific modes or preferences around convenience, safety, social acceptability or other characteristics – that influence their choices.

The three key drivers of travel demand

1.9 Demand for road travel is driven by 'macro' factors, like population, demography, economic growth, money cost of driving. Demand is also driven by more 'micro' influences on individuals' decision-making such as time costs and personal circumstances and preferences. These drivers of demand are constrained by network capacities and performance limitations (which put people and businesses off transport they would otherwise have used). Figure 1 illustrates how the three key drivers of road travel demand impact road transport demand and the rest of this chapter discusses each of these key drivers in more detail.

Figure 1: Key drivers' relationship to road transport demand



Population

1.10 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 trips.

1.11 In the forecasts for car travel demand the population in England is assumed to rise by around 20% (or 10.5 million people) from 2010 to 2040, putting substantial additional pressure on road infrastructure. The low population projection assumed a rise of 10% and the high a rise of 30%.[3] The projection population is produced by the Office of National Statistics (ONS). The modelling presented here uses the ONS 2008 Principle Population projections which are the basis of DfT's detailed population and demographic projections, NTEM 6.2, produced in 2011. In time it will be updated to a more recent set of projections. The forecasts also include a set of high and low

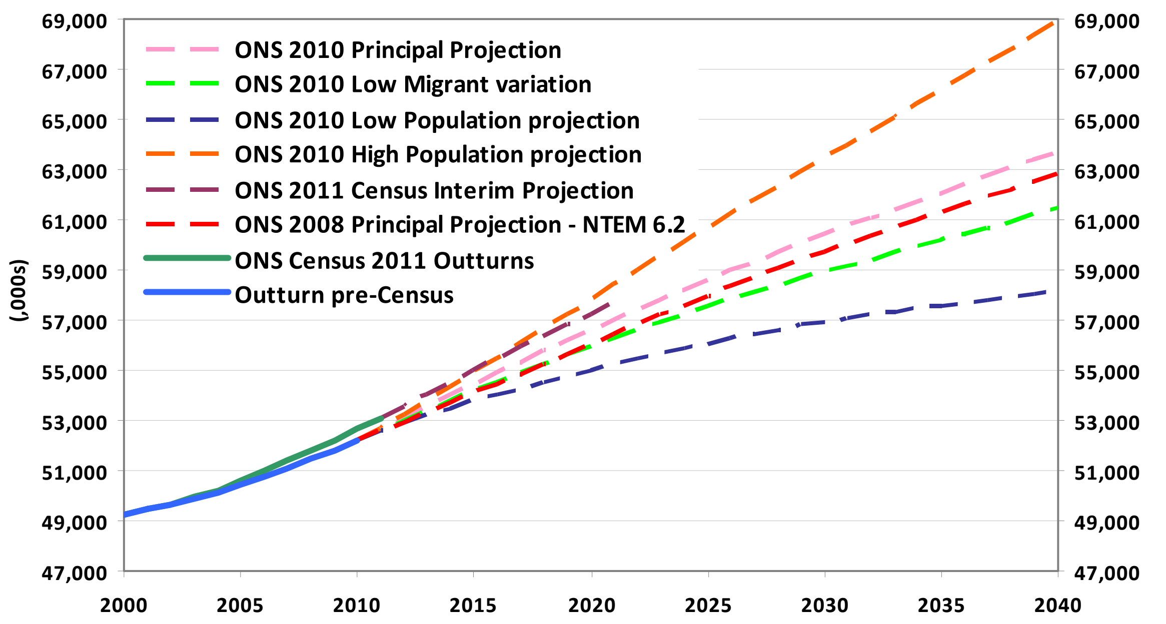
3 The modelling of future trip rates and car travel demand uses the ONS 2008 Principal Population projections which are the basis of DfT's detailed population and demographic projections, NTEM 6.2, produced in 2011. For forecasts of commercial vehicle traffic growth (Light Goods and Heavy Goods vehicles) the ONS 2010 Low Migrant Variant population projection was used to be in line with the OBR's projection of economic growth. High and Low population projections are also from the ONS and are based on assumption variants of assumptions on population birth rates, life expectancy and net migration. See http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Population+Projections

road traffic demand scenarios which use the ONS 2010 high and low population projections.

1.12 The ONS have since produced a new set of 2010 population projections and based on analysis of the 2011 Census an interim set of population projections to 2021. The Office for Budget Responsibility (OBR) and the Department for Energy and Climate Change (DECC) have recently used the ONS 2010 Low Migrant Variant population projection for their forecasts of economic and energy consumption growth.

1.13 Figure 2 below plots the different population projections, highlighting the difference between the population projections used by OBR and DECC, and the one used in NTEM 6.2. The ONS 2008 Principle Population projects higher population than compared to the 2010 Low Migrant Variant, but lower than the 2010 ONS Principal Projection. Furthermore results from the 2011 Census interim projections, going up to 2021 show a higher level of population than any of the previous ONS projections. Population in the 2011 Census interim projections is projected to rise 8.6% in 2011-2021 versus 7.3% in the 2008 ONS Principle Projection used for these forecasts. Therefore, the forecasts presented may be using a lower population projection than the most recent ONS projections would suggest. Figure 2 below also includes the high and low population used for the low/high Demand forecasts presented later.

Figure 2 : ONS Population projections comparison ('000s)



1.14 Demographics within a population can also play a significant role in transport demand, in terms of age and household size. In particular population ageing will decrease number of trips, as elder people tend to make less trips. The forecasts assume that the proportion of population that is aged 65+ rises from 16% in 2010 to 23% in 2040.

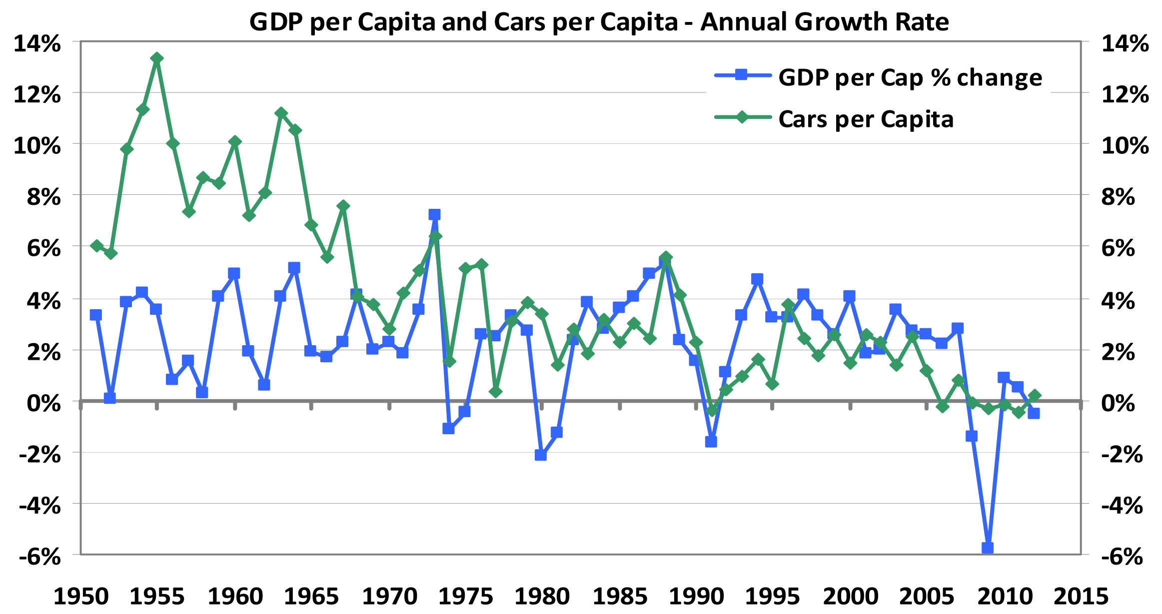
Economic Growth

1.15 Increases in GDP per capita mean individuals will have more disposable income, increasing general demand for goods and services. As people are better off they may also spend a share of their increased income on road transport through purchasing and using a car. Moreover, as economic activity increases because of higher consumption levels, road transport demand is also likely to increase in order to allow for additional production and distribution of goods and services through commercial freight vehicles. Rising GDP impacts on car traffic growth specifically through two channels:

Car Ownership

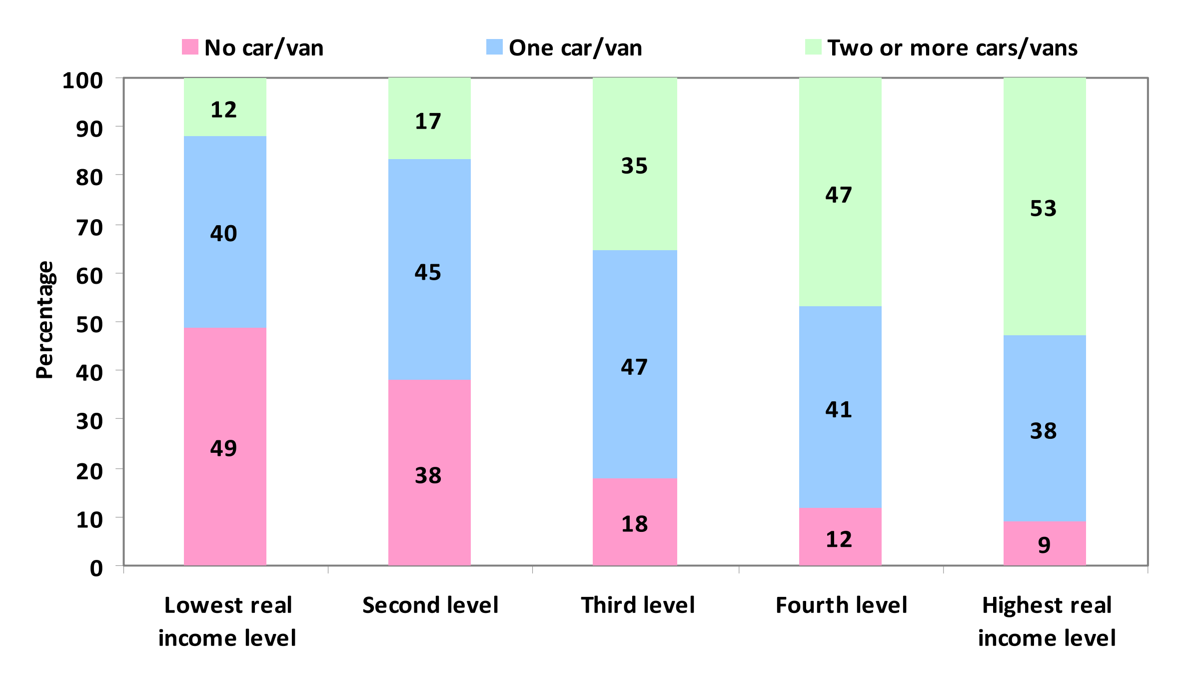
1.16 Increases in GDP per capita make car ownership more affordable, and thus increase the availability of using a car. Figure 3 shows the annual growth rate of GDP and the number of cars per capita since 1950. There is an evident link between the two, but the strength of this relationship has shown a declining trend over time. Until the 1980s car ownership per person growth rate was higher than GDP per capita, although declining through time. Since the 1980's car ownership grew at around the same rate of GDP per capita, and more recently falling below GDP per capita growth. There are no signs of a structural decoupling between GDP per capita and car ownership. A weakening of the relationship is evident over the last 60 years as the market slowly moves towards saturation. Over the last few years we have seen some stagnation due to the recent economic downturn.

Figure 3: GDP and Cars per capita annual % growth rate – 1950-2010



1.17 There may be a saturation point in car availability 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, less wealthy, sections of the population. Figure 4: Household car availability by household income quintile, GB 2014 below illustrates the current relationship between income and car ownership in Great Britain. While 49% of the lowest real income quintile has no car, only 9 % of the highest income quintile has no car. In fact, over half the highest quintile group have two or more cars, while only 12% of the lowest income quintile has two or more cars.

Figure 4: Household car availability by household income quintile, GB 2011[4]



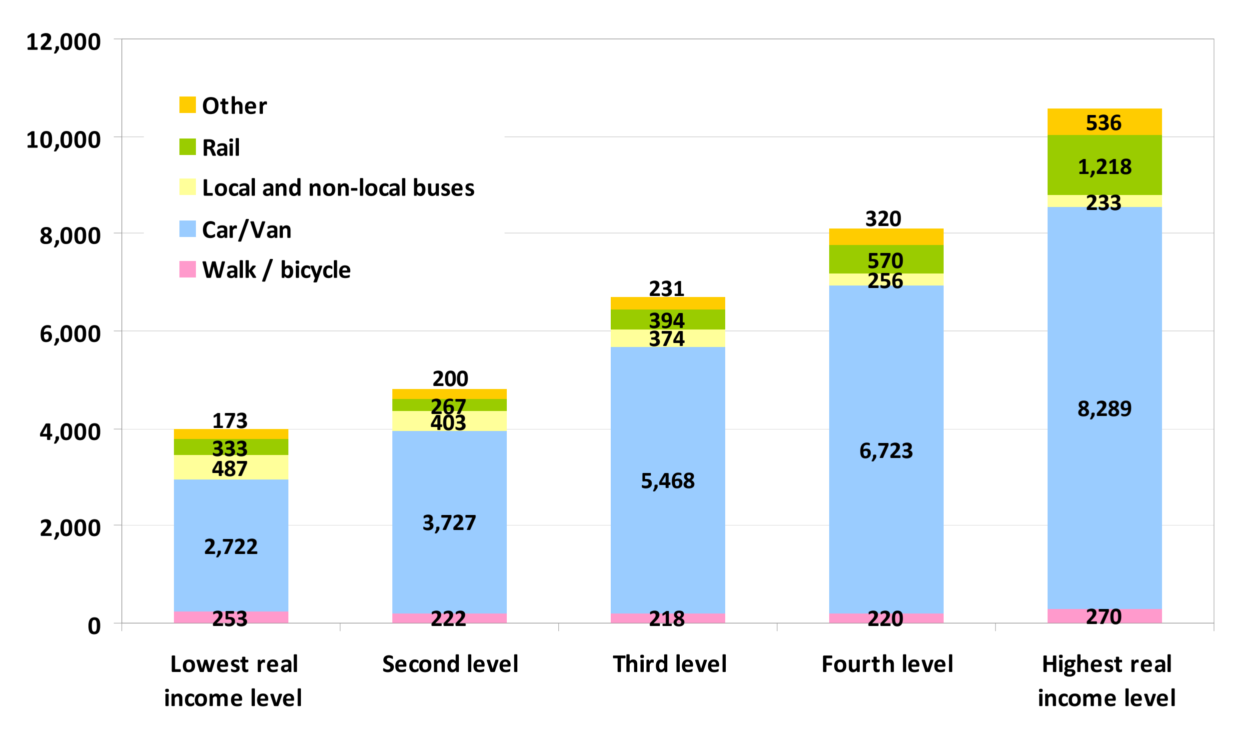
Value of Time

1.18 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 time. 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.

1.19 Figure 5 below shows the total distance per person by mode and by household real income quintile.[5] The figure illustrates that those households with higher real incomes make more car trips, the car trips are longer and thus the overall distance travelled in cars is longer, therefore implying that a rise in incomes and car ownership can increase demand for transport.

[4] DfT NTS - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9968/nts0703.xls
[5] Households divided into quintiles according to their gross real income. Each quintile represents 20%, or one fifth, of all households.

Figure 5: Distance (Miles) Travelled by main mode and household real income quintile Great Britain, 2011



1.20 Table 1: Projected Real GDP and Real GDP per capita growth below presents the levels of GDP and GDP per capita growth assumed for each forecast year in the scenarios analysed.[6]

Table 1: Projected Real GDP and Real GDP per capita growth

	Low		Central Forecast		High	
Period	**Total**	**Per Capita**	**Total**	**Per Capita**	**Total**	**Per Capita**
2010-2015	1.3%	-2.2%	5.9%	2.2%	10.4%	6.6%
2010-2020	8.9%	1.9%	20.1%	12.4%	31.2%	22.8%
2010-2025	19.8%	9.1%	35.3%	23.2%	51.6%	38.1%
2010-2030	32.4%	17.8%	53.1%	36.3%	75.9%	56.6%
2010-2035	45.3%	26.9%	72.2%	50.4%	103.0%	77.2%
2010-2040	59.9%	37.1%	94.1%	66.4%	134.6%	101.1%

[6] GDP growth rates consistent with Budget 2013 OBR Economic Outlook and June 2012 OBR Fiscal Sustainability Report long-term growth projections. Previous publications used OBR GDP based on the RPI GDP deflator. OBR has shifted to a CPI GDP Deflator methodology, which has increased real GDP by an average of 0.2% per annum, although this does not reflect any actual change in the underlying economy.

Fuel Cost of Driving: Fuel price and fuel efficiency

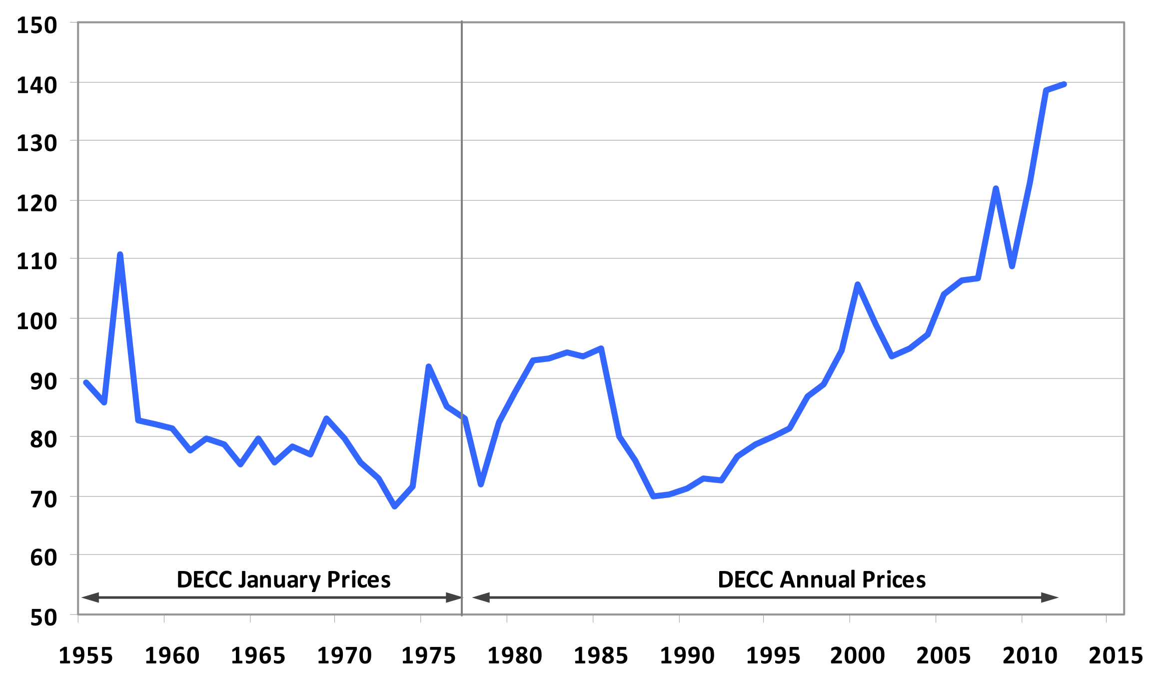
1.21 The money cost of driving impacts on transport demand as the higher the money cost of road transport relative to alternatives (other travel modes or activities) the lower the projected demand will be. The cost of road travel is highly dependent on the oil price, taxation on the marginal use of road transport (fuel duty and VAT) and the vehicle fuel efficiency (i.e. the miles that a vehicle can travel per litre of fuel). Falls in the cost of driving increase car ownership and distance per trip as road travel becomes cheaper.

1.22 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 DfT forecasts. The assumptions regarding fuel prices and fuel economy are combined to produce car fleet average costs of driving per mile for each year.

Fuel Price

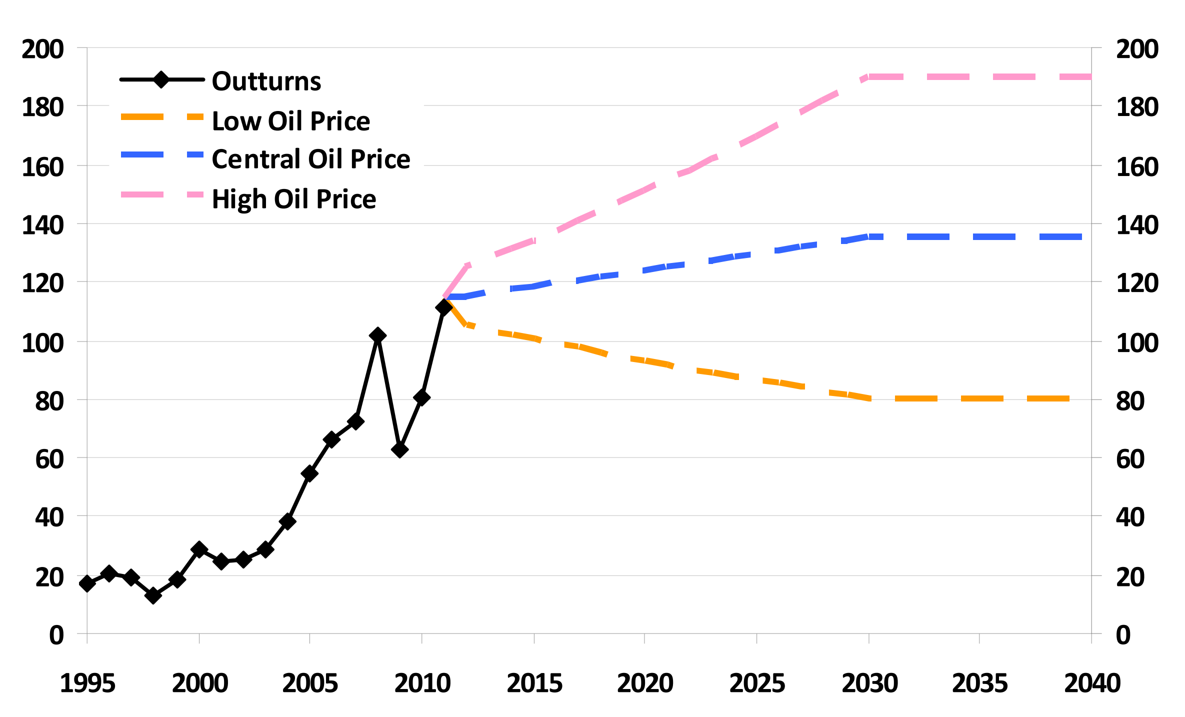
1.23 The underlying driver for changes to pump fuel prices, in the absence of changes to rates of taxation, is oil prices. Figure 6 below shows historical real road fuel prices from 1955 to 2012, highlighting the Suez crisis in the late fifties, the Oil price crisis in the mid-1970's and after 1979 which lasted until the mid-80s, and the recent oil prices spikes in 2000, 2008, and 2011/12.

Figure 6: Weighted Average real Road Fuel Prices (£2012) 1955 – 2011



1.24 The Road Transport Forecasts 2013 are based on the latest DECC crude oil price projections, published in October 2012.[7] DECC has produced three oil price scenarios (low, central and high) to 2030, represented in Figure 7. DECC projects that oil prices will rise to $ 135 bbl by 2030 in 2012 prices. DECC's high and low scenarios project oil prices to either fall to $80bbl or rise to $190 bbl 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 7: DECC Oil Price projections (£2011 - $ per barrel)



Fuel efficiency

1.25 The rate at which vehicles use fuel is a key determinate of the cost of driving, and road transport CO2 emissions. The projected impact on fuel use from fleet fuel economy improvements in cars, light vans and HGVs are set out in Table 2: Fleet fuel economy improvements in cars, light vans and HGVs (litres per mile) below.

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

Table 2: Fleet fuel economy improvements in cars, light vans and HGVs (litres per mile)		
Vehicle	**Policy**	**Fuel Use Impact 2010-2040**
Cars	- EU 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)	-47%
Light Vans	- EU 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	-14%

1.26 This forecast includes the EU car CO2 regulation, including the mid-term target of 130 grams of CO2 per kilometre by 2015 and the long-term target of 95 grams of CO2 per kilometre by 2020. In addition to this the model also takes into account 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.

1.27 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 CO2 target is implemented.

1.28 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 47% between 2010 and 2040

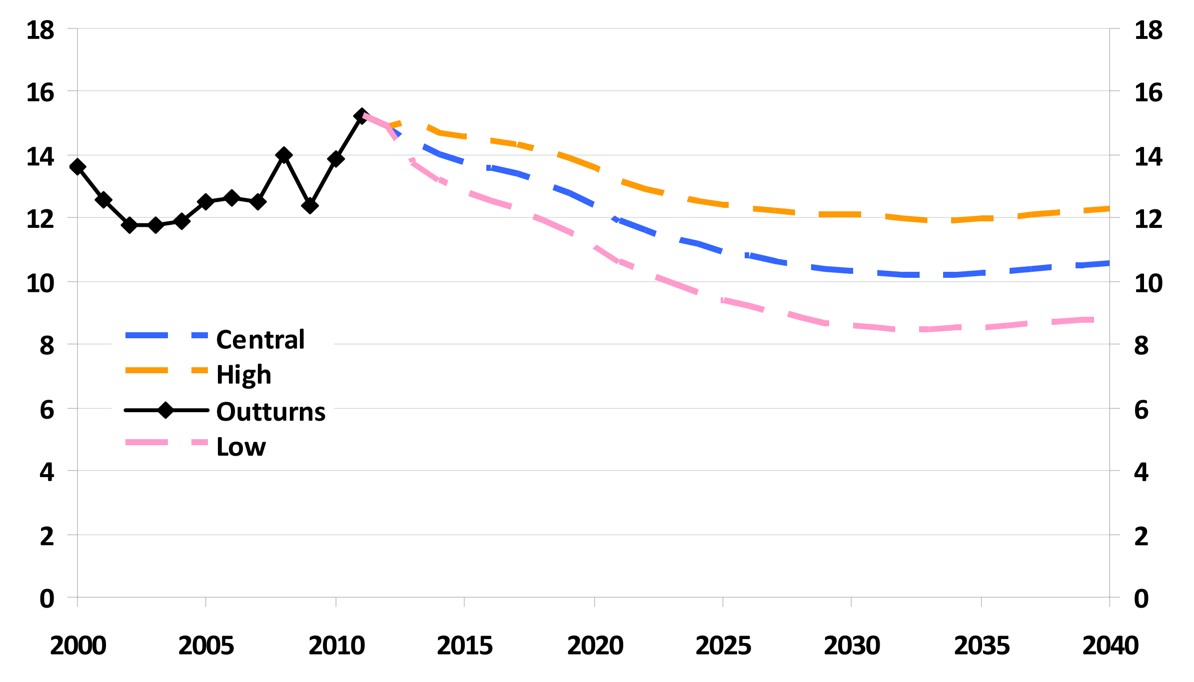
1.29 For light vans the forecasts include the EU van CO2 regulation; the mid-term target of 175 grams of CO2 per kilometre by 2017 and the long-term target of 147 grams of CO2 per kilometre by 2020. Due to this, van fleet fuel economy is projected to improve by 34% between 2010 and 2040. As with cars, 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.

1.30 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

1.31 Combining projections of fleet fuel efficiency and fuel cost determines the fuel cost of driving. From 2010 to 2040 these fuel costs of driving are projected to fall by 24% for cars and 7% for vans. 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 2040, HGV fuel cost of driving is projected to rise by 36%.

1.32 Figure 8 shows the impact fuel efficiency improvement in cars with the three DECC Oil price projections. The fuel cost of driving is has increased in 2011 due to increase in the oil price, but from 2012 onwards fuel economy improvements begin to reduce the fuel cost of driving for cars.

Figure 8: Car Fuel Cost of driving projections - High, Central and Low scenarios – pence per mile (£2012)



1.33 Government policies are already encouraging the uptake of ultra-low emission vehicles such as electric cars, supporting the early market through upfront purchase subsidies and infrastructure provision. In line with the Department's approach, we have estimated the impact of announced and committed policies on uptake of ULEVs. The impact of ULEVs uptake on Co2, NOx and PM10 emissions are covered in Box 4 in Section 5. As detailed in the box, here it is not assumed that uptake of ULEVs impacts people's travel choices or traffic trends for these scenarios.

The changing strength of impact of Key Drivers

1.34 The impact of these 3 key drivers of travel demand is decreasing over time, mostly because of advancing degrees of maturity of the market (many more people own a car today than in the 1960s), congestion and crowding impacts, government policies on of public transport and more environmentally sustainable travel patterns, such as cycling.

1.35 This falling key driver impact is reflected in the NTM model. Although elasticities are not directly used in the NTM it is possible to derive them from model outputs. Table 3: Impact of a 1% increase in Key Driver on Car Trafficbelow illustrates implied elasticities for the central forecast. It appears that the elasticity of car traffic to GDP per capita will fall from 0.28% in 2010 to 0.19% in 2035, while cost of driving elasticity will decrease (in absolute terms) from -0.30% in 2010 to -0.17% in 2035. For a higher demand scenario we would expect that the GDP per Capita and fuel cost elasticities would fall further as demand for road transport moves further towards saturation.

Table 3: Impact of a 1% increase in Key Driver on Car Traffic[8]

	2010	2025	2035
Population	0.95%	0.94%	0.92%
GDP per Capita	0.28%	0.22%	0.19%
Fuel Cost	-0.30%	-0.21%	-0.17%

Network Capacity and Congestion

1.36 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. A rise in journey time cost of driving will lower demand for road transport.

1.37 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. Around 400 lane miles of capacity have been added to the existing network by 2020 based on the Spending Review 2010 (SR 2010)[9], Growth Review 2014 and the announcement in May 2012 of six schemes designed to ensure the maintenance of a "pipeline" of future Highways Agency projects.[10]

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[8] Elasticities are based on changes in real GDP per capita and fuel cost of driving in real terms using an RPI based GDP deflator and thus cannot be used directly with the % changes reported in this document which use the CPI based deflator.

[9] The Investment in Highways Transport Schemes (2010) sets out the projects assumed in the modelling. http://webarchive.nationalarchives.gov.uk/20110504115831/http://www.dft.gov.uk/pgr/roads/network/strategic/highwaystransportschemes/pdf/highwaystransportschemes.pdf

[10] More information on future HA transport infrastructure schemes to upgrade the Strategic Road Network can be found here: http://www.highways.gov.uk/our-road-network/managing-our-roads/major-projects/highways-agencys-future-delivery-programmes/future-spending-reviews/

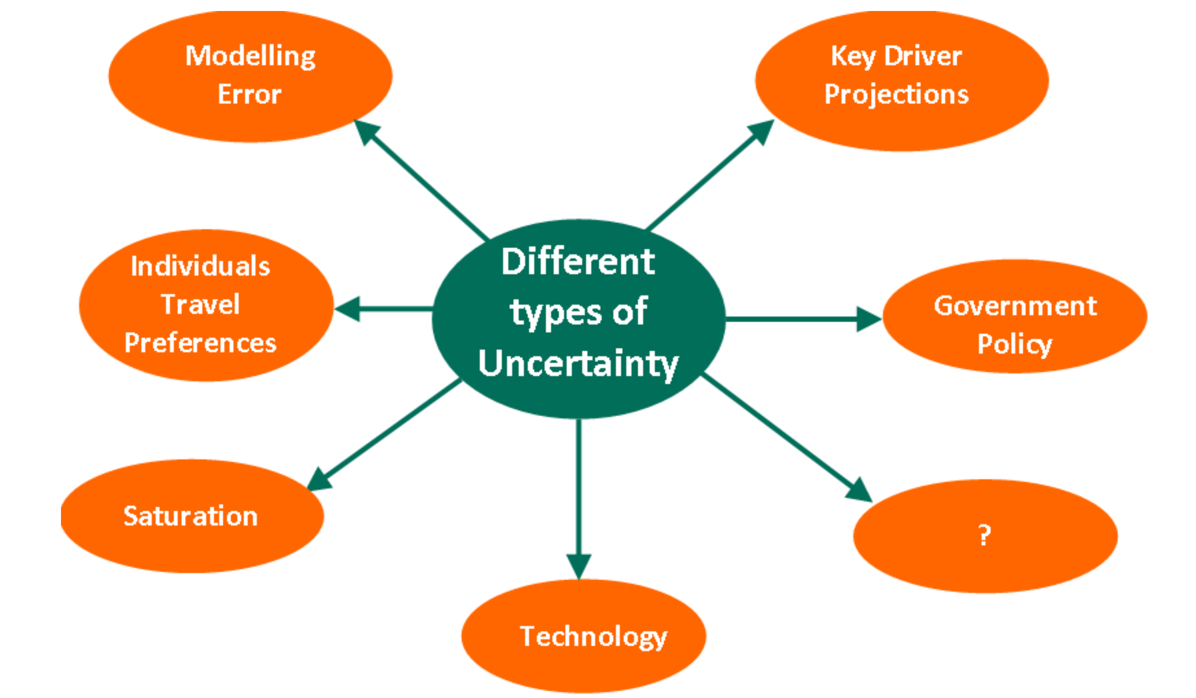
2. Uncertainty and Modelling

Nature of Uncertainty

2.1 Uncertainty is inherently part of forecasting and predicting future behaviour and trends. As traffic trends and outcomes depend on a large number of variables, economic (GDP, oil prices) and behavioural (people preferences, trends and social habits). As these drivers are not certain and could be subject shifts in trends or shocks in the future, forecasting is a highly uncertain exercise that must be interpreted as best estimates given current state of information and assumptions.

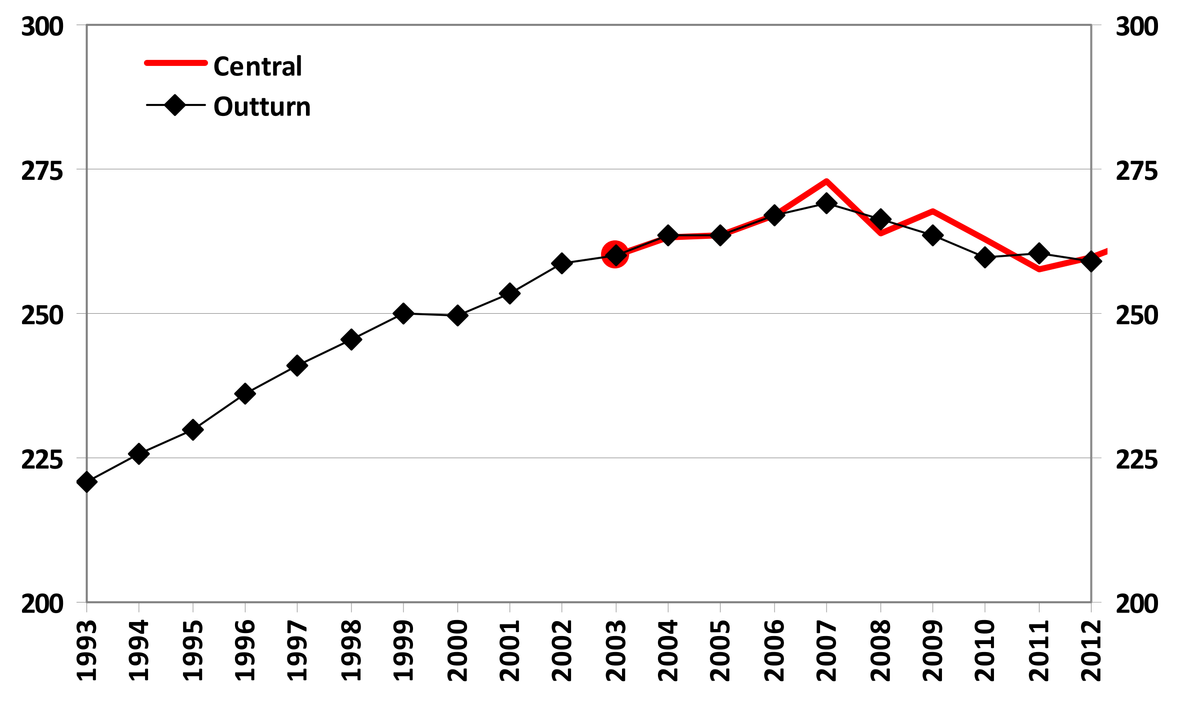
2.2 Uncertainty arises from multiple areas, highlighted in Figure 9 below.

Figure 9: Sources of uncertainty in forecast



2.3 First, modelling error might impact on traffic projections, and it might not be possible to fix this, either because it would make it too complex or because it might not be possible to observe the source of these errors. Figure 10 below shows that the NTM forecast in 2010 is within 1.3% of observed traffic data. The forecast interpolation (estimated in addition to the NTM forecasts and based on changes in population, GDP and fuel costs of driving) follows observed traffic data closely between 2003-2010 and after 2010.

Figure 10: Historical and forecasted traffic – England (Bn vehicle miles)



2.4 Second, as Figure 11 shows, the NTM has previously over- or under-forecasted traffic. The key macro variables driving traffic growth are uncertain themselves and DfT relies on projected estimates of these, normally produced by other government departments, as detailed in the previous chapter. This was mainly driven by inaccurate projections of key underlying macro variables, i.e. fuel prices, GDP and population growth. Figure 11: DfT Central or Mid-point Car Traffic Projections and Outturn Statistics shows past ONS projections as well as actual outturns, showing how actual future trends were over-forecast in the 60s and early 70s and generally under-forecasted afterwards.

Figure 11: DfT Central or Mid-point Car Traffic Projections and Outturn Statistics

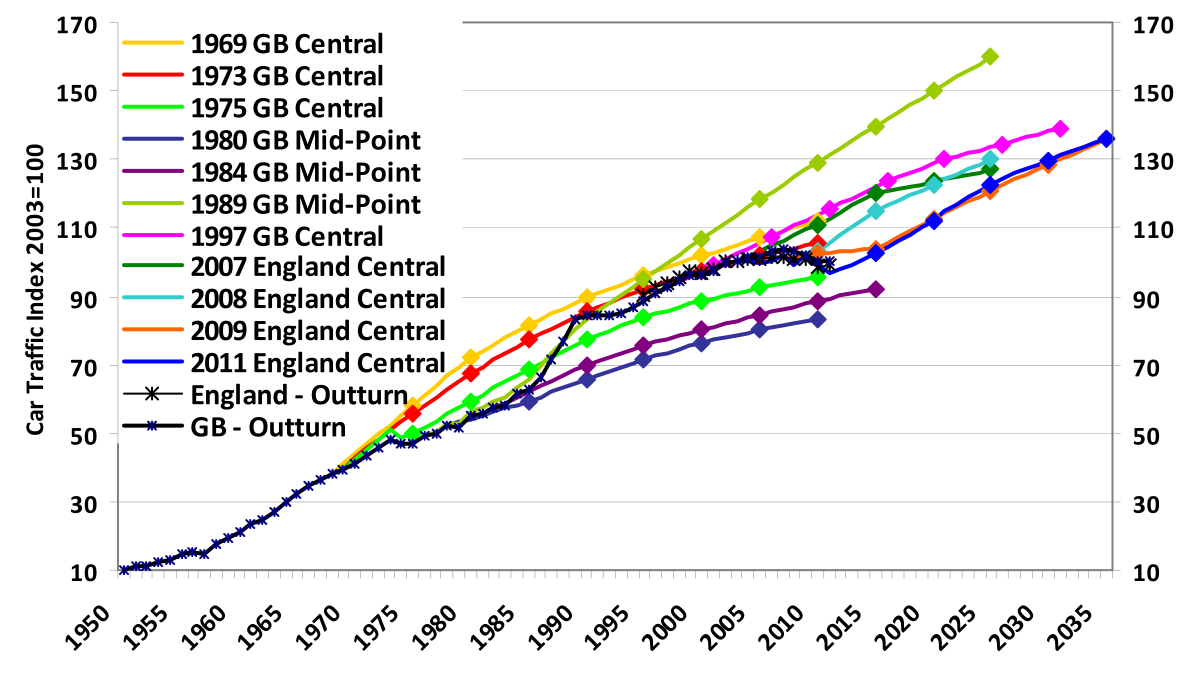
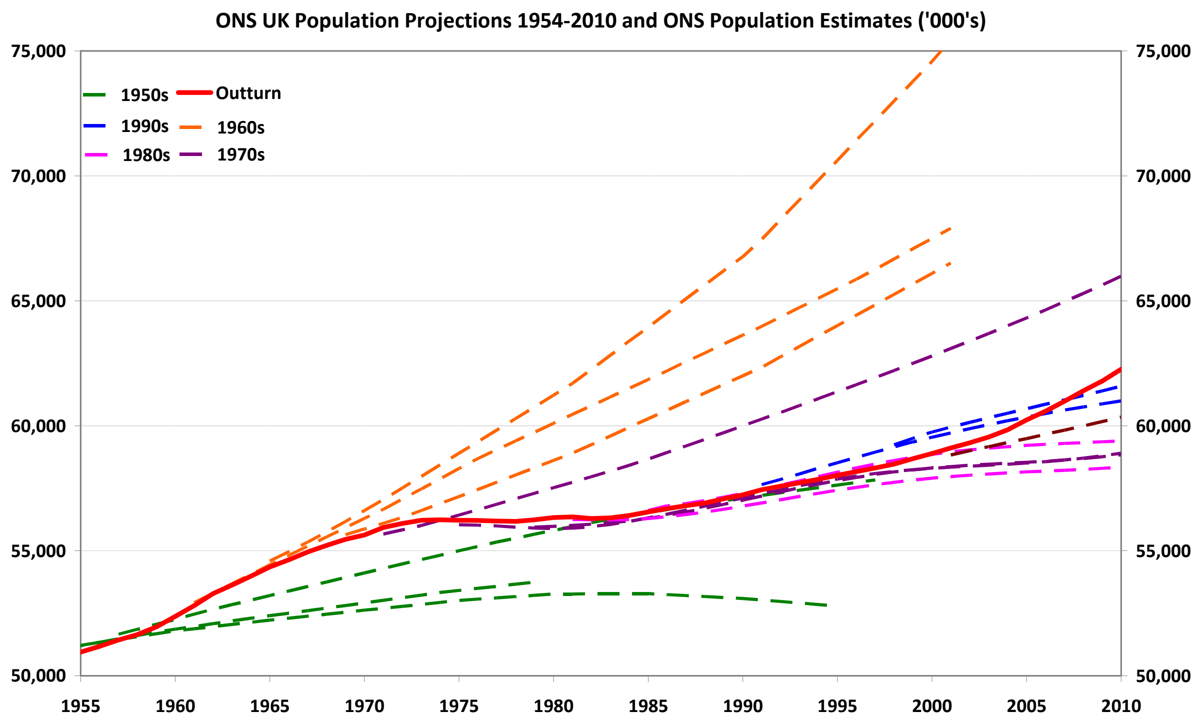


Figure 12: ONS UK Population Projections 1954 – 2010 and ONS Population Estimates ('000s)



2.5 The relationship between these variables is uncertain and could vary over time. The way the strength of these relationships evolves is implicitly incorporated in the assumptions of the model. This is reflected in the discussion in the previous chapter on the varying relationship between key drivers and traffic outcome as expressed by decreasing elasticities over time.

2.6 Technology can also impact on the decision to travel and the way people travel. Development of smart phones and social network could reduce the need of people to travel for social reasons, as they rely more on virtual communication, or have substituted fancy cars as social status symbols. Self driving cars could make travel more attractive in the future as people could be able to do more activities while driving therefore being less concerned by time spent in traffic jams, etc. The impact of these technological changes on traffic may have opposite effects. For instance telecommunications may drive economic progress increasing future traffic, while others may reduce traffic, leaving the final outcome unclear.

2.7 Government policy adds to the uncertainty of traffic projections; housing policies and decisions to build major infrastructure critically affect travel patterns across the country. It is enough to think to the impact of traffic on the strategic road network of a project such as HS2 (see Box 3 in Section 3). Public transport policies, fuel efficiency regulation, cycle lanes and schemes, congestion charge, taxation of fuel and roads also have major impacts on road traffic and travel, making forecast even more uncertain.

2.8 Individual behaviour and preferences also impact on travel patterns. If in the future home working were to become more and more popular, less commuting traffic would be produced. ITC research has shown that young people tend to drive less or start driving at a later stage in their life. This is due in part to high costs of learning, general cost of driving and the cost of getting a license which impact more heavily on young people’s budget. Also, families have children later and therefore there may be some stable (long-term) change in travel patterns across different sections of the population.

Challenges for Modelling

2.9 Modelling is by its very nature is an exercise of simplification of reality, to be used to explain and to predict given a set of assumptions and inputs. Its accuracy relies on the precision of its assumptions and on the degree of variability of the inputs.

2.10 Modelling using the NTM involves making choices based on past evidence on what assumptions to adopt, how and when to update them, and what inputs to employ. The forecasts of the NTM are based on calibration and studies done in the past on individual choices, and on the elasticities estimated for each of the inputs, as well as their interaction with each other and their final impact on traffic outcomes.

2.11 The NTM Road Traffic Forecasts should not be viewed as what we think will actually happen in the future, or what we want the future to look like. The forecasts are what may happen, based on:

- Our current understanding of how people make travel choices,
- The expected path of key drivers of travel demand,
- Assuming no change in government policy beyond that already announced.

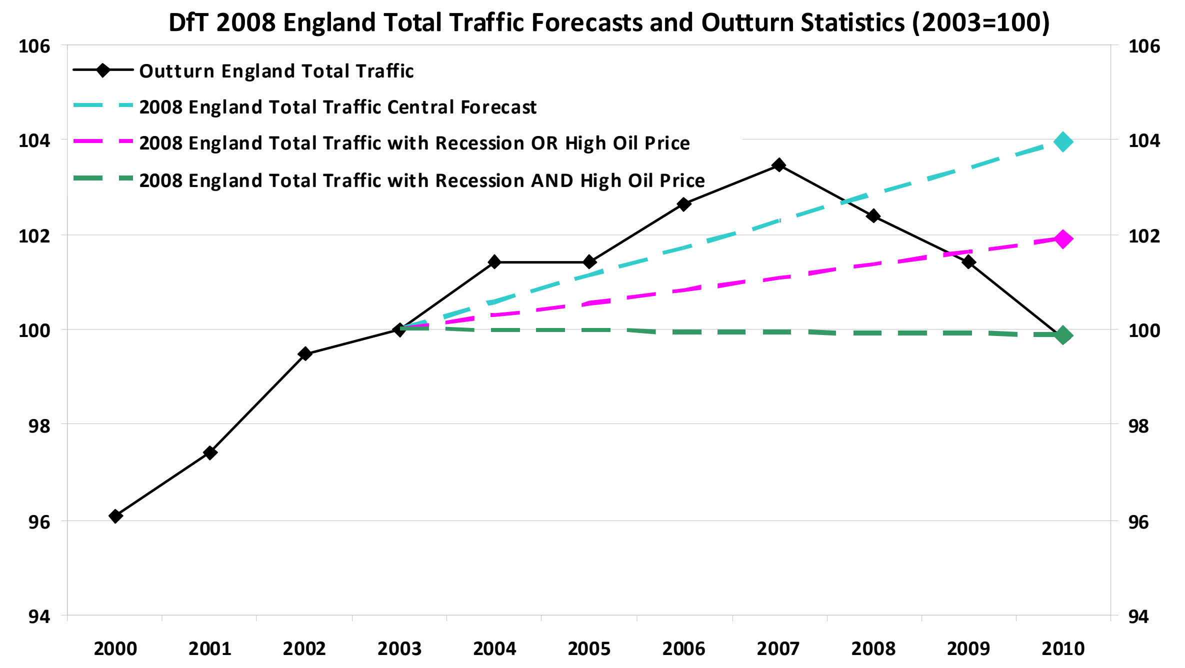
Sensitivity and Scenario analysis

2.12 It is possible to recognise and examine this uncertainty by segmenting it and using sensitivity analysis to understand its impact. Sensitivity analysis gives you a range of potential alternative outcome, based on alternative assumptions or combination of assumptions.

2.13 Scenario analysis is a useful tool to limit the impact of uncertainty by forecasting in advance the potential outcome in case of extreme events. Figure 13 below shows an example of how such an approach has proved very useful. In the 2008 NTM Road Traffic Forecast an extreme case forecast scenario was included which estimated the impact of an economic recession similar to the early 1980's combined with high oil prices. As the crisis hit severely after 2007, traffic declined following a fall in GDP with sustained high oil prices, reaching a level very close to what had been anticipated by the scenario.

2.14 Road Traffic Forecasts 2013 present a central demand forecast and 6 other scenarios varying the projections of population, GDP per Capita and Oil prices. This does not mean that they include all possible actual outcomes, but they represent the range which will "most likely" include the future figure, given current assumptions and data. Extreme outcomes might occur, but, as far as we know, the probability of them to happen is, as of today, very low. The aim of these scenarios is to show how the forecasts change when the key input variables are varied and represent extreme outcomes and ranges.

Figure 13: DFT 2008 England Total Traffic Forecasts and Outturn Statistics (2003=100)



Updating the NTM

2.15 Peer review and external validation have consistently shown that the National Transport Model (NTM) provides robust results and is fit for purpose as a high level strategic model. 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 are updated before each new forecast and the projections set out in this paper have made use of the latest available data.

2.16 The National Trip Ends Model (NTEM) is used to forecast trip ends (the number of trips generated from/to each location) and these are calculated by multiplying two elements:

- Demographic data forecasts: population by age and households, both split according to car ownership, and employment;
- Trip rates: the number of trips per person, segmented by person type. These are calculated based on observed results from household surveys. At present they are assumed to be constant through time for each person type.

2.17 Regarding demographic data, version 6.2 of the NTEM data set has now replaced NTEM 5.4 as the definitive version. This latest version has been updated with:

- Population updated using ONS 2008-based projections;

- Dwellings updated using Local Authority Annual Monitoring Reports;
- Employment forecasts updated consistent with more recent GDP forecasts from the Office of Budget Responsibility. The forecasting method has also been slightly revised. The distribution of - Employment and Workers by Region in the base year 2001 (and hence in all years), has been updated using Workforce Jobs and the Labour Force Survey;
- An update to the Car Purchasing Cost Index in the Car Ownership Model in line with more recent RPI data.[11]

2.18 At the moment Trip Rates are based on National Travel Survey (NTS) data from 1988-1996. An ongoing project will update them in line with recent NTS data and, subsequently, adapt the model in order for it to allow trip rates to vary through time.

2.19 We have included further market maturity assumptions in LGVs and separated the impact of Population and GDP per capita on LGV traffic. While population elasticity has been kept constant at a value of 1, GDP per capita elasticity from 2010 onwards has been assumed to fall to around 1 for Low Demand scenario, 0.7 for the central scenario and 0.5 for High Demand scenario. We intend to consider further evidence of market maturity for LGVs in the long run.

2.20 We are continuously upgrading and improving the NTM incorporating new features and adapting the modelling assumption to observed trends. Future NTM projects include analysis and recalibration of trip rates, the in-depth investigation of LGV market maturity assumptions, the incorporation in the fleet of Electric vehicles and London forecasts, as detailed more in depth in the boxes dedicated to each of these themes.

2.21 We aim to stay open and keep engaging with external stakeholders extensively in the future. We will collaborate with experts and professionals to make sure we communicate our vision, our NTM development programme and that these are widely recognised as appropriate.

[11] If you wish more information about NTEM and TEMPRO please visit DfT website http://www.dft.gov.uk/tempro/

3. Road Traffic Projections

3.1 This section presents the NTM forecasts of traffic demand growth over the period to 2040. As described in the previous section the main changes to the central demand forecast from ‘Road Transport Forecasts 2011’, have been to revised central projections of population, GDP, and oil prices.

3.2 Figure 14 below shows the NTM forecasts for total traffic on the all roads in England up to 2040 and Figure 15 focuses on traffic on the Strategic Road Network (SRN). Table 1 details the forecasts for total traffic on the SRN, Non-SRN and all roads in England through to 2040. The NTM starts from a base year of 2003 and projects traffic in 2010 and every 5 years to 2040.

3.3 Overall we can see that the NTM has modelled the general trend in total traffic from 2003-2010, with flat growth attributable to the economic slowdown and sustained high oil prices. The NTM projects that traffic will be sluggish up to 2015 in line with projected low GDP growth and high fuel costs. As England then moves out of the recession and rapid fuel efficiency improvements significantly decreasing the fuel cost of driving, traffic is expected to rise by 19% from 2015 to 2025. As the rate of improvements in vehicle fuel efficiencies declines after 2025 we observe a slower growth in traffic. The central forecast from 2010-2040 projects traffic to grow by 41% for Non-SRN roads, 46% for SRN and an average of 43% for all roads.

3.4 Figures 14 and 15, and Table 1 below also show the impact of sensitivities of the three key drivers discussed above, one of top of another. For example, below we can see the impact of the low population projection, then low population and low GDP per capita, then finally the forecasts if we also saw a high oil price. This combined low demand scenario assumes that all three sensitivities occur which is highly unlikely and should be seen as extreme scenario.

3.5 There are many other variables that have not been included where further scenario testing could be done. We will continue to review how we can represent uncertainty within the forecasts.

Figure 14: England Traffic on all roads (bn vehicle miles)

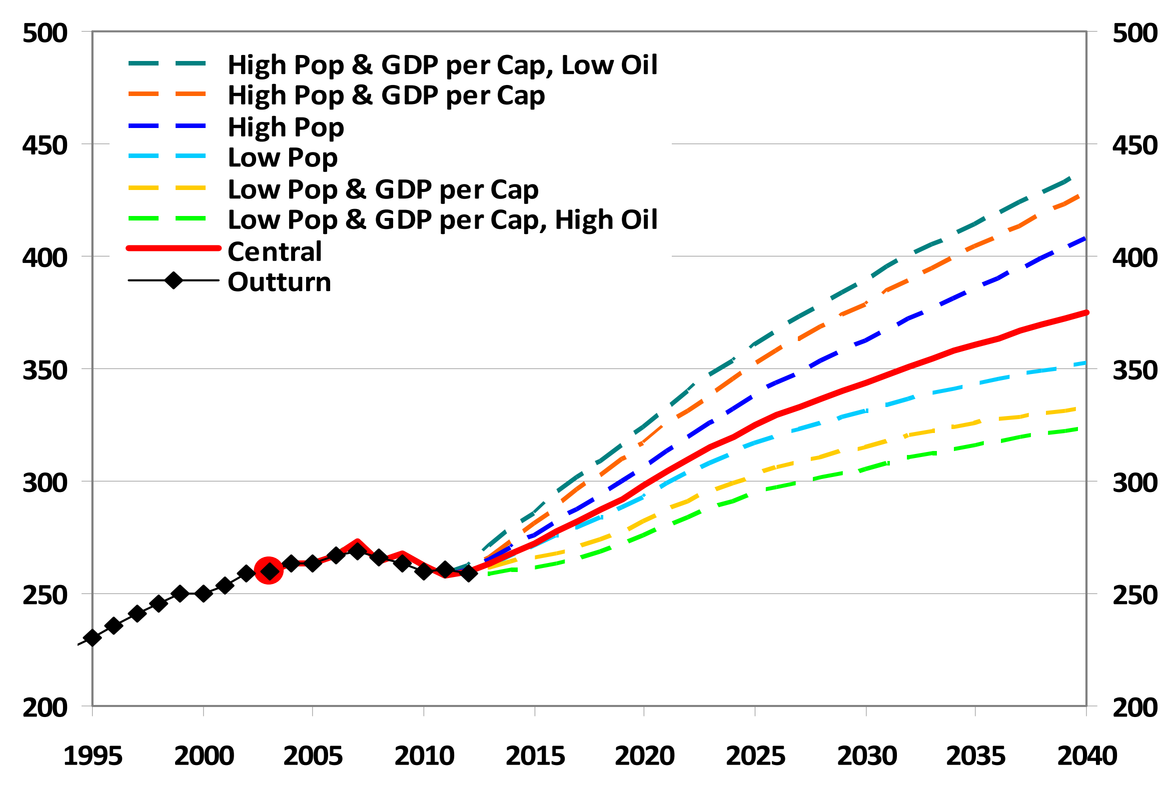


Figure 15: England Traffic on the SRN (bn vehicle miles)

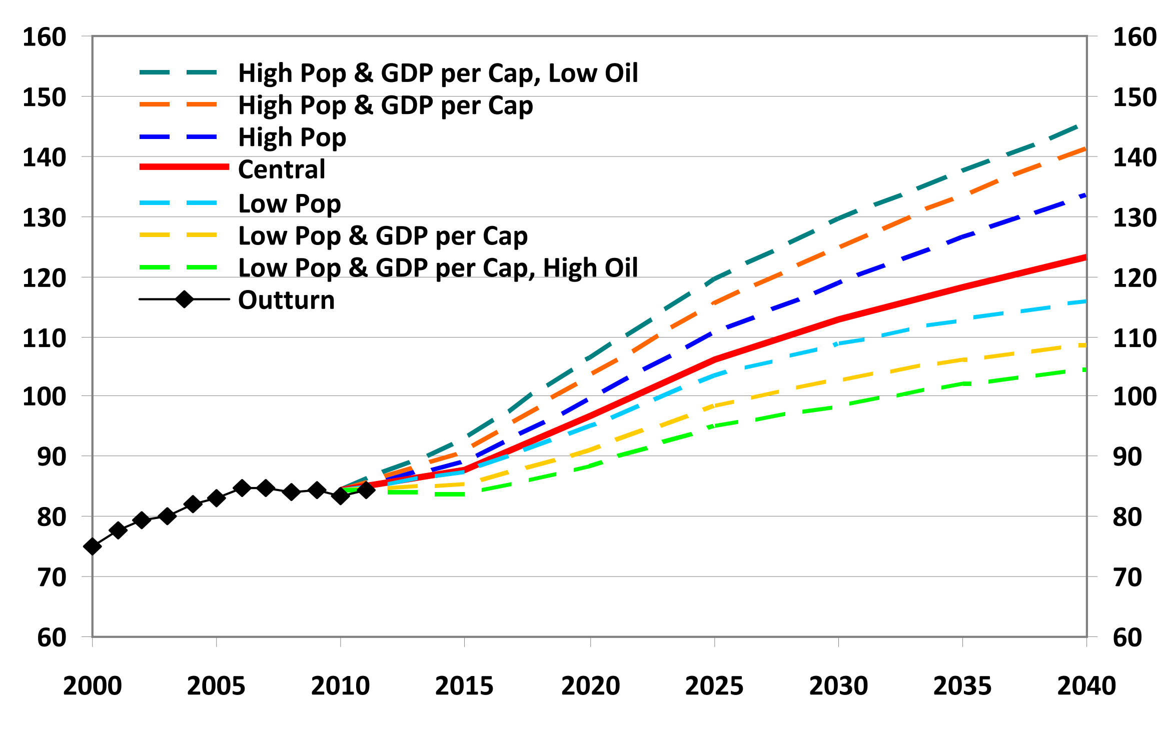
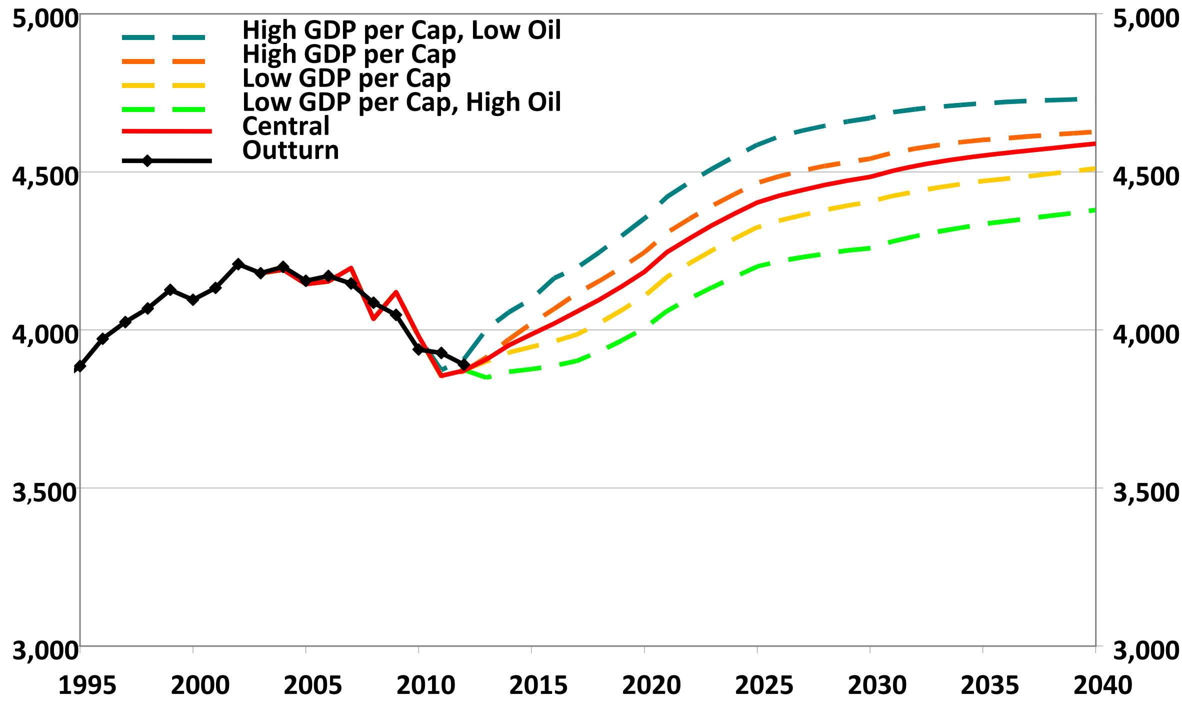


Table 4: England Traffic % growth by Road, Vehicle type and Scenario, 2010-2040

	Road Type	Car	LGV	HGV	PSV	Total
Low Pop & GDP per Cap, High Oil	SRN	24.7%	45.7%	-8.9%	-0.3%	23.6%
	Non-SRN	21.0%	45.6%	-16.7%	0.7%	23.0%
	All	22.1%	45.6%	-11.8%	0.5%	23.2%
Low Pop & GDP per Cap	SRN	29.7%	50.6%	-7.2%	-0.3%	28.2%
	Non-SRN	24.0%	49.9%	-17.9%	0.7%	26.1%
	All	25.8%	50.1%	-11.1%	0.5%	26.8%
Low Pop	SRN	34.7%	70.7%	14.5%	-0.3%	37.0%
	Non-SRN	28.0%	70.0%	6.4%	0.7%	32.8%
	All	30.1%	70.2%	11.5%	0.5%	34.2%
Central	SRN	43.5%	80.0%	21.5%	-0.3%	45.6%
	Non-SRN	36.7%	79.4%	14.3%	0.7%	41.5%
	All	38.8%	79.6%	18.8%	0.5%	42.8%
High Pop	SRN	54.5%	98.6%	36.6%	-0.3%	58.0%
	Non-SRN	48.0%	98.1%	31.6%	0.7%	53.9%
	All	50.0%	98.2%	34.8%	0.5%	55.2%
High Pop & GDP per Cap	SRN	58.5%	117.4%	69.8%	-0.3%	66.9%
	Non-SRN	51.7%	117.5%	69.8%	0.7%	60.7%
	All	53.8%	117.5%	69.8%	0.5%	62.7%
High Pop & GDP per Cap, Low Oil	SRN	63.2%	125.0%	72.9%	-0.3%	71.8%
	Non-SRN	54.7%	124.8%	66.6%	0.7%	64.1%
	All	57.3%	124.9%	70.6%	0.5%	66.6%

3.6 Figure 16 below shows that, according to our forecast, miles per person will increase by 15% percent by 2040 (9% above pre-recession levels) despite an increase in GDP per capita of 66% and fuel cost decreasing by 24%. As explained in section 2, the elasticity of miles per person to key drivers is falling over time, and will keep falling into the future as the market moves further towards saturation. This increase in miles per person, however smaller than it would have been in the past, reflects the fact that people will be able to travel longer distances with their cars, as the cost per mile will decline sharply compared to ability to pay.

Figure 16: Car miles per person - all England roads



Box 1: Has demand for car travel peaked?

Historically, static growth or falls in car miles per person correlate with periods of high oil prices or economic contractions. This is seen during fuel rationing of 1957, spikes in the oil price and economic recessions in the 1970s, 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. Figure 16 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 oil prices combined with either weak growth in GDP or a large economic contraction. This is confirmed by Figure 16 before, which shows how based on the three key drivers, the NTM correctly forecasts recent trends in car miles per person from 2003 to 2012.

The NTM central forecast projects that car demand per person will begin to grow once again as the economy recovers, averaging 1% from 2015-2025, similar to the late 1990s. After 2025 travel demand will continue to grow at a slower rate, on average 0.3% per annum over 2025-2035 and down to 0.2% per annum in 2035-2040. The projections show car travel growing but at a declining rate.

'On the Move' report commissioned by the RAC foundation published in 2012 investigated the issue of "Peak car". The report concluded that once the shift from company cars to rail has been taken into account there is evidence of continuing strong growth in car use for the vast majority of the age groups (i.e. over 30 years old), up to the economic downturn, with the exception of London.

Box 2: London Scenario

Our London forecast is higher than what other institutions such as Transport for London are currently projecting. This is partially because the NTM is designed to project national traffic levels, not regional or local ones. We are aware of this discrepancy and analysis of our forecast from 2003-2010 shows that although the NTM predicts a fall in London car traffic of 1.5%, this was not as great as the actual 7.8% fall in traffic count statistics.

We believe that the reason for this short-term model error and long-run discrepancy with other forecasts is due to:

Car Ownership – the number of cars per person in London has been relatively flat over the last decade. While we have different car ownership saturation levels for different area types, including London, these may need to be re-estimated.

Public Transport - London has seen high levels of investment in public transport, capacity and quality improvement on buses and rail based public transport. London will continue to see high levels of investment in public transport with increase in capacity into the future, e.g. Cross Rail. We will need to revisit our modelling on the impact this may have on car travel.

Road capacity, car parking space cost and availability – There is evidence to suggest that In recent years London road capacity has been significantly reduced due to bus lanes, congestion charge and other road works. There is also a significant constraint and cost to parking in London which would reduce the demand to travel by car. We will need to revisit our modelling on the impact this may have on car travel.

A sensitivity scenario has been constructed for the 2020 NTM forecast that attempted to match TfL forecasts for car ownership and car traffic for the same period[12]. Using this sensitivity we were then able to evaluate the impact of that this would have on the NTM forecast for England SRN traffic growth. This scenario assumed the same level of cars per person in London in 2020 as has been seen in recent years. This meant the number of cars per person in London was reduced from 0.39 in the central case to about 0.33 cars per person in this scenario. Also, a 10% constraint to London roads capacity was applied as in recent years London road capacity has been significantly reduced due to bus lanes, congestion charge and other road works. We are investigating what London road capacity constraint should exactly be, in the meanwhile, 10% best approximates the potential impact.

As a result of this scenario sensitivity, the NTM 2020 forecast broadly matched TfL's forecast with total London car ownership fell by 16% in 2020 compared to our current NTM central forecast, with 2020 London car traffic around 9% lower than our central forecast. Overall, car traffic on the SRN in 2020 was around 1% lower than central forecast. Therefore it appears that this London car traffic over-

[12] TfL's model (LTS), as the NTM, produce forecasts for certain years only. TfL's forecasts were interpolated for 2020, to match the NTM's 2020 data.

forecasting issue in the NTM does not significantly affect the forecasts for England SRN traffic growth.

Box 3: HS2 Impact on the SRN

In 2026 the new High Speed rail line between London and Birmingham will be finalised, and in 2033 the second phase, the Y network from Birmingham to Manchester and the Yorkshire, will be open to the public. This new line represents a major link connecting key urban and economic areas of the country attracting an important share of long distance passenger's trips along its trajectory.

We complement the traffic forecasts presented in this section with an assessment of the impact HS2 is projected to have on car traffic on the SRN, using the demand projections produced by HS2 Ltd.[13] HS2 Ltd forecasts that around 7% of its travel demand will be shifted from road travel. In 2037 this means that around 25,000 trips per day, equivalent to 0.9% of long distance inter-zone car trips will be shifted to HS2. This 0.9% is equivalent to one year's traffic growth and highlights that the impact of HS2 does not affect the key facts and conclusion of this document.

[13] http://www.hs2.org.uk/news-resources/publications/economic-documents

4. Road Congestion Projections

4.1 The NTM forecasts where congestion may arise by comparing traffic demand with road capacity. With constrained road space, increased road traffic means greater pressure on the network and therefore higher levels of congestion. Congestion here is measured in 'lost time' – the difference in journey time between modelled and 'free flow' speeds.

4.2 Table 2 below shows that by 2040 the central scenario projects that on the SRN lost seconds per mile will increase by 114%, whereas average speed will decrease by 8%. The proportion of all traffic travelling in highly congested condition on the SRN will significantly increase to 15% by 2040. Even in the extreme 'Low pop, GDP per Cap and High Oil' scenario a deterioration in travelling conditions is still present, with lost seconds per mile on the SRN increasing by 36% and average speed travelled falling by 2%.

Table 5: Traffic and measures of delay - England, SRN

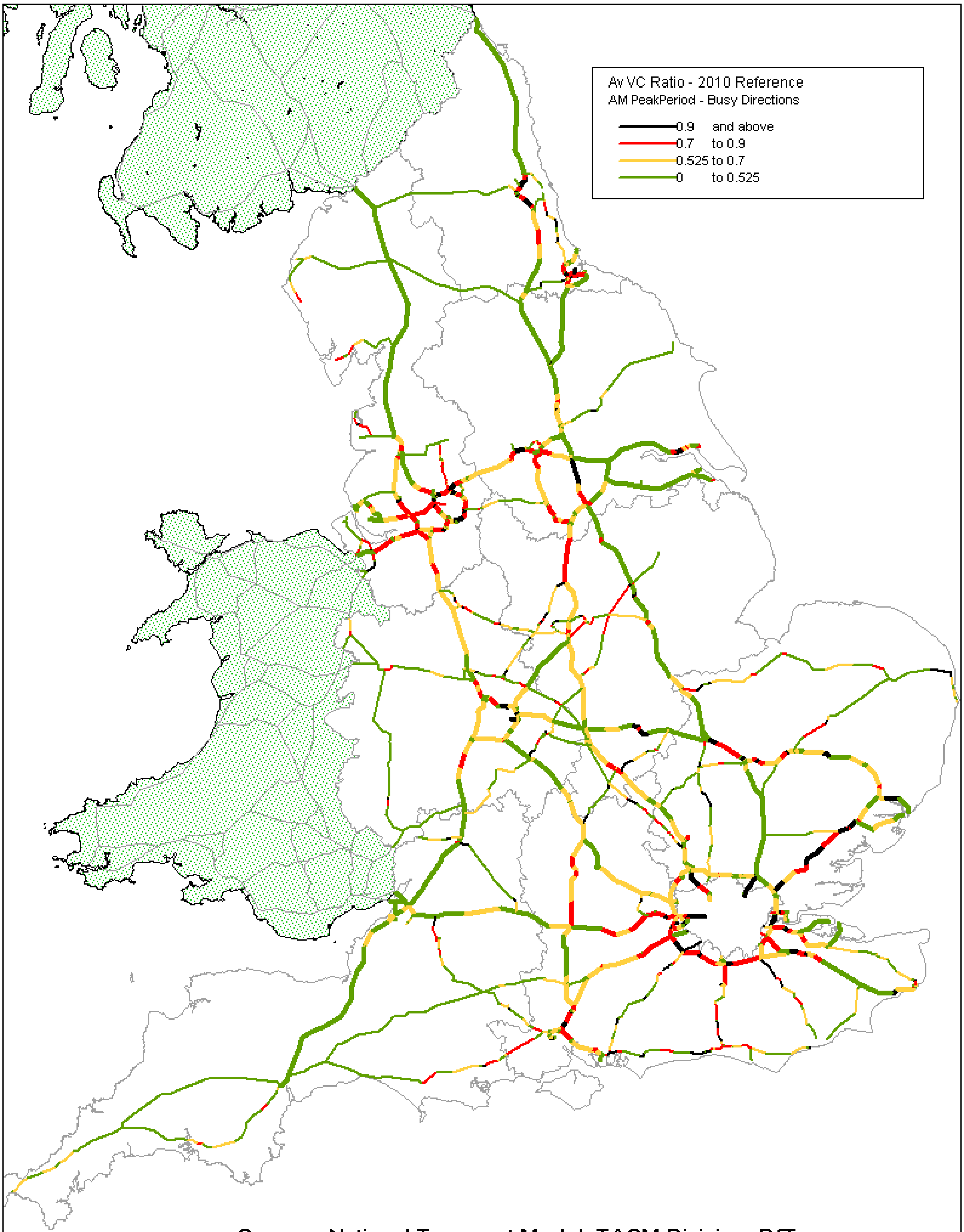
		2010-2040 % change			% of traffic in very congested conditions[14]
	Road Type	Total Traffic	Congestion (Lost Sec's/Mile)	Vehicle Speed	
Low Pop & GDP per Cap, High Oil	SRN	24%	36%	-2%	8%
	Non-SRN	23%	25%	-4%	11%
	All	23%	26%	-4%	10%
Low Pop & GDP per Cap	SRN	28%	47%	-3%	9%
	Non-SRN	26%	31%	-5%	11%
	All	27%	32%	-5%	11%
Low Pop	SRN	37%	79%	-6%	12%
	Non-SRN	33%	42%	-7%	13%
	All	34%	45%	-6%	13%
Central	SRN	46%	114%	-8%	15%
	Non-SRN	41%	56%	-9%	14%
	All	43%	61%	-9%	15%
High Pop	SRN	58%	179%	-13%	21%
	Non-SRN	54%	78%	-12%	17%
	All	55%	87%	-12%	18%
High Pop & GDP per Cap	SRN	67%	245%	-17%	27%
	Non-SRN	61%	93%	-14%	19%
	All	63%	107%	-14%	21%
High Pop & GDP per Cap, Low Oil	SRN	72%	278%	-19%	30%
	Non-SRN	64%	101%	-15%	19%
	All	67%	117%	-15%	23%

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

4.3 The maps below show the current modelled (2010) and forecast (2040) stress levels of traffic in the busiest direction of flow during the Monday to Friday morning peak period. The network has been banded as follows:

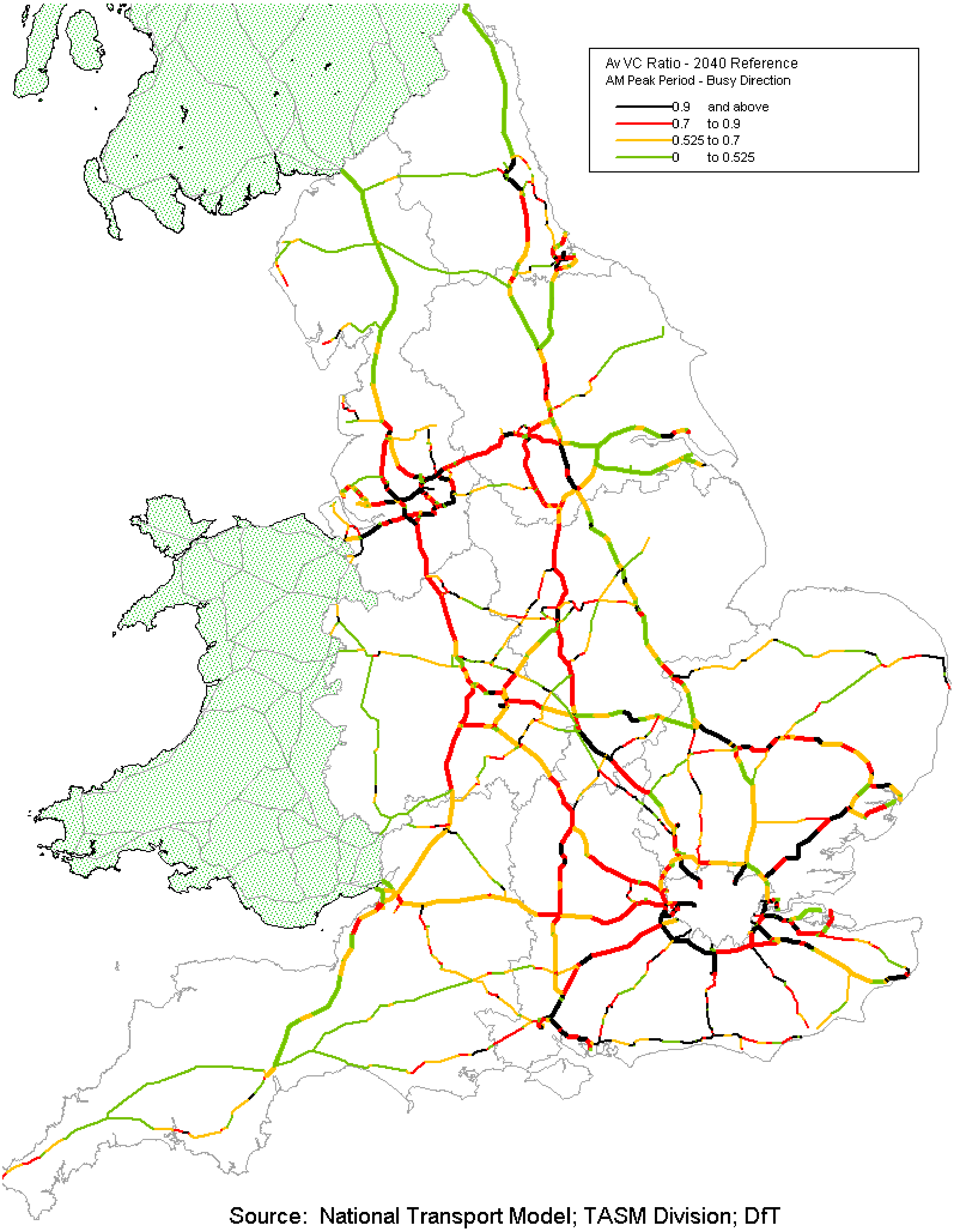
- Green (0 – 50% Capacity) - Roads generally operating satisfactorily with occasional peak period congestion,
- Amber (50 – 70% Capacity) -Roads generally operating satisfactorily but experiencing peak period congestion on about half the days of the year,
- Red (70 – 90% Capacity) - Experiencing regular congestion during the peak periods with congestion likely during some other time periods as well,
- Black (over 90% of capacity) - Experiencing regular severe congestion during the peak periods as well as frequent congestion during other periods throughout the week.

4.4 The maps show that from 2010 to 2040 the percentage of links with a flow under 50% (road sections shown as green) falls from 50% to below 30%. The proportion between 70 and 90% of stress levels (sections shown as red) increase from 15% to 25% and that at or over capacity (sections shown as black) goes up from 10% to 20% from 2010 to 2040. The majority of the more heavily congested links are located in areas outside or within a large metropolitan area, in particular around London and Liverpool-Manchester.



Source: National Transport Model; TASM Division; DfT

Scenario: A096_ha_2010_Central_FinalRun_Re-RunF



Source: National Transport Model; TASM Division; DfT

Scenario: A096_ha_2040_Central_FinalRun_RunF

5. Road Emissions Projections

5.1 The reduction of CO_2, Nox and PM10 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 and expectations in the uptake of Ultra Low Emission Vehicles (see box 4 below). 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.

5.2 This document assumes improvements in car fleet fuel efficiencies due to EU car CO_2 regulations for 2015 (130g CO_2/km) and 2020 (95g CO_2/km) plus complementary measures implemented through EU regulations, including gear shift indicator lights, low rolling resistance tyres, tyre pressure monitoring systems and fuel efficient air conditioning systems.[15]

5.3 In this forecast 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) were assumed.[16]

5.4 For HGVs we assume 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.[17]

5.5 In the present forecast it was assumed 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.

5.6 Ultra-Low Emission Vehicles (ULEVs) are assumed to lead to a further reduction in CO_2 emissions, assuming that 5.31% of car mileage is powered by mains electricity by 2030 in alignment with WebTAG guidance.

5.7 Other assumptions include the Local Sustainable Transport Fund (LSTF) reduction of urban car trips by around 2% in 2015 with decay in impact over time, and an expanded use of Low Carbon buses within London, further reducing CO_2 emissions from road transport.

[15] See chapter 3 for more details on the fuel efficiency assumptions.
[16] Ibid
[17] Ibid

Box 4: Ultra-Low Emission Vehicles (ULEVs)

The government's Carbon Plan (2011) set out the likely scale of greenhouse gas (GHG) reductions necessary in transport to meet the government's goal of reducing GHGs by 80% in 2050. It concluded that almost every new car and van needs to be zero-emission at the tailpipe by 2040.

Government policies are already encouraging the uptake of ultra-low emission vehicles such as electric cars, supporting the early market through upfront purchase subsidies and infrastructure provision. Administered by the Office for Low Emission Vehicles, bringing together officials from BIS, DECC and DfT, these policies are a first step on the road to the decarbonisation of cars and vans.

We have estimated the impact of announced and committed policies on uptake of ULEVs. The technologies covered by these models include pure electric, hybrid, plug-in hybrid and fuel-cell vehicles.

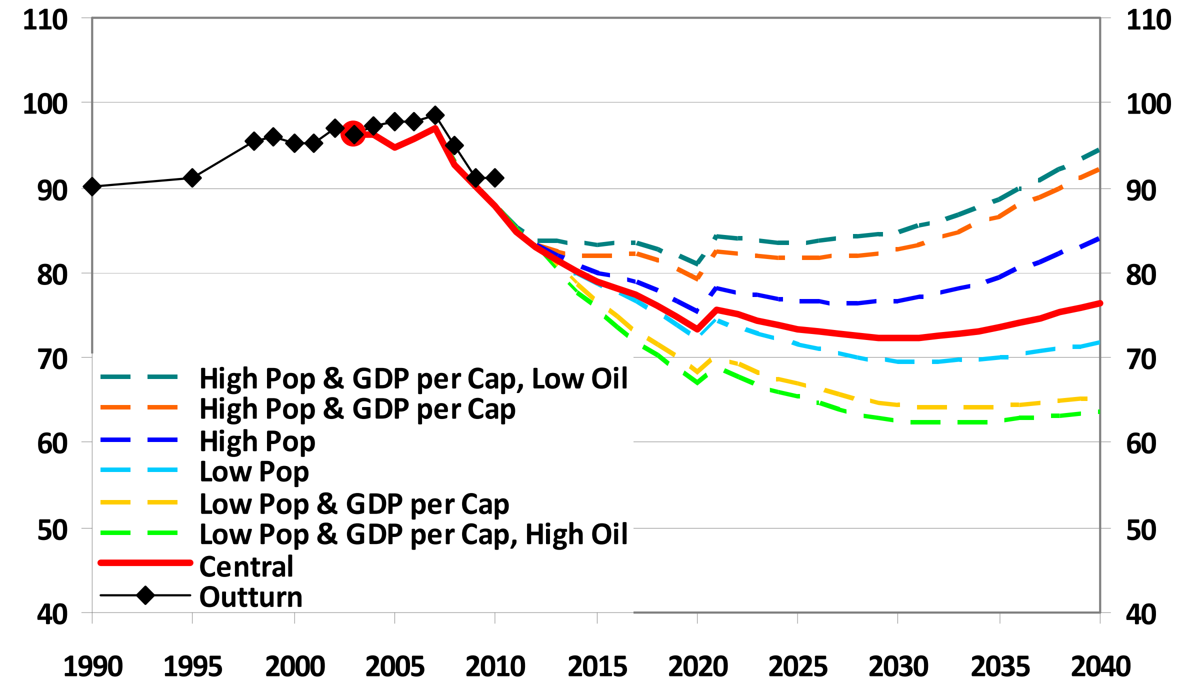
We have used these estimates to adjust the total estimated emissions from the National Transport Model. We are working to develop the NTM to incorporate ULEVs so that key outputs such as CO2 emissions and air pollutants are estimated directly by the NTM.

5.8 Figure 17: England All Roads CO2 (mtCO2) Forecasts and Table 3 below present the outturn data and forecasts for CO2 in England on all roads. Up to 2030 CO2 emissions are projected to decline by 20% before starting to slowly rise again due to increasing travel demand. Without further policy intervention and improvements in fuel efficiency, this would imply a 15% reduction on 2010 levels by 2040.

Table 6: England CO2 emissions % change by Vehicle type, 2010-2040

Scenario\Vehicle	Car	LGV	HGV	PSV	Total
Low Pop & GDP per Cap, High Oil	-38.3%	-5.2%	-23.3%	-11.2%	-29.7%
Low Pop & GDP per Cap	-36.4%	-2.2%	-22.3%	-10.7%	-27.8%
Low Pop	-34.1%	11.0%	-3.0%	-9.6%	-20.5%
Central	-29.4%	17.4%	3.6%	-8.2%	-15.4%
High Pop	-23.3%	30.0%	17.7%	-6.1%	-6.8%
High Pop & GDP per Cap	-21.0%	42.7%	48.2%	-4.6%	2.6%
High Pop & GDP per Cap, Low Oil	-19.1%	47.6%	50.4%	-3.9%	5.0%

Figure 17: England All Roads CO2 (mtCO2) Forecasts



5.9 Road transport NoX and PM10 emissions from 2010-2040 are forecast to fall substantially by 62% and 93% respectively. Figures 4 and 5 below present NTM projections of NOx and PM10 emissions from road transport in England up to 2040. The NTM forecasts a continuing downward trend until 2025, in line with historical precedent and deployment of new vehicle EURO standards. After 2025, PM10 and Nox emissions are projected to plateau, at significantly lower levels than those observed in 2010.

Figure 18: England All Roads Nox (kt) Forecasts

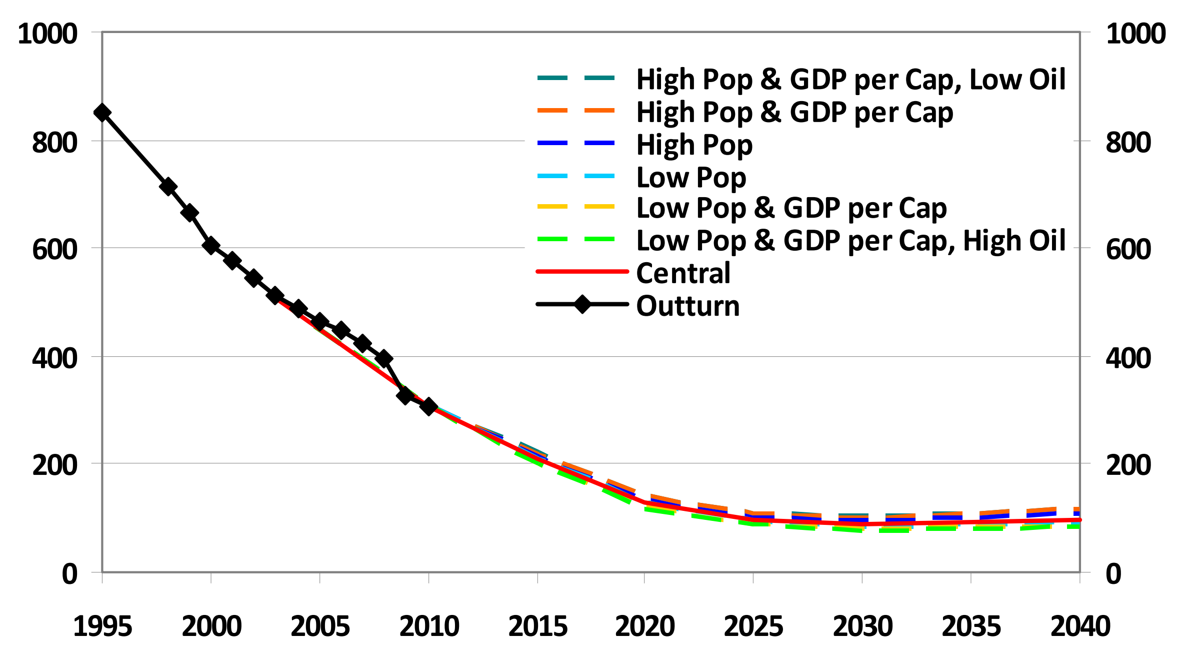


Figure 19: England All Roads PM10 (kt) Forecasts