Department for Transport

Road Traffic Forecasts 2015

March 2015

The Department for Transport has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the Department's website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact the Department.

Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR
Telephone 0300 330 3000
Website www.gov.uk/dft
General enquiries https://forms.dft.gov.uk

Contents

Executive summary

1. Understanding the future demand for road travel is essential to help shape the policies we implement and the investments we make and to ensure that the outcomes for people's lives and livelihoods are fully understood. These are issues that have important outcomes for people's lives and livelihoods and involve billions of pounds of taxpayers' money.

2. Forecasts are not a target to be met nor do they define the level of road capacity required, but to develop the right strategy it is vital that we are able to understand how road traffic might change over time. This requires a robust forecasting approach that is based on the best available evidence of the underlying drivers of traffic demand, their relationship with changes in traffic and an approach that can model this appropriately.

3. This document presents the latest road traffic forecasts for England produced by the Department for Transport. The main use of these forecasts is to inform the Department's strategy, while individual scheme decisions are based on more localised evidence. Summaries have already been published in the Roads Investment Strategy[1] and the National Policy Statement for National Networks.[2] In this report we provide detail on how the forecasts have been produced, the underlying evidence that supports the forecasts and more detailed analysis of the results including forecasts of demand, congestion and emissions.

4. These forecasts are produced using a broad range of evidence and data on travel behaviour and the factors that influence it. This is brought together in the National Transport Model (NTM) which is designed to forecast long-term trends and provide us with a strategic view of possible future trends in road traffic. When considering these forecasts they should not be viewed as what we want the future to look like, but what may happen, using the best available evidence, based on:

   - Our 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.

---

[1] www.gov.uk/government/collections/road-investment-strategy and
www.gov.uk/government/publications/national-policy-statement-for-national-networks[3]
www.gov.uk/government/publications/understanding-the-drivers-of-road-travel-current-trends-in-and-factors-behind-roads-use

Improvements to our forecasts

5. This new set of forecasts is an update to Road Traffic Forecasts 2013 (RTF13). Some stakeholders have expressed a general concern around how our forecasts of significant traffic growth fit with recent data showing a largely flat trend over the last decade, and highlighted specific issues such as the performance of the forecast in London.

6. We have listened to these concerns and we have responded - both in terms of reviewing our assumptions to ensure they reflect the latest evidence, and in terms of giving greater transparency around the results.

7. We have carried out a systematic review of the evidence on road demand, which we have summarised in our *Understanding the Drivers of Road Travel* report.[3] In this, we concluded that the factors we typically highlight as being key drivers of road demand - incomes, costs and population - have been important drivers of recent trends in traffic but that they may not tell the whole story.

8. Other factors such as increasing concentrations of people living in urban areas, increased costs such as company car taxation and insurance, capacity constraints, technological developments which allow for homeworking and online shopping. Related to this, the number and nature of the journeys that people make, may all be playing a role. Meanwhile established relationships, such as the one between income and car travel, may be changing.

9. Some of this (such as the road congestion in constraining traffic growth, the spatial distribution of the population, and a weakening link between income and car travel) is routinely captured in our forecasts. In other cases, we have attempted to make changes to our assumptions to incorporate new and emerging trends. Alongside this, we have updated the macroeconomic data that feeds into the model and some of the evidence that is used in the modelling.

10. The Department is taking forward a programme of work to understand these trends and how they should influence future demand. Ahead of this work being completed these road traffic forecasts employ a scenario approach to attempt to capture more of the uncertainty. For the first time we have shown how traffic levels may change when we vary assumptions besides the growth in GDP and population, or changes in fuel costs. The purpose of the scenarios is to map out the broad range of potential outcomes given the uncertainty and the evidence available.

11. While there is currently little evidence on the impact that certain issues, such as online shopping, may be having on travel decisions, we know that most of the recent fall in per person car mileage has arisen through a decline in the number of trips people are making. We have extended our range of forecasts to include alternative assumptions for how trip making behaviour may evolve (whatever technological, social or attitudinal changes may cause this). We have also considered how traffic levels may change if the relationship between income and car use

---

[3] www.gov.uk/government/publications/understanding-the-drivers-of-road-travel-current-trends-in-and-factors-behind-roads-use

breaks down, as this is an issue which has been of increasing interest in the literature.

12.   This work is just one step in the process of understanding the trends in future traffic demand and ensuing that our forecasts remain relevant for the use that we put them to.

What our forecasts show

13.   National traffic is forecast to increase in all our scenarios, but the size of that growth varies, depending on the number and types of journeys that people make, the effect of rising incomes on car ownership and car use, and future trends in income growth and fuel prices - three key uncertainties we have identified for future road demand. The range of our forecasts is for 19% to 55% growth between 2010 and 2040.

14.   The growth in national traffic levels is predominately driven by the projected growth in population levels. Average distance travelled per person by car is forecast to grow under most scenarios - as rising incomes and falling costs result in more trips being taken by car. However, in one of our scenarios average car mileage per person is forecast to fall by 7% and only population growth explains the growth in traffic. In the other scenarios population is just one factor in the overall growth.

15.   The growth in national traffic levels masks much more variation across area, road and vehicle types. While traffic growth may continue to be strong nationally there is a different picture locally. Growth is expected to be particularly strong on the Strategic Road Network - between 29% to 60% from 2010 to 2040 while it is 12% to 51% on other principal roads and 10% to 54% on minor roads. While in most scenarios we expect traffic to grow strongly on local roads and in urban areas and cities, the lower end of the forecasts represents an outcome where the recent fall in trips continues over the next 30 years.

16.   Meanwhile, significant growth in LGV traffic makes an important contribution to our forecast of national road traffic. Even under our scenario where individual car mileage falls, and overall car traffic (as a result of population growth) is just an increase of 9%, the forecast growth in LGVs means national traffic levels are forecast to be 19% higher in 2040.

17.   We have repeated our previous tests for how well the NTM forecasts traffic trends, and find that it continues to perform well when inputs for GDP growth, fuel costs and population are correct - the NTM forecast for car traffic in 2010 is within 1% to 3% of observed traffic data. We have also tested what our forecasts imply about how much time people spend travelling a day, and find that where we forecast strong growth this does not imply that people spend significantly more time travelling.

18.   We believe our forecasts provide a reasonable range of outcomes for future traffic levels, and we remain confident that they are suitable for the uses to which they are put.

19.   The model and the analysis presented here provides a rich and insightful picture of what might be behind future traffic growth, and how this may

vary across different road, area and vehicle types given different assumptions about future travel behaviour and economic conditions.

20.   This is a complex picture. The range of potential outcomes covers different patterns of demand as well as levels of traffic growth. Our alternative assumptions about travel behaviour provide a range of potential outcomes between each of the scenarios, reinforcing our view that this set of forecasts is just one step in the process of improving our understanding of the evidence and its potential impact on road traffic.

21.   We recognise that travel trends continue to evolve, as do the range of factors behind them, and there is still much uncertainty around travel behaviour. So we have more work to do to understand how these patterns may emerge over time and to continue updating and improving the NTM and our range of forecasts to reflect this.

22.   The number and type of trips that people make is an important element in the uncertainty. We set out our plans for further developing this in *Understanding and Valuing the Impacts of Transport Investment*[4] progress report and our forthcoming analytical strategy will give more detail on how our we will develop this in the context of the National Transport Model. Finally, we look forward to continuing the work with our stakeholders on the approach to modelling and forecasting.

1. Our approach to forecasting

What are these forecasts used for?

1.1 Road traffic forecasts are used by a variety of external stakeholders and experts with diverse interests. Forecasts are interesting in their own right as we try to understand, and project, what might happen in the future and how it might affect us as individuals, our business or the organisations we work for.

1.2 Traffic forecasts also have direct relevance to the work of Government. They are used:

1.3 to inform roads strategy (the forecasts presented here fed into the Roads Investment Strategy published in December of last year);

- as an important tool in policy simulation where understanding future travel demand helps us understand how people will respond to policy changes and whether those are the right policies to implement;

- in investment appraisal to understand the combined impact and value for money of packages of schemes across the whole network using the National Transport Model (NTM);

- to estimate the mode shift benefits, like reduced congestion, which are used in appraisals for schemes where models of the highway network are not available;

- to assess the impact of environmental policy and are an important part of the Department's work on transport's contribution to meeting the UK's climate change targets.

1.4 The forecasts are designed to provide a national view of possible future trends in road traffic and are used to analyse the implications of a variety of strategic level policy options on traffic levels, emissions and congestion. They provide a tool to understand the case for, and impact of, investment in the road network across the country as a whole, and other road transport policies.

1.5 They are not and should not be used to appraise individual road schemes, nor can they be used to consider the right level of capacity on a specific road or solutions to specific local issues. Analyses of specific schemes use bespoke models fitted to local conditions to inform decisions.

Modelling transport demand

1.6 Forecasting travel demand requires an understanding of the factors that influence travel demand. The interactions between these factors, the nature of their relationship with travel demand, and important

demographic variations within them make traffic forecasting a complex process. We believe that a multi-modal and highly disaggregated approach using a suite of models is the correct way to deal with this complexity.

1.7 Evidence suggests that it is useful to think about an individual making travel choices across five dimensions:

- Whether to travel (trip generation/frequency) – the individual decides whether they need to make a trip (e.g. to work, the shops or to visit friends). The aggregation of all individuals' micro decisions determines the total number of trips.

- Where to travel to (destination choice) – 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 (route choice) – 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 quicker and lower cost mode and route to travel to their destination of choice. The higher the costs of travel both in time and money, the less likely someone is to choose to travel at all. However, every individual will also have other preferences that influence their choices – preferences for specific modes or around convenience, safety, social acceptability or other characteristics. Our recent work *Understanding the Drivers of Road Travel*[5] has highlighted the extent to which travel behaviours vary by individual characteristic and location. In practice, it is clear that many individual travel decisions are habitual, significantly more complex than this and almost certainly not sequential, but it is a useful way to conceptualise the decisions which drive traffic levels.

1.9 In particular, analysing decisions using these five dimensions helps us explain the aggregate travel patterns observed, identify where changes are occurring and where the main uncertainties are. For example, the decline in trip rates over the last decade suggests behaviour at the first stage might be changing, while the rise in rail demand and increasing levels of cycling in some cities may point to changing preferences around different modes. The implications of this for our forecasts are set out in the next section on our scenario approach to forecasting.

---

[5] www.gov.uk/government/publications/understanding-the-drivers-of-road-travel-current-trends-in-and-factors-behind-roads-use

1.10 The starting point for our forecasts is the National Trip End Model (NTEM) dataset and suite of models which is the basis for forecasting multimodal demand.[6] This provides an initial forecast of travel demand for all modes and is based on evidence and research, gathered over many years, which can be used in bespoke transport models. NTEM is described in more detail in chapter 2.

1.11 The NTEM dataset provides forecasts for the first two dimensions of travel choices in paragraph 1.7, while the NTM takes this and projects forward based on assumptions for the last three dimensions.

1.12 The NTM covers the whole of Great Britain and is the Department's primary tool for forecasting national road traffic. The model and the underlying evidence are under continuous review and the Department is keen to work with stakeholders to best identify the priorities for further evidence gathering.

1.13 The NTM uses the four stage modelling approach which is the standard methodology for transport demand forecasting. It is able to take account of the complex range of choices and interactions that models based on aggregate trends cannot. As a result, we believe that the NTM is currently the best tool available by which to forecast road traffic demand and, by continually reviewing and improving the underlying evidence, we expect to ensure the forecasts that it produces remain fit for purpose.

Scenario approach to forecasts

1.14 It is important that our forecasts provide a sound basis on which to inform and test policy. The uses that forecasts are put to and the decisions that they inform require that we properly understand the uncertainty around them and the impact that this has on the policy decision.

1.15 Alongside previous traffic forecasts we have shown that the NTM is able to explain much of the recent trend in national traffic levels, suggesting it remains a suitable approach to forecasting road transport. However, in light of the recent slowing down in traffic levels, and concerns around whether the model is capturing the full range of influences, we have carried out a review of the evidence on the factors behind road demand. As the result of this review we have made some changes to the forecasting approach.

1.16 Even with a better understanding of the underlying evidence there remains uncertainty about how some trends and relationships will carry on into the future. This, combined with uncertainty around the key economic and demographic inputs, leads us to adopt a scenario approach that enables us to understand the impact of a range of risks to the forecasts.

1.17 In previous publications we have produced sensitivity analyses of the key macroeconomic variables - population, income measured by GDP per capita and fuel prices. In this analysis we have extended this to include the impact of alternative outlooks for two important behavioural factors -

---

[6] www.gov.uk/government/publications/webtag-si-ntem-sub-models-november-2014

the number of trips that people make and the relationship between income and car ownership and car use.

1.18 The scenarios are a tool for understanding a range of potential states of the world and the implications for traffic demand. Of particular interest will be the assumption of a fall in the future level of trip rates as set out in *Understanding and Valuing the Impacts of Transport Investment* progress report. The Department will be introducing an update to the NTEM dataset early in 2016 which will consider the latest evidence on trip rates. Ahead of the completion of this work we have used this scenario analysis to understand the impact of a range of potential outcomes for road traffic. The range is bounded by two sets of assumptions - that trip rates remain at their historic levels and by exploring the impact of the current declining trend continuing until 2040. This approach should capture a broad range of possible outcomes.[7]

1.19 In scenario 1 we have used the same assumptions as we did in Road Traffic Forecasts 2013 (RTF13)[8], with some slight improvements (described further in the next chapter). In this scenario we assume that the number of trips people make remains constant at the historic average, that incomes and costs affect travel choices in the same way as previously modelled, and use Office for Budget Responsibility (OBR) and Department of Energy and Climate Change (DECC) central forecasts for future changes in incomes and fuel prices.

1.20 Although the evidence generally finds that income positively influences road demand, it is noted that much of this is dated and there is some limited evidence that the strength and nature of this relationship may be changing. Although higher income groups still drive significantly more than those with lower incomes, the recent decline in car use amongst higher income groups may suggest that there may be other factors which are offsetting the effect of rising incomes on demand. In scenario 2 therefore we have removed the relationship between income and car travel to test the potential impact of this on the forecasts.

1.21 The evidence of a change in travel behaviour observed through a decline in the trip rates over the last decade, and the extent to which this will continue into the future is a key uncertainty for the future direction of growth in travel demand. In scenario 3 we have updated trip rates for modelled years 2003 and 2010 to reflect outturn values and extrapolated this recent trend to 2040 to understand how this might impact on traffic growth.

1.22 Extrapolating this far may be seen as a strong assumption, but it is one of the main areas of uncertainty and it is important that we explore the potential for it to impact on traffic demand. The reasons for the fall are as yet unclear and this approach extrapolates from a period that includes the recession which may be a causal factor. However, for the purposes of this exercise, scenario 3 assumes a wider set of underlying issues is driving this trend.

---

[7] An update to NTEM is scheduled for early 2016 which will consider the latest evidence on trip rates. For the avoidance of doubt scheme promotors should continue to use NTEM v6.2 until the update is ready for use, taking into account the guidance under the WebTAG Proportionate Update Process.
[8] www.gov.uk/government/publications/road-transport-forecasts-2013

1.23 Finally, the volatility in the oil price and the historical difficulties in forecasting GDP we believe requires that we continue to vary assumptions around the growth in these variables, to take that uncertainty into account. In scenarios 4 and 5 we have produced low and high demand variants of scenario 1 using alternative assumptions for GDP and fuel.

1.24 Over the last year we have also tested our assumptions around road capacity, car ownership in London and the demand for other modes. All of these had a very small impact on demand, giving us confidence in the robustness of our forecasts against these assumptions, and were therefore not taken forward (see the annex for further details on our road capacity tests).

1.25 In summary, there are 3 key or critical uncertainties we have chosen to focus on in our scenarios - (i) peoples' propensity for travel (as reflected in trip rates); (ii) the cost of travel and peoples' ability to pay for it (as reflects in fuel costs and income growth); and (iii) the extent to which rising incomes lead to higher rates of car ownership and car use. These uncertainties are reflected in our 5 forecast scenarios. Scenarios 1, 4 and 5 use central, high and low estimates of income and fuel cost, scenario 2 removes the link between income growth and travel and scenario 3 explores the impact of alternative assumptions for future trip rates. Table 1.1 summarises these.

Table 1.1: Summary of variations between forecast scenarios			
	Trip rates	**Income relationship**	**Macroeconomic**
Scenario 1	Historic average	Positive and declining	Central
Scenario 2	Historic average	Zero	Central
Scenario 3	Extrapolated trend	Positive and declining	Central
Scenario 4	Historic average	Positive and declining	High oil, low GDP
Scenario 5	Historic average	Positive and declining	Low oil, high GDP

1.26 This scenario approach will be developed further in future, and we are interested in other variants. The future direction of trip rates in particular is an area where there is potential for a much wider range of alternative assumptions to reflect a number of different issues, and we will explore these as our understanding of road demand and the evidence base develops. However, we believe that the assumption the recent trend continues to 2040 presents us with a particularly conservative forecast of traffic growth.

Structure of document

1.27   This paper is structured as follows:

- Chapter 2 describes the factors that are taken into account in the forecasts, describes the National Transport Model (NTM) that is used to produce the forecasts and sets out the changes that we have made to the model and the forecasting process.

- Chapter 3 presents the results of the forecast scenarios and the historical performance of transport forecasts and the current performance of the NTM as a forecasting tool.

- Chapter 4 sets out the next steps

2. Factors taken into account in the forecasts

2.1 Road demand depends on a range of factors including the cost of driving, where people live, the availability of other modes, their employment, income, and car ownership. It also depends on land use, the availability and cost of other modes and the level of congestion. Whether and how these various factors are represented in the forecasting approach is a key element in the usefulness of the results.

2.2 Travel patterns and behaviour change and new evidence is continually emerging that sheds further light on what determines peoples' travel choices and the aggregate level of travel demand. Recently the rate of traffic demand growth has slowed down, even preceding the recession, and this has brought into question some of the long understood relationships which underpin our forecasts. Traffic forecasts have been produced by the Department for a number of years and the methodology has developed over that time, taking into account changes in behaviour.

2.3 Within the forecasts we attempt to use the best data and evidence that is available to us and that can reasonably be used as part of the forecasting process. This chapter describes the factors that are taken into account, the data that is used within the forecasting process and how we have updated the model with recent data and evidence.

Improvements to our forecasts

2.4 Since the publication of the last forecasts we have worked on a number of improvements to the NTM and the forecasting approach to address a number of challenges. These include specific issues around the performance of our forecasts in London and how our forecasts fit with recent travel trends more generally.

2.5 We have carried out a review of the evidence on trends in road demand and the factors behind them and published the findings of this in *Understanding the Drivers of Road Travel*. We have separately looked at how this evidence is represented in the modelling process and we have attempted to ensure our forecasts are as consistent with the new evidence base as possible to ensure that they provide a sound basis with which to inform transport policy.

2.6 There are a number of factors where we have a reasonably good understanding of how they affect traffic levels such as where people live, levels of congestion, costs and income. These have all had an impact on dampening traffic levels over the last decade and these factors are all

accounted for in the forecasts. Later on in this section we set out in more detail how they are incorporated.

2.7   There are other factors that we know have impacted in the past but that are unlikely to have much influence in the future. Most notably changes to company car taxation and ownership and the subsequent reduction in company car mileage will not continue indefinitely.

2.8   There are other factors that could continue to have an effect on traffic growth, but on which we currently have insufficient evidence. For example, lifestyle changes or impacts of changes in technology, that could affect the nature of the trips that we make and reduce the potential for car dependency.

2.9   These factors are more difficult to incorporate as the evidence on their causal effect is not readily available or conclusive, or (as in the case of company car mileage) because they reflect a one-off change to policies that are not explicitly captured in the model. However, their impact is captured through the extent to which it is reflected in the data on the trips people make (e.g. fewer company car trips, or fewer trips to the shops due to online shopping), which goes into our model.

2.10   To explore further we have used alternative assumptions about how trends in trip rates may evolve and how income affects travel demand. These address uncertainty around how factors may affect travel in the future while we carry out further analysis.

2.11   The performance of the forecast in London has been an issue in previous forecasts. RTF13 set out the reasons for this, citing lower outturn car ownership than we forecast, significant investment in public transport and a reduction in road capacity.

2.12   As part of these new forecasts we have addressed the issue of road capacity using TfL data on road capacity and traffic speeds to update the model which is explained further in paragraph 2.57 below. When tested on RTF13 forecasts this reduced the London traffic forecast by around 1.7% for 2030.

2.13   The NTM is designed to forecast traffic at a national level and at local levels there will be specific issues that are more challenging for us to capture in a strategic model. We will continue to look at this issue to see if what further improvements we can make. We have tested the effect of reduced car ownership in London and this will be explored in future work.

Summary of changes to the forecasting approach

- The introduction of a forecast scenario in which income growth does not result in rising car travel for comparison with other scenarios where increased income increases car ownership and car travel.

- The introduction of a forecast scenario where the past trend in trip rates has been extrapolated forward to 2040 for comparison with the other scenarios where trip rates have been held constant from 2010.

- Update to the speed and capacity of the London road network to reflect observed data.

- Update of fuel price, fuel efficiency and GDP forecasts.

- Update to the capacity of the road network to reflect the December 2014 Road Investment Strategy.

Trip Rates

2.14   Trip rates are an estimate of the number of weekly trips that people make and represent one of the primary input parameters in the NTEM dataset used in the road traffic forecasts. The rates used in NTEM are the basis of the modelling of the first stage of the travel decision (trip generation). Over recent years they have also become an area of particular uncertainty and therefore require further consideration.

2.15   Trip rates are estimated for 11 socio-economic groups, (e.g. gender, working status, age), 8 household types (e.g. number of adults and cars in a household), 8 journey purposes (e.g. shopping, commuting, visiting friends) and 8 area types (e.g. inner London, outer London, urban, rural). Overall there are over 700 unique trip rate values estimated for 5,600 individual segments.

2.16   Historically, the rates for each of these individual segments have been assumed to remain constant into the future in the forecasts. Nationally, trip rates vary only due to projected demographic changes and income growth (see below for more detail) - the latter of which tends to move people into higher car owning segments and thus more likely to undertake different types of trips.

2.17   Our analysis of National Travel Survey (NTS) data has however shown that the average number of trips has been falling for a number of years[9]. NTS data for home based trips covering the period 1998 – 2010 (the latest data available at the outset of our study) was used to analyse travel records for over 200,000 individuals with almost 2 million trips.

---

[9] www.gov.uk/government/statistical-data-sets/nts03-modal-comparisons

2.18   Investigation of the trends has revealed a general downward trend in trip rates which has also been similarly described in headline statistics reported by NTS publications. The two most common journey purposes (shopping and commuting), exhibit a statistically significant downward trend with reductions of 6% and 10% respectively between 2003 and 2010. The trends in the data are not uniform and vary according to purpose and segmentation (e.g. gender, area, household type). For example, the personal and employer's business purposes are stable while the holiday trip rate is increasing. It is worth noting at this point that the trips that reduce tend to be shorter distance.

2.19   The recent decline may be partly due to economic conditions, and as these are forecast to improve in the future there is reason to believe the decline will not continue at its current rate in the long term. However, there are a range of other factors which could be contributing to the decline and could continue to push trip rates down. For a fuller discussion of this work see the DfT publication *Understanding and Valuing the Impacts of Transport Investment Progress Report*.

Figure 2.1: Change in trip rates 2003 to 2010
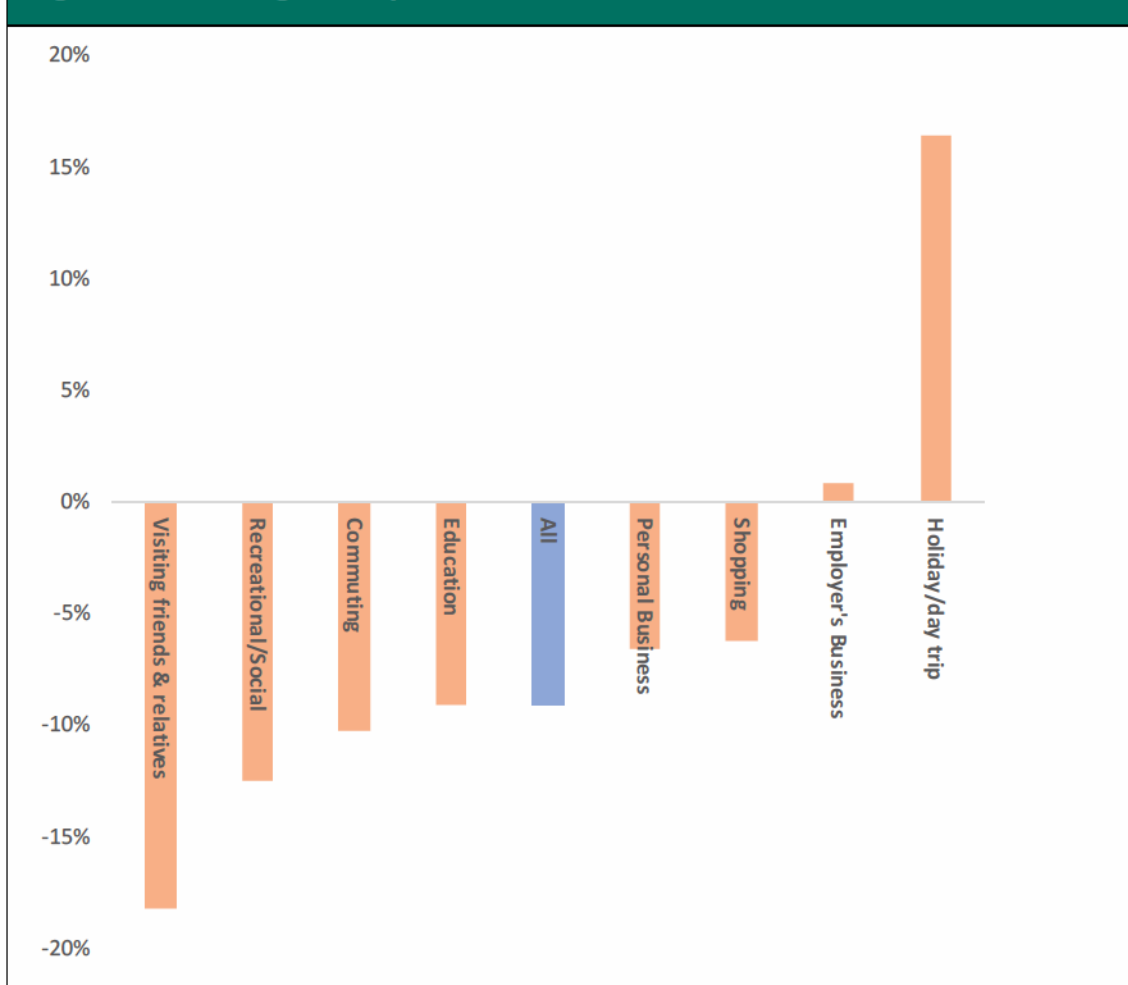
2.20   We have taken a number of steps to account for this recent decline in trip rates in the traffic forecasts. We used the latest trip rate data, collected by our trip rates review, in our NTM forecasts for 2003 and 2010 - whilst holding all other assumptions constant - and maintaining
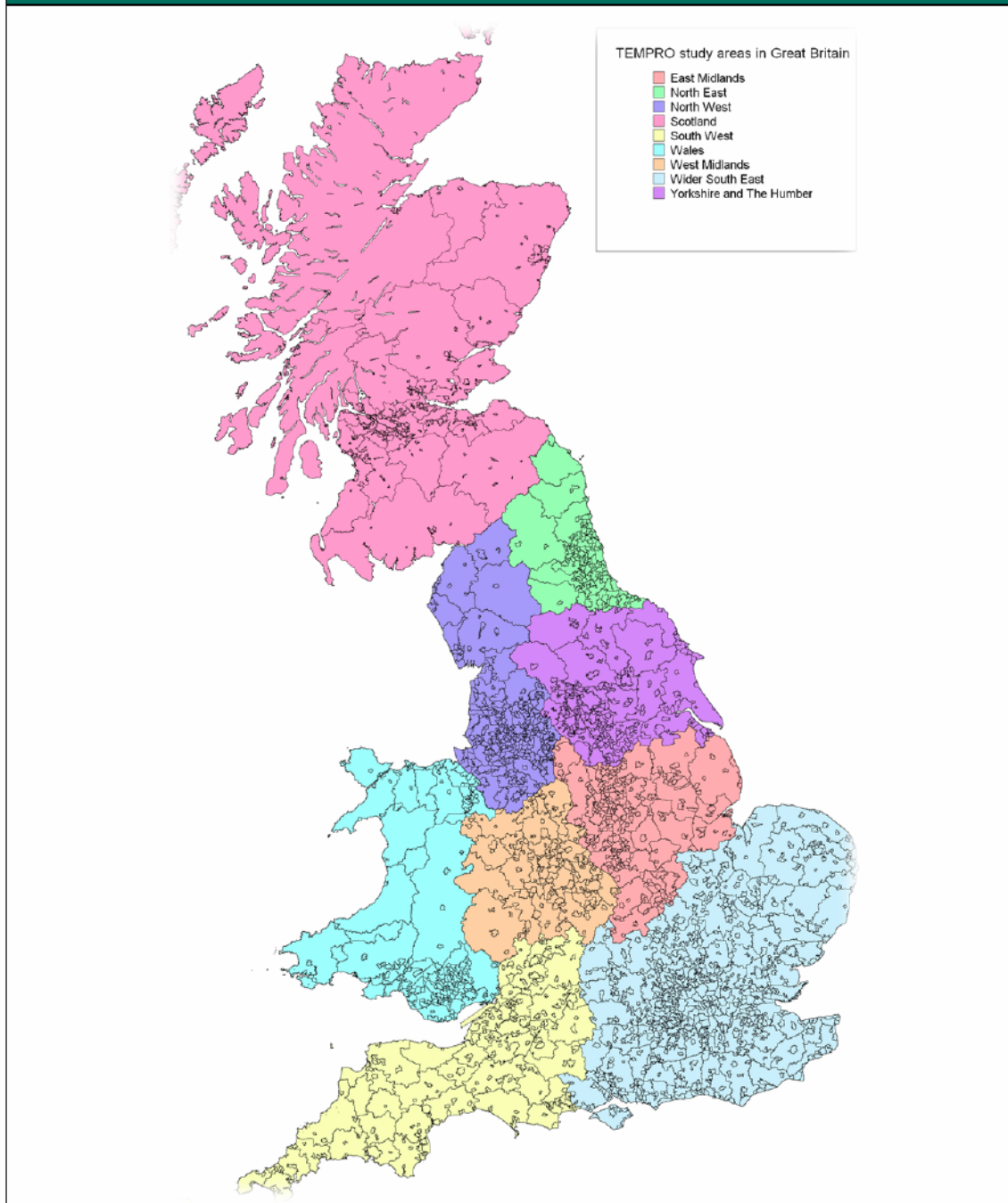
the assumption that trip rates will remain constant but at their 2010 levels into the future.

2.21   Our tests show that this has a limited impact on the forecasts for traffic growth, with a reduction in traffic volume of around 2% for 2010 but with no impact on the rate of demand growth as trip rates are held constant into the future. The calibration of the NTM to actual traffic levels in 2003 means that the assumption about how trip rates change in the future is more important than the absolute level.

2.22   Given the importance of the decline in trip rates for recent traffic trends however, we have used two different sets of trip rates in our forecasts. At one end of the scale we assume that they remain at their historic level and at the other end of the scale we have, in one forecast scenario, assumed trip rates decline at their current rate all the way to 2040. We might reasonably expect that the outcome will be somewhere between these two.

2.23   This is the first time we have adopted an alternative assumption for trip rates and ensures that, until we have a better understanding of the reasons behind the recent decline, we can capture a range of possible outcomes based on alternative assumptions of trip making behaviour.

2.24   The forecast decline is estimated by extrapolating the recent trend from the NTS data for each of the trip rates segments (household structure, gender, journey purpose, employment) to 2040.

Spatial and Demographic demand for travel

2.25   Demographic changes are a key driver of the number of trips (travel) demand changes in NTEM. Within the NTEM suite the Department utilises a land-use model (called the Scenario Generator) that rationalises various local and national data sources for population, employment and housing supply to give future estimates of where people live and where they work. Our forecasting approach uses planning data projections largely taken from other Government Department sources and Local Authorities. The spatial detail of the current model is illustrated in figure 2.2.

Figure 2.2: Zoning System of the National Trip End Model Data Sets

TEMPRO study areas in Great Britain
- East Midlands
- North East
- North West
- Scotland
- South West
- Wales
- West Midlands
- Wider South East
- Yorkshire and The Humber

2.26 The detailed demographic projections are split by broad age group and gender and are further disaggregated to identify whether households own a car, based on factors such as income growth and car ownership saturation levels. This has been shown to be an important indicator in determining the number and type of trips which people will make. The car ownership modelling is described in paragraph 2.30 below.

2.27 This is combined with census data, employment data and with trip rates for different socio-economic groups and journey purposes estimated from the National Travel Survey, as described above, to forecast future trips to and from areas in Great Britain.

2.28 The spatial representation of the population allows us to capture issues such as differences in the population growth between types of areas such as cities and rural that are included in the ONS population forecasts included in the NTEM planning data. This creates very detailed forecast datasets comprising the number of trips, the purpose of the trip and the household types they are generated from for approximately 2,500 zones in Great Britain.

Future changes to NTEM

2.29 With the publication of the 2011 Census data and updated demographic and planning projections we have the opportunity to update our models. A full update of NTEM is underway and is scheduled to complete early in 2016. This includes a thorough review of the forecasting capability of the whole suite of models. It will also include the re-estimation of people's trip-making patterns with the most recently available data from the National Travel Survey, which will implicitly incorporate the latest information we have on people's travel choices, capturing many elements of behavioural change that have occurred in the previous decade.
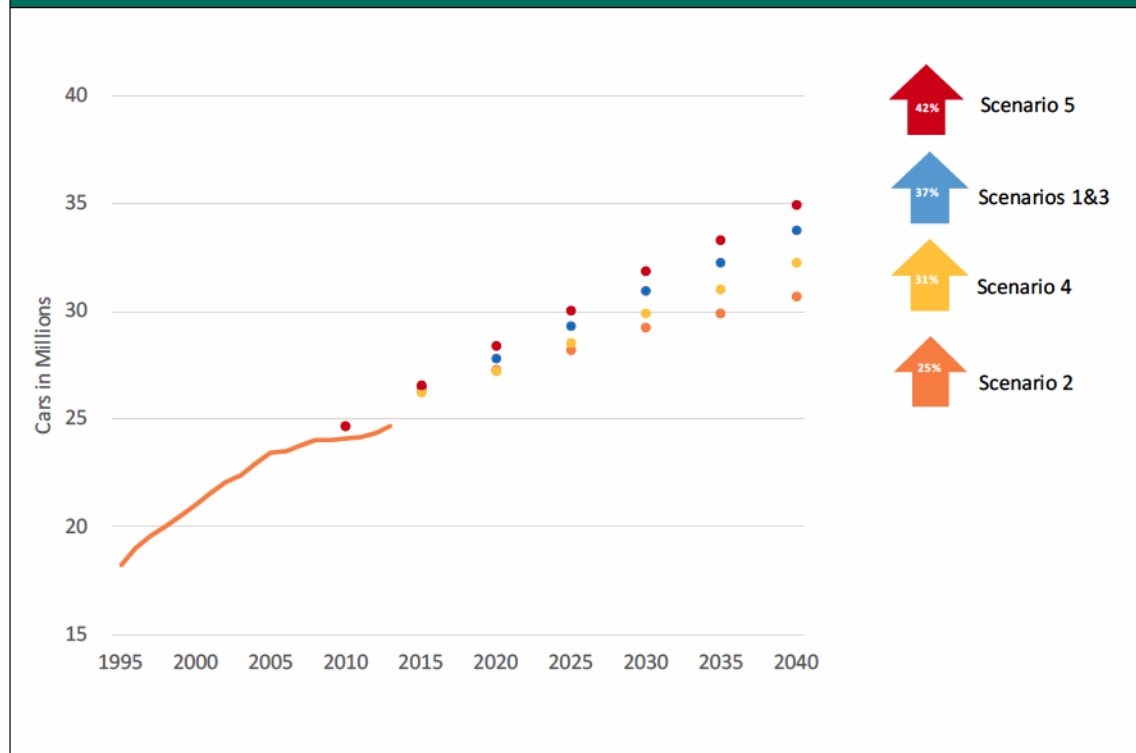
Car Ownership

2.30 Whether a household has access to one or more cars is a key factor in their trip making patterns, their choice of mode and the resulting level of road travel demand.

2.31 The National Car Ownership model (NATCOP) is part of the NTEM suite of models.[10] Its projections of car ownership affect the number and purpose of trips by different person types within the NTEM, based on evidence (from the NTS) around how these differ according to the number of cars a household has access to.

2.32 Forecasts of car ownership take into account forecasts of factors which evidence shows have an impact on the probability of owning none, one or multiple cars. Specifically these are - household structure (including age and number of children), income and economic background, area type, rates of company car ownership and car license holding. These are combined with our demographic projection, forecasts of income growth and car purchasing costs to produce forecasts of car ownership.

2.33 The resulting forecast of the number of cars owned is used in forecasting the number and purpose of trips, and through this it has a direct effect on the level of car travel in the model. Maintenance and insurance costs as well as parking costs are not explicitly considered in the model and this may affect the quality of the forecasts, especially for younger drivers who cite costs as a key factor for not learning to drive. We can gauge the extent to which it does from how the forecasts from the model compare to recent data.

---

[10] www.gov.uk/government/publications/webtag-si-ntem-sub-models-november-2014

2.34 In this latest set of forecasts car ownership in England is forecast to grow from 25m in 2010 to between 31m and 35m in 2040, an increase of 25% to 42% over 30 years. This compares to a rise in the vehicle stock from 18m to 24m (a 32% increase) between 1995 and 2010.[11] This shows how significant the rise in car ownership has been, even through the years of the recession.

Figure 2.3: Total car ownership, England 2010 - 2040 (millions of cars)

2.35 The difference between car ownership in each scenario is due to the treatment of income. Scenarios 1 and 3 assume a positive relationship between income and car ownership, and incorporate the central GDP forecasts produced by the Office for Budget Responsibility (OBR). Scenario 2 removes the link between income and car ownership by negating the increased probability of car ownership as households move into higher income groups but retains the impact of population growth. Scenarios 4 and 5 use low and high GDP sensitivities and produce lower and higher forecasts of car ownership.

---

[11] Vehicle licensing statistics www.gov.uk/government/statistical-data-sets/veh02-licensed-cars

Figure 2.4: Forecast car ownership per person by region (scenario 1)
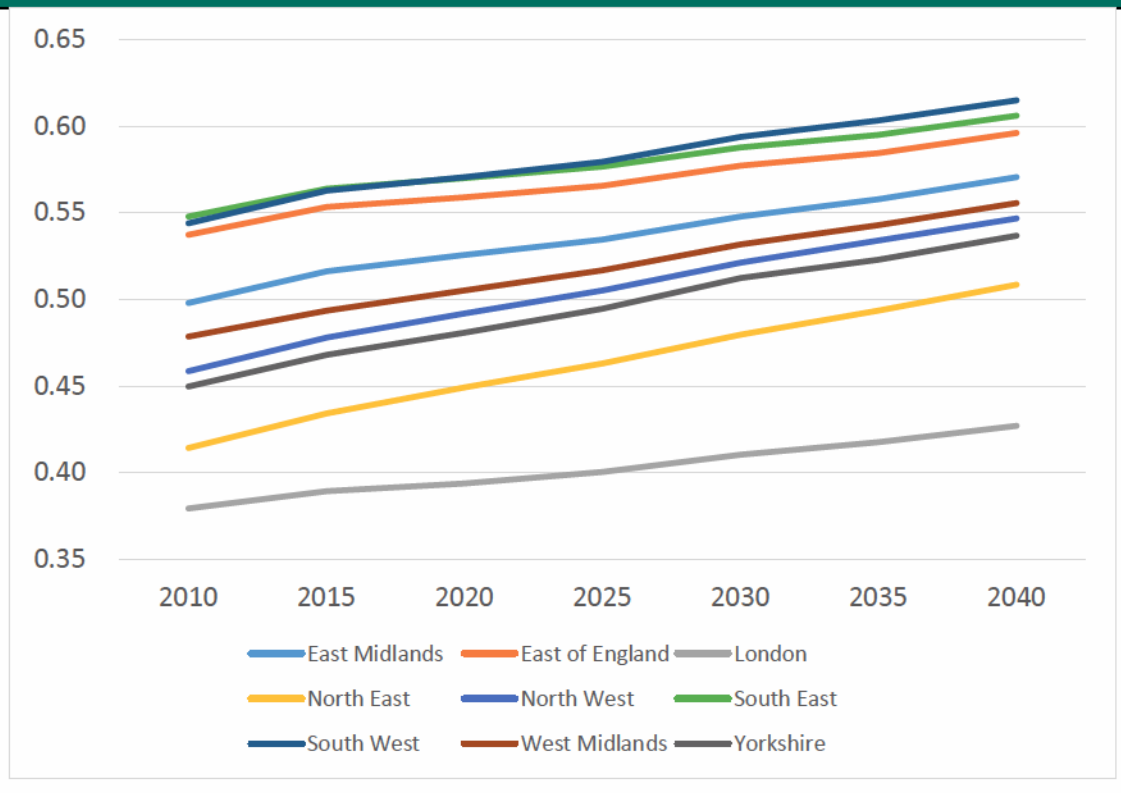
2.36 Geographical representation of car ownership demonstrates the importance of area type in the forecast. In London, in spite of higher GDP per capita, the forecast of car ownership is lower than other regions and forecast to grow at a slower rate. This is broadly consistent with the different trends in car ownership found for London and the rest of England in our *Understanding Drivers of Road Travel* publication - although our forecasts do assume that, as incomes rise, the recent flattening of growth in car ownership observed in London does not continue. There may be other factors, such as the availability and costs of parking, which may have contributed to the recent decline in London, which we haven't taken account of in the car ownership forecasts. Further investigation of the link between these factors and car ownership is part of the wider update to the NTEM dataset set out in *Understanding and Valuing the Impacts of Transport Investment* progress report.

Population

2.37 ONS population projections are embedded within the NTEM dataset. While the spatial and demographic disaggregation of these is critical to producing robust forecasts of traffic, understanding aggregate population changes is important in understanding the overall trend in car use.

2.38 Population growth has been a crucial factor in overall car travel at a time when annual distance per person has fallen. As population continues to

increase there is a logical link to an increase in the aggregate level of road traffic. Population is forecast to grow by 19% between 2010 and 2040.

Income

2.39   There is a long established link between income and road demand. Higher levels of income increase the amount people are prepared to spend on transport. In the forecasts this is represented in three ways:

- Firstly, directly through people being more likely to own a car (through the car ownership model)

- Secondly, through people being more likely to use a car and travel further as their household income rises. In the NTM the choice of mode is influenced by how much an individual values their own time. This is assumed to increase in line with income, and people with higher values of time prefer faster modes of transport - i.e. car and rail.

- Thirdly, income is also included within the NTEM dataset as people on average make more trips as they move into higher income bands. In the model the overall impact of income is diminishing over time due to impacts such as increasing maturity in car ownership and the impacts of congestion on mode choice.

2.40   Our review of the evidence - including a commission into road traffic elasticities has found that, while there is some evidence that the relationship between income and car travel may be weakening, it is still positive. However, much of the evidence in this area is old and there is a case for updating it.

2.41   The assumptions in our model already result in a weakening relationship between rising incomes and traffic - as demonstrated in the extended version of Road Traffic Forecasts 2013. Nonetheless, to capture the potential for this relationship to break down further we have introduced a forecast scenario where income growth does not result in increases in car ownership, mode choice or distance travelled. This may be viewed as a relatively strong assumption, or one which crudely captures other factors which aren't in the model that might offset the effect of rising incomes.

2.42   While the evidence points to a weakening of the relationship, there is currently little to suggest income has no effect on car travel. Higher income groups still drive significantly more than those on lower incomes and the *Understanding the Drivers of Road Travel* report showed how falls in income for males and the young have coincided with falling mileage, and how increasing incomes amongst women and the elderly have coincided with increasing mileage. Income growth used in the forecasts is GDP per capita based on the Office for Budget Responsibility short and long run GDP forecasts. Income per capita

growth is forecast at 60% between 2010 and 2040 in scenarios 1, 2 and 3 (1.6% annual average growth).

2.43   As forecasting GDP growth is uncertain, sensitivity tests based on the OBR's 20th and 80th percentile short term forecasts and on low and high productivity long term scenarios are included in high and low demand forecasts. This results in 30% per capita income growth (0.9% annual average) in scenario 4 and 88% (2.1%) in scenario 5.

Figure 2.5: GDP per capita growth (2010 = 100)
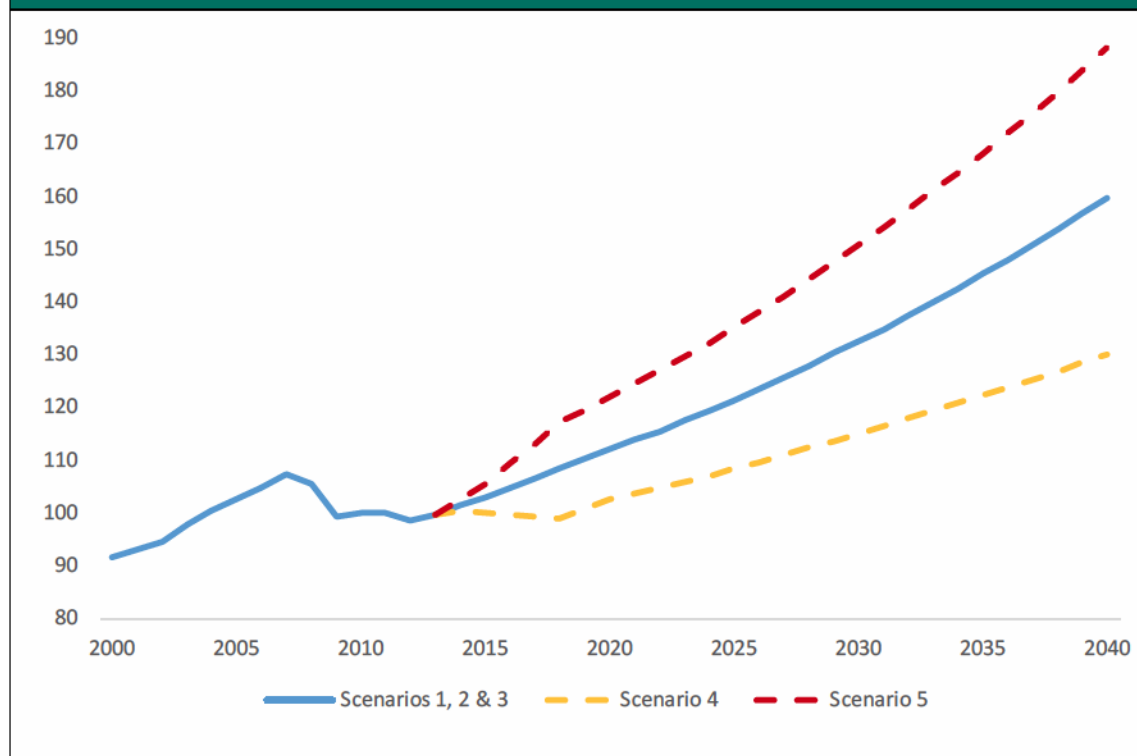
Fuel Price and Fuel Efficiency

2.44   The cost of travel is a key determinant of the choice of mode and the nature of the journey undertaken. The money cost is combined with various time based factors (including estimates of travel time, access and egress time) to produce a generalised cost which is compared across modes. The higher the cost of one mode relative to others then the lower the probability that mode will be chosen.

2.45   In practice the money cost of driving comes from a number of factors. In these forecasts the principal drivers are the price of fuel and the amount of fuel a vehicle uses over a journey. Of the other costs of driving, vehicle purchasing cost is included in the decision to purchase a car but it does not feature in the journey and travel decisions once the car is owned. Insurance costs may have had a downside impact on certain

groups such as the young and males but such effects are too complex to include in the model.

2.46 Simple analysis of data shows changes in road travel during periods of extreme changes in the oil price. More detailed analyses confirm this relationship with a recent literature review of road demand elasticities carried out for the Department by RAND Europe finding typical estimates of a 0.1%-0.5% fall in demand as the result of a 1% increase in the fuel price[12]. The NTM does not directly use elasticities, but assigns people to different modes based on the probability of using them under different cost assumptions. In line with DfT modelling guidance the NTM is calibrated to an implied relationship of -0.3 (i.e. a 0.3% fall in demand for a 1% increase in fuel costs) and analysis of outputs has shown that this falls over time to around -0.2 to 2035.[13]

2.47 Fuel price forecasts used in these road traffic forecasts are taken from the Department's Fuel Price Forecasting Model, which uses Department of Energy and Climate Change (DECC) oil price projections, planned VAT and fuel duty, and the OBR predicted GDP deflator to forecast future real prices. These are disaggregated into petrol and diesel. The pump price of petrol is forecast to rise in real terms by 26% between 2010 and 2040 and by 30% for diesel.

2.48 Anticipated fuel efficiency improvements are a key factor in reducing the cost of road travel over time and reduced fuel consumption reduces the amount of CO_2 emitted per vehicle mile. Fuel efficiency forecasts are broken down by vehicle type (car, HGV and LGV). Fuel efficiency assumptions for cars and LGVs are based on the improvements manufacturers are obliged to make at an EU level in order to meet the 2020 CO_2 targets and the impact of those targets on overall fleet efficiency in the UK. For cars, this takes into account the impact of electric cars and flexibilities agreed in 2013 to 'phase in' the target. It is assumed that industry action continues to drive fuel efficiency improvements in HGVs in the short term.

2.49 Efficiency improvements are forecast to result in a 40% improvement in the average fuel consumption of the car fleet, a 34% improvement for LGVs and a 14% improvement for HGVs. These improvements are seen despite an assumed increase in biofuel blending in road transport fuel to 2020 and beyond. Biofuels have a lower energy content than petrol and diesel and therefore as the blend rate increases, more fuel is required to drive the same distance. The combined impact of fuel price and efficiency is a forecast reduction in the cost of fuel per mile of 26% between 2010 and 2040 for cars, 15% for LGVs and an increase of 10% for HGVs.

[12] www.gov.uk/government/publications/road-traffic-demand-elasticities
[13] www.gov.uk/government/publications/road-transport-forecasts-2013

Figure 2.6: Car fuel price and efficiency forecast (2010 = 100)
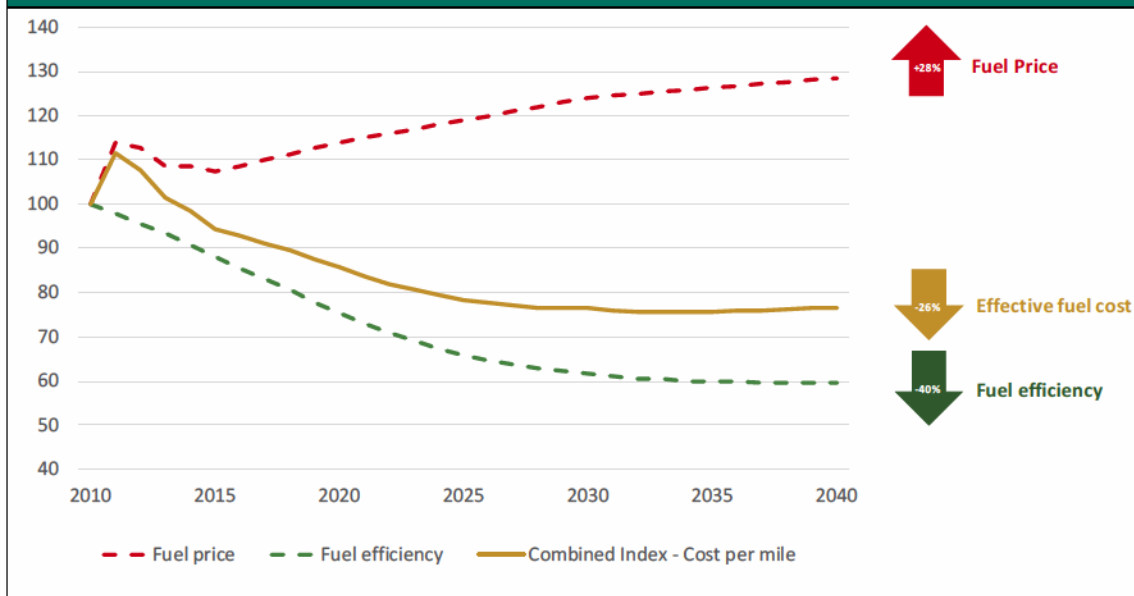
Road Capacity

2.50 Road capacity is an important factor in the allocation of demand to the road network (i.e. route choice) and the level of traffic demand both locally and nationally. Congestion and journey times increase as the levels of demand approach the capacity of the road, resulting in a higher cost of travel by road which pushes travellers towards other modes or making shorter trips. There is also a negative impact on emissions if cars slow down to below the optimal speed.

2.51 The geographic extent of the road network is represented in the NTM using data based on the lengths and number of lanes of different types of road in different areas (as given in Ordnance Survey datasets) and published in Transport Statistics of Great Britain (TSGB).[14]

2.52 The capacity of the network is a statistical concept which is governed by the numbers of lanes available on each of the roads and the theoretical maximum throughput of vehicles that is possible per traffic lane over a given time period. The maximum possible throughput varies by road and area type and typically ranges from about five hundred vehicles per hour on a minor urban road up to 2000 per hour for a motorway lane.

2.53 The speeds that traffic can achieve at different flow levels (or traffic volume to capacity ratios) as well as the theoretical maximum throughput, are defined in the NTM through the use of a number of 'speed flow' curves. These vary by road and area type[15].

2.54 These curves are used to ensure that as the flow of traffic (traffic volumes) changes - as a consequence of the income, population, demographic, trip rate and cost assumptions above - the speeds at

---

[14] www.gov.uk/government/statistical-data-sets/tsgb07
[15] Speed Flow Curves are described in Annex A

which people travel change appropriately. The lower speeds result in a longer journey time and higher generalised cost in the model, which increases the relative cost of travelling by car, and makes other modes more attractive.

2.55   Changes to the capacity of the road network to represent different policy impacts can be entered into the model. When road capacity increases and volume to capacity ratios fall the model will estimate the change in speed of traffic from the speed flow curves in a similar way to changing traffic levels (which as before, will in turn result in a change to the generalised cost of travel, feeding back through to a change in mode choice and traffic volumes).[16]

2.56   In the forecasts, changes to the capacity of the network are made to represent both historic and future capacity changes stemming from:

   • The national roads programme (delivered by Highways Agency),

   • The capacity impact of the local major schemes programme ,

   • Increases to minor road capacity from new estates and developments etc.

2.57   These latest forecasts include those road schemes up to and including those committed under the Road Investment Strategy announced in December 2014[17].

2.58   Capacity constraints have been identified as a potential factor explaining the decline in traffic volumes in London, and the NTM's relatively weaker forecasting performance in the capital. To address this we have updated the modelled speeds and capacity of the London road network using the latest observed data from Transport for London. This new data means that the model takes into account the reduction in effective road capacity in London resulting from the increased use of bus and cycle lanes. This has been incorporated into all forecast scenarios.

2.59   When tested using the RTF13 forecast data (i.e. before any of the other model updates or improvements were made), this led to a 1.7% reduction in London's forecast traffic levels in 2030 and a 0.1% reduction nationally. More details on the modifications to speed flow curves are available in the annex.

2.60   In conditions of high demand it is possible for the NTM to produce traffic forecasts that, in a small number of specific time periods or locations, exceed the theoretical capacity of the network. This is a consequence of the fact the model does not impose a hard constraint on volumes, but applies the softer constraint of reducing average speeds to increase the costs of travelling on heavily congested roads (and even at the very lowest speeds, some people will continue to find travelling by car more attractive than any other option).

2.61   To ensure the impact of potential overcapacity on the forecasts is not skewing our results, we have carried out a test using the original version of the model that was developed to produce the 1997 forecasts. This

---

[16] The change of speed in turn results in a change to the costs of making particular road trips and this finally impacts back on the levels of demand
[17] www.gov.uk/government/collections/road-investment-strategy

enabled the production of a forecast that did not permit traffic to exist at levels that exceed the theoretical capacity maxima.

2.62   While the impact of this test curtailed moderate amounts of traffic growth in certain time periods and at certain specific locations, the impact nationally was seen to be very small. The results of this test are recorded in the annex.

Freight

2.63   The NTM combines inputs from specialist freight models with passenger transport forecasts to produce a combined forecast of road traffic, taking into account the impact of freight and passenger traffic on congestion and the feedback to total traffic.

2.64   LGV demand is modelled outside of the NTM using an elasticity based approach where LGV demand is a function of diesel price, fuel efficiency and GDP. There is a long established link between GDP and LGV use which reflects the fact that increases in economic activity result in increases in demand for delivery and construction where LGVs are used.

2.65   HGV demand forecasts are derived from a bespoke multi stage behavioural choice model (the GB Freight Model). Base year data are taken from domestic and international freight movements for a range of commodities. This is then grown based on forecasts of manufacturing growth for each of the commodities and the cost of moving goods using HGVs.

2.66   In both the GBFM and the LGV models vehicle fuel efficiency and GDP forecasts have been update to reflect the most recent data.

2.67   The freight forecasts are assigned to the different modes of road and rail using a generalised cost model and then to different parts of the road network in accordance with achieving the shortest journey times between the origins and destinations. The resulting HGV growth rates on different road and area types and regions are then passed into the NTM enabling the model to estimate levels of congestion and emissions. Freight demand can vary from the initial forecasts once the effect of congestion is taken into account, but there is no direct substitution within the NTM between LGVs, HGVs and other forms of transport.

2.68   As part of our work to better understand the demand for travel, DfT commissioned a research project last year to make better use of existing data, evidence and knowledge of the LGV market to strengthen our modelling of LGV traffic. Recognising the relative lack of data in this area, in particular evidence on how LGVs are used and for what purpose, the project also aimed to identify the potential for new and emerging data sources to develop our modelling in the future.

2.69   The project has delivered an updated model of LGV traffic that is now disaggregated by region and road type; it has also briefly explored some

of the opportunities and challenges with using new data sources to represent LGV movements. While the update had not completed by the time the RIS baselines were established, the structure of the model has not fundamentally changed and GDP and fuel price remain the key explanatory variables. We intend to publish a report of the new model in the future.

Other modes

2.70   The objective of this publication is to present the Department's road traffic forecasts. In order to produce these forecasts it is important that all modes are represented in the model. The NTM takes account of the fact that people have a choice between walking, cycling, rail and bus as well as car. The purpose of the representation of other modes in the NTM is to ensure that responses to changing costs, levels of congestion or policy changes are captured.

2.71   The NTM allows for a total of six main modes of travel. These are:

- Walking
- Cycling
- Car Driver
- Car passenger
- Bus
- Rail

2.72   The choice of which mode to travel by is determined in the NTM by a series of costs that are made up from a number of components that vary according to each particular mode. For example, bus travel costs include access and egress times to get to or from the bus stop, waiting time, time travelling on the bus itself and finally the fare paid. All the mode specific costs are added together and a series of probability functions, taking account of current mode choices and projected values of time, are then used to split the total numbers of trips (or journeys) across the different modes.

2.73   For the two car based modes (driver, passenger), costs are then re-estimated using more dis-aggregate models that simulate the resulting levels of congestion and these revised costs (i.e. taking account of congestion) are then fed back into the NTM to re-evaluate the expected mode choice of individuals.

2.74   For other modes such as cycling, bus or rail a number of factors that may affect the levels of demand, such as fares, are input to the model but there are no feedback loops in which the costs are dependent on the forecast levels of demand.

2.75   Our recent review of the literature and understanding of the surrounding data shows that the costs of other modes may vary by area to a higher degree than what is assumed in the model. For example, while car costs may be similar across the country (depending on congestion which is taken account of in the feedback mechanism described above), the

generalised cost of a cycling trip may be lower in London where there is greater cycling infrastructure.

2.76 However, while the NTM does produce figures relating to the numbers of trips that are assigned to all these other modes, it was not intended to be used to forecast demand for these. The original specification and design of the model related solely to the production of road traffic forecasts, and the primary use of the other modes is to help capture the impact of their availability on car use. Demand forecasts for other modes should be generated using models that are designed specifically for that purpose capturing a wider range of relevant issues at a greater level of detail than would be possible or sensible in the NTM.

2.77 It should be noted in particular that for producing rail demand and revenue forecasts the Department makes use of specialist models that use rail industry standard methodologies for producing, rather than the four stage approach used in the NTM that is found most appropriate for car travel.

2.78 For buses the Department has specialist bus market models that are used to predict bus patronage levels and whilst bus fares and subsidy levels are input into the NTM, the results which come from it are not used for bus policy.

2.79 In the NTM we use forecasts of bus service levels, prices and levels of subsidy to predict bus patronage which is then converted into changes in bus vehicle miles. These bus miles are then input directly onto the road network, along with freight traffic, in order to model the impacts of all the principal types of vehicular traffic using the road.

2.80 The Department does not currently produce specific forecasts of walking and cycling. The need for these will be considered as part of the ongoing development of the policy. Given the nature and length of these trips it is unlikely that changes in cycling will have a significant impact on traffic at the national level.

2.81 As relationships describing the impact of cycling and motor cycling on road capacity and traffic congestion are unavailable, these modes or vehicle types are not assigned to the NTM's road network.

The National Transport Model

2.82 Figure 2.7 below is a simple representation of the forecasting process and data flows, showing how the wide range of issues and data identified above flow into the model and the production of the forecasts. Figure 2.8 represents the same process but from the perspective of the models in the forecasting suite.

2.83 The process starts with the NTEM model which, as described above, produces estimates of the total number of trips in the future, disaggregated across a number of different trip purposes, for a wide

range of different segments of the resident population (105 in total). When projecting forward to 2040 we have assumed that trip rates for each segment will either remain constant (scenarios 1, 2, 4 & 5) or continue the trend observed between 2003 and 2010 (scenario 3).

2.84   The trip rates for these different segments are aggregated up, taking account of population forecasts, changes in where people live (based on ONS projections), employment forecasts, and forecasts of car ownership, which in turn is based on different rates of car ownership across different household structures, incomes, area types, as well company car ownership and licence-holding, and projections for how these underlying influences will change in the future.

2.85   All this data is generally used at the most dis-aggregate levels that is available and therefore includes ward level data, and the output is a set of forecast datasets comprising the number of trips, the purpose of the trip and the household types they are generated from for approximately 2,500 zones in Great Britain.

Figure 2.7: Data flows in the NTM modelling suite
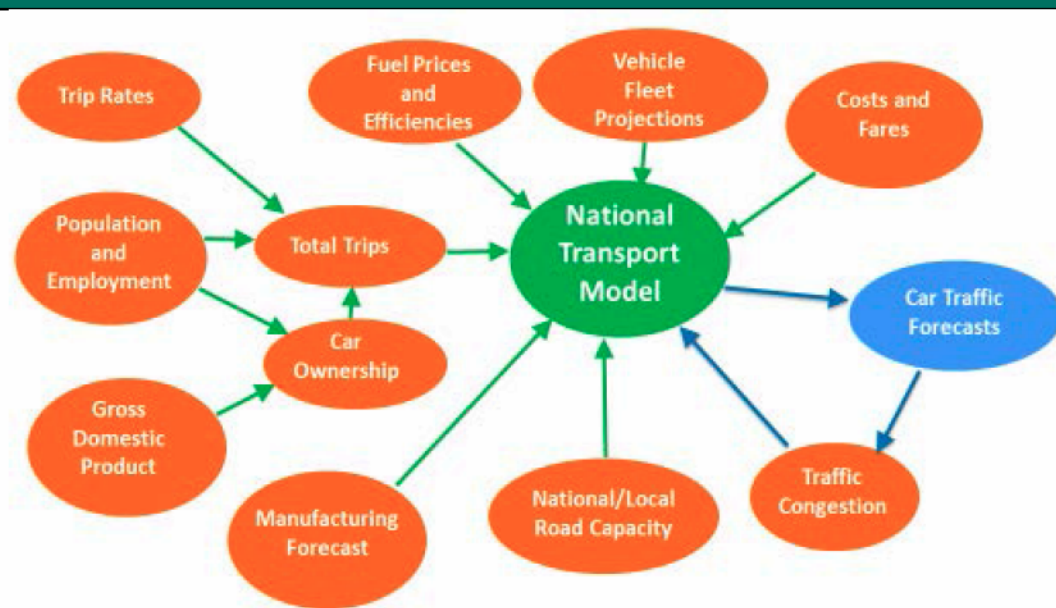
Figure 2.8: Schematic of the NTM suite
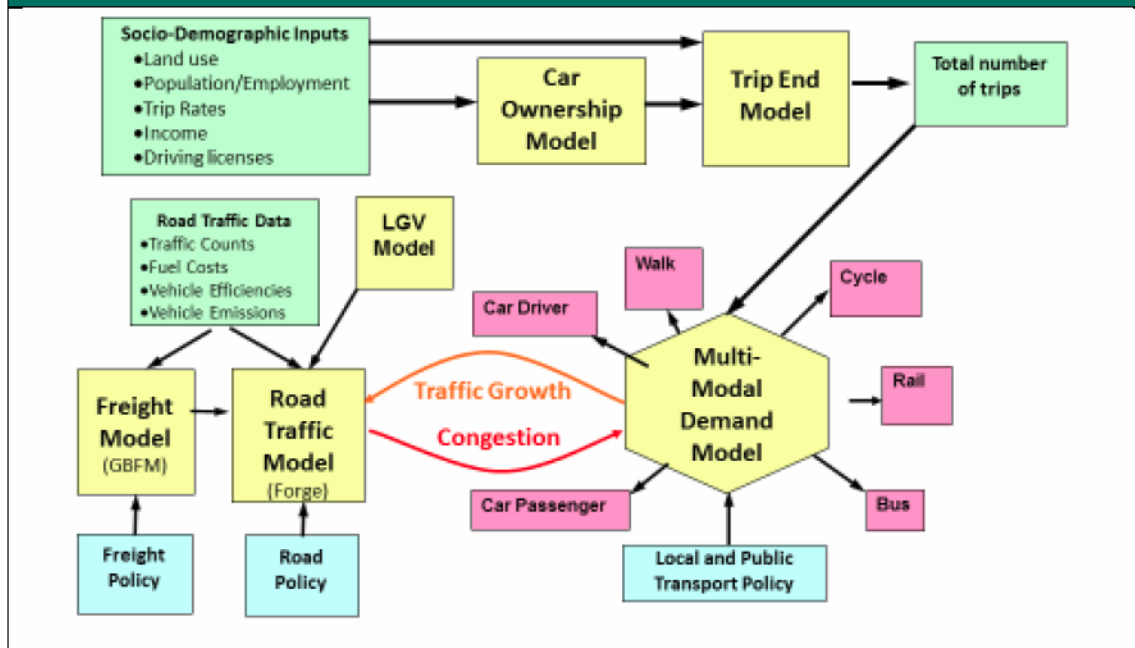
2.86   These trip forecasts are then fed into the NTM multi-modal demand model which allocates them first to different origins and destinations (that is, where people wish to travel to and from) and then the mode by which the trips are made, based on the historical mode shares, estimated generalised costs of travelling by each mode over time and people's value of time.

2.87   The costs are comprehensive in their nature and are based on detailed historic survey data or forecast values and cover all aspects of travel relating to each of the particular modes.

2.88   The outputs from the multi-modal demand model are forecast numbers of trips by each mode, segmented by the area type of the origin and destination, the trip length, trip purpose and person type up to 2040. The demand model is calibrated to replicate behaviours as observed from the National Travel Survey. It also segments by user class (as it is known that different user classes have different responses to changes in generalised costs).

2.89   These outputs are then allocated to the road network in the NTM highway model (FORGE) - seen on the left of Figure 2.9 - to account for the effects of capacity and congestion. This model uses observed data on the level of traffic on each link of the road network in 2003, and then increases this in accordance with the traffic growth that is derived from the NTM demand model, to forecast the future levels of traffic on different road types in different areas, at different times of the day from its 2003 base year.

2.90   The data on traffic levels in 2003 is taken from the national road traffic database, which is populated from the department's twelve hour traffic count censuses of every major road and a sample of minor road sites across Britain. It includes data on vehicle types, their flows and direction

for each hour between 7:00am and 7:00 pm. Other data, from Automatic Traffic counters is used to populate other time periods.

2.91   Using the estimated level of traffic and the speed-flow curves described above, the associated levels of congestion and journey times are then fed back into the costs in the demand model, and the process is repeated several times. The resulting outputs provide the forecasts of traffic, congestion and emissions presented here.

3. Results of forecast scenarios

Introduction

3.1 This chapter presents our forecasts. All five forecast scenarios are based on the factors set out in the previous chapter, with scenarios 2-5 adopting an alternative assumption from scenario 1 for one of the three key areas of uncertainty that have been discussed. For clarity they are summarised in table 3.1 below. Forecasts results are presented for roads in England only.

Table 3.1: Summary of variations between forecast scenarios			
	Trip rates	**Income relationship**	**Macroeconomic**
Scenario 1	Historic average	Positive and declining	Central
Scenario 2	Historic average	Zero	Central
Scenario 3	Extrapolated trend	Positive and declining	Central
Scenario 4 [18]	Historic average	Positive and declining	High oil, low GDP
Scenario 5	Historic average	Positive and declining	Low oil, high GDP

3.2 The five scenarios are best considered together to map out the range of possible outcomes for the level and pattern of road traffic demand, capturing key uncertainties identified in our *Understanding the Drivers of Road Travel* report. We believe that the results presented here provide a reasonable range within which outcomes for traffic levels, congestion and emissions may result and a reasonable basis with which to inform policy decisions.

3.3 Model results are shown as growth rates against 2010 modelled outputs. Results in the Roads Investment Strategy and NN NPS were presented against 2013 outturn data so these may differ slightly, however they are entirely consistent and relate to the same model results.

---

[18] In the Road Investment Strategy and the National Networks National Policy Statement scenarios 4 and 5 were called scenario 1 low and scenario 1 high.

Trips and aggregate distance

3.4   This section presents forecasts for the number of trips and distance travelled - on an individual (per person) basis and on aggregate.

3.5   The total number of trips across all modes is predominantly determined by the inputs from the NTEM which, as highlighted above, includes an assumption that trip rates (before accounting for demographic shifts) will remain constant - although in the case of scenario 3 we have linearly extrapolated the trend in trip rates, observed between 2003-2010, through to 2040.

3.6   Even under the assumption of trip rates remaining constant in the future, the proportion of these trips which are taken by car can change considerably, especially where income is forecast to grow and fuel costs to fall, which increases the probability of travelling by car.

Results

3.7   Figures 3.1 and 3.2 show the forecast changes in trips using all modes and car driver trips for scenarios 1 and 2.

3.8   For total trips (using all modes):

- The number of trips per person is forecast to fall slightly to 2040 but is broadly constant. This is the result of the trip rates assumptions contained in the NTEM dataset. This is shown by the red bars in the charts.

- Travel distance per person increases slightly in scenario 1 and remains broadly constant in scenario 2. The income effect is increasing travel distance in scenario 1 but is not present in scenario 2 where the income relationship has been removed. This is shown by the orange bars in the charts.

- When aggregated across the population both total trips and total distance travelled increase at a much faster rate. This is the effect of forecast increases in population growth. This is shown by the lines on the left hand charts.

3.9   For car driver trips:

- The number of car driver trips is forecast to increase by around 12% in scenario 1 and 5% in scenario 2. This is shown by the green bars. This is caused by growth in income as people are more likely to use faster modes and own cars (scenario 1) and by the reduction in the cost of driving (scenarios 1 and 2). Car distance per person also increases under both scenarios (yellow bars) but by a greater amount under scenario 1 due to the income effect.

- Population growth results in a faster growth rate for total car trips and distance. This is shown by the lines on the right hand charts.

3.10 It is important to note that the forecast increase in car distance travelled is in large part caused by a greater proportion of trips being made by car with the remainder of the aggregate increase due to population growth. After taking into account the increase in car ownership, the distance per car driver (as opposed to per head of the population) will be growing at a slower rate.

Figure 3.1: Travel distance and trips (scenario 1), 2010 = 100
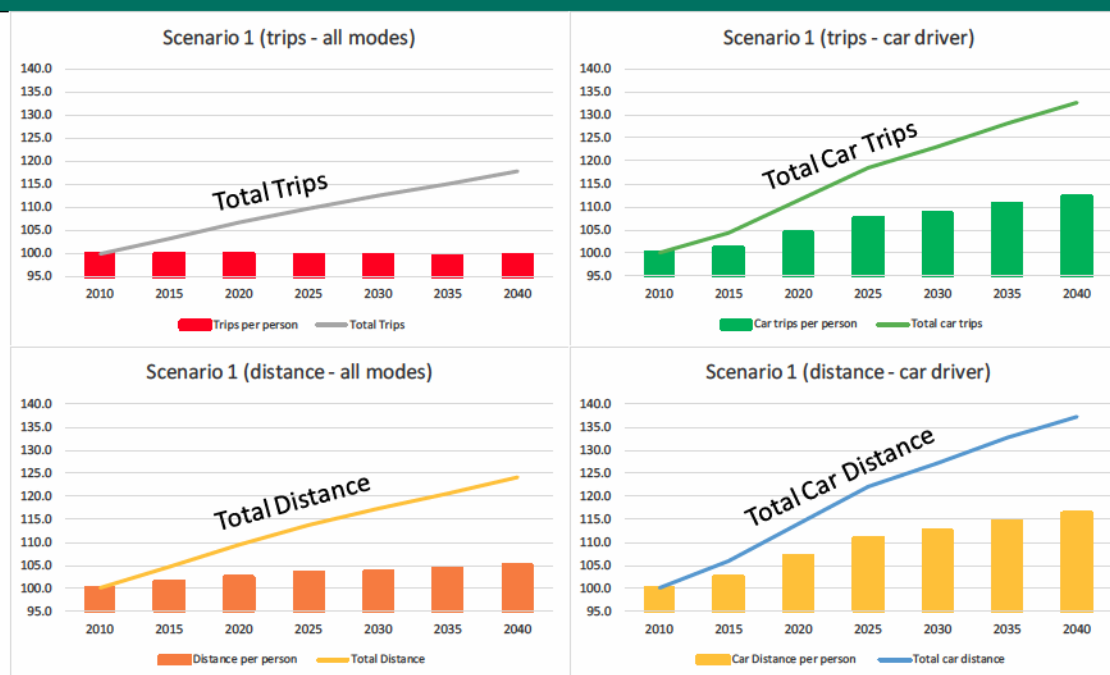
Figure 3.2 Travel distance and trips (scenario 2), 2010 = 100
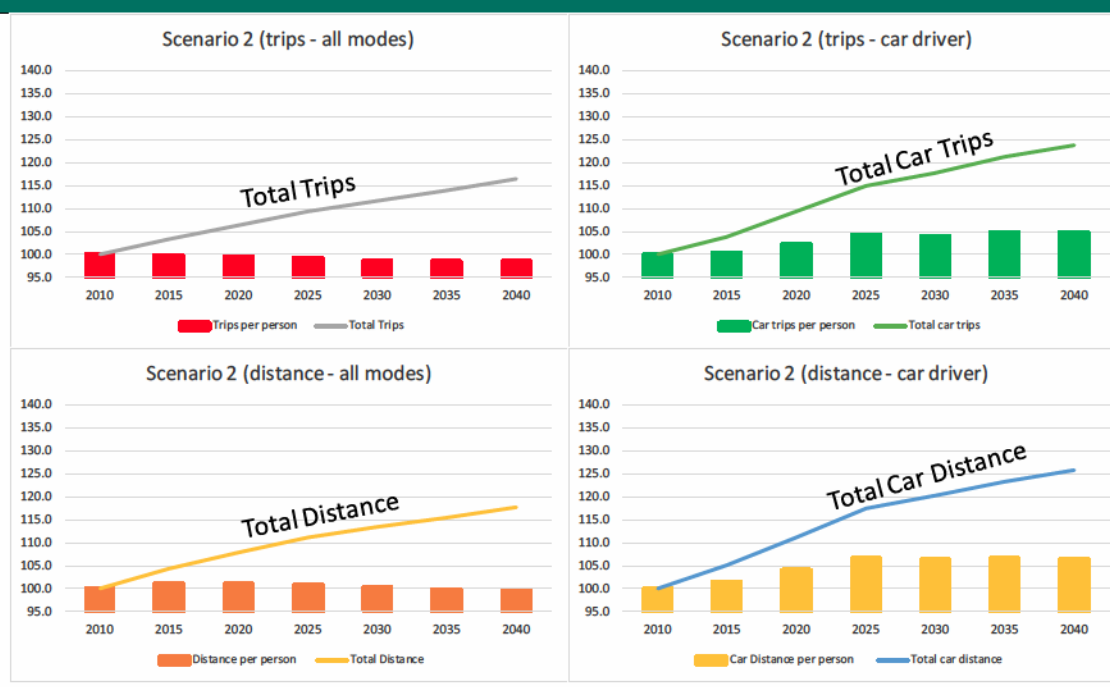
3.11 There is different pattern under scenario 3. For trips across all modes:

- The number of trips per person is forecast to fall by around 30% between 2010 and 2040 due to the extrapolation of the recent trend (red bars).

- Distance travelled per person decreases by only 5% however - due to an increase in the average trip distance (orange bars). This is the result of the fall in trip rates being greater for shorter trips, with some longer distance trip types (e.g. holiday trips) increasing.

- Even though the distance people travel is on average falling in this scenario, population growth drives an increase in aggregate distance travelled.

3.12 A similar phenomenon is seen for cars:

- Car trips per person are projected to fall sharply as a direct consequence of the extrapolation of the recent trend.

- Car distance travelled per person also falls, but again by a much smaller amount (due to the same reasons above).

- When population increases are taken into account the aggregate car distance travelled increases.

Figure 3.3 Travel distance and trips (scenario 3), 2010 = 100
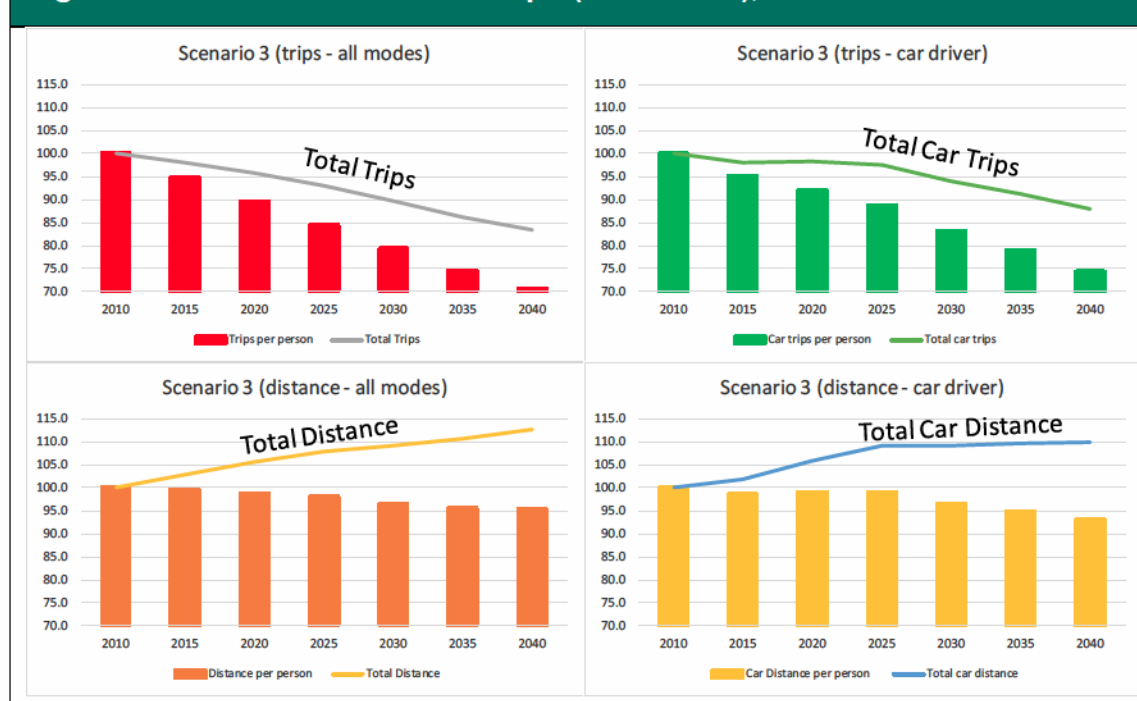
3.13 The patterns of growth for scenarios 4 and 5 are not shown but are similar to that of scenario 1, just to a lesser or greater extent.

3.14 In summary, while most of our scenarios forecast that individuals will on average increase the number of car trips they make and mileage they

drive, included within our range is a forecast (scenario 3) where individuals take less car trips on average, and average car driver mileage falls. Whether individuals travel more or less by car in the future depends on how close future travel behaviour is to the assumption for trip rates under scenario 3, or whether it remains constant over time, which in turn depends on the factors which are behind the fall to date.

3.15   We might reasonably expect the fall in trip rates to cease if economic factors, and one-off changes (such as falling company car use), have been behind recent trends. On the other hand, if it is due to social or technological changes, and if the impact of these grows over time, it may be reasonable to expect trip rates to continue falling. Our *Understanding the Drivers of Road Travel* report considers the impact of these different factors on recent trends in more detail.

3.16   However, as is clear from the results above, even when individual car mileage is forecast to fall, as is the case in scenario 3, population growth results in total car mileage growing. In this scenario population growth explains all the growth in traffic, but even in the other scenarios it is a significant part of the overall growth in traffic.

Total traffic and congestion

3.17   The section above presented forecasts for car travel. The NTM combines these forecasts with the outputs of the LGV, HGV and bus models to produce estimates of total road traffic. Detailed tables of results are published alongside this document.

Figure 3.4: Traffic growth by scenario (bn miles, all vehicles)
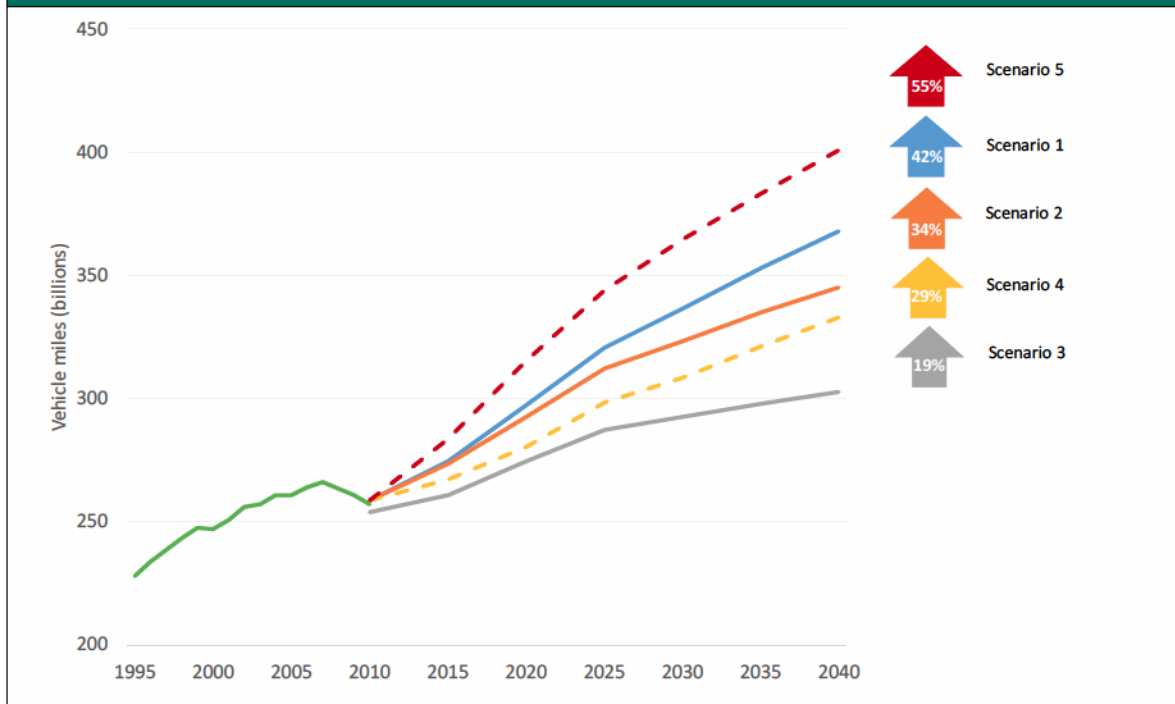
3.18   Taking into account all motor vehicles (and the resulting levels of congestion this generates), the range of traffic growth forecast across our scenarios is 19% to 55% between 2010 and 2040.[19]

3.19   The forecast growth in income and decrease in fuel costs which leads to greater use of the car also results in increased freight traffic.

3.20   Scenario 3 produces the lowest rate of traffic growth at 19% between 2010 and 2040. As described above, the declining number of car trips supresses the rate of growth but the increase in car trip distance and total population generates an overall increase in car mileage. When combined with strong growth in freight the result is a slower but still significant growth in the level of road traffic. The contribution of different vehicle types to overall traffic growth is discussed further below.

Total congestion

3.21   Congestion in the NTM can be measured in lost time, changes in average speed or in the proportion of traffic travelling in congested conditions. For a given change in traffic the change in congestion should be broadly consistent across all three measures.

3.22   Congestion is dependent on the overall level of traffic relative to road capacity and should be expected to increase as traffic grows. However, congestion will vary where there are differences in the places and times of day where traffic growth occurs. Traffic growth concentrated in already congested areas and times of days will naturally have a greater impact

---

[19] Growth rates in the Road Investment Strategy and National Networks National Policy Statement were quoted against 2013 outturn traffic. For the purpose of this document growth rates are quoted against 2010 modelled traffic. Outturn data in this chart excludes motorcycles in order to be consistent with the NTM outputs.

than growth that is spread more evenly. The forecasts includes the impact on congestion of the road schemes announced as part of the Roads Investment Strategy.

3.23   Figure 3.5 shows that, when measured at an aggregate level, congestion is forecast to grow in broadly the same proportions as traffic demand, with higher congestion growth in those scenarios which forecast higher demand growth.

3.24   The exception is scenario 3 where, in spite of 19% growth in vehicle miles, congestion across the road network as a whole is forecast to be largely unchanged. This is due to demand growth being spread over different road and area types and at different times of day, the result of the assumption that the recent trend in trip rates continues. Trips for purposes that occur in the more traditional peak periods reduce, while those that are increasing such as holidays and leisure travel are more likely to occur away from these time periods. This is explained in more detail in the following sections.

Figure 3.5: Congestion (proportion of traffic in congested conditions)

Scenario 5: 17%
Scenario 1: 14%
Scenario 2: 13%
Scenario 4: 11%
Scenario 3: 8%
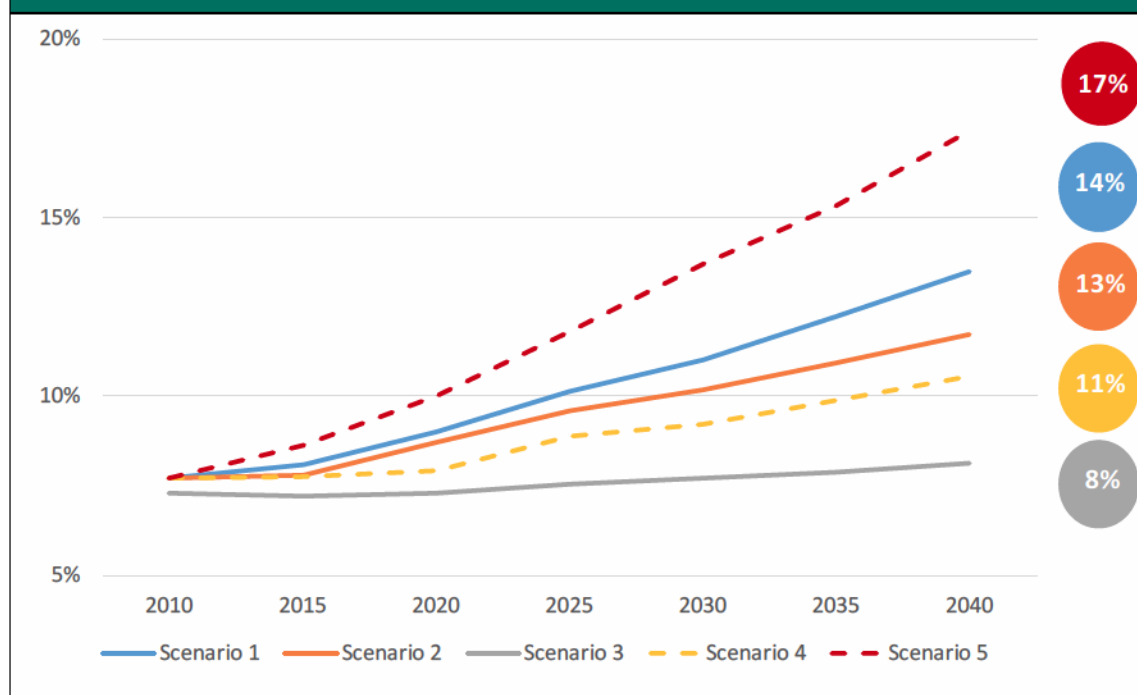
Table 3.2: Traffic demand and congestion forecasts 2040				
	Bn veh miles	Lost seconds per vehicle mile	Average speed (mph)	Traffic >80% capacity
2010 modelled (all scenarios)[20]	258.7	18.3	32.1	7.7%
Scenario 1	367.9	29.0	29.5	13.5%
Scenario 2	345.5	26.5	30.1	11.7%
Scenario 3	303.0	18.3	33.1	8.1%
Scenario 4	332.9	24.8	30.4	10.6%
Scenario 5	400.8	34.0	28.3	17.4%

Vehicle type

3.25 Cars are the dominant mode of road transport and are forecast to remain so in spite of a slight reduction in the proportion of total traffic they make up. Based on our modelling:

- Cars made up 80% of traffic miles in 2010 and are forecast to make up between 73% and 80% of traffic miles in 2040.

- LGVs made up 14% in 2010 and this is forecast to be in the range 15% to 20% in 2040.

- HGVs made up 6% in 2010 and this is forecast to be in the range 4% to 6% in 2040

3.26 The changing composition of road traffic reflects the fact that in some scenarios the growth in car use and HGV traffic is forecast to be modest - between 2010-2040 just 9% for cars in scenario 3, 1% for HGVs - in scenario 4 while LGVs are forecast to continue growing significantly in all scenarios, as shown in Figures 3.7-3.9.

3.27 The strong growth predicted for LGV traffic means that even when car traffic is forecast to grow by just 9% in scenario 3, overall traffic growth is still seen to be 19% with LGV traffic accounting for half of the increase.

---

[20] Due to differences in assumptions for 2010 trip rates in scenario 3 there is a small difference in the 2010 forecast. For clarity in presentation only the value for scenarios 1, 2, 4 and 5 is used in the tables in this document.

Figure 3.6: Car traffic 2010 to 2040 (bn vehicle miles)
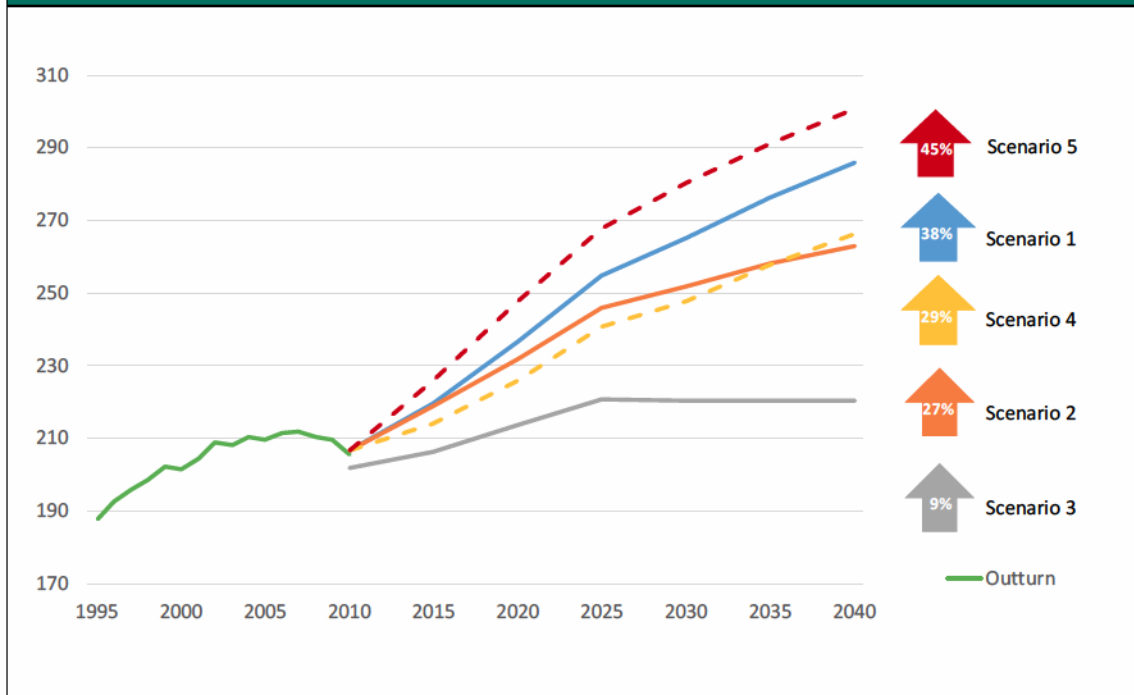
3.28 Freight (LGV and HGV) traffic forecasts are assumed to depend only on GDP growth and fuel efficiency improvements (although they are very sensitive to changes in GDP and fuel cost - as demonstrated by the variation between the high and low demand scenarios). Freight forecasts are unaffected by the removal of the income relationship in scenario 2 and the trip rates assumption in scenario 3 - both of which relate only to personal travel.[21]

3.29 Based on these assumptions LGV traffic is forecast to grow by at least 42%, and as much as 115%, between 2010 and 2040. In contrast, with the cost of fuel per mile projected to rise by 10% for HGVs (compared to falling by 15% for LGVs) HGV traffic is forecast to rise by 58% at most, and in the lowest scenario be virtually flat.

---

[21] Small differences in LGV and HGV growth between scenario 1 and scenarios 2 and 3 are the due to lower overall traffic in the latter two scenarios resulting in less traffic being 'congested off'.

Figure 3.7: LGV growth 2010 to 2040 (bn vehicle miles)
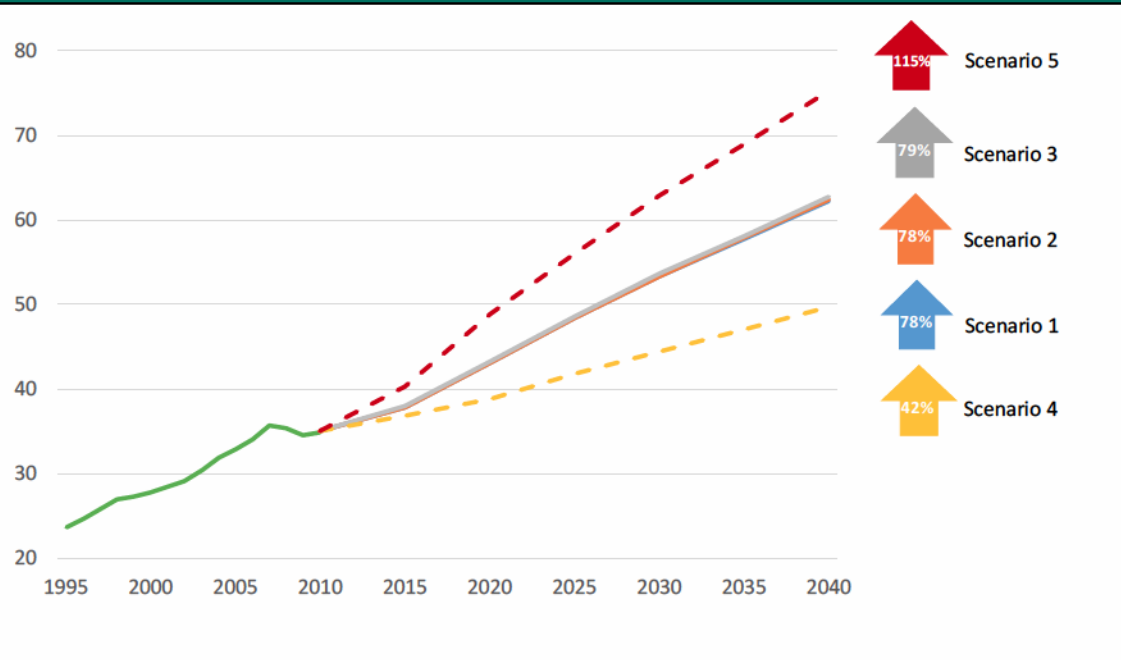
Figure 3.8: HGV growth 2010 to 2040 (bn vehicle miles)
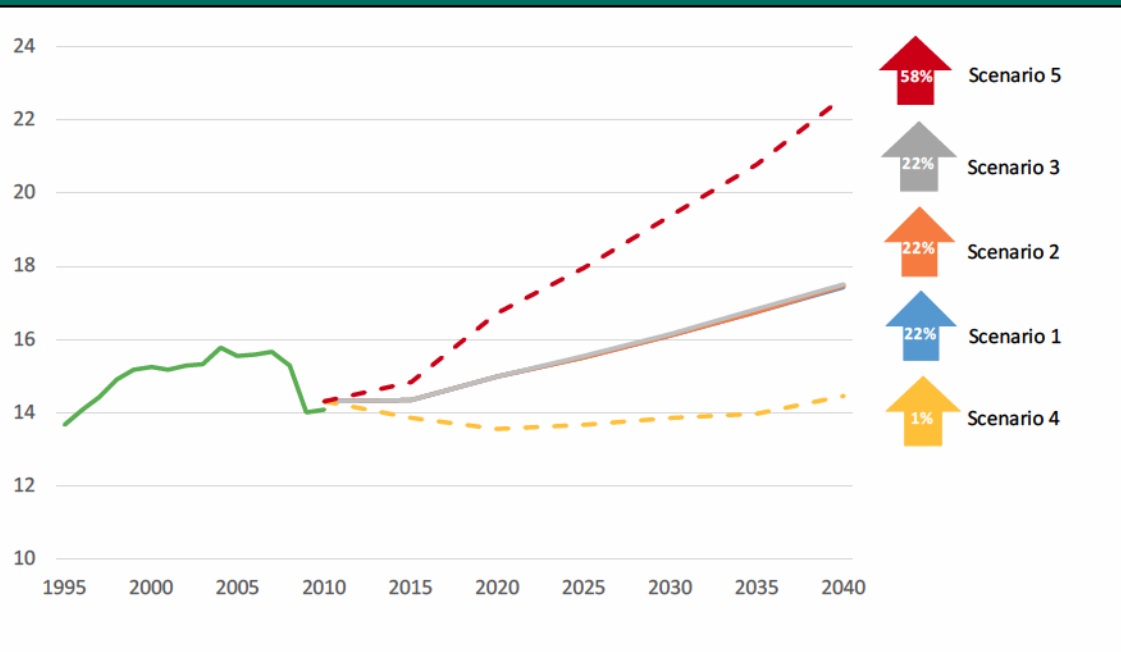
3.30 At the high end of our range, forecast growth rates for cars and HGVs are similar to the growth seen for these vehicle types between 1995 and 2005 (Figure 3.9). The scenarios which suggest lower demand growth (2, 3 and 4) are more in line with the lower rates of growth seen for these vehicle types in the pre-recession period. Our forecasts for LGV growth over the next 30 years are higher than during the recent economic downturn, but generally lower than the growth that has been seen over most of the last two decades.

Figure 3.9: Average annual growth rates by vehicle type

Legend:
- Outturn 1995-2000
- Outturn 2000-2005
- Outturn 2005-2010
- Scenario 1 2010-2040
- Scenario 2 2010-2040
- Scenario 3 2010-2040
- Scenario 4 2010-2040
- Scenario 5 2010-2040
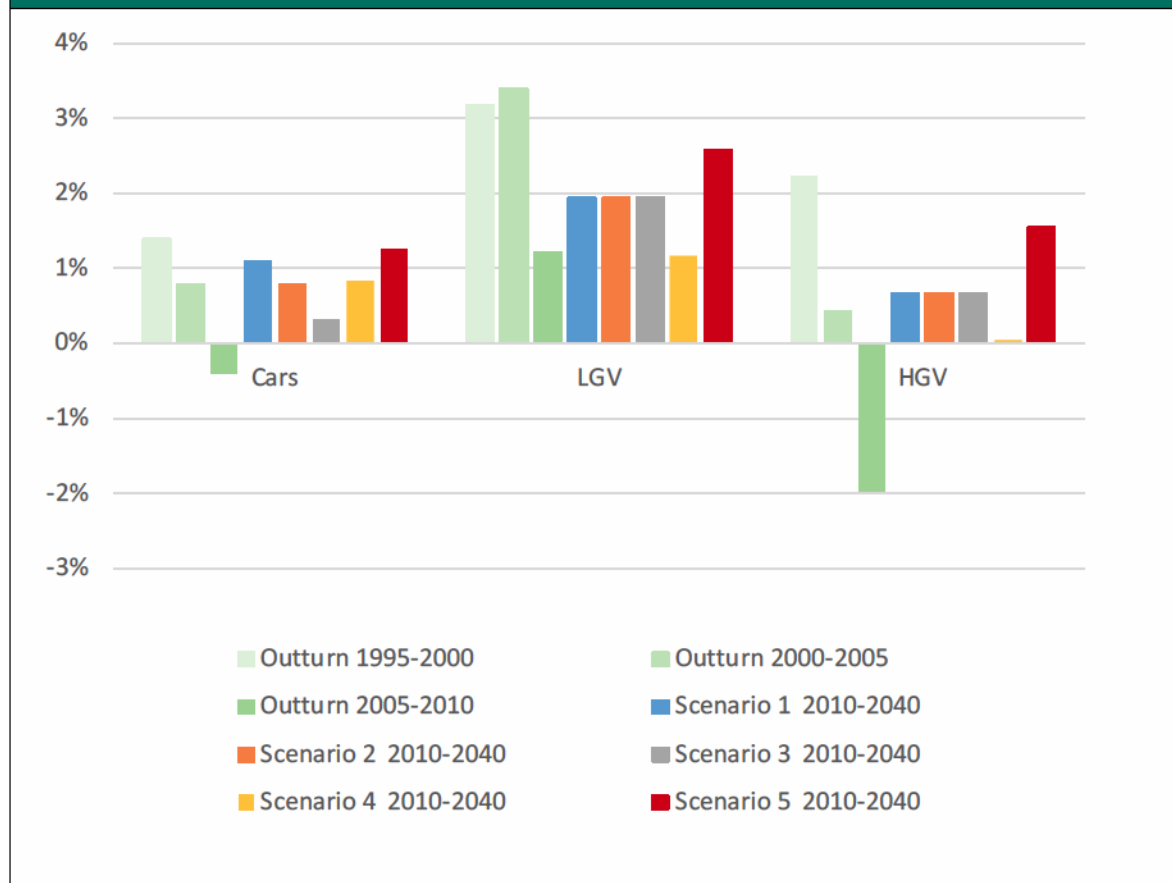
Road Type

Traffic by major and minor roads

3.31 The NTM produces traffic forecasts for all roads disaggregated across 7 road types. For the purpose of clarity in the analysis these have been grouped into:

- The Strategic Road Network (SRN) - 'Trunk roads' managed by the Highways Agency

- Principal A roads - A roads managed by local authorities

- Minor roads - all other roads (B, C or unclassified)

Strategic Road Network

3.32 Traffic growth on the SRN is forecast to be strong and positive in all scenarios driven by increases in the number of car trips and trip distances described above, as well as rising LGV traffic.

3.33 In scenario 3, where overall road traffic is forecast to grow more slowly, growth is forecast to be strong on the SRN. This reflects the exploratory assumption of the extrapolation of the recent trend in trip rates which, as shown in figure 3.3, results in fewer overall journeys and distance travelled per person but longer average length of trips. In the NTM longer trips are more likely to be routed on the SRN as these roads will be more likely to produce a lower generalised cost.

3.34 Congestion on the SRN is forecast to increase in all scenarios and in scenarios 1 and 2 the extent of the increase is in line with traffic growth. The exception is again scenario 3 where, in spite of strong forecast traffic growth, congestion growth is more limited. This is because under the assumption used for future trip rates the additional demand is spread more widely across the week and is less concentrated on the times where the network is already more congested.

Table 3.3: Demand growth and congestion on Strategic Road Network		
Scenario	Traffic Growth	Congested traffic (above 80% capacity)
2010 modelled (all scenarios)		5.9%
Scenario 1 2040	+45%	12.7%
Scenario 2 2040	+36%	10.1%
Scenario 3 2040	+36%	7.3%
Scenario 4 2040	+29%	8.1%
Scenario 5 2040	+60%	19.5%

Principal A and minor roads

3.35 Under scenarios 1, 2, 4 and 5 traffic growth on principal A and minor roads is similarly strong to that forecast for the SRN - rising between 28% and 51% - with the growth driven by the reasons given above for the road network as a whole. The slightly lower growth rates for principal and minor roads reflects the forecast lengthening of journeys and a slight shift in traffic to the SRN.

3.36 However, in scenario 3, where trip rates are assumed to continue falling, traffic growth is forecast to increase by just 13% on principal roads and by 10% on minor roads. All of this growth is freight traffic with car growth just 2% on principal roads and -3% on minor roads. Therefore, while in most scenarios we forecast traffic growing strongly, at the other end of the range is for car traffic to plateau over the next 30 years on all roads other than the SRN. This reflects our assumption that recently observed trends in different trip purposes continue over the forecast period.

3.37 This variation in potential growth rates across the principal A and minor road network is reflected in the congestion forecasts, with congestion expected to increase in all scenarios apart from scenario 3 where it is unchanged.

3.38 It is clear from this that different future trends in trip rates can have very different impacts on car use across different parts of the road network. There are a number of alternative outcomes for trip rates within the spectrum of the two scenarios we have considered here, and new forecasts of trip rates will be included in the forthcoming NTEM update.

Table 3.4: Demand growth and congestion on Principal A roads		
Scenario	Traffic Growth	Congested traffic (above 80% capacity)
2010 modelled (all scenarios)		12.1%
Scenario 1 2040	+40%	20.1%
Scenario 2 2040	+32%	18.1%
Scenario 3 2040	+13%	11.9%
Scenario 4 2040	+28%	16.9%
Scenario 5 2040	+51%	23.9%

Table 3.5: Demand growth and congestion on minor roads		
Scenario	Traffic Growth	Congested traffic (above 80% capacity)
2010 modelled (all scenarios)		5.5%
Scenario 1 2040	+41%	8.4%
Scenario 2 2040	+33%	7.6%
Scenario 3 2040	+10%	5.6%
Scenario 4 2040	+29%	7.2%
Scenario 5 2040	+54%	9.7%

Time of day

3.39   Our forecasts can be split by time of day and day of the week to analyse the impact of traffic growth on the peak periods of congestion. We have further disaggregated this analysis across the SRN, principal A roads and minor roads to show how the impact of traffic growth on the SRN varies across different times of the day/week, and see whether the slower growth on minor roads hides an increase at specific periods.

3.40   The weekday peak covers 0700 to 1000 and 1600 to 1900 Monday to Friday. The inter-peak period is 1000 to 1600. Weekend daytime 0900 to 2000 Saturday and 1000 to 2000 Sunday. Off peak covers all other times.

Strategic Road Network

3.41 Table 3.6 shows modelled congestion levels in 2010 and the forecasts under each of the scenarios for 2040. As would be expected congestion in 2010 is higher in the weekday peak than at other time periods.

3.42 In most scenarios the impact of growth on congestion is expected to be spread across all time periods with congestion increasing to significant levels at peak times.

3.43 In scenario 3 however congestion is forecast to remain largely unchanged in the weekday peak but increases more at other times, including the weekend, when congestion is forecast to be worse than in other scenarios with the exception of scenario 5. The lower overall level of congestion under scenario 3 (as seen in table 3.3) is therefore due to traffic growth arising during periods where the roads are less congested, and this reflects a reduction in journeys that are more likely to take place in the traditional weekday peak, such as commuting, and an increase in more weekend journeys such as leisure and holidays.

Table 3.6: Traffic in congested conditions by time of day - SRN 2040					
	Road Type	**Weekday peak**	**Weekday inter-peak**	**Weekend day**	**Off peak**
2010 Forecast (all scenarios)	SRN	13.6%	4.5%	1.8%	0.5%
Scenario 1	SRN	26.1%	12.3%	6.1%	2.4%
Scenario 2	SRN	21.2%	9.5%	4.8%	1.5%
Scenario 3	SRN	13.8%	7.3%	6.3%	1.1%
Scenario 4	SRN	17.6%	6.9%	3.7%	1.2%
Scenario 5	SRN	35.0%	23.5%	12.3%	3.4%

Principal A roads and minor roads

3.44 The effect of traffic growth seen on the SRN is repeated on principal A and minor roads. In most scenarios congestion is expected to increase across all time periods, but in scenario 3 the effect of low levels of demand growth (table 3.4) and reductions in trips that are more likely to take place at peak times generates reduced congestion in the weekday peak period, while congestion grows, albeit only slightly, at other times of the week.

Table 3.7: Traffic in congested conditions by time of day - Principal A roads

	Road Type	Midweek peak	Midweek inter-peak	Weekend day	Off peak
2010 Forecast (all scenarios)	Principal	19.0%	10.6%	9.4%	4.4%
Scenario 1	Principal	29.8%	19.1%	17.7%	8.0%
Scenario 2	Principal	27.2%	17.2%	15.2%	7.3%
Scenario 3	Principal	17.0%	11.5%	10.7%	5.3%
Scenario 4	Principal	25.8%	15.6%	14.2%	6.5%
Scenario 5	Principal	34.6%	24.3%	21.3%	9.7%

Table 3.8: Traffic in congested conditions by time of day - minor roads

	Road Type	Midweek peak	Midweek inter-peak	Weekend day	Off peak
2010 Forecast (all scenarios)	Minor	9.0%	5.2%	3.5%	1.2%
Scenario 1	Minor	12.2%	8.7%	7.1%	2.7%
Scenario 2	Minor	11.3%	7.8%	6.2%	2.2%
Scenario 3	Minor	8.6%	5.8%	4.3%	1.5%
Scenario 4	Minor	10.9%	7.2%	5.9%	2.1%
Scenario 5	Minor	13.7%	10.3%	8.4%	3.4%

3.45 The forecasts therefore generate a range of outcomes for congestion, where at one end we might see congestion continue to follow current patterns in the traditional peak periods across most of the network while at the other we see congestion growth focussed more on the SRN at weekends and little impact on the local road network.

Area Type

3.46 Analysis by area type allows us to understand whether forecast changes in demand and congestion impact differentially between towns and cities. A number of factors are likely to affect the amount of traffic and traffic growth between different area types. For example the nature and size of

population growth, the availability of other travel options and variations in travel behaviour such as different journey purposes.

3.47 The NTM produces traffic forecasts across 10 different area types. This analysis shows the results for four broad area types - (i) London, (ii) other conurbations and major cities, (iii) other urban areas (population over 10,000), and (iv) rural (population under 10,000).

3.48 Under scenarios 1, 2, 4 and 5, traffic growth is forecast to rise at a broadly similar rate across all areas - rural and urban, as well as in London. However, at the end of the range in scenario 3 where we have extrapolated the recent trend in trip rates, growth in traffic is slower across all area types, but affects London, other conurbations and urban areas much more. The strong growth in rural areas under this scenario is due to the fact that we have included the SRN in the table and we have seen that the increase in longer journeys generates higher growth on these roads. In contrast, in urban areas and major cities (including in London) traffic is forecast to grow by just 6-14%.

3.49 Therefore, while in most cases we forecast traffic in all area types to grow strongly, depending on how trip rates (and the factors behind their recent decline) evolve, although we may see slower growth in urban areas and major cities over the next 30 years if the trend in travel behaviour continues.

Table 3.9: Traffic (bn vehicle miles) and growth by area type 2010 - 2040					
	London	Conurbations	Urban	Rural	Total
2010 all scenarios	19.3	48.3	65.2	125.9	258.7
Scenario 1 2040	37.2%	41.4%	39.4%	44.7%	42.2%
	26.5	68.3	90.9	182.2	367.9
Scenario 2 2040	29.4%	29.4%	31.0%	35.6%	33.6%
	25.0	63.9	86.0	170.7	345.5
Scenario 3 2040	13.4%	13.7%	6.4%	28.9%	19.3%
	20.8	54.1	67.5	160.5	303.0
Scenario 4 2040	25.8%	28.5%	28.3%	29.7%	28.7%
	24.3	61.7	83.7	163.3	332.9
Scenario 5 2040	47.4%	53.8%	50.3%	58.9%	54.9%
	28.5	74.3	98.1	199.9	400.8

Regional breakdown

3.50   Figure 3.11 shows regional growth rates for scenarios 1, 2 and 3. The different levels of growth between regions largely follow the differences in forecast population growth. The lowest rates of traffic growth are forecast for the regions with the lowest forecast increase in population - the North West, the North East and the West Midlands.

3.51   The exception to this is London which is forecast to have one of the highest rates of population growth, comparable with the South East and the South West, but is forecast here to have a much lower rate of traffic growth. This dichotomy between rates of population and traffic growth in London is broadly consistent with the recent trends observed in *Understanding the drivers of road travel* and will be in large part the result of lower car ownership growth forecast in London (see Figure 2.4), but there will also be other factors such as greater congestion constraining traffic growth and greater choice of other transport modes.

3.52   The variation in national traffic growth forecast across the three scenarios is broadly followed for each of the regions, although a decoupling between income and car use is found to have a relatively limited impact on future traffic growth in London (this appears to be due to income growth having a smaller impact on car ownership in London than other regions in the NTM).

3.53   The forecast for London is higher than outturn data by around 4% under scenario 1 and by 3% under scenario 3 in 2010. We will continue to explore the reasons for this and ways of addressing it in the forecasting approach.

Figure 3.10: Regional growth rates by scenario 2010 to 2040

Emissions

3.54   The NTM produces forecasts of emissions of CO2, NOx and PM10 and allows us to forecast the impact of traffic demand on our domestic and international policy commitments. Aggregate emissions are the result of the volume of traffic, the speed of the traffic and assumptions of technological changes in the vehicle fleet that reduce emissions for a given speed. Speed emissions curves are applied to the traffic forecasts from the NTM, and the results aggregated up to give emissions at the national level.

3.55   These forecasts take account of committed transport policies in projecting emissions. However, progress towards the UK's carbon budgets is forecast by taking account of policy across all sectors of the economy and published in *Updated energy and emissions projections 2014* produced by the Department of Energy and Climate Change.[22]

3.56   These forecasts represent what would happen if no further emission reducing policies were introduced beyond current announced policy and expectations, and should not be interpreted as a statement of policy.

3.57   The engine technology assumptions are the same for all forecasts so the differences in forecast emissions between scenarios results from the differences in vehicle speed and traffic demand. Take up of electric vehicles is assumed as set out in WebTAG.

---

[22] www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014

CO2

3.58 The main drivers behind the forecast changes in CO2 are the levels of traffic of each of the different vehicle types taken together with assumptions regarding the fuel efficiency of the vehicle fleet. For cars and LGVs fuel efficiency is forecast to improve due to technological improvements driven by EU regulation and the increasing dieselisation of the fleet. Our forecasts are for average efficiency to improve by 40% for cars, 34% for LGVs, 14% for HGVs between 2010 and 2040.

3.59 Based on these assumptions, and our traffic forecasts above, CO2 is forecast to fall by between 3% and 26% from 2010 to 2040. As would be expected the scenarios which result in greater levels of traffic result in higher emission forecasts.

3.60 Significant fuel efficiency improvements in cars and LGVs are the main driver of this downward trend, though there is also an impact of increased biofuel blending in road transport fuel (biofuels are counted as zero emission at the tailpipe). Year on year fuel efficiency improvements start to flatten out between 2025 and 2030, after which traffic growth results in CO2 emissions starting to increase.

Figure 3.11: CO2 road traffic emissions (kt CO2)
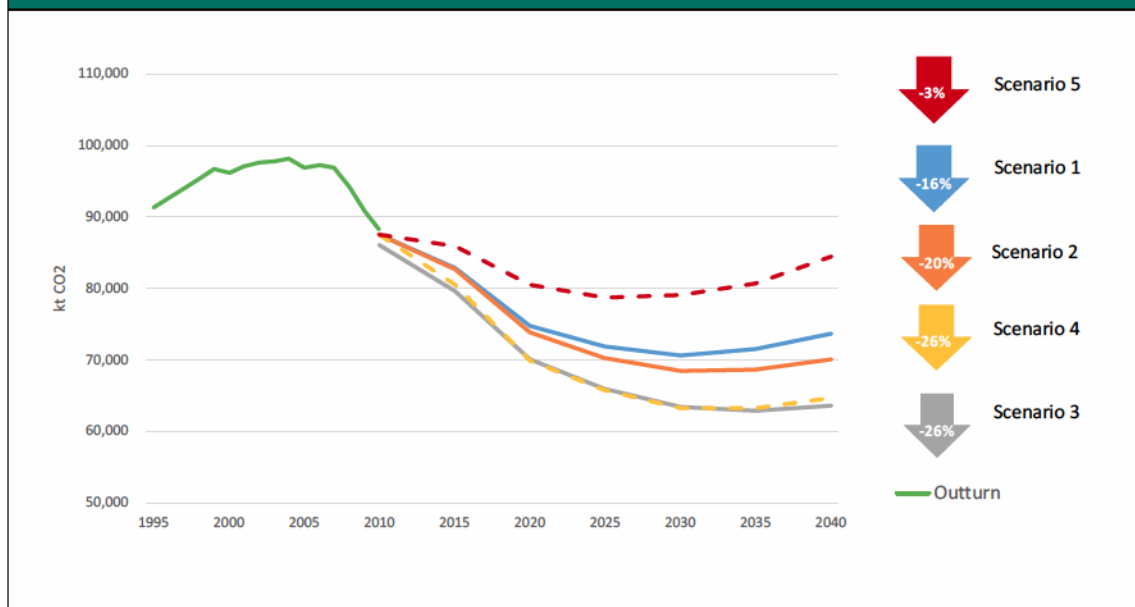
NOx

3.61 The forecast for NOx emissions is that these will decline by 65% to 73% between 2010 and 2040. Predictably the lower end of the range again relates to the lower demand scenarios. The steep downward path is relatively insensitive to the different range of traffic levels we forecast - the assumptions for declining emissions per vehicle mile expected to be achieved through European vehicle standards are much more important,

and more than offset the increases in demand projected over most of the forecast period.

3.62   This large reduction in NOx emissions relies on the effectiveness of the future European standards to control emissions under actual driving conditions. While we are confident that this will be achieved, this large reduction may be an overestimate if their introduction is delayed.

Figure 3.12: NOx road traffic emissions (kt NOx)

PM10

3.63   PM10 emissions are forecast to reduce by 92% to 94% between 2010 and 2040. Again, the assumption of improvements in vehicle PM10 emissions through European vehicle standards dominates increases in demand, and the results are insensitive to our different forecast levels of traffic.

Figure 3.13: PM10 emissions (kt PM10)
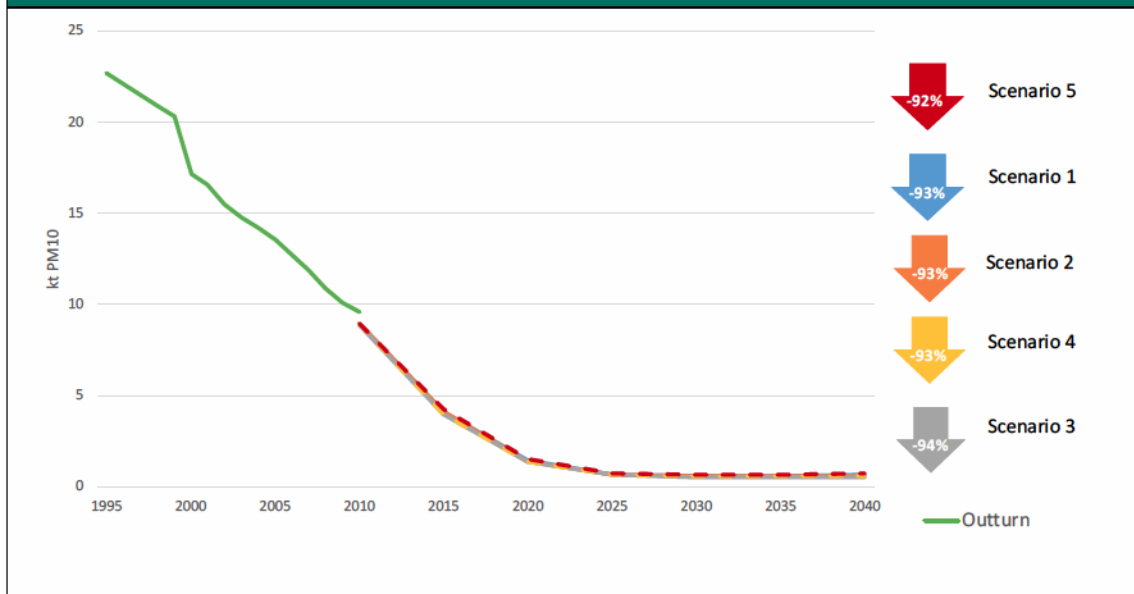
Monitoring model performance

3.64 It is important to look at the performance of the model and how well it forecasts past trends in traffic and captures established travel behaviours. Understanding this can help us learn how we might improve the forecasting process.

3.65 Uncertainty in the model can result from three key sources:

- Forecasts of key inputs, such as the forecasts of GDP, fuel prices and population
- The relationship between these key drivers and traffic demand.
- The emergence of new factors which affect travel behaviour

3.66 Clearly forecasts of the inputs are very uncertain - oil prices are historically volatile and pre 2007 forecasts of GDP did not anticipate the recession. We can't eliminate this risk, but through the scenario analysis we can test the sensitivity of our forecasts to the likely range in outcomes for these factors, and acknowledge it within the range of forecasts we present.

3.67 The model is calibrated against 2003 road traffic levels and is set up to produce forecasts in 5 yearly intervals from 2010 to 2040. By using outturn data for GDP, population and fuel prices between 2003 and the latest data we are able to control for errors in these inputs, and test how well the model captures the extent to which these and other factors affect road demand.

3.68 While the model does not produce forecasts for the intervening years, we can also use the implied relationships derived from the model to see how well they trace the broad path of growth.

55

3.69 The tests of the model we have conducted are:

- How well does the model forecast 2010 outturn traffic

- How effectively can the relationships in the model trace the broad path of traffic growth between modelled years

- How well does it follow recent traffic data since 2010 including the latest 2014 data

3.70 These are tough challenges. Against a backdrop of rising traffic pre 2000s, does the model perform well during the period of flattening growth or does it continue to predict the steep growth seen in the previous century?

3.71 For scenario 1 figure 3.14 shows that the NTM forecast for car traffic in 2010 is within 1% of observed traffic data. This shows that, when controlling for errors in the economic and demographic inputs, the model was able to predict reasonably well the period of flat growth.

3.72 The grey line in figure 3.14 joining the modelled years of 2003 and 2010 is an estimate of what the NTM forecast would be for the intervening years constructed using the implied long run elasticities derived from the model (and scaling so it fits back to the 2010 modelled value). The purpose of this exercise is to show the extent to which on a year by year basis traffic in the NTM responds to changes in the external drivers and whether this traces broadly what outturn traffic shows. In this case we can see that outturn traffic does not respond as sharply to the combined effect of the large year on year changes in GDP and fuel prices that have been seen over the period since 2007. This is perhaps unsurprising, given the well-established finding that long-run elasticities (which are derived from the NTM and used in our test) are higher than short-run elasticities.

3.73 The final test shows a similar pattern, where the NTM forecast describes a more volatile pattern between modelled years than the outturn data. Forecast traffic is 2.4% higher than outturn in 2014, based on initial estimates of 2014 traffic.[23] Though the recent data showing an increase in GB car traffic of 1.5% for last year suggests that the upward trend in growth may be returning. This would be consistent with scenario 1, although this is only one year and the alignment with a trend should be assessed over a longer period.

---

[23] 2014 outturn here is based on 1.5% car traffic growth in GB for 2014 from provisional estimates in www.gov.uk/government/statistics/road-traffic-estimates-for-great-britain-october-to-december-2014. Growth rate for GB assumed to be the same for England as regional data for 2014 is not yet available.

Figure 3.14: Outturn v/s NTM - Cars, Scen 1 (bn vehicle miles)
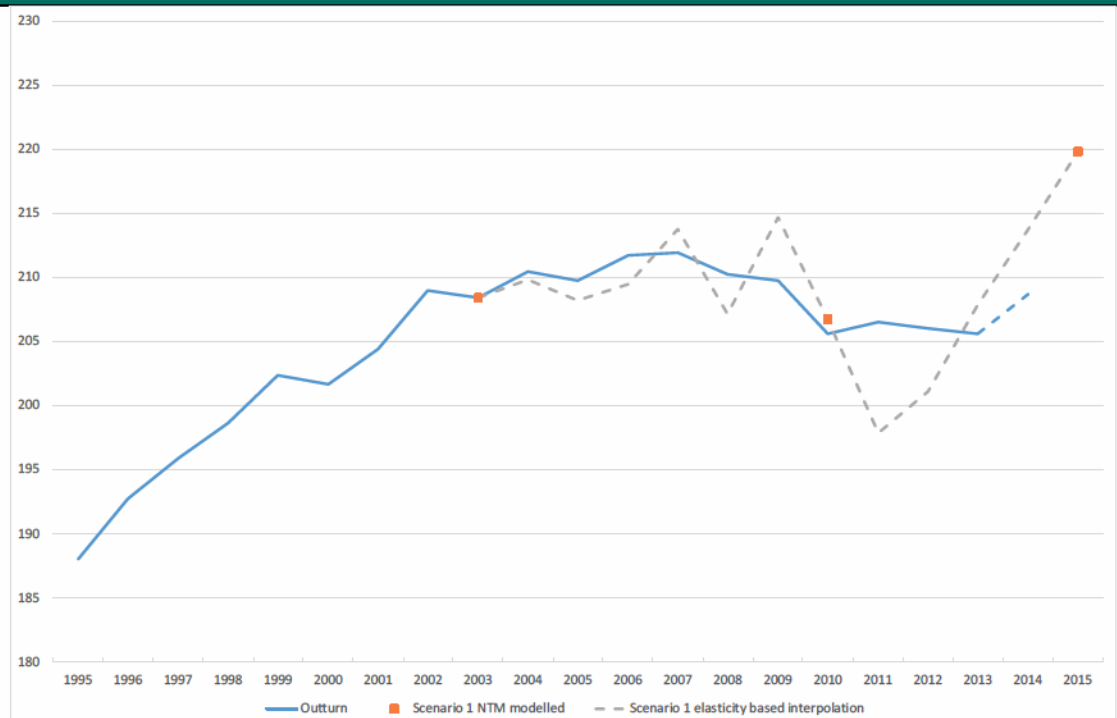
3.74   Figure 3.15 below presents the same analysis for scenario 3. This scenario underestimates demand in 2010 by around 2%.[24] The results for the interpolation are similar to those for scenario 1, where a more volatile trend is described for the forecast than for outturn traffic. By 2014 the model is around 3% below outturn demand and the modelled growth rate slightly lower for that year. Again, the alignment with the trend should be assessed over a longer period.

Figure 3.15: Outturn v/s NTM - Cars, Scen 3 (bn vehicle miles)

— Outturn   ■ Scenario 3 NTM modelled   – – Scenario 3 elasticity based interpolation
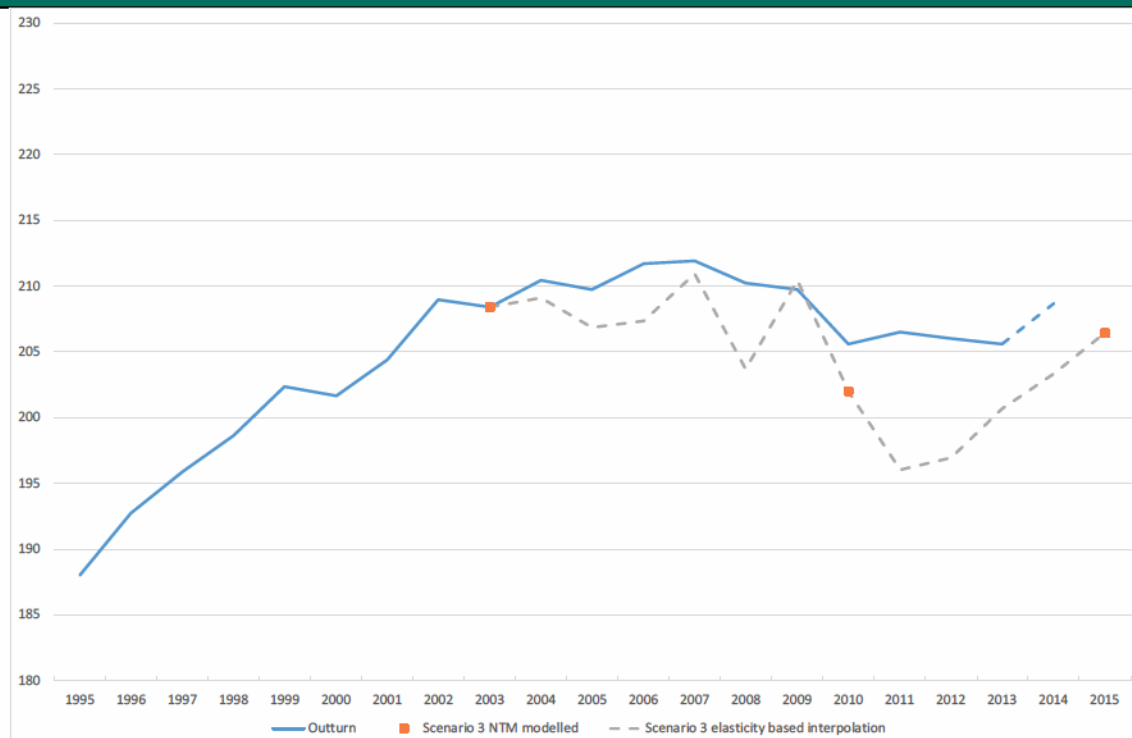
3.75 This analysis gives us confidence that the model, and the assumptions on which it is built, is suitable for providing forecasts of traffic over a number of years, even if it is not able to fully capture year by year changes, particularly where the key drivers experience more volatile swings.

3.76 Of course, that does not guarantee that this will continue to be the case into the future if we do not continue to review, update and improve the model and its underlying assumptions. The range of factors influencing travel demand and the way in which they do will continue to change over time.

3.77 Our *Understanding the Drivers of Road Travel* work has identified a number of emerging factors that may be affecting road travel and create uncertainty in future demand. Until we have a better understanding of them, our scenario approach can help us understand the nature and extent of this risk, and in these forecasts we have provided alternative scenarios for how income growth might affect car ownership and car use, and for trends in trip rates. Along with alternative scenarios for GDP growth and fuel cost changes, we think these capture a number of key uncertainties, but will continue to review and develop the evidence base, and improve our modelling assumptions and forecast scenarios to ensure they continue to provide an appropriate range of forecasts.

Time expenditure

3.78 The National Travel Survey (NTS) shows that the average time people spend travelling per day increased from 61 minutes in 1995 to 64 in 2005 but has since fallen back to 60 minutes in 2013.[24]

3.79 In the analysis below for scenario 1 we find that the average (mean) amount of time people spend travelling each day is forecast to go up from 68 minutes in 2010 to 72 minutes in 2040, across all modes. Although the NTM was calibrated to capture NTS mode shares and personal travel both by journey purposes and distance band, the model was not calibrated to match NTS travel times. It is therefore not surprising that the NTM has a slightly different figure and this may well represent definitional differences especially in relation to public transport transit time (which excludes waiting) and total journey times.

3.80 However, it can be seen that the forecast increase in average travel times of 4 minutes occurring over 30 years is not large and does not suggest the model is assuming a large change in travel behaviour.

3.81 The time spent as a car driver is forecast to go up by 6 minutes from 27 to 33 minutes while time spent as a car passenger is forecast to remain broadly flat accordingly to our analysis.

3.82 The amount of time people spend travelling overall is therefore forecast to be within the range it has been over the last two decades, but more of this time is forecast to be spent travelling in a car. The reason behind this shift is an increase in incomes which results in an increase in car ownership and in people's propensity to use faster modes of transport such as cars.

3.83 A good test of the model is whether it can replicate the past trend of a relatively consistent proportion of the day spent travelling, or whether the forecast implies a significant beak from past trends. The forecasts predict a small increase in individual travel time, with much of the overall increase in traffic coming from a shift to driving from other modes. This gives us further reassurance that our forecasts are reasonable. Although it forecasts a growth in time spent travelling by car, this is not primarily due to people spending considerably more time travelling, but rather due to a shift in mode - spending more of their travel time driving cars, as opposed to walking or taking the bus.

3.84 The forecasts below for the different modes are based on results from the NTM model. As previously stressed, the NTM is not the primary model used by the Department to forecast future growth in use of Cycles, Bus and Rail and we use bespoke models for those forecasts.

---

[24] www.gov.uk/government/statistical-data-sets/nts03-modal-comparisons

Table 3.10: Average daily travel time per person by mode (minutes)						
Scenario 1	Walk	Cycle	Car Driver	Car Passenger	Bus	Rail
2010	11.9	0.9	26.6	14.8	9.0	5.3
2015	12.0	1.0	27.3	14.5	9.2	5.6
2020	11.7	1.0	28.8	14.4	8.6	5.5
2025	11.5	0.9	30.3	14.4	7.9	5.3
2030	11.4	0.9	31.0	14.4	7.7	5.4
2035	11.1	0.9	32.0	14.5	7.2	5.3
2040	11.0	0.9	32.8	14.6	7.1	5.5

4. Next Steps

4.1   In this document we have described the range of evidence that has been accumulated and updated over decades and the detailed data and modelling that is used to produce these forecasts.

4.2   As we said in the *Understanding and Valuing the Impacts of Transport Investment* progress report, there are some interesting changes to travel behaviour going on and how this changes over time. This uncertainty is widely recognised. Here we have taken steps to accommodate this into the forecasts and in doing so we have highlighted the impact. That is, making alternative assumptions about the future change in trip making behaviour can have major implications for our view of road traffic in the future.

4.3   We continue to improve our understanding of the evidence and update the data and modelling approach. As we have stated here, this document is not the end of the process improving our understanding of future traffic demand, it is just one step on that journey. We published a suite of documents presenting our latest research to accompany the Road Investment Strategy in December 2014[25] and will shortly publish our analytical strategy. We will continue to work on the evidence base and develop the forecasting approach to improve the transparency and robustness of the model and we will continue our analysis of trip rates as set out in the *Understanding and Valuing the Impacts of Transport Investment* progress report. As we do this we will work with stakeholders to increase the understanding of our forecasting approach and to draw on their expertise for how it might be improved.

---

[25] www.gov.uk/government/collections/road-investment-strategy#analysis-social-research

Annex A: Model updates and tests

London update

1. Following receipt of new data from Transport for London confirming that the capacity of London's roads had declined over the last ten to fifteen years a review of the speeds and capacities of London's roads which are assumed in the NTM was performed as part of this forecasts exercise.

2. The speeds of London traffic in the model base year of 2003 were compared with monitoring data. This showed discrepancies in excess of those recommended by WebTAG guidance so some small changes were made to the speed flow curves of some road types.

3. To validate these new speed flow curves, the model was run from its base year of 2003 to 2010 using both the outturn traffic demand data and the assumed capacity reductions that had been received from TfL. The resulting speeds implied by the model were compared to outturn.

4. The modelled reductions in Central, Inner and Outer London traffic were 15%, 9% and 6% respectively and over the same time period the capacity of the network was simultaneously reduced as shown in table A1 below.

Table A.1: Road capacity in London, index 2003			
Year	Central	Inner	Outer
2003	1.00	1.00	1.00
2004	0.99	0.97	0.98
2005	0.96	0.93	0.99
2006	0.94	0.94	1.00
2007	0.90	0.95	1.00
2008	0.86	0.92	0.96
2009	0.83	0.89	0.95
2010	0.81	0.87	0.94

5. This test showed a good match between the observed and modelled speeds, confirming the acceptability of the revised speed flow curves and their implied capacity assumptions.

6. The revised London curves were then compared with all the other speed flow curves used by the NTM and it was considered that the new Outer London Principal road curve had become in-consistent with those used for other similar roads. A test was then run with Outer London adopting the Outer Conurbation A road Curve and, as use of this curve also led to

similar improvement in London's modelled speeds, the Conurbation curve was adopted for Outer London in the new forecasts.

7. Compared to the 2013 forecasts the finally adopted curve led to a 1.7% reduction in London's forecast traffic Levels in 2030 and a 0.1% reduction nationally.

Capacity Constraint

8. This section describes the developments and testing involved in incorporating a new 'capacity cut-off' mechanism in the NTM. It resulted in any traffic that, at the end of the forecasting process, is projected to be above the theoretical capacity of the particular link being removed or cut-off.

9. This modification results in lower traffic levels than would otherwise be the case and will therefore result in lower levels of forecast traffic overall.

10. The enhancement to the model involved the addition of a new optional facility that, if selected, removed any such excess traffic from the road network but stored it in the main output files so that the correct functionality of the 'cut-off' could be confirmed.

11. By running the program both with and without the 'capacity cut-off' selected it was possible to confirm the correct operation of the facility and the size of its impact.

12. The program was tested using a 'development' version of the model with the assumptions used for Scenario 1 for the year 2040. This included the new assumptions for London speeds and capacities.

13. Use of the capacity constraint cut off resulted in the total volume of traffic in 2040 falling by 1.8 billion miles (or 0.4%) from 426.9 to 425.1bn.

14. Whilst the impact of this change is relatively small nationally, it does have a larger impact in some areas as shown in the Table below. However, even in London, it only makes 2.6% difference in 2040 and the impact in other urban areas only approximately 0.5%.

15. As expected, the largest impacts were seen in the Peak periods on Principal A roads and whilst the cut-off removed 4.2% of such traffic in London and approximately 1% in other urban areas the analysis does suggest that, outside of specific locations or time periods, the network does have the capacity to absorb quite significant levels of growth.

16. The figures below show the percentage change of the 'constrained' outputs compared to the 'unconstrained' figures.

Table A.2: Impact of capacity constraint in 2040 by Area and Road type					
	Motorway	**Trunk**	**Principal**	**Minor**	**All Roads**
London	-0.88%	-----	-3.48%	-1.62%	-2.60%
Conurbations & large Urban	-0.13%	-0.59%	-0.62%	-0.44%	-0.44%
Urban	------	-3.16%	-0.39%	-0.02%	-0.51%
Rural	-0.05%	-0.04%	-0.02%	-0.12%	-0.06%
All Areas	-0.09%	-0.56%	-0.63%	-0.28%	-0.39%

Constant 2010 trip rates

17. Historically, the numbers of trips that the National Transport Model assumes for past and future years has been founded on the same figures as given in the National Trip End Model (NTEM). These figures are based on contemporary population forecasts, estimates of car ownership and assumptions around the numbers of trips made by different people in different employment categories and household structures.

18. The NTEM has always assumed that the trip rates for each of the population segments (for example a student) remain constant through time. Nationally however, trip rates have been projected to increase due to the assumed growth in income levels and change in demographic distribution of the population moving more people into segments that make greater numbers of trips.

19. Over recent years analysis on National Travel Survey data has suggested that the numbers of trips that people make is reducing and the Department is in the process of performing research into trip rates with a view to up-dating NTEM trip rate assumptions.

20. Prior to commissioning this up-date some preliminary research has been carried out on NTS data between the years 1998 and 2010 and it was felt that this new data should, if possible, be incorporated into the NTM forecasts.

21. New trip rates for the years 2003 and 2010 were produced and these were deployed in the National Transport Model's implementation of NTEM to produce revised numbers of trips for these years taking account of the other assumptions in NTEM; for example, around income growth, demographic changes and car ownership). Therefore, besides the incorporating of new trip rates, on all other aspects the results for this analysis were consistent with NTEM version 6.2.

22. In particular, we kept the assumption that trip rates remained constant for all future years to 2040.

23. Whilst the absolute numbers of trips in 2003 and 2010 was somewhat less than those used in previous forecasts, the fact that the NTM is pivoted off actual outturn traffic data for 2003 meant that the traffic figures for 2003 remained unaltered.

24. Furthermore, because the new trip rates were assumed to remain constant in the future (as before), the percentage traffic growth from 2010 was found to be very similar to those in RTF13.

25. Clearly, the assumption about how trip rates will change in the future is more important than what their starting level is. That is why we produced a scenario where trip rates were assumed to continue to fall in the future.

26. A number of options were tried or considered however as most relied on subjective decisions relating to how many years different rates might continue to change (note, not all rates are declining), it was concluded that the simplest and most transparent option would be to simply extrapolate the change in rates occurring between 2003 and 2010 out to

2040 in a linear manner. Any rates that declined to the extent they became negative were simply set to zero.

27.   It was these extrapolated rates that were then deployed in Scenario 3 of the latest forecasts.

28.   Trip rates developed using a more sophisticated regression analysis s were tried but these led to large exponential growths occurring in some trip purposes (where increases have been observed) whilst some trip rates that are in decline became asymptotic to zero. This test resulted in counter intuitive results and was therefore discarded.

Forge Speed flow curves

29. This Section presents details of the speed flow curves used in the National Transport Model. They are consistent with the capacity assumptions and version of the model used in the production of the forecasts above.

30. The curves were originally based on those described in the COBA manual but were lowered slightly to account for network effects (ie, junctions).

31. As in COBA, the curves provide the speeds on different road types occurring in different area types and are based on 'network average' conditions. They therefore represent average levels of hilliness, bendiness and minor (side) road or other accesses. They also assume fair (daytime) visibility and weather conditions.

32. The curves are up-dated from time to time to reflect more recent data relating to speeds, or any other issues that may arise. In this version the London curves have been updated to reflect more recent analysis of vehicle speeds based on GPS and other data collected by TfL. Different forecast year curves have been produced for London only, based on capacity data from TfL for 2010 - as described above.

33. Details of the speed flow curves used historically can be found in the FORGE report available on the Department's Website[26]

Speed/Flow Relationships (vehicles)

34. Table A.3 and A.4 describe the speed flow curves in terms of the number of vehicles per hour per traffic lane. The curves assume average road conditions and percentages of heavy vehicles appropriate to the different road and area types. The curves are also plotted in Figures A.5 and A.6.

Table A.3: Values used in Rural Area speed flow curves (Vehicles)

Road Type	Motorway		T&P Dual		T&P Single		B Roads		C & Uncl Roads	
Point on Curve	Speed kph	Flow veh	Speed kph	Flow veh	Speed kph	Flow veh	Speed kph	Flow veh	Speed kph	Flow veh
A	114.2	0	101.4	0	79	0	77	0	60	0
B1	-----	-----	-----	-----	60	1000	----	----	----	----
B2	112.6	1200	100.0	1071	10	1625	73	400	55	800
C*	55.6	2000	51.6	1750	36	1300	40	1100	40	1000

---

26 See National Archive theroadcapacityandcosts3031.pdf

P	20	2500	20	2193	5	2600	10	1320	10	1400

Heavy Speeds: Mway = 87 (v/c=.78); Dual = 79 (v/c = .85); Single A Rd = 69.6 (v/c= .38) ; B Rd = 69.2 (v/c= .47)

* Point C represents link capacity & is listed in the table as occurring after point B2, but this is not always the case.

Table A.4: Values used in Urban Area speed flow curves (Vehicles)

Road	Area	Point A	Point B1		Point B2		Point C		Point P	
Type	Type	Speed	Speed	Flow	Speed	Flow	Speed	Flow	Speed	Flow
Mway	1, 2 &	77	-------	------	74	120	47.0	180	20	2400
Mway	3 & 5	114.2	-------	------	112.6	120	55.6	200	20	2500
Trunk	4-6	65	60	619.	50	105	30.2	150	15	1845
A Rd*	1	49	38.8	380	7.5	800	17.5	667	5	1333
A Rd	1	49	38.8	308	7.5	648	17.5	540	5	1080
A Rd*	2	49	43	380	7.5	800	18.8	667	5	1333
A Rd	2	49	43	330	7.5	696	18.8	580	5	1160
A Rd*	3	58	50	572	10	132	21.8	110	5	2200
A Rd	3	58	50	538	10	124	21.8	103	5	2068
A Rd	4	49	43	367	7.5	774	18.8	645	5	1290
A Rd	5	58	50	520	10.0	120	21.8	100	5	2000
A Rd	6 to 9	64.8	57	620	10.0	141	34.5	100	5	2000
B&C*	1	30	14	210	7.5	629	9.1	524	5	1048
B&C	1	30	14	170	7.5	425	9.1	510	5	849
B&C*	2	30	15.9	419	7.5	629	15.9	524	5	1048
B&C	2	30	15.9	365	7.5	456	11.7	547	5	911
B&C*	3	35	18.7	632	7.5	948	13.1	790	5	1580
B&C	3	35	18.7	594	7.5	743	13.1	891	5	1485
B&C	4	40	24	473	7.5	630	18.5	525	5	1050
B&C	5 & 6	40	24	675	7.5	900	18.5	750	5	1500
B&C	7 to 9	40	24	900	7.5	120	18.5	100	5	2000
Unc*	1	30	9.3	157	7.5	629	7.9	524	5	1048
Unc	1	30	9.3	128	7.5	510	7.9	425	5	849
Unc*	2	30	15.9	157	7.5	629	9.4	524	5	1048
Unc	2	30	15.9	137	7.5	547	9.4	456	5	911
Unc*	3	30	21.7	237	7.5	948	10.7	790	5	1580
Unc	3	30	25.7	223	7.5	891	10.7	743	5	1485
Unc	4	30	19	420	7.5	630	13.3	525	5	1050
Unc	5 & 6	40	24	675	7.5	900	18.5	750	5	1500
Unc	7 to 9	40	24	750	7.5	105	10.2	100	5	1700

* Used for year 2003 only

Figure A.5: Rural speed flow curves

Figure A.6: Urban speed flow curves

Stress Maps

35.   The maps show stress levels of links on the major (Motorway and A) road network in years 2010 and in 2040 for both Scenarios 1 and 3. The stress levels are based on the volume to capacity ratios of links in the busy direction during the Monday to Friday peak periods.

Scenario1 Reference Case 2010
VC Ratio - AM Peak Period
Severe Congestion
Regular Congestion
Moderate Congestion
Occasional Congestion

Source: National Transport Model; TASM Division; DfT

Scenario: A104_RTF15_2010_Baseline1_Ref
(c) Crown Copyright and database rights 2015. Ordnance Survey Licence Number 100039241
Department for Transport

Scenario1 with RIS1 Invesment 2040
VC Ratio - AM Peak Period
Severe Congestion
Regular Congestion
Moderate Congestion
Occasional Congestion

Source: National Transport Model; TASM Division; DfT

Scenario: A104_RTF15_2040_Baseline1_Pack2
(c) Crown Copyright and database rights 2015. Ordnance Survey Licence Number 100039241
Department for Transport

Scenario 3 With RIS1 Invesment 2040
VC Ratio - AM Peak Period

- Severe Congestion
- Regular Congestion
- Moderate Congestion
- Occasional Congestion

Source: National Transport Model; TASM Division; DfT

Scenario: A104_RTF15_2040_Baseline4E_Pack2
(c) Crown Copyright and database rights 2015. Ordnance Survey Licence Number 100039241
Department for Transport