

# The wider costs of transport in English urban areas in 2009

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**CabinetOffice**

The Strategy Unit

Department for  
**Transport**



## Executive summary

The challenges faced by transport in urban areas are broad, affecting not only the economy of cities but also people's health and well-being. The estimates presented in this paper show that congestion, poor air quality, accidents and physical inactivity all impose costs of around £10 billion every year.

Understanding the full range of impacts that transport has on urban areas is therefore vital for policy to deliver successful towns and cities.

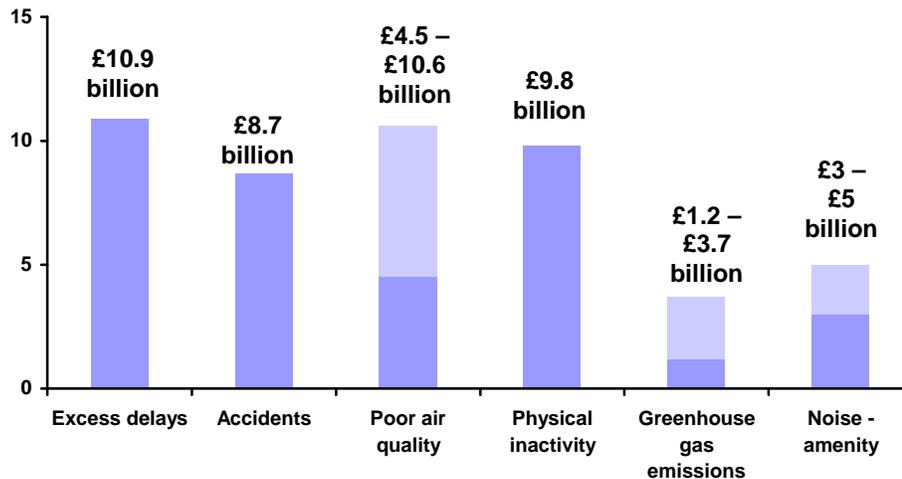
This paper focuses on urban areas as the challenges and opportunities for transport are more pronounced in larger towns and cities. This is because the intensity of transport use is higher in urban areas and the population affected by transport is larger given the significantly higher densities.

There is no single definition of a successful city although all mainstream measures stress the importance of meeting a balance of needs such as economic competitiveness and liveability. Transport can contribute to success in a number of ways although the relationships are complex. The connectivity provided by transport is crucial for a modern economy – allowing goods to be moved to market, helping employees get to work, and providing access to a wide range of services and leisure activities. However, transport can have other impacts which influence other aspects of quality of life. For example, improving air quality and increasing levels of physical activity can help reduce the incidence of diseases which shorten life and exacerbate existing conditions such as asthma.

To illustrate the scale of these challenges we have reviewed evidence of the costs of various outcomes associated with transport in urban areas. This builds upon work produced by the joint Cabinet Office Strategy Unit and Department for Transport study of Urban Transport. Whilst it may not be feasible or efficient to eliminate these costs, they provide an indication of the scale of the challenges faced by urban areas. The right balance of investment in urban areas will depend on the effectiveness and costs of individual measures.

These estimates show that the costs of excess delays, accidents, poor air quality and physical inactivity in urban areas are of similar scale. Whilst the costs of greenhouse gas emissions and the annoyance associated with noise are smaller, these are still significant and in the case of greenhouse gases expected to rise sharply in future years.

### Comparison of the wider cost of transport in English urban areas (£ billion per annum, 2009 prices and values)



These results suggest that transport policy has the opportunity to contribute to a wide range of objectives. This is supported by emerging evidence on specific schemes e.g. high benefit cost ratios for cycling interventions. This suggests that there is a strong case for saying that successful cities and towns will be the ones which consider how transport can deliver a wide range of goals.

Finally, this paper reinforces the message that decision makers should consider the full range of impacts when making decisions about transport. As such, it is important to recognise that the estimates presented above are a sub-set of relevant impacts. There is emerging evidence of other impacts e.g. noise can negatively impact on health. This highlights the need to continuously review the emerging evidence to ensure that decisions are based on robust and up-to-date information.

We are interested in views about this analysis and the conclusions which have been drawn. Any comments should be addressed to:

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## Introduction

Transport is a vital part of a successful economy allowing goods to be moved to market, helping employees get to work, and providing access to a wide range of services and leisure activities. However, transport imposes costs on society over and above the financial cost of building infrastructure and operating services. This is most evident in towns and cities where high levels of traffic – particularly at peak times – can lead to delays, poor air quality and accidents.

Understanding the full range of impacts that transport has on urban areas is vital for delivering successful cities and towns. Studies such as the Eddington Review have clearly set out how transport can generate significant economic benefits through improved connectivity. This paper seeks to build upon these studies by setting out some of the other impacts associated with transport in urban areas.

This paper reviews evidence on the size of these wider costs of transport in urban areas. There are three linked reasons for doing this:

1. 'Delivering a Sustainable Transport System' (DaSTS) set out five goals for transport policy. These focus on the challenge of delivering strong economic growth whilst also taking full account of transport's wider impact on climate change, health, quality of life and the natural environment. Understanding the relationships between transport and these wider objectives is an important part of taking the DaSTS agenda forward.
2. The case for continued investment in transport will in part depend on having a clear understanding of what government is trying to achieve through its transport policy. This analysis supports the DaSTS goals by providing an assessment of the potential gains that could be achieved by ameliorating the wider costs of transport and encouraging higher levels of, and broader participation in, physical activity.
3. Over the last few years there has been a growing interest in the impact of transport in urban areas, particularly the role of transport investment in delivering benefits through agglomeration. The high levels of population and employment densities in cities and towns (which support these agglomerations) can magnify these wider costs of transport e.g. poor air quality.

This paper builds on a joint project led by the Cabinet Office Strategy Unit and Department for Transport supported by a number of government departments particularly the Department of Health, DEFRA, Communities and Local Government and HM Treasury. This work found that the wider costs imposed by transport in urban areas through poor air quality and accidents are of similar order of magnitude to the costs of excess delay caused by congestion. Furthermore, this work found that the costs of physical inactivity in urban

areas (which can be influenced by transport policy) were also of similar magnitude.

This paper reviews the evidence collected by the Strategy Unit and adjusts the estimates to use a consistent price base and geographical coverage. This paper also sets out some of the caveats around the interpretation of this results and concludes by discussing what further research might be undertaken to extend the analysis to other impacts. The paper also extends the scope of the original analysis to consider evidence on the impact of CO<sub>2</sub> and transport related noise in urban areas.

Care should be taken in interpreting the result of this paper. Whilst this analysis indicates that the wider costs associated with transport are of similar order, this does not necessarily mean that spending should be split evenly between the various objectives. Efficient spending decisions will depend on the effectiveness and cost of individual measures and should be considered on a case by case basis through robust cost-benefit analysis. However in terms of option generation, there may be a strong business case for interventions which address these impacts simultaneously.

It is intended that this paper will help central and local government understand and quantify those challenges faced by urban areas which could be influenced by transport policy.

The rest of this paper is divided into seven sections:

- Section 1 briefly reviews the results from a previous study which attempted to allocate the wider costs of transport. This study indicated that the significant non-financial costs were accident costs, air pollution, noise and climate change.
- Section 2 sets out the basis approach and key concepts used in putting together these estimates. This covers how the wider costs have been measured, the definitions of urban areas used, the modes included and time period to which the analysis relates.
- Section 3 presents evidence on the size of the wider costs. This describes the analysis on which these estimates are based and how these estimates have been adjusted to focus on urban areas in England.
- Section 4 adjusts the estimates to show them at 2009 prices and values.
- Section 5 discusses some of the main issues associated with interpreting these estimates.
- Section 6 outlines the implications for policy raised by these estimates.

- Section 7 discusses how these estimates could be refined and extended to cover other impacts.

## Section 1. Previous research

There have been attempts in the past to measure the full costs of transport. The last major study we are aware of in Great Britain was 'Surface Transport Costs and Charges' by Sansom et al (2001). This was commissioned to provide information to inform policy development in relation to charging, taxation and subsidy. As a result it considered both the short-run marginal cost of road and rail transport and the fully allocated costs and revenues. This information would give policymakers sufficient information to consider charges, taxes and subsidy from both an efficiency and cost coverage perspective.

As the research was primarily interested in informing policy development in relation to charging, the results were presented as costs per vehicle or train km. The results for the cost categories considered are reproduced below. These are average costs for all areas i.e. no distinction was made between urban and rural areas.

### **Comparison of 1998 Road and Rail Sector Costs (1998 prices and values) – Great Britain**

	Results for road sector (pence per vehicle km)		Results for rail sector (pence per train km)	
	Low	High	Passenger	Freight
Cost of capital for infrastructure	0.78	1.34	5.33	3.41
Infrastructure operating costs and depreciation	0.75	0.97		
Vehicle operating costs	0.87	0.87	7.07	9.28
External accident costs	0.06	0.78	-	-
Air pollution	0.34	1.70	0.46	0.68
Noise	0.24	0.78	0.16	0.37
Climate change	0.15	0.62	0.10	0.33
VAT not paid	0.15	0.15	1.32	N/A

Annex B of the report set out the total fully allocated environmental costs for Great Britain as a whole. These gave central estimates of (1998 prices and values):

- Climate change: £1.4 billion
- Air pollution: £3.2 billion
- Noise: £2.35 billion

Since these estimates were published there have been significant advances in the way impacts are measured and valued. This reflects better scientific evidence of the impact of various factors on health and well-being as well as the availability of alternative ways of valuing impacts. Where possible, this paper draws on the most recently available research.

## Section 2. Basic approach and key concepts

The estimates of wider costs presented in this paper are based on published research (details on individual sources are provided below). Given that the valuations presented in the published research relate to different years and geographical coverage, they have been adjusted for the purposes of comparison.

There are a number of considerations when defining the scope of costs included in this exercise:

- What do we mean by the wider costs of transport?
- How do we measure the wider costs?
- What is an urban area?
- Should the wider costs be measured at source (i.e. where the “bad” is created) or where the costs are experienced?
- What is included in the definition of transport?
- What time period should this analysis relate to?

The approach we have taken to addressing these questions reflect the objective of the analysis – to help identify and quantify the challenges and opportunities faced by transport in urban areas. We have tried to define a consistent framework for comparing these wider costs but the use of existing research has inevitably limited the extent to which this can be achieved in practice. The extent to which individual estimates deviate from this framework is documented in the sections below. Whilst these inconsistencies mean that caution must be exercised when comparing these estimates, we think the general conclusions still hold.

### *(a) What do we mean by the wider costs of transport?*

The operation of transport in urban areas has significant direct and indirect costs. The direct costs tend to be financial and are primarily comprised of infrastructure costs (e.g. building and maintaining road and rail links) and operating costs (e.g. fuel). However, transport imposes wider costs which are not included in the direct financial costs e.g. poor health caused by reduced air quality in urban areas.

The full range of costs (and benefits) associated with new transport schemes are considered by DfT when making investment decisions. This is formalised in the New Approach to Appraisal (NATA). NATA is a multi-criterion decision tool used to assess all the impacts of transport schemes based on cost-benefit appraisal and environmental assessment techniques. It is state-of-the-art and was last updated in 2009<sup>1</sup>.

NATA is a useful starting point for thinking about the range of costs that we might want to consider. As our focus is on the costs from transport, we have focused on those impacts which are likely to impose costs overall. NATA is organised under five headings which align with the DaSTS goals:

- Tackle climate change

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<sup>1</sup> <http://www.dft.gov.uk/consultations/archive/2008/consulnaterefresh/natarefresh2009.pdf>

- Support economic growth
- Better safety, security and health
- Improve quality of life and promote a healthy, natural environment
- Promote equality of opportunity

Each scheme or policy is assessed against a number of challenges within each goal<sup>2</sup>. NATA presents the impact on these challenges in monetary terms where possible. This makes it easier to compare the relative impact of schemes on a range of goals. Most impacts within the first three objectives can be monetised although with varying degrees of robustness.

This paper presents estimates of the wider costs of transport associated with congestion, poor air quality and accidents. It also reports on the cost associated with CO2 emissions from transport activity in urban areas as well as previous research on the annoyance factor of transport related noise. The costs of physical inactivity are also reported. Whilst there are a number of different causes of sedentary lifestyles, policies which change how people get about have the potential to reduce these costs.

These cost categories cover (to some extent) the main wider costs of transport in urban areas with the possible exception of one aspect – the impact on the built environment. Whilst advances are being made in the valuation of streetscape and amenities for pedestrians, it is not yet possible to systematically value what impact transport systems have on how people perceive and value urban areas. However, emerging evidence suggests that these costs could be significant. For example, 27% of UK companies asked reported that the quality of life for employees was an important factor in deciding on where to locate their business.

Whilst this paper sets out the main wider costs of transport in urban areas, it should be stressed that this provides only a partial picture of the impact of transport in an urban area.

- First, it only presents an assessment of the wider costs of transport. A complete picture of the impact of transport in urban areas would need to include the direct costs of transport (e.g. infrastructure costs) as well as the benefits that transport systems provide modern urban economies.
- Second, the wider costs presented in this paper are only a sub-set. As indicated above there are other impacts which are more difficult to quantify or very localised in nature. For example, it has not been possible to value the loss of landscape and townscape amenity associated with the provision of transport infrastructure.

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<sup>2</sup> E.g. the impact on the economy is measured by the extent to which a scheme: improves reliability, improves connectivity, supports the delivery of housing, enhances resilience and contributes to wider economic impacts.

- Third, even where it has been possible to monetise certain impacts it is not clear that these provide a complete estimate of all the wider costs. For example, the costs of accidents do not include delays caused to other road users.

*(b) How do we measure the wider costs?*

As the focus of this paper is on the challenges and opportunities faced by transport in urban areas we have attempted to estimate the total costs of each impact considered. This differs from an efficiency perspective (on which appraisal is based) which would consider the marginal cost of different activities. As discussed in section 1, these alternative perspectives can give very different results of the relative cost of impacts.

There are two options for measuring the total costs of these impacts. The first option is to measure the total value of all the impacts associated with each cost category e.g. the costs associated with all accidents. The second approach builds on the fact that most of these impacts are externalities by measuring the total value of all impacts over and above the “optimal” amount. This gives an estimate of the welfare loss associated with the externality.

In most cases the paper presents the wider costs based on the first approach. This is because we do not have the evidence with which to easily identify the efficient level of these costs. The exception to this are the costs associated with delay. By modelling the impact of introducing road user charging it is possible to estimate the efficient level of delay – i.e. the level at which the charge is equal to the value of delay imposed on others. We have used this estimate of the costs of delay in this paper.

Whilst the cost of excess delays and other impacts are not strictly presented on the same basis we think this approach is reasonable for the purposes of this paper as delays are imposed on other road users. In effect, the wider costs associated with delay are both created and experienced through road use. As a group road users would only be willing to pay to reduce delays to the efficient level. Those who bear the costs of other impacts (e.g. noise pollution) are unlikely to directly benefit from the activities which cause them.

There are a number of other technical issues which have been considered as part of this study:

- None of the cost estimates presented in this paper include the costs people incur trying to avoid these impacts. For example: poor air pollution may impose additional losses in productivity if fewer people are willing to work in polluted environments. The cost of avoiding or insuring against these impacts may be significant.
- Many of the estimates presented in this paper are based on contingent valuation or stated preference studies. One of the characteristics of these studies is that people’s willingness to pay is positively correlated with income. As we are using disaggregated data it is possible to apply valuations which vary by location to reflect higher incomes in different

parts of the country (e.g. higher values of time in London and the South East). However, this paper presents estimates of costs based on equity values i.e. a single value of time is applied throughout. This is consistent with DfT appraisal guidance and ensures that transport investment decisions are not biased towards high income areas (or those modes most heavily used by high income people).

- The estimates presented in this paper are based on the market unit of account. As a number of studies report costs in the resource unit of account we have used the market cost adjustment factor (20.9%) to convert costs into market prices where applicable.
- The valuation studies on which these estimates of wider costs are based have generally sought to measure the value associated with marginal changes in particular outcomes (e.g. probability of longer life expectancy). These changes are small and do not affect the prices of goods and services. As most of the costs presented in this paper would imply large changes in outcomes it is likely that this assumption does not hold and as a consequence some of these costs will be overestimated.

*(c) What is an urban area?*

This analysis focuses on urban areas because the wider costs associated with transport tend to be more severe in larger towns and cities. The simple explanation for this is that the intensity of transport use is higher in urban areas (e.g. vehicle flow per hour on each road is higher in cities and large towns) and the population affected by transport is larger given the significantly higher densities. These higher population densities in urban areas also increase the relative importance of other impacts relative to the delays from congestion. The health impacts of poor local air quality and the annoyance from noise will depend on the total population exposed and their vicinity to the pollution source (e.g. roads). This will be significantly higher in towns and cities than in rural locations.

There are a number of characteristics which are commonly used to define and identify urban areas:

- Administrative areas with a minimum population
- Settlements with a minimum population
- Settlements with a minimum population density
- Functional urban areas
- Travel to work areas

Each of these definitions has their own strengths and weaknesses in relation to transport. The analysis in this paper is based on administrative boundaries. In part this reflects the availability of data, which is generally more comprehensive at this level of disaggregation. The use of administrative boundaries also seems relevant in this context as this is the level at which transport planning and decision making takes place.

This paper presents estimates of wider costs for three different geographical areas:

- ITAs: those areas which were formerly covered by metropolitan counties i.e. Great Manchester, Merseyside, South Yorkshire, Tyne and Wear, West Midlands and West Yorkshire. This covers approximately 22% of the population of England<sup>3</sup>.
- ITAs and London: as above plus the boroughs making up Greater London. This covers approximately 36% of the population of England<sup>4</sup>.
- All urban areas with more than 10,000 resident population – this is based on the 1991 Office of the Deputy Prime Minister definition of urban settlements. This is a fairly broad definition of urban areas and encompasses 81% of the population of England<sup>5</sup>.

The analysis considers the wider costs in urban areas in England only. This reflects DfT's geographical responsibilities for local transport. However, the general conclusions are likely to apply in the urban areas of Scotland, Wales and Northern Ireland.

*(d) Should the wider costs be measured at source (i.e. where the "bad" is created) or where the costs are experienced?*

The purpose of this analysis is to consider the impact of the operation of transport systems in urban areas. In principle, this could be viewed in a number of ways:

- The costs caused by activity occurring in urban areas (e.g. driving a car);
- The costs experienced in urban areas resulting from transport related activity; or
- The costs to residents of urban areas resulting from transport related activity.

These perspectives on the definition of an urban area will inevitably give different results. For example, particulates emitted in the course of driving in rural areas may be blown into urban areas. This would not be counted as a wider cost under the first definition described above but included under the other two. Whilst we would want to use a consistent definition throughout, limits on the available data and research means that we have had to be pragmatic. However, where possible we have tried to estimate the impact on costs experienced in urban areas.

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<sup>3</sup> Analysis of 2007 mid-year population estimates (ONS).

<sup>4</sup> Ibid.

<sup>5</sup> Analysis of 2001 Census.

In practice it will be difficult to determine where the costs are ultimately experienced. For example, the transmission mechanisms of a modern economy may mean the delays from congestion in urban areas may impact on the prices of goods and services in rural locations. Equally, the pain and suffering associated with a fatal road accident in an urban area will not necessarily be limited to that area e.g. if relatives and friends live in rural areas or other countries.

*(e) What is included in the definition of transport?*

The aim of this paper is to measure the wider costs from transport in urban areas (including travel within the urban area for journeys that take places either to/from or through urban areas). As a result we have focused on surface transport in urban areas. The main modes covered by this definition include walking, cycling, car (driving or passenger), bus, goods vehicles, trains, light rail and underground.

Given that this paper summarises results from other studies the coverage of wider costs from surface transport isn't complete. The level of coverage of summarised in the table below. All the categories of wider costs include the impact of traffic using the highway – primarily cars, goods vehicles and buses. This should mean that the primary driver of cost has been captured.

	Modes included				Comment
	High-way	Walk/cycle	Rail	Light Rail	
Delays resulting from congestion	✓	✗	✗	✗	Impact of congestion on public transport (including buses) may also be experienced through crowding
Poor air quality	✓	N/A	✓	✓	Allocated to all transport sources
Accidents	✓	✓	✗	✓/✗	Estimates include all accidents which occur on roads (including light rail accidents on carriageways) although number of accidents on rail comparatively small
Physical inactivity	N/A	N/A	N/A	N/A	Not strictly a cost attributable to transport
Noise	✓	N/A	✓	✓	Allocated to all transport sources
CO2	✓	N/A	✗	✗	Impact of other modes is likely to be small given that 92% of emissions from domestic transport come from road <sup>6</sup>

This paper does not cover the wider costs of shipping (inland and at sea) or air travel. Whilst these activities may have an impact on urban areas – e.g. contributing to poor local air quality or noise – these are more difficult to

<sup>6</sup> 'Carbon Pathways Analysis: informing development of a carbon reduction strategy for the transport strategy', DfT (July 2008)

attribute harms in urban to and are less likely to be influenced by local policies. It also does not cover the wider costs associated with the construction of infrastructure or the manufacture of transport related products (e.g. cars).

*(f) What time period should this analysis relate to?*

The objective of this analysis is to inform short- to medium-term strategies for urban areas. As a result we have considered the wider costs of transport as experienced today. Where possible we have used the most up to date figures on wider costs although in some cases (most notably physical inactivity) we have to rely on older data.

The magnitude and relative size of the wider costs are likely to change over time. This reflects changes in the relationship between transport and outcomes over time (e.g. cleaner engines may reduce particulate emissions per vehicle kilometre) as well as the value attached to different outcomes (e.g. shadow cost of carbon is expected to rise much quicker than other costs). We anticipate that if this exercise was completed for a later year that greenhouse gas emissions would be more relatively more important and poor air quality relatively less important (as tighter vehicle emissions standards reduce air pollution).

### Section 3. Estimates of wider costs

#### *(a) Delays*

One of the main ways in which transport imposes wider costs is through the delays to journeys caused by congestion. In deciding whether to drive to a location at a particular time (e.g. work, school, shops etc) people will consider the delays they face themselves but do not take into account the additional delay their journey imposes on others. This additional delay can be significant, particularly in dense urban areas where heavy traffic and congestion are common occurrences.

In principle congestion can occur on all modes of transport. Congestion on public transport is usually experienced as crowded services rather than increases in journey time (although journey times may also be longer). The extent to which this can be considered “excessive congestion/crowding” will depend on whether fares have been set at a level which internalises the additional crowding costs e.g. through peak pricing. This paper however only values the excess congestion experienced on the road network. This is because of the relative proportion of journeys made by car and goods vehicles in relation to the total as well as the difficulties of establishing the impact of congestion on public transport networks.

The approach to estimating the costs of excess delays has been to use the National Transport Model (NTM) to compare the level of delays on the road network under the status quo and road user charging scenarios. The latter test effectively reports the level of delays that would occur if the price paid for using the road network were set at a level which reflected the delays motorists impose on others i.e. the congestion costs are internalised and this therefore represents the optimal or most ‘efficient’ use of the network. The charges also included allowances for CO<sub>2</sub>, air quality and accidents – but this was a relatively small component.

#### **The National Transport Model (NTM)**

The Department developed the NTM as an analytical and policy-testing tool. The NTM provides a systematic means of comparing the national consequences of alternative national transport policies or widely-applied local transport policies, against a range of background scenarios which take into account the major factors affecting future patterns of travel.

The NTM is able to represent a number of different pricing schemes. Prices can be set by time of day, area type, road type, level of congestion and vehicle type. When prices are input into the road capacity module of the NTM, there are three initial responses related to drivers changing either their route or time of travel. They can switch:

- to a different road of the same type;
- to a different road of a lower order, e.g. from a motorway to an A road; and
- to a different time period – from the peak to one of the adjacent time periods.

Other parts of the NTM take into account the impacts of modal shift and changes in destination choice.

As with all forecasts, there is uncertainty around the NTM forecasts and the projections should be treated as indicative and illustrative of broad trends.

The results from the 2008 runs of the NTM have been abstracted for this work. The headline results for these runs are reported in DfT (2008c). These provide forecasts of traffic and delay for the base year of 2003 and 2010, 2015, 2025. These forecasts are consistent with the approach used and reported in the Eddington Study.

The results for 2003 were output by area type (London, conurbation, urban, rural) and Local Authority. This provided sufficient disaggregation to identify the costs of delays for the three categories of urban area. These results were then uplifted to 2009 congestion levels by interpolating the growth in total delay on urban roads between 2003 and 2010.

To convert from total delays to excess delay we have used the results of analysis reported in the Eddington Study (2006) and the Road Pricing Feasibility Study (DfT, 2004). These studies report that delays would reduce by just over a half if efficient road pricing were implemented. The resulting estimates of the costs of excess delay are presented below.

	<b>Costs of excess delays (2009 levels, 2002 prices and values)</b>
ITAs and London	£2.9 billion
ITAs	£6.0 billion
All urban areas	£8.6 billion

There are a number of reasons to suggest that these cost figures can be considered to be conservative:

- They exclude reliability impacts;
- They exclude wider economic impacts such as the implications for trade, globally mobile investment or the more dynamic effects of changing land use patterns and impacts on labour markets; and
- They do not account for higher values of time in London and the South East (where incomes are higher) although even if we are looking at economic welfare there are arguments for using the equity value of time.

It should be noted that policies which reduce congestion will usually not only reduce delays but deliver benefits through reduced CO<sub>2</sub>, noise etc. To avoid double counting we have only presented the time cost of delays in this section.

*(b) Accidents*

Transport accidents impose a range of impacts on people and organisation, including:

- pain, grief and suffering\*;
- lost economic output\*;
- medical and healthcare costs\*;
- material damage^;
- police and fire service costs^;
- insurance administration^; and
- legal and court costs^.

Those impacts marked (^) are closely related to the number of accidents, while those marked (\*) are related to the number of casualties. Therefore, numbers of accident and numbers of casualties form the key quantitative indicators for estimating the wider costs of accidents in urban areas. Combining these numbers with the values for the costs of accidents and casualties yields a monetary estimate of the accident-related costs of transport.

The impact of casualties and accidents differs according to the severity of the injuries sustained. Three groups are usually differentiated; these are defined in the following way:

- **Fatality**: any death that occurs within 30 days from causes arising out of the accident<sup>7</sup>.
- **Serious injury**: An injury for which a person is detained in hospital as an “in-patient”, or any of the following injuries, whether or not they are detained in hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident<sup>8</sup>.
- **Slight injury**: An injury of a minor character such as a sprain (including neck whiplash injury), bruise or cut which are not judged to be severe, or slight shock requiring roadside attention. This definition includes injuries not requiring medical treatment.

The benefit (or disbenefit) of changes in the number of accidents or casualties are routinely included in the appraisal of transport schemes and we have taken the values from current DfT guidance published in TAG (DfT, 2009). These are reproduced below.

#### Casualty related costs (£ June 2008)

Injury severity	Lost output	Human costs	Medical and ambulance	TOTAL
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<sup>7</sup> Note: conformed suicides are excluded.

<sup>8</sup> An injured casualty is recorded as seriously or slightly injured by the police on the basis of information available within a short time of the accident. This generally will not reflect the results of a medical examination, but may be influenced according to whether the casualty is hospitalised or not. Hospitalisation procedures will vary regionally.

Fatal	578,840	1,103,980	990	1,683,810
Serious	22,300	153,400	13,510	189,210
Slight	2,360	11,230	1000	14,590
Average, all casualties	10,940	39,270	2,410	52,620

The values for the prevention of fatal, serious and slight casualties include the following elements of cost<sup>9</sup>:

- Loss of output due to injury. This is calculated as the present value of the expected loss of earnings plus non-wage payments made by employers.
- Ambulance costs and the costs of hospital treatment.
- The human costs of casualties. These are based on willingness to pay to avoid pain, grief and suffering to the casualty, relatives and friends, as well as intrinsic loss of enjoyment of life in the case of fatalities.

The methodology used for valuing non-fatal casualties was described in an article in Road Accidents Great Britain in 1992, and a subsequent article in the 1994 edition gives updated information. More detailed descriptions of methods and the underlying research has been published by the Transport Research Laboratory. Road Accidents Great Britain 1997 contained an article describing the results of more recent research into the value of prevention of a road accident fatality.

The values for the prevention of accidents include the following elements of cost:

- Cost of policing accidents. These have been estimated based on a study of the time taken to undertake policing tasks associated with accidents. These were converted into monetary amounts using a police ready reckoner which took account of the cost of time spent by individuals of different rank.
- Insurance and administration costs. This covers the administration costs associated with the handling of insurance claims resulting from road accidents. These estimates are based on the average staff time required to process a claim plus some allowance for overheads and expenses. The average costs were adjusted to take account of the proportion of accidents with no claim. The amounts

<sup>9</sup> A number of the estimates presented in this paper apply assumptions about the value of preventing fatalities (e.g. physical inactivity and poor air quality). These values are based on different methodologies and to some extent reflect the context in which fatalities are incurred. No attempt has been made in this paper to adjust the values applied in individual studies. Some of these issues are discussed in a recent report for the Interdepartmental Group on the Value of Life and Health (<http://www.homepages.ucl.ac.uk/~uctyjow/IGVLH.pdf>).

paid out by insurance companies in respect of claims for property damaged are excluded as they represent a transfer.

- Damage to property. A survey of insurance claims data from a major insurance company was used to obtain estimates of the cost of damage arising from accidents occurring in different locations and of different levels of severity. These included related costs such as engineer' and assessors' fees.

Details on the derivation of these costs are available in Simpson and O'Reilly (1994).

Casualty related costs are based on equity values and are assumed not to vary by location. Therefore, we do not need to make any allowance for differences in urban areas. However, accident costs can be expected to vary according to location as differences in the mix of accidents and operational response will differ. For example, fatal accidents on motorways are likely to involve higher property costs given the speeds involved. We have therefore used more detailed data from DfT (2008b) to look at the accident related costs on urban roads and motorways separately. This is based on the same studies as used for the TAG values.

#### **Accident related costs – urban roads only<sup>10</sup> (£ June 2008)**

<b>Injury severity</b>	<b>Police cost</b>	<b>Insurance and admin</b>	<b>Damage to property</b>	<b>TOTAL</b>
Fatal	1,970	309	8,051	10,330
Serious	164	192	4,315	4,671
Slight	60	117	2,545	2,722
Damage only	4	55	1,820	1,879

#### **Accident related costs – motorways (£ June 2008)**

<b>Injury severity</b>	<b>Police cost</b>	<b>Insurance and admin</b>	<b>Damage to property</b>	<b>TOTAL</b>
Fatal	1,624	183	10,316	12,123
Serious	256	114	8,802	9,172
Slight	36	69	4,453	4,558
Damage only	1	33	1,553	1,587

The total cost of accidents in urban areas is calculated by multiplying the total number of reported casualties by the average cost per casualty (split by severity) and then adding the total number of accidents multiplied by the cost per accident (again split by severity).

Data on the number of reported casualties and accidents in 2008 split by local authority and area type has been taken from DfT (2009). Damage only accidents are not generally reported to the police and are assumed to occur at

<sup>10</sup> The definition of urban roads used in this breakdown of accident related costs relates to the speed limit of the road (all roads with a speed limit of 40mph or less). This differs from the definitions of urban areas used in this paper. Given that damage costs will tend to fall as average speeds reduce, it is likely that this represents an underestimate of the average cost of accidents in urban areas.

a rate of 17.7 per personal injury accident on urban roads and 7.6 per personal injury accident on motorways. This is consistent with the latest advice in TAG (DfT, 2009).

**Cost of accidents in urban areas – 2008 (2008 prices and values)**

	Casualty related costs	Accident related costs	TOTAL
ITAs and London	£3.3 billion	£1.9 billion	<b>£5.2 billion</b>
ITAs	£1.9 billion	£1.1 billion	<b>£3.1 billion</b>
All urban areas	£5.4 billion	£3.6 billion	<b>£8.9 billion</b>

There are a number of reasons to view these estimate as conservative, representing a lower bound for the costs of accidents:

- The total number of accidents used relates to road accidents only and excludes accidents on public transport other than buses and trams running on-street;
- The costs of responding to accidents do not include those borne by the fire service; and
- The impact of accidents on congestion and journey time reliability is not estimated.

It is only the last of these impacts which is likely to be significant. It should also be noted that the casualty related costs estimated here are based on the number of accidents reported to the police. A considerable proportion of non-fatal casualties are not known to the police and hospital, survey and compensation claims data all indicate a higher number of casualties than are reported. Inclusion of these un-reported accidents could significantly increase the wider costs presented here.

*(c) Local air quality*

Poor air quality can impose a number of health and non-health costs on society. The main impacts are summarised in the 2007 Air Quality Strategy (DEFRA, 2007) and include:

- Loss of life expectancy
- Deaths brought forward
- Increased hospital admissions
- Reduced crop yields
- Damage to materials
- Soiling of buildings
- Damage to forests and other ecosystems

Transport contributes to poor air quality primarily through the use of petrol and diesel and to a lesser extent, through brake and tyre wear<sup>11</sup>. The table below

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<sup>11</sup> The construction of roads and rail lines and the production/maintenance of vehicles may also contribute to poor air quality in urban areas.

summarises the evidence of the health impacts of poor air quality by differing pollutants<sup>12</sup>.

Pollutant	Evidence
Particles	<p>Evidence has been accumulated in recent years to show that day to day variations in concentrations of airborne particles, measured as PM10, PM2.5, Black Smoke or other measures, are associated with day to day variations in a range of health end-points. These include daily deaths, admissions to hospital for the treatment of both respiratory and cardiovascular diseases and symptoms amongst patients suffering from asthma.</p> <p>In addition to these effects there is evidence from the United States that long term exposure to particulate air pollution is associated with a decrease in life expectancy.</p>
Sulphur dioxide	<p>Studies have shown that day to day variations in concentrations of SO2 are associated with the number of deaths occurring each day and also with admissions to hospital for the treatment of respiratory diseases. There is also evidence linking concentrations of SO2 with chest symptoms and with the use of bronchodilator therapies.</p> <p>There is evidence from the United States that long term exposure to SO2 itself may be linked to losses in life expectancy.</p>
Nitrogen dioxide	<p>The evidence on the impact of NO2 is mixed. Increases in daily deaths were found to be associated with increases in mean daily concentrations of NO2 but this finding was not supported by evidence on either respiratory or cardiovascular deaths. There is some evidence that hospital admissions for respiratory diseases are related to concentrations of NO2 although COMEAP did not consider the evidence robust enough for quantification.</p> <p>There is some evidence for the long terms effects of NO2 although the evidence is weak.</p>
Ozone	<p>Evidence for associations between daily deaths and admissions to hospital with daily mean concentrations of ozone is strong. It is not currently known whether there is threshold of effect for the effects of ozone on health.</p> <p>There is evidence from US studies that long term exposure to raised ozone concentrations leads to lower levels of lung function and may impair development of lung function. Whether this occurs in the UK is unknown. The evidence regarding whether long term exposure to ozone increases mortality is not clear cut.</p>

Estimates of the costs of poor air quality are published in the 2007 Air Quality Strategy. This reported that the health impact of man-made particulate air pollution in 2005 was estimated to cost up to £8.5 – £20.2 billion per annum.

<sup>12</sup> Summarised from chapter 2 of Air Quality Strategy: Volume 2

The valuation of poor air quality is based on the impact-pathway approach. This approach follows the logical progression from emission of air pollutants, exposure and a range of endpoints which can be valued. The relationship between concentrations of particulates in atmosphere (measured by PM10) and health outcomes used in the 2007 Air Quality Strategy is based on a detailed review of the evidence by COMEAP.

The evidence on the valuation of health benefits are drawn mainly from two UK and EU based contingent valuation studies: Chilton et al (2004) and Markandya et al (2004). The Chilton study elicited household WTP for increasing life expectancy by reducing the risks of four adverse health effects of air pollution: chronic mortality; acute mortality; emergency admissions to hospital; and days of breathing discomfort caused or aggravated by raised levels of pollution. The Markandya study asked respondents for WTP for a new product that reduces their chance of dying from a disease or illness. Respondents were told the produce would reduce their chance of dying over the next ten years by some magnitude of risk change (either 5 in 1,000 or 1 in 1,000 reduction in risk).

We have based the estimate of the impact of transport on local air quality on the figures reported in the 2007 Air Quality Strategy. The approach we have taken is to allocate a proportion of these costs to the operation of transport in English urban areas. This top-down approach required three assumptions which are discussed below:

- What proportion of the costs are incurred in England?
- What proportion of the costs are incurred in urban areas?
- What proportion of the costs are attributed to transport?

In the absence of detailed modelling results which reported costs in specific geographical areas we made a number of simple assumptions to convert the 2007 Air Quality Strategy figures from a UK wide figure to one covering English urban areas. To convert from a UK to England total we have assumed that the costs of poor air quality are distributed in proportion to each country (84%). We then assumed that all the costs were incurred in urban areas. This is potentially an overestimate given that particulates are observed in rural areas but this should be fairly minor given that over 80% of the population live in urban areas and concentrations of particulate matter are generally higher in these areas.

It has not been possible to source an assumption about the contribution of transport to concentrations of particulates in urban areas. In allocating costs to the transport sector we have therefore looked at data on particulate emissions. The proportion of particulate matter (measured by PM10) accounted for by transport varies significantly across the country. The share of transport in the total UK emissions of PM10 is around a quarter (NAEI, 2007). However, this share rises significantly in urban areas, where higher concentrations of particulate matter are observed. Data reported by ERM (2002) indicate that the source of 59% of PM10 within the West Midlands is accounted for by transport. The figure reported for Greater London is even

higher (83%). Given that London is unlikely to be representative we have assumed that 50% of emissions in urban areas are accounted for by transport.

Applying these adjustments to the wider costs of particulates reported in the 2007 Air Quality gives a range of £3.6 - £8.5 billion per annum (2004 values and prices) for transport in urban areas with a population greater than 10,000.

It should be clearly noted that this estimate is particularly sensitive to the assumption about the contribution of transport to concentrations of PM<sub>2.5</sub> in the atmosphere. There is a high level of uncertainty about the proportion of particulate matter which can be attributed to transport. The assumptions applied above are based on emissions although the relationships between health and particulates are based on concentrations of particulate matter. Potential options for improving these estimates are discussed in section 7. Other caveats with these estimates include:

- The figure reported in the 2007 Air Quality can be considered a conservative estimate of the costs of poor air quality. As noted at the start of this sub-section, there is a growing body of scientific evidence which suggest that a range of pollutants can have an adverse impact on human health. The costs reported in the 2007 strategy are based on the health impacts of particulates only. The costs also do not include non-health impacts such as the degradation of physical environment, losses of crops and the impact on ecosystems through [acidification and eutrophication](#).
- This is a complex area where the evidence base is developing. As noted in ICGB (2007) *‘there is considerable uncertainty surrounding the precise scale and mechanisms linking air quality and health, especially for the long term effects on life expectancy’*. For example, there is a debate over whether the effects of particulate matter are due to the finer particles (measured by PM<sub>2.5</sub>). It is possible that the proportion of health costs attributed to transport may vary as our understanding improves.
- The costs of poor air quality are likely to be towards the top end of the range presented. The range presented in the 2007 Air Quality Strategy reflects uncertainty about the lag between exposure to particulates and the impact on health. The top end of the range assumes that there is an immediate impact whereas the bottom end assumes that there is a 40 year lag. Evidence presented in ICGB (2007) suggests that there is a large probability that a high proportion of the health impacts occur in the first five years after a change in exposure.

#### *(d) Inactivity*

The final set of costs considered in this section are those associated with the impacts of physical inactivity. These costs are the most difficult to directly attribute to the transport system but there is emerging evidence that the

promotion of active modes such as cycling and walking can have beneficial impacts on health.

Ossa and Hutton (2002) identifies four categories of economic cost associated with physical inactivity:

- the additional costs to the NHS of the treatment of long-term conditions and associated acute events such as heart attacks, strokes, falls and fractures, as well as the costs of social care arising from the loss of functional capacity
- reduced productivity through sickness absence
- lost output from premature death
- wider social costs from sedentary lifestyles such as congestion and poor environmental outcomes

*Be Active, Be Healthy* (2009) extends the impact of physical inactivity and identifies costs to the individuals themselves and the costs of lost productivity to carers of those that suffer from acute conditions.

Estimates for the annual costs to the NHS in England as a result of physical inactivity are between £1 billion and £1.8 billion. The costs of lost productivity to the wider economy have been estimated at around £5.4 billion from sickness absence and £1 billion from premature death of people of working age. Taken together, these costs total £7.5-£8.2 billion every year (1998 prices and values).

Source	Cost category	Cost (1998 prices and values)	Methodology
Ossa & Hutton (2002)	Additional costs to NHS	£1.78 billion	The proportion of medical conditions attributed to physical inactivity estimated using relative risk ratios and the proportion of population considered inactive. This is then used to estimate the costs of inactivity: <ul style="list-style-type: none"> <li>– Direct health costs: applied to secondary sources on the costs of different diseases and conditions</li> <li>– Sickness: applied to the cost of absences due to different medical conditions (days lost are from secondary sources, value of lost output based on mean daily earnings)</li> <li>– Premature death: applied to deaths by disease category and working years lost. Value of lost working years based on mean annual earnings</li> </ul>
	Lost output through sickness	£5.42 billion	
	Lost output through premature death	£1.04 billion	
Allender et al (2007)	Additional costs to NHS	£1.06 billion	The proportion of the total costs of various medical conditions associated with physical inactivity estimated using Population Attribution Factors (PAFs). PAFs indicate

			the proportion of each disease that can be attributed to a particular risk factor. This was then multiplied by the costs to the NHS of different diseases extrapolated to 2002
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The research by Ossa & Hutton produces estimates for a broader range of impacts than Allender and also indicates that the direct costs to the NHS only represent a proportion of the costs of physical inactivity, overshadowed by the costs of lost output through sickness. The difference in estimates of costs to the NHS between the two studies mainly reflects the scope of conditions included. Unlike Allender, Ossa & Hutton include the impact of physical activity on reducing the rate of chronic reoccurrence of depression and back pain. Comparing estimates of the costs to the NHS based on “primary” prevention produces similar results between the two studies - £1.03 billion for Ossa & Hutton and £1.06 billion for Allender (albeit with a price base of 1998 for the former and 2002 for the latter).

Two different approaches have been used to allocate costs to urban areas. For the ‘ITA’ and ‘ITA plus London’ categories we have estimated the proportion of inactive people living in Local Authorities served by these councils. This was estimated using the 2<sup>nd</sup> Active People Survey (Sport England) which measures of the proportion of adults (aged 16 and over) participating in at least 30 minutes of sport at moderate intensity at least three times a week. As it is not possible to use the same method to estimate the proportion of inactive people living in settlement of more than 10,000 people, it is assumed that the distribution of inactive people is the same in urban and non-urban areas. The results are presented below.

	<b>Proportion of total inactive population</b>	<b>Total cost of physical inactivity (1998 prices and values)</b>
ITAs plus London	40%	£3.3 billion
ITAs only	22%	£1.8 billion
All urban areas with more than 10,000 population	81%	£6.6 billion

There is evidence to suggest that these figures represent conservative estimates for the costs of inactivity:

- They exclude the cost implications of other diseases and health problems influenced by physical activity, such as osteoporosis and falls – which affect many older people.
- These figures also do not include some of the wider social costs of ill health and death associated with physical inactivity. Ossa & Hutton report on studies of costs in Scotland and Northern Ireland which generate significantly higher costs associated with premature death resulting from using values which incorporate these wider costs.

Increases in physical activity can also reduce levels of obesity which have been estimated by Foresight (2007) to cost the NHS £2.3 billion per annum. They also report that the wider costs of overweight and obese people may be seven times higher than the direct NHS costs alone.

*(e) Other wider costs of transport – CO2 and Noise*

The Strategy Unit report did not review the wider costs that the operation of transport in urban areas could impose through noise and greenhouse gas emissions. These are potentially significant and reinforce the point that the wider costs discussed above are a sub-set of the full social costs of urban transport.

Using the outputs of the NTM it is possible to estimate the total amount of CO2 emitted through road transport. The level of disaggregation in the NTM allows for the u-shaped relationship between speed and emissions to be taken into account. The NTM estimates that the level of CO2 attributable to the transport sector was 98 million tonnes in 2003. Applying a shadow price of carbon of £50.94 (non-traded sector) in 2009 gives a total cost from road transport in England of £5.0 billion. £2.47 billion of this total is incurred on roads within urban areas.

The shadow price of carbon used is based on marginal abatement costs. These show the cost of policies required to meet the UK government's binding target to reduce carbon dioxide emissions by 20% by 2020<sup>13</sup>. There are two important implications associated with the use of these shadow prices. First, they are expected to increase significantly over time. Secondly, they are sensitive to assumptions about the impact of policies to reduce carbon emissions and as result the values have a large range attached to them. Using the recommended range gives costs in urban areas of between £1.24 billion and £3.71 billion.

The amenity cost of noise pollution in Great Britain has previously been estimated by Sansom et al (2001) to be £2.3 billion per annum (1998 traffic levels, prices and values). This covers the annoyance or nuisance aspects on noise. The authors report that around 70% of these costs (circa £1.6 billion) occur in urban areas. These estimates are based on a case study approach looking at the noise levels from vehicles travelling on a number of road types (motorway, trunk and other), assuming typical speeds and 'annual average' daily traffic flow. Noise levels above a 55 dB(A) threshold were then valued at 0.436% of property prices in affected areas for each 1 dB(A) above the threshold. The Interdepartmental Group on Costs and Benefits (Noise) have produced estimates using a similar methodology combining webtag values with data on population exposure to road noise in major agglomerations. This work found a total disutility of current road noise in England of £3 – £5 billion per annum.

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<sup>13</sup> Provisional – subject to international agreements.

There is emerging evidence that noise also impacts on health, productivity and ecosystems. These impacts are not included in the estimates above although a review of existing evidence has found that noise can negatively impact on health (see Health Protection Agency (2009)). Therefore they represent a lower bound for the noise related costs of transport in urban areas. Work is ongoing to robustly measure the relationships between noise and health and to value these impacts through the Interdepartmental Group on Cost and Benefits (Noise). These impacts could be significant – first estimates published in ICGB(N) (2008) suggest that these impacts may add in the order of £4-5 billion to the cost of noise (£2-3 billion through reduced health and £2 billion in lost productivity).

#### Section 4. Uplifting results to 2009 prices and values

The figures presented in the sections above are expressed in a number of different prices bases and at different points in time. To adjust prices (and where appropriate, values) to 2009 levels we have used the methods recommended in the literature for uplifting these values:

- Excess congestion: costs for working time increases at GDP per capita. The value of time for non-working purposes rises with income with an elasticity of 0.8.
- Accidents: increase in line with nominal GDP per capita.
- Local air quality: costs increase at 2% per annum in real terms.

Our review of the literature found no methodology for uplifting the costs of physical inactivity. Therefore, we assume that costs to the NHS rise by the GDP deflator and that the costs of lost productivity (sickness and premature death) increase in line with nominal GDP per capita. No adjustments have been made to the estimates of the amenity costs of noise as these were reported to the nearest billion.

	<b>ITAs<sup>14</sup> plus London</b>	<b>ITAs only</b>	<b>All urban areas greater than 10,000 population</b>
Excess delays (2009)	£7.6 billion	£3.7 billion	£10.9 billion
Accidents (2008)	£5.1 billion	£3.0 billion	£8.7 billion
Poor air quality (2005)	Not currently available	Not currently available	£4.5 - £10.6 billion
Physical inactivity (1998)	£4.9 billion	£2.7 billion	£9.8 billion
Greenhouse gas emissions (2003)	Not currently available	Not currently available	£1.2 – £3.7 billion
Noise – amenity (2006)	Not currently available	Not currently available	£3 – £5 billion

It should be emphasised that this method is limited to adjusting results to a common price and value base. No adjustments have been made to reflect any growth or decline in the incidence of these costs over time e.g. changes in the air quality. Therefore, strictly speaking the costs presented in the table above value the cost in 2009 prices of problems in specific years. The years to which they refer are stated in parenthesis.

<sup>14</sup> Integrated Transport Authorities – these cover the former Metropolitan Counties of Merseyside, Greater Manchester, South Yorkshire, Tyne & Wear, West Midland and West Yorkshire.

## Section 5. How to use these results

The estimates presented in this paper provide an indicative assessment of the relative size of the wider costs of transport in urban areas. They are intended to inform discussions about the role of transport in urban areas and the extent to which transport policy can contribute to a range of government goals. As such they provide support to the DaSTS process.

As with any exercise of this kind, the results presented in this paper are dependant on a number of assumptions and simplifications. These have been discussed in relation to each cost category in the sections above. However, there are some wider considerations which the reader should bear in mind when interpreting these results:

- Whilst the wider costs associated with excess delays, poor local air quality, accidents and physical inactivity are of similar size it does not follow that government should invest equal amounts in addressing these problems. It is likely that the ease in which these costs can be reduced will vary significantly. As such, investment decisions should be guided by cost benefit analysis which considers the marginal costs and benefits of investments to reduce these costs.
- These estimates do not represent a comprehensive list of the wider costs of transport in urban areas. A range of other impacts (e.g. severance) are not included because either they cannot be robustly valued at this time or are considered to have a fairly modest impact in urban areas compared to the impacts presented here.
- These wider costs of transport in urban areas need to be seen against the benefits that transportation services provide.
- The relative size of these wider costs is likely to change over time with some becoming significantly more or less important. A significant driver of these changes will be improvements in technology. For example, improvements in engines and the use of cleaner fuels are forecast to reduce emissions of PM10 by around a fifth between 2005 and 2010 (DfT, 2008c).

The estimates presented in this paper are not intended to replace or substitute for the appraisal process used by DfT. Whilst similar methods have been used to generate these estimated, the purpose of this analysis has been to quantify the challenges and opportunities faced by transport in urban areas. As such we envisage these estimates of the wider costs of transport to be used alongside the appraisal values – the estimates of total harms can be used to help identify the objectives for intervention, whilst the appraisal values can be used to select or justify specific interventions or strategies.

## Section 6. Policy implications

In the past there has been a tendency for urban transport policy to be broadly based upon reducing congestion reflected in the DfT's urban congestion targets and the Transport Innovation Fund. This partly reflected the economic analysis of the marginal cost of transport and concerns about reducing the barriers to economic growth.

The cost estimated presented in this paper demonstrate the wider costs of transport are large in urban areas and of comparable size to the costs of congestion. This supports the department's view that the five goals for transport as set out in *Delivering a Sustainable Transport System* are of equal intrinsic weight:

1. To support national economic competitiveness and growth, by delivering reliable and efficient transport networks.
2. To reduce transport's emissions of carbon dioxide and other greenhouse gases, with the desired outcome of tackling climate change.
3. To contribute to better safety security and health and longer life-expectancy by reducing the risk of death, injury or illness arising from transport and by promoting travel modes that are beneficial to health.
4. To promote greater equality of opportunity for all citizens, with the desired outcome of achieving a fairer society.
5. To improve quality of life for transport users and non-transport users, and to promote a healthy natural environment.

Furthermore, the results of this analysis reinforce the message that it is not only the links between transport and the economy which matter. The way that transport is provided in urban areas has a large impact not only on greenhouse gas emissions but local air quality. The promotion of walking and cycling (either for whole journeys or part of a trip involving public transport) can potentially help reduce the costs of physical inactivity to the NHS and contribute to government's wider goals on health e.g. as set out in *Be Active, Be Healthy: A Plan for Getting the Nation Moving* (2009).

The conclusion that the costs of excess delays, poor air quality, accidents and physical inactivity are of comparable size does not mean that similar amounts should be invested in each objective. However, in a world of tight fiscal constraints, interventions which contribute towards each objective may particularly offer high value for money. This is discussed further in the Strategy Unit report into urban transport.

Finally, the estimates presented in this paper demonstrate that transport has a wide range of impacts. All these impacts (and others which cannot yet be robustly valued) should be considered by policymakers when making

decisions about investment and other policies. This highlights the need to continuously review the emerging evidence to ensure that decisions are based on robust and up-to-date information.

## Section 7. Developing these estimates

The results presented in this paper have been taken from existing analysis and published research. Whilst it has been possible to pull together a range of estimates with minimal resources, there are a number of limitations with the estimates presented. Further research would allow the estimates of the wider costs of transport to be developed and extended to other impacts. Possible priorities for updates of these figures which could be considered are:

- Produce estimates of wider costs for a future year e.g. 2020. Transport infrastructure tends to have a fairly long asset life (typically over 50 years). This means that decisions made today will have an impact over a long time period. Understanding the economic, environmental, health and social challenges faced by urban areas in future years can help ensure that transport infrastructure is well targeted.
- Update the estimates of the wider costs to amenity of transport related noise to cover all urban areas. Any update could also consider the potential health impacts associated with high levels of noise. This could draw on work by the Health Protection Agency Ad Hoc Expert Group on Noise and the Interdepartmental Group on Costs and Benefits (Noise).
- Review the available evidence linking urban transport to other impacts on the natural environment. This might include considerations of impacts on the landscape and townscape amenity and urban ecosystems.
- Undertake detailed modelling of transport related emissions to estimate how much transport contributes to concentrations of PM10 in urban areas. This will provide a more reliable estimate of the costs of particulate emissions.
- Consider whether the impacts associated with other air pollutants can be monetised in the same way as particulates.
- Review the costs of physical inactivity and obesity. These could be usefully updated to reflect current resource costs and the impacts monetised extended to consider the willingness to pay to avoid certain health outcomes.
- Further work to establish the impact that the design of roads and other transport infrastructure can have on how people feel about particular areas. The Strategy Unit report detailed emerging evidence which suggest that the townscape and pedestrian environment can have a large influence on people's willingness to work and undertake activities within particular areas.

This is rapidly developing area and much of the work which could inform these updates is already taking place e.g. through the ICGB<sup>15</sup>.

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<sup>15</sup> See <http://www.defra.gov.uk/evidence/economics/igcb/index.htm>

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