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Executive summary

1. A social and distributional impact (SDI) occurs when there is both a:
   i) **Social impact**, i.e. an impact on either an individual or society; and a
   ii) **Distributional impact**, i.e. there are different impacts on different groups in society, including those at different geographical locations.

   The importance of monitoring for SDIs is to identify whether some social groups, and/or people in certain geographical locations, might be disproportionately affected by a given policy intervention, so that the introduction of mitigating measures might be considered.
2. A range of SDIs potentially occur from the introduction of policies to reduce transport's carbon dioxide (CO_2) emissions. The aim of this report was to review available evidence in order to:
   a. Identify **potential SDIs** that might arise from a set of predefined policies;
   b. Identify the **impact of such SDIs** in practice, e.g. on the travel behaviour and CO_2 emissions of different groups, as well as the potential attitude of the public; and
   c. Identify **gaps** and propose how these might be filled.
3. Four types of transport policy were considered, i.e. those that would:
   a. **Reduce trips**;
   b. Improve the **utilisation of vehicles** and **encourage a change in mode**;
   c. Stimulate the **purchase/use of more fuel efficient vehicles** and driving; and
   d. Stimulate the use of **alternative fuels**.
4. The report does not cover all policies that could reduce transport's CO_2 emissions. Polices were **excluded** if they were the responsibility of other government departments, e.g. fuel and vehicle taxation and spatial planning, or if they were not generally implemented for environmental reasons, e.g. speed regulation and the provision of infrastructure. Additionally, barriers to the potential implementation of policies are not discussed.
5. The consideration and recognition of potential SDIs that might result from the DfT's policies to reduce transport's CO_2 emissions are important for two main reasons. First, people that are currently economically and socially disadvantaged within the UK already experience the worst negative impacts of the transport system. It is important not **to further disadvantage** such groups. Second, the recognition of such SDIs will enable them to be **mitigated in policy design**, which should contribute to the public's acceptance of such policies.
6. It is also important to distinguish between the impacts on **transport users** and **non users**, as the impacts on these groups will be different. The impact on any one non-user is often marginal, and perhaps unnoticeable, but the net impact across all of those affected could be significant. Additionally, the scope and scale of any SDI will depend on both the location and transport modes concerned.

Findings for policies focusing on reducing trips

7. Policies that aim to reduce transport's CO_2 emissions by reducing trips have the potential for significant SDIs, particularly on the ***affordability*** of transport and the ***accessibility*** of different groups, particularly low income groups and those living in rural areas.
8. On average, such policies (e.g. ***congestion charging*** and ***parking charges***) could be considered to be progressive (i.e. they impact relatively more on those on higher incomes), as higher income groups own and use cars more than those on low incomes.
9. The group that is potentially most adversely affected by such policies will be those **low income drivers** who do not have alternatives to using their car, e.g. those whose jobs are in the affected zone, but who live outside of this area.
10. The **design** of policies is important as exemptions and concessions could help to minimise any adverse SDIs. Also, using revenue that is raised to fund improvements in modes that are used more by those on low incomes, the young and old, e.g. buses, would make the policies more progressive. Complementary measures are also important to "lock-in" the benefits of such measures, and thus reduce the potential for **rebound effects** (and to maintain the beneficial impacts on SDIs) from policies that aim to reduce traffic levels.
11. Such policies have the potential to **deliver benefits for transport users and non users** alike in terms of improvements in air quality and reduced noise levels, severance and road traffic accidents that result from less traffic.
12. People are generally **in favour of individuals trying to limit their car use** for the sake of the environment. The public also recognises that issues of fairness will be important in introducing road pricing policies.

13. The most important **knowledge gaps** are: the extent to which low income car drivers would be adversely affected by such policies and the best way of mitigating such effects; the best way of engaging the public to support the design and implementation of such policies; and the identification of the most appropriate set of local measures that can lock-in the benefits of such policies.
14. When designing local schemes, policy makers need to **understand** the type, scope and geographical location of the **disadvantaged groups** that might be affected, **engage** with such groups and **take their concerns** into account, particularly with respect to accessibility and affordability. In particular, the potential impacts on **low income drivers** need to be understood and addressed. The use of **exemptions or concessions** when addressing the concerns of disadvantaged groups should be considered, as should the introduction of **complementary measures** in order to ensure that the CO_2 benefits of the original policies are "locked in".

Findings for policies focusing on modal shift and increasing vehicle utilisation

15. Currently, policies that aim to reduce CO_2 emissions through modal shift are more likely to improve the ability of those on high incomes and men to **access** employment opportunities and services, if they focus on improving rail or cycling infrastructure. In contrast the benefits would be felt by those on low incomes, women, younger and older people if such policies focus on improvements to bus infrastructure and services.
16. All policies have the potential to benefit all groups, but the design of the policy is important in order to ensure that disadvantaged groups do benefit. Some policies, such as the regulation of fares and concessionary fares, as well as car clubs and car sharing, have the potential to improve the **affordability** of transport, as well as improve the ability of the targeted groups to **access** employment opportunities and services.
17. Policies that increase the amount of walking and cycling (in any group) have the potential to ***improve physical fitness***, while if reduced traffic levels result from such policies, there will be ***wider benefits***, such as improved air quality and reduced levels of noise and severance.
18. Any of these policies have the potential to increase the capacity of the transport network and thus, potentially transport's CO_2 emissions. Consequently, **complementary measures would need to be used in parallel**, such as those measures that could be used to reduce the number of trips, in order to tackle both transport's CO_2 emissions and address its SDIs.
19. The most important **knowledge gaps** include: the best way of targetting measures to encourage those in disadvantaged groups to benefit from all relevant policies, particularly those that stimulate rail use and cycling; the best way of ensuring that such policies both deliver CO_2 emissions reductions and address SDIs; and the best way of translating public support for non-car modes into greater use of these modes.
20. As with other types of policy measure, policy makers need to **understand** who the relevant disadvantaged groups are, where they live and how and to where they travel. It is important to **engage** with such groups in the design and implementation of policy, and **take relevant concerns into account**. As with other policy measures, **complementary measures** should be considered in order to ensure that the CO_2 benefits of the original policies are "locked in".

Findings for policies focusing on stimulating the purchase/use of efficient vehicles

21. Such policies generally aim to stimulate the market for more efficient vehicles, which can be more expensive than conventional vehicles. If the uptake of more expensive vehicles was the result, these policies would marginally **reduce the affordability of buying new cars** for some groups who would otherwise have bought a new car. In turn, there might be short-term, knock-on effects on the second-hand car market as such cars might also become more expensive.
22. For most drivers, it is **arguable whether this is an SDI**, as most of those potential purchasers of new vehicles could as easily buy either a smaller new vehicle or a second-hand vehicle of the same size.
23. Policies that encourage the use of more fuel efficient cars, or encourage cars to be used in a more efficient manner, have the potential to **increase the affordability of car use** for all of those using them, i.e. to reduce running costs, as less fuel would be used to travel the same distance, everything else being equal.
24. Such policies also have the potential to deliver **wider benefits** for users and non-users alike in the form of improved air quality, reduced noise levels and reduced adverse impacts from climate change.
25. The main **knowledge gaps** relate to: the potential impact on the second-hand car market, and the social groups that would be affected; the role of vans in passenger transport, and the groups affected; the way in which different groups understand and relate to different fuel efficiency

technologies; how to further translate apparent support for measures to encourage the purchase of more fuel efficient vehicles, into practice[2]; and how best to target eco-driving for the low income drivers who would most benefit from it.

26. Policy makers need to assess the potential impact of such policies on **low income groups** in particular, including in relation to the potential effects on the second-hand market, and ensure that any potential benefits are experienced by low income drivers. It is also important to introduce complementary measures to **ensure that CO_2 reductions are delivered**, as the policies considered generally make car use more affordable, and therefore are likely to lead to a rebound effect of increased travel. In such cases, the subsequent rebound effect could be beneficial for low income groups; this effect could be exploited in the design of such policies.

Findings for policies focusing on stimulating the use of alternative fuels

27. There was **little evidence** on the SDIs associated with the promotion and use of sustainable biofuels, the one alternative fuel policy that was considered. It is likely that if there were any SDIs, these would be similar to those already discussed above for other types of policy. For example, if increased use of biofuels led to increases in the price of transport fuels, the issues will be similar to those discussed with respect to using other economic instruments that reduce trips by raising the price of travel (see above). In the longer term, if dedicated vehicles able to use high blends of biofuels, are produced, the issues for policy makers will be similar to those discussed for more fuel efficient vehicles (see above).

[2] Policy instruments, such as company car taxation and graduated Vehicle Excise Duty, are already encouraging the purchase of more fuel efficient vehicles.

1 Introduction

1.1 Background to the report and the project

This is the final report of the project "Knowledge Review of Social and Distributional Impacts of Climate Change Policy Options" for the Department for Transport (DfT; reference: SRE002). The project was led by AEA partnered by TTR and Dr Karen Lucas from the Transport Studies Unit at the University of Oxford. It began in August 2009 and the main research was undertaken between September 2009 and January 2010[3].

1.2 The need to reduce transport's CO_2 emissions

The UK is the first country in the world to set national legally binding carbon dioxide (CO_2) emissions reduction targets. At the end of 2008 the Committee on Climate Change, which is advising government on how to meet these targets, proposed an interim carbon budget for the UK to reduce CO_2 emissions across the whole economy by 34% by 2020 against 1990 levels. Should a global deal to reduce greenhouse gas emissions beyond 2012 be agreed, the interim budgets will be replaced by the intended budgets, which would place an even more stringent target of reducing economy-wide emissions by 42% by 2020 against 1990 levels. The need to tackle transport's CO_2 emissions is reflected in the fourth of the Coalition Government's structural reform priorities with respect to transport, which is to tackle carbon and congestion on the roads (DfT, 2010).

However, as many of the policies for reducing transport's CO_2 emissions are likely to be based around trying to change people's transport behaviour, it is important to understand the potential social and environmental impacts of such policies. In particular, it is important to understand any negative social and distributional impacts (SDIs) that might arise from the implementation of policies to tackle climate change and to mitigate these impacts as far as is possible.

1.3 What are SDIs and why are they important?

The DfT uses the following definitions of social and distributional impacts[4]:

> "**'Social'** impacts relate to impacts on individuals and society and lend themselves to assessing the social change processes invoked by the introduction of a transport intervention. These impacts include the effects on communities such as cohesion, stability and services, people's way of life (how they live, work and play), the environment such as the quality of the air and landscape, health and well-being and personal fears and sense of security. There are points of overlap between social, economic and environmental impacts, because economic and environmental impacts can have social consequences and vice versa. Social research provides one of the toolkits, alongside economics and physical science, which can be used to measure and explain these impacts."
>
> "**'Distributional'** impacts relate to the extent to which there are differences in the impacts of interventions across different groups in society. For example, the noise impacts of an intervention will affect different groups of households, with some experiencing increases in noise, and others experiencing decreases. Impacts such as noise and air quality arising from a transport intervention tend to be geographically concentrated, for example affecting some particular residential areas, and the impacts on households will therefore depend on which households are present at the affected geographical locations. Households can be characterised in different ways, including income levels, and the distribution of impacts can therefore be assessed using

[3] We would also like to thank two peer reviewers – Graham Parkhurst of UWE and Noel Smith (Loughborough University) – who attended an internal project workshop and commented on earlier versions of this report.
[4] DfT (2010) *Summary Guidance on Social and Distributional Impacts of Transport Interventions* In Draft; see www.dft.gov.uk/webtag/documents/index.php. It had been anticipated that the guidance would have been finalised in April 2010, but this was still not the case at the time of writing (mid December 2010).

> alternative ways of characterising the affected groups. Other impacts may be less spatially concentrated and people affected may come from a variety of groups."

An SDI, which could be either positive or negative, arises when both of these effects occur[5]. Understanding the SDIs of policies is particularly important for policy makers at both the national and local level of decision making because it helps to ensure that those people who are already economically or socially disadvantaged within society are not further negatively affected by any new policy decisions. In response, policies may be designed to reduce any potentially negative impacts, as well as any inequalities that already exist within the system.

Better understanding and consideration of SDIs in the development of transport policy to tackle transport's CO_2 emissions will also allow policy makers to target them in ways that help to meet a number the coalition's structural reform priorities for transport. It is also important in terms of communicating the benefits of such policies to the wider public. If policy-makers can demonstrate that they understand the concerns of those potentially affected by climate change policies and have taken measures to mitigate potential adverse impacts, then the chances of the public accepting the policies will increase. In this respect, it is also important to understand the current views of different groups to policies that could be put in place to reduce transport's CO_2 emissions.

1.4 Who are potentially vulnerable social groups?

The Social Exclusion Unit (2003) firmly established that the people who are already economically and socially disadvantaged within UK society also tend to experience most negatively the worst adverse environmental and social effects associated with the transport system. This is not only in terms of increased levels of exposure to noise, poor air quality, severance and crime but also reduced access to life enhancing opportunities, such as well-paid employment, a high standard of education and well-equipped health care services. The lower travel horizons of low income populations can also mean reduced social networks and potentially reduced social capital as a result of this (Ohnmacht *et al*, 2009).

Lucas *et al* (2001) identify that a lack of transport already prevents some people from participating in important life opportunities and that anything that makes transport less affordable will impact negatively on their already beleaguered circumstances. Similarly, Litman (2009b) argues that if transport is not affordable, individuals may travel less and not access services or activities that they wish to. This is likely to have knock-on effects for a variety of social groups in terms of access to employment, education, key services (younger people, the elderly, low income households, unemployed, mobility impaired).

Given that such inequalities in transport already exist, the understanding and consideration of SDIs is important in order to ensure that transport policy that aims to tackle climate change does not disadvantage such groups further. This is important both in relation to the development of climate change policies and also from the perspective of other, more local transport policy responses to these national targets.

1.5 DfT's Climate Change Policy Options

This project has considered existing and possible future policy options for reducing transport's CO_2 emissions in England. These covered mandatory and voluntary policy instruments of relevance at both the national and local levels. Additionally, the policies considered related to the three essential elements of climate change policy that was outlined in the Stern Review, i.e. technology, pricing and behavioural change (Stern, 2006).

The policies considered within the project were those climate change policies that are the ultimate responsibility of the DfT. In this respect, the list of policies considered were those that were being discussed in the context of reducing transport's CO_2 emissions, e.g. as mentioned in such documents as the 2006 Eddington Report. The policies were categorised under the following headings:

[5] It is worth noting that there are overlaps between social, economic and environmental impacts, as economic and environmental impacts can have social consequences, and vice versa.

i) **Reducing trips**, i.e. reducing the amount of passenger (and tonne) kilometres travelled.
ii) **Improving the utilisation of vehicles**, e.g. car sharing, **and changing mode** to use less carbon-intensive modes[6].
iii) **Purchase and use of more efficient vehicles and driving behaviour**. This covered i) policies that aim to improve the efficiency of new vehicles, e.g. reducing their average CO_2 emissions per vehicle kilometre, and that stimulate the purchase and use of these vehicles; and ii) policies that aim to improve the efficiency of the way in which vehicles are used.
iv) **Alternative fuels**, i.e. policies that aimed to reduce the carbon intensity of transport fuels.

The full list of policies considered within each category can be found in Table 1 to Table 4 (see the introduction to Sections 3.2 to 3.5, respectively).

It is important to note from the outset that the project did not consider all of the potential policies that could be introduced to reduce transport's CO_2 emissions, as the focus was only on those policies that could be implemented by the DfT. Hence, instruments such as fuel or vehicle taxation or spatial planning, which could deliver CO_2 emissions from transport, are not covered in this report because they are the delivery responsibility of other government departments.

Additionally, it is important to note that there are other DfT policies, such as the provision of infrastructure and the regulation of speeds, that also potentially significantly influence travel behaviour and the level of transport's CO_2 emissions. These were not covered in this report, as the reduction of CO_2 emissions is generally not considered to be one of the main aims of such policies.

1.6 Aims and objectives for the research

The context of the research was, therefore, to obtain a better understanding of the SDIs that might arise from the introduction of transport policies to tackle transport's CO_2 emissions. In order to achieve this, the research had three core aims:

i) To identify the potential social and distributional impacts of a predefined set of targeted climate change policies for transport;

ii) To identify how these SDIs are likely to play out in practice, e.g. the impact on the transport behaviour and CO_2 emissions of particular groups, and what the public's attitudes might be to these various measures; and

iii) To identify the gaps that remain in the evidence base and to propose ways in which these might be filled.

Hence, the primary objectives of the project were to:

a) Draw together and review the social research evidence base as it relates to potential SDIs associated with climate change policy options;
b) Review the evidence base to draw conclusions on any differences in the responses of different social groups to climate change policy options (e.g. acceptability, behavioural response) and the effect of policy options on CO_2 emissions from social groups' travel; and
c) Identify remaining gaps within the reviewed evidence base and our understanding of the issues involved and make recommendations on how the gaps could be addressed.

In order to achieve these objectives, the project focused on the following research questions:

1. Which specific climate change policies could be implemented in the transport sector?
2. What are the potential key social impacts of these different climate change policy options?
3. How will the impacts of these policies (positive or negative) differ between the affected social groups (distributional impacts)?
4. How will take-up (and the barriers to take-up) of voluntary CO_2 reduction measures differ between groups?

[6] It is important to remember that, for any particular journey, the mode that is in fact the least carbon intensive mode will be determined by such issues as their respective occupancy rates, as well as the ages of the respective vehicles, as newer vehicles on the whole are less carbon intensive than older vehicles.

5. How are public attitudes (including public acceptability) likely to differ between social groups for both mandatory and voluntary options?
6. What remaining gaps exist in the evidence base and how could these be filled?

While a significant amount of work already exists on the climate change impacts of transport and transport-related mitigation measures, these effects are rarely socio-demographically and/or spatially disaggregated. Similarly, there is an increasing body of literature on transport disadvantage and its impacts on social exclusion but not specifically in relation to climate change policies. A core aim of this project, therefore, was to bring these two research areas together. Where evidence was found to be lacking, impacts are inferred in the report, where this was appropriate on the basis of the available evidence.

1.7 Structure of the Report

Section 2 reviews how different groups currently use and experience the transport systems in order to provide a context for the subsequent discussion on SDIs.

Section 3 presents the results of our knowledge review, including gaps in the knowledge, as well as our assessment of the existing evidence. It also summarises the findings of the knowledge review and discusses their implication for the development and implementation of DfT's potential climate change policies. Section 4 concludes the report.

The overview of the methodology used in the project can be found in Appendix 1, with more detail in subsequent appendices. All of the appendices can be found in a separate document.

2 Existing differences in the experience of different groups of the transport system

As noted in Section 1.4, there are already socially and economically disadvantaged groups within the UK whose disadvantage is compounded by their ability to access, and their experience of, the transport system. These disadvantages exist even without any additional transport policies, whether aimed at addressing transport's CO_2 emissions or otherwise. The aim of this section is to set out the existing differences associated with travel, including different groups' experience of travel, as well as different groups' experience of the adverse impacts associated with the transport system. This helps to establish from the outset the social groups that are potentially the most vulnerable to the impacts of climate change policies for transport, as well as how they might be affected.

The main determinants of difference in people's travel behaviours are:

i) **Income**.
ii) **Economic activity** (e.g. employment, retirement, etc.).
iii) **Age**. Young people (i.e. under 17) and older people (older than 65) have different behaviours, and those of people in the latter category increasingly encompass a wider range of travel behaviour, as the population ages.
iv) **Gender**.
v) **Ethnicity**.
vi) **Disability**.
vii) **Caring responsibilities**.
viii) **Access to a car**.

In some cases, these simply reflect different circumstances and are not necessarily indicative of reduced well-being or an inequality of opportunity, e.g. people of working age travel more than those who have retired. If this effect is due to the fact that the latter group no longer have to commute to work, this could not be considered to be an inequality. However, where this effect is due to the lower incomes of the latter group, then there might be an inequality that policy could try to address.

Additionally, there can be a geographical or spatial determinant to people's experience of the transport system. The usual distinction that is made is between the differences faced by those living in urban areas and those living in rural areas. However, the differences are actually more subtle, as the key element is the quality of the transport services and/or infrastructure that serves a particular area. For example, low income estates that are peripheral to urban areas are often poorly served by public transport and also tend to be overlooked in behaviour change treatments. It is important to distinguish whether such "area effects" are the result of the area itself or because a particular vulnerable group lives there in higher than average concentrations. In the latter case, the effect could not really be considered to be an area effect. However, area effects might be more relevant for transport schemes rather than transport policies, which are the main focus of this report.

The remainder of this section considers the following five key aspects associated with different groups' experience of the transport system, covering both access and exposure to adverse effects, namely:

i) Car ownership and use;
ii) Use of other modes;
iii) Travel expenditure;
iv) Adverse environmental and social effects of transport; and
v) CO_2 emissions arising from this travel.

Much of the following discussion is based on information contained in the *National Travel Survey* (DfT, 2009a)[7] and the *Family Expenditure Survey* (ONS, 2008)[8], which were the most recent versions of the respective surveys at the time when the analysis was undertaken.

[7] DfT (2009a) was the most recent version of the National Travel Survey that was available at the time of the initial analysis. Hence, the analysis was based on the information contained within that report. In the interval between the analysis and the publication of this report, a further version of the NTS was published in September 2010.

2.1 Car ownership and use

The car ownership and car use of households are, not surprisingly, linked to their respective incomes. **The poorest households are twice as likely on average not to have access to a car**, as 51% of the households in the lowest real income quintile do not have access to a car (Table 6.3 of DfT, 2009a). However, car access amongst this group has experienced the greatest increase (compared to other quintiles) in recent years; in the 1995/97 survey 66% of low income households did not have access to a car (Chart 6.2 of DfT, 2009a).

Households in major **urban areas are less likely to have access to a car**, e.g. 43% of London households and 32% of households in other metropolitan area do not have access to a car, whereas only 10% of rural households are in this position (Table 2.2 of NTS, DfT, 2009a). This is probably a result of better access to public transport (see Section 2.2).

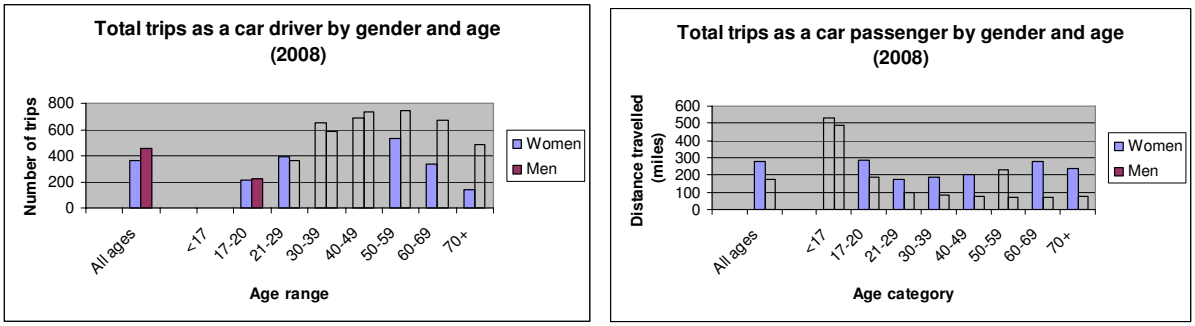
By ethnicity, **33% of black/black British people with a Caribbean origin live in a household without access to car**, making such people twice as likely to live in such a household as white British or those from Indian or Pakistani backgrounds (all around 17%). People from "other" ethnic backgrounds ("other white", "other Asian", African) have similar (or worse) levels of access to a car than those of black Caribbean origin (Table 6.6 of NTS, DfT, 2009a).

More **men than women are able to drive**, as 81% of men compared to 65% of women have licences. Whereas the proportion of men with a licence has been relatively stable since the early 1990s, the proportion of women has been steadily increasing and continues to do so (Table 2.3 of NTS, DfT, 2009a). However, adult **women are twice as likely to be a non-driver** in a household with a car (18% as opposed to 9% for men) and are also more likely to live in a household without access to a car than men (22% compared to 17%; Chart 2.11 of NTS, DfT, 2009a). Another group where the possession of driving licences is on the increase is in those **in their sixties**, where the proportion able to drive has increased by 15% to 78% in the last 15 years (Chart 2.9 of NTS, DfT, 2009a).

Those living in **households without a car travel less** than other households. Compared to persons in a household with access to one car, those in households without access to a car make 25% fewer trips, they travel less than half the distance and spend 13% less time travelling per year (calculated from Table 6.1 of NTS, DfT, 2009a).

Bayliss (2009) analysed the data underlying the *NTS* in more detail and identified that **people on low incomes with cars travel on average twice as much as their non-car owning counterparts** but still 38% less than the average of all car owning households. The reason for this is fewer and shorter car journeys and less travel by rail.

Figure 1: Car trips (as driver and passenger) by gender and age (2008)



On average, **women make more trips (generally and by car) than men** (see Figure 1). However, women make more trips as a passenger, while men make more as a driver. However, this varies significantly by age, as women younger than 40 make more trips as a driver than men. Trips as a driver peak in a man's 50s, but a woman's 40s, whereas trips as a car passenger not surprisingly peak

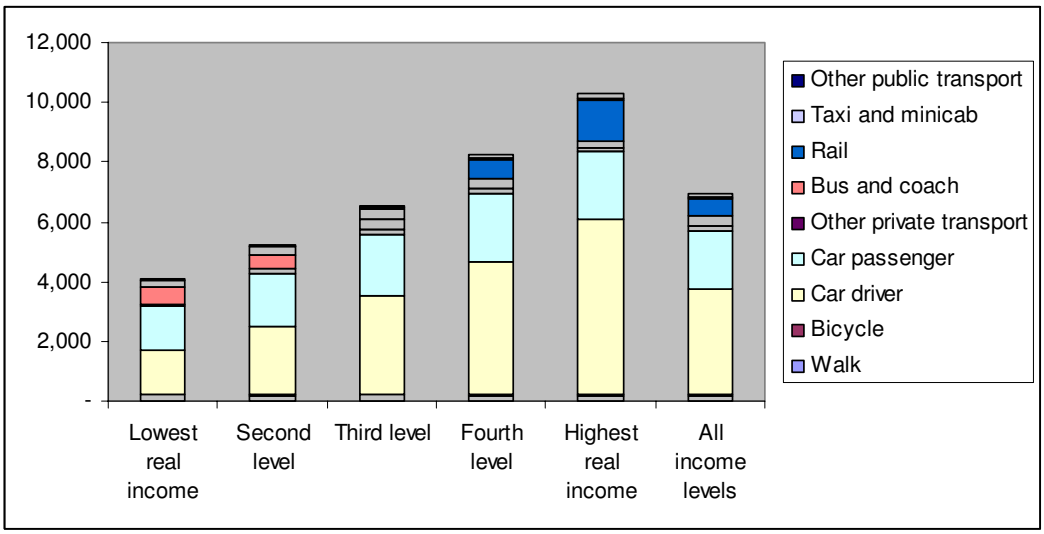
[8] In the interval between the analysis and the publication of this report, a more recent version of the Family Expenditure Survey was published in 2010.

in the non-driving under 17s age group. Since 1996, the distance travelled by men as a car driver has declined by 10%, whereas that driven by women has increased by over 20%.

2.2 Use of other modes

Modal use is also influenced by income, as can be seen in Figure 2. The distance travelled as a car driver, as a car passenger, by rail and even by bicycle, increases by income, with only bus use showing a steady decline as income increases (data from Table 6.5 of NTS, DfT, 2009a).

Figure 2: Distance travelled (miles) per mode by household income quintile (2008)

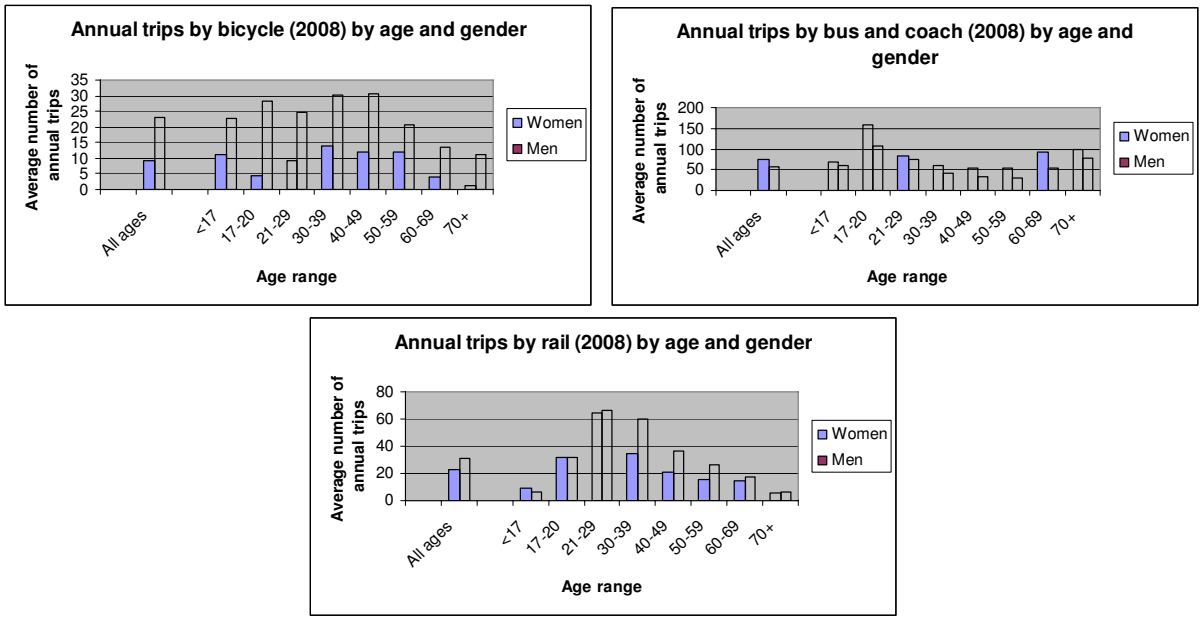


Source: National Travel Survey 2008 (DfT, 2009a)

Bayliss (2009) found that those **on low incomes with cars use other modes less** than their non-car owning counterparts. Bus and rail usage by car owning low income households is about half of that of low income non-car owning households, while walking and cycling is about a third less.

Those in **urban areas have better access to public transport**, e.g. in London and other metropolitan areas, 98% live within 13 minutes of a regular (at least hourly) bus service, whereas in rural areas, the equivalent figure is 58% (Table 6.8 of NTS, DfT, 2009a).

Figure 3: Trips by bicycle and public transport (2008) by gender and age

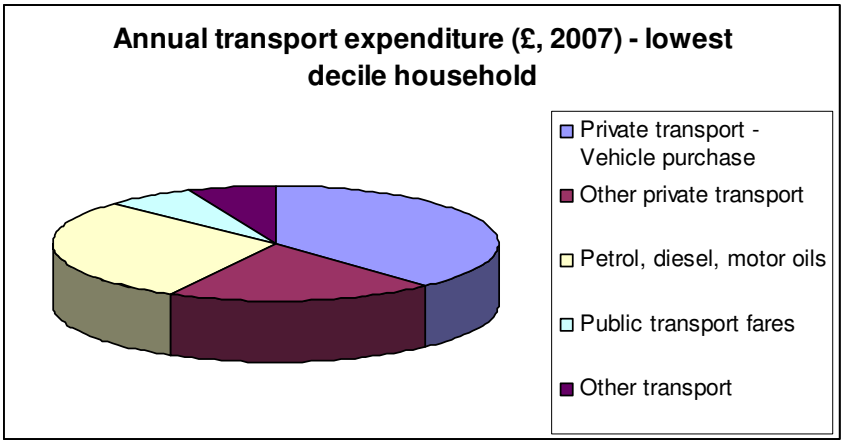


Women make half as many trips by bicycle as men, a proportion that does not vary significantly by age (see Figure 3), while bicycle use peaks in a woman's 30s compared to a man's 50s. Women use trains less than men, but buses more frequently, although the use of train's by young women is similar to that for young men.

2.3 Travel expenditure

According to *Family Spending* (ONS, 2008), households in the lowest income decile spend ***on average*** only 25% of the expenditure of an average household on transport (i.e. £15.60), although the proportion of this expenditure is split across the key transport expenditure categories in similar proportions (see Figure 4).

Figure 4: Annual household expenditure (£) for 2007, for all households and those in the lowest decile



On average, a household in the lowest income decile spends 9% of their total expenditure on transport, while the equivalent figure for an average household is 13%. However, this figure is misleading, as car ownership is lower in low income households (see Section 2.1). Of those households that own a car, the proportion of **the weekly expenditure of low income motorists spent on driving and maintaining private vehicles is high**, i.e. 24% compared with 15% of the highest income motorists (Lucas *et al*, 2001).

For households where the main reference person (for the purpose of the survey) was in employment, transport expenditure was the highest of all categories at £80.80 a week. On the other hand, in those households where the main reference person was unemployed or economically inactive, more was spent on non-transport categories. Expenditure on transport by households in rural areas is over 25% higher than expenditure in households in urban areas (£73.80 compared to £58.00).

The **cost of running a car is usually higher in rural than in urban areas** because of the distances people have to travel to access services and the higher cost of fuel at many non-urban petrol stations. Low-income households in the least densely populated non-metropolitan areas spend, on average, over 30% more on motoring per week than those in more densely populated areas (SEU, 2003).

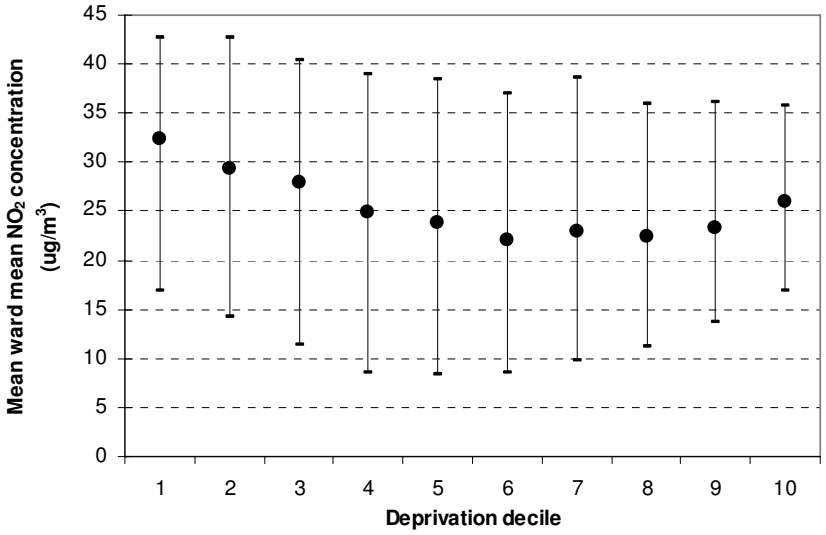
2.4 Adverse environmental and social effects of transport

It is not only the use of the transport system that is experienced differently by different groups, but the adverse environmental and social effects of the transport system, such as pollution and noise. In an earlier report for the DfT on SDIs associated with transport schemes, Parkhurst and Shergold (2009) found that direct SDIs in relation to **air quality** can be identified where groups are defined by either medical vulnerability or age, and that indirect SDIs exist when the population is subdivided by income and ethnicity. Additionally, they identified that there was a spatial dimension to the issue, as more affordable housing, as well as housing located in or near to centres of employment opportunities, was

often in areas experiencing higher levels of air pollution. Finally, they found that the groups that experience the highest levels of exposure to poor air quality, much of it due to emissions from transport, are often the least likely to benefit from the high levels of mobility that the car provides.

Similar results were found in a report for the European Commission environmental inequalities, i.e. different social groups being subject to different levels of environmental problems. Pye *et al* (2008) reviewed a range of studies that found that **disproportionately negative SDIs existed for air pollution**. For example, in England **deprived wards experience poorer ambient air quality**, as the highest annual mean concentrations of nitrogen dioxide (NO_2), fine particulates (PM_{10}), sulphur dioxide, carbon monoxide and benzene are found in such wards (Walker *et al*. 2003; see for example, Figure 5). Analysis undertaken by Pye *et al* (2006) and Mitchell and Dorling (2003) found similar trends.

Figure 5: Distribution of ward mean NO_2 2001 in England



With respect to transport schemes, Parkhurst and Shergold (2009) found that SDIs with respect to **noise** arise from exposure of different groups by age, particularly children, and spatial location. Within communities, high levels of noise can inhibit physical and social activities on streets, which can also become a barrier, thus contributing to severance. They also found evidence that noise can also be spatially re-distributed, particularly where transport developments take traffic out of towns, in which case noise disturbance has been transferred from the urban to rural communities, although those in towns generally experience higher levels of noise in the first place.

The review undertaken by Pye *et al* (2008) found that different people are also affected differently by the **impacts of climate change**. For example, increased flood risk is recognised as one of the potential major future impacts of climate change and a number of studies in the UK have looked at the link between flood risk and deprivation. A study for the Environment Agency (2007) found that more **deprived populations are more likely to be living in areas at risk from tidal flooding** (the link is not as clear for river flooding). These reflected the earlier findings of Walker *et al* (2003). **Older people are also more likely to suffer the effects of climate change related heat waves and cold shock weather spells**.

In relation to transport schemes, Parkhurst and Shergold (2009) found that SDIs in relation to the **risks of accidents** relate to travel mode, particularly pedestrians, cyclists and motor cyclists, and age, especially the young and the elderly. Gorman *et al* (2003) found that **accident rates are higher among people of low socio-economic status, especially for children**, whose probability of being involved in a traffic-related accident can be five to seven times higher than that of children from other socio-economic groups.

Parkhurst and Shergold (2009) also found that **personal security** in relation to the development of transport schemes is an issue for some vulnerable groups, with the young and elderly again being the main groups affected, along with ethnic minorities. In such cases, the effect is largely that such groups are often deterred from travelling in the first place or at least from using certain modes. Additionally,

they found that negative aspects on **landscape** often impact on rural areas as a result of transport schemes, whereas urban areas often experience improvements in **townscape** resulting from transport developments, as urban transport schemes are often associated with redevelopment.

2.5 CO_2 emissions arising from travel

It is also important to note that different sectors of the population contribute differently to transport's CO_2 emissions. There seems to be little work that has looked at which groups actually contribute to transport's CO_2 emissions, although a couple of relevant studies were identified. In a study focusing on the inhabitants of two villages in rural Oxfordshire, Anable *et al* (1997) identify that the top 10% of emitters of transport CO_2 in the sample emitted 33% of all the CO_2, whilst the bottom 10% emit only 1%. **Income was the clearest indicator of these differential levels with the higher income households in the sample being responsible for four times the level of emissions per capita compared to the lower income households.** There was little variation either by household size or whether there were any children present in the household. **Households with only one vehicle were also associated with lower than average emissions.**

Brand (2008), having widened the analysis of Anable *et al* (1997) to include urban and peri-urban residents, also concluded that it is a minority of travellers who account for the differences in emissions between high and low income quintiles. The highest emitters were responsible for 61% of emissions for all travel (including air), whilst the lowest were responsible for less than 1% of the total. **Emitters in the lower deciles tend to be women, children and people over 75 years old, the economically inactive, non-car drivers and people on incomes of less than £10k.** Emitters in the highest group were more likely to earn £40k plus, be men in full-time employment (but the gender link is weaker than the income relationship), be 36-65 years of age and be in a single occupancy household. Households with access to two cars or more produced 6 tonnes of CO_2 per person, i.e. 25% more CO_2 per annum than the average household.

2.6 Summary of existing differences in the experience of different groups of the transport system

As has been shown in the preceding sections, there are already existing differences in the ways in which different groups experience the transport system, both in terms of their access to and use of different modes, but also with respect to their experience of the adverse impacts associated with transport. Consequently, the introduction of policies to reduce transport's CO_2 emissions needs to recognise such existing differences and, as a minimum, not exacerbate these further.

The **access of a household to a car** varies by income, location and ethnic group, in particular those from black households. Those in poorer households are less likely to have access to a car, although the proportion of the lowest income households that have access to a car has been increasing. Those in households in urban areas are also less likely to have access to a car, but such groups often benefit from better **public transport access**, so the lower access may not necessarily be a disadvantage in all cases, but a choice. However, those in households without a car tend to travel less than households that have access to a car. Generally, fewer older people and fewer women **possess driving licences**, but in both cases the difference between these groups and the general population has been diminishing. Women make more trips than men, but make fewer trips as a car driver, although this latter difference is also narrowing.

The **use of most modes** increases by income, with only bus use declining as income increases. Among low income groups, those who own a car use other modes significantly less than low income households that do not have access to a car. Women generally cycle less than men, but uses buses more. On average, women use trains less than men, although among younger people there is no gender difference.

On average, those in poorer households **spend less** on transport than other households. However, for those households that own a car, the weekly expenditure on private transport is proportionately higher for low income households than it is for richer motorists. Where the main income provider in a household is an employment, more of the weekly budget is spent on transport than any other spending category, whereas in households where the main income provider is unemployed or

economically inactive, expenditure is higher in non-transport categories. The cost of running a car is also generally higher in rural areas than in urban areas.

With respect to the adverse environmental and social effects of transport, existing SDIs can be found in relation to air quality, noise and the impacts of climate change, as well as in relation to some social impacts. In relation to **air quality**, inequalities can be found when groups are differentiated by medical vulnerability, age, income and ethnicity. There is also a spatial dimension as, for example, more affordable housing is generally found in areas experiencing higher air pollution. Similarly, **noise** has adverse affects according to age group and location, with differences being experienced between those living in urban and rural locations, and by the young in particular. The **impacts of climate change** can also be experienced worse by certain groups, e.g. the elderly are at more risk from extreme weather episodes, while deprived populations can be more at risk from tidal flooding.

The young and the elderly are more at **risk from accidents**, with low income children in particular experiencing an increased risk compared to children in higher income households. The travel of the young and of the elderly, as well as of ethnic minorities, is also affected by concerns by concerns over **personal security**.

The **contribution to climate change** also varies by different groups, with higher income groups being responsible for significantly higher emissions of CO_2 than lower income groups. Additionally, the young, elderly, women, economically-inactive and non-car drivers are generally responsible for less CO_2 on average than those in other groups.

3 Findings of review and assessment of existing knowledge and evidence

3.1 Understanding social and distributional impacts

3.1.1 Limitations of the evidence base

Before presenting the results of the literature review, it is worth noting that few of the pieces of literature that could be identified for the review were entirely comprehensive, either in their coverage of the potential social impacts of transport policies or with respect to the social groups that might be affected. Additionally, in many cases, reports focus on particular impacts and only infer others. The impacts on the CO_2 emissions of different groups of different policy options are even less well discussed in the literature. To some extent, this is not surprising, as reports have been drafted for particular purposes, e.g. focusing on a particular group of people, a particular location and/or a particular subset of policies. In the sections that follow, the discussion is based on evidence from the literature, where this was available, or inferred where it was felt that it was possible to do this. Where we infer our findings, this is based on:

- The existing travel patterns of different social groups and the differences that already exist in these behaviours, as well as the adverse environmental and social effects of the transport system, as set out in Section 2;
- The likely impact of climate change policies for transport on behaviour; and
- The likely social impacts of climate change policies and the groups which are identified as the most positively and negatively affected by these.

Within each section, there is a sub-section that identifies the specific gaps in the knowledge and makes some recommendations about how these can be addressed.

3.1.2 Positive and negative policy impacts

As discussed in Section 1.3, the focus of this report is on SDIs. While such impacts are generally taken to be negative, it is also important to note that some policy instruments can impact beneficially on different groups in different ways. Additionally, impacts on users and non-users could be different. For example, an instrument that reduces traffic levels could be beneficial to non-users who potentially benefit from improved air quality and reduced severance, whereas the users that remain would benefit from less congestion and potentially improved reliability of the system. However, if this same instrument has reduced traffic levels by pricing people out of travel, then it is likely that SDIs would also result. Recognising these different impacts is fundamental to mitigating the potential adverse effects of policies, as the adverse impacts of one policy instrument could be mitigated by the beneficial impacts of another instrument. The potential for such mitigation will be explored in the sections that follow.

3.1.3 Direct and indirect policy impacts

It is also important to note that there are two main types of SDIs that need to be understood and taken account of in policy development, which broadly reflect whether an impact is direct or indirect. First, there are impacts that could directly affect specific population groups, some of which may already be disadvantaged and vulnerable. For example, a policy instrument that increases the price of travel in some way is likely to restrict the amount of travel that certain groups of the population undertake, particularly those who struggle to cover the costs of travel anyway. As was noted in Section 2.3, those on low incomes who own a car spend a larger proportion of their income on transport and therefore this group is likely to be particularly vulnerable to policies that increase prices.

Second, there are impacts that potentially affect a wide part of the population, but have limited, noticeable impacts on specific population groups. For example, a policy instrument that reduces air pollution might have a marginal, and potentially unnoticeable, effect on individuals, but taken as a

whole over the entire population affected, its benefits could be significant. Given that those on low incomes often experience worse air pollution and are often more at risk from the impacts of climate change (see Section 2.4), these groups might be expected to benefit more from these wider improvements than other members of the population. These two types of impact are noted in the following discussion with reference to a potential long-list of SDIs that was drawn from the relevant DfT documentation (e.g. DfT, 2009b) and preceding work (i.e. Parkhust and Shergold, 2009 and Atkins, 2009).

Finally, it is important to point out that the actual SDIs of many of the policy instruments discussed will depend on the population that is affected. As Brand (2008) notes, the impact of policy options on travel behaviour and CO_2 emissions would depend on price, individual and household circumstances, location and the alternative travel options that were available.

3.1.4 The policy instruments

As identified in Section 1.5 above, the report focuses on four main categories of policy instrument, namely:

i) **Reducing trips**, i.e. reducing the amount of passenger (and tonne) kilometres travelled.
ii) **Improving the utilisation of vehicles**, e.g. car sharing, **and changing mode** to use less carbon-intensive modes.
iii) **Purchase and use of more efficient vehicles and driving behaviour**. This covered i) policies that aim to improve the efficiency of new vehicles, e.g. reducing their average CO_2 emissions per vehicle kilometre, and that stimulate the purchase and use of these vehicles; and ii) policies that aim to improve the efficiency of the way in which vehicles are used.
iv) **Alternative fuels**, i.e. policies that aimed to reduce the carbon intensity of transport fuels.

The report now considers the findings of the literature review under these four sub-headings, with each of these four sections covering the following elements in turn:

- The introduction to each section sets out the **policies considered** and the way in which these impact on transport behaviour and therefore CO_2 emissions generally. It also includes a box containing **key findings** of the review in relation to the policies covered in that section.
- The first sub-section of each of these sections sets out the potential **social impacts** of the policies covered in that section from the literature. A summary of the potential social impacts by category of policy instrument is given in Appendix 6.
- The second sub-section identifies the key **distributional impacts**, i.e. the main social groups that are potentially affected by the respective policies, again based on the literature and supplemented by inferences where appropriate. More detail on these is given in Appendices 7 and 8.
- Each third sub-section presents the findings of the literature with respect to the **attitudes of different social groups** to the respective policies.
- This is followed by an overview of the most important **knowledge gaps** with respect to the SDIs of the policies covered in the section.
- The final sub-section discusses the **implications for policy makers** in terms of the mitigation of potentially negative SDIs resulting from policies and the maximisation and targeting of potentially positive policy effects towards socially disadvantaged groups and areas.

Information and communication technologies also potentially enable excluded groups to experience the benefits of accessibility to services and employment without having to travel, as well as enabling some transport policies. In this respect, such technologies could be considered to be alternatives to travel and are discussed in Section 3.6.

There are clearly potential barriers to the implementation of many of the policies discussed in the following sections, including the public acceptability of pricing policies and car sharing, although analysis of these barriers is outside the scope of this report. However, there is a segmentation study that is being conducted separately for the DfT that identifies a range of motivators and barriers to sustainable travel behaviours amongst different social groups (Thornton *et al*, 2010). The interim report of that separate research was published following the completion of this study and has therefore

not been reviewed within this report. It should be noted that the research carried out by Thornton *et al* provides useful information on the issues to be considered in implementing the types of policy covered in this report.

3.2 Policies that aim to reduce trips

This section focuses on policies that would reduce transport's CO_2 emissions mainly by reducing the number of car trips that take place (see Table 1). It is assumed that the policies considered would generally only reduce car trips (and therefore CO_2 emissions) in and around the areas affected by the respective pricing or charging schemes. The exception to this is personal carbon trading, which could potentially affect the use of other modes, in addition to the car, depending on the way in which it is designed[9]. As noted in Section 1.5, there are policies that could reduce transport's CO_2 emissions, including by reducing the number of trips, e.g. fuel taxation, which are not considered in this report as they are not the responsibility of the DfT.

Table 1: List of the DfT's potential climate change policy instruments considered in this report that aim to reduce trips

Mode	Policies considered
Cars	Local road pricing schemes
	Congestion charging
	Parking charges
All modes	Personal carbon trading

The following sections set out results of knowledge review in relation to the possible SDIs that might result from the introduction of the policies listed in Table 1. A summary of the key findings is presented in **Error! Reference source not found.**.

3.2.1 Key social impacts of policies to reduce trips

There is a considerable body of literature on the potential social impacts of reducing trips by private vehicles, which **largely focuses on the potentially negative impacts of pricing policies on affordability and accessibility** (e.g. Golub and Kelly, 2010; West, 2002). A smaller literature base discusses the potential benefits that might arise from such policies in terms of reduced traffic levels and increased physical activity (e.g. Lucas and Jones, 2009).

Negative impacts

Litman (2009b) notes that the introduction of policies that affect the affordability of transport also potentially has impacts on accessibility and severance. Similarly, Wadud *et al* (2008) suggest that the key social impact of tradable carbon permits is affordability as such permits might result in **increased costs for vehicle users**. Barham and May (2009) identify more specific social impacts of local road pricing schemes that relate to accessibility, i.e. **reduced choice and flexibility** in terms of when and how to travel.

Consequently, the literature identifies the principal social impact of policies to reduce trips as affordability, which will have **knock-on effects on accessibility** for those whose travel behaviour is affected by the increase in prices. For some, the increase in prices may simply lead to trips that have little marginal benefit being sacrificed, whereas **for those who are already struggling to afford the cost of their travel, the increases in the cost of travel may affect their ability to attain the wider social benefits of the transport system, e.g. access to employment opportunities and the ability to maintain social networks.** Those affected in this way are clearly the ones who will suffer the most significant adverse effects from policies to reduce trips. As was noted in Section 2.3, car owning low income households already spend a significantly higher proportion of their weekly expenditure on transport, which suggests that transport is a very important element of their lives as they are prepared

[9] This is a policy that is analogous to the emission trading schemes that are currently used to reduce emissions from industry, e.g. the EU's emissions trading scheme. Under such a policy, each individual would be allocated (or would have to buy) permits to travel a maximum distance (or emit a maximum amount of CO_2 emissions). The total permits allocated would be set to ensure that wider CO_2 targets are met. If any individual travelled less (or emitted less CO_2) than the permits they had, then they would be able to sell these additional permits to those who wanted to travel more (or emit more CO_2).

to spend so much of their relatively low incomes on it. Consequently, any policy that increases the cost of transport, such as road pricing, would mean that such households would either have to travel less for the same level of expenditure, or increase expenditure further on transport by sacrificing expenditure on other items.

Box 1: Key findings in relation to SDIs associated with trip reduction policies

1. Policies that aim to reduce transport's CO_2 emissions by reducing trips have the potential for significant SDIs, particularly on the ***affordability*** of transport and the ***accessibility*** of different groups, particularly low income groups and those living in rural areas. Those likely to be worst affected are those with no viable alternative to the car, although exemptions and concessions could help to at least minimise such impacts. The public recognises that issues of fairness will be important in introducing road pricing policies.
2. On average, such policies (e.g. ***congestion charging*** and ***parking charges***) could be considered to be progressive (i.e. they impact relatively more on those on higher incomes), particularly if the revenue raised is used to fund improvements in modes that are used more by those on low incomes, the young and old, e.g. buses. This is due to the fact that those on higher income groups own and use cars more than those on low incomes. The groups that are potentially most adversely affected by such policies will be those low income drivers who do not have alternatives to using their car, e.g. whose jobs are in the affected zone, but who live outside of this area.
3. ***Personal carbon trading*** could have similar, or even more adverse, SDIs compared with those other policies aimed at reducing trips. However, if the policy is designed appropriately, e.g. if a certain level of allowances were distributed for free, then there is the potential for beneficial and equitable impacts across different groups.
4. Policies such as those above that aim to reduce trips by reducing the affordability of car use are likely to **deliver benefits for transport users and non users** alike in terms of improvements in air quality and reduced noise levels, severance and road traffic accidents that result from less traffic. However, such benefits will be marginal at the individual level, but could be significant when assessed across the wider population.
5. There is the potential for **rebound effects** from policies that aim to reduce traffic levels, as the road space that has been freed up could be used for new journeys. If such effects are allowed to occur, this would undermine any benefits in terms of addressing SDIs that had resulted from the implementation of the policies. This underlines the importance of "locking-in" the benefits of local measures.
6. The majority of people in all socio-demographic groups are in **favour of individuals trying to limit their car use** for the sake of the environment. Around half would be prepared to walk instead of drive for shorter journeys, while around 40% where prepared to eliminate some non-essential car trips.

Whilst there are a number of potential second order effects from such policies (see the discussion in Section 3.2.5), Bonsall and Kelly (2005) identified two main ones, i.e. problems caused by diversion onto roads just outside the charge areas or parking outside the charge area to avoid paying the charge; and changing to another mode. They also noted the possibility of third-order effects relating to land-use changes stimulated by changed travel patterns.

Positive secondary benefits

However, the literature also identifies the potential benefits of policies that reduce trips, principally from the knock-on effects of reduced traffic levels, which in turn has the potential to reduce severance for non users, as well as potentially delivering improvements in air quality and reduced noise levels. Similarly, policy instruments that reduce traffic levels have the potential to reduce journey times and improve reliability for transport users. As noted in Section 2.4, as those on low incomes are more likely to be exposed to poor air quality and some adverse effects of climate change, then it is these groups who could benefit more from any improvements in air quality and reduced CO_2 emissions arising from such measures.

Barham and May (2009) identify benefits that might result from **reduced traffic levels, including cleaner air, reduced noise and visual intrusion, reduced community severance and improvements in road safety**. Lucas and Jones (2009) also note the potential benefits of **increased physical activity** (from increased walking) and increased **opportunities to socialise on public transport** for a minority from reductions in trip numbers.

Whether there would be improvements in road safety resulting from policies to reduce trips would be highly dependent on local circumstances. If traffic levels decline, then there is the potential for some benefits with respect to a reduction in the risk of accidents, but only if traffic levels do not decline sufficiently to allow speeds to increase, which could have the opposite effect. Any measure that reduces traffic levels has the potential to affect non-transport users adversely, particularly in more remote locations and off-peak times, if the presence of fewer vehicles increases the risk, or the perception of risk, in relation to personal security.

Marginal environmental impacts

Other potential environmental impacts, such as the impact on landscape, are not mentioned in the literature as being relevant for policies that reduce trips. It is possible that there might be some **marginal impacts on some of these other environmental issues, but it is unlikely that these will be significant**. For example, any policy instrument that reduces the amount of traffic on the roads would potentially contribute to less pollution from run-off and spillages, and would therefore reduce impacts on biodiversity and the water environment. However, these are minor indirect impacts. Similarly a policy that results in less traffic will have minor indirect benefits with respect to landscape and townscape through reduced traffic levels.

Area-based impacts

Finally, it is important to note that the scale of the impacts associated with policy instruments that aim to reduce trips will be heavily dependent on the location in which transport activity is discouraged. For example, if alternative means of (cheaper) transport exist, e.g. in areas with a high population density, then the impact on accessibility resulting from reduced affordability may not necessarily be that significant. However, **where cheaper alternatives do not exist, accessibility could be significantly reduced**. Additionally, there is the potential for rebound effects from policies that potentially reduce traffic levels, if the road space that has been freed up is used for new journeys. This underlines the importance of "locking-in" the benefits of local schemes through the introduction of parallel measures.

3.2.2 Distributional impacts

The literature on the social groups that will be affected by policies to reduce trips tends to highlight **low income groups and those living in rural areas**, generally.

Affected social groups

For example, Bayliss (2009) identifies **low income car owners** as being at risk of exclusion as a result of policies to reduce car use, although he does note that mitigation is possible. It is arguably **people who have no viable alternative to using their car** who are disproportionately affected by local road pricing schemes, since an inability to pay a charge might cause them to be excluded from access to employment and training opportunities, and to other important goods and services; equally, paying a charge that they can ill afford might cause them to reluctantly make economies elsewhere (Rajé, 2003).

Among this group of people, those not eligible for exemptions and discounts are particularly disadvantaged. The inclusion of exemptions for some groups of people is an important aspect of any pricing scheme, and one which has a major bearing on the SDIs of such a scheme, particularly in terms of the impacts on the members of society who are especially at risk of social exclusion. In London, for example, those who are at least partially exempt from the city's congestion charge include taxi drivers, Blue Badge holders and residents living within the Congestion Charging Zone. Low-paid workers, who might be on the margins of being able to afford to run a car, have no exemption.

Lucas *et al* (2001) suggested that **pricing measures may serve to further exclude already transport poor groups**. On behalf of the DfT, Parkhurst *et al* (2006) undertook a rapid evidence assessment of literature relating to the SDIs of road pricing schemes. Whilst noting that the evidence base was very limited, they underlined that a persistent theme concerned the potential impact of road pricing on social exclusion, i.e. it is people with no alternative to car use who are the most vulnerable. They note that there are difficult choices to be made for lower-income households in those areas where limited local employment opportunities, the rise of irregular and anti-social work hours, and inadequate public transport facilities force them into running a car at considerable expense. On the other hand, if a congestion charge resulted in shorter journeys for those paying the charge, it may enable people previously excluded from participation in certain activities to take part. There may also be positive distributional effects for bus users if, as a result of less congestion, services become quicker or more reliable, or improved operating conditions lead to more services being introduced. In such a case, it would be those on low incomes, women, the young and old, who would benefit as these groups use buses more (see Section 2.2).

Gorman *et al* (2003) imply that affluent people would drive less as a result of car restraint and road user charging measures and that the most deprived people would benefit from the reduced congestion, better air quality and public transport improvements. While making a valid point, this overlooks the fact that the progressive nature of road user charging only applies on average; in practice, it is likely to be lower income drivers who are most significantly affected by road user charging, as these are the most likely to restrict their journeys in response to increased costs (as noted by other authors; see above).

Another important group of people whose situation should be considered is public transport users who never use a car; whilst it is possible that they might benefit from improvements to their public transport system paid for by toll revenues, it is also possible that they might suffer disbenefits from services becoming over-crowded.

While there is some evidence in the literature with respect to the benefits in terms of CO_2 reduction from the introduction of the policies discussed in this section, it was not possible to find any evidence on the impacts of policies on the CO_2 emissions of different groups. Given the above discussion, however, it can be anticipated that it would be those low income car drivers who might experience the largest decline in their personal carbon footprint from such instruments.

Affected areas

Policies for charging people for the use of the roads can affect people differently according to where they live in relation to the charging zone. For example, people resident on the edge of a charging zone might experience “second order” effects, such as an increase in traffic that is parked in, or diverted through, their residential area in order to avoid payment of the charge. Similarly, there might be so-called “third order” effects for residents and businesses located within a charging zone; for example, a reduction of traffic might ease access to business premises for both customers and suppliers, and might generally create a cleaner and more pleasant environment in which to live and trade (Bonsall and Kelly, 2005). Parkhust (2006) identifies five factors that may mitigate or aggravate questions of equity: i) the basis of charging; ii) the area covered by the charge; iii) the time period covered by the charge; iv) discounts or exemptions; and v) linkages to other transport charges. Anable *et al* (1997) note that rural dwellers[10] are under-represented in the consideration of, and therefore potentially vulnerable from, policies to reduce car use.

3.2.3 Attitudes of different social groups to policies to reduce trips

In reviewing the results of the DfT’s Omnibus Survey, Eleini (2010) concluded that around 60% of adults favoured individuals trying to limit their car use for the sake of the environment. While the majority in all socio-demographic groups said that they would be willing to change their travel behaviour to limit climate change, those who were more willing to take action were in managerial or professional occupations, had a degree or higher level qualifications or had higher incomes. On the other hand, those over 75 were least likely to be willing to change their behaviour.

[10] Defined in their study as living in settlements with populations of under 3,000.

Respondents were also asked what types of activities they were likely to undertake in the next 12 months due to concerns about climate change and over three-quarters mentioned at least one activity linked to reducing their car use. Around 50% of people stated that they would walk instead of using their car for some short journeys, while more than 40% were prepared to cut out some non-essential car journeys. On the other hand, fewer (less than 30%) were prepared to share car journeys and to cycle instead of use their car on some of their short journeys (nearly 20%). Higher proportions of younger people were prepared to walk and cycle, whereas older people were more likely to switch to public transport for some shorter journeys.

Although there have been various studies of the likely equity impacts of the different pricing options, as well as studies of public reactions to different actual schemes (e.g. the London Congestion Charge (LCC), the Edinburgh city-cordon and the Bristol central city cordon), there is only partial information on the responses of different social groups in relation to this (Lucas and Jones, 2009). An overview of the role public attitudes played in the rejection of the Edinburgh city cordon is presented in Box 2.

Box 2: Public attitudes towards road user charging

In Edinburgh, there was specific consideration of potential impacts of the proposed congestion charging scheme on social exclusion. The Public Inquiry for the scheme concluded that people who do not have a car cannot be adversely affected by the charging scheme, except from the point of view of a slightly reduced likelihood of being given a lift by car drivers. The Inquiry also identified people who are on the margins of being able to afford to run a car, who are most likely to be in low-paid employment, as the group of people likely to be most adversely affected by the proposed congestion charge. People in this category who are less mobile in terms of their choice of alternative employment would be less able to make life changes in order to cope with the increased cost of travelling by car, and some, such as shift workers, would have few, if any, alternative options for travelling to work. The report's conclusion, however, was that such problems would be alleviated in the longer term, due to planned improvements in the transport system.

These equity issues were a major factor in the subsequent referendum in Edinburgh. Whilst it was demonstrated, during the planning phase, that no group of residents would actually lose out as a result of the introduction of the scheme, a city-wide referendum resulted in the plans being rejected by almost 75% of the residents who voted, and neighbouring authorities, who were not included in the referendum, were also against the proposed scheme, on the grounds that they perceived the charging regime to be unfair.

Owen et al (2007) undertook research for the DfT on the public acceptability of road pricing based on group discussions and in-depth interviews. This found that the equity and fairness of such schemes was considered essential for all groups, but it was recognised that it would be difficult to achieve. Participants were also concerned about the fairness of road pricing for specific groups of people, referring to low earners, those in rural areas, businesses, and those having to use a car, e.g. disabled people or parents with young children. Those in higher socio-economic groups also raised the concern that those in lower income groups might suffer adversely, including potentially losing employment, as a result of road pricing.

In a study of the travel choices and needs of low income households Taylor *et al* (2009) primarily focused on the social benefits of car use amongst this social sector. The study identified that the car is now considered an essential item for many low income households, with direct benefits such as greater access to services and maintenance of social networks as well as indirect benefits such as improved mental well-being and feelings of independence. This finding has been borne out in several other studies (e.g. Lucas and Jones, 2009; Urry, 2007; Smith *et al*, 2009). This suggests that any fiscal measures to reduce private car use need to take account of the impact on low income motorists.

In a series of focus groups with different types of motorists, mostly including those who were at the margins of driving and non-driving, Lucas and Jones (2009) identified attitudes to the increased cost of motoring to be fairly uniform across all the groups, with people mostly favouring increased fuel costs over area-based charges. Although, in common with Taylor *et al* (2009) the authors identified that, on the whole, participants did not budget the cost of their motoring and saw this as a something they would seek to afford whatever the increase or impact on other items of household expenditure. Participants also found it difficult to identify exactly how they would modify their driving behaviours in

the light of considerable increases in cost, but most said that they would first consider eco-driving (young motorists group); reducing unessential leisure trips (older motorists); reducing their escort trips (parents); walking or taking public transport more (people who had already reduced their car driving in the last year).

Clearly, the design and location of pricing projects has an influence on the acceptability of such measures for different social groups. For example, in a study for the DfT, Parkhurst (2006) evaluated the evidence on the social and distributional effects of local road pricing schemes. He found that, in the case of the LCC, disabled people (who were considered to be particularly transport disadvantaged and possibly more car dependent than other groups and so were specially consulted on this issue) had a reasonably positive attitude to the charge. They believed that it might help to deter private car journeys, but many felt that it would not work as well as greater pedestrianisation because the charge was too low. They also predicted that LCC would mean greater demand for public transport, which could negatively affect their own transport needs.

3.2.4 Knowledge gaps

While there is a reasonable amount of evidence in relation to SDIs associated with, and the attitude of people to, policies that reduce trips, key knowledge gaps are:

- There is clearly the potential for those **on low incomes and the traditionally transport disadvantaged groups** who own and drive cars to **be disproportionately affected by policies to reduce trips**, but there is little evidence as to the extent to which this would happen. This is linked to the fact that the scale of impacts will be dependent on the location. It is important that these potential impacts are understood for the particular location, and that policies to mitigate the adverse SDIs are put in place in parallel.
- **How best to engage the public in the develeopment and design of instruments to reduce the number of trips?** Evidence suggests that on average it is likely that those on low incomes will benefit from such schemes, as bus reliability could increase and air quality could improve. However, it has proved to be difficult to convince people to support such schemes, even though when surveyed a majority of people appeared to be in favour of reducing their car journeys.
- **Designing schemes to address the genuine concerns of low income drivers.** Low income drivers spend more on transport than other drivers and also use other modes less often than other lower income households. Such drivers often have concerns regarding the impact on the affordability, and the subsequent impact on their personal accessibility, of pricing schemes. It is the needs of these drivers that need to be considered in more detail when such schemes are developed.
- **The benefits of the Webtag guidance.** The Webtag guidance that sets out the approach to the implementation of local transport schemes includes guidance aimed at local road pricing schemes, as well as guidance focusing on the evaluation of SDIs. These documents were in the process of being revised in 2010. Given the potential significance of such instruments on the affodability of transport for low income car drivers in particular, as well as the likelihood that instruments to reduce trips will become increasingly common, it is important to monitor the application of the particular units of Webtag guidance to ensure that the potential SDIs of road pricing schemes are being considered and mitigated as far as possible in the design and implementation of such schemes.
- **What package of measures will best lock-in the benefits of charging and pricing schemes?** In order to ensure that the benefits of pricing and charging schemes are maintained, packages of measures have to be designed to ensure that any reduction in traffic levels are maintained.

3.2.5 Implications for policy makers

Consequently, when considering the introduction of policies to reduce transport's CO_2 emissions by reducing the number of trips, such as those covered in this section, key issues for policy-makers are the need to:

- **Understand** the type, scope and geographical location of the **disadvantaged groups** that might be affected. **Engage** with such groups, or at least their representatives, to understand

their concerns, particularly with respect to accessibility and affordability. **Take such concerns into account** when designing policies, and communicate to disadvantaged groups how their concerns have been met. In this respect, the Webtag guidance on road pricing and assessing SDIs is relevant[11].

- Focus on the potential impacts on **low income drivers**, particularly those who have a lack of viable alternatives to the car at the times at which they need to drive, or to the locations to which they need to drive.
- Consider the use of **exemptions or concessions** when addressing the concerns of disadvantaged groups, e.g. exemptions from the charge; direct compensation to low income groups, such as credits (similar to credits provided to low income utility customers); or tax credits to low income commuters.
- Take account of the **alternatives to travel**, and potentially improve, these, as a means of addressing the concerns of potentially disadvantaged groups.
- Ensure that the resulting reductions in transport's **CO_2 emissions are maintained**. Measures that reduce trips potentially free up space for new additional trips, at least in the medium-term, which could undermine the CO_2 reductions that were achieved. In this respect, complementary measures are also needed in order to ensure that the CO_2 benefits of the original policies are "locked in".
- Take account of, and communicate, the **wider benefits** of such policies for transport users and non-users in the course of developing policies, e.g. improvements in air quality and reduced noise levels, severance and road traffic accidents, that result from less traffic.
- **Monitor** the impact of policies on different groups over time in order to ensure that the benefits are maintained and that additional measures are taken to address any erosion of the CO_2 and SDI benefits.

3.3 Policies that aim to stimulate modal shift and increase car occupancy

The discussion of this section focuses on policies that aim to reduce transport's CO_2 emissions by either stimulating modal shift or increasing car occupancy (see Table 2). Policies aiming to stimulate modal shift would reduce transport's CO_2 emissions if they encouraged the use of more CO_2-efficient modes for existing trips. For example, a policy that managed to replace a number of single person car trips by trips undertaken using well-used and CO_2-efficient public transport has the potential to reduce transport's CO_2 emissions. Similarly, policies that stimulate the use of cycling or walking for trips previously undertaken using a motorised mode have the potential to reduce transport's CO_2 emissions. As noted in Section 1.5, the policies of other government departments, such as spatial planning, which have the potential to deliver CO_2 emissions reductions, are not covered in this report.

It should be noted that policies that aim to increase car occupancy have the potential to reduce transport's CO_2 emissions only if they result in fewer trips by car. For example, if car sharing by employees to a common place of work reduces the number of otherwise single-person commuting trips by car, then there are potential CO_2 emissions reductions[12]. Similarly, if people join car clubs and give up their car in doing so, it is likely that they will undertake fewer car trips, and thus reduce their personal CO_2 emissions.

The following sections set out results of knowledge review in relation to possible SDIs that might result from the introduction of the policies listed in Table 2. A summary of the key findings is presented in Box 3.

[11] See respective guidance documents at www.dft.gov.uk/webtag/documents/index.php.
[12] As with all policies, it is the net impact that determines whether CO_2 reductions actually occur. If a place of work encourages car sharing, but does not reduce the number of spaces that it provides, then there is a possibility that the parking spaces freed up by the new car sharers could be filled by cars making new journeys, whose drivers may have previously come to work in less CO_2-intensive modes. It will be the net impact of all of these effects on CO_2 emissions that matters, rather than the fact that car sharing will have increased.

Table 2: List of the DfT's potential climate change policy instruments considered in this report that aim to stimulate modal shift and to increase car occupancy

Mode	Policies considered
Policies that aim to stimulate modal shift	
Public transport	Investment
	Introduction of smart ticketing
	Regulation of fares and concessions
	Potential plans for electrification
	High speed rail
Cycling	Development of a National Cycle Plan
	Investment in infrastructure, e.g. cycle interchange facilities at stations
	Promotion of cycling e.g. cycle demonstration towns
Cross modal	Active transport strategy (including walking)
	Sustainable Travel city
	Smarter Choice initiatives including school travel plans, workplace travel plans, personalised travel plans.
	Walking – new infrastructure, specific promotion
Policies that aim to increase car occupancy	
Cars	Car clubs
	Car sharing

Box 3: Key findings in relation to SDIs associated with modal shift and increased car occupancy policies

1. Policies that aim to reduce CO_2 emissions through **modal shift** are more likely to benefit the ***accessibility*** of those on high incomes and men, if they focus on improving rail or cycling infrastructure. In contrast those on low incomes, women, younger and older people will benefit more if such policies focus on improvements to bus infrastructure and services. There is the potential for policies to benefit all groups, depending on how a policy is designed. There is also a risk that the development of large-scale transport infrastructure is more likely to impact adversely on those living in more disadvantaged areas, if the infrastructure passes through rather than serves such areas. The exact nature of the impacts will depend on the locations that the infrastructure serves and passes through.
2. Policies that increase the amount of walking and cycling (in any group) have the potential to ***improve physical fitness***, while if reduced traffic levels result from modal shift policies, there will be ***wider benefits*** in terms of improved air quality and reduced levels of noise and severance.
3. The ***regulation of fares*** has the potential to benefit all groups, but it is a less well targeted measure than ***concessionary fares***, which could be used to benefit particular groups, as it has the potential to improve the **accessibility** to employment and local services for these groups.
4. There is insufficient evidence regarding the impact on the travel behaviour of different groups from ***car clubs and car sharing***. However, such policy instruments clearly have the potential to benefit some groups by improving the **affordability** of accessing a car, and therefore their **accessibility** to services and social networks that are more easily accessed using this mode. For example, policies to stimulate car clubs could benefit those on low incomes who are not able to afford to own a car or those who would otherwise not have access to a car at certain times, e.g. mothers whose partners use the household's only car during the day, as long as these policies encourage take up and ensure that these schemes are affordable.
5. Any of the policies that aim to encourage modal shift or to increase car occupancy have the potential to increase the capacity of the transport network and thus, potentially increase transport's CO_2 emissions, which would undermine the main objective of the policy. Hence, **complementary measures would need to be used in parallel**, such as those measures that could be used to reduce the number of trips (see above), in order to ensure that transport's CO_2 emissions are tackled and that SDIs are addressed.

3.3.1 Key social impacts of policies to stimulate modal shift and increase car occupancy

The CO_2 impacts of policies aimed at encouraging modal shift will depend on the relative CO_2 emissions of the two modes involved. For example, there may be emissions reductions if cycling is encouraged and it replaces motorised journeys, but this would tend to reduce the CO_2 emissions of higher income groups as these groups tend to cycle more. On the other hand, if, as noted above, concessionary bus fares increase trips then the CO_2 emissions of these groups, e.g. older people, could increase as a result. With respect to high speed rail, however, the CO_2 emissions benefits would depend on the relative CO_2 emissions of the new and former trip, but again as this policy would largely benefit those on higher incomes it will be the emissions of these groups that are affected. The benefits of policies to stimulate modal shift only occur, of course, if modal shift actually occurs. The evaluation of several schemes has indicated that, while some car trips can be removed, the impact on non-car modes can also be significant. Rather than looking at the social impacts of changing mode, the literature tends to look at the social impacts of using non-car modes.

The main modes considered within the literature are cycling and walking, public transport improvements including fare reductions, car sharing and car clubs. The literature suggests that the most important social impacts from the policies discussed in this section are increased **accessibility** and **improved physical fitness** from cycling and **wider benefits** resulting from reduced traffic, including improvements in air quality and reduced levels of noise and severance. As with the policies that aim to reduce trips, any reduced traffic levels also have the potential to improve the reliability of the transport system, as well as have impacts on landscape, townscape and reduced climate change impacts (see Section 3.2.1). Whether changing mode reduces the risk of accidents and improves security will depend on the relative safety and security of the respective modes, both generally, but also locally, as accident risk is dependent to some extent on location.

It should also be noted that there is often an implicit assumption within the literature that there will be a significant modal shift away from cars as a result of the introduction of new alternative transport projects. This may not always be the case in practice (see examples in Box 4).

Box 4: Modal shift from cars onto public transport

Several large public transport infrastructure projects have attempted to secure modal shift from cars onto new public transport services, such as the Jubilee Line Extension (JLE) in London, the Manchester Metro and the Sheffield Supertram. All have had varying impacts in effecting mode choices. In general, existing passengers tend to use the new services to increase their journey distances or number of trips. People who have previously been travelling by slower modes will often upgrade their travel onto these new services (e.g. from walking onto buses or from buses onto trains).

For example, the JLE Impact study household survey showed a global increase in the public transport trips of households across all the station catchment areas. However, whilst the Isle of Dogs cordon counts showed an overall increase of public transport use of 11% in the morning peak and a decrease of approximately 10% in private vehicle trips, the use of buses and the Docklands Light Railway also decreased significantly.

The surveys to evaluate the impact of the Manchester Bus Quality Partnerships on passengers' mode choice found that most people had changed mode due to changes in their personal circumstances, e.g. banned from driving, because their partner was no longer available to drive or because of change of job or address. Only a small number of respondents along each route, 8 out of 200 on Corridor 1 and 5 out of 200 on Corridor 2 transferred to bus from their previous mode because of the introduction of the QBC or other closely related transport policies.

Gardiner and Hill (1997) argue that *cycling to work* has social impacts in relation to **accessibility, severance, affordability, personal safety and security**, while potential **indirect impacts** (from reduced car use) on noise and air quality. Jones (2008) argues that the increased amount of cycling resulting from the development of a national cycle network in the UK would improve **accessibility and the affordability** of transport, while **improving the health** of those using the network. Whilst it is clear that cycling has the potential to increase physical fitness, policies to encourage the use of other

modes or increase car occupancy have the potential to be detrimental to physical fitness if these policies lead to a transfer of trips from cycling and walking.

In relation to *buses*, Rye and Mykura (2009) identified that the use of concessionary fares for older people potentially had benefits with respect to **accessibility, severance and affordability**, while potential indirect impacts (from reduced car use) with respect to noise and air quality. For *high speed rail*, Van Exel *et al* (2002) note that such schemes have the potential to improve **accessibility** by enabling people to travel farther in a shorter time period, for those who can afford it.

From a wider health perspective, Gorman *et al* (2003) note the benefits of walking and cycling as a means of providing people with **regular physical activity**, including evidence of a **reduction in heart disease, diabetes, hip fractures and mental health conditions such as depression, anxiety and stress.** On the other hand, high traffic levels that lead to severance to community and social networks can in turn have a negative impact on health. For example, having a good social network can reduce a person's risk of coronary heart disease, depression or susceptibility to infection. The lack of such social support has been associated with higher mortality rates from all causes. Similarly, air pollution can have a negative impact on health, as exposure to air pollutants is related to respiratory and cardiovascular diseases.

Some literature also discusses policy instruments to increase vehicle utilisation from which potential social impacts can be inferred. For example, in assessing the public's experience of *car sharing*[13], DfT (Robinson *et al*, 2008) found that the most common reason for people to receive a lift in this way was convenience (63%), followed by an inability to drive (25%), while 22% mentioned problems with public transport, including lack of services available, and cost factors (either to reduce the cost of car use or because public transport was too expensive). This list of reasons implies that the key social impacts that are addressed by car sharing relate to **accessibility and affordability**. In the latter case, the implication is that even taking into account the costs of belonging to a car club, this option is considered to be more affordable than some alternatives. Carplus (2004) suggest that *car clubs*[14] can have a number of benefits for the community including contributing to cohesion as the development of clubs tends to bring together sectors of the community who would not necessarily naturally find a common focus. Additionally, the "club" aspect of the projects implicitly involves sharing resources, which can help to foster community pride from being involved in a local initiative that provides environmental and communal benefit.

3.3.2 Distributional impacts

In the literature there is little information on the distributional impacts of increasing vehicle utilisation, while the distributional impacts of modal shift are often implied on the basis of who tends to use the modes more often at the moment.

In their evidence based review, Smith *et al* (2006) indicate that **older people were more likely to depend on public transport and less likely to drive**. However, the focus groups in the study by Lucas and Jones (2009) reported that public transport was often not useful for older people, particularly if the services that they wanted to access were distributed around the town. The literature stresses the need to maintain older people's independence and access to transport services in order to avoid isolation. Rye *et al* (2009) identified that low income seniors have increased their bus use by as much as 30% as a result of the National Concessionary Bus Fares Scheme. People with household incomes of £500 or less a month made over 50% more trips than those on incomes of £750-£1000 per month and twice as many as those on £1000 or more a month. Perhaps more importantly for this study, the concession also served to stimulate bus use amongst retired car owners.

Disabled people are more likely to depend on public transport, but have accessibility and safety concerns, as well as less flexibility in travel choices than people who are not disabled (Penfold *et al*, 2008; Smith *et al*, 2006). Therefore disabled people need to plan ahead if they wish to travel. This means that all stages of the transport chain need integrating to meet these concerns (Stanchev and Menaz, 2006).

[13] i.e. when one person effectively gives a lift to one or more other people
[14] i.e. where a collection of cars is owned centrally and used by a number of people

Smith *et al* (2006) note that **adults from black and minority ethnic groups are more likely to depend on public transport than white adults**, but there are safety concerns about using public transport for some. They also note that women are more likely than men to have safety concerns about using public transport and that services may not meet travel needs at off-peak times and on non-radial routes.

In an assessment of the health impacts on the residents of Edinburgh of different funding and investment scenarios for transport, Gorman *et al* (2003) found that the option with the highest level of transport funding (funded from standard city funds and road tolling) would provide the most benefits for deprived groups, due to the investment in non-car modes of transport. In another analysis relating to Scotland, this time with respect to buses, Rye and Mykura (2009) noted that in some cases, **the introduction of concessionary fares for buses in Scotland resulted in newly generated trips (27%), or a modal shift, including from cars (23%) and walking (44%) for older people or the mobility impaired.**

However, for rail, Segal (2009), in the course of estimating the impacts of a high speed rail network in Britain, estimated that only 7% of the trips would replace a car journey and 17% would replace a plane journey, while the majority of trips on the new network (57%) would come from normal rail. As noted in Section 2.2, as **rail is predominantly used by high income groups**, then the development of a high speed rail network has the potential to be of more benefit on average to those on higher incomes.

With respect to cycling, Jones (2008) points out that the distribution of the benefits of cycling is limited as **it is only people who are actually able to cycle who will be the beneficiaries of investment in the provision and promotion of cycling facilities**. The ability and propensity to cycle is, in turn, **dependent on age, sex, level of household responsibility and social class**, although there is no demonstrable correlation between cycling propensity and income – approximately two in three people cycle “once a year or never”. A major tranche of investment funding for the improvement of cycling infrastructure and the marketing of cycling as an activity was directed at Cycle Demonstration Towns in the 2000s. A specific group targeted was **school-aged children**, and the results of school surveys identified a 7.3% increase in cycling to school. As well as this positive impact on young people, monitoring studies have also shown that **adults living in households with children have had a greater propensity to increase their cycling than other adults** (Review of Cycle Demonstration Towns, 2009). However, clearly there is the potential for all groups to benefit from cycling. The fact that some groups of the population currently choose not to cycle could be addressed by targeting policies to promote cycling at such groups. This is underlined by DfT (2006b), which showed that one of the key benefits of cycling schemes, in this case links to school, was to increase access for all parts of society, including those without a car, those groups, such as older people and the disabled, who feel most vulnerable on busy roads, and people from ethnic minority groups.

Litman (2009a) notes that critics often claim that mobility management programmes harm poor people. He argues that this might be true if the only strategy was to increase road, parking and fuel prices, but **lower income people can benefit significantly from integrated programmes that include improved travel options, particularly affordable modes such as walking, cycling, car sharing and public transport**; positive incentives such as distance-based vehicle charging; flexitime and teleworking; as well as land use policies that create more accessible, multi-modal communities with affordable housing.

IEEP (2004), in reviewing a number of studies that reviewed the environmental and other impacts of car clubs and car sharing, identified a number of studies that suggested that car club users generally spend less time travelling by car than those who have access to a private car. In four different schemes on continental Europe, the average reduction in vehicle mileage by car club members after having joined a car club was between 28% and 42%. However, there is a clear difference between members that previously owned a car and those who did not. **Generally, car club members who did not previously own a car travel more by car than before having joined a car club, but this is more than made up for by the fact that those who previously owned a car travel significantly less by car than before.** In this respect, the CO_2 emissions of lower income groups might be increased as a result of car clubs, whereas the emissions of higher income groups, i.e. those who give up their car, might decline. However, it was not possible to find any evidence on which income groups use car clubs. Additionally, car club membership often provides or replaces second car ownership by a household, which may assist women in single-car households.

3.3.3 Attitudes of different social groups to policies to stimulate modal shift and increase car occupancy

As noted in Section 3.2.3, over half of all socio-demographic groups believe that they could use alternatives to the car for short journeys, so efforts to promote and enable alternatives appear to have a potentially willing audience. Having said that older people and those in rural areas are amongst the least supportive of changing their own behaviour, which is probably due to their already relatively reduced access to the transport system. Such considerations would be important to take into account in developing polices to stimulate modal shift.

A study of the travel aspirations of young adults (Taylor *et al*, 2007) identified strong support for the extension of a concessionary fare to 16-25 year olds who are unemployed, students and parents of young children. This reflected the personal and financial circumstances of many of the people interviewed, who were often on low incomes and found the cost of public transport prohibitive.

Better and more accessible information about local public transport services is a repeated theme in studies about the transport needs of low income and disadvantaged groups (e.g. Lucas *et al*, 2001; SEU, 2003; Taylor *et al*, 2007). The need for information and travel assistance to be available in different languages is also raised as an important issue for non-English speakers (Taylor *et al*, 2007).

In his PhD on the role of the National Cycle Network, Jones (2008) found that older respondents were more likely to place a value on measures to reduce the impact of traffic and that a higher proportion of women than men believe cycling to be impractical and dangerous. In their study of the choices and barriers to mobility for different social groups Smith *et al* (2006) identify that boys are more likely to have positive attitudes to cycling than girls. Young people who are still at school are more amenable to public transport improvements than adults and both older people and teenagers are more likely to feel unsafe whilst walking and/or travelling on public transport, particularly at night. They also found that whilst there is strong support for public transport improvements across all social groups, affordability is more likely to act as a barrier to its use for low income travellers.

Box 5: Smarter choices

This describes the combined use of 'soft' measures such as workplace and school travel plans, personalised travel planning and awareness campaigns, travel information and marketing, car clubs and car sharing schemes, teleworking and teleconferencing. Studies of specific initiatives have shown reductions in local urban traffic levels of around 5% in the low intensity scenarios (where these measures are not given policy priority) and 21% in the high intensity scenario. If fully captured, these measures would not only secure significant reductions in the level of CO_2 emissions but would also contribute to considerable improvements in local air quality and traffic noise reductions. This can be of particular benefit to people living in lower cost urban housing, which is often located alongside busy roads.

However, there could be a knock-on tendency to attract new car trips onto these roads, which would offset the overall impact of those who reduce their car use unless there are measures in place to prevent this. As such, the success of smarter choice measures depends on the implementation of additional supportive policies, such as road space reallocation, improved public transport service levels, parking controls, traffic calming, pedestrianisation, cycle networks, congestion charging or other traffic restraint, other use of transport prices and fares, speed regulation, or stronger legal enforcement levels[15].

The range of voluntary behavioural change measures covered by "Smarter Choices" have the potential to deliver social benefits, although accompanying measures to reduce rebound effects are also important (see Box 5). However, it is important to note the overall findings of Anable *et al* (2007) in relation to public attitudes towards such voluntary measures that potentially reduce an individual's transport CO_2 emissions. The authors warn that, regardless of their stated attitudes to the different proposed measures, people are unlikely to change their travel behaviours voluntarily in favour of less polluting modes if there are adverse social effects for themselves or their families. Although not

[15] Such measures were tested in three demonstration sustainable travel towns: Darlington; Peterborough; and Worcester. The results of the final evaluation was published in February 2010 and can be found at www.dft.gov.uk/pgr/sustainable/smarterchoices/smarterchoiceprogrammes/

specifically stated within their study, this is more likely to be the case in low income households where existing economic and social disadvantages also prohibit behaviours which bear an additional financial or activity cost.

More generally, Heiskanen (2009) identifies low carbon communities as a possible future context for individual behaviour change suggesting that previous energy conservation and climate change mitigation programmes have suffered from too individualistic an approach and that people could be more successfully engaged in these programmes as citizens of their community. This could be particularly relevant in the case of low income communities, where door-to-door treatments can often be received with suspicion and more general capacity building for smarter choices measures may be needed.

3.3.4 Knowledge gaps

While there is a reasonable amount of evidence relating to the SDIs assocated with policies that aim to stimulate modal shift and icnreased vehicle occupancy, there are a number of important knowledge gaps, as follows:

- **How best to target measures to encourage those in disadvantaged groups to gain the benefits from cycling and rail use?** While in theory most people could benefit from policies to stimulate cycling and rail use, at the moment it is more likely that men and those on high incomes would benefit due to existing patterns of use.
- **How best to ensure that modal shift occurs?** While the improvement of non-car modes is important in stimulating modal shift, it is important to identify the packages of measures that are needed to ensure that modal shift to more CO_2-efficient modes occurs and is maintained.
- **How to translate public support for using non-car modes into use?** There appears to be support for the use of other modes, but this support is not always translated to reduced trips in practice. The barriers to the use of non-car modes need to be understood better and then these can be overcome in the development, design and implementation of policies.
- **How to best target transport CO_2 emissions and address SDIs through increasing car occupancy?** Evidence suggests that, at least in the short-term, there are potential social and climate change benefits to be achieved from increasing car occupancy. However, the extent of the benefits that can be achieved is not clear. Those who first replace their car with a car club membership might contribute to an overall travel reduction from car clubs, on average. However, it is not clear what proportion of the population could join a car club and enable that car club to reduce average CO_2 emissions and deliver increased accessibility for those who previously did not have access to a car.

3.3.5 Key implications for policy makers

The discussion of the previous sections raises a number of key issues for policy makers. As things stand, policies aimed at developing and improving rail and cycling infrastructure and services would benefit those on higher incomes and men, as it is these groups who make more use of these modes. On the other hand, those aimed at improving buses are more likely to be of benefit to women and those on low incomes. However, it is clearly possible for all modes to be of benefit to all groups of society. The challenge therefore is to make all modes more accessible and attractive to all groups in order to ensure that all modes are used to their optimum to tackle transport's CO_2 emissions and address and mitigate SDIs. Consequently, it is important for policy makers to:

- **Understand** the type, scope and geographical location of the **disadvantaged groups** that might be affected. **Engage** with such groups, or at least their representatives, to understand their concerns. **Take such concerns into account** when designing policies, and communicate to disadvantaged groups how their concerns have been met. In this respect, the Webtag guidance on assessing SDIs is relevant[16].
- Ensure that the **barriers to access are overcome** for potentially vulnerable groups, particularly with respect to policies that aim to improve rail and cycling infrastructure and services, as both have a potential role to play in tackling transport's CO_2 emissions and addressing and mitigating SDIs.

[16] See respective guidance documents at www.dft.gov.uk/webtag/documents/index.php.

- Ensure that the resulting modal shift or increased vehicle occupancy does **deliver CO_2 emissions reductions in transport**, or at least does not increase these emissions. Whether an actual reduction in total transport CO_2 emissions occurs would depend, at least in the medium-term, on the balance between the impact of any modal shift and the impact of any trips generated by the fact that successful modal shift will have freed up infrastructure that could be used by new motorised trips. Such rebound effects need to be taken into account in the development and implementation of policies in order to ensure that the desired CO_2 reductions are delivered and that any beneficial impacts on SDIs are maintained. Again, mitigation measures are important in this respect to ensure that the CO_2 reduction and other benefits are "locked in".
- **Understand** the net travel impacts of measures to stimulate car clubs and car sharing in order to ensure that both measures deliver their potential contributions to tackling transport's CO_2 emissions and in addressing and mitigating SDIs.
- **Monitor** the impact of policies on different groups over time in order to ensure that the benefits are maintained and that additional measures are taken to address any erosion of the CO_2 and SDI benefits.

3.4 Policies that aim to encourage the purchase and use of more fuel efficient vehicles and more fuel efficient driving behaviour

The policies considered in this section either focus on purchasing, and therefore using, more efficient vehicles or improving the way in which a vehicle is used (see Table 3). In both cases, CO_2 reductions would be delivered simply because the vehicles would use less fuel to cover the same distance. In the first instance, this would be because the vehicle was more fuel efficient overall, while in the second case, the emissions reductions would be due to the fact that the vehicle will have been driven in a more fuel efficient manner. As noted in Section 1.5, policies that could contribute to encouraging the purchase and use of more efficient vehicles, but which are not the responsibility of the DfT, e.g. vehicle taxation, are not covered in this report.

Table 3: List of the DfT's potential climate change policy instruments considered in this report that aim to encourage the purchase and use of more fuel efficient vehicles and more fuel efficient driving behaviour

Mode	Policies considered
Policies that aim to encourage the purchase and use of more fuel efficient vehicles	
Cars	The EU's passenger car CO_2 Regulation
	The government in leading by example - targets exist for central government departments and their agencies to procure low carbon new cars
	Financial incentives to purchase lower carbon vehicles
	Increased use of electric cars - Electric car cities
Vans	The EU's van CO_2 Regulation
	Low Emission Zones (including set hours)
Buses	Modifications to the Bus Service Operators Grant to incentivise technological change
	Grants provided to encourage uptake of low emission bus technology
Policies that aim to encourage more fuel efficient driving behaviour	
Cars	Provision of better information on more efficient use and emphasis on eco-driving
Vans	Provision of better information – Act on CO_2 extended to vans

The following sections set out results of knowledge review in relation to possible SDIs that might result from the introduction of the policies listed in Table 3. A summary of the key findings is presented in Box 6.

Box 6: Key findings in relation to SDIs associated with fuel efficient vehicle purchasing and driving behaviour

1. Many of the policies focusing on stimulating **the purchase and use of more efficient vehicles**, such as ***the EU's passenger car CO_2 Regulation*** and ***electric car cities***, aim to increase the number of more efficient vehicles on the market, including electric cars. Such vehicles can be more expensive than conventional vehicles. If the uptake of more expensive vehicles was stimulated, these policies would marginally **reduce the affordability of buying new cars** for some groups who would otherwise have bought a new car. This might have knock-on effects on the second-hand car market, at least in the short-term, as such cars might also become more expensive as potential purchasers of new cars are put off from buying a brand new car and instead turn to the second-hand car market. For most drivers, it is arguable whether this should be considered to be an SDI, as most of those potential purchasers of new vehicles could as easily buy an alternative vehicle, albeit one that might be smaller or older than the one they would otherwise have bought.
2. As such cars are more fuel efficient, they have the potential to **increase the affordability of car use** for all of those using them, i.e. to reduce running costs, as less fuel would be used to travel the same distance, everything else being equal. Hence, this potential rebound effect would reduce the benefits from such policy instruments.
3. Similarly, policies aimed at encouraging more fuel efficient driving behaviour, such as ***better information on the more efficient use of cars***, would also **increase the affordability of vehicle use**. While, generally, the resulting rebound effects should be recognised and reversed, there is the potential to exploit such effects to benefit low income drivers. Given that it is low income drivers who are likely to struggle more in paying for the costs of driving, it is these drivers, as well as other members of their respective households, who would probably benefit more, relatively speaking, from adopting such policies. As low income households are less likely to have access to the internet, care needs to be given as to how best to target such drivers.
4. Many of the policies aimed at the purchase and use of more efficient vehicles and driving behaviour have the potential to deliver **wider benefits** on users and non-users alike in the form of improved air quality, reduced noise levels and reduced adverse impacts from climate change. Even though the impact on any individual will be marginal, and perhaps unnoticeable, the net impact across all of those affected could be significant. The scope and scale of such impacts will depend on both location and mode.

3.4.1 Key social impacts of policies to encourage the purchase and use of more fuel efficient vehicles and driving behaviour

There were few references in the literature to the social impacts of the use of more fuel efficient vehicles and driving behaviour, but the references that do exist refer to **affordability, as more fuel efficient vehicles will generally cost more**. For cars, it has been estimated that the impact of the EU passenger car Regulation on retail prices is between €1,000 and €2,500, which resulted mainly from improvements to existing cars, rather than increased numbers of battery electric and hybrid electric vehicles17 (IEEP et al, 2007). However, the extent to which such an increase in prices actually occurs in practice is not clear. Additionally, from the perspective of conventionally-fuelled vehicles, it is often possible to buy a more fuel efficient car within the same vehicle class. The additional cost of electric vehicles and hybrid vehicles compared to conventional vehicles is likely to be significant and such vehicles are expected to continue to be more expensive, even if battery prices come down significantly (Hill et al, 2010). Hence, some more fuel efficient vehicles are more expensive than less fuel efficient vehicles of a similar size and so will potentially impact on the affordability of such vehicles. The impact on affordability depends on a number of factors, including the extent to which manufacturers and public transport operators (in the case of buses) pass on the increased cost of vehicles to vehicle buyers and public transport users. However, it is of course possible for purchasers to buy a smaller, less expensive vehicle, but this could have an impact on the level of utility that purchasers will experience from the vehicle, e.g. an inability to transport as many people or as much luggage. It is likely that any price increases for new vehicles will have knock-on effects on the second-hand market,

[17] It is important to recognise that technically what are generally referred to as electric vehicles and hybrid vehicles are more properly referred to as battery electric vehicles and hybrid electric vehicles, respectively, as both are electric vehicles. However, in order to avoid potential confusion, the generally-used terms are used in the remainder of this report.

as the prices of second-hand vehicles are likely to increase due to potential purchasers of new cars being put off from buying a brand new car and instead turning to the second-hand car market.

It should be noted **that more efficient vehicles, and vehicles that are driven in a more fuel efficient manner, will reduce the cost of vehicle use**. This rebound effect will need to be taken account of in policy development and implementation in order to ensure that the desired CO_2 reductions are delivered.

There are recognised co-benefits from using more fuel efficient vehicles. **Electric and hybrid vehicles emit fewer air pollutants at the point of use[18] and are quieter at low speeds, so will deliver benefits in this respect, particularly in urban areas**; vehicles fuelled by hydrogen would also deliver air quality benefits (Hill *et al*, 2010). The impact of cleaner vehicles using conventional technologies is not as clear cut, as the synergetic effects that might be expected are not necessarily created in practice (Sharpe, 2010).

3.4.2 Distributional impacts

There is also little information in the literature on the groups that will be affected by the policies being considered in this section. However, in a review of a wide range of climate change abatement policy instruments for transport, Golub and Kelly (2010) suggest the benefits of such policies are often unequally distributed. For example, they suggest that the benefits of policies focusing on more fuel efficient vehicles, e.g. constructing alternative fuel infrastructure and providing tax rebates for hybrid fuel vehicles, tend to favour higher income groups that can afford these new technologies.

In the specific context of more fuel efficient cars, Heffner *et al* (2007) conclude that there is **little or no evidence for financial benefits of hybrid vehicles**, since higher purchase prices cancel out the advantages of cheaper fuel – although owners of hybrid vehicles derive intangible benefits from knowing that their choice of vehicle represents a more "sustainable" means of travel. However, as noted in SEI (2007), the purchase of hybrids can be beneficial for those drivers who driver farther than average or those who own their cars for a long time.

In terms of the purchase of vehicles with more fuel efficient technologies, such as hybrids or electric vehicles, the common characteristics shared by early adopters (Shell, 2004 in Lane, 2005) include that they are predominantly new car purchasers; have higher than average education levels; have high incomes; are urban dwellers and are interested in technology and innovation. It was noted that fleets play a key role in the early stages of market development and are seen as the key drivers of infrastructure and vehicle development. Additionally, it is generally those on higher incomes who purchase new cars, so it will be these groups that will be most affected by such policies. However, 12% of new cars were bought by semi and unskilled manual workers, or pensioners.

Such policies will, therefore, affect the CO_2 emissions of those on higher incomes who generally buy new cars, at least in the short-term. However, eventually, the CO_2 emissions of all groups will be reduced by such measures, as the low carbon cars become more common in the second-hand market and therefore less expensive.

More fuel efficient driving, or eco-driving, involves the use of a more efficient driving style, as well as other operational measures, such as optimal engine maintenance, maintaining optimal tyre pressure and reducing unnecessary loads. In terms of impacts on social groups it is again those who drive, i.e. more likely to be those on high incomes, those living in rural areas, etc (see Section 2.1), who will potentially benefit the most. Clearly, more fuel efficient driving would potentially reduce the CO_2 emissions of these groups more than others.

3.4.3 Attitudes of different social groups to policies to encourage purchase/ use of more fuel efficient vehicles and driving behaviour

There appears to be evidence that people are in favour of the use of more efficient vehicles. For example, reporting on the findings of the DfT's Omnibus survey Eleini (2010) found that over 80% of

[18] In other words, when they are being driven. It is possible that the use of electric vehicles will lead to increased emissions in power stations, which are generally not in or even near urban areas, so any additional emissions will result in less exposure for people. It should also be noted that the emission of air pollutants from power stations is strictly regulated.

adults supported the government persuading people to purchase less environmentally damaging vehicles. Responses to the survey also suggested that over two-thirds of adults were prepared to pay more for a less polluting car, while 11% were prepared to pay a lot more.

It also appears that motorists already take a car's CO_2 emissions into account when choosing which car to buy, as, according to the Private Motorists Survey (DVLA, 2006), 71% of motorists stated that a car's CO_2 emissions would influence their choice of vehicle to buy. **By social group, older drivers were more likely to take account of CO_2 emissions than younger drivers (76% to 66%), women were more likely to do so than men (77% to 66%) and whites were more likely to do so than non-whites (73% to 59%).** However, a report for the European Commission, IEEP *et al* (2006) reviewed a wider range of literature (including Lane, 2005) on the reasons why people buy cars and concluded that there were many other factors that had more influence on which car was chosen than environmental factors, including reliability, safety and cost. Fuel economy, which is obviously linked to a car's CO_2 emissions, was important, but generally less so than these other factors.

It was not possible to identify any direct studies on the public attitudes of different social groups to the take-up of such technologies. In 2004, O'Garra *et al* (2004) considered the public awareness and acceptability of hydrogen vehicles and found that **prior knowledge of hydrogen vehicles was the main determinant of support for their introduction with men demonstrating stronger interest and involvement in the subject than women. Younger people and those having a university education were also seen as being positively associated with prior knowledge.** More recently in California, Heffner *et al* (2007) identified five main reasons people gave for buying a hybrid; these were i) to preserve the environment; ii) to oppose war; iii) for cost savings; iv) to reduce support for oil producers; v) to embrace new technology (some households mentioned more than one reason but none mentioned all five). Although the authors do not identify these responses by different socio-demographic groupings, it is possible to assert that most of them are likely to have differential levels of importance for different income, gender and age groups (as identified above).

3.4.4 Knowledge gaps

A number of gaps in the evidence were identified:

- **The social groups that buy new and second-hand cars.** While generally those on high incomes buy more new cars than those on lower incomes, some people potentially on low incomes do buy new cars. A better understanding of who buys what type of new car and why, and also who buys what type of second-hand car, would assist in identifying the extent of potential SDIs from such policies.
- **The potential knock-on effect of higher new vehicle prices on the second-hand market.** An indirect effect of higher new car prices could, at least in the short-term, be higher prices for second-hand cars. The extent to which this effect might lead to SDIs is not clear. A better understanding of this effect would help to clarify the extent of this potential SDI and also to identify measures that could be put in place to mitigate any resulting SDI.
- **The extent to which vans are used as passenger transport and by whom and for what purposes.** It is likely that in certain households, e.g. those where the principal income provider is self-employed and uses a van for work, that vans will be used as a source of passenger transport. However, it is not clear the extent to which this is the case and therefore whether this is an SDI.
- **The views and understanding of different technologies by different groups.** Given that some new vehicle technologies are distinctly different to those used in conventional vehicles, it is important that the views and potential attitudes towards these technologies are understood in order for the benefits to be communicated well, the concerns to be allayed and any potential barriers overcome. At the moment, there is little information as to how people might deal with the new vehicle technologies.
- **Translating apparent support for measures to encourage the purchase of more fuel efficient vehicles to practice.** There appears to be support for government action to encourage people to purchase more fuel efficient vehicles and a majority of the population claim to take account of a car's CO_2 emissions when purchasing a vehicle. While policies are in place to stimulate the purchase of more fuel efficient vehicles, such as the differential rates of Vehicle Excise Duty and exemptions under the London Congestion Charge, it might be possible to do more to stimulate such behaviour. With this in mind, it is important to note that

evidence suggests that factors other than CO_2 emissions are more important to potential buyers. It is important to understand how best to translate this apparent support for more fuel efficient cars to influence more actual purchasing decisions.

- **Taking account of the rebound effect of improved affordability from using more efficient cars or using cars more efficiently.** A rebound effect of all the policies that will make vehicle use more fuel efficient is that they make use more affordable. The most appropriate complementary policies need to be identified to ensure that the climate change and social benefits of the polices are realised and maintained. These might differ by social group.
- **Communicating eco-driving to the groups who would most benefit from it.** Given that low income drivers already spend a relatively large proportion of their expenditure on transport, it is this group which is more likely to experience a higher relative benefit from taking up eco-driving. Consideration could be given to how such drivers could be best targetted taking into account their potential lower access to the internet.

3.4.5 Key implications for policy makers

The main implications of the above discussions for policy makers are the need to:

- Recognise and assess the potential impact of such policies on **low income groups** in particular. While increased prices of new cars would on average affect those on higher incomes more, there might be short-term, knock-on effects (in terms of higher prices) on the second-hand market, which could impact low income groups. As with policies to reduce the number of trips (see Section 3.2.5), the impact on low income drivers might be disproportionate. The use of financial incentives could be targeted at such groups, if this was found to be appropriate.
- **Ensure that CO_2 reductions are delivered**, as many of the policies considered, including those aimed at raising awareness, make use more affordable, and therefore are likely to lead to a rebound effect of increased travel. In this respect, complementary instruments, such as those aimed at reducing trips (see Section 3.2), might be appropriate to ensure that the CO_2 reductions are maximised.
- **Consider targeting low income groups** with policies, including awareness raising and eco-driving, that reduce the cost of driving, as such an approach has the potential to address SDIs and tackle transport's CO_2 emissions.
- Ensure that policies targeting **vans take into account the needs of the self-employed**, as these vehicles could also be used for the purposes of passenger transport.
- **Explore how best to capitalise on apparent public support** for action to encourage people to buy less environmentally-damaging vehicles.

3.5 Policies that aim to stimulate the uptake of alternative fuels

The policy considered that aims to stimulate the uptake of alternative fuels would reduce well-to-wheel CO_2 emissions by replacing some conventional fuel, e.g. petrol or diesel, with biofuels that have been sustainably produced (see Table 4). The main impact on travel behaviour would arise if the replacement of conventional fuels with biofuels were to increase the cost of the fuel used in transport and thus the cost of using vehicles, or were to require changes to existing vehicles or the purchase of new vehicles.

The following sections set out results of knowledge review in relation to possible SDIs that might result from the introduction of the policy presented in Table 4. A summary of the key findings is presented in Box 7.

Table 4: List of the DfT's potential climate change policy instruments considered in this report that stimulate the uptake of alternative fuels

Mode	Policies considered
All road modes	Promotion and use of sustainable biofuels

Box 7: Key findings in relation to SDIs associated with increased use of alternative fuels

There was little evidence on the SDIs associated with the one policy covered that would reduce transport's CO_2 emissions through the use of **alternative fuels**, i.e. ***promotion and use of sustainable biofuels***. However, it was considered that there would not be any SDIs from the perspective of the transport user, as the policy would not have a significant affect on travel behaviour, at least in the short-term. While a short-term increase in the price of fuels might result, it is not clear whether this would be significant and noticeable in the context of ongoing changes to the price of fuel caused by other factors.

At lower blends, e.g. 5% or less for bioethanol (mixed with petrol) and 7% or less for biodiesel, there is no need to modify a vehicle to use biofuels. In 2008/9, biofuels accounted for 2.7% of road transport fuel supply in the UK. While biofuels are more expensive than conventional transport fuels, in the UK they initially benefited from a 20p per litre incentive, which the RFA estimated made biofuels cheaper than conventional fuels in 2008/9 (RFA, 2010). This incentive ended in April 2010, which together with costs from improved certification, had the potential to contribute to increases in the price of fuel, which could in turn have impacts on behaviour, if less fuel is bought as a result. However, given that by 2010 less than 5% of road transport fuel in the UK was biofuels, it is likely that if there were any increase in fuel prices, this would be in the order of no more than a few pence, which is in line with fluctuations in fuel prices that drivers experience on a regular basis.

In the longer term, it is clearly possible that, if transport users begin to change their transport behaviour more proactively (e.g. as has happened with organic and fair trade products, for example), that they might more proactively choose to purchase "sustainable" biofuels, which might lead to more behavioural change. **By different social group, it will be the CO_2 emissions of those who use their cars the most, e.g. those in higher income groups, whose CO_2 emissions will benefit the most from this measure.** Additionally, in the longer-term, if dedicated vehicles able to use high blends of biofuels are introduced onto the market, there could be changes in the behaviour with respect to these, e.g. if the vehicles are more expensive or are more expensive or cheaper to use.

3.5.1 Key social impacts of policies to stimulate the uptake of alternative fuels

There is a wide range of issues – environmental, social and economic – that are associated with the increased use of biofuels (e.g. RFA, 2008; CRC, 2008). Many of the social issues relate to issues that are relevant outside of the UK, i.e. in countries that are potentially supplying the UK market with feedstocks. Given that the focus of the report was on the social impacts relating to transport in the UK, these wider potential impacts of biofuels were considered to be outside of the scope of the project, as these are being addressed in work undertaken elsewhere by the DfT. **Apart from this wider literature that was not reviewed, we were unable to identify any other relevant literature that discussed the potential social impacts of alternative fuels in the UK.**

If biofuels do make transport fuels more expensive in the future, then this might reduce demand for fuel and therefore the amount of travel that is undertaken. **Given that this is an impact on the affordability of travel, it will have similar effects to those discussed in previous sections where reductions in the amount of travel were discussed** (e.g. with respect to reduced trips in Section 3.2.1). Similarly, if cars able to use high blends of biofuels are developed, it is likely that these would be more expensive than conventional vehicles and as such would have similar social impacts as policies to encourage the purchase of more fuel efficient cars (see Section 3.4.1).

In theory, of course, biofuels have the potential to reduce transport's CO_2 emissions, if measured on a well-to-wheel basis, i.e. if the way in which fuels are produced is also taken into consideration. Hence, if such reductions in CO_2 emissions are delivered, then there is the potential for this policy to reduce the impact of climate change on individuals. With respect to air pollution, however, the impact of biofuels is less clear, as some biofuels have the potential to increase emissions of key air pollutants (Hill *et al*, 2010). Given that the policy under consideration refers to sustainable biofuels, then it is assumed that the potential wider environmental impacts associated with the production of biofuels, e.g. with respect to biodiversity and the water environment, are not relevant in this context.

3.5.2 Distributional impacts

There was little evidence in the literature with respect to the distributional impacts of alternative fuels. The promotion and use of biofuels currently impacts more on users of diesel vehicles, as around 80% of biofuels used in UK transport fuels is blended with diesel, than those who drive petrol vehicles (RFA, 2009).

The impact on the **CO_2 emissions of different groups of this policy instrument will be directly related to the amount of fuel each group uses.** As noted in Section 2.1, it is higher income households and households in rural areas who drive cars more and therefore it is the CO_2 emissions of these households that will be reduced more *on average* than those of other households, although the relative impact on households CO_2 emissions will not vary between groups.

In the future, **if fuel prices were to increase due to the uptake of biofuels, the group that might be most significantly affected could be low income drivers, who have no alternative to using their car for certain journeys**, e.g. journeys to work. This is similar to the groups affected by other policies that increase the cost of travel (e.g. see Section 3.2.2).

3.5.3 Attitudes of different social groups to policies to stimulate the uptake of alternative fuels

No information was found in the literature reviewed regarding the views of different social groups to biofuels.

3.5.4 Knowledge gaps

The one potential gap that might be important in the context of alternative fuels is:

- **The views and understanding of alternative fuels by different groups.** Given that the use of biofuels (and potentially other renewable sources of energy) is likely to increase, it might be useful to understand people's perspectives of and attitudes to such fuels in order that benefits can be communicated and any potential barriers to their use overcome.

3.5.5 Key implications for policy makers

No specific implications for policy makers were identified in relation to the ***promotion and use of sustainable biofuels*** that have not been addressed in previous sections. If increased use of biofuels leads to significant increases in the price of transport fuels, the issues for policy makers will be similar to those discussed with respect to using other economic instruments that reduce trips by raising the price of travel (see Section 3.2.5). In the longer term, if dedicated biofuels vehicles are produced, the issues for policy makers will be similar to those discussed for more fuel efficient vehicles (see Section 3.4.5).

3.6 Alternatives to travel: The potential role of Information and Communication Technologies

The use of information and communication technologies (ICT) is relevant as it potentially enables excluded groups to experience the benefits of travel without having to travel in the first place. In 2005, the Office of the Deputy Prime Minister (ODPM) undertook a study to understand more about the role of ICT in tackling social exclusion in terms of reducing the need to travel and improving access to employment through teleworking and other flexible working arrangements. It also considered wider access to electronic services, public engagement and civic participation and social networking. **The report concluded that low take-up due to the cost of equipment and lack of physical access to the Internet outside of the home is the biggest barrier to use, but also that many excluded groups simply do not see a need to use the Internet.**

The report does not stipulate which excluded groups are included within this response, but it did identify that the highest income group is seven times more likely to have home access to the Internet

than those in the lowest income group (ODPM, 2005). However, given that internet use has expanded significantly in recent years, it is likely that any differences are no longer as great. An earlier study by Lucas *et al* (2001) which was undertaken with various socially excluded groups in five different UK locations identified that public information needs to be paper-based and readily available in the places people regularly visit, such as the shop, post office, housing office or GPs surgery in order for socially excluded individuals to access it. Skills-training and capacity-building were also often identified by the participants as important prerequisites to their take-up of public information.

ODPM (2005) identifies various barriers to use of ICT: older people lacking access to ICT; literacy and language skills; low income; and a lack of access outside the home in rural areas. The ability to maximise the positive effects of ICT requires reducing such barriers to use. Also, it is important that ICT should complement, not replace, other more traditional forms of information such as printed timetables and maps (Stanchev and Menaz, 2006).

Generally, it can be concluded from these studies that low income households prefer television communication or leaflets in local shops, GP surgeries, etc, while word of mouth through trusted informants is often preferred for complicated messages. SMS is a popular form of communication with young people, while older people tend to prefer written communication.

However, ICT is developing fast and access to the internet is also increasing. Hence, it is not clear the extent to which the ODPM's findings from 2005 are still relevant. For example, real time travel information on the internet is increasingly common and more and more mobile phones are able to be used to browse the internet. Hence, it is important the potential of this fast-moving area is identified and used for meeting the climate change and social goals of transport.

Consequently, there is the potential, if some of the existing barriers are addressed, for ICT to benefit socially-excluded groups by enabling access to work and services, without requiring travel and thus causing CO_2 emissions. However, while ICT has the potential to be of benefit to those currently experiencing exclusion, when ICT replaces an existing journey reductions in CO_2 emissions do not necessarily result due to potential rebound effects. For example, enabling more home working has the potential to:

- Increase CO_2 emissions by requiring increased heating at home; and
- Increase average commuting distances in the longer-term, as a result of the lower number of days that people need to travel to work and a tendency to accept longer travel times on the fewer days on which commuting is necessary (van Essen et al, 2009).

Consequently, implications for policy makers in using ICT to enable alternatives to travel include:

- For **low income and other disadvantaged groups**, introduce policies to overcome the barriers that these groups currently face in using ICT, in particular when it comes to accessing services and employment opportunities.
- For the population generally, ensure that stimulating ICT **delivers CO_2 emissions**, by introducing parallel measures to address any rebound effects.

4 Key issues and conclusions

The study has reviewed a cross section of the main published literature in relation to the likely behavioural and attitudinal responses of different social groups to the DfT's own transport policy options for reducing transport's CO_2 emissions. It has not considered polices that are outside of the DfT's own jurisdiction to deliver. Hence, instruments such as fuel or vehicle taxation or spatial planning, which could potentially make a contribution to the reduction of transport's CO_2 emissions, are not covered in this report because they are the delivery responsibility of other government departments. Additionally, it is important to note that there are other DfT policies, such as the provision of new transport infrastructure or the regulation of vehicle speeds, that also potentially significantly influence travel behaviour and the level of transport's CO_2 emissions, but which were not covered in this report.

4.1 General conclusions

Some general conclusions of the report are as follows:

- While many of the **policy instruments considered have the potential** to benefit disadvantaged groups, **it is often not clear the extent to which they would do in practice**. For example, investment in public transport, policies that reduce the cost of motoring (e.g. those under more fuel efficient vehicles and more fuel efficient driving) and policies that increase vehicle utilisation could enable disadvantaged groups to travel more. However, care needs to be taken in the design of such policies to ensure that it is these groups who do benefit from these policies. More work is needed to identify how best to target such policies on those who would benefit most from them, e.g. low income drivers.
- There are **knowledge gaps in many cases**. While some of these potential impacts could be inferred or implied, the fact that the data do not exist means that there is a risk of reaching incorrect conclusions on the potential SDIs.
- Linked to this is the need to **consider, and mitigate for, rebound effects** in policy development: policies that increase the capacity of the transport network need to be accompanied by policies that reduce trips to prevent the additional space attracting more journeys. For example, measures to encourage modal shift from cars to public transport need to be accompanied by measures to reduce car use, as otherwise the space freed up on the roads will simply attract additional journeys.
- While there appeared to be public concern about climate change and general support for more fuel efficient vehicles and using cars less, **it is not clear whether this concern and support would be maintained in the face of specific policy proposals**. For example, while most drivers state that they consider a car's CO_2 emissions when buying a car, in practice other factors appear to be more important. More needs to be done to better understand how general support changes when people are faced with the adverse and beneficial impacts of climate change policies, and the mitigating measures that are needed to maintain support.

4.2 The importance of the consideration and mitigation of SDIs in climate change policy development

The report has identified that policies that the DfT could introduce to reduce transport's CO_2 emissions are likely to have a considerably differential impact on different sub-groups within the UK population. Some already economically and socially disadvantaged groups may potentially be disproportionately negatively affected by some of the policies that could be implemented. It is important for policy makers to mitigate the negative impacts of such policies on these already vulnerable groups. It is also important to ensure that any positive benefits arising from these policies are fairly distributed across the whole population, as far as is possible and appropriate.

Better understanding and consideration of the SDIs in the development of transport policy to tackle climate change can also help policy makers develop policies that do not adversely impact on disadvantaged groups. It is also important in terms of communicating the benefits of such policies to

the wider public. If policy-makers can demonstrate that they understand the concerns of those potentially affected by transport's climate change policies and have taken measures to mitigate potential adverse impacts, then the chances of the public accepting the policies will increase.

Care needs to be taken in the design of climate change policies for transport to ensure that already socially disadvantaged groups also benefit from them. More work is needed to identify how best to target such policies on those who would benefit most from them, i.e. those at the margins of car ownership, low income drivers, families living in rural areas, young people, etc.

The DfT and other government departments have already undertaken work that will assist with the considerartion of SDIs in the course of policy development, i.e.:

- As part of its Webtag on how to conduct transport studies that meet its requirements, the DfT has defined SDIs and has developed guidance on assessing SDIs[19].
- The work undertaken in relation to Equality Impact Assessment provides guidance on the assessment and considertaion of equalities in the course of policy design and appraisal[20].

4.3 The importance of measuring SDIs

In order to consider and mitigate SDIs in the development of policy, they need to be measured in the first place. Without such measurement, knowledge about SDIs will not exist.

The evidence review that is the subject of this report identified a number of national survey datasets that are potentially relevant to the measurement of SDIs. There is the potential that these could tell us something about different people's vehicle ownership patterns, travel behaviours and expenditures or their awareness of transport related climate change and their attitudes to different types of transport policy responses. We have identified the following publicly available and regularly updated datasets to be of particular relevance:

- National Travel Survey (annual);
- Family Expenditure Survey (annual);
- Driver and Vehicle Licensing Agency (DVLA) data;
- British Omnibus Survey – Public Attitudes to Climate Change and Transport (August 2006; April and August 2007; January 2010); and
- British Social Attitudes Survey – Attitudes to Climate Change and the Impact of Transport (2007).

It has not been possible to undertake any primary or secondary analysis of these datasets within the scope of this study. However, review of the published reports that are associated with these surveys has identified that some additional disaggregate social and distributional analysis of these datasets would be useful in helping to determine the potential SDIs of climate change policies for transport. For the purposes of measuring SDIs, such surveys of attitudes often **lack a sufficient categorisation of respondents**, thus inhibiting an analysis of the views of different social groups. Thought could be given to developing the categories within these surveys in order to enable researchers to compare the views of different groups, where appropriate.

However, categorising people in surveys according to all possible SDIs could potentially prove to be prohibitively expensive, as it would take more time to do the same survey and would require larger sample sizes to ensure that the results would be statistically insignificant for all sub-groups. Hence, consideration needs to be given to the most appropriate SDIs that could be incorporated in each case, which would benefit policy development, but not incur significant additional costs.

A brief outline of the surveys that are available, and how these might be used to measure SDIs, if the information was available, is described below.

[19] See www.dft.gov.uk/webtag/
[20] See www.idea.gov.uk/idk/core/page.do?pageId=8017247

4.3.1 National Travel Survey

The Excel tables that are publicly available can be used to look at the travel behaviours of different social groups disaggregated by income, age, gender, ethnicity and disability, mode of transport, journey purpose, for different settlement types and by proxy indicators for access to public transport. The data can be used to model the likely travel responses of different social groups to different policy measures and/or to look at the likely responses for different types of areas. However, it is often difficult to analyse a combination of these factors, especially for lower income groups due to small sample sizes in any one year.

4.3.2 Expenditure and Food Survey

This includes data about spending on motoring and public transport which is available by income group (see Section 2.3). Further disaggregate analysis of this could be useful for determining the vulnerability of different social groups to pricing measures.

4.3.3 DVLA data

The DVLA Private Motorists Survey collects data on numbers of private vehicles by age, size and capacity of the vehicle and can be made available on special request by postcode area. This could potentially be used, in combination with census data and the Index of Multiple Deprivation, to determine the likely uptake rate of new vehicles using time series analysis.

4.3.4 British Omnibus Survey

Questions have been asked in all of the National Statistics Omnibus Surveys since 2006 to assess public attitudes towards climate change and the impact of transport (see Eleini, 2010). Each survey has involved interviewing over 1,000 and up to 1,200 adults face-to-face in their homes. Some disaggregate analysis of public attitudes to climate change and transport has already been undertaken by age and gender. However, it should be possible to flag responses by ward and use this in combination with census data and the Index of Multiple Deprivation Further to identify the attitudes of different income groups.

4.3.5 British Social Attitudes Survey

The 2007 British Social Attitudes Survey included questions on public attitudes to climate change and transport. Data are also collected on social groups but current reporting does not appear to include any analysis of this, but could be useful for comparison with the Omnibus Survey.

4.4 The importance of monitoring and evaluating SDIs

Once a policy has been implemented, it will be important to monitor and evaluate its effects on any SDIs, particularly any that were identified as being particularly important with respect to the policy under consideration.

However, in the course of the evidence review it was identified that the evaluation of social and distributional impacts is **often not considered in a systematic way**, with some reports tending to focus on selected potential social impacts and implying or inferring other impacts. In some cases inferences are not fully thought through, either making conclusions on the basis of average impacts (e.g. on low income groups generally rather than on low income drivers) or neglecting rebound effects.

In the literature, SDIs are often mentioned with respect to the impacts, say, on low income groups of measures to reduce trips, whereas the **benefits for the wider population are either inferred or ignored**. Hence, in monitoring and evaluating SDIs, it is important to take account of the adverse (or beneficial) impacts on a small group of individuals, often low income drivers, as well as the potential net benefits (or adverse impacts) on the wider population, which might not be noticeable by individuals, e.g. from lower (or higher) traffic levels.

The review also concluded that there is also often **insufficient monitoring** and therefore reporting of SDIs once policies have been put in place. It is important that ex ante assessments of potential SDIs are undertaken, that the potential SDIs are mitigated in the course of the design of the policy and its implementation and then that ex post assessments are undertaken to ensure that adverse SDIs are not occurring. If ex post assessments found that SDIs were occurring, mitigating action should be taken, accordingly.

Furthermore, a large amount of the literature available on the potential SDIs of climate change policies is qualitative or small scale; statistically significant data on specific groups is usually simply not collected. Consequently, in order to fill these gaps, **a large scale data collection exercise on the SDIs** of policy measures and the attitudes of different groups towards these measures would be beneficial, although clearly it would be necessary to undertake such an exercise in the appropriate context. In this respect, perhaps the inclusion of such an exercise on the evaluation of the Sustainable City projects would be appropriate.

However, covering all SDIs in the evaluation, monitoring and reporting of policies could potentially increase costs significantly. Consequently, consideration needs to be given to which are the most appropriate SDIs to monitor and report in each case. For example, those that have been identified in the course of the development of the policy as being of particular importance for the policy would be appropriate candidates for monitoring, reporting and evaluation.

4.5 Ensuring that CO_2 emissions reductions are delivered

As was mentioned in many sections of this report, it is important to identify the net impacts of any policies on both transport's CO_2 emissions and SDIs in order to ensure that both are addressed and achieved to the fullest extent possible in the implementation of policies. In this respect, it is important to consider whether it would be appropriate to implement any **complementary measures** that could help to lock in the benefits of the original policy. Such considerations are of particular importance with respect to following rebound effects:

- There is the potential for rebound effects from policies that aim to reduce traffic levels, as the road space that has been freed up could be used for new journeys. This potentially undermines the potential for CO_2 emissions reductions, unless complementary measures, e.g. reallocation of road space, are introduced in parallel.
- Any of the policies that aim to encourage modal shift or to increase car occupancy have the potential to increase the capacity of the transport network and thus, potentially transport's CO_2 emissions, which would undermine one of the main objectives of the policies. Complementary measures, so as those that have the potential to reduce trips, could help lock in these benefits.
- Policies that stimulate the purchase and use of more fuel efficient vehciles, or which lead to more fuel efficient driving behaviour, have the potential to increase the affordability of car use for all of those using them, as less fuel would be used to travel the same distance, everything else being equal. Similarly, policies that have the potential to reduce trips, could help lock in these benefits.

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Appendices

Please see separate files for appendices 1 to 10

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