Towards a Healthier Economy

Why investing in sustainable transport makes economic sense

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EXECUTIVE SUMMARY

Background to this report

Most key Scottish transport investments are based on their economic case. Other impacts such as social and environmental issues are sometimes considered but rarely used as deciding factors. The economic case is usually based mainly on enhanced productivity through 'time savings.' Other direct economic factors, such as increased productivity from improved health, are rarely given the same prominence despite their very real impacts. This is partly due to a more limited understanding of these other factors.

In this report, we seek to increase understanding of transport's known 'non-time savings' direct economic impacts, and also identify gaps in our collective knowledge. We therefore consider six categories: smarter choices, active travel, local public transport, long distance public transport, private motor transport, and air transport. For each category, we review the available information on the travel mode and its impact on the economy; present the questions we would like to answer; and attempt to answer the questions based on the evidence, only using that which is considered sufficiently robust. This leads to a set of findings on the economic impacts of travel modes as well as areas where more research is needed. Based on these findings, we also make a series of recommendations.

Key findings

The table below summarises our key findings by showing the economic impacts for several different transport-related measures or goals. The data sources used to calculate the impacts are listed in the third column.

Measure	Economic Impact	Source
Scottish cycle mode-share of 13%[1]	£1–£2 billion/year *savings*	*Health Economic Assessment Tool for Cycling*, World Health Organisation
Scottish cycle mode-share of 27%	£2–£4 billion/year *savings*	
Switch 20% of Scottish car commutes to walking or cycling[2]	£2.8–£11.6 million/year *savings*	*Guidance on the appraisal of walking and cycling Schemes: TAG unit 3.14.1* Department for Transport; *Economic appraisal of local walking and cycling routes*, Sustrans
Switch 40% of Scottish car commutes to walking or cycling	£5.6–£23.1 million/year *savings*	
Each extra car driver	£172–£250/year *cost*	*European transport policy for 2010: time to decide*, European Commission; *Handbook on estimation of external cost in the transport sector*, Maibach et al.
Each extra car passenger	£100–£145/year *cost*	
Net Scottish tourism spend, 2004	£1.3 billion annual *deficit*	*Why airport expansion is bad for regional economies*, Friends of the Earth England, Wales, & Northern Ireland
Net Scottish tourism spend, 2020 (projected)	£2.6 billion annual *deficit*	
Health and climate change impacts of international flights	£7.7 billion/year *cost*	*Handbook on estimation of external cost in the transport sector*, Maibach et al.

1. The current Scottish cycle mode-share is 1 percent.
2. Currently, car-based trips account for up to 69 percent of all commuting in Scotland.

Key areas identified for further work

Smarter choices	What is the overall economic impact of smarter choices initiatives (for instance, including health effects) and how does it compare to investing in enhanced road capacity and shorter trip times by private cars?
Active travel	What are the economic impacts due to improved general health when walking and cycling rates increase?
Air transport	What impact do flight subsidies and tax breaks have on displacing resources that would otherwise be spent on more economically beneficial and sustainable activities?

Key recommendations

(1) Scottish Transport Appraisal Guidance (STAG) should include the direct economic benefits resulting from improved health due to increased cycling and walking. This could make use of the *HEAT for Cycling* tool, but must also incorporate walking and benefits resulting from improved health. Evidence on increased productivity and reduced absenteeism should also be included.

(2) STAG should substantially reduce the emphasis given to time savings. The benefits attributed to these time savings are often unproven, and there are very real economic benefits associated with the other aspects of transport projects discussed in this report.

(3) The productivity benefits resulting from working when travelling by train or bus should be incorporated in STAG. These benefits can outweigh any benefits estimated to arise from time savings.

(4) The health and congestion costs of additional car drivers and passengers should be fully considered in transport project appraisal.

(5) Research should be conducted on the displacement effect of car purchases. It is important to understand what people would spend their money on if they didn't have the desire or need to buy a car, and how these alternative purchases would affect the Scottish economy.

(6) The Scottish Government should publish annual statistics quantifying the net effect on the Scottish economy of air-based tourism. It is vital to know how much to visitors spend in Scotland compared with the amount Scots spend when they fly abroad.

Scope of this report

This report focuses on macro-economic effects in Scotland: how investment in various transport modes affects Scotland's economy. The purpose is not to conduct new primary research, but to bring together, make accessible, and calculate economic impacts based on a survey of existing work. Some questions we post lead to sample calculations that could be used (with different inputs) when appraising specific projects, while other questions look for indicative or average values that can be used to set policy priorities.

1. INTRODUCTION

1.1. Setting the scene

In the field of Scottish transport policy, most key investment decisions are taken when an economic case has been made. A major component of these claimed economic benefits tends to result from enhanced productivity through time savings. Direct economic impacts from other factors, such as productivity effects of changes in the population's health, are not given the same prominence. Other impacts such as social and environmental issues are sometimes considered, but rarely used as the primary reason for accepting or rejecting large transport projects.

Factors other than time savings can lead to direct positive economic impacts from transport projects. Such factors include improved health (resulting in a lower drain on the health system) and increased productivity when people are able to work whilst travelling (which can actually cancel out the assumed economic benefits due to hypothetical time savings). However, these factors are not always well understood or not given prominence.

The Scottish Government, in setting out their economic strategy, has defined its key purpose as "to increase sustainable economic growth." This very clearly positions the economy – and in particular gross domestic product growth – as a key concern of the current administration. At the same time, the prevailing political and media opinion often accepts projected economic benefits from transport as correct without questioning their voracity.

The importance of economic arguments in transport decisions, coupled with a perceived lack of information on transport's full economic impacts, led the Transform Scotland Trust to conduct this research. The aim of this research is to identify where information on non-time savings economic impacts exists, and to locate the gaps in current literature. As a result, we sought to draw together existing information to make it accessible, and to identify where future research efforts should be focused.

To this end, we devised a list of questions in six categories: smarter choices, active travel, local public transport, long distance public transport, private motor transport, and air transport. Our focus is on macro-economic effects in Scotland – how investment in these different transport modes affects Scotland's economy. Each chapter looks at one of the aforementioned travel categories and: considers the available information on the travel mode and its impact on the economy; presents the questions we would like to answer; and attempts to answer the questions based on the evidence, only using that which is considered sufficiently robust. In the first section of each chapter, we focus on Scottish and UK findings, but present information from outside the UK where it is of interest. However, when attempting to answer the questions in the last section of each chapter, we only use non-UK data if we are confident that it is applicable within Scotland's social and economic structure.

1.2. Context: the claimed economic benefits of big transport projects

As mentioned in *Section 1.1*, the justification for many big transport projects is based on their expected economic impact. The economic benefits of these projects are claimed to be significant. Recent examples include:

- Dualling the A9 will inject almost £1.3 billion into the Scottish economy (HITRANS, 2008).
- London Crossrail will create £19 billion of GDP (GLA, 2004).
- Building a second Forth road bridge could be the only way to avoid a £1 billion drop in economic output, an over £1.3 billion drop in turnover, and a loss of 3,200 jobs (FETA, 2008).
- Completing the M74 in Glasgow will create 2,900–4,000 new jobs (1994) or 6,050–6,780 new jobs (1998) or 12,000 new jobs and massive regeneration (January 2001) or up to 25,000 new jobs (February 2001) or 44,000 new and safeguarded jobs (September 2001) (Spaven, 2002).

The last example shows the problem with the economic benefits claimed by large transport projects: many are, "just statements of hope, with little or no analytical rigour" (Goodwin, 2002). McQuaid and Greig

(2002) also found that much policy on transport is not based on firm evidence, but rather expectations and anecdote without regard for the displacement effects.

In his report for the UK Treasury, Eddington (2006) noted concern about large transport projects and their justifications. He found little evidence of actual GDP benefits from interventions in urban areas and found that benefit to cost ratios on large projects were often only estimates. Even with these estimates, the ratios were frequently lower than those of 'less-exciting' transport projects. Overall, Eddington found that the claimed transformational aspects of large transport projects rarely materialise and that basing their decisions on predictions of macro-economic benefits is risky because of the large sunk cost investment required.

Because of the nature of project appraisals, many of the claimed benefits from big transport projects result from time savings. SACTRA (1999) found that on average, 85–90 percent of major road schemes' projected benefits come from time savings. The above problems surrounding economic benefits stem in part from the dominance of time savings and the assumption that these savings will produce the claimed benefits.

In this context our work seeks to establish where evidence of economic impact for different transport modes exists. We then seek to apply this evidence to the Scottish economy to show the actual economic impact that transport choices can have. Through this work we hope to encourage a shift away from an over-reliance on the questionable benefits of time savings.

1.3. Study limitations

This report is not an endorsement of the practice of using Gross Domestic Product (GDP), or its regional equivalent Gross Value Added (GVA), as a way of measuring the country's well-being or setting policy goals. It is well established that there is more to a society's welfare than wealth accumulation. At a national level, NHS Health Scotland recently commissioned work that provides a critique of relying on GVA and develops an alternative in its Index of Sustainable Economic Well-Being (Jackson et al., 2008). Transform Scotland is supportive of these kinds of efforts, as we believe such measures can lead to decision-making based on the interests of people rather than that of the economy. However, we recognise that given current decision-making processes, we also need to be able to engage in the argument over transport's impact on the economy.

We also recognise that the Scottish Transport Appraisal Guidance (STAG) works on a problem-led basis. Therefore answers to some of the questions we ask would not be used directly by the appraisal process. With these questions, we are instead looking for indicative or average values that can be used to set policy priorities.

2. SMARTER CHOICES

2.1. Overview of findings related to smarter choices and the economy

Scotland's National Transport Strategy found that 20 mph zones with traffic calming measures result in reduced accidents: 60 percent fewer injury accidents, 70 percent fewer child pedestrian accidents, and 48 percent fewer child cyclist accidents (Scottish Government, 2006). While these accidents will have economic impacts (through associated treatment costs and reduced productivity of the parents), no information was found to put a figure on them. Anable et al. (2006) also looked at speed limits and what the effect of reducing the national speed limit would have. They found that reducing the speed limit from 70 mph to 60 mph (and enforcing it) would halve annual road deaths in the UK. This represents a saving of more than 100 lives and a reduction in serious injuries by over 600 cases, resulting in an annual savings to the UK economy of £120 million.

As well as the health impacts of smarter choices, there are also economic impacts due to reduced congestion which can be brought about through these measures. Eddington (2006) found that reducing the travel time of all business and freight journeys on the roads would equate to a cost savings of £2.5 billion per year in the UK, which is 0.2 percent of GDP. Looking at the situation more generally, the UK Department for Transport (2004) found that Smarter Choices measures have a benefit to cost ratio (BCR) of 10 due to reduced congestion alone. They found that while these measures cost 1.5p per vehicle kilometre saved, each vehicle kilometre removed by a Smarter Choices measure brings an average benefit of 15p due to reduced congestion.

2.2. Smarter choices questions we set out to answer

Question 2-1: *What is the ratio of the economic benefit derived from investing in smarter choices compared with the benefit from investing in private motorised transport?*

2.3. Answering the smarter choices questions

Given projects such as the recent abolition of NHS car parking charges by the Scottish Government, it would be interesting to know if that money would have been better spent on supporting a smarter choices initiative like travel plans. While the DfT data provide some indication on the benefit due to reduced congestion of investing in smarter choices, it does not include the health-related economic benefits. In addition, we did not find generalised data on the benefits of investing in increased road capacity and private motorised transport. So it is not possible to even compare just one aspect (benefits from congestion reduction) of investing in smarter choices compared with private motorised transport. Comparing these two issues would be extremely useful when policy is being developed, and further research needs to be done in this area.

3. ACTIVE TRAVEL

3.1. Overview of findings related to active travel and the economy

Walking and cycling provide a means of exercise, even when undertaken as a form of travel and not explicitly for health purposes. In addition to health benefits active travel has the potential to reduce congestion and provide individuals with greater productivity through reliable, lower-stress journeys. Some work has been done to quantify these economic benefits, and the cost effectiveness of investing in cycling and walking was found by Eddington (2006) to result in strong benefit to cost ratios that can sometimes be over 10. In Australia, Bauman et al. (2008) found that cycling saves AU$63.9 million (£26.7 million[3]) per year due to reduced congestion and contributes AU$155 million (£64.8 million) per year to the economy through health benefits. This is in the context of the AU$198.57 (£83.06) per year that an inactive adult costs the Australian health budget. Bauman also calculated a unit cost for cycling's health benefits in Australia of AU$0.376 per kilometre (around £0·16/km).

In the UK, Sustrans (2006) found that the health benefits from each new user of a cycling and walking scheme represent a positive economic impact of £122·93 per person. There is a knock-on effect on productivity, as improved health reduces absenteeism, and Sustrans finds that this results in a benefit of £8·30 for each commuter using a traffic-free walking or cycling route. Looking at cycling more generally, the World Health Organisation has developed the *Health Economic Assessment Tool for Cycling* (*HEAT for Cycling*; WHO, 2007). This tool makes it possible to calculate, over time, the economic impact of increased cycle usage. However, as the UK Department for Transport (DfT) notes, this is still a conservative method, as it underestimates the monetary benefits cycling provides due to improved health (DfT, 2008). This is because *HEAT for Cycling* only considers benefits from reduced mortality and not those from reduced morbidity[4]. As the DfT notes, the morbidity benefits are potentially as significant as those due to reduced mortality. The DfT also considers the productivity benefits of reduced absenteeism and finds that an organisation will realise an annual benefit of 0.4 days' gross salary for each additional employee who walks or cycles at least 15 minutes each way on their commute.

3.2. Active travel questions we set out to answer

Question 3-1: *What is the financial benefit of switching X% of short journeys from cars to walking or cycling?*

Question 3-2: *What is the financial benefit due to improved health of switching X% of weekday commutes from cars to walking or cycling?*

3.3. Answering the active travel questions

In 2004/2005, the average Scot travelled by car for 53 percent of journeys which were less than five miles, and 39 percent of journeys which were less than two miles. These are distances that can comfortably be completed by cycling. However, the cycling rate in Scotland is only around one percent for all distances travelled, compared to 18–27 percent in Denmark and the Netherlands. This is not due to cultural differences, but simply because of government investment and policy (Pucher and Buehler, 2008; Scottish Government, 2007A). To emulate its European neighbours, Scotland could reach an overall cycling rate of 25–27 percent by increasing cycling's share of distances under five miles to 37–40 percent[5].

Using the *HEAT for Cycling* tool it is possible to calculate what the benefit would be to the economy if Scotland reached these targets, bringing us into line with our European neighbours. The economic benefits would be realised by replacing car journeys with cycling, and result from improved health and reduced

3. Australian dollars have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008B).

4. Morbidity refers to the incidence of disease whereas mortality refers to the incidence of death.

5. Based on the Scottish Government's (2007A) travel statistics, 37–40 percent of distances under five miles equates to 25–27 percent of all distances travelled by all modes in Scotland.

death rates. As improved health is not immediate, the stated benefit would not be reached in full in the first five years, though a lesser benefit would still be realised in these initial years.

We have used the *HEAT for Cycling* tool to calculate what the benefits would be from both a conservative 20 percent target and a more ambitious 40 percent target of journeys under five miles being completed by bicycle. This represents a cycle rate for all distances of 13 percent and 27 percent, respectively. Note that we only consider targeting the working-age population of (15–64 year olds) in Scotland[6]. When calculating the monetised economic benefits, we used the following inputs to the *HEAT for Cycling* tool:

(1) For cycling to reach a 20 percent or 40 percent mode share on short trips, 19 percent and 39 percent of all journeys under five miles, respectively, would be new cycle journeys previously undertaken by car; this is based on the current cycle mode share of one percent (Scottish Government, 2007A)

(2) 'Number of trips per day' is set to the number of trips that would need to be undertaken by bicycle instead of car every day, as shown in *Table 1*

(3) The 'mean trip length' is set to 3.077 kilometres (1.912 miles) as this is the average distance of all journeys under five miles in Scotland, based on the figures given by the Scottish Government's transport statistics (2007A)

(4) 'Days cycled per year' is set at 365 as the 'number of trips per day' is based on the total number of trips annually (which therefore takes into account seasonal variations in travel)

(5) 'Proportion of trips that are one part of a return journey' is set at zero as the 'number of trips' is calculated from the actual number of trips (which already includes any return journeys)

(6) 'Proportion undertaken by people who would not otherwise cycle' is set at one as we are calculating the effect of people switching from car travel; hence all trips are by definition taken by people who would not otherwise cycle

(7) The working age death rate is calculated from death rates and population figures for 15–64 year olds as given by the GRO Scotland (2008B; 2008C) and the Scottish Government (2007A)

(8) The cost of death is taken from the Department for Transport (2008)

Full details of the calculations can be found in *Appendix A* on page 22.

Table 1. Benefit to the Scottish economy of 15–64 year olds switching short journeys from car to bicycle. Overall (all distance) targets would be achieved through people switching journeys less than 5 miles, which have an average length of 1.9 miles, from car to bicycle. The economic benefit was calculated using the *HEAT for Cycling* tool (WHO, 2007) with travel statistics from the Scottish Government (2007A), death rate and population statistics from the GRO Scotland (2008B; 2008C), and the economic cost of death from the Department for Transport (DfT, 2008). Full details of the calculations are in *Appendix A* on page 22.

Cycling's share of travel after switch from cars		Number of new cycle trips	Annual economic benefit after 5 years
of distances < 5 mi	of all distances		
20%	13%	1,211,261	£990,227,000
40%	27%	2,486,272	£2,032,571,000

In answer to *Question 3-1*, the figures in *Table 1*, indicate that the Scottish economy would realise a benefit of almost £1 billion from an overall cycle target of 13 percent for 15-64 year olds, or £2 billion from a target of 27 percent. What is interesting about these figures, is that they actually underestimate the real economic benefit of increased cycling. As the Department for Transport (2008) points out, the *HEAT for Cycling* tool is "likely to underestimate the health benefits of increased physical activity as it only evaluates the benefit as a result of decreased mortality and ignores benefits due to reduced morbidity or sickness." They go on to state that the potential sickness reduction benefits would be significant and might even be as much of a benefit as the fatality reduction benefits calculated by the *HEAT for Cycling* tool. This

6. Using a subset of the population results in lower economic benefits, but more accurately reflects the group that would need to switch to cycling. This age group is the same as the one used by the DfT (2008) in their document on cycle scheme appraisal guidance.

means that an overall Scottish cycle target of 13 percent likely represents a benefit to the economy of almost £2 billion, while an overall target of 27 percent would probably benefit the Scottish economy by more than £4 billion.

It should be noted that we did not find a general-purpose tool that can calculate the economic benefits of increased walking in the same way as for cycling. We also did not find data that allow for the calculation of other economic benefits from increased cycling and walking, such as benefits due to reduced congestion. These other benefits tend to be calculated on a project-specific basis.

According to Scottish Government statistics (2007A), car-based trips account for up to 69 percent of all commuting[7]. This provides plenty of room for switching to walking or cycling and so in answering *Question 3-2*, we considered reducing car commuting by 20 percent and 40 percent through a switch to walking and cycling. It is possible to calculate the economic benefits of these reductions in car commuting by using figures from Sustrans (2006) and the DfT (2008). These identify the financial benefit that results from switching a commute to walking or cycling, due to the increased productivity and reduced absenteeism that results from the commuter's improved health. By combining these figures with the Scottish population of 15-64 year olds (GRO Scotland, 2008C) and the Scottish average gross income of £432 per week (Scottish Government, 2007B), we can determine the potential benefit to the whole Scottish economy, as shown in *Table 2* (details of the calculations can be found in *Appendix A*, page 23).

Table 2. Economic benefit from reduced absenteeism of switching commutes from cars to walking or cycling. Two scenarios are provided: Switching 20 percent and switching 40 percent of car commutes to walking or cycling. The monetised benefits come from Sustrans (2006) and the Department for Transport (2008), and the number of trips, gross average income, and population of 15–64 year olds in Scotland come from the Scottish Government (2007A; 2007B) and the GRO Scotland (2008C). Full details of the calculations are in *Appendix A* on page 23

Reduce car commutes by	New walking or cycling commuters	Sustrans (2006) economic benefits	DfT (2008) annual economic benefits
20%	334,762	£2,778,528	£11,569,387
40%	669,525	£5,557,055	£23,138,774

The results in *Table 2* show economic benefits for the Scottish economy due to reduced absenteeism. These benefits are £2.8–£11.6 million through a 20 percent switch and £5.6–£23.1 million through a 40 percent switch from car commuting to walking or cycling. The DfT states that these are annual economic benefits, and it should be noted that the Sustrans data was only compiled for commutes undertaken on traffic-free paths. Importantly, these benefits accrue due to reduced employee absenteeism and so they are in addition to other economic benefits such as those from reduced mortality and morbidity. More work is needed to quantify the benefits that result from these other factors so that we can gain a full picture of the impact of a switch away from car commuting. As indicated by the results from reduced mortality due to cycling (*Table 1*), these other benefits are likely to be much larger than those from reduced absenteeism. The difference between the DfT and Sustrans figures also shows that more work needs to be done to improve the accuracy of the absenteeism benefit factors. However, the results provide a good indication of the scale of economic benefit that can be realised from reduced absenteeism due to healthier commutes.

7. The statistic relates to commutes undertaken by car, van, or lorry, but it is reasonable to assume that the bulk of these commuter journeys are car-based.

4. LOCAL PUBLIC TRANSPORT

4.1. Overview of findings related to public transport and the economy

In the Scotecon report, *Transport and the Scottish Economy: Key Issues*, McQuaid and Greig (2002) cite research showing that investment in public transport made towns and cities more attractive business locations. However, the level of economic activity or job creation that can be attributed to public transport investment is not specified. On the other hand, Laconte (1999) puts numbers on public transport's job creation benefits in the UITP report *Investing in Urban Transport*. He finds that when judged by passenger kilometre, public transport generates twice as many jobs as the car. And when judged by barrel of oil, public transport's job creation benefits are four times that of the car. A more recent report by UITP (2003) puts the job creation advantage of public transport at two- to three-times that of private transport. The same report finds that every US$10 million (£5 million[8]) invested in public transport capital projects creates more than 300 new jobs and a US$30 million (£15 million) gain in business.

4.2. Local public transport questions we set out to answer

Question 4-1: *What would be the cost due to extra congestion if local public transport were removed?*

Question 4-2: *What would be the financial benefit from congestion relief of switching X% of journeys from private transport?*

4.3. Answering the local public transport questions

The cost of congestion to the UK economy is estimated to be anywhere between £7–£19 billion a year (British Chambers of Commerce, 2007B; Eddington, 2006; Green Party, 2004). Significantly reducing congestion could therefore be of great benefit to the economy. However, we did not find figures showing what percentage of car journeys would have to be switched to public transport to achieve this goal (*Question 4-2*). Similarly, this lack of a link between units of public transport usage and units of congestion makes it impossible to answer *Question 4-1*.

To answer such questions, work needs to be done to determine how increasing public transport use in Scotland would impact on congestion. This will depend on the how many new public transport journeys are due to people switching from cars, how many are additional journeys, and whether when some people leave their cars behind, others are encouraged to make additional car journeys. Even if a link between public transport use and congestion can be established, further work needs to be done to relate units of decrease in congestion to economic impact.

8. United States dollars have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008C).

5. LONG DISTANCE PUBLIC TRANSPORT

5.1. Overview of findings related to long distance public transport and the economy

The Transport Research Institute (TRI) at Napier University conducted a study comparing the relative costs between train and car for long-distance travel (Kirby et al., 2006). This research determined the average monetised value (to employers) of time spent working on the train for three routes: Manchester–London, Birmingham–London, and Manchester–Birmingham. The figures are based on extensive data and conservative assumptions, however they are specific to the three routes and it is not immediately possible to generalise them to a national level. With further work, the data and methods employed by the Napier study could be combined with other data (e.g. number of business trips annually) to produce national figures.

There are also various claims about the positive benefits of specific rail schemes:

- A UK high-speed rail network will generate £16–£44 billion in GDP productivity benefits over 60 years, and £6.3–£32 billion in net benefits (Atkins, 2008)
- High-speed rail from London to Birmingham could produce £2.24 billion in productivity benefits (Rail Management, 2008A)
- Eddie Stobart's three year rail freight contract with Tesco is estimated to bring £3 million of environmental benefits (BCC, 2007A)
- Reopening the Thornton to Leven railway line would have major benefits to Leven's economy (BBC, 2008)

However, the above claims should be viewed with caution in light of Eddington's (2006) finding that claimed macro-economic benefits of large transport schemes are risky and prone to inaccuracies (see *Section 1.2* for details). In any case, there is no way to generalise the above economic benefits as they are based on analysis of specific projects. The research that comes closest to demonstrating general economic impacts of long distance public transport is the UITP (2003) report already cited in *Section 4.1*. Their findings stated that every US$10 million (£5 million[9]) invested in public transport capital projects creates more than 300 new jobs and a US$30 million (£15 million) gain in business.

5.2. Long distance public transport questions we set out to answer

Question 5-1: *What is the benefit to the Scottish economy due to work completed on trains?*

Question 5-2: *What would be the financial benefit from extra productivity if X% of car or air journeys were switched to the train?*

5.3. Answering the long distance public transport questions

More work needs to be done to answer either of the above questions. The best starting point for further work is the research by the TRI at Napier University (Kirby et al., 2006). If the number of business journeys undertaken by rail in Scotland can be determined, this can be combined with the methods and data sources in the TRI research to calculate an answer to *Question 5-1*. Once this has been established, it is possible to approach *Question 5-2*. The methods employed by the TRI involve calculating the financial benefit due to productivity on an average rail journey, and so this could be used with figures on the number of car- or air-based business trips in Scotland to answer the question.

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9. United States dollars have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008C).

6. PRIVATE MOTOR TRANSPORT

6.1. Overview of findings related to private motor transport and the economy

6.1.1. General issues

Road schemes are often promoted because of the monetary benefit it is claimed they will bring to the economy. However, SACTRA (1999) found that 85–90 percent of these monetised benefits are due to time savings. Against this, motorised traffic in urban areas has an impact on non-motorised traffic in the form of time loss for pedestrians and space loss for bicycles. Maibach et al. (2007) found that passenger cars cost the economy 0.26€ct (0.18p[10]) per vehicle kilometre due to these impacts. And Eddington (2006) found that car owners do not pay the true costs of travelling on the roads at peak times and that positive impacts of transport projects are overstated when environmental impacts are not taken into account. The Green Party of England and Wales (2004) places road transport's 'hidden' economic burden on the UK economy at £11–£17 billion per year.

6.1.2. Health and noise impacts

On top of these general economic costs, work has been done to determine the economic impact of road transport due to specific issues. The Green Party of England and Wales estimates that annual UK health costs due to road transport are £11.1 billion and annual noise impacts impose an annual cost of £2.6 billion. Maibach et al. (2007) calculate unit costs based on European averages, putting the costs due to car-generated air pollution at 0.05€ct–0.93€ct (0.03p–0.64p) and costs due to car noise at 0.07€ct–0.84€ct (0.05p–0.58p), both per passenger kilometre. Road accidents also represent a cost to the economy, of £2.5 billion or £2.9 billion per year, depending on the source (Eddington, 2006; Green Party of England and Wales, 2004). The unit cost of passenger car accidents in the UK is placed at 3.43€ct (2.35p) per passenger kilometre by Maibach et al. (2007). Combining all these sources – pollution, noise, and accidents due to passenger cars – the European Commission (2001) finds that the average European unit cost is approximately 5.50€ct (3.77p) per passenger kilometre.

6.1.3. Congestion

In *Section 4.3* some of the findings related to congestion's cost to the economy were discussed. These findings put congestion's impact on the economy at £7–£8 billion per year, £17.5 billion per year, and £19.1 billion per year according to Eddington (2006), the British Chambers of Commerce (2007B), and the Green Party of England and Wales (2004), respectively. Eddington (2006) further estimates that by 2025, congestion across the UK will cost businesses £10 billion per year and result in £12 billion worth of wasted time to households. In unit costs, the European Commission (2001) calculated that congestion due to passenger cars costs the UK economy 0.80€ct (0.55p) per passenger kilometre.

6.1.4. Road user charging

The former UK transport minister, Ruth Kelly, claimed that a road user charging scheme in Manchester will deliver far greater economic growth and quality of life benefits than only investing in public transport. Across the UK, Eddington (2006) puts the figure on road user charging's potential benefits at £28 billion per year, with £15 billion of that being direct GDP benefits. In urban areas, Eddington calculates that for every £1 spent on a road user charging scheme, £3·80–£4·40 additional GDP will be generated.

6.2. Private motor transport questions we set out to answer

Question 6-1: *What is the economic cost, due to health and congestion impacts, of additional car drivers on Scottish roads?*

Question 6-2: *How much is lost to the Scottish economy due to the purchase of new (imported) cars?*

10. Euros have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008A).

6.3. Answering the private motor transport questions

The Scottish Government's (2007C) transport statistics show that in 2005/2006, the average distance travelled by a car, van, or lorry driver was 3,595 miles (5,786 kilometres), while the average distance travelled by a passenger in a car, van, or lorry was 2,080 miles (3,347 kilometres). We can therefore calculate the average economic burden of car drivers and passengers due to health and congestion impacts, as shown in *Table 3*.

Table 3. Worst-case average annual cost to the economy of each car driver and passenger, due to health and congestion impacts. Calculations are made using two different sources for health impacts: Maibach et al. (2007) and the European Commission (2001). Travel statistics come from the Scottish Government (2007C). Euros have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008A).

Impact	Cost	
	Maibach et al.	European Commission
Car Drivers		
Air pollution, noise, & accidents	5,786km × 0·0356£/km† = £205·9816	5,786km × 0·0377£/km‡ = £218·1322
Congestion‡	5,786km × 0·0055£/km = £31·8230	5,786km × 0·0055£/km = £31·8230
Total	**£238**	**£250**
Car Passengers		
Air pollution, noise, & accidents†	3,347km × 0·0356£/km† = £119·1532	3,347km × 0·0377£/km‡ = £126·1819
Congestion‡	3,347km × 0·0055£/km = £18·4085	3,347km × 0·0055£/km = £18·4085
Total	**£138**	**£145**

sources: †Maibach et al., 2007; ‡European Commission, 2001; Scottish Government, 2007C; HMRC, 2008A

Since Maibach et al. (2007) provide a range for costs due to air pollution and noise, it is also possible to calculate the 'best-case' average cost to the economy. In this case, the unit cost due to air pollution, noise, and accidents is £0·0243 per passenger kilometre. Following the same process as in *Table 3*, this provides a cost per driver of £172·4228 and a cost per passenger of £99·7406. *Table 4* provides a summary of the results based on these different data, rounded to the nearest pound.

Table 4. Summary of average Scottish car drivers' and passengers' average annual cost to the economy due to health and congestion impacts.

Source	Car driver economic cost	Car passenger economic cost
Maibach et al. (2007) worst-case	£238	£138
Maibach et al. (2007) best-case	£172	£100
European Commission (2001)	£250	£145

The above figures could be used to answer *Question 6-1* if we assume that each additional driver or passenger on Scottish roads is average. This could be used to calculate an indicative figure of the economic burden due to health and congestion of a scheme that will generate extra car-based journeys.

The sources that were used for this research did not provide any answers to *Question 6-2*. This question would be an interesting avenue of further research, as there is no mass market car manufacturing in Scotland and so all new cars are imported. Work on this topic could look at the opportunity cost by considering what people might otherwise spend their money on if they didn't have the need or desire to purchase an imported car. It is possible that spending on cars displaces money that would otherwise be put into the Scottish economy.

7. AIR TRANSPORT

7.1. Overview of findings related to air transport and the economy

7.1.1. General issues, tax breaks, and unpaid external costs

One of the general dangers of assigning benefits to air travel expansion is discussed by Eddington (2006). He states that, "where the environmental impact of transport growth is not factored into decision-making, the positive impact of a transport project is likely to be overstated, since the negative long-term impact of transport emissions is not balanced against the short-term benefits." Because the negative environmental impacts of air transport can be significant over the long term, it is vital that these impacts are considered alongside any positive ones. When considering aviation's impacts from climate change alone, Whitelegg et al. (2003) calculate the cost to the UK economy at £2 billion per year. Maibach et al. (2007) and the European Commission (2001) also calculated aviation's economic cost due to climate change and found this to be €530 (£362[11]) per passenger per flight and €32 (£22) per 1,000 passenger kilometres, respectively. And when WWF used the UK government's own models for determining the benefits of a third runway at Heathrow, but with more realistic assumptions in line with UK Treasury guidance and the Stern Review (2007), they found that the project will be a cost to the UK economy of £5 billion (WWF, 2008).

More generally, through tax breaks, aviation receives an effective subsidy of £9.2 billion per year[12], and generates annual external costs of £3.7 billion (Sewill, 2003; Whitelegg et al., 2003). This is the equivalent of every person in the UK paying £220 each year to the aviation industry (excluding oil companies and aircraft manufacturing). And as the Royal Commission on Environmental Pollution notes, if restrictions were placed on air transport, the displaced resources would find other uses which would likely provide a similar market value but with much less environmental damage (RCEP, 2007). Considering Eddington's warning on the need to include environmental impacts in decisions, this indicates that displacing resources from air travel is likely to have a net positive economic impact.

7.1.2. Health and noise impacts

Whitelegg et al. (2003) estimate that the UK aviation sector is responsible for health costs due to air pollution of more than £1.3 billion per year and costs to the economy due to noise pollution of £313 million per year. More generally, they cite a European Environment Agency finding that puts that the combined environmental and health costs due to aviation at €44 (£30) per 1,000 passenger kilometres. Maibach et al. (2007) also calculate unit costs for a European average and they find that per flight, the average European air passenger costs the economy €117 (£80) due to air pollution, €118 (£81) due to accident costs, and €228 (£156) due to noise pollution. The European Commission (2001) puts the economic cost due to the first three sources – air pollution, noise, and accidents – at €5 (£3) per 1,000 passenger kilometres.

7.1.3. Consumer spending deficit

Air links to other countries represent the potential for incoming people to spend money in Scotland, and therefore contribute to the economy, and also for Scots travelling abroad to spend money outside of Scotland that they might otherwise have spent at home. How much is spent by foreigners coming in versus Scots going abroad determines whether air links represent a net economic boost or an economic drain in the context of consumer spending. Transport Times (2008) states that regional airport expansion is driven by an increase in second homes in Europe and Eastern European workers travelling home on their time off. This kind of demand takes money out of the local economy.

Whitelegg et al. (2003) found that in 2001 UK residents spent £18.7 billion abroad, whilst visitors to the UK only spent £7.6 billion – a deficit of £11.1 billion. According to Friends of the Earth England, Wales, and Northern Ireland (FoE EWNI), by 2004 this deficit had grown to £15 billion as foreigners only spent £11 billion whilst British travelling abroad spent £26 billion (FoE EWNI, 2005). They also found that when considering the purchasing of air tickets and air freight, the UK has recorded a deficit since the mid-1980s,

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11. Euros have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008A).
12. This 'effective subsidy' to the aviation industry comes from money lost to the Exchequer due to a lack of fuel tax and VAT on tickets, and duty free goods sold at airports and onboard flights.

as more British residents purchase services from foreign airlines than foreigners purchase services from British airlines. This deficit was £3.2 billion in 2003 and £3.3 billion in 2004.

When looking at Scotland specifically, in 2004 the ratio of Scots' spending abroad versus visitors spending in Scotland was 2.5:1. Only £866 million was spend by visitors compared to the £2.157 billion spent by travelling Scots, representing a deficit of £1.291 billion (FoE EWNI, 2005). The deficit alone is more than was spent by incoming visitors. With current airport expansion plans, Scotland's deficit will likely rise to £2.6 billion per year assuming passenger growth is equal for incoming and outgoing travel. However, that assumption might not be realistic as from 1995–2005, outward tourism grew at twice the rate of inward tourism to Scotland, so the annual deficit by 2020 could be much larger (FoE EWNI, 2005).

7.2. Air transport questions we set out to answer

Question 7-1: *What is the financial cost of climate change impacts due to Scottish residents flying?*

Question 7-2: *What is the net financial impact to the Scottish economy due to incoming and outgoing air-based tourism spending?*

7.3. Answering the air transport questions

We could not find reliable figures for the number of passenger kilometres due to flights originating and terminating at Scottish airports, so it is not possible to make calculations for Scotland's economy using the European Commission's (2001) figures. However, Maibach et al. (2007) provide figures for each passenger. The Scottish Government (2007C) statistics show that in 2006, Scottish residents made 4,562,000 trips outside the UK by air. This represents 9,124,000 total passenger flights between Scotland and destinations outside the UK, but does not include flights within the UK. It is not therefore possible to properly answer *Question 7-1*. However, *Table 5* shows the impact international Scottish-based air travellers are having on the economy.

Table 5. Average annual cost to the economy due to Scottish residents flying outside of the UK. The economic impacts are calculated using economic impact data from Maibach et al., (2007) and Scottish travel data from the Scottish Government (2007C). Euros have been converted to pound sterling using the HM Revenue & Customs average exchange rate for 2007 (HMRC, 2008A).

Cause of economic impact	Economic cost due to Scottish residents flying abroad
Air pollution	£80·12 × 9,124,000 = £731,014,880
Accident costs	£80·80 × 9,124,000 = £737,219,200
Noise pollution	£156·12 × 9,124,000 = £1,424,438,880
Climate change	£362·92 × 9,124,000 = £4,835,720,000
Total	**£7,728,392,960**

As can be seen, even when internal UK flights are discounted, Scottish travellers are already costing the economy £7.7 billion each year due to health and climate change impacts. If internal UK flights could be included this number would be significantly higher. This is not to suggest that Scotland should aim to eliminate all flights, but these economic costs will increase with air passenger numbers. It is important for the government to shape policy to eliminate unnecessary flying and therefore minimise the cost incurred to the Scottish economy.

Section 7.1 provided an answer to *Question 7-2* for previous years, showing that in 2004, air-based tourism resulted in a real cost to the Scottish economy of £1.291 billion due to more money being spent by Scottish residents abroad than was spend by incoming visitors. This economic cost is predicted to rise to £2.6 billion by 2020, but there are no current figures for more recent years. As this is a key figure that can inform tourism and transport policy, the Scottish Government should maintain regular statistics on the net spending impact due to air-based tourism. This would make it easier to discover the true costs of subsidising flights in Scotland. More work is also necessary on determining the impact that air industry subsidies and tax breaks have on displacing resources that could be spent on more sustainable and economically beneficial activities.

8. CONCLUSIONS

8.1. Summary of the purpose of this research

Findings discussed in *Section 1.2* found that projected economic impacts of big transport projects are often based on the assumed benefits of time savings. The section also looked at sources that found these benefits are often just estimates, many simply statements of hope, and that there is little actual evidence of GDP benefits or transformational aspects from completed projects (Eddington, 2006; McQuaid and Greig, 2002). It is therefore important for us to gain a better understanding of the actual economic impacts of transport projects, especially the impacts that result from factors other than time savings. Overall, we found a mixed picture. There are several holes in our understanding but also evidence in some areas that produces interesting figures. What follows is a summary of both areas where we were able to answer the questions we had posed, and also areas where more work is needed.

8.2. Answers to our questions

Smarter choices

- Smarter choices initiatives have a benefit to cost ratio of 10.

Active travel

- Switching short journeys in Scotland from car to bicycle to reach a cycling mode-share of 20 percent on short distances (or 13 percent of all distances) would result in an economic benefit of at least £1 billion per year due to reduced mortality and more likely £2 billion per year when improved health is included.
- Switching short journeys in Scotland from car to bicycle to reach a cycling mode-share of 40 percent on short distances (27 percent of all distances) would result in an economic benefit of at least £2 billion per year due to reduced mortality and more likely £4 billion per year when improved health is included.
- Switching 20 percent of car commutes in Scotland to walking or cycling would result in economic benefits from reduced absenteeism of up to £11.6 million per year.
- Switching 40 percent of car commutes in Scotland to walking or cycling would result in economic benefits from reduced absenteeism of up to £23.1 million per year.

Motorised transport

- Each driver in Scotland costs the economy £172–£250 per year due to health and congestion impacts.
- Each car passenger in Scotland costs the economy £100–£145 per year due to health and congestion impacts.

Air transport

- In 2004, Scottish residents abroad spent £1.3 billion more than visitors spent in Scotland. With current air transport growth, this deficit will likely rise to more than £2.6 billion per year by 2020.
- Scottish residents flying to destinations outside the UK cost the economy £7.7 billion per year due to health and climate change costs. This does not include Scottish residents flying to destinations within the UK.

8.3. Areas where more work is needed

Smarter choices

- Calculating the overall economic impact of smarter choices initiatives (for instance, including health effects) and how this compares to investing in enhanced road capacity and shorter trip times by private cars.

Active travel

- Calculating the economic impacts due to improved general health when walking and cycling rates increase.

Local public transport

- Determining the relationship between increased public transport use and congestion. Furthermore, it is necessary to understand what effect a unit of decrease in congestion would have on the economy.

Long distance public transport

- Information should be compiled on how many business trips are undertaken by rail in Scotland. This could be combined with the monetised benefit calculation methods from Kirby et al. (2006) to understand their economic benefit.

Motorised transport

- Scotland has no mass-market car production facilities, and so all new cars are imported. However, there is a lack of information on what the resulting loss to the economy is and the displacement effects. This work should determine what people would otherwise spend money on if they did not have the need or desire to purchase a car.

Air transport

- It is vital to understand what the net financial impact is to the Scottish economy of incoming and outgoing air-based tourism. The Scottish Government should publish annual statistics on these figures as a guide to policy-making.
- A robust understanding should be developed of the impact that flight subsidies and tax breaks have. They displacing resources which would otherwise be spent on more economically beneficial and sustainable activities.

8.4. Concluding Remarks

Further research into the issues highlighted in *Section 8.3* will enhance our understanding of the relationship between transport choices and their economic impacts. A better understanding is important for sound decision-making. However, with the existing information we can already see that there are some real, significant, economic benefits to be realised by moving people from their cars and onto bicycles or their feet. Revisions to the appraisal system and following the recommendations in *Chapter 9* will help to improve the basis for decision-making and fill some of the gaps in our knowledge.

At the same time, every single car driver and passenger is costing the economy hundreds of pounds a year in health and congestion costs, so there is benefit from reducing car use even before replacing it with a more active mode. And as well as air transport's well-understood environmental problems, it is placing an economic burden on Scotland's economy. This is felt both through health costs and through the net outflow of over a billion pounds a year due to tourism.

9. RECOMMENDATIONS

Section 8.3 summarises where further work is needed. Transform Scotland believes that carrying out this work would be of benefit to our understanding of the true economic impacts of transport decisions. In addition, based on our findings, we have six recommendations:

(1) Scottish Transport Appraisal Guidance (STAG) should include the direct economic benefits resulting from improved health due to increased cycling and walking. This could make use of the *HEAT for Cycling* tool, but must also incorporate walking and benefits resulting from improved health. Evidence on increased productivity and reduced absenteeism should also be included.

(2) STAG should substantially reduce the emphasis given to time savings. The benefits attributed to these time savings are often unproven, and there are very real economic benefits associated with the other aspects of transport projects discussed in this report.

(3) The productivity benefits resulting from working when travelling by train or bus should be incorporated in STAG. These benefits can outweigh any benefits estimated to arise from time savings.

(4) The health and congestion costs of additional car drivers and passengers should be fully considered in transport project appraisal.

(5) Research should be conducted on the displacement effect of car purchases. It is important to understand what people would spend their money on if they didn't have the desire or need to buy a car, and how these alternative purchases would affect the Scottish economy.

(6) The Scottish Government should publish annual statistics quantifying the net effect on the Scottish economy of air-based tourism. It is vital to know how much to visitors spend in Scotland compared with the amount Scots spend when they fly abroad.

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APPENDIX A
DETAILS OF SELECTED CALCULATIONS

Details of the *HEAT for Cycling* calculations behind *Table 1* (p. 9)

The first input necessary for the *HEAT for Cycling* tool is 'number of trips per day.' As we are investigating the benefits of switching 19 percent and 39 percent of all journeys under five miles from car to cycling, we used the average annual trips under five miles per person in Scotland (Scottish Government, 2007A) and Scotland's population of 15–64 year olds (GRO Scotland, 2008C).

Table 6. Calculations for number of journeys to input into the *HEAT for Cycling* tool. The resulting inputs are shown in the last two rows of the table.

Item	Datum	Source
Scotland's population of 15–64 year olds (2007)	3,447,253	*Mid-2007 Population Estimates Scotland* (GRO Scotland, 2008C)
Trips under 5 miles per person per year (2004/2005)	675.00	*Travel by Scottish residents* (Scottish Government, 2008A)
19% of trips under 5 miles per person per year	128.25	0.19 × 675.00
39% of trips under 5 miles per person per year	263.25	0.39 × 675.00
Total trips under 5 miles taken by 15–64 year olds per year	2,326,895,775	675.00 × 3,447,253
19% of 15–64 yos' annual trips under 5 mi.	442,110,197	128.25 × 3,447,253
39% of 15–64 yos' annual trips under 5 mi.	907,489,352	263.25 × 3,447,253
19% of 15–64 year olds' *daily* trips under 5 miles	**1,211,261**	442,110,197 ÷ 365
39% of 15–64 year olds' *daily* trips under 5 miles	**2,486,272**	907,489,352 ÷ 365

The next input that is needed is the mean trip length in kilometres. The Scottish Government (2007A) provides figures for the number of trips: under one mile; from one to under two miles; and from two to under five miles. So as not to overstate the mean trip length, the median distance for each range was used to calculate the overall figure, as shown in *Table 7*.

Table 7. Mean trip length for all trips under five miles, per person per year, in 2004/2005. Data for the number of trips in each distance range come from the Scottish Government (2007A).

Distance range	Nº trips in range	Median dist. in range	Total dist. of trips
under 1 mile	226	× 0.5 miles	= 113.0 miles
1 to under 2 miles	197	× 1.5 miles	= 295.5 miles
2 to under 5 miles	252	× 3.5 miles	= 882.0 miles
all under 5 miles	675	–	1,290.5 miles
all under 5 miles		1290.5 ÷ 675 = 1.911851852 miles **= 3.076827307 kilometres**	

The third input we needed was the mean proportion of the working age population who die each year. To find this, we used data from the GRO Scotland (2008B; 2008C).

Table 8. Death rate for the working age population in Scotland in 2007. The working age population is taken to be men and women aged 15–64 years old. The number of deaths are taken from GRO Scotland, 2008B and the total population is taken from GRO Scotland, 2008C.

Deaths of 15–64 year olds	Scotland's population of 15–64 year olds	Mean proportion of 15–64 year olds that die each year
11,153	÷ 3,447,253	**= 0.00323533**

Finally, we used the *HEAT for Cycling* tool (WHO, 2007) to calculate the economic savings due to reduced mortality of switching 19 percent (*Table 9*) and 39 percent (*Table 10*) of trips under five miles in Scotland from car to bicycle.

Table 9. *HEAT for Cycling* tool inputs and result showing the economic savings of switching 19 percent of short journeys in Scotland from car to bicycle. The final result (shown with a grey background) was calculated using the *HEAT for Cycling* tool (WHO, 2007).

Item	Datum	Comment
Number of trips per day	1,211,261	see *Table 6*
Mean trip length (km)	3.076827307	see *Table 7*
Mean number of days cycled per year	365	trip figures are based on average annual individual trip data
Proportion of trips that are one part of a return journey (or 'round trip')	0	
Proportion undertaken by people who would not other-wise cycle	1	benefit of all these trips switching from car to bicycle
Mean proportion of working age population who die each year	0.00323533	see *Table 8*
Value of life (in pound sterling)	£1,215,000	from DfT, 2008
Maximum annual benefit	**£990,227,000**	

Table 10. *HEAT for Cycling* tool inputs and result showing the economic savings of switching 39 percent of short journeys in Scotland from car to bicycle. The final result (shown with a grey background) was calculated using the *HEAT for Cycling* tool (WHO, 2007).

Item	Datum	Comment
Number of trips per day	2,486,272	see *Table 6*
Mean trip length (km)	3.076827307	see *Table 7*
Mean number of days cycled per year	365	trip figures are based on average annual individual trip data
Proportion of trips that are one part of a return journey (or 'round trip')	0	
Proportion undertaken by people who would not other-wise cycle	1	benefit of all these trips switching from car to bicycle
Mean proportion of working age population who die each year	0.00323533	see *Table 8*
Value of life (in pound sterling)	£1,215,000	from DfT, 2008
Maximum annual benefit	**£2,032,571,000**	

Details of commuting switch from car to walking or cycling calculations behind *Table 2* (p. 10)

To calculate the economic benefit of switching 20 percent or 40 percent of car-based commutes to walking or cycling required some basic data first: number of trips involved and the median gross weekly income in Scotland. *Table 11* shows where these data came from and the calculations that were made.

Table 11. Data and calculations needed to determine the benefits of switching commuters from car to walking or cycling.

Item	Datum	Source
Scotland's population of 15–64 year olds (2007)	3,447,253	*Mid-2007 Population Estimates Scotland* (GRO Scotland, 2008C)
Car, van, or lorry driver commutes per person per year (2004/2005)	93	*Travel by Scottish residents* (Scottish Government, 2008A)
Car, van, or lorry passenger commutes per person per year (2004/2005)	23	*Travel by Scottish residents* (Scottish Government, 2008A)
Total car-, van-, or lorry-based commutes per person per year (2004/2005)	116	93 + 23
Total car commutes by 15–64 year olds	399,881,348	116 × 3,447,253
20% of car commutes by 15–64 year olds	**79,976,270**	0.2 × 399,881,348
40% of car commutes by 15–64 year olds	**159,952,539**	0.4 × 399,881,348
Median Scottish gross weekly income (2006)	£432·00	*Scottish Economic Statistics 2007* (Scottish Government, 2007B)
Median Scottish gross daily income (2006)	**£86·40**	£432·00 ÷ 5

Using the results (shaded grey) from *Table 11*, it is possible to calculate the total economic benefit of switching 20 percent (*Table 12*) and 40 percent (*Table 13*) of car commuters to walking or cycling, the results of which were used in *Table 2* (*Section 3.2*, p. 8).

Table 12. Calculation of the economic benefit of switching 20 percent of car-based commuters to walking or cycling.

Sustrans (2006) economic benefits		DfT (2008) economic benefits	
79,976,270	see *Table 11*	79,976,270	see *Table 11*
× £8·30	Sustrans (2006) benefit	× 0.4 × £86·40	DfT (2008) benefit see *Table 11*
= £663,803,038		**= £2,763,979,877**	

Table 13. Calculation of the economic benefit of switching 40 percent of car-based commuters to walking or cycling.

Sustrans (2006) economic benefits		DfT (2008) economic benefits	
159,952,539	see *Table 11*	159,952,539	see *Table 11*
× £8·30	Sustrans (2006) benefit	× 0.4 × £86·40	DfT (2008) benefit see *Table 11*
= £1,327,606,075		**= £5,527,959,755**	

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