

Valuing the benefits of cycling

A report to Cycling England

May 2007



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1: Introduction

- 1.1 This study was undertaken by SQW Limited on behalf of Cycling England to examine the economic benefits of cycling and the ways in which cycling can contribute to Government objectives. The study is a review of existing research, bringing together different sources of evidence.
- 1.2 There is a common perception that cycling is “a good thing” and that people should do more of it. While this is true, it is more difficult to be specific about the types and scale of benefits that could be achieved if the number of people cycling increased. The findings of this report demonstrate that cycling is not only beneficial for those that participate, but also has real benefits for society. The report argues that these benefits must be considered together if the full potential of cycling is to be understood. Cycling is in a unique position to contribute to better health, fewer absences from work, reducing congestion and pollution as well as saving lives.
- 1.3 In 1996, a target to quadruple the amount of cycling by 2012 was set, but not only is this unlikely to be met, according to the National Travel Survey cycling activity has actually fallen over the past 10 year. Among school children, the number cycling to school has fallen while the number of car trips made to schools has continued to grow.
- 1.4 The aim of this study is to review the evidence of the potential economic benefits of increased cycling and assess its contribution to addressing some of the major challenges faced by society and Government. The brief identified three areas to which cycling can make a contribution:
- increasing health and fitness
 - reducing transport congestion
 - reducing pollution.
- 1.5 In each of these sections we have drawn together evidence to provide estimates of the value of encouraging additional cyclists and cycle trips. By expressing the benefits in monetary terms it becomes possible to aggregate the benefits of cycling across these themes and provide a basis on which to make a comparison with the costs of investment.
- 1.6 The estimates should be considered indicative. There are a range of factors and assumptions made, but even so this provides a better understanding of the potential scale and variations of the benefits of increasing cycling than has been possible before.

Context

- 1.7 Over the past ten years there has been increasing concern over the rapid rise in levels of obesity, particularly among children. The scale of the problem was captured by the chief executive of the Audit Commission who reported that if the trend continues, the current

generation of children will be the first for many decades that doesn't live as long as their parents.

- 1.8 Aside from the considerable medical costs, obesity can reduce both the quality and longevity of life. There are serious concerns that obesity among young people will lead to much greater problems in the future. A large part of this increase is a result of reduced physical activity. Cycling to school and for fun offers one of the best opportunities to encourage physical activity. It fits easily into everyday routines, provides exercise that helps keep children fit and encourage muscular and skeletal development. Despite these benefits the number of children cycling to school has fallen over the past 20 years, replaced by car travel with its associated effects on congestion and pollution.

*"If the Government were to achieve its target of trebling cycling in the period 2000-2010 (and there are very few signs that it will) that might achieve more in the fight against obesity than any individual measure we recommend within this report."*¹

- 1.9 The level of inactivity among adults has also risen as a result of many aspects of modern life and greater car ownership, while the number of cycle trips has declined. The cost of physical inactivity was estimated to be £8.2 billion a year in 2002. Greater physical activity is linked to prevention of a range of chronic diseases including heart disease, stroke and colon cancer. Physical activity also improves physical and mental health and reduces absences from work. Together, these can contribute to higher rates of productivity in which the UK continues to lag behind the US and major European competitors. Protection against heart disease is particularly strong among older people and given the accepted need to extend working life in order to ensure adequate pension provision, maintaining physical fitness will become even more important. Cycling offers one of the best forms of exercise for adults as part of a regular commuting journey, for leisure or for other short trips to the shops or local services.
- 1.10 The Stern report provided the first measure of the economic costs of global warming and the damage of continuing current levels of pollution. In the 2003 Energy White Paper, the government set a target of reducing carbon dioxide emissions by 60% by 2050 with significant progress to be achieved by 2020.² Road traffic is responsible for 22% of the UK's total greenhouse gas emissions.

*"At ten to nine in the morning one in five cars is on the school run. By encouraging cycling, seemingly small choices can have big impacts - improving the health of children, tackling congestion and helping the environment."*³ - Douglas Alexander, Transport Secretary (June 2006)

- 1.11 All commuters know the huge improvement in travel times that occur during the school holidays. Each additional car on the road increases the travel time of all those behind it. There is a value to the time that could be saved by reducing the number of cars, either by reducing traffic to schools and encouraging commuting by bike. To date more emphasis has been placed on improving public transport which is effective for key routes but cannot offer the flexibility of personal travel. Most major cities are facing severe congestion challenges.

¹ Conclusion 46 from the House of Commons Health Committee: Obesity, Third Report of Session 2003–04, Volume I, May 2004

² DTI website

³ http://www.direct.gov.uk/N11/Newsroom/NewsroomArticles/fs/en?CONTENT_ID=10037848&chk=wMTKKv

Trains, buses and trams are frequently full and uncomfortable and the opportunities for expanding capacity can be limited without major new investment in infrastructure. Encouraging cycling to school or work reduces traffic at peak times, reducing pressure on other forms of transport and travel times for other road users.

- 1.12 While other forms of transport and other activities can achieve some of these benefits, cycling is unique in being able to contribute to all of them. Walking can provide health benefits, but is less likely to be a realistic replacement for journeys of three or four miles, particularly when travel time is important. Greater use of public transport can reduce car use but does not offer the health benefits of cycling or walking or the flexibility.
- 1.13 Cycling has a beneficial impact that cuts across policy areas and Government PSA targets. It is beneficial for everyone who participates, old and young, employers and employees, the health service, the environment, and communities. This report brings together and provides indicative values of cycling across these three areas. It considers how the scale of the benefits vary depending on the characteristics of those that participate and uses the values to present examples of the potential benefits of cycling as well as a broad estimate of the resultant cost of the fall in cycling trips over the past 20 years.
- 1.14 Finally, there is often an assumption that increasing the amount of cycling will increase the number of accidents and it is often perceptions about safety that discourage cycling. This must be considered in context. Data for London over the past ten years show that as the number of cycle trips has grown, the number of cyclists killed or injured has fallen. Similar results have been found in other countries suggesting that increased cycling does not necessarily increase the number of fatal or serious injuries and may contribute to a reduction.

Summary

- 1.15 One of the most important findings is the extent to which benefits will vary depending on the profile of new cyclists as well as the amount of cycling. Cycling contributes to improvements in levels of physical activity offering protection against chronic disease and premature death. The methods adopted produce much higher values for older people who are encouraged to become active, than younger people. The scale of these benefits can vary substantially. While they are appropriate for adults a new approach is needed to value the health benefits for children.
- 1.16 This does not mean that the focus of cycling investment should be only on older age groups. It is just as important to encourage younger people to cycle in order to develop healthy habits and encourage continuing physical activity. Influencing children's development and attitudes towards cycling at an early age will have significant benefit in future years for the child and later, for the economy.
- 1.17 The contribution to congestion and pollution rests on the extent to which new cycle trips replace car journeys and the values associated with both congestion and pollution are much higher in urban areas than rural ones.

- 1.18 In total, the values vary to a maximum of just over £300 per additional cyclist per year, but actual values will depend on the distances and frequency of trips and the characteristics of the new cyclists.
- 1.19 Throughout the report it is assumed that a cyclist travels an average of 3.9 km per trip and makes 160 trips a year (3 trips a week)⁴. This is equivalent to 624 kms a year. This assumes that new cyclists encouraged to participate will reasonably regularly. The report argues that this is sufficient to meet the requirements of the health model used which assumes a fairly modest “step up” in physical activity to provide health benefits.
- 1.20 There is considerable debate over the amount of cycling activity that takes place. The National Travel Survey, the DfT’s official source of transport data and which only records on-road cycling, reports a decline in trips over the past ten years. This excludes the rising number of cyclists reported by Sustrans using traffic-free routes. Based on the declining number reported in the NTS data, the cumulative cost of these “lost trips” is estimated to be around £600 million. Looking forward, estimates are constructed which suggest that even achieving a modest target of returning the number of trips to the 1995 level within the next ten years could save around £500 million.
- 1.21 The analysis covers only the benefits that can be valued. It does not include the potential benefits that cycling could offer in protecting against obesity, although the link between regular exercise and weight control is well tested.
- 1.22 There is also evidence to suggest that increased cycling would lead to mental health benefits, physical development benefits, social benefits, potential reductions in the number of accidents and even tourism opportunities. The opportunities to realise these will all depend on the type of investments made. For these reasons, the values explored here should be treated as conservative. To avoid biasing projects against cycling, appraisal should ensure that these wider benefits are set out and quantified where possible.
- 1.23 The report examines four examples of cycling intervention. Each is shown to produce positive returns to investment. The benefit to cost ratio ranges from 7.4 in the case of a cycle training programme to 1.4 for Bike It, an initiative that funds cycling officers who work with selected schools to encourage cycling. The two physical infrastructure projects show returns of between two and four. These values exclude any potential benefits to children’s health or contribution to preventing or reducing obesity (Table 1-1).

⁴ See analysis in Chapter 7

Table 1-1 Summary Benefits, costs and ratios for intervention examples

	£ millions			
	Links to Schools	Bike It ⁵	LCN +	Training
Appraisal period	30 years	4 years	30 years	5 years
Benefits	£4.80	£0.33	£794	£0.79
Costs	£2.22	£0.24	£201	£0.11
Net Present Value	£2.58	£0.09	£592.50	£0.68
Benefit cost ratio	2.17	1.36	3.94	7.44

Source: SQW estimates

- 1.24 Because cycling contributes to a number of policy agendas the benefits are substantial when brought together. This does not mean that all investment in cycling will produce high returns. Each case needs to be assessed on its own merits, but the relatively high values where projects are able to generate new cyclists, suggests that there is a major opportunity to make investments that will, over time, more than repay their costs.

Structure of report

- 1.25 The remainder of this report is structured as follows:

- health benefits
- environment benefits
- congestion benefits
- summary and review of benefits
- applying the values
- cost benefit analyses
- conclusions.

⁵ Benefits for Bike It are lower than other interventions because the health (and safety) related benefits for children cannot be quantified.

2: Policy context

- 2.1 The challenge for cycling is to ensure that the combined benefits it can generate are recognised as a whole, across policy areas, and not treated as a set of separate, weaker outcomes which may compare less favourably with other investments. For example, encouraging walking may well be a cost effective measure to help increase physical activity from a health perspective, but would be less likely to deliver as significant an impact on reducing congestion or pollution. From a transport perspective, investment in bus and tram systems may contribute as effectively to reducing congestion and pollution but would not deliver the same health benefits. This makes it important to demonstrate the potential in total as well as the contribution that can be made to different policy agendas.
- 2.2 Equally, many other initiatives related to transport, health or environment will impact on levels of cycling without explicitly recognising or valuing the benefits. The most obvious examples are speed restrictions which as a result of making roads safer, encourage more cyclists and potentially reduce the number of car trips. In these cases it is important that the full benefits of any anticipated increase in cycling are captured within project appraisals.
- 2.3 Despite efforts to ensure joint objectives across departments in central government, agencies and within local authorities, it is challenging to ensure that the contributions of different activities are fully accounted for in project appraisal.
- 2.4 This overlap between government department objectives is by no means exclusive to cycling. For example, increasing the employment rate is an objective shared by both the HM Treasury and the Department for Work and Pensions. In part, it was the recognition of these overlaps and the subsequent need to reflect these in department strategies that led to the introduction of Public Service Agreements (PSAs). Introduced following the 1998 Comprehensive Spending Review (CSRs), PSAs signified a marked attempt by Government to improve the accountability of department investment in public services, and in particular, to underline the importance of outcome achievement. The 2004 CSR continued to emphasise the importance of joint PSAs and cross cutting themes. For example, the joint PSA to halt the rise in child obesity is shared between the Department of Health (DH), the Department for Education and Skills (DfES) and the Department for Culture Media and Sport (DCMS). With respect to cross-cutting themes, ‘sustainable development’ PSAs support all 15 headline sustainability indicators spanning 10 government departments⁶.
- 2.5 In addition to the three main challenges, there are other cycling related benefits which are reported in the research literature but not covered in this report
- **tourism** - cycling can be a source of increased tourism trips. Long distance cycle routes, mountain bike tracks, networks and paths as well as cycling events can all encourage tourism. While this can be beneficial for specific areas, many of these trips are made on day trips or by UK residents which, other than the health benefits, do not represent additional income.

⁶ HM Treasury, 2004 Spending Review, PSAs

- **quality of life/regeneration** - there are also arguments that encouraging drivers out of their cars can boost the vitality of communities and contribute to regeneration.
- **social exclusion** - as an affordable form of transport, cycling can improve access for lower income groups and those without access to cars or public transport.

2.6 It is useful to consider the PSAs that cycling is best positioned to contribute to (there are others concerned with public transport, road accidents, planning, health and safety, tourism and regeneration which cycling activities are also relevant). The main examples are shown in Table 2-1 and are discussed again at the end of the report.

Table 2-1: PSA targets and departments most relevant for cycling

PSA	Departments
Reduce mortality rates and health inequalities	DH
Reduce levels of obesity	DfES, DCMS, DH
Reduce congestion in the largest urban areas	DfT
Reduce levels of child obesity	DH, DCMS, DES
Improve air quality by reducing transport emissions	DfT, DEFRA
Reduce greenhouse gas emissions	DfT, DEFRA, DTI
Increase levels of sporting activity	DCMS, DES

Source: PSA targets

Cycling strategies

- 2.7 There have been various attempts over the last 10-15 years to raise the profile of the benefits of cycling, either through government strategies or academic research. The *National Cycling Strategy* (NCS) was produced in 1996 and contains a target of quadrupling the level of cycling in England by 2012.⁷ The strategy identifies the potential of cycling to contribute to the government's wider objectives on air quality, transport efficiency and public health. The NCS also set up a National Cycling Forum to oversee the implementation of the strategy.
- 2.8 The delivery of the NCS was reviewed in 2005 and it was agreed that this original target was too ambitious and it was dropped from the *Future of Transport White Paper* published in 2004⁸. The review states that in 2004/05, local authorities outside London were forecast to spend £36 million on cycling measures, an increase of £6 million from 2000/01. In London, a record £13 million was forecast to be spent. However, in light of the apparent lack of progress in increasing cycling levels, the review highlights a shift in cycling policy towards developing more realistic targets at a local level, for example through the Local Transport Plan (LTP) process.
- 2.9 The *Walking and Cycling Action Plan*, produced in 2004, outlines the government's support for cycling across different departments primarily focusing on the potential to increase physical activity to combat forms of obesity, heart disease, cancers and strokes.⁹ The action

⁷ *National Cycling Strategy* – DfT (1996)

⁸ *Delivery of the National Cycling Strategy* – DfT (2005)

⁹ *Walking and cycling, an Action Plan* – DfT (2004)

plan also highlights the potential to assist transport networks (reducing congestion) and improve physical environment (reducing pollution).

Health policy

- 2.10 The government's *Choosing Health White Paper* outlines the government's long term strategy for improving health and tackling health inequalities.¹⁰ One of the overarching priorities is to reduce obesity and improve diet and nutrition thereby reducing the likelihood of health problems such as heart disease, cancer, diabetes, stroke, high blood pressure and high cholesterol later on in life.
- 2.11 Other government departments also have responsibility for promoting physical exercise. In 2002, the government published a strategy for delivering Government's sport and physical activity objectives.¹¹ This illustrates the fact that cycling has relevance across different government departments.

Environmental policy

- 2.12 Cycling is a sustainable form of transport which has a minimal impact on the environment. Non-motorized transport will become increasingly important as governments take action to address climate change and promote sustainable development. This concept is defined as 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs.'¹² The main threat to sustainable development in recent years has been the impact of carbon emissions from industry, transport and other sources on climate change. As transport is recognised as one of the main producers of carbon emissions, a significant modal shift from car use to cycling has the potential to reduce transport based pollution.
- 2.13 The recently published *Stern Review* on the economics of climate change has been hailed by the Prime Minister as the most important report on the future which has been produced by the Labour government.¹³ Whilst there has been awareness and considerable concern regarding the increase in global carbon emissions and the threat of climate change, this research led by Sir Nicholas Stern highlights the potentially catastrophic consequences for the global economy unless action is taken now. The potential results of inaction on climate change are compared to the major disruption which followed the world wars and economic depression in the first half of last century. There is a positive message in the report which argues that the benefits of early action far outweigh the costs of inaction.
- 2.14 The UK government's approach is shaped by *Securing the future*, a sustainable development strategy published in 2005.¹⁴ This document reinforces the government's commitment to encouraging sustainable growth whilst protecting the environment and natural resources for future generations. The main principles are as follows:

¹⁰ *Choosing Health, Making Healthy Choices Easier* – DH (2004)

¹¹ *Game Plan, a strategy for delivering Government's sport and physical activity objectives* – DCMS/ Strategy Unit (2002)

¹² United Nations Division for Sustainable Development

¹³ *Stern Review, the Economics of Climate Change* – HM Treasury (2006)

¹⁴ *Securing the future, the UK Government Sustainable Development Strategy* – DEFRA (2005)

- living within environmental limits
- ensuring a strong, healthy and just society
- achieving a sustainable economy
- promoting good governance
- using sound science responsibly.

2.15 In terms of sustainable development, most attention focuses on targets for reducing greenhouse gases. In the 2003 Energy White Paper, the government set a target of reducing carbon dioxide emissions by 60% by 2050 with significant progress to be achieved by 2020.¹⁵ This is also expected to appear within an upcoming bill on climate change.¹⁶ As a signatory of the *Kyoto Protocol*, the UK also has ambitious national targets of reducing carbon dioxide emissions by 20% below 1990 levels by 2010.¹⁷

Transport policy

2.16 The UK is the most car dependent country in Europe.¹⁸ In addition to the environmental impact of transport emissions, there is also the ever increasing problem of congestion within urban areas which again has an impact on the economy. Following the Stern report, the *Eddington Review* is another independent study commissioned by the government this time to examine the long-term links between transport and the UK's economic productivity, growth and stability, within the context of sustainable development and the environment.¹⁹ The report suggests that cycling and walking interventions can produce very high returns on investment, but on their own are unlikely to tackle the true scale of transport problems. It says that:

Encouraging cycling, walking and smarter choices has the potential to provide benefits to the economy and welfare through both reduced congestion and the associated likely reduction in greenhouse gas emissions and other pollutants, and improved health.

Improving walking and cycling capacity by creating or upgrading routes that make these more attractive modes of travel could provide good welfare and GDP returns, especially if utilising dedicated infrastructure targeted around key services or growing urban areas.

Where larger scale cycling interventions are implemented, preliminary evidence suggests that the returns may also be relatively high. Given the current use of cycling as a mode of transport in the UK, which is among the lowest of EU countries, this may suggest the potential for larger-scale uptake of cycling under the right conditions.

¹⁵ DTI website

¹⁶ Announced in Queen's speech, 15th November 2006 – www.parliament.uk

¹⁷ The Kyoto Treaty was signed in Japan in 1997 with over 160 countries now signed up to reducing greenhouse gas emissions to combat climate change. The two main exceptions are the US and Australia.

¹⁸ *Study of European best practice in the delivery of integrated transport* - Commission for Integrated Transport (2001)

¹⁹ The Eddington Review December 2006

2.17 The *Future of Transport White Paper* published in 2004 sets out the government's long term vision for creating an efficient and sustainable transport system.²⁰ Congestion is becoming a major constraint on growth in many towns and cities and this white paper highlights the need to develop effective transport management systems. The strategy specifically highlights the need to encourage more cycling over the next 30 years, especially for short journeys to school and work, for the three following reasons:

- to help to reduce congestion and improve air quality
- to help to reduce car use and help to tackle social inclusion, making towns and cities safer and more pleasant places to live
- to increase levels of physical activity and improve public health. Moderate physical activity such as walking and cycling helps reduce obesity, heart disease, stroke, cancer and diabetes.

²⁰ *The Future of Transport: a Network for 2030 – DfT (2004)*

3: Health outcomes

- There is a strong link between physical activity and health. The current recommendation of 30 minutes exercise, five days a week is being met by 37% of men and 25% of women
- Physical activity reduces the risk of developing major chronic diseases (e.g. coronary heart disease, stroke and type 2 diabetes) by up to 50%, and the risk of premature death by about 20-30%
- Physical inactivity costs the economy £8.2 billion a year and obesity a further £3.2 - £3.7 billion. Reducing inactivity and obesity will improve lives, reduce health care costs and improve productivity
- The easiest and most acceptable forms of physical activity are those that can be incorporated into everyday life, which include walking or cycling instead of driving
- The relationship between inactivity and risk of chronic diseases is “curvilinear”. The scale of benefit is greater at higher levels of activity but there is a ‘law of diminishing returns’
- Based on the risk factors for chronic diseases and levels of inactivity it is estimated that the value of reducing these risk factors is £11.16 a year for those under 45 and £99.53 a year for those between 45 and 64. Other similar models have used values of £123 a year (Sustrans and DfT model)
- The Copenhagen Heart Study provides a set of data that produces much higher values associated with the protective qualities of cycling. It suggests that the health benefits of cycling are potentially four times greater than those derived from the more widely used models.
- In addition, inactivity leads to higher health care costs and absences from work. The report estimates the former as £28.30 per inactive person per year and the productivity that is lost through absence as £47.68 a year.
- Cycling can make a major contribution to reducing obesity, although this cannot be valued in the same way. As well as the possibility that obesity will track through into adulthood and the associated costs, reducing obesity can help improve confidence and self esteem among children. Cycling can build up physical activity as a habit as well as help other aspects of physical development
- The values identified here are lower than values found in cost benefits studies in several Scandinavian countries.
- The values for health vary considerably, but the value of reducing disease risk factors, the costs to the health service and reductions in absence from work are all likely to be positively linked to age.

Introduction

- 3.1 Increasing levels of physical inactivity and obesity in the population is impacting on quality of life and on life expectancy. At the same time the costs of treating illnesses related to inactivity generally and obesity specifically are expected to grow, requiring increasing health service resources. One of the root causes of obesity and other major diseases is an increasingly sedentary lifestyle and lack of exercise. Increasing the number of people cycling regularly will raise the amount of exercise taken and consequently contribute to better health, a better quality of life and reduce the financial costs of treatment. Research also reports that exercise and, by extension cycling, also contributes to better mental health and reduced absenteeism from work.

Relationship between health and physical activity

- 3.2 The importance of physical activity to health is the subject of the report “At least five a week“, published by the Chief Medical Officer (CMO).²¹ This suggested that for most people the easiest and most acceptable forms of physical activity are those that can be incorporated into everyday life, which include walking or cycling instead of driving, and taking up active hobbies and leisure pursuits which include mountain-biking.
- 3.3 The CMO report identifies a number of key health benefits of increased physical activity:
- a reduction in the risk of developing major chronic diseases (e.g. coronary heart disease, stroke and type 2 diabetes) by up to 50%, and the risk of premature death by about 20-30%
 - improvements in psychological well-being and musculoskeletal health.

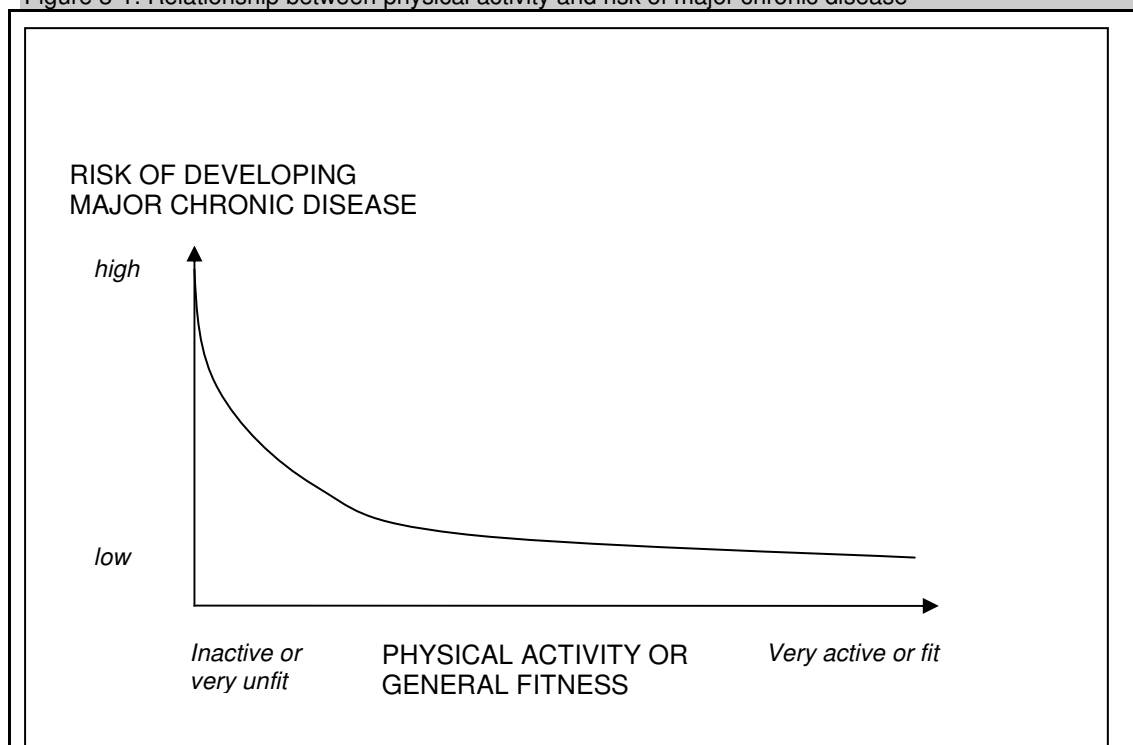
What is ‘physically active’?

- 3.4 According to the CMO a healthy level of activity would be achieved by 30 minutes a day of at least moderate intensity physical activity on five or more days of the week. For children, it is recommended that this should be one hour of moderate activity. This definition is also used by the World Health Organisation.²²
- 3.5 One of the challenges in measuring the contribution of cycling to health is the complex “dose-response” between physical activity and prevention of disease, although the marginal benefit of additional activity reduces the fitter you are. This reflects a “curvilinear” relationship which suggests that even small differences in physical activity level can result in important reductions in coronary heart disease risk, especially among the least active.
- 3.6 Figure 3-1 shows a stylised version of this relationship and is important in determining how different people would benefit from either starting to cycle or cycling more. It shows that more physical activity will always lead to higher levels of disease prevention, but that the effects are weaker the fitter you are.

²¹ *At least five a week, evidence on the impact of physical activity and its relationship on health* – Chief Medical Officer/ Department of Health (2004)

²² *Myths about Physical Activity, World Health Day Factsheet* – World Health Organisation (2002)

Figure 3-1: Relationship between physical activity and risk of major chronic disease



Source: At least five a week, evidence on the impact of physical activity and its relationship on health – Chief Medical Officer/ Department of Health (2004)

- 3.7 There is evidence that the strong protective effect of physical activity on cardiovascular disease can be transient. In other words, people have a reduced risk of cardiovascular disease during the periods of life when they lead a physically active lifestyle, but they can lose much of the benefit once they stop being physically active. In the Harvard Alumni study in the USA, active college students who subsequently adopted an inactive adult lifestyle were at greater risk of dying of coronary heart disease compared with inactive students who subsequently adopted an active adult lifestyle²³.
- 3.8 People also benefit from activity even if they have previously been inactive until middle age or beyond. Adult men aged 45-84 years who exchanged an inactive adult lifestyle for a more active one over a period of 11-15 years reduced their risk of coronary heart disease²⁴. There is a wealth of data reporting inverse relationships between overall activity level (volume of activity) and reduced risk of cardiovascular disease, particularly coronary heart disease: higher overall activity levels are associated with lower risk of cardiovascular disease. There are fewer data available on the specific types of activity – in terms of intensity, duration, frequency and type – needed to confer a benefit. As Figure 3-1 shows greater benefits can be obtained at higher levels of activity but there is a ‘law of diminishing returns’. There is some suggestion that, at the very highest activity levels, no further decrease in risk occurs, or there may be a slight increase in risk²⁵.

²³ Paffenbarger RS, Wing AL, Hyde RT. *Physical activity as an index of heart attack risk in college alumni*. American Journal of Epidemiology 1978; 108: 161-175

²⁴ Slattery ML, Jacobs Jr DR. *Physical fitness and cardiovascular disease mortality. The USA Railroad Study*. American Journal of Epidemiology 1988; 127: 571-580.

²⁵ Sandvik L, Erikssen J, Thaulow E, Eriksson G, Mundal R, Rodahl K. *Physical fitness as a predictor of mortality among healthy, middle aged Norwegian men*. New England Journal of Medicine 1993; 328: 533-537.

Decreasing physical activity and increasing obesity

- 3.9 Recent trends show that people are becoming less physically active. The Health Survey for England found that only 37% of men and 25% of women are active at the levels recommended in the CMO report. It is clear that inactivity increases with age. In the oldest age group, just over 70% of men and 80% of women are inactive. However, the CMO also reports a small increase in the proportion of people taking physical activity for leisure.
- 3.10 In relation to cycling, the proportion of the population travelling by bike has fallen over the past 25 years in England. In 1995 the National Travel Survey reports that there were, on average 20 cycle trips per person in England. By 2005 this had fallen to 15, a decline of 25%. Social Trends provides data on the proportion of the adult population that cycled in the last year and in the last four weeks. In 1996, 21% of adults had cycled in the last year and 11% in the last four weeks, by 2002/03 this had fallen to 19% and 9%.
- 3.11 Trends in trips to school have seen an increase in car use and a decrease in cycling and walking. In 1985/86, 22% of 5 - 10 year olds were driven to school and that had risen to 39% by 1999–2000. Around 1% of school journeys made by 5 to 10 year olds were by bicycle and among 11 to 15 year olds the number cycling to school has fallen by 40% from 5% of trips in 1990/91 to just 3% in 2004. Activities to encourage cycling are therefore not necessarily just about increasing numbers, but in some cases sustaining them within a context of a declining trend.
- 3.12 One of the most striking trends over the past twenty years is the emergence of obesity as a serious threat to health. The CMO in 2004 reports that 22.1% of men and 22.8% of women in England were classed as clinically obese. These proportions increase with age and among people aged 55-74 years more than two-thirds of women and three quarters of men were overweight or obese.
- 3.13 These numbers increased threefold between 1980 and 2002. Levels of overweight and obesity among children in England are also high and rising. In 2003, 32% of boys and 28% of girls aged 2-15 years were at least overweight, and 17% of boys and 16% girls aged 2-15 were obese. Based on current trends, 12 million adults (33% of men and 28% of women) and 1 million children will be obese by 2010.²⁶

Costs of inactivity and obesity to the economy

- 3.14 Several studies have been carried out to quantify the economic costs of physical inactivity and obesity. The DCMS Game Plan report in 2002, estimated the annual cost of physical inactivity in England as ranging from £1.9 billion to £8.2 billion,²⁷ depending on the definition of physical activity (the first figure considers the number of people doing up to three occasions of moderate or vigorous exercise over the last four weeks and the second counts those who do less than 30 minutes of moderate exercise five days a week) and the range of diseases that inactivity is assumed to impact on. The different costs and sources are summarised in Table 3-1.

²⁶ *Forecasting Obesity to 2010* – DH (2006)

²⁷ *Game Plan*– DCMS / Strategy Unit (2002)

- 3.15 A separate study estimates that obesity costs the economy between £3.3 billion and £3.7 billion each year. This figure includes the costs to the NHS and the economy, such as absence from work.²⁸ This figure represents an upward revision by the House of Commons Clerk’s Scrutiny Unit (for 2002)²⁹ of a 1998 report.
- 3.16 While obesity has justifiably been the focus of much attention in recent months, it is only one of up to 20 chronic disease and disorders which physical inactivity can lead to.³⁰

Table 3-1 The costs of inactivity and obesity

Calculation	Value per year	Source
Cost of physical inactivity (including treatment of disease and indirect costs through sickness absence)	£8.2 billion	CMO (2004) (uses the high estimate)
Cost of physical inactivity	£1.9 - £8.2 billion	DCMS/Strategy Unit (2002)
- direct costs to NHS	- £0.3 - £1.7 billion	
- earnings lost due to sickness	- £0.8 - £5.4 billion	
- earnings lost due to premature mortality	- £0.8 - £1 billion	
Cost of obesity to NHS (direct costs of treating obesity)	£1 - £1.1 billion (2002 values)	HoC Scrutiny Unit (2004)
Cost of obesity to the wider economy (indirect costs relating to loss of output due to illness or death resulting from obesity)	£2.3 - £2.6 billion (2002 values)	HoC Scrutiny Unit (2004)

Source: various

Calculating the health benefits of cycling

- 3.17 The analysis used here is restricted to the contribution of cycling to reducing inactivity in adults rather than children and excludes the costs associated with obesity. Although there is considerable evidence of the link, it has not been possible to value the contribution of cycling to reducing obesity.
- 3.18 In calculating the health benefits of cycling (as a means of increasing physical activity) there are three main elements to consider:
- **the value of the lost lives** – deaths which could be prevented as a result of cycling
 - **NHS savings** – reducing the costs relating to the treatment of illnesses resulting from physical inactivity
 - **productivity gains** – reducing absenteeism relating to illness which is preventable through increased activity, such as cycling
- 3.19 Inactivity among children is likely to contribute to obesity and have an impact on health, productivity and health costs in the future, but there is currently no research that can satisfactorily quantify the strength of these links. Valuing the health benefits among children requires a different approach which should incorporate an increased likelihood of those

²⁸ *Tackling obesity in England* – National Audit Office (2001)

²⁹ *Health - Third Report* - House of Commons Select Committee on Health (2004)

³⁰ *At least five a week, evidence on the impact of physical activity and its relationship on health* – Chief Medical Officer/ Department of Health (2004)

introduced to cycling as children, going on to cycle as adults in later life. In effect the propensity of cycling to change behaviour in adults based on experience as a child.

Valuing the loss of life

- 3.20 There are several approaches used in the literature for calculating the value of loss of life. This is usually based on estimating the number of deaths that could be prevented through an increase in physical activity. The underpinning variable in this type of model is the number of deaths from certain diseases attributable to inactivity.
- 3.21 The three main disease groups are coronary heart disease (CHD), stroke and colon cancer which are most closely linked in epidemiological studies with physical inactivity. One of the main studies detailing the epidemiological evidence is Hahn et al. (1986) which has been used frequently as a basis for cost benefit analyses.³¹
- 3.22 The latest mortality data provides the number of deaths from the three main diseases (highlighted above) most strongly linked with a lack of physical activity.³² A relative risk factor (RRF) is then calculated to estimate the number of deaths from each of these diseases attributable to physical inactivity. Applying this to the population gives the population attributable risk (PAR). The PAR for these diseases will be greater for older age groups because the proportion of that age group who are physically inactive will be larger.
- 3.23 Our own analysis of the health benefits in relation to the value of lives lost also uses the model developed in the US and applied in Northern Ireland by Swales³³.
- 3.24 Thirty nine per cent of deaths in England from coronary heart disease (CHD), stroke and colon cancer, among over 16 year olds, can be attributed to a lack of regular physical exercise. This equates to just less than 45,000 deaths. Table 3-2 shows how the estimated benefit can differ depending on age group targeted.
- 3.25 The value of preventing a death varies considerably. It can be calculated using foregone earnings, foregone output (which includes losses to the wider economy) and can include welfare losses and medical costs. The most appropriate base value is the DfT figure of £1.4 million per death prevented.³⁴ This includes:
- loss of output due to injury – present value of the expected loss of earnings plus any non-wage payments (national insurance contributions, etc.) paid by the employer
 - ambulance costs and the costs of hospital treatment
 - human costs, based on “willingness to pay” values, which represent pain, grief and suffering to the casualty, relatives and friends, and the intrinsic loss of enjoyment of life.

³¹ *Excess Deaths from Nine Chronic Diseases in the United States* – Hahn et al. (1986)

³² *Mortality statistics, all causes* – ONS (2005)

³³ Economics Branch, Department of Health for Northern Ireland

³⁴ DfT (2004)

- 3.26 The average number of years lost as a result of a fatal crash is about 32 which after excluding the ambulance and hospital costs, which are specific to road accidents, gives a value per life year of around £30,000. This value has been adopted by both Sustrans and in other studies³⁵.
- 3.27 Under these scenarios, the value of loss of life ranged from £22 for those under 44 to £235 per new cyclist between 45 and 64. Using this method it is very noticeable how the premature death value per cyclist rises very steeply with age. These differential values are reflected in the cost benefit model used in Sweden³⁶ which assumes much higher values for cyclists between 50 and 60.

Table 3-2: SQW calculated values for preventable deaths

16 – 44 years old	45 - 64 years old
2 deaths averted/lives saved per year	33 deaths averted/lives saved per year
74 life years saved	782 life years saved
Annual economic benefit from reduced mortality of £2.2 million	Annual economic benefit from reduced mortality of 23.5million
estimated <i>annual</i> economic benefit per cyclist of £22	<i>Annual</i> economic benefit per cyclist of £235.

Source: SQW

- 3.28 Applying these figures to the number of new cyclists assumes that they were previously inactive, and are now active (according to the CMO definitions). This restricts the ways in which the values can be applied. Many people encouraged to cycle will already be active while those that were inactive may not achieve the necessary amount of cycling to be defined as “active” (30 minutes of exercise, 5 days a week).
- 3.29 A more sophisticated approach can be derived from a National Heart Forum report³⁷ which allows an assessment of the impact of a number of different levels of physical activity. Although this is limited to CHD, we also know that CHD represents around 80% of the deaths caused by inactivity. To allow for the other major diseases, stroke and colon cancer, we have increased the values by 25%.
- 3.30 The NHF analysis defines four categories of physical activity; vigorous, moderate, light and sedentary³⁸. The study examines a number of potential scenarios. The most appropriate for this work assumes that *all those in each group move up to the next level as a result of cycling*. This allows an assumption that cycling represents a “step up” in the level of exercise, rather than moving from no exercise to cycling five days a week.
- 3.31 In other words, when applied to new cyclists this scenario assumes that, by cycling, each person takes a step up in the amount of physical activity they do. Those that are already moderately active would, if they started to cycle, become vigorous while those who are sedentary would move into the light category.

³⁵ Figure used in DfT/Sustrans guidance

³⁶ *CBA of Cycling, TemaNord 2005:556* Nordic Council of Ministers, Copenhagen 2005

³⁷ *Coronary Heart Disease: Estimating the impact of risk factors*, National Heart Forum (2002)

³⁸
 Vigorous = 12+ occasions of vigorous exercise of 20 minutes in past 4 weeks
 Moderate = 12+ occasions of moderate exercise of 20 minutes in past 4 weeks
 Light = 1 – 11 occasions of moderate exercise of 20 minutes in past 4 weeks
 Sedentary = 0 occasions of moderate exercise of 20 minutes in past 4 weeks

- 3.32 The results can also be presented by age and show the same pattern as the previous values. The protective effects of physical activity grow larger as we get older. These results give values that can reasonably be applied to all additional cyclists according to their age group.
- 3.33 A key question is whether the assumption about 160 trips (three trips a week) is sufficient to generate this “step up”. It would certainly move those that were previously sedentary into the light category. Light exercise is, on average, six occasions of moderate exercise every four weeks. Adding three cycle trips a week to those in the light category would move them into the moderate category and we have assumed that by making additional cycle trips those that are already moderately active will cycle fairly vigorously (they are already fairly fit and are more likely to use cycling to get more exercise).
- 3.34 The assumption of 160 cycle trips a year would meet the criteria set out as the basis for the NHF results.

Table 3-3 Health value through reduced life years lost based on National Heart Forum report

Age groups	Value for each year of cycling
16 – 44	£11.17
45 – 64	£99.53
All ages	£58.77

Source: SQW extrapolation from figures in the National Heart Forum report, *Coronary Heart Disease: estimating the impact of risk factors*

- 3.35 For comparison, the Sustrans/DfT guidance includes an estimate of £123 per person within their appraisal methodology for each additional cyclist, while the Transport for London study uses a value of £88. Both of these studies use the NHF results.
- 3.36 A slightly different approach has been taken by Rutter who uses data collected as part of the Copenhagen Heart Study by Andersen et al (2000)³⁹ to calculate the health benefits for cycling commuters.⁴⁰ His estimate is then adjusted downwards to allow for an estimate of the excess deaths from cyclist accidents to get a net benefit of 50 prevented deaths per 100,000 cyclists, equivalent to around 1,660 life years. Using the estimate of £30,000 per life year⁴¹ the result is a net benefit of just under £50 million which can be expressed as £498 per cyclist per year.
- 3.37 This is an interesting approach as it produces estimates related *specifically to cycling* rather than general physical activity. As a result it allows for other potential risks that are not included in the standard analysis (limited to three major diseases). It is also related directly to people of cycling age (commuters) rather than across the population as a whole. These results suggest that cycling has a much higher preventative effect than is produced by other methods

³⁹ All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. Archives of Internal Medicine 2000, 160, 1621-1628 (Andersen et al. 2000)

⁴⁰ The Copenhagen study covered 6,954 regular cycle commuters out of a total study population of 30,640, followed for an average of 14.5 years. The mean journey time for the cycle commuters was 3 hours per week and the relative risk of death for the cycle commuter cohort was found to be 0.72 (with a 95% confidence interval between 0.57-0.91) after adjustment for age, sex, educational status, leisure time physical activity, body mass index, blood lipid levels, smoking and blood pressure

⁴¹ Based on the 40 life years lost for a cyclist death, and the DfT cost per life of £1.25million (after allowing for hospital and ambulance costs associated with road accidents) the cost per life year is £31,250

- of analysis. It would be useful to find further research that supports these results, but they indicate that the values used here could be a considerable underestimate.
- 3.38 The BMA Report, *Cycling: Towards Health and Safety*,⁴² made conservative calculations based on the survival rates of very large samples of respondents who had and had not adopted a regular physical exercise regime over a long period of time. It concluded that to cycle an average of 97 kilometres a week for about 30 years (150,000 kilometres) would extend life by over two years. The MACAW research⁴³ which also used the DfT valuation of a life lost as a result of being killed on the road uses the valuation of the two life years gained to calculate that the increase in life expectancy is worth about £60,000. This is presented as 40 pence for each kilometre cycled. As the MACAW model makes clear “putting a ‘per kilometre’ figure presupposes that the subject will complete the minimum amount of exercise”.
- 3.39 Among children one of the difficulties in valuing the benefits of cycling is that inactivity does not immediately lead to changes in the risk factors associated with the main diseases. The CMO reports that there is “relatively little direct evidence (compared with adults) linking physical inactivity in children with childhood health outcomes”.⁴⁴ This means that traditional methods of valuation, using mortality rates, cannot easily be applied.
- 3.40 The encouragement of cycling among children is better considered as a longer term investment, preventing obesity, illness and premature death, possibly a long time in the future. An active child does not immediately have a significant change in their risk factors, but may be more likely to be active in the future. The various results have been brought together in Table 3-4. The range of values reflects the different approaches and assumptions made in these studies.

⁴² *Cycling: Towards Health and Safety* – Hillman, M / British Medical Association (1992)

⁴³ *Modelling and Appraisal of Cycling and Walking Projects (MACAW)* – DETR (2001)

⁴⁴ *At least five a week, evidence on the impact of physical activity and its relationship on health* – Chief Medical Officer/ Department of Health (2004)

Table 3-4 Summary of loss of life results for cyclists

	Value of additional cyclist PER YEAR	Notes
SQW calculations	£22 for 16 - 44 £235 for over 45	Inactive people achieving definition of active (30 minutes a day, 5 times a week) as a result of cycling
	£11.16 for 16 – 44 year olds £99.53 for 45 - 64 year olds £242.07 for 65 year olds and over £58.77 weighted average	Values calculated using National Heart Forum results. Assumes a “step” increase in physical activity associated with cycling e.g. sedentary people become lightly active, lightly active become moderately active etc. ⁴⁵ Shown by age and includes uplift to allow for stroke and colon cancer
DCMS Game Plan (2002)	Between £40.79 and £50.73 depending on scenario	Implied value from report results. Uses foregone earnings, not full welfare costs
Copenhagen Heart Study/Rutter	£498	Based on all cyclists (not just those becoming active) and all causes of mortality. Applied to UK mortality data and DfT value of life by Rutter
DfT/Sustrans model		£123 Uses number of deaths through inactivity and the National Heart Forum average values
TfL Business case (2006)		£88 As above but using London data
MACAW model	40 pence per kilometre	Assumed to be part of long term regular cycling

Source: various

NHS savings

- 3.41 The values above do not include the costs to the NHS of inactivity. The *Game Plan* report suggests the NHS costs associated with physical inactivity range from £325m to £1.7bn, when the range of diseases is extended and a higher level of activity is assumed. An analysis of the costs of inactivity for Sport England indicated that the higher figure was more likely to be correct. This analysis estimates that the cost to the NHS of inactivity would be around £1.4 billion⁴⁶. The higher estimate is also used in the subsequent CMO report.
- 3.42 In the US, Colditz estimated the direct health care costs associated with inactivity at between \$24.3 billion and US \$37.2 billion (or between 2.4% and 3.7% of the total US health care cost).⁴⁷ Another US study, found that the medical costs of an active person (over 15 years old) were on average \$330 lower per year, which works out at around £175.⁴⁸ In Canada about \$2.1 billion, or 2.5% of the total direct health care costs in Canada, were attributable to physical inactivity in 1999⁴⁹.
- 3.43 The Game Plan estimates use 28 million inactive adults in England under the high scenario and 15 million in the low scenario. On the basis of these estimates, the cost per year per

⁴⁵ See earlier definitions

⁴⁶ *Driving up participation: The challenge for sport*. London: Sport England, Sport, Health and Economic Benefit Chris Gratton, Sport Industry Research Centre, Sheffield Hallam University

⁴⁷ *Economic cost of obesity and inactivity* – Colditz, G in *Medicine and Science in Sports and Exercise* (1999)

⁴⁸ *Higher medical costs associated with physical inactivity* – Pratt, Macera & Wang in *The Physician and Sports Medicine* (2000) 28(10)

⁴⁹ *The economic burden of physical inactivity in Canada* Peter T. Katzmarzyk*, Norman Gledhill* and Roy J. Shephard, 2000

inactive person ranges from £18.86 per person to £37.98.⁵⁰ This is a rather simplistic assumption as the actual costs will vary hugely. Some people will be inactive and will add nothing to the NHS burden, particularly while they are younger, while others will require considerably more resources. However, this gives some indication of the value that could be attached to encouraging more activity.

- 3.44 Another approach is based on an estimate of the cost of cardiovascular disease which has been estimated at around £29 billion per year⁵¹ to the UK economy. Fifty six percent of these costs are attributable specifically to CHD and cerebrovascular disease (such as stroke). It is assumed that incidences of stroke make up the majority of the cost of cerebrovascular disease, we can say that CHD and stroke cost the NHS approximately £16 billion per year (56% of £29bn).
- 3.45 CHD and stroke are two of the three diseases most closely associated with inactivity (the other being colon cancer). Together these account for 95% of the deaths from the three diseases attributable to inactivity. It is reasonable to assume that the bulk of the cost of inactivity is caused by these two diseases.⁵² Of the total deaths from CHD and Stroke (106,374), using the NHF scenario adopted in the previous section would reduce the number of CHD cases by 12% (including uplift to allow for stroke deaths).
- 3.46 If this proportion of reduced deaths reflects a similar proportion of the health care costs then this would suggest a cost to the economy of approximately £1.92 billion (12% of £16bn). Applying this to the number of adults in the UK, 40.7 million, gives £47.17 per adult. This figure represents the cost to the economy that can be split between healthcare (60%), lost productivity (23%) and the cost of informal care (17%). Based on these calculations the potential savings for the NHS for each person who starts to cycle is therefore just under £28.30 per year.

Table 3-5 Reduction in NHS costs as a result of increase in physical activity

	Value of additional cyclist per year	Notes
High estimate from Game Plan	ranges from £18.86 per person to £37.98	The higher estimate is more likely given CMO's use of figures and comparison with other countries
Estimate derived from costs of cardiovascular disease	£28.30 (all additional cyclists)	SQW estimate based on cyclists moving up one activity level - based on CHD and stroke deaths – applicable to all cyclists

Source: various

Productivity costs

- 3.47 Potential productivity effects are realisable from reducing levels of absenteeism from work due to ill health. For example, Shore et al (1989) show that there is a positive empirical link between increase physical activity and reduced absenteeism.⁵³ Active people take fewer days' sick leave than inactive employees⁵⁴. They are also more likely to be able to work for

⁵⁰ The figure of 28 million is based on physical inactivity rates in the Health Survey for England 2004 and the 2005 mid year population estimates

⁵¹ Oxford University Health Economics Research Centre (2006)

⁵² Mortality statistics, all causes – ONS (2005)

⁵³ Shore et al (1989)

⁵⁴ Physical Activity Task Force, 2003

more years as they grow older. Maintaining physical work capacity over time is important because the UK has an ageing population and therefore an ageing workforce. Physically fit workers are also likely to be more productive.

- 3.48 These costs to employers of inactivity are summed up as:
- cost of absenteeism and long-term sick pay
 - cost of temporary staff
 - loss of production
 - retention of staff, staff turnover and early retirement.
- 3.49 Workplace physical activity programmes in the USA have produced results that show reduced short-term sick leave by 6% to 32% (reported by WHO, 2003). Another workplace study in the US found that the high participation group in a fitness programme had a significant decline in sick days (4.8 days)⁵⁵. The *Game Plan* report estimates a low value of 10,000 and a high value of 72,000 days lost as a result of inactivity. This is valued using £75 per day (average earnings in 2002). Using the low and high numbers of inactive people in their model gives estimates of £51.96 per person and £45.98 per person. The results do not vary substantially as the number of people defined as inactive changes between the two scenarios.
- 3.50 In the UK, the average employee has 6.8 days off sick a year⁵⁶. The figure is higher among older employees and lower among younger ones. Given the likelihood that reduced absences are most likely to be related to vigorous exercise in particular we have used the more conservative estimate of 6% (the lower value reported by WHO). This suggests increased physical activity would prevent the loss of 0.4 of a day absence for each worker. Average GVA per employee in England is approximately £37,000 a year which would give a cost of £161 a day and £64.40 per working person in reduced absence cost.
- 3.51 This should be adjusted to allow for the proportion of the population that are working. In England 74.5% of working age adults are in work, assuming a similar proportion among cyclists gives an average value of £47.68 across *all* adult cyclists.

Obesity

Adults

- 3.52 The previous sections produced values relating to cycling's contribution to reducing inactivity. The contribution of cycling to obesity is much harder to value. Obesity is caused by an imbalance of energy or calories consumed and energy expended. This means that obesity is a combination of diet and physical activity. Where cycling represents additional physical activity it will contribute to reducing an individual's likelihood of being obese and, as a consequence, the associated risks of disease are reduced with benefits to the individual and the economy.

⁵⁵ *Effect of an Employee Fitness Program on Reduced Absenteeism. Journal of Occupational & Environmental Medicine*, 1997 Lechner L.

⁵⁶ Confederation of British Industry *Absence and labour turnover*, 2003

- 3.53 Like physical inactivity the reduction in risk of premature death as a result of obesity can be calculated and potentially valued, but it is more difficult to attribute reductions in weight to diet, physical activity and in this case cycling. Certainly physical activity has an important part to play in managing weight. The CMO reports that “only a small proportion of those following weight loss programmes maintain their weight loss in the long term. Those who achieve and maintain regular physical activity are more likely to be successful.” Research suggests that regular exercise is an important part of *maintaining* weight reductions as a result of dieting.
- 3.54 The extent to which cycling will contribute to weight loss depends on diet, the amount of cycling and how vigorous it is. The CMO estimates that physical activity by itself can result in modest weight loss of around 0.5kg-1kg per month.
- 3.55 The cost of obesity in England was estimated by the Government White Paper on public health as up to £3.7 billion per year, among 11 million adults this represents £336 per person per year. The National Audit Office report⁵⁷ argues that on average, each person whose death could be attributed to obesity lost nine years of life. Where cycling can contribute to protecting against obesity, the savings would be substantial.

Children

- 3.56 Among children aged 2-10 years, 13.7% are obese and 27.7% are overweight (including obese)⁵⁸. Childhood overweight affects self-esteem and has negative consequences on cognitive and social development. Conditions such as type 2 diabetes mellitus, hypertension and hypercholesterolemia are becoming more common among children and because childhood overweight often persists into adulthood there will be increases in the associated risk factors. In addition, there is evidence that physical activity is important for children’s psychological well-being. Children with higher physical activity levels are more likely to have better cognitive functioning. A meta-analysis of 44 studies concluded that there is a significant positive relationship between physical activity and cognitive functioning. Cycling is also one of a number of activities that has the potential to contribute to bone health. Taken together, it is important that any value of the contribution of cycling to children’s health does not underestimate these benefits.
- 3.57 Although the relationship between inactivity and obesity in children will depend on many factors, the CMO report concludes that “the primary role of physical activity in the context of childhood cardiovascular disease risk status may, therefore, be an indirect one – that of helping to prevent excess weight gain during childhood, or helping children who are already overweight to lose weight.”
- 3.58 The literature frequently cites the importance of setting good habits at an early age. Intuitively this makes sense. In other European countries such as the Netherlands, Dutch men and women are more likely to continue cycling into adulthood and old age. In these cases, getting children cycling is more likely to lead to them cycling as adults. In Britain, cycle use

⁵⁷: *Tackling Obesity in England, 2001* National Audit Office

⁵⁸ *Obesity among children under 11*. London: National Centre for Social Research, Department of Epidemiology and Public Health at the Royal Free and University College Medical School Jotangia D, Moody A, Stamatakis E, Wardle H (2005)

drops off markedly in the mid-teenage years, particularly for women. If these good habits for life are to be effective, more effort will be needed to encourage young people to keep cycling through their teens.

- 3.59 Intuitively, we would expect experiences in childhood to influence physical activity as adults. The relationship is complex to track, but examples in one study⁵⁹ suggest that those who were not active as adults had negative perceptions of activities from childhood. The authors concluded that “neither men nor women felt adept at attempting new skills in their adult years; they thought it was necessary to have at least tried the physical activity/sport in their childhood or adolescence to consider participating as adults”. If this is generally true, the importance of encouraging participation in cycling in childhood is crucial if there is to be any chance of maintaining or re-enthusing adults.
- 3.60 In other studies there is only weak to moderate evidence that participation in physical activity tracks through from childhood to adulthood⁶⁰, although this may be stronger for sports⁶¹ as suggested by longitudinal studies in Finland.
- 3.61 Cycling is only one way to help protect against obesity in children, but it has a major advantage as a form of regular exercise which can be fitted into existing daily life. Given the considerable costs of obesity as well as the potentially high but unquantifiable costs to the quality of life and confidence of children, an increase in cycling among children almost certainly will have significant long term value. There is not sufficient evidence at present to develop a simple value for this. Further work could be done to develop some appropriate approximations.
- 3.62 This is a complex research field and further research is needed to address two links:
- the contribution that cycling plays, along with other factors in protecting against obesity, and
 - how this tracks into later life.
- 3.63 In the meantime, care must be taken that simply because these benefits cannot easily be quantified the process of investment appraisal is not biased. On this basis estimates of benefits should err on the positive side rather than being overly conservative.

Other health cost analyses

- 3.64 Health costs are also included in a number of international examples. In Norway, Sælensminde (2004)⁶² estimates health benefits of NOK 7300 (£593) per person per year including medical costs, treatment costs and potential productivity loss. The study also

⁵⁹ *A Longitudinal Study of the Impact of Childhood and Adolescent Physical Activity Experiences on Adult Physical Activity Perceptions and Behaviors* Angela M. Thompson M. Louise Humbert Robert L. Mirwald, Qualitative Health Research, Vol. 13 No. 3, March 2003 358-377

⁶⁰ CMO report

⁶¹ Physical activity from adolescence to adulthood and health-related fitness at age 31. Cross-sectional and longitudinal analyses of the Northern Finland birth cohort of 1966

⁶² *Cost-benefit analyses of walking and cycling track networks taking into account insecurity, health effects and external costs of motorized traffic*, Kjartan Sælensminde 2004

includes an allowance for welfare loss as a result of suffering through illness. In Sweden⁶³, a value of 12,000 SEK (£875) is suggested where an inactive person between 50 and 60 becomes more active. For all cyclists this is 2,600 SEK (£190) and for projects aimed at older people 8,300 SEK (£605).

- 3.65 The Finnish Transport and Communications department has proposed that despite difficulties in providing evidence, a pragmatic approach is needed to make sure that the health benefits of cycling and walking projects are considered. It proposed a value of 1,200 Euros (£800) per additional cyclist per year to capture health related benefits.

Conclusions

- 3.66 Valuing the health benefits of cycling depends on who the cyclists are and how much cycling they do. The curvilinear relationship between amount of activity and protection against disease suggests that there is more benefit in getting less active people to cycle than in getting already active people to cycle more. This is an important conclusion in designing interventions.
- 3.67 In terms of valuing the benefits, a value can be presented as per kilometre, per trip or per new cyclist. The values presented using the National Heart Forum data allow a realistic estimate of the reduction in premature deaths as a result of cycling. The assumption in the calculations (that every cyclist “steps up a level” in their physical activity as a result of cycling) is a fair reflection of the difference that would be made to physical fitness of around 160 trips a year.
- 3.68 The health benefits, reducing disease risk factors, NHS costs and reducing days off sick, all increase with age. It is apparent from the analysis that the older the cyclist the higher the value. Interventions that attract older cyclists are likely to have a higher value than those that encourage younger people. The profile of cyclists is therefore critical in attributing values.
- 3.69 While the immediate health benefits are for older people, in the longer term, encouraging cycling across all age groups is valuable. The estimated values are based on the impact of inactivity on health risk factors, but the contribution of cycling to reducing obesity is excluded. Given the life long cost of obesity to an individual, the health service and the economy, the benefits of cycling in helping to protect against this are potentially substantial.
- 3.70 Of real importance is the Copenhagen Heart Study which points towards particularly high benefits among cycling commuters. This study and its interpretation by Rutter points to a much higher level of benefit than reported in the NHF and used here.

Summary of health benefits

- 3.71 Based on the evidence reviewed in this section, a summary of the values of health benefits per person is included in Table 3-6 below.

⁶³ *CBA of Cycling, TemaNord 2005:556 Nordic Council of Ministers, Copenhagen 2005*

Table 3-6: Summary of health benefit values PER YEAR for adult cyclists

Health benefit	Values PER YEAR of cycling	Note
Value of loss of life	£11.16 for 16 – 44 year olds £99.53 for 45 - 64 year olds £242.07 for 65 year olds and over £58.77 average	SQW estimates based on NHF data Note £498 for commuters found by Copenhagen study
NHS savings	£28.30 for all cyclists	Uses National Heart Forum scenario applied to costs of treating CHD – applicable to all cyclists
Productivity gains	£47.68 all cyclists	Based on conservative assumption of lost GVA – applicable to working population cycling
Total health benefits	£87.06 for 16 -44 year olds £175.51 for 45 – 64 year olds £159.48 average	Assumes a full year of cycling by adult Note that older people will tend to have higher values
Child health and obesity	Not quantified	Requires a different approach based on cycling as an investment in reducing future health costs

4: Pollution-reduction outcomes

- The contribution of cycling to reducing pollution depends on substituting car use for cycle trips – this is likely to be most effective as part of a wider set of transport measures
- Pollution estimates refer to the external costs from the production of airborne pollutants and greenhouse gases. This includes the health costs associated with pollutants and the cost of carbon emissions based on the value of carbon derived from the Stern report’s “business as usual” case
- The Stern Review on the Economics of Climate Change (October 2006, HM Treasury) argued that strong and early action aimed at reducing carbon emissions is vital to combating climate change, and that delays in action would lead to serious implications in terms of costs of mitigation
- For agglomerations (or major urban centres such as London) the report estimates values of 4.9 pence and 31.6 pence for petrol engine and diesel engine per car kilometre removed. In rural areas this would be 2.1 pence and 2.0 pence
- If a cyclist in an agglomeration makes 160 cycle trips of 3.9km, rather than take a car, this would equate to pollution-related savings of £69.14 a year. This could include cycling to school rather than being taken by car. In rural areas, this value is much lower, £12.98 a year with the same assumptions
- Values for most towns would be between these two extremes and in case studies the analysis uses a midpoint.

Introduction

- 4.1 This section includes values that cover both the health benefits that can be achieved by reducing the emission of pollutants by substituting car trips for cycle trips and the value of the reduction in carbon emitted. Although the focus is frequently on carbon emissions, it is the health costs that are currently more significant in urban areas.
- 4.2 The rise in carbon emissions is widely accepted as contributing to climate change and one of the major sources of carbon emissions is car traffic. Reducing the number of car trips and distance of trips would reduce levels of pollution and help the UK meet its targets. Local pollution in some cities caused by traffic is also a serious problem, contributing to poor health. Over half of car trips are less than five miles in distance and it is argued that cycling could provide a viable alternative if the appropriate facilities and conditions were in place. Replacing short car trips can have a disproportionate impact on pollution as starting cold engines will release more pollutants than the equivalent distance added to existing journeys. Cycling can reduce car travel by replacing trips to work, school and for personal business, although there are many factors that will impact on how practical this is. This is obviously subject to other traffic control measures being in place to reduce the induced traffic effect.
- 4.3 The reduction of pollution will depend on a number of key variables:

- vehicle type (model, age, usage)
- location (e.g. city = more stop/start)
- average occupancy of vehicles.

4.4 The actual impact will also depend on the type of transport scheme implemented and – ultimately – the distances and number of car kilometres which are reduced.

Pollution effects

4.5 Pollution can have an impact on the following factors:

- **human health** – aggravation of existing heart, vascular and respiratory illnesses
- **biodiversity** – defoliation, disease, lower yields and death of vegetation
- the **built environment** – surface corrosion and erosion of buildings
- **cultural heritage** – surface corrosion and erosion of public buildings and landmarks
- **climate** – local microclimate and global climate.

4.6 All of these can be seen to have a monetary cost. However, a European project on the external costs of transport⁶⁴ concluded that:

“health impacts dominate the damages quantified [...]; in particular, mortality due to primary (PM_{2.5}) and secondary particulates (nitrates, sulphates). Carcinogens[...] proved to be of much lower importance.”

4.7 In total, emissions from road transport contribute around 70% of the air pollution in our towns and cities⁶⁵, and there are over 120 ‘pollution hotspots’ in the UK where national air quality targets won’t be met⁶⁶. Evidence from the Department of Health suggests that each year the deaths of between 12-24,000 vulnerable people are brought forward, and between 14-24,000 hospital admissions may be associated with short-term impact of air pollution on health⁶⁷.

Greenhouse gas emissions

4.8 The UK has made a number of commitments to reducing greenhouse gas, and particularly CO₂, emissions in the future. The most quoted of these are summarised in the bullets below.

- Kyoto Agreement – UK target of reduction in greenhouse gas emissions by **12.5%** below 1990 levels in 2008-2012.

⁶⁴ *External Costs of Transport in ExternE*, 1997 European Commission, DG XII, JOULE III,

⁶⁵

www.direct.gov.uk/HomeAndCommunity/EnvironmentalMatters/Pollution/PollutionArticles/fs/en?CONTENT_ID=4001684&chk=h79jOa (last accessed 17/11/06)

⁶⁶

http://www.direct.gov.uk/Motoring/OwningAVehicle/AdviceOnKeepingYourVehicle/AdviceOnKeepingYourVehicleArticles/fs/en?CONTENT_ID=4022065&chk=sMxJKK (last accessed 17/11/06)

⁶⁷ *Greening communities campaign kit – ideas into action*, Local Government Association (2005), www.lga.gov.uk/Documents/Publication/greeningair.pdf

- UK domestic target – **25%** reduction in CO₂ emissions below 1990 levels by 2010 (DETR, 2000)
- The DTI Energy White Paper 2003 adopts a path towards a **60%** reduction in CO₂ by 2050, following the recommendation of the Royal Commission on Environmental Pollution (RCEP, 1994).

4.9 Road transport is responsible for 22% of the UK's total greenhouse gas emissions. The VIBAT (Visioning and Backcasting for UK Transport Policy) project made summary extrapolations of projections from Transport Statistics Great Britain (DfT) and Energy Paper 68 (DTI), which project that all transport emissions – under a Business as Usual scenario – would rise by 35% from 38.6MtC in 1990 to 52 MtC in 2030⁶⁸. Over the same period all emissions of greenhouse gases in the UK are expected to increase by 3%.

4.10 The VIBAT target is to reduce all transport end user CO₂ emissions by 60% from a 1990 base (i.e. an emissions level of 15.4MtC in 2030). Whilst ambitious, it is stated that this is around the level required to achieve a future CO₂ atmospheric concentration of 500ppm (depending on other sectors). The project concluded that it will not be possible to rely on a scenario of technological change (i.e. all new vehicles are hybrid by 2030, combined with considerable investment in alternative fuels) to achieve a 60% reduction in CO₂ emissions by 2030:

*“The overall conclusion reached is that the 60% CO₂ reduction target (in 2030) can be achieved by a combination of strong behavioural change and strong technological innovation. **But it is in travel behaviour that the real change must take place, and this should be implemented at the earliest possible occasion.**”(p.18)*

4.11 Whilst the figures provided in this paper, based on a 1997 European Commission study, include an element of external costs due to greenhouse gases, we do not re-examine the issues and costs attached to the wider environmental impacts of reducing greenhouse gases on the global economy. This is an area which has developed cogency over recent years, although the figures are still highly contested. Most recently, the Stern Review on the Economics of Climate Change (October 2006, HM Treasury) argued that strong and early action aimed at reducing carbon emissions is vital to combating climate change, and that delays in action would lead to serious implications in terms of costs of mitigation. As the figures provided here do not include the enhanced costs linked to ‘non-action’, they should be seen as conservative.

The economic case

4.12 The economic case is built on a three-stage model:

- the reduction in car kilometres
- the impacts of this reduction on pollutants
- the cost saving attributable to these impacts

⁶⁸ Looking over the horizon, Bartlett School of Planning, UCL and Halcrow Group for Department for Transport, January 2006

- 4.13 There are a number of sources that can help in making estimates of the potential value. An analysis presented in Surface Transport Costs and Charges (DETR 1998) provides average figures for air pollution, climate change and noise which. These figures indicate air pollution ranging from 0.34 pence per km to 1.74 and climate change effects of 0.15 to 0.62. A high carbon dioxide price of £29 per tonne is used. This is well below the “business as usual values used the Stern report (around £44). Assuming that the climate change value per kilometre would increase proportionately, gives a higher CO₂ figure of around 0.94p using the Stern value.
- 4.14 However, this analysis includes motorway driving (which has lower environmental values per kilometre) and which is less likely to be substituted for cycling. Car trips switched to cycling are more likely to take place within populated areas and therefore the higher value estimates for air pollution and noise are more appropriate. Combining these gives 3.42 pence per kilometre in 1998 prices or around 4.20 pence in 2006 values.
- 4.15 A European Commission report⁶⁹ also provides figures for cars. This formed the basis for a 2004 study by Transport for London on the impacts of Cycling in London⁷⁰ which assumed a 0.09£/km overall external environmental cost and concluded that benefits from a shift of 25,000 to 150,000 car trips to cycle journeys in London would be £2m to £10m per year.
- 4.16 These values combine both the health effects of air pollution and the reduction in carbon emissions. The values for greenhouse gas emissions incorporated in the ExternE report were based on a range quoted by the IPCC of \$5-\$125/tC. However, the Stern report values are much higher, with a ‘business as usual’ scenario of \$314/tC.
- 4.17 In order to incorporate this higher value, our analysis identified the proportion of pollution costs generated by carbon emissions and this was adjusted to reflect the higher values in the Stern report.
- 4.18 The ExternE work calculated that the external costs due to airborne pollutants and greenhouse gases in agglomerations (areas of highest population densities over a large area) as 0.034£/pkm for petrol cars – at 1997 prices – (fitted with a three-way catalyst) and 0.25£/pkm for diesel cars. The equivalent costs quantified for ‘extra-urban areas’ (medium to low population densities) were 0.003£/pkm for petrol cars and 0.01£/pkm for diesel cars. A further 0.005£/pkm was added for up and downstream processes.
- 4.19 The impact figures are significantly higher for diesel cars because diesel cars have higher emissions of NO_x and the proportion of NO₂/NO_x is higher than petrol cars (typically 10-15% compared to < 5% by volume)⁷¹. In the context of rising proportions of diesel cars in the UK fleet, this is important.
- 4.20 On the basis of the ExternE results, the formula (for agglomerations) is therefore:

$$\text{Annual pollution-related savings of displacing cars from road (in £) =} \\ \text{Number of car kilometres saved per year} * [(\% \text{ of petrol cars}) * 0.034 + (\% \\ \text{of diesel cars}) * 0.25 + 0.005] * \text{inflation since 1997}$$

⁶⁹ External Costs of Transport in ExternE, (1997) European Commission, DG XII, JOULE III,

⁷⁰ A Business Case and Evaluation of the Impacts of Cycling in London, Transport for London, January 2004

⁷¹ Project for the Sustainable Development of Heathrow: Air Quality Technical Report (19 July 2006, DfT), Chapter 3: Emissions; sub-heading: Road traffic emission technology developments (para 290)

Source: European Commission, DG XII, JOULE III, External Costs of Transport in ExternE, (1997)

- 4.21 These figures have been adjusted for inflation of 2.6% per annum⁷² over the nine-year period to 2006. Table 4-1 shows the ExternE-based values in 2006 prices and an average value allowing for the profile of the car fleet. Diesel cars accounted for about 20% of the car fleet in 2004, with projections for 2010 suggesting a level of around 31.5%⁷³. The results assume a conservative value of 20% for 2006.

Table 4-1 Inflation adjusted pollution values (including processing)

	Petrol	With Stern carbon value	Diesel	With Stern carbon value	Weighted averages
Agglomeration (major city)	4.9p	5.8p	31.6p	32.2p	11.1p
Rural	1.0p	2.1p	1.6p	2.0p	2.1p

Source: SQW estimates

- 4.22 Including the allowance for up and downstream processing, inflation and higher carbon prices these calculations give values of 11.1p per car kilometre in major cities and 2.1p in rural areas.
- 4.23 For rural area trips the pollution-related savings of switching from car use to cycling would be much lower, predominantly because of the lower population density in the surrounding area, and because the health impacts of road pollution tend to be very localised, falling off exponentially as distance from the road increases.

Contribution to improving air quality

- 4.24 We have only been able to find details for particulate emissions for Euro II **diesel** passenger cars (1-5 passengers per vehicle)⁷⁴. These indicate a saving of 4-17 grams PM (particulate) emissions per person displaced from single-occupancy diesel car to cycle. The value of improved air quality, particularly the implications of particulates reduction for human health, is included in the overall estimated value.

Reducing greenhouse gas emissions

- 4.25 The values associated with reduced car use can also be used to derive a reduction in carbon emitted. We have assumed that each cyclist makes 160 trips of 3.9 kms by bike instead of car per year; the total saving is estimated to be 112,000 grams of CO₂ per person (displaced from single-occupancy car to cycle) or 112 metric tonnes of CO₂ per 1,000 people.

Conclusions

- 4.26 It is important to note that most of the value from reducing pollution is generated as a result of health protection rather than the value of reducing greenhouse gases. In rural areas the

⁷² Based on RPI quarterly statistics over the time period (ONS)

⁷³ Project for the Sustainable Development of Heathrow: Air Quality Technical Report (19 July 2006, DfT), Chapter 3: Emissions; sub-heading: Road traffic emission technology developments (para 290)

⁷⁴

http://themes.eea.europa.eu/Sectors_and_activities/transport/indicators/technology/TERM28%2C2002/Specific_emissions_TERM_2001.doc.pdf

number of people affected by emissions is much lower than in built up areas. Therefore the value of reducing emissions in urban areas is much higher than in those that are less populated.

- 4.27 The average cycle trip is 2.4 miles or 3.9 km according to the National Travel Survey 2005. For the purposes of our calculations we have used the average trip distance and assumed that return trips are double this. We have assumed that the average cyclist makes 160 trips per year this would equate up to 624 kilometres per year.⁷⁵
- 4.28 Applying this would suggest that the annual economic benefit in reduced pollution of one person switching from single-occupancy car use to cycling would be worth £69.14 in major cities and £12.98 in rural areas.
- 4.29 Below, we provide calculations for reductions in single-user car trips in both agglomerations and in extra-urban (rural) areas. For other trips, for example in market towns, a sensible mid-way point should be assumed.

Table 4-2: Valuing pollution impacts

	Pence per kilometre	Estimate for 160 trips of 3.9 kms
Agglomeration (major city)	5.8 (petrol) & 32.2 (diesel) (average of 11.1p)	£69.14
Rural	2.1 (petrol) & 2.0 (diesel) (average of 2.1p)	£12.98

Source: SQW estimates

⁷⁵ This value represents trips which replace car journeys

5: Congestion outcomes

- The contribution of cycling to reducing congestion depends on substituting car for cycling trips. This is more effective where encouragement of cycling is part of a wider set of transport measures
- The value of reducing congestion is the benefit, as a result of less traffic, created for other road users
- Sloman (2003) estimates that increased cycling could contribute to a 0.3% reduction (2003 – 2010) in national car travel demand. In the ambitious change scenario she argues that there could be a 1.2% reduction in car traffic
- Cairns et al (2004) estimates that a high intensity scenario could result in a reduction in national traffic of 11% whilst the low intensity scenario would result in a reduction of 2-3%. These reductions would be dependent on other supportive policies
- The value of substituting car for cycle trips is higher in areas of greater congestion and at peak times. Initiatives in cities are therefore likely to generate higher values than in rural areas
- To derive urban and rural values, data from the Surface Transport Costs and Charges report (1998) have been used to produce estimates of 11 pence per kilometre in rural areas and 22 pence in urban areas.
- If a cyclist makes 160 trips a year of 3.9km, rather than take a car, this would equate to savings for other road users of £137.28 a year as a result of reduced congestion in urban areas and £68.64 in rural environments.

Introduction

- 5.1 Various approaches to addressing traffic congestion are being adopted throughout the UK's main towns and cities. These include physical planning and road design, speed and parking restrictions, congestion charging and improvements to public transport. High volumes of traffic increase journey times, which in turn impact on productivity for businesses or reduce leisure time. Cycling, where it reduces the number of cars on the roads will reduce travel times for car drivers, increasing productivity and leisure time.
- 5.2 The potential transport outcomes in relation to increased levels of cycling relate primarily to the issue of traffic congestion and persuading more vehicle drivers to travel by bicycle, especially for short distance journeys.

Congestion

- 5.3 Traffic congestion is now severe in many towns and cities with latest estimates putting the cost of congestion to the UK economy at around £20 billion.⁷⁶ Congestion is defined as a

⁷⁶ *Utilities Street Works and the Cost of Traffic Congestion* – Goodwin (2005)

negative externality which arises when the volume of traffic exceeds the free-flow capacity of the link or junction and in such cases each additional vehicle causes delays to other vehicles and suffers in turn from a slower and thus more costly journey.⁷⁷

5.4 Congestion causes various problems which translate as costs to society and which are clearly interlinked with the other cycling related outcomes considered in this report:

- *waste* – inefficient use of time and employee delays during a working day
- *pollution* – cars emitting pollutants into the atmosphere and engines being used inefficiently
- *health problems* – these include NHS costs treating people with respiratory diseases and absenteeism caused by stress

5.5 The calculations highlighted in this section relate to the issue of lost time caused by congestion. The costs relating to the two other congestion-based issues are discussed in other sections.

Reducing congestion

5.6 There are two ways in which congestion can be relieved; through increasing the capacity of road infrastructure or through encouraging the use of alternative modes of transport known as transportation demand management.

5.7 Cycling is one of the alternative modes of transport which is promoted especially for shorter distance journeys in urban areas where congestion is at its highest. According to the 2005 National Travel Survey, over half of car trips made in a year are less than five miles in distance⁷⁸ and 23% less than 2 miles. In addition, only 1.4% of trips are currently made by bicycle compared to 64% of trips made by car or van (42% as driver and 22% as passenger).

5.8 This all suggests a potential for increasing levels of cycling subject to the relevant infrastructure and facilities being in place. The geography of urban areas is also likely to be a significant factor (i.e. a relatively flat town landscape will encourage more cyclists).

Reducing congestion but generating traffic?

5.9 Reducing congestion in one urban area can have the effect of displacing traffic to another. This is often referred to as *generated* or *induced traffic* and appears to be a more significant issue for projects which seek to reduce congestion by increasing the capacity of the road network as opposed to promoting alternative forms of transport.

5.10 Litman (2005) argues that road capacity expansion often delivers fewer benefits than is imagined due to the fact that generated traffic often fills the new capacity.⁷⁹ The research does however highlight the benefits of transport demand management strategies which often

⁷⁷ *Road Pricing on the basis of Congestion Costs: Consistent Results from Two Historic UK Towns* – Santos (1999)

⁷⁸ *Last year the average person made 1,044 trips of which 435 were made driving a car. Of these trips, 244 were less than 5 miles in distance*, National Travel Survey 2005

⁷⁹ *Generated Traffic and Induced Travel, Implications for Transport Planning* – Litman (2005)

cost less and have greater impact. These may include congestion charging, parking controls, traffic constraint measures or improvements to pedestrian, cycle and public transport facilities.

- 5.11 In their review of Smarter Choices, described in more detail later, Cairns et al (2004) note the potential importance of induced traffic but do not consider it explicitly within their calculations of congestion savings.⁸⁰ In a separate study, Cairns, Atkins and Goodwin (2002) argue that the potential level of induced traffic is overstated. *'When pedestrianisation schemes or wider pavements or cycle lanes or bus (and other priority vehicle) lanes or road closures are introduced, pre-scheme predictions of what will happen are usually excessively pessimistic'*.⁸¹ These findings are based upon extensive research examining 70 international case studies of road reallocation initiatives and the collation of opinions from 200 transport professionals worldwide.
- 5.12 There appears to be general agreement that in order to maintain reduced levels of traffic and realise the subsequent economic benefits there is a need to lock-in behavioural changes through supportive control measures which will minimize the potential impact of induced traffic. For this reason, cycling's contribution to reducing congestion needs to be considered alongside other initiatives.

How cycling can contribute to reduced congestion

- 5.13 Shayler et al (1993) in their cost benefit analysis of cycling reports that cycling has an obvious part to play in displacing short car trips and can use space much more efficiently within congested urban areas.⁸²
- 5.14 Litman (2004) also states that improving non-motorized conditions, increasing non-motorized travel and shifts from motorized to non-motorized forms of travel can provide various benefits including reduced traffic congestion.⁸³ Litman also discusses the conditions under which cycling reduces congestion. These conditions are:
- uncongested roads and separate paths
 - congested roads with space for bicyclists
 - narrow congested roads with low speed traffic
 - narrow congested roads with high speed traffic.
- 5.15 The study finds that congestion is reduced when motorists shift to cycling in the first three situations, but in narrow congested roads, with traffic still flowing at a higher speed than cyclists, additional cyclists can actually increase congestion.

⁸⁰ *Smarter Choices, Changing the Way We Travel* – Cairns, Sloman, Newson, Anable, Kirkbride and Goodwin (2004)

⁸¹ *Disappearing traffic?, the story so far* – Cairns et al (2002) in Municipal Engineer

⁸² *Costing the Benefits, The value of Cycling* – Shayler, Fergusson & Rowell/ CTC (1993)

⁸³ *Quantifying the Benefits of Nonmotorized Transportation For Achieving Mobility Management Objectives* – Litman (2004), Victoria Policy Transport Institute

- 5.16 The Department for Transport (DfT) has recently commissioned various studies looking at how smarter travel choices, including cycling, walking and public transport, can help to reduce congestion.
- 5.17 Sloman (2003) considers how different local transport initiatives can help to reduce car traffic for the period 2003-10.⁸⁴ Under the ‘enlightened business as usual’ scenario it is estimated that traffic can be reduced by 12 - 15% whilst under the ‘ambitious change’ scenario, the study estimates a reduction of between 26 - 33%.⁸⁵ In terms of cycling, Sloman estimates that in the first scenario increased cycling could contribute to a 0.3% reduction in national car travel demand. In the ambitious change scenario she argues that there could be a 1.2% reduction in car traffic.
- 5.18 Cairns et al (2004) adopted a similar approach for their Smarter Choices study which considers two different policy scenarios (high intensity and low intensity) for the next ten years.⁸⁶ The measures include workplace/school travel plans, personalised travel planning, travel awareness campaigns, and public transport information and marketing, car sharing schemes and teleworking. The study reports that the high intensity scenario would result in a reduction in national traffic of 11% whilst the low intensity scenario would result in a reduction of 2-3%. These reductions would be dependent on some or all of supportive policies such as re-allocation of road capacity, public transport improvements, parking control, traffic calming, pedestrianisation, cycle networks and congestion charging.
- 5.19 Whilst monitoring of cycling projects and congestion levels at local authority level is often not very reliable, there are some notable examples among the towns and cities which have been successful in demonstrating reductions in congestion and increasing cycling levels.⁸⁷
- 5.20 In recent years London has introduced a number of transport improvement initiatives with the aim of reducing congestion. During the last three years, congestion in the city centre has decreased by 22%.⁸⁸ The biggest factor has been the introduction of a congestion charge for vehicle access to the city centre in 2003 which has encouraged people to alter their travel behaviour. Cycling levels in the city increased sharply by 43% between 2003 and 2006.
- 5.21 Other similar examples include Peterborough and Worcester which in 2004 were designated ‘sustainable travel demonstration towns’ and together received £3 million over five years to reduce car use through the promotion of alternative modes of transport. Some initial evaluation findings suggest that the projects have resulted in a reduction of 13% in car driver trips in Peterborough and a 12% reduction in Worcester.⁸⁹ In Peterborough, car distances travelled were reduced by around 9.1 million kilometres per year. Cycling levels in the two towns increased by 25% and 36% respectively and there were also increases in other forms of transport.

⁸⁴ *Less Traffic where People live, How local transport schemes can help cut traffic* – Sloman (2003)

⁸⁵ The first scenario involves rolling out current best practice from all local authorities whilst the second scenario would incorporate the best international practice and significant additional investment by government

⁸⁶ *Smarter Choices, Changing the Way We Travel* – Cairns, Sloman, Newson, Anable, Kirkbride and Goodwin (2004)

⁸⁷ Based on conversations with a number of council officials, it was highlighted that although monitoring is now required for Local Transport Plans, the results are often not the most reliable

⁸⁸ *Central London Congestion Charging, Fourth Annual Report* – Transport for London (2006)

⁸⁹ *Peterborough/Worcester: Sustainable Travel Demonstration Town, Interim Evaluations of ITM Programme* – Sustrans/ Socialdata (2006)

- 5.22 In these cases, cycling is part of a wider integrated transport package and in order to have an impact on congestion, any increase in cycling needs to lead to reduced car use. It is not always easy to make a causal link but the changes in use of transport mode would suggest that the cycle trips are replacing car trips and contributing to reduced congestion.

Quantifying the benefits of reduced congestion

- 5.23 The *Smarter Choices* research estimates that for every £1 spent on smarter travel choices, this could bring about £10 of benefit in congestion relief with further potential gains from environmental improvements and other effects, provided that the tendency of induced traffic to erode such benefits is controlled. The study also suggests that each car kilometre removed by soft measures brings an overall average benefit in reduced congestion of about 15 pence, varying from about 45 pence in city streets to 3 pence in rural or other urban streets.
- 5.24 This 15 pence calculation derives from DfT and Strategic Rail Authority figures on the congestion savings from transferring lorry miles to rail.⁹⁰ The calculation is based on time values associated with congestion and does not include air and noise pollution. The average congestion benefit for lorry miles saved is quoted at 44 pence per mile. This is then divided by three to calculate the average congestion benefit for car kilometre saved. This same calculation has been used again in subsequent DfT publications, such as the recent evaluation of personalized travel planning.⁹¹
- 5.25 A slightly lower estimate for the savings in car kilometres removed is used by Sansom et al (2001).⁹² This research estimates the savings at between 9.71 and 11.16 pence per car kilometre removed and again is based solely on the value of time. Factored up to present values this estimate would be broadly in line with the *Smarter Choices* estimate of 15 pence.
- 5.26 In the recently published methodology for economic appraisals of cycling and walking projects, Sustrans uses a range of between 7 pence for off-peak transportation to 23 pence for peak-time transportation.⁹³ For the three schools based case studies considered in their research, the lower value is used to produce more conservative estimates of congestion savings). Table 5-1 summarises the different calculations used in recent research to quantify the benefits of reducing congestion per car kilometre removed.

Table 5-1: Congestion savings estimates

Source	Range values per km
Surface Transport Costs and Charges Great Britain 1998 – Sansom et al (2001)	9.71p – 11.16p
Smarter Choices, changing the way we travel – Cairns et al (2004)	3p - 45p (15p average)
Economic Appraisal of Cycling and Walking Projects – Sustrans (2006)	7p - 23p

Source: various

- 5.27 To allow more flexibility in assessing benefits, it is useful to differentiate between urban and rural environments. The Surface Transport Costs and Charges Great Britain report provides a

⁹⁰ *Sensitive Lorry Miles* – Strategic Rail Authority (2003)

⁹¹ *Personalized Travel Planning, Evaluation of 14 Pilots Part-Funded by DfT* – Operational Research Unit, DfT (2005)

⁹² *Surface Transport Costs & Charges Great Britain 1998* – Sansom, Nash, Mackie, Shires and Watkiss (2001)

⁹³ *Economic appraisal of local walking and cycling routes* – Sustrans (2006)

range of marginal congestion cost estimates. Table 5.2 shows the values identified in this report uplifted for inflation to 2006 values.

Table 5-2 Congestion savings, urban and rural values

Category	Pence per km
rural trunk and principal	11.1
urban non-central (peak)	29.0
urban non-central (off-peak)	15.0
average urban non central	22.0

Source: *Surface Transport Costs and Charges Great Britain 1998*⁹⁴

5.28 Assuming the same calculations used in the previous section for switching car/private vehicle to bicycle use (amounting to 624 kilometres per year) and using the values above per car kilometre removed, this would suggest that **the economic benefit in reduced congestion of one person switching from car use to cycling in a rural area would be £68.64 per year and £137.28 in an urban area.**

5.29 Cycling, alongside a range of support measures, can make an important contribution to encouraging a shift in travel behaviour from motorized to non-motorized transportation. In these circumstances, it is possible to quantify the benefits to society by reducing the levels of congestion across the UK's towns and cities.

Table 5-3: urban and rural values for congestion

	Congestion saving per km of car travel reduced	Estimate for 160 trips of 3.9 kms
Urban area	22.0 pence	137.28
Rural area	11.0 pence	68.64

Source: *SQW estimates*

⁹⁴ Figures inflated using the RPI from 1998 values to 2006.

6: Other cycling outcomes

- The impact of a cycling on accidents is very difficult to quantify as the effect will vary depending on the type of investment
- Casualty rates associated with cycling do not increase proportionately with the number of cyclists. Evidence indicates that the number of fatal or serious injuries can fall as the number of cyclists increases.
- The benefits gained from “regular” cycling outweigh the loss of life years in cycling fatalities by a factor of around 20 to 1
- Improvements to cycling infrastructure can be accounted for through valuations of “ambience” - the improved security and comfort of a journey. Depending on the types of investment, research suggests that this can vary from 9 pence per trip for modest changes to 94 pence for new, separate routes. These values can be applied to appropriate route improvement projects
- For groups that have no access to cars or public transport, cycling can be an important way of connecting within and between communities and offering more freedom than walking
- There are other benefits that an increase in cycling can generate including contributing to mental wellbeing, community regeneration and tourism which cannot readily be quantified.

Accidents

- 6.1 Research has found that road safety is a major barrier to persuading more people to cycle. The latest road accident statistics demonstrate that after motorcyclists and pedestrians, cyclists are the most likely to be killed on the road (per kilometre travelled).⁹⁵ The figures are shown in Table 6-1.

Table 6-1: 2004 Passenger casualty rates (per billion kilometres)

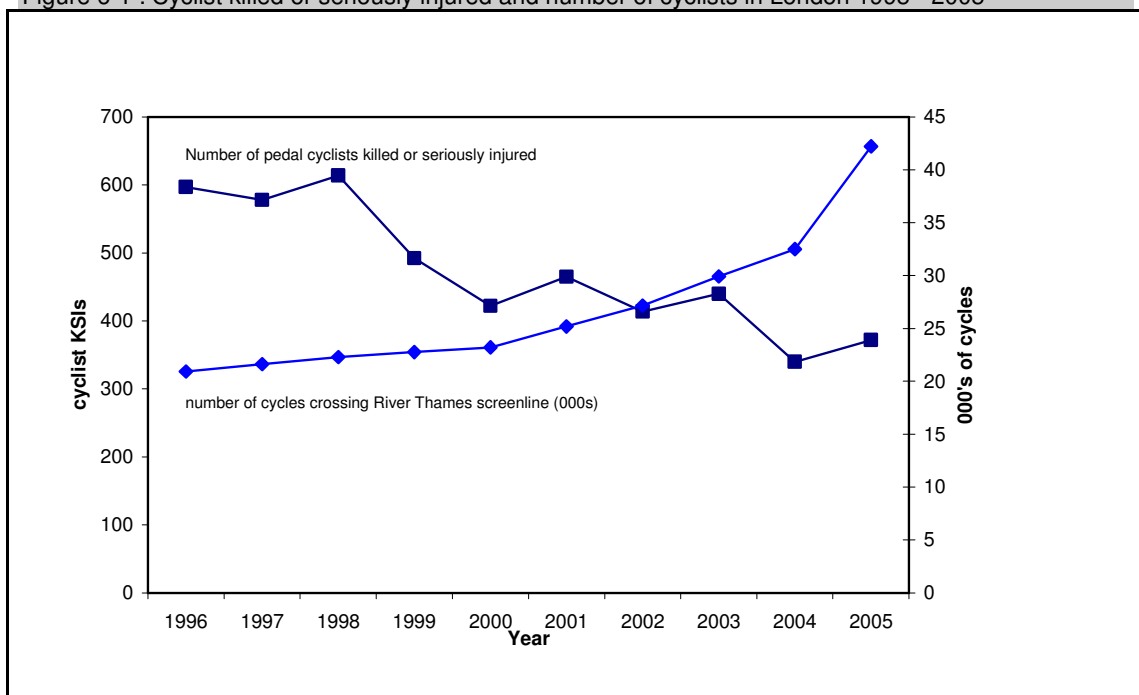
Mode of transport	Killed	Killed or seriously injured	Killed, seriously and slightly injured
Bus or coach	0.4	9	167
Car	2.5	25	280
Van	0.8	8	76
Two wheeled motor vehicle	105	1,194	4,606
Pedal cycle	35	597	4,309
Pedestrian	37	409	1,907

Source: Road Casualties Great Britain 2005 (air, rail and water figures omitted)

⁹⁵ Road Casualties Great Britain 2005 – DfT (2006)

- 6.2 While it appears from these statistics that cycling is one of the higher risk modes of transport, this is not necessarily true. The way in which accident statistics are recorded is also potentially misleading. The figures in Table 6-1 are based on distance travelled, long distance motorway journeys are likely to lessen the risk of accidents for cars and other vehicles compared to bicycles and pedestrians. It also does not take into account the risks to other road users. Cars are more likely to injure or kill pedestrians than cyclists. These figures relate only to passengers.
- 6.3 In contrast, many recent studies have found that increases in the amount of cycling are associated with reductions in the number of cyclists killed or injured. Data collated by Sloman shows that as the number of cyclists in London has increased over the last 10 years, the number of deaths of serious injuries has fallen (Figure 6-1).

Figure 6-1 : Cyclist killed or seriously injured and number of cyclists in London 1995 - 2005



Lynn Sloman 2006

- 6.4 Similar results have been found in other countries. Krag (2005) reports the case of Copenhagen where during the decade 1990-2000 the level of cycle traffic increased by 40%, the number of accidents fell by 25%.⁹⁶ In the Netherlands, between 1980 and 1998, there was a 30% increase in cycling and a 54% fall in cyclist fatalities⁹⁷. In Germany between 1975 and 1998 the modal share of cycling rose from 8% to 12% whilst cycle fatalities fell by 66%⁹⁸.
- 6.5 At a project level, the impact of a cycling project on the number of cyclist accidents and depends on the context. For example, improving cycling infrastructure at a busy road junction is likely to reduce the number of cyclist deaths and injuries (as would, for example cycle training). Alternatively encouraging more cyclists on to the road in some areas, without any supporting traffic control measures could increase the number of cyclist accidents.

⁹⁶ CBA of cycling, p.33 – Nordic Council (2005)

⁹⁷ "The Dutch Bicycle Master Plan, description and evaluation in an historical context", Ministry of Transport (NL)(1999),

⁹⁸ Pucher J. (1997), "Bicycle Boom in Germany: A Revival Engineered by Public Policy" in Transportation Quarterly 51 (4)

- 6.6 The evidence suggests it is important not to assume that an increase in cycling leads to an increase in accidents (in fact in many cases it may be associated with a reduction). This may be because as safety has improved, more cyclists have been encouraged to do it, or because more people cycling offers greater protection from other road users.
- 6.7 In the Nordic Council's review of cycling cost benefit analyses, Saelensminde (2005) argues that 'it is not known whether substituting walking or cycling trips for car and public transport use will result in more or fewer people injured in traffic accidents'.⁹⁹ Consequently, in the author's analysis of cycling projects in three Norwegian towns, there is an assumption made that there will be no change in the number of cyclist accidents. Within the same report, Lind et al (2005) state an increase in bicycle traffic can lead to positive or negative effects on the number of bicycle accidents.¹⁰⁰
- 6.8 Perhaps the most practical solution is to recognise that the impacts will differ in different circumstances. The effects are complex, but investment in well planned programmes should be able to both improve safety and increase cyclists at the same time.

Journey ambience

- 6.9 Improvements to cycling facilities will in themselves have a value to those that use them. Where they improve the comfort and security of journeys, they have a value to those that use the route. Work on these types of values has been done by Hopkinson and Wardman (1996) on safety and insecurity value. This is reported and used in the Sustrans' methodology for cost benefit analysis.
- 6.10 In the DfT's WebTAG guidance, the definition for journey ambience, which covers all travellers, is defined as the quality of the journey experience in terms of noise and air quality, comfort levels, whether they are distracted, cleanliness of the vehicle, and so on.¹⁰¹ Journey ambience is based around three factors:
- traveller care
 - travellers' views
 - traveller stress
- 6.11 It is included as part of the Sustrans' methodology for appraising cycling projects and a value of 91 pence is used per cycle trip. This is a similar value to those used in several Scandinavian cost benefit analyses¹⁰². Hopkinson and Wardman (1996) found that travellers were willing to pay a premium for facilities which are deemed safer and that increasing safety is more important than reducing travel times in terms of increasing cycling levels.¹⁰³ Whilst the study acknowledges the potential environmental and congestion-related benefits of switching to cycling from car use, it also highlights the economic benefits of improving facilities for existing cyclists, through improving the travel experience or journey ambience.

⁹⁹ *CBA of cycling, p.16* – Nordic Council (2005)

¹⁰⁰ *CBA of cycling, p.23* – Nordic Council (2005)

¹⁰¹ *The Journey Ambience Sub Objective, WebTAG guidance* – DfT (2003)

¹⁰² See earlier references to Saelensminde, 2004

¹⁰³ *Evaluating the demand for new cycle facilities* – Hopkinson and Wardman (1996)

The study quantifies the benefit of between 7 pence and 71 pence per cycle trip which varies according to the infrastructure improvements which have been implemented (1996 prices)

- 6.12 Hopkinson and Wardman’s argument that increasing cycling amongst existing cyclists is economically worthwhile suggests that even if a project has limited success in achieving the health, environment and transport outcomes described in previous sections, investing in cycling can still generate economic benefit. Their work produced a range of values that can be applied appropriately for physical improvement projects (Table 6-2).

Table 6-2: Case examples calculated from Hopkinson and Wardman (1996)

	Pence per trip (1996 values)	Pence per trip(2006 values using RPI)
Canal road widened	18	24
Canal road segregated path	30	40
Bus lane	7	9
Free cycleway	71	94

Source: Updated from Hopkinson and Wardman (1996)

- 6.13 There are also aspects of journey ambience that are part of other infrastructure projects. A reduction in the speed limit in Hull has led to a large increase in cycling in the town centre. Other traffic calming measures that deter cars from short cuts through built up areas can also have the effect of improving the ambience for cycle journeys.
- 6.14 New cycle routes are particularly highly valued as the growing numbers of cyclists using the National Cycle Network demonstrates. Sustrans has many examples of how improvements to routes can greatly enhance the quality of cyclists’ journeys.
- 6.15 Although not included in the calculations in this analysis, many traffic interventions can generate positive ambience values for existing cyclists which can be substantial. As far as possible, these should be included in CBA for specific projects.

Social inclusion

- 6.16 Around 30% of all households don't own a car and in rural communities many people have no access to a car during the day. Furthermore half of all women do not hold a driver's licence and four out of five elderly people living alone have no car. For some of these groups at least cycling provides an opportunity to make trips that would take more time to walk and access services that would otherwise be too far away to use. These are also people where cycling tends to be under represented (just 8% of women cycle regularly, compared to 18% of men).
- 6.17 It is impossible to value the type of access that cycling could afford specific groups, but it should not be ignored. This supports a more general theme in this report that the value of cycling will vary greatly between those encouraged to cycle and that a more sophisticated assessment will help identify more effectively which interventions will deliver greatest benefit.

7: Outcomes summary

- 7.1 Intuitively, cycling would be expected to contribute to addressing many of the challenges and objectives of government. Cycling is good for those that do it, the businesses they work for, the health service, the environment, communities and for other road users. The bigger question is the scale of these benefits. The previous chapters demonstrate how the scale of the contribution varies depending on the profile of cyclists and the amount of cycling that they do. It also depends on the wider transport systems within which any new cycling intervention takes place.
- 7.2 The analysis suggests that there is merit in looking at the benefits of cycling in a more sophisticated way. Not all new cyclists are the same and the value of encouraging them to cycle can vary depending on whether or not their trips replace car travel or take place in urban or rural areas. This has implications for the way in which we measure cycling projects. In particular the research highlights the complex issues around valuing the “investment” in children cycling.
- 7.3 Table 7-2 summarises the values calculated in the previous four chapters. In this Table and subsequent analyses it is assumed that the average cyclist makes 160 trips a year. This is based on the LATS¹⁰⁴ household survey in London. Note that cycling on one day assumes two trips. Of the 18% that cycle, the average number of trips per cyclist is just over three a week.

Table 7-1 Frequency of cycling LATS 2001

frequency	%
cycle on 5 days or more a week	3%
3 or 4 days a week	2%
2 days a week	2%
1 day a week	3%
One day a fortnight	1%
Once a month	2%
Less than once a month	5%
Don't cycle	81%
Total	99% (rounded)

Source: LATS 2001, household survey of 3291 interview

¹⁰⁴ London Area Travel Survey

Table 7-2: Summary of values

Health benefit	Comment	Values (assumes full year of cycling)
Value of loss of life	Note £498 for commuters found by Copenhagen study	£11.16 for 16 – 44 year olds £99.53 for 45 - 64 year olds £242.07 for 65 year olds and over £58.77 average
NHS savings	SQW estimate	£28.30 for all cyclists
Productivity gains	Based on conservative assumption and on lost GVA	£47.68 all cyclists
Total health benefits	Note that older people will tend to have higher values	£87.06 for 16 -44 year olds £175.51 for 45 – 64 year olds £159.48 average
Pollution reductions	Pence per kilometre	Estimate for 160 trips of 3.9 kms
Agglomeration	5.8 (petrol) & 32.2 (diesel)	£69.14
Rural	2.1 (petrol) & 2.0 (diesel)	£12.98
Congestion savings	Congestion saving per km	Estimate for 160 trips of 3.9 kms
Urban area	22.0 pence	137.28
Rural area	11.0 pence	68.64

Source: various

7.4 The values depend principally on a relatively small number of variables. These are:

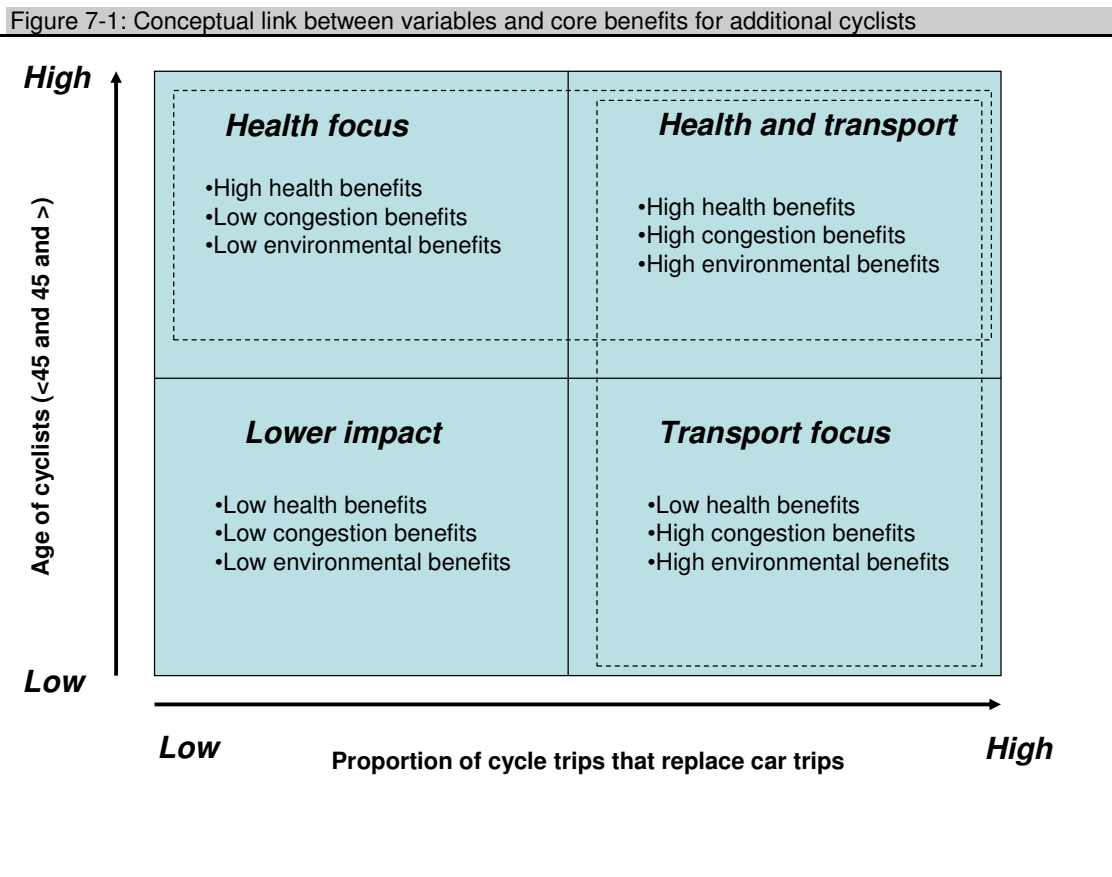
- the number of additional cyclists (and additional cycle trips)
- the profile of target group of cyclists (age and level of fitness)
- the number of cycle trips that replace car trips
- whether the new trips are made in rural or urban environments.

7.5 More broadly the effects should also take account of the wider operation of the transport system and the nature of the intervention itself, whether it encourages a regular cycling trip or just occasional cycling.

7.6 There are examples of where this type of evidence is being used to try to make these links. The DfT/Sustrans model developed in 2005 considers both whether cyclists are additional (relative to a baseline) and whether they would otherwise have made a car trip. The Bike It programme considers whether children would otherwise have made their trip to school by car. Other examples identified were more complex, particularly where the aims are not simply to replace car trips with cycling but to also to encourage other forms of “smart” travel.

7.7 Because the health benefits and changes in car use vary depending on the specific type of intervention and where it is implemented, the net effects can only be determined case by case. It is helpful to consider the main variables in the form of a matrix, which allows at least some conceptual assessment of the range of benefits. In fact the matrix shown (Figure 7-1) is potentially a useful tool in setting out the interests of different policy areas and their overlap.

- 7.8 The Figure 7-1 shows the relationship between age, which determines the value of the health benefits, and congestion and environmental benefits, which depend on the proportion of cycle trips which are substitutes for car journeys. The focus of health interventions is on the top half of the matrix and transport and the environment on the bottom. The top right box represents significant impacts on both areas, increasing levels of physical activity and reducing car travel.
- 7.9 It is important to recognise that this represents a very static or short term interpretation of the impacts. It will be just as important to build up habits of cycling among younger people so that these are carried through into older age.
- 7.10 This approach can be extended using some of the estimates made earlier in the outcomes section. Broadly, although we do not know the actual levels of changes in car use or physical activity for many interventions, we can provide guidance on the maximum and minimum values. These are helpful in framing the *scale* of the potential value of interventions. In some cases, where more information is available, a better judgement can be made on its contribution.
- 7.11 Taking this a step further requires considering the values produced in the previous chapters. These can be used to provide a frame within which the impact of specific interventions can be assessed.



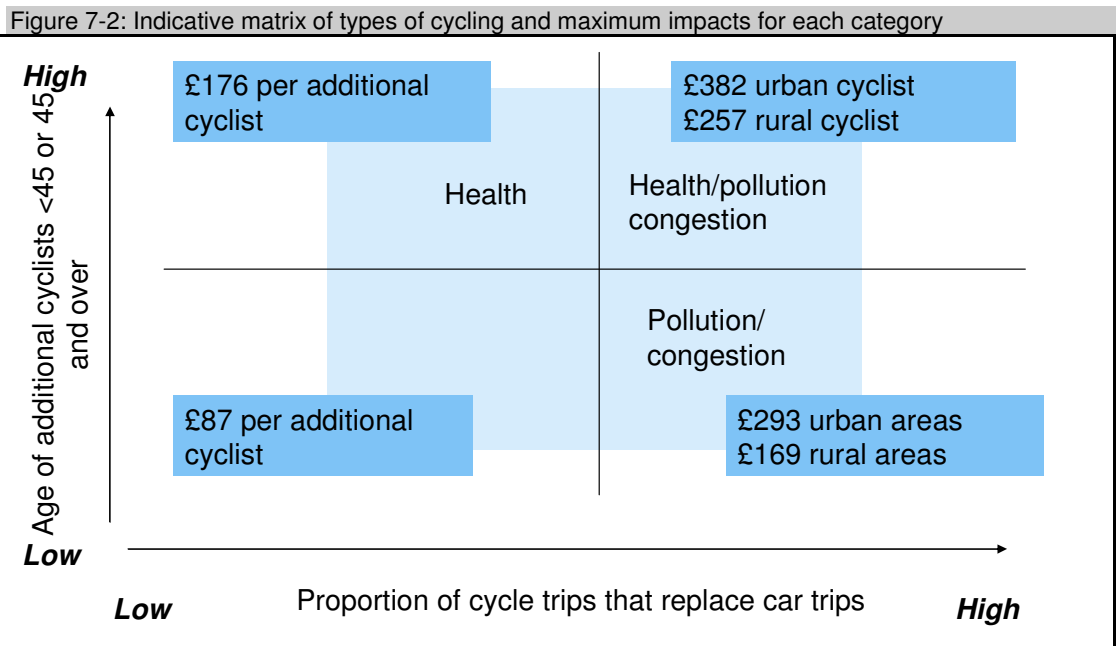
Health benefits

- 7.12 At the extremes of the diagram, we can estimate the ranges produced for health outcomes. These values vary dramatically, typically increasing as the cyclist gets older.
- 7.13 The values calculated assume that all additional cyclists effectively “step up” one level of physical activity (definitions are included in Chapter four) as a result of cycling. This gives values in a range from £11.16 for 16 – 44 year olds to £99.53 for 45 - 64 year olds and £242.07 for 65 year olds and over.
- 7.14 The average cost to the health service is estimated to be around £28.30 for all cyclists and the impact on productivity is conservatively assumed to be £47.68 of lost GVA *for all cyclists* who are working. Taken together, these produce a range of £87.06 for 16 - 44 year olds to £175.51 for 45 – 64 year olds. However, the evidence from the Copenhagen Heart Study points toward the possibility that these values being a considerable underestimate for commuters.

Car reduction

- 7.15 Along the other axis, the value of reducing car travel has two main components, the value of the reducing congestion and the contribution to reducing pollution. The value of reduced congestion is estimated to be 22p per km in urban areas and 11p per km in rural areas. These values would be higher in London.
- 7.16 The reduction in car use will also reduce pollution. The cost of pollution was valued earlier as 5.8 pence and 32.2 pence per car kilometre removed for cars with petrol and diesel engines respectively in an urban area, and 2.1 pence and 2.0 pence per kilometre in rural areas. The average annual benefit of reduced pollution for each cyclist in an agglomeration or major urban area, switching from single-occupancy car use to cycling for a regular trip of 3.9 kilometres, would be around £69.14. In a rural area the figure would be £12.98.
- 7.17 Taking the pollution and congestion benefits together, the value of an additional cyclist, making 160 trips of 3.9 km a year, by bicycle rather than single occupancy car would be **£206.42 in major urban areas and £81.62 in rural areas**. Unlike the health benefits, these values can be used pro-rata for shorter or less frequent trips.
- 7.18 This value varies depending on the number of kilometres cycled and the number of trips made. It would also depend on other changes in the transport system. Where a substituted trip takes place within a wider set of measures that encourage reduced car use, it is less likely that there will be any induced effect (other people switching mode to take advantage of the reduction in traffic). Where school trips are made by bicycle rather than car, for example, the impact may be on the distance of car travel rather than the substitution of trips entirely, if parents still travel by car but do not pass the school.
- 7.19 We have concentrated here on values per cyclist, but this is not always appropriate and can be more difficult to monitor. At a town or city level it may be easier to monitor a reduction in car traffic and an increase in cycling separately, but this makes it more difficult to prove that the additional cycling is responsible for the impacts on congestion and pollution.

7.20 Even where there are no health benefits and there is no substitution of car trips, there will still be benefits. Improving the quality of cycling infrastructure and facilities for existing cyclists can in itself demonstrate a positive return on investment. This depends on the type of improvement made and the number of cyclists that benefit. The values in Chapter 6 produced by Hopkinson and Wardman give an indication of the scale of the effects which would be taken into account as part of a cost benefit assessment. These potential values are not included in Figure 7.2.



Source: SQW

Summary

7.21 There are greater benefits in getting previously inactive and older people to cycle. These benefits are increased further when they replace car trips, particularly in urban areas. The value of these differentials is substantial, to the extent that estimating the profile of new cyclists is critical in comparing the costs and benefits of investment.

7.22 The value of cycling is higher where:

- less active people become active
- older people are encouraged to cycle
- where it replaces car trips, particularly in urban areas
- it is part of a regular journey

7.23 There are two other important aspects to this. The first is that this represents only a static view of economic benefits. There is an important dynamic element in that investing in encouraging cycling among young people will help to form behaviour when they are older. This is discussed in chapter three where the difficulties in demonstrating the link between physical activity in young people through into adulthood are covered. This link was

described as “weak to moderate”, although getting people to cycle when they are older is greatly helped by them having positive experiences of cycling when they are younger.

- 7.24 The second element is that the scale of the potential benefits needs to be balanced with the potential costs. While older groups may generate greater benefits now, they may be considerably harder to reach and more difficult (and expensive) to persuade. It might make sense to consider more cost effective options. This relates to the long term nature of the process of encouraging cycling. It should not be about maximising the economic benefit in the short term. Equally, encouraging leisure cycling may be more productive in making inroads into the fitness of the population than targeting harder to reach groups.
- 7.25 The value of increasing cycling among adults in part relates to the health benefits and these are typically based on the lives that can be saved through greater physical activity. For children, this is not appropriate. The value is in helping children to provide a stronger base for good health throughout their life by reducing the risk of obesity and diseases later in life. Most important in this is through helping to provide positive experiences of cycling that will be carried into (or more possibly, reawakened) into adulthood.
- 7.26 The value of early cycling is likely to relate to its contribution to reducing risk factors in later life. Other than to indicate that there is a positive association, it is impossible to quantify easily. Although the chances of a child’s activities tracking through to adulthood are likely to be considerably less than 100%, the impact could be on changing behaviour over a whole lifetime. If this were the case the impact would be greater than those reported for adults.
- 7.27 With congestion values there are other issues. Assuming that car trips are replaced by cycling, taking cars from major roads is more valuable than taking them from quieter roads. When pollution is also included, substituting car trips with cycling is more valuable in bigger cities than in rural areas, and is most likely to be effective as part of a wider set of measures that reduce any induced traffic.
- 7.28 Given the potentially very significant unquantifiable benefits, it is important that values used to appraise or evaluate cycling projects should not be treated conservatively and values should be used which fully reflect the value of additional cycling to society. A summary of the example values is shown in Table 7-3.

Table 7-3: estimates of values based on activity and reduction in car use

Additional cyclists...	Car switching	Area	Value per year (assuming 160 trips)
45 and over	switching 160 trips of 3.9 km per year from car to bike	Urban area	£382
	switching 160 trips of 3.9 km per year from car to bike	Rural area	£257
	Making 160 trips of 3.9 km but not switching from a car	All	£176
Under 45	switching 160 trips of 3.9 km per year from car to bike	Urban	£293
	switching 160 trips of 3.9 km per year from car to bike	Rural	£169
	Making 160 trips of 3.9 km but not switching from a car	All	£87
Ambience	Range from 9p to 91p per trip (applies to existing cyclists)		All

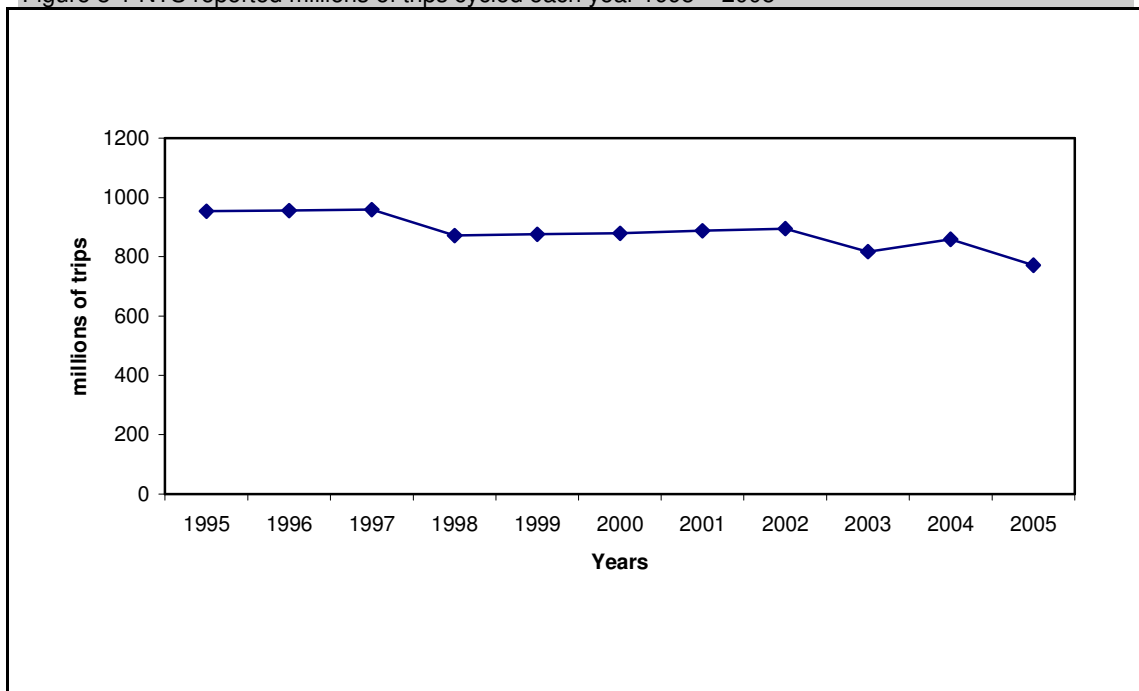
Source: SQW

8: Applying the values

Calculating the cost of the reduction in cycle trips since 1995

- 8.1 The National Travel Survey (NTS) 2005 reports that between 1995 and 2005, the number of cycle trips made in the UK fell from 18 to 14 per person and from 20 to 15 in England, a fall of 25%. The fall in absolute number of trips is slightly less (19%) because of the increase in population over the same period. Figure 8-1 shows the number of trips each year. Estimates are made for years where the data was not produced.
- 8.2 There is considerable debate about how representative these figures are. The survey does not include cycling that takes place off the road network and therefore excludes the large number of trips made on cycle tracks or routes. It only includes trips where cycling is the “main mode” and excludes cycle trips to stations, where train travel would be recorded as the main mode. Sustrans reports that during 2005, 193 million trips were made on traffic-free sections of the National Cycle Network, a figure that has increased every year since the Network was launched. This means that the NTS is likely to underestimate the amount of cycling taking place.
- 8.3 The NTS remains the official source of data on cycle trips and forms the basis of the following examples. With these caveats, the analysis used in the next section should be considered as only *indicative* of the levels of benefits that could be achieved through an increase in the number of cycling trips.

Figure 8-1 NTS reported millions of trips cycled each year 1995 – 2005



Source: Extrapolated from National Travel Survey data 2005

- 8.4 On the basis of the NTS data, if the number of trips cycled had remained at the 1995 level, 953 million a year, over the past ten years, the cumulative effect would have been an

additional 762 million cycle trips. Using assumptions, these “lost trips” can be valued using the calculations in the previous chapters. The assumptions are:

- that these trips would have been evenly spread across the adult population
- health savings are only applied to adult trips
- that 50% of them were replaced by car journeys
- that these trips would have been equally spread between urban and rural areas
- that 6.5% of trips are made by cyclists that are not cycling sufficiently to make any difference to health¹⁰⁵ and the remaining 93.5% of trips are made by people cycling 286 trips a year
- in fitness terms, the “lost cyclists” are assumed to drop down one level of physical activity as defined in the National Heart Forum report.

8.5 Table 8-1 shows the values associated per cyclist. The values for congestion and pollution assume that half of the trips are replaced by car. On this basis, the combined value per trip for adults is £0.91. Assuming that the cycle trips are made evenly across the population, the figures are adjusted to exclude the value of health-related benefits among children. This leaves just the pollution and congestion benefits associated with trips made by those under 16 (£0.44 per child trip).

Table 8-1: Average values per trip

	Per cyclist	Per trip
Premature death	£58.77 (adults)	£0.21 (average of 286 trips per person per year)
Absence from work	£47.68 (adults)	0.10 (average of 286 trips per person per year)
NHS saving	£28.30 (adults)	0.17 average of 286 trips per person per year
Pollution	£34.57 (all)	£0.11 (assumes 50% of trips are replaced by car)
Congestion	£102.96 (all)	£0.32 (assumes 50% of trips are replaced by car)
Total per trip	Adult	£0.91
	Children	£0.44

Source: SQW estimates

8.6 On the basis of the NTS data, the cumulative cost in terms of health, congestion and pollution that would have been avoided had the number of cycle trips remained at the 1995 level is £600 million¹⁰⁶.

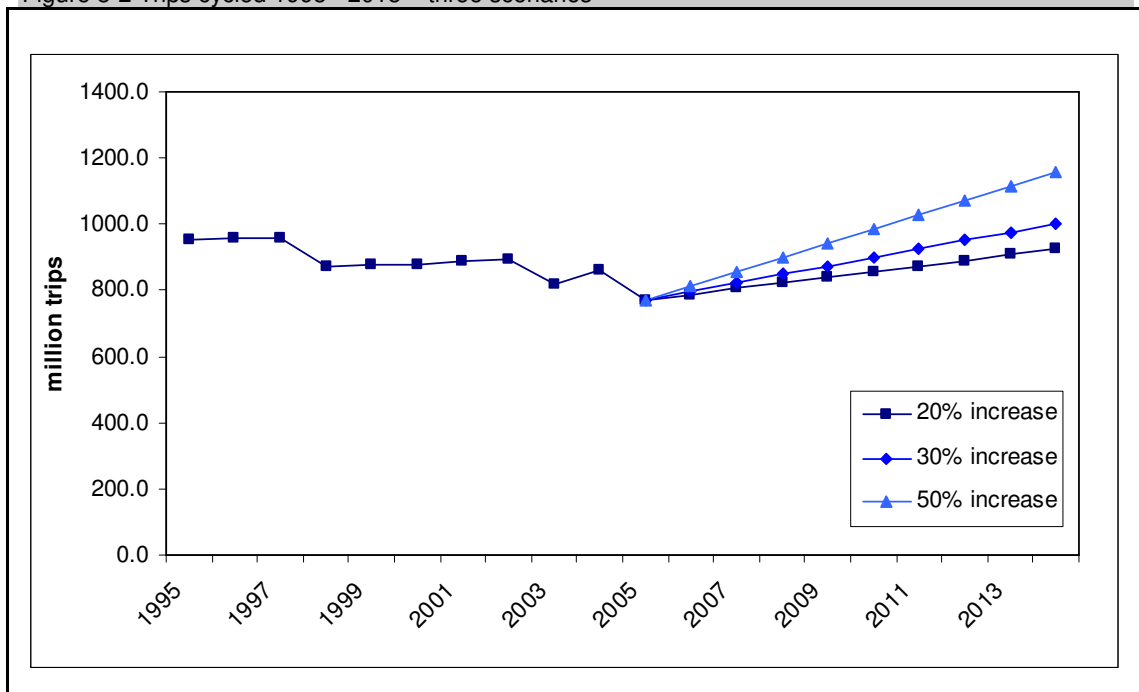
¹⁰⁵ Based on the London Area Travel Survey cycling frequencies (2001)

¹⁰⁶ This figure is not adjusted for inflation. Calculation is shown in Annex A – Table 1

Looking Forward

- 8.7 A similar process can be used to estimate the potential benefits of increasing cycling over the next ten years. Three scenarios are presented in which the number of trips cycled increases by 20%, 30% and 50% to 2015.
- 8.8 Figure 8-2 shows the pattern of trips reported by the NTS from 1995. It shows the fall to 2005 and then three scenarios which each show different levels of straight-line increase to 2015. The scenarios use 2005 as the base year (the most recent NTS data) but the effects will be broadly the same if 2006 – 2016 is used.
- 8.9 A 20% increase would, over a period of ten years, mean a return to the level of 1995. This would be a very modest target, considerably less than the 400% increase proposed in the original cycling strategy. Increasing the number of trips cycled by 50% over ten years would not be unreasonable and the value of resources and lives saved would be substantial.

Figure 8-2 Trips cycled 1995 - 2015 – three scenarios



Source: SQW estimates

- 8.10 The assumptions are similar to those set out previously:
- that these trips are evenly spread across the adult population
 - that 50% of them replace by car journeys
 - health benefits are only applied to the proportion of adult trips
 - that these trips are evenly spread between urban and rural areas

- that 6.5% of trips are made by cyclists that are not cycling sufficiently to make any difference to health¹⁰⁷ and the remaining 93.5% of trips are made by people cycling 286 trips a year
- that new cyclists are assumed to “move up” one level of physical activity as defined in the National Heart Forum report.

8.11 The results are shown in Table 8-2. The values have been calculated over ten years and discounted at 3.5% to provide a net present value. However, this is likely to be an underestimate as over the next ten years the values are almost certain to rise in real terms. NHS drugs, value of premature death and lost earnings and potentially the cost of congestion will all rise as output per person increases in real terms. Pressure to reduce carbon emissions means that the value of reducing pollution will also increase.

8.12 The results show that if the number of cycle trips returns to 1995 levels by 2015, the savings would be around £500 million. An increase of 30% in trips would generate £800 million pounds of savings and a 50% increase just over £1.3 billion. Table 8-3 shows the projected value of savings with increases in the number of kilometres cycled over the next ten years.

Table 8-2: **Cumulative** savings generated as a result of increases of 20%, 30% and 50% in the number of cycle trips made between 2005 and 2015

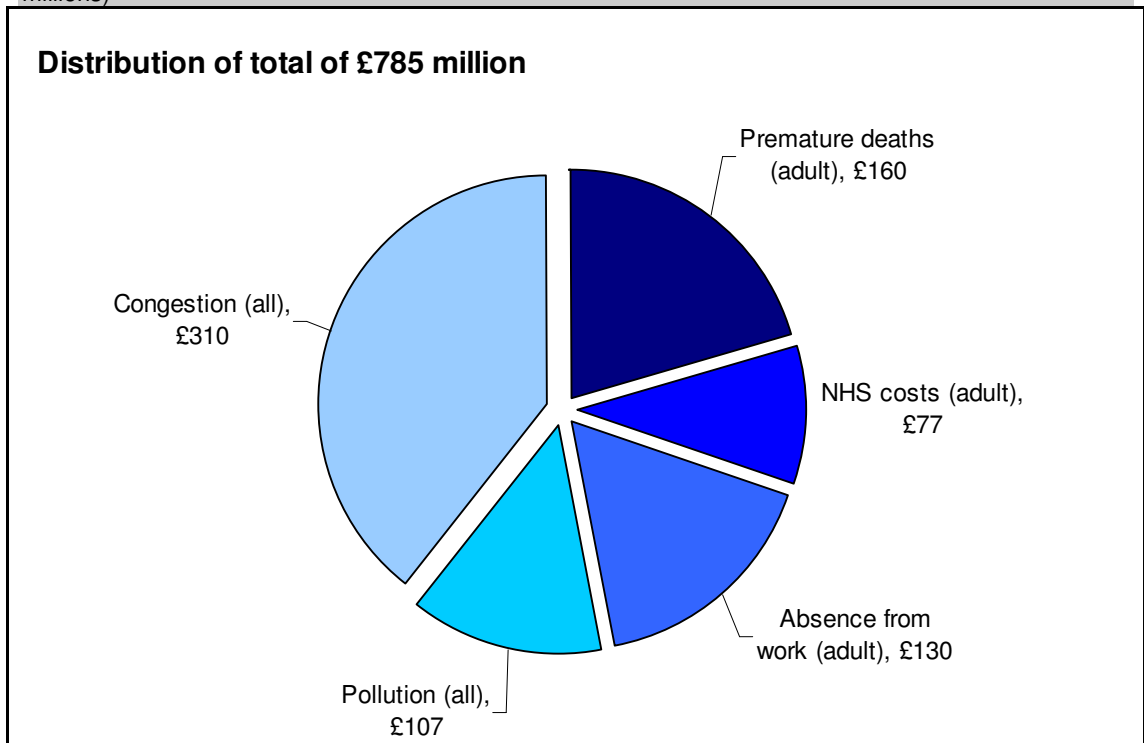
	20% increase in cycling (£ millions)	30% increase in cycling (£ millions)	50% increase in cycling (£ millions)
Premature deaths (adult)	£107	£160	£267
NHS costs (adult)	£52	£77	£129
Absence from work (adult)	£87	£130	£217
Pollution (all)	£71	£107	£178
Congestion (all)	£207	£310	£517
Totals	£523	£785	£1,308

Source: SQW estimates – results are included in more detail in Annex A

8.13 In Figure 8-3 the distribution of these savings is shown graphically. Around 40% of the savings relate to reduced congestion and 40% to health related savings prevention of premature death, reduced absenteeism and reductions in NHS costs. Pollution represents a smaller part of the saving, partly because of the assumption of 50% of new trips replacing car trips.

¹⁰⁷ Based on the London Area Travel Survey cycling frequencies (2001)

Figure 8-3 Distribution of **cumulative** savings as a result of a 30% increase in cycle trips by 2015 (£ millions)



Source: SQW

9: Intervention cases

- 9.1 In this section we have used the values from the analysis to produce impact results for four investments made to encourage cycling. The report has found that there is very limited data on the extent to which different types of investment have led to additional cycling in the form of either more frequent or longer trips or new people cycling. There is a tendency to monitor the absolute level of activity rather than the *difference* that the intervention is made. This is partly because of the difficulty determining what would have happened in the absence of the investment. Typically, projects will report the total number of cycle trips made rather than the amount of new cycling. A second and connected challenge is determining the number of people making these trips. To estimate the possible health benefits it is necessary to understand the profile of those making the trips. Monitoring data tends not to capture this, focusing instead on the number of trips.
- 9.2 In this section we have used the monitoring data available for four interventions and where necessary applied a series of assumptions. This allows at least some indication of the net value of the investments and the benefit cost ratio. In turn, some comparison of value for money can be made.
- 9.3 Having reviewed a number of examples of cycling investment, these four projects were considered to have at least basic monitoring data that could be used to derive estimates of number of additional trips. There are a number of important caveats that run through these examples:
- the results shown are based on monitoring data in three cases and estimates for the LCN+. It is not possible to revisit the original data or to test the robustness of the monitoring that has been done.
 - in converting the number of reported additional trips to cyclists, data on cycling frequency and age profile has been used from different sources
 - the use of the various benefit factors (calculated earlier in this report) must be applied appropriately. Congestion values vary depending on the timing of trips and where they take place. School and commuting projects will tend to have higher values. The pollution values in chapter four are extremes. The value for agglomerations is appropriate for London and major urban centres. For most towns and cities a mid point value between the rural and urban figures is used.
 - the analysis presents the results of investments in isolation. In practice, the support of cycling and walking will depend on a package of measures. The full benefits of reducing pollution and congestion can only be achieved within a broader approach to discouraging private car use. Physical infrastructure may only generate benefits when it is supported by marketing and training support. Equally, marketing and training will not deliver benefits unless there are safe and convenient cycle routes.

9.4 Finally, transport appraisal has developed over the course of forty years to reach the relatively sophisticated level it is today. There is now a lot of guidance published on how to appraise transport schemes related to the main modes such as road and rail. In contrast, cycling (and walking) appraisal has only been developing over the last three or four years. As a result, it is certainly not complete. It would be misleading however if the limited availability of data and challenges of the methodology prevented consideration of these modes.

There is certainly an urgent need for better monitoring and evaluation of cycling interventions to build up evidence and strengthen the methodology. In the meantime, the examples below offer at least some comparison of the likely benefits and costs.

10: Links to Schools

Description

- 10.1 The Links to Schools programme aims to connect young people to their schools by providing traffic-free and traffic-calmed walking and cycling routes. The project started in October 2004 and is administered by Sustrans with the majority of the links being completed between spring and autumn 2005. There have been 147 links developed providing improved walking and cycling access for over 300 schools. The first phase has invested £26.3 million including a £10 million grant to Sustrans from the DfT.

Monitoring Data and Outputs

- 10.2 Monitoring data has been collected by Sustrans on 15 of these routes and is presented by Sustrans in a publication produced with the DfT¹⁰⁸. This sets out the highlights achieved in these cases. The data provides the number of trips made at survey points on the routes and profiles the people using them. Each case is unique and involves a combination of improvements to existing routes and development of new paths. The Sustrans analysis considers both cyclists and walkers, but here the data has been disaggregated to cover only cycling trips.
- 10.3 The published information has been supplemented with the original monitoring data, provided by Sustrans, collected from each of 15 routes. For example, although only the Sustrans administered grant is shown in the publication, other cost data has been collected to allow the full costs to be included.

Additionality

- 10.4 A proportion of the cycling and walking trips made on these routes are likely to have been made anyway, prior to the improvements or construction of the new links. To assess the benefits, it is important to determine the number of *additional* cycle trips. In a number of cases the monitoring surveys were done before and after the improvements were implemented and where this was the case we have used the *change* in the number of trips. In most cases surveys *followed* the interventions and to measure the change the analysis uses monitoring data on levels of physical activity.
- 10.5 The monitoring data reports whether *the route* has helped respondents to increase levels of regular physical activity by “a large amount, a small amount or has made no impact”. This is used as an indicator of whether or not these are genuinely new cycling trips or whether they have been displaced from other routes. It is reasonable to expect that among those that were not already cycling or walking the use of the route would lead to a “large” change in their level of physical activity.

¹⁰⁸ *Walking and cycling: ‘Links to Schools’*, Sustrans and DfT 2006

- 10.6 The analysis assumes that those that reported “small” or “no change” in levels of activity have been displaced from other routes and do not represent additional trips. The number reporting a large change in physical activity typically represents around 25% of cycle trips across the 15 cases, although this figure varies by projects.

Age groups

- 10.7 Although the Links to Schools interventions aim to increase walking and cycling trips by children, the routes are regularly used by others. The survey data has allowed the analysis to identify the proportions within each age group and the appropriate health benefits have been applied. The survey also identifies the proportion of those making trips that could have used a car but chose not to.
- 10.8 There is also data on the average distance of the trips made. Where the monitoring data reports specific cycle trip distances we have used them. Where there are several figures, the analysis uses commuter averages rather than the longer distances for leisure trips. Where there is no evidence we have used the national average of 3.9 kms per trip. The average distance across the 15 cases is 4.9 kms.

Journey ambience

- 10.9 From the descriptions of each of the 15 routes and reviewing the maps shown for six of the projects we estimate that there is around 0.5 km of new paths and 1 km of improved shared use routes on average, for each case. Not every trip made will include travel on all parts of the new or improved route, although some of the links make it easier to access existing routes, which also improves journey times. We have assumed that for each of the existing users, those that use the routes benefit from half of the distance of the improvements (0.25 km of new paths and 0.5 km of new shared cycle lane). Table 10.1 shows the aggregate numbers across the 15 cases.

Table 10-1 : Links to Schools data (Results for individual projects in appendix)

	Based on most recent surveys Aggregates	Comment
Total trips	2,894,000	Total walking and cycling trips based on surveys conducted for 15 routes
Cycling trips (per year)	694,738	Number of <i>cycling</i> trips (based on proportion in each case)
Estimate of additional cycling trips	185,255	Based on proportion of respondents who reported that the route has led to a "large change" in physical activity
Children trips(per year)	79,717	From route surveys
Adults trips (assumed to be under 45)	92,691	From route surveys
Older adults trips (assumed to be 45 or over)	12,930	From route surveys
Additional trips choosing not to use a car	68,277	Respondents asked whether they had chosen not to take a car on this trip
Average trip length	4.9kms	Average of trip lengths reported in surveys
Journey ambience	Average of 0.5 new path and 1.0 km of improved shared route	Based on simple assessment of amount of new and improved paths

Source: Sustrans monitoring of Links to Schools

Estimating the benefits

- 10.10 Because the routes are used by people of all ages and not just children some direct health benefits can be calculated (among additional cyclists). We have assumed that to achieve the health related benefits *each cyclist cycles on one day a week*. Around 6.5% of trips are made by people who will not cycle sufficiently to achieve the health benefits. Based on the profile of cycling frequency in the main report, the remaining 93.5% make around 290 trips a year. On this basis the number of cyclists that will benefit from the health effects can be estimated. The profile data from the monitoring surveys allows the estimate of new cyclists to be distributed between age categories and the appropriate values for loss of life, productivity and health costs to be applied.
- 10.11 The locations of the interventions impact on the estimates of pollution and congestion. The analysis assumes an equal distribution between urban and rural trips and uses the proportion of additional cyclists that could have used cars as a basis for calculating the reduction in the number of car kilometres. The appropriate values for pollution and congestion have then been applied.
- 10.12 Journey ambience is based on the value of the improvements to the full population of those using the routes. This is applied in full to those that would have cycled anyway along the route and half values are applied to the additional cyclists (where their decision to cycle

reflects an improvement in quality)¹⁰⁹. The values are set out in the full report. In this case the values are adjusted pro-rata to reflect the amount of improvement on an average trip. On average the contribution to journey ambience is 11p per trip.

- 10.13 It is assumed that the number of trips generated by the intervention remains the same over a 30 year period. There are arguments that this number may rise over time, but this is more likely to be the result of other factors rather than the improvements themselves. Equally, transport models suggest that as incomes rise and car ownership grows, car travel will increase while other modes decline. It is not possible to anticipate whether the number of cyclists will increase or reduce over time and the analysis therefore assumes a simple step increase as a result of the intervention, to a level that remains constant thereafter.
- 10.14 The values for each of these categories are shown for one year in Table 10.2. The total for one year is £261,000.

Table 10-2 LtS benefits by Category

Type of Benefit	Value (£ per year)	
Loss of life	£	41,000
NHS costs	£	11,000
Productivity	£	19,000
Pollution	£	26,000
Congestion	£	66,000
Ambience	£	98,000
Total per year	£	261,000

Source: SQW estimates

Costs

- 10.15 Sustrans has provided the full cost of each of the 15 routes. This is assumed to be capital expenditure made within the first year of the project. There may be a small amount of maintenance spending required over the period of the appraisal. The details of this are not available. We have assumed that 1% of the capital budget is spent each year on repair and maintenance for the 30 years of the appraisal (around £19,000 a year)
- 10.16 Although the total investment for the 15 projects is £3.5 million, not all of this can be attributed to cycling. The projects are also intended to encourage walking and the majority of trips reported by Sustrans are walkers rather than cyclists. To determine the proportion of the cost that should be attributed to cycling, the descriptions of each of the 15 projects have been reviewed. Where the project was primarily improvements for cycling 100% has been allocated, where it was *mainly* cycling, 75%, and where it was mixed use, cycling and walking, 50% has been allocated to cycling.

¹⁰⁹ This is referred to as the “rule of half”. New users benefit just as old users did. But they don’t benefit as much because there is no indication of their previous willingness to pay, so the rule of half is applied.

- 10.17 The total costs attributed to cycling are estimated to be £1.9 million, just over half of the total investment.
- 10.18 The benefits and costs have been discounted using a 3.5% discount rate over a 30 year lifespan. This is shorter than the full 60 years that is frequently used for transport appraisals of other infrastructure projects on the basis that 30 years represents a realistic estimate of lifespan before major resurfacing or replacement would be required. Over a longer period, there would also be other uncertainties such as schools relocating, closing or merging, for example. The benefit to cost ratio is shown in Table 10-3.

Table 10-3 Links to Schools: costs, benefits and ratio based on discounted values over 30 years excluding the values for children's health

	Benefits and costs excluding child health benefits £ millions
Benefit (£ PV)	£4.80
Cost (£ PV)	£2.22
Net Present Value	£2.58
Benefits to cost ratio	2.2

Source: SQW

Scope of the analysis and comparison

- 10.19 Projects that encourage cycling to school will generate greater benefits than those that can be valued in this analysis. The estimates exclude contributions to the physical development of children, reducing obesity and its associated costs, the possible benefits to educational performance and potential reductions in accidents as a result of safer routes.
- 10.20 An analysis of three of the Links to School routes was conducted by Sustrans. This produced much higher cost benefits ratios (Table 10-4). There are many reasons for the differences in the two results. The main ones are that the Sustrans evaluation:
- uses a 60 year time period rather than the 30 used here
 - includes the costs and benefits of walkers as well as cyclists
 - includes growth in the numbers over time (5% a year over first five years) which is not done here
 - applies average health benefits to children, which is not done here
 - uses ambience values for trips associated with separated cycle paths
 - includes a value for reductions in accidents, which is not included here.

Table 10-4 Sustrans' estimates of costs and benefits from three school routes

	Case study 1	Case study 2	Case study 3
Present value of benefits	£12,601,051	£5,766,824	£16,782,954
Present value of costs	£430,294	£177,224	£1,126,014
Net present value	£12,170,757	£5,589,600	£15,656,940
Benefit to cost ratio	29.3	32.5	14.9

Source: Sustrans' evaluation of school routes

11: Bike It

Project Description

- 11.1 Bike It aims to increase the number of young people cycling to schools and on other journeys. It funds dedicated school Bike It Cycling Officers who work closely with selected schools to encourage cycling. Activities undertaken by the Bike It Cycling Officers include explaining and promoting the benefits of cycling, providing practical advice to school management teams, contributing to classroom work, addressing concerns about safety and liability and organising cycling events such as Bike to School Week. The four original Bike It Schools Officers were based in Derby, York, Manchester and Bristol and worked with 40 schools. In the second year of the project, this expanded to include officers in Exeter, Lancaster, Aylesbury, Brighton and Hove (the new Cycle Demonstration Towns) and two new officers in London. The project's target age group is 9-12 years old with goals that include reducing congestion, lowering pollution outside schools, improving fitness and forming good travel behaviour habits. The project is managed by Sustrans, funded by the bike industry and supported by DfT and the National Cycling Strategy Board.

Monitoring Data and Outputs

- 11.2 Sustrans estimates that the percentage of all pupils cycling to school rose from an average of 2% to 8% over the first year of Bike It. Every school participating recorded an increase in cycling. The first survey covered 3010 pupils and 810 parents to determine the baseline cycling levels. A second survey received responses from 2132 of the same pupils at the end of the summer term. This survey found an increase from 3.9% of students cycling to school to 11.3%. One third of these new cyclists had previously travelled by car.
- 11.3 The results show that cycling in the 40 participating schools quadrupled from 2% to 8% of all school journeys over the course of the programme and every school that participated reported an increase in cycling to some extent. The data allowed Sustrans to estimate that between 2,500 and 3,500 *additional* parents and pupils cycling to school.
- 11.4 The analysis uses Sustrans' monitoring data. It is not possible to verify the results independently and we have taken the mid point of 3,000 additional children and parents cycling as the basis for the assessment. The analysis assumes that 10% of this figure (300) is parents and that these are additional trips.
- 11.5 The monitoring data does not indicate the distances cycled, the frequency of trips or whether these *new* trips replaced walking or bus trips, but the survey found that 33% of the new cycle trips, replaced car borne trips. The relevant factors and assumptions are shown in Table 11-1.

Table 11-1 Bike It appraisal inputs

Factor	Determinants	Value
Number of new users that significantly increase activity	3,000 new cyclists (from Sustrans estimate)	3,000
Age group of new users	Although the description includes parents there is no indication of the number of adults. We have assumed 10% are adults	2,700 children and 300 adults
Car km that do not take place	Following have been used: <ul style="list-style-type: none"> Assume 6 trips per week – survey simply describes the number cycling to school (SQW assumption) Assume trip length of 3.7 kms to school¹¹⁰ (from NTS data on average school trip length) Assume that although parents may still take cars to work and that the actual reduction in car travel is shortened by half this amount 1.8 kms (SQW assumption) Assume 33% of new trips were previously car-based (from survey) Assume for multiple occupancy that parents would make car trip with one child Annualisation of 35 weeks used (40 excluding holidays and reduced by a further five to allow for bad weather sickness, school trips etc. 	Number of reduced car trips 187,110 Reduction of 336,798 car kms
Urban / rural	Analysis assumes 50% of trips are rural and 50% urban	Trips allocated between urban and rural environments

Source: SQW

- 11.6 The results of the calculation of benefits split by category are shown in Table 11.2. Although the small number of additional adults cycling provides some quantifiable health benefit, the benefits through protection against heart disease, reduction in work absence and NHS costs are not appropriate for children and are not included.
- 11.7 The pollution estimates are based on the reported reduction in car use as described above. The urban pollution values are based on London and therefore likely to be too high for non-London schools. To allow a more realistic indication of the value of benefits the trips are the divided evenly between urban and rural environments.
- 11.8 The congestion values for urban and rural environments shown in the model are for off-peak travel and therefore potentially underestimate this aspect. The peak time value appropriate for travelling to school is £0.29 for urban, non central car travel per kilometre¹¹¹. The rural value remains unchanged.
- 11.9 There is no change in physical infrastructure through this intervention and so no ambience values are included. The values for each of these categories are shown for one year in Table 11.2. The total for one year is £114,000.
- 11.10 The impact of the intervention is assumed to last for three years. This reflects the duration over which the intervention is assumed to have an impact on a single cohort of participants.

¹¹⁰ From the National Travel Survey 2005, average distance travelled to school 5 – 16 years old is 2.3 miles or 3.7 kms.

¹¹¹ Surface Transport Costs and Charges (1998)

The level of cycling activity generated by Bike It, and used in the model, assumes that there will be a fall off in interest in the second and third years. As a result, cycling activity among those that participated in the first year is assumed to fall by 10% in each of the second and third years. This is the impact on a single cohort after the initial intervention. It does not reflect the effectiveness of the intervention working with new cohorts in future years.

Table 11-2 Bike It benefits by category

Type of Benefit	Value (£ per year) (excluding health benefits for children)	
Loss of life	£	3,000
NHS costs	£	8,000
Productivity	£	14,000
Pollution	£	22,000
Congestion	£	67,000
Ambience	£	-
Total per year	£	114,000

Source: SQW

Costs

- 11.11 Bike It costs a total of £500,000 over two years, however, the results presented in the review are for the first year of the intervention. The cost of the first year was £250,000. There is assumed to be no additional revenue or maintenance costs beyond this sum.
- 11.12 The benefits and costs have been discounted using a 3.5% discount rate over the three years. The results show that including the health benefits for children at this level increases the value of benefits by around £500,000. Without health benefits for children the present value of the benefits generated by Bike It are roughly equal to the present value of the investment. Including the values of health benefits applicable to 16 – 44 year olds generates a present value return that is three times the investment.

Table 11-3 Bike It costs, benefits and ratio based on discounted values over 3 years

	Benefits and costs excluding child health benefits £ millions
Benefit (£ PV)	£0.33
Cost (£ PV)	£0.24
Net Present Value	£0.09
Benefits to cost ratio	1.4

Source: SQW

Scope of the analysis

11.13 Projects that encourage cycling to school will generate greater benefits than those that can be valued in this analysis. There are several elements that would substantially increase the level of benefit:

- the contribution of Bike It to safety among those that cycle to school is not valued. It is very likely that the Programme will have an impact on this and that its value would be significant
- the results also include the potential health benefits for children which again are likely to be substantial but cannot be measured.
- other potential benefits include contributions to the physical development of children, reducing obesity and its associated costs and the possible benefits to educational performance Each of these would contribute significantly to the overall benefit of the Programme.

12: London Cycle Network

LCN+ Project Description

- 12.1 LCN+ aims to increase the level of cycling by delivering a well-designed cycle network that is fast, safe, convenient and easy to use. The project got underway in 2004 and seeks to extend the existing cycle routes in London by 900km by 2010. By increasing the number of cycle lanes and improving access to stations, popular destinations and the rest of the transport network in London, LCN+ aims to improve journey times and increase safety for both new and existing cyclists. Other specific measures include giving cyclists greater priority at junctions and crossing points and minimising conflicts with other traffic as well as redressing the inappropriate use of road space. The LCN+ has a particular emphasis on high density commuter routes and aims to improve journey ambience taking into account urban design principles for cyclists.
- 12.2 Because LCN+ is part of this package it makes it both difficult and potentially misleading to consider this part of the investment in isolation. Even so, it provides an indication of how the values calculated can be applied. The analysis is based on Transport for London's Business Case which provides both estimates of additional cycle trips associated with the LCN+ and the costs separately. This allows at least an indicative assessment of the related benefits.
- 12.3 It should be borne in mind that the attribution of additional cyclists to the LCN+ (as opposed to other measures) is not very precise and that this analysis does not allow recognition of the important linkages between the different measures that collectively contribute to any increases in cycling.
- 12.4 A further factor is the role of the London bombings and the congestion charge in increasing the number of cyclists in the capital. The contributions that each of these factors and the investments have made to the increase in cycling levels cannot be quantified, but should be considered when reviewing the results.

Monitoring Data and Outputs

- 12.5 The data provided in the 2004 Business Case uses examples from other cities to anticipate the number of additional cycle trips that would be made under different scenarios. The TfL 2006 Business Case estimates that there has been a growth of 157,000 daily trips and it attributes the LCN with generating 89,000 of these. This has been calculated using the expected impacts for each element of the programme (TfL, 2006).
- 12.6 The LCN+ Business Cases (2004 and 2006) provide a variety of information that informs the appraisal. There are several important caveats in presenting these estimates:
- The data on which the analysis is based represents estimates of the *potential number of additional cycling trips* that is anticipated as a result of investment. Unlike the previous examples, it is not based on actual monitoring data. The data presented for the 2006 Business Case update is based on the proportion of each element of the

cycling investment package that has been completed. This method gives a figure which is close to the number of additional cycle trips reported in the cycling trip monitoring data, leading the Business Case update to conclude that the original estimates are being achieved. The figures are not based on direct monitoring of the LCN+ and the additional cyclist numbers should be treated only as indicative.

- The second major caveat is the difficulty in attributing cycle trips to specific measures. Increasing trips on the LCN+ will not only be the result of the infrastructure but the combined effect of other activities such as promotion, training and other cultural changes. It is impossible to disaggregate the effects. The TfL Business Case does, however, provide a separate estimate for new trip generation.

12.7 In preparing the estimates a cashflow spreadsheet was prepared to allow for the number of additional cyclists to build up from the reported 89,000 a day in 2006 to 165,000 in 2012, when the full investment has been made. The increase is assumed to be in a straight-line. The appraisal inputs are shown in the table below.

Table 12-1 LCN+ Appraisal inputs

Factor	Determinants	Value										
Number of new users that significantly increase activity	<p>The following have been used:</p> <ul style="list-style-type: none"> • Profile from 2004 – 2012 – from 89,000 additional daily trips claimed in 2005 up to 165,000 in 2012 when the work is completed. • The number of trips remains at 165,000 from 2012 to 2032 (20 years from completion) • LATS data for 2001 estimates that the average number of cycle trips taken by residents in London is 160, however, those that cycle only once a fortnight or less would not achieve health benefits (this group makes up 6.5% of trips) • The remaining 150,000 trips would be made at an average of 290 trips per person per year • Assumes that 13% are made by people who switched from journeys that involved walking as a significant element 	After 2012, 182,000 cyclists making 290 trips a year each										
Age group of new users	The following age profile has been used based on the NTS data 2005 for all cycle trips. It is assumed that this is the same profile for London cyclists	<table> <thead> <tr> <th>Age</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>0-16</td> <td>27%</td> </tr> <tr> <td>16-44</td> <td>37%</td> </tr> <tr> <td>45-64</td> <td>22%</td> </tr> <tr> <td>> 65</td> <td>14%</td> </tr> </tbody> </table>	Age	%	0-16	27%	16-44	37%	45-64	22%	> 65	14%
Age	%											
0-16	27%											
16-44	37%											
45-64	22%											
> 65	14%											
Car km that do not take place	<p>The following have been used:</p> <ul style="list-style-type: none"> • assume an average trip length of 3 kms (from TfL Business Case) • assumes 25% of new trips were previously car-based (TfL / Accent survey) 											
Urban / rural	Analysis assumes all trips are urban although London congestion values in particular are likely to be higher. This is especially the case on routes near to schools.											

12.8 The assumptions for journey ambience (the improved perception of safety and feeling of security) are based on the planned investment to create 1,000km of new route. The profile of the network set out in the original Business Case has been used to calculate the number of

kilometres of segregated paths, shared bus lanes and free cycleways. Though TfL is presently researching values for other improvements, these are the only ones that values have been obtained for to date (taken from Hopkinson and Wardman 1996). As a result, all other improvements, such as signage, have not been assigned a value. The value per trip has been derived from the proportion of improved route passed on an average journey of 3.2km.

- 12.9 The profile of improvements is shown in the following table. By applying the Hopkinson and Wardman values to the proportion of each category, an average value of 29p per trip cycled has been derived.

Table 12-2 LCN+ ambience values

Equivalent category of route	Kms planned on LCN+	Value per trip £'s	Average value per trip £'s
(Canal road) segregated path	180	0.4	
Bus lane	216	0.09	
Free cycleway	180	0.94	
Other (eg signage)	334	0	
Average per Km			0.29

Source: SQW, TfL and Hopkinson and Wardman estimates

- 12.10 This value would apply to all trips on the existing routes. There is no data on the numbers cycling on these routes before the improvements so no value has been applied to existing users. We have used half of this value in applying it to the new cyclist trips¹¹². In addition there will be benefits for existing cyclists switching to the LCN+ routes.

Table 12-3 LCN+ benefits by category shown for 2006

Type of Benefit	Value (£ per year)
Loss of life	£5.4
NHS costs	£1.9
Productivity	£2.5
Pollution	£2.7
Congestion	£5.4
Ambience	£4.5
Total based on 2006 figure	£22.3

Source: SQW estimates

¹¹² Often referred to as the “rule of half” – because the improvements are not fully relevant for people cyclists who did not use the route before the investment.

Costs

- 12.11 The cost of the LCN+ programme during the years 2004 – 2012, totals £205 million including investment by both TfL and the London boroughs. The timing of the expenditure is used in the discounted cashflow to calculate the NPV and BCR.
- 12.12 Although the capital costs end in 2012, the model has included a further 1% of the total capital spend (£2 million each year) as maintenance to the end of the appraisal period. In fact, the total applicable for the business case may be less than this as cycle routes add only a small marginal cost to the maintenance of roads that are covered by existing maintenance programs and budgets.

Results

- 12.13 The benefits and costs have been discounted using a 3.5% discount rate over a 30 year lifespan. This represents 30 years from the completion of the Network. The benefit to cost ratio is shown in Table 12.4. The full breakdown of results is provided in the Annex.
- 12.14 The BCR of 3.94 suggests that the benefits significantly outweigh the costs by almost four to one. However, it needs to be kept in mind that this is a partial appraisal of the benefits. Infrastructure is more effective in generating benefits when combined with marketing (as has been the case in London). The physical elements which directly tackle safety and security are therefore combined with soft elements that make people aware of the changes.
- 12.15 The results exclude the potential impact on accidents that would be expected from this type of infrastructure project. It also excludes health benefits to under 16s and journey ambience benefits to those cyclists already using the routes and whose journey would be improved as a result of the investment.

Table 12-4 LCN+ Costs, benefits and ratio based on discounted values over 30 years

	£ millions
Benefits (£ PV)	£794
Cost (£ PV)	£201
Net Present Value	£592
Benefit-Cost Ratio	3.94

Source: SQW estimates

Comparison with TfL

- 12.16 The TfL Business Case also produced cost and benefit values associated with the full package of investment. This included values for increased road safety, travel time reductions for cyclists, travel time reductions, , short-term absence reduction, health benefits wider economy and reduced external costs of motorised road transport
- 12.17 The results were produced showing the impact of the full Programme (not just LCN+) benefits. Over 20 years (30 years was used above) the NPV of the investment was £318 million and a BCR of 1.8 without health benefits and 2.5 with them.

- 12.18 The results reported by TfL are lower than those calculated here because they exclude journey “ambience” or comfort benefits which are likely to be substantial as a result of the physical improvements being made.

13: Cycle Training

Introduction

- 13.1 Cycle training is potentially an effective method to increase the number of cycle trips and the number of cyclists. Because it does not involve constructing new physical infrastructure, it is relatively low cost. Cycle training is usually associated with improvements in cyclists safety. The training itself is intended to build confidence and traffic awareness to help cyclists travel more safely. This in turn can increase the amount of cycling that those trained do and potentially, as cycling is perceived as being safer will encourage others to participate.
- 13.2 There are very few studies on either changes in cyclist safety or the amount of cycling that training stimulates. The studies that have been undertaken tend to focus on the former and measure, for example, the cyclist's own perception of their confidence following the training.

Project Description

- 13.3 We have only found one study which provides data that covers a number of years and quantifies the additional cycle trips that participants report making as a result of the training. This work was carried out in 2003 for Cycle Training UK by Transport for London's Centre of Excellence. This reviewed the effectiveness of their cycle training courses over the previous five years. The training included one-to-one sessions that aim to assist people of all ages to gain more confidence and develop their cycling skills.

Monitoring Data and Outputs

- 13.4 All training recipients between 1998-2003 (2,200) people were sent a questionnaire as part of the research. Based on a 30% response rate, the survey indicated that the number of cycle trips among participants increased from an average of 0.9 trips per week to 2.4 trips per week. If the sample is representative of all those participating then it suggests that before training these people were collectively making 1,980 trips per week. Following the training this increased to 5,280 trips per week (an increase of 3,300 trips each week). As a minimum we can assume that the number responding to the survey generated 990 new trips each week.
- 13.5 While the value of the additional trips can be calculated, it is more complex to estimate the number of people who will make them. For example, the majority of the new trips could be made by a minority who have started to commute. The survey provides some information on the number of people who *previously* cycled on at least one day a week (26%) prior to training, and the number that are cycling that amount now (57%). It shows that 31% of the sample 682 people are now cycling at least once a week after the training.
- 13.6 Despite these outputs it should also be noted that the relationship may not be causal. People who have decided to commute by bike may take a 'refresher' course before undertaking the commute. In this sense, training may not be the generator of trips as implied by the appraisal, but rather an important part of a wider process.

Appraisal

- 13.7 Table 13.1 sets out the main assumptions and sources. The number of cyclists is imputed from the survey responses and the total number that have started to cycle on at least one day a week. The age profile is based on NTS data on cycle trips. Mode switching is based on the research for Transport for London which reported that 25% of new cycle trips generated replaced car trips. The average length of trip is based on NTS 2005 data.
- 13.8 Although benefits through reduced accidents has not been included in the other cases, with training interventions, safety is one of the main objectives and there is a direct link between training and reductions in accidents. The following provides an indication of the potential scale of the safety benefit and the estimates used.
- 13.9 There were 372 KSIs in Greater London in 2005 compared with an estimated 450,000 cycle trips a day (164 million a year). This equates to around one KSI per 450,000 cycle trips. The 57% that are cycling more than once a week following training are making 340 trips a year each (426,000 in total). This would indicate around one KSI each year among those that took part in the training. Research produced by the Transport Research Laboratory in 1989 concluded that children that had been trained were “up to three times” less likely to be a casualty than those that had not been trained.
- 13.10 Using a slightly more conservative estimate, that training reduces the likelihood of a KSI by around half, would reduce the likely number of KSIs within the survey frame from one to around 0.5. Transport for London uses a sum of £189,000 for each prevented KSI. The reduction of 0.5 of a KSI for this investment would be valued at around £95,000 each year. Table 13-1 sets out the assumptions and values used.

Table 13-1: Appraisal inputs

Factor	Determinants	Value										
Number of new users that significantly increase activity	2,200 recipients of surveys suggested an average increase of 1.5 trips per week <ul style="list-style-type: none"> This gives a total of 3,100 trips a week. Number cycling at least once a week has increased from 572 to 1,254, an increase of 682 people who would be expected to benefit from physical fitness improvements 	682										
Age group of new users	The following age profile has been used based on the NTS data 2005 for all cycle trips. It is assumed that the training was provided across all age groups in proportion to the overall pattern of cycling in the UK	<table border="1"> <thead> <tr> <th>Age</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>0-16</td> <td>27%</td> </tr> <tr> <td>16-44</td> <td>37%</td> </tr> <tr> <td>45-64</td> <td>22%</td> </tr> <tr> <td>> 65</td> <td>14%</td> </tr> </tbody> </table>	Age	%	0-16	27%	16-44	37%	45-64	22%	> 65	14%
Age	%											
0-16	27%											
16-44	37%											
45-64	22%											
> 65	14%											
Car km that do not take place	The following have been used: <ul style="list-style-type: none"> Based on 3,300 additional trips a week for 52 weeks (CTUK survey) Assume average trip length of 3.9 kms (from NTS data on average school trip length) Assume 25% of new trips were previously car-based (TfL / Accent survey) 	42,900 fewer car trips made 167,310 fewer car kilometres a year										
Urban / rural	Analysis assumes 50% of trips are rural and 50% urban	Trips allocated between urban and rural environments										

Source: SQW

Results

- 13.11 The results of the calculation of benefits are split by category and shown in Table 13-2. The results suggest that training has a positive impact on all of the government and project objectives. The greatest benefits come through accident prevention and congestion.

Table 13-2 Cycle Training benefits by category

Type of Benefit	Value (£ per year) (excluding health benefits for children)
Loss of life (health)	£41,000
NHS costs	£14,000
Productivity	£19,000
Pollution	£17,000
Congestion	£35,000
Reduced accidents	£95,000
Total per year	£221,000

Source: SQW estimates

Costs

- 13.12 The cost of an hour training session provided is estimated to be around £50 per person (based on TfL's estimate of £100,000 buying two hours of training for 2,000 adult and teenage participants¹¹³). More intensive training for children is included in London's Business Case, which plans for £3 million supporting training for 20,000 children (£150 per child). The analysis in this section is based on two, hour long training sessions with a cost of £50 per cyclist.
- 13.13 The benefits and costs have been discounted using a 3.5% discount rate and five year lifespan. This is the period that the survey covered. The effect is assumed to depreciate by 20% each year so that after five years the number of additional trips (and cyclists) has dropped to around 40% of the first year level. The benefit-cost ratio is shown in Table 13-3 .

Table 13-3 Costs, benefits and ratio based on discounted values over 3.5 years

	Benefits and costs excluding child health benefits and reductions in accidents £ millions
Benefits (£ PV)	£0.791
Cost (£ PV)	£0.106
Net Present Value	£0.685
Benefit-Cost Ratio	7.44

¹¹³ Transport for London *Business Case for Cycling in London* (2004)

Results

- 13.14 The benefit-cost ratio of the programme is 7.4, however, there is a great deal of uncertainty around this figure. For example, the lifespan of the training impact may be less than the five years chosen. A lifespan of three years would reduce the BCR to 5. The survey results may paint an overly positive picture if the sample is biased or participants were actually younger than estimated.
- 13.15 If the sample is not representative (for example if people unaffected by training chose not to return the form) then the BCR would still be in excess of 5 to 1. The results would improve further if part of the training costs were paid for by the participants.

14: Interventions summary

- 14.1 Table 14-1 sets out the main results from the analysis of the four interventions. All four produce positive net present values using the assumptions presented. The highest value was found for the training investment, helped by the inclusion of a value for accident prevention. Training is less expensive than physical development and where it can demonstrate even modest increases in levels of cycling it is likely to produce high returns.
- 14.2 The LCN+ also produced a strong BCR. These figures are based on estimates of increased cycling trips rather than monitoring data and consequently should be treated as indicative only. The results are higher than those produced by TfL as they are measured over a longer period and include values for “journey ambience”.
- 14.3 Links to Schools and Bike It are both initiatives targeted at school children. Links to Schools provides improved infrastructure and as a result also benefits for other residents. Because of the physical infrastructure element it also has value to those using the existing routes and this also strengthens the BCR. Even without any value for children’s health or accident prevention, Links to Schools produces a positive result. If these could be valued the results would be even better.
- 14.4 The results for Bike It must also be seen in context. The main beneficiaries are schoolchildren and although the values for reducing car use can be measured, any positive impact on children’s health and development cannot readily be included. Even so, the Programme still produces a positive net return after a short time.

Table 14-1 Summary Benefits, costs and ratios for intervention examples

	£ millions			
	Links to Schools	Bike It ¹¹⁴	LCN +	Training
Appraisal period	30 years	4 years	30 years	5 years
Benefits	£4.80	£0.33	£794	£0.79
Costs	£2.22	£0.24	£201	£0.11
Net Present Value	£2.58	£0.09	£592.50	£0.68
Benefit cost ratio	2.17	1.36	3.94	7.44

Source: SQW estimates

- 14.5 There are four key points from the analysis:
- the results from these four cases are all positive to varying degrees. However, their effectiveness will always depend on how they work with other transport. The LCN+ is part of a package of measures and its success will also be determined by other “soft” interventions. Bike It relies on having the infrastructure in place that can safely support cycling. Although individual results can be presented, interventions

¹¹⁴ Benefits for Bike It are lower than other interventions because the health (and safety) related benefits for children cannot be quantified.

should be considered in a wider context. Different areas will need different balances of investment.

- there may be a tendency for “softer measures” to produce better results as the costs are much lower than physical improvements. For physical improvement projects, “journey ambience” benefits are often the most substantial. Much of the benefit will be derived from improvements in the quality, security and safety of trips made by existing cyclists. Excluding these benefits risks biasing projects towards other modes.
- there is a lack of good cycling monitoring data. The examples presented here are the strongest that we could find, but still require a more robust profile of cyclists, participants and the additionality of their trips. In particular, finding out whether cycling is displacing other physical activity. Better monitoring data would allow better assessment of costs and benefits and a clearer indication of the best use of resources. It is much harder to attract investment where the benefits are not known.
- the benefits valued are only partial. There is good reason to believe that there are other benefits that would improve the estimates of value for money. Specifically in contributing to reducing (and preventing) obesity, preventing accidents among existing cyclists and in the contribution that physical activity can make to child development.

15: Conclusions

- 15.1 Despite earlier pledges to increase cycling, the levels reported in the National Travel Survey show a continuing decline in the number of cycle trips being made and the distances cycled. At the same time car use has increased. These trends exacerbate a number of high profile challenges faced by Government. In the last few years reports by Stern on the costs of climate change, by Eddington on transport, by the Chief Medical Officer on declining levels of physical activity and by the Health Committee on Obesity are all relevant to cycling. An increase in cycling would directly contribute to the objectives set out in each of these reports.
- 15.2 Increasing the number of people cycling and the number of trips taken has a direct value for the cyclist themselves, the health service, employees, other road users and the environment. The analysis in Chapters three to five shows how these values can vary depending on the profile cyclists and the types of trips that they make. It suggests that there is a need for a more sophisticated understanding of participants in order to more accurately assess the value of outcomes. There is a big difference between encouraging inactive people to become fitter and encouraging those that are already fit to do more cycling. There is also a big difference in the value between cycle trips that replace car trips and those that do not.
- 15.3 The health benefits are complex, but the values associated with encouraging older people to cycle offers the greatest direct benefit, but this is also likely to be a group that is more difficult (and expensive) to persuade to start cycling. It may well make more sense to focus on more moderate levels of leisure cycling rather than trying to convince older people to make a big step up to daily commuting.
- 15.4 The analysis that has been used assumes that new cyclists simply “move up” a level of physical exercise. This includes encouraging light exercise through cycling as much as encouraging those that are already moderately fit to participate more often. Getting more individuals to cycle is better than getting existing enthusiasts to cycle more.
- 15.5 Estimating the value of increasing cycling among children is more difficult as current methods based on causes of mortality are inappropriate. These approaches should consider cycling as both an investment in reducing the future costs of inactivity and obesity and the direct benefits to children’s mental and physical development. Intuitively the benefits would be expected to be substantial and even though they cannot easily be quantified it would be a mistake to exclude them.
- 15.6 Values based on mortality statistics and the analysis of the National Heart Forum suggest that a cyclist that increases his or her level of activity could be valued at around £59 for the average adult. This figure is much lower, around £11 for 16 – 44 year olds and higher for older cyclists (£100 for 45 - 64 year olds and around £242 for 65 year olds and over).
- 15.7 The results of the Copenhagen Heart Study suggest that these estimates may seriously underestimate the full protective value of cycling. Unless there is good reason to exclude these results, we would suggest that it points to the use of higher values, rather than more conservative ones, particularly in valuing changes in commuter cycling.

- 15.8 The values associated with reduced congestion and pollution are based on reductions in car use. For urban areas these impacts are substantially higher than rural areas as a result of the number of people living and working near roads. The values are even higher in London. The largest element of the pollution values relates to the health impacts caused by traffic fumes rather than the value of the carbon emissions, even with the inclusion of higher values adopted in the Stern report.
- 15.9 The values are presented per year. The health benefits are best related to people, or new cyclists, while the impacts on car reduction are linked to trips. The total values range from £87 to just over £300 a year for older cyclists. In addition, for infrastructure projects there would be significant additional values associated with improvements in the quality of the journey (ambience) as well as substantial social benefits that are not valued.
- 15.10 In Chapter 8, we have used the NTS for 2005 to show the decline in cycling trips over the past ten years. Based on the trips per person reported in the NTS data, the cumulative cost of “lost trips” is estimated to be around £600 million. Looking forward, potential savings are estimated in a range from £500 million to £1.3 billion depending on the rate of growth in cycle trips over the next ten years.

Addressing government objectives

- 15.11 The case for cycling fits neatly within the current policy context. Increasing physical activity and encouraging the use of sustainable transport are key government objectives and cycling can make an important contribution to achieving PSA targets across departments. It is important that the joint contribution to these PSAs is considered rather than appraisal against them individually. In the following table we make the link between cycling and the relevant PSAs.

Table 15-1: PSA targets and departments most relevant for cycling

PSA	Contributions
Increase levels of sporting activity	<p>Cycling can be considered a sporting activity and increasing the number of cyclists contributes to this target. This is particularly important in schools where there are examples of very cost effective investments to increase number of children participating. Bike IT for example has generated 2,500 new cyclists at very little cost.</p> <p>An increased investment in cycling to school would contribute significantly to active children and participation in sport.</p>
Reduce levels of child obesity	<p>Physical activity is considered one of the main ways to reduce child obesity. Cycling is one of the most effective ways of including regular physical activity into lifestyle.</p> <p>Increasing cycling to school will have a direct effect on levels of physical activity and reduce obesity. Although it is not possible to value the contribution of cycling or the benefits, the cost of obesity among adults is approximately £330 a year for each person.</p> <p>Even if the contribution of cycling is only one factor in reducing obesity, the benefits are likely to significantly outweigh the costs.</p>
Reduce levels of obesity	<p>Where cycling increases physical activity, it will directly contribute to protecting against obesity. The CMO estimates that around 0.5 – 1 kg can be lost each month through regular cycling.</p> <p>The cost of obesity is around £3.7 billion a year. Physical activity is a key element in maintaining weight loss and cycling is a convenient and easy way to encourage physical activity.</p>
Reduce mortality rates and health inequalities	<p>Inactivity is a major cause of mortality. Becoming active greatly reduces the risks of premature death. The analysis indicates that if 100,000 additional people between 16 and 44 became active it would save 72 life years. For 100,000 people aged 45 – 64, becoming active would save 782 life years.</p> <p>Using the NHF results, where cycling increases activity more marginally, an increase in the number of cycle trips by 50% over the next 10 years would save around 675 lives.</p>
Reduce congestion in the largest urban areas	<p>Cycling reduces congestion in urban areas where car trips are substituted by cycle trips. This works best where it takes place as part of a wider set of measures.</p> <p>Cycle to work schemes have attracted investment by private companies which have all reduced car use and most increased the number of cyclists.</p>
Improve air quality by reducing transport emissions	<p>Cycling reduces pollution where car trips are substituted by cycle trips. Switching 160 car trips to cycle trips a year is valued at £69 in an urban area.</p> <p>Euro II diesel passenger cars (1-5 passengers per vehicle). These give a saving of 14-67 grams PM per person displaced from single-occupancy diesel car to cycle</p>
Reduce greenhouse gas emissions	<p>Cycling reduces pollution where car trips are substituted by cycle trips.</p> <p>For a commuter making 160 trips of 3.9 kms by bike instead of car, a year, the total saving is estimated to be 112,000 grams CO₂ per person (displaced from single-occupancy car to cycle) or 112 metric tonnes of CO₂ per 1,000 people.</p>

Source: PSAs and SQW estimates of contribution

Future monitoring

- 15.12 Previous monitoring data has tended to focus on number of cycle trips and length of trips rather than the number and profile of people participating. The health benefits relate to the types of people participating and better information would help assess the change in physical activity. This would help address concerns that cyclists are typically young males who would be fairly active anyway.
- 15.13 The Cycling Demonstration Towns provide the best potential resource for monitoring investment in cycling and changes in use of transport. The data should be able to indicate the

number of people that are now cycling regularly but were previously inactive, their ages and any reduction in the number of car kilometres.

- 15.14 Sustrans is addressing many of the monitoring needs from their projects and their approaches should be rolled out to include other beneficiaries of cycling investments to help build an evidence bank that links investment to new cyclists and distances cycled.

Further research

- 15.15 There is potentially a great deal of valuable research that could be undertaken to better understand the impact of cycling. The social impacts of cycling are only covered briefly in this report yet are potentially very valuable. Part of this relates to how target groups are encouraged to cycle, but there are more subtle benefits around encouraging more women to cycle, providing access to services and helping to reduce health inequalities.
- 15.16 Valuing the benefits of cycling for children is one of the biggest challenges. A new approach to this should be developed. Measures that use prevention of premature death cannot be applied to children where it is difficult to track through cycling and active lives generally into adulthood. Instead the focus should be on the contribution to reducing obesity in children for its own sake.
- 15.17 The Copenhagen Heart Study results should be considered seriously as a basis for valuing additional commuter cycling as it offers “cycling specific” evidence of health benefits. Its use would radically increase the value of cycling and strengthen the case for further investments.
- 15.18 The health benefits remain a complex element of the work that has thrown up different approaches and results. We suggest that further work is done to differentiate the benefits between cyclists of different ages and that a set of agreed values is calculated.

Conclusions

- 15.19 The economic value of cycling hinges heavily on two things; the health benefits and replacing car travel. The methodology used for assessing health benefits depends on making more people more active and because the risk of illness is greater among older people, the preventative effects of physical activity mean that it has a larger value. This is useful, but also dangerous as it ignores the importance of maintaining physical activity throughout one’s life. It is also inappropriate for valuing children’s cycling, but simply because it is more difficult to measure does not mean that it is any less valuable.
- 15.20 The research points to the need for refinement in appraising investment, but it should also be recognised that there are dangers in getting bogged down in analysis. Where it is possible, there should be differentiation between the target groups in order to better understand the economic contribution in each case. Further work would help develop measures that can be used consistently for different types of cyclist, however, given the pressing importance of the issues that cycling can help to address there is limited time to develop the evidence base.
- 15.21 We conclude that cycling investment that targets new cyclists in particular would generate substantial additional economic benefit. Where this can be shown to reduce car travel, the

combination of health benefits and reduced congestion and pollution would in most cases justify investment. There are likely to be considerable economies of scale in investing to release the potential of existing infrastructure through training, promotion and travel planning, but there is also a great deal of scope for new and improved cycling infrastructure.

- 15.22 The report examines four examples of cycling intervention. Each is shown to produce positive returns to investment. The benefit to cost ratio ranges from 7.4 in the case of a cycle training programme to 1.4 for Bike It, an initiative that funds cycling officers who work with selected schools to encourage cycling. The two physical infrastructure projects show returns of between two and four. These values exclude any potential benefits to children's health or contribution to preventing or reducing obesity
- 15.23 This does not mean that all investment in cycling will produce high returns on investment. Each case needs to be assessed on its own merits. But the relatively high values where projects are able to generate new cyclists suggests that there is a major opportunity to make investments that will, over time, more than repay their costs.
- 15.24 It is important that appraisal approaches consider the full extent of benefits and that the values used are not overly "conservative" when there are likely to be considerable benefits that are not readily quantified. These potential economic benefits are large and they directly address many of the challenges that society and government face, but in order to make a step change, substantial investment will be required to attract new people to cycling rather than just getting existing cyclists to cycle more.

Annex A: Tables

Health value calculations using National Heart Foundation results

Coronary Heart Disease: Estimating the impact of risk factors, National Heart Forum (2002)

Assumes cyclists "step up" one category



Vigorous = 12+ occasions of vigorous exercise of 20 minutes in past 4 weeks
Moderate = 12+ occasions of moderate exercise of 20 minutes in past 4 weeks
Light = 1 – 11 occasions of moderate exercise of 20 minutes in past 4 weeks
Sedentary = 0 occasions of moderate exercise of 20 minutes in past 4 weeks

Calculation of avoided deaths per year as a result of stepping up one level of physical activity - based on National Heart Forum analysis

		16-24	25-34	35-44	45-54	55-64	65-74	75+	Totals
Deaths in population (ONS)	males	10	77	704	2242	5626	10618	26342	45619
Deaths in population (ONS)	females	1	17	146	477	1525	4643	29368	36177
NHF estimates of % of reductions in deaths resulting from increased activity	males	15%	16%	16%	15%	13%	12%	10%	
Equivalent number of deaths		2	12	111	332	748	1285	2555	5044
NHF estimates of % of reductions in deaths resulting from increased activity	females	15%	16%	16%	15%	14%	11%	8%	
Equivalent number of deaths		0	3	23	73	206	511	2408	3223
Number of lost years (based on mid point)	males	57	48	39	29	21	13	5	
Number of lost years (based on mid point)	females	62	52	42	33	24	16	6	
Life years saved	males	87	597	4273	9768	15599	17177	12797	60298
Life years saved	females	9	138	992	2395	4955	8114	14178	30782
Total		96	735	5266	12163	20554	25292	26974	91080
Life years uplifted to include deaths from stroke and colon cancer (19.6% of total)	80.4%	119	914	6551	15131	25570	31464	33557	113306
Value of a life year (DfT)	£	30,000	£ 30,000	£ 30,000	£ 30,000	£ 30,000	£ 30,000	£ 30,000	
Total value of lives saved (£ millions)	£	3.6	£ 27.4	£ 196.5	£ 453.9	£ 767.1	£ 943.9	£ 1,006.7	£ 3,399.2
Population in England within each age category		5911340	6701437	7772355	6414711	5852954	4191417	3866716	40710930
Value per person stepping up a level	£	0.60	£ 4.09	£ 25.28	£ 70.77	£ 131.06	£ 225.20	£ 260.35	£ 83.50
Average value per person 16 - 44				£ 11.16					
Average value per person 45 - 65					£ 99.53				
Average value per person 66+							£ 242.07		
Weighted average								£	58.77

Lost years calculation - value of reduction in cycle trips since 1995

Lost years calculation - value of reduction in cycle trips since 1995

	Totals	Year										
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
England population (000s)		48,383	48,519	48,665	48,821	49,033	49,233	49,450	49,647	49,856	50,093	50,432
trips per person		19.7	19.7	19.7	17.9	17.9	17.9	17.9	18.0	16.4	17.1	15.3
total trips 000s		953399	956079	958956	871845	875631	879203	887257	894988	817648	858942	771202
Difference with 1995	762237 381119		-2680	-5557	81553	77768	74196	66141	58411	135751	94457	182197
adult trips (80.5%)	613601	0	-2157	-4473	65651	62603	59728	53244	47021	109279	76038	146669
Adult trips sufficient for health		0	-2017	-4183	61383	58534	55845	49783	43964	102176	71095	137135
children trips (19.5%)	148636	0	-523	-1084	15903	15165	14468	12898	11390	26471	18419	35528
Premature deaths (adult)	£0.21	£0	-£0	-£1	£13	£12	£11	£10	£9	£21	£15	£28
NHS costs (adult)	£0.10	£0	-£0	-£0	£6	£6	£6	£5	£4	£10	£7	£14
Absence from work (adult)	£0.17	£0	-£0	-£1	£10	£10	£9	£8	£7	£17	£12	£23
Pollution (all)	£0.11	£0	-£0	-£1	£9	£9	£8	£7	£6	£15	£10	£20
Congestion (all)	£0.32	£0	-£1	-£2	£26	£25	£24	£21	£19	£43	£30	£58
Totals		£0	-£2	-£4	£64	£61	£58	£52	£46	£107	£74	£143
Total (£ millions)		£598										

Impact of increases in cycle trips to 2015

Impact of increases in cycle trips to 2015

	increase	Year										
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
total trips	20%	771202	786626	802050	817474	832898	848322	863746	879170	894594	910018	925442
	30%	771202	794338	817474	840610	863746	886882	910018	933154	956290	979426	1002562
	50%	771202	809762	848322	886882	925442	964002	1002562	1041122	1079682	1118242	1156803
cumulative additional trips (straightline increase)	20%	0	15424	30848	46272	61696	77120	92544	107968	123392	138816	154240
	30%	0	23136	46272	69408	92544	115680	138816	161952	185088	208224	231361
	50%	0	38560	77120	115680	154240	192800	231361	269921	308481	347041	385601
			134825	269651	404476	539302	674127	808953	943778	1078604	1213429	1348255

20% increase by 2015

benefits	value	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Premature deaths (adult)	£0.21	£0	£3	£5	£8	£10	£13	£15	£18	£20	£23	£26
NHS costs (adult)	£0.10	£0	£1	£2	£4	£5	£6	£7	£9	£10	£11	£12
Absence from work (adult)	£0.17	£0	£2	£4	£6	£8	£10	£12	£14	£17	£19	£21
Pollution (all)	£0.11	£0	£2	£3	£5	£7	£8	£10	£12	£14	£15	£17
Congestion (all)	£0.32	£0	£5	£10	£15	£20	£25	£30	£35	£39	£44	£49
totals		£0	£12	£25	£37	£50	£62	£75	£87	£100	£112	£125
Total (£ millions)		£687										
Discounted total @3.5% (£ millions)		£523										

30% increase by 2015

benefits	value	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Premature deaths (adult)	£0.21	£0	£4	£8	£11	£15	£19	£23	£27	£31	£34	£38
NHS costs (adult)	£0.10	£0	£2	£4	£6	£7	£9	£11	£13	£15	£17	£18
Absence from work (adult)	£0.17	£0	£3	£6	£9	£12	£16	£19	£22	£25	£28	£31
Pollution (all)	£0.11	£0	£3	£5	£8	£10	£13	£15	£18	£20	£23	£25
Congestion (all)	£0.32	£0	£7	£15	£22	£30	£37	£44	£52	£59	£67	£74
totals		£0	£19	£37	£56	£75	£94	£112	£131	£150	£169	£187
Total (£ millions)		£1,030										
Discounted total @3.5% (£ millions)		£785										

50% increase by 2015

benefits	value	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Premature deaths (adult)	£0.21	£0	£6	£13	£19	£26	£32	£38	£45	£51	£57	£64
NHS costs (adult)	£0.10	£0	£3	£6	£9	£12	£15	£18	£22	£25	£28	£31
Absence from work (adult)	£0.17	£0	£5	£10	£16	£21	£26	£31	£36	£41	£47	£52
Pollution (all)	£0.11	£0	£4	£8	£13	£17	£21	£25	£30	£34	£38	£42
Congestion (all)	£0.32	£0	£12	£25	£37	£49	£62	£74	£86	£99	£111	£123
Totals		£0	£31	£62	£94	£125	£156	£187	£218	£250	£281	£312
Total (£ millions)		£1,716										
Discounted total @3.5% (£ millions)		£1,308										