



CATCH
(Clean Accessible Transport for Community Health)

LIFE02 ENV/UK/000136-2000-10988

ANALYSIS OF LONG-TERM BENEFITS

August 2005

Analysis of long-term benefits (LIFE Environment criteria June 2004)

Project Reference: LIFE02 ENV/UK/000136-2000-10988

Project Title: CATCH(Clean Accessible Transport for Community Health)

A. Environmental benefits

1. Direct / quantitative environmental benefits

(e.g. reductions of emissions, energy or resource savings)

Emissions analysis for Liverpool has been conducted by TTR using the JET model which uses the COPERT III methodology¹ published by European Environment Agency. The COPERT III methodology uses an average speed approach to take into account the variation in emission factors with changing traffic conditions as a function of traffic speed and further factors, such as the impacts of cold starts. This approach was considered ideal for this analysis because it takes into account the level of detail of the strategic data that is available to this study from existing sources and the potential for detailed amendment of the input parameters in order to enhance the accuracy of the study whilst respecting the differences between the selected corridors and scenarios.

The methodology has been used to provide emissions factors for each vehicle category in the appropriate proportions in order to produce an inventory for the modelled scenario based on that scenario's set of traffic input data of the following pollutant emissions:

- Carbon monoxide (CO);
- Nitrogen oxides (NO_x);
- Volatile organic compounds (VOC);
- Total particulate matter (TPM);
- Carbon dioxide (CO₂).

as well as energy use.

These pollutants were chosen because:

- Road traffic was traditionally a major source of CO, particularly from spark ignition engines, although this has been dramatically reduced through the introduction of modern engine management systems and three way catalysts.
- Nitrogen oxides, particularly NO₂, are a respiratory irritant linked with reduced resistance to conditions such as asthma and chronic bronchitis for those who already suffer from these conditions and are also a precursor in the formation of ozone. Transport sources, particularly diesel engines, are a major source of NO_x in the UK.
- VOCs encompass a range of hydrocarbons emitted as gases predominantly from the exhausts of spark ignition engines and which are linked to respiratory problems and in some cases considered as carcinogens. VOC emissions have been dramatically reduced through the introduction of modern engine management systems and three

¹ COPERT III Computer Programme to Calculate Emissions from Road Transport. European Environment Agency Technical Report No 49, November 2000.



way catalysts, although specific species still give cause for concern even at low concentration levels.

- Particulate matter includes a range of solid and semi-solid agglomerations of varying chemical composition in the range of 0 to 50µm, although generally quantified for those that are less than 10µm in diameter (PM₁₀). These can act as a respiratory irritant inducing coughing and lower lung efficiency and concern is growing over the smallest particles which can penetrate deep into the lungs and cause complications in many different conditions including as a carcinogen and may also enter the bloodstream through this path.
- CO₂ is included not from a local air quality perspective but because it is the main greenhouse gas and transport in all forms is a major source.

The JET model combines the COPERT III calculation methodology with factors such as the number of vehicle kilometres travelled by different categories of vehicle, the distribution of the fleet by size and age (and hence emissions reduction technology as defined by EC directives), average vehicle speeds and loading factors.

Model runs have been conducted showing:

- the baseline situation at the start of CATCH (autumn 2002) i.e. the before situation;
- the estimated situation at the end of the CATCH contract period (late summer 2005), assuming that the project had not been implemented i.e. the do nothing scenario;
- the position at the end of CATCH including the impacts of the technical elements of project i.e. the do project scenario;
- the estimated impact that wider implementation of the CATCH measures in the project area would have i.e. the wider scenario;
- the estimated maximum impact if the CATCH measures were further implemented as a high investment package (this particularly relates to investment in new hybrid buses to replace the oldest vehicles in the bus fleet rather than merely using retrofit technology to reduce emissions) i.e. the ultimate scenario.

Emissions calculations in the example are for point of use emissions because the project in question is targeted at local air quality impacts in the city centre.

The do nothing scenario allows for a significant proportion of fleet renewal with Euro III and some Euro IV compliant cars replacing the oldest section of the pre-existing vehicle stock. Before conducting a detailed analysis of the evaluation scenarios, it is also worth noting the contribution of different modes to the different pollutants considered in the analysis, as this shows the extent to which interventions in a particular sector can influence overall emissions levels (Table A.1).

Table A.1: Percentages of different pollutants from Different Vehicle categories

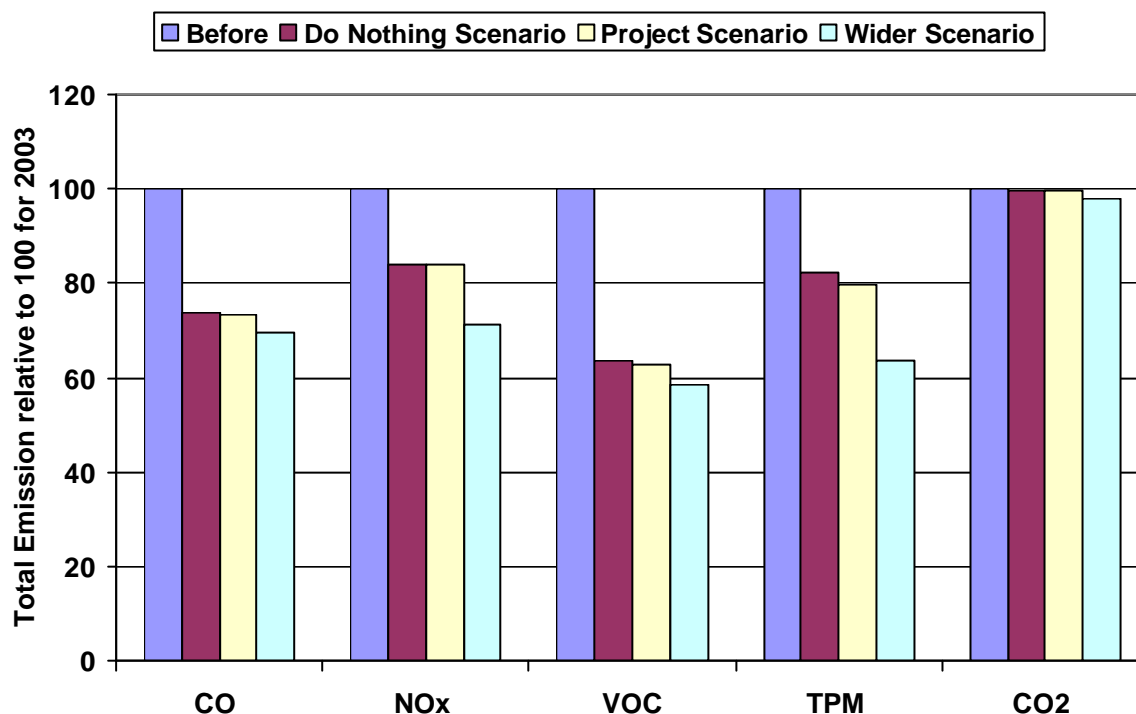
	CO	NO _x	VOC	PM ₁₀	CO ₂
% from Car	94.3	24.8	64.1	20.9	67.0
% from PT	3.3	50.1	10.2	32.2	16.8
% from HGV	2.5	25.2	25.7	46.9	16.2

Figure A.1 shows the comparative emissions for the before situation, the do nothing scenario, the project scenario and the wider scenario.



The significant impact of EC directives such as 70/220/EEC and 88/77/EEC for light and heavy duty vehicles respectively on total emissions in the do nothing scenario compared to on the before situation is clear. The size of this impact on the totals in comparison to the impact of the project is not surprising as the directives apply to all new vehicles in the study area, whereas the technical measures in the demonstration have only been applied to a minority of buses, which themselves comprise a small proportion of the total vehicle fleet and the behavioural change elements of the project have only reached a small proportion of the people who travel within the target area of Liverpool city centre.

Figure A.1: Total City Centre Emissions, rebased to 100 for Autumn 2002.



When considered in isolation the results show that the impact of the EC directives on emissions from new cars has a considerable effect as the cleaner new cars that respect Euro 3 and Euro 4 standards replace old, dirty cars which reach the end of their life (figure A.2). However, during the course of the project there has been little in the way of new vehicle purchase for buses operating in Liverpool city centre and so this feature is not seen when public transport emissions are considered (figure A.3). Hence, it is only when the project measures are included that any reduction in public transport emissions is evident.

Figure A.3 indicates that the project has demonstrated a significant additional reduction in particulate emissions from public transport through the retrofitting programme (104 buses out of an estimated total of 1042 which operate in Liverpool city centre). Installation of exhaust gas recirculation equipment on 16 buses had reduced NOx emissions from these vehicles by 35%. This impact is, however, counteracted by the introduction of the CATCH city centre shuttle service, operated by six hybrid buses, which is a new service and hence increases total NOx emissions from an enlarged buses fleet. This effect is only partially offset by reductions in emissions from other vehicles as few of users of the CATCH city centre shuttle service transferred to the service from cars.

Figure A.3 shows that wider application of the technological measures to buses offers the possibility to significantly reduce emissions, particularly of particulates and NO_x, largely through the widespread use of the retrofit technologies (particulate traps and EGR).

Figure A.1 shows that the project resulted in a marginal reduction in CO₂ emissions, which would become more noticeable in the case of wider implementation. Comparison of figures A.2 and A.3 shows that CO₂ emissions from buses increased as a result of the project because more bus kilometres are being travelled due to the additional city centre shuttle service and because the particulate traps have been shown to increase fuel consumption slightly. However, the reductions in private car use from the other project measures (e.g. the healthy travel promotion, city centre walking and cycling improvements and ECOtravel) more than offset this when the project is viewed in its entirety.

Figure A.2: City Centre Emissions from Cars, rebased to 100 for Autumn 2002.

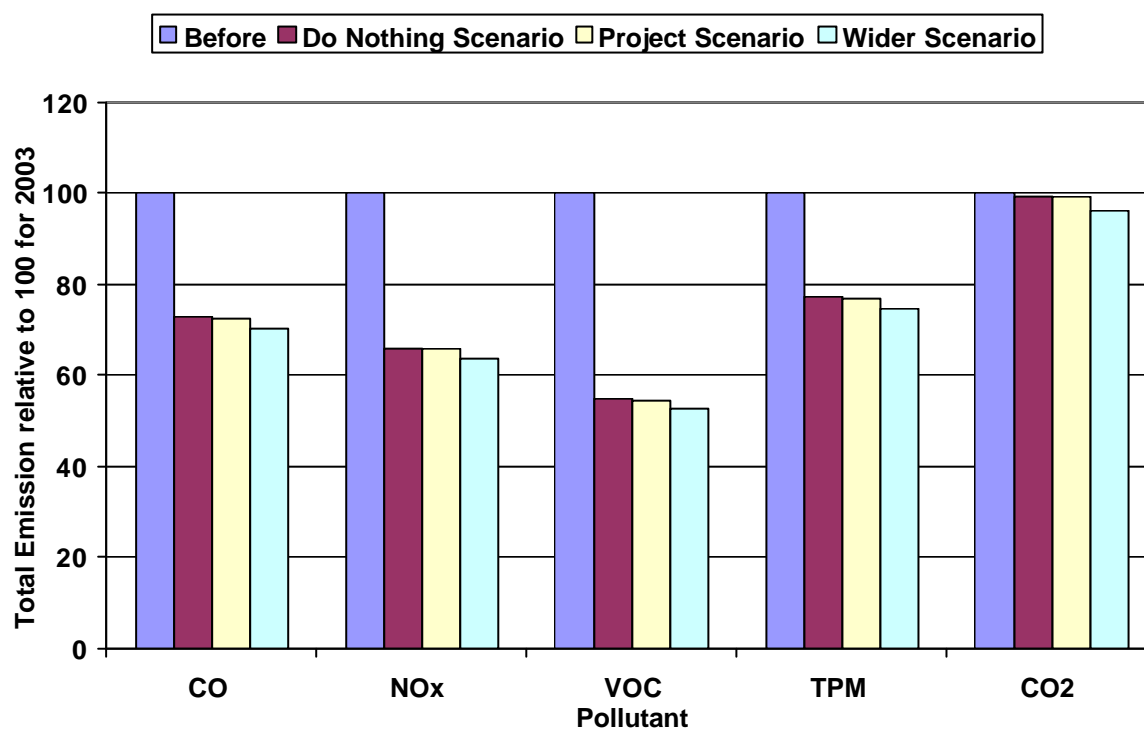


Figure A.3: City Centre Emissions from Public Transport, rebased to 100 for Autumn 2002.

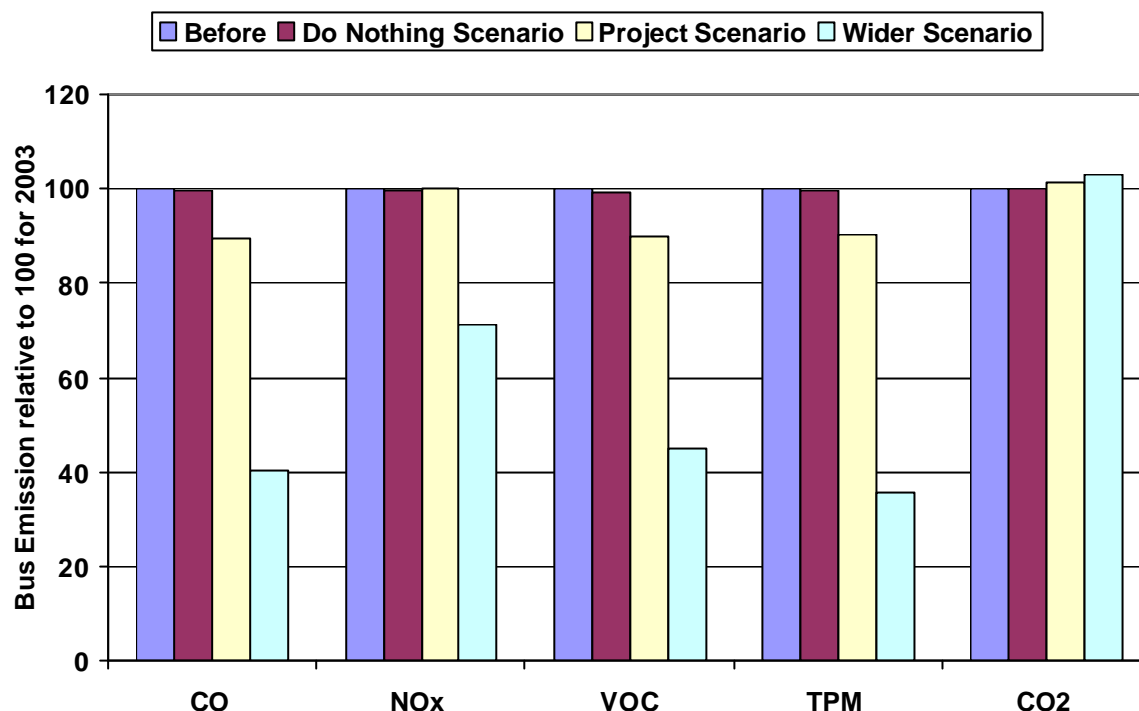


Table A.2: Reductions in Pollutant Emissions in Central Liverpool as a Result of the Project (plus Wider and Ultimate Scenarios) Compared with the Before and Do Nothing Scenarios

	Reductions in Emissions in Central Liverpool (Tonnes per year)						
	Compared to Before Scenario				Compared to Do Nothing Scenario		
	Do Nothing	Project	Wider	Ultimate	Project	Wider	Ultimate
CO	-348.4	-354.1	-399.9	-440.2	-5.6	-51.4	-91.7
NOx	-47.5	-47.1	-85.5	-154.9	+0.3	-38.0	-107.4
VOC	-53.6	-54.7	-61.2	-66.8	-1.1	-7.7	-13.2
TPM	-3.1	-3.6	-6.4	-8.0	-0.5	-3.3	-4.9
CO ₂	-292.5	-217.4	-1433.1	-3874.9	+75.1	-1140.6	-3582.4

NB: This analysis is restricted to emissions within central Liverpool only. The buses operate outside this area and as such their contribution to improved air quality will be felt over a much wider area. See section B for further information.

Table A.2 shows the impact of the project in absolute terms and also shows the potential benefits of the project under the wider application scenario. The data in Table A.2 emphasises the impact of the sheer volume of private car traffic compared to the impact of the demonstrated measures. However, taken in conjunction with Figure A.1 it can be seen that the wider and ultimate project scenarios offer significant further benefits if they were to be implemented.

In order to investigate the possibilities further, the relative impacts of the vehicle-related measures (particulate traps, EGR and hybrid buses) and other measures (healthy travel promotion, community mobility plans, walking & cycling promotion etc.) have been

estimated in terms of the percentage change they contribute compared to the do nothing scenario for each of the five pollutants considered (see figures A.4-A.7).

Figure A.4: Percentage Change for Project Scenarios Compared to the End-of Project Do Nothing Scenario: Carbon Monoxide.

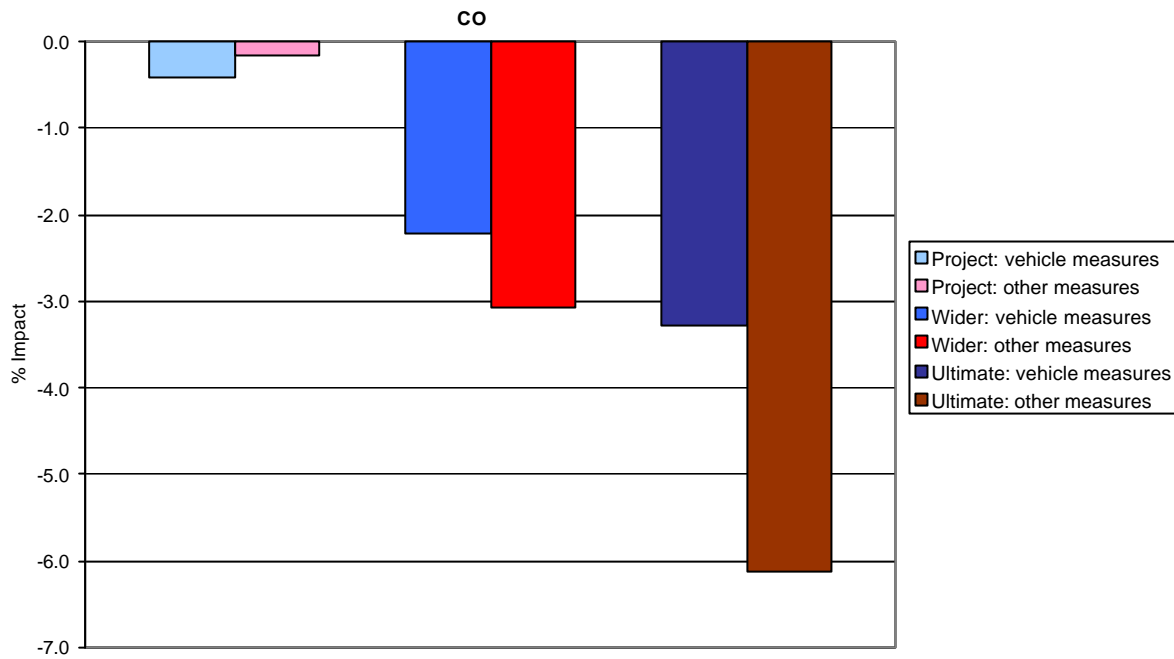


Figure A.5: Percentage Change for Project Scenarios Compared to the End-of Project Do Nothing Scenario: Oxides of Nitrogen.

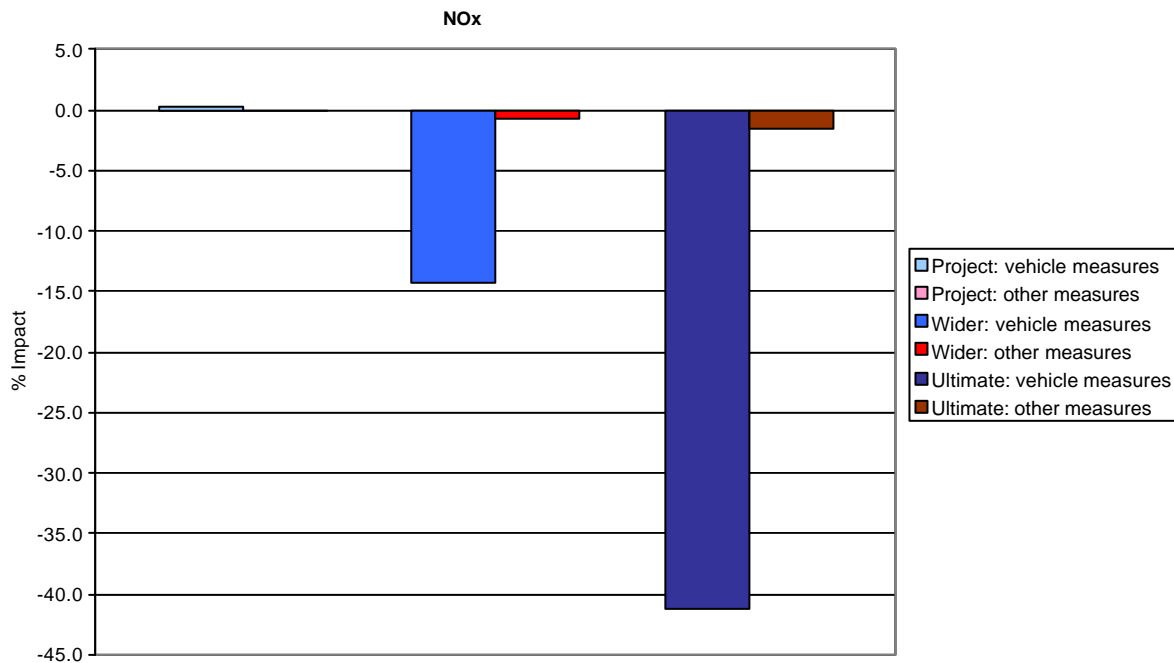


Figure A.6: Percentage Change for Project Scenarios Compared to the End-of Project Do Nothing Scenario: Volatile Organic Compounds.

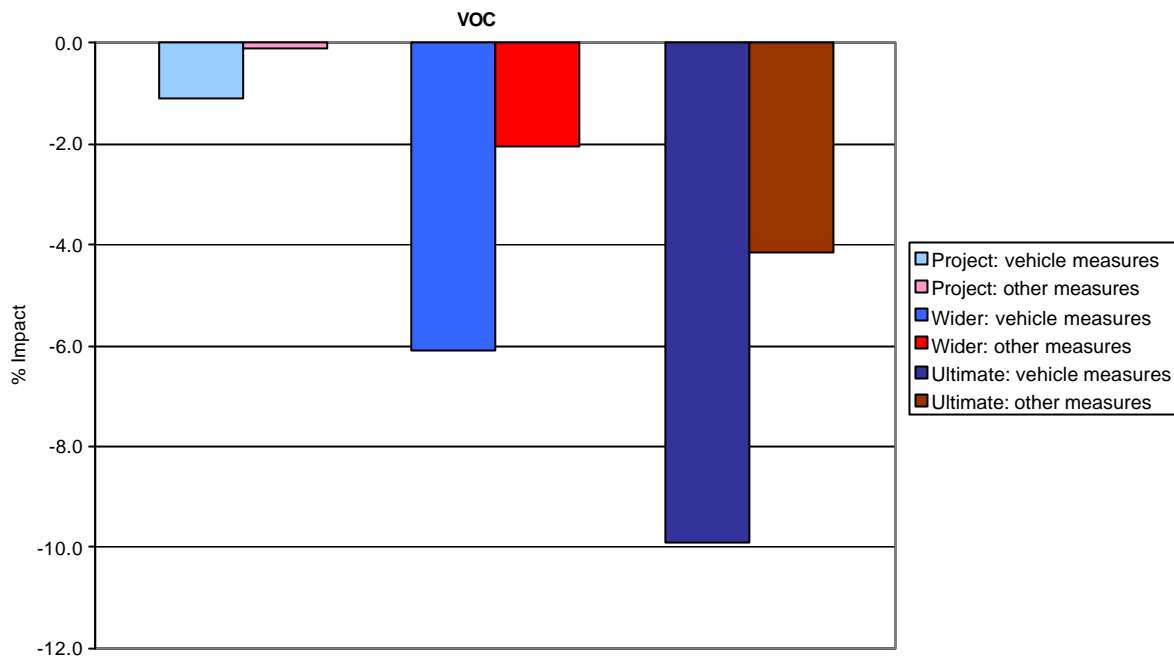


Figure A.7: Percentage Change for Project Scenarios Compared to the End-of Project Do Nothing Scenario: Particulates.

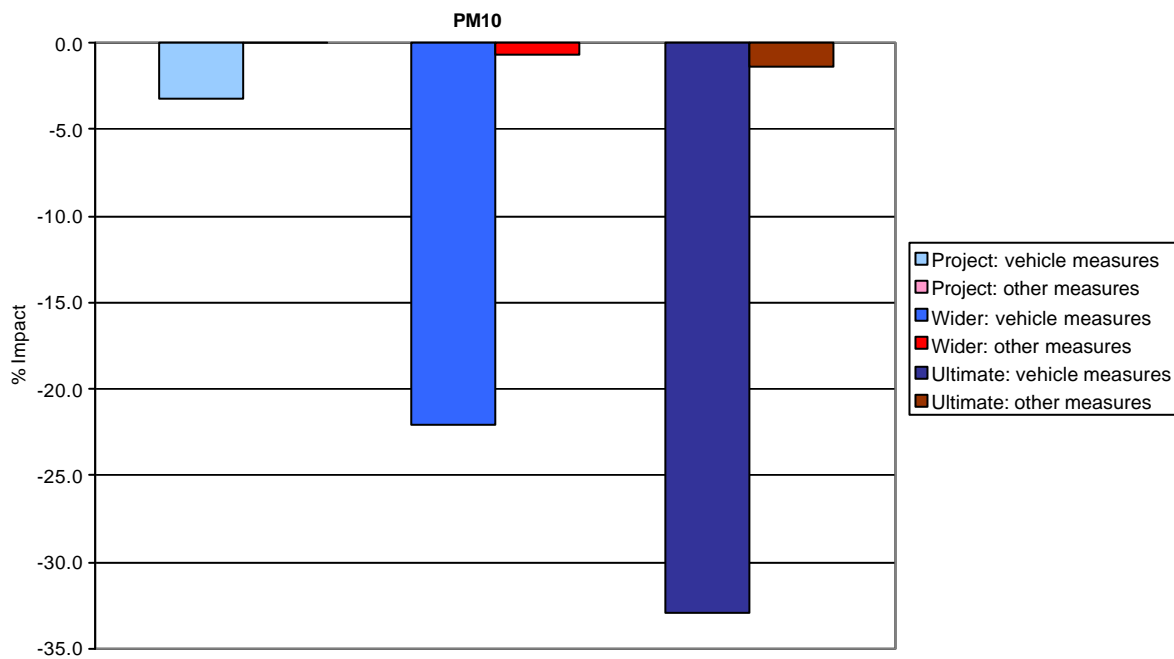
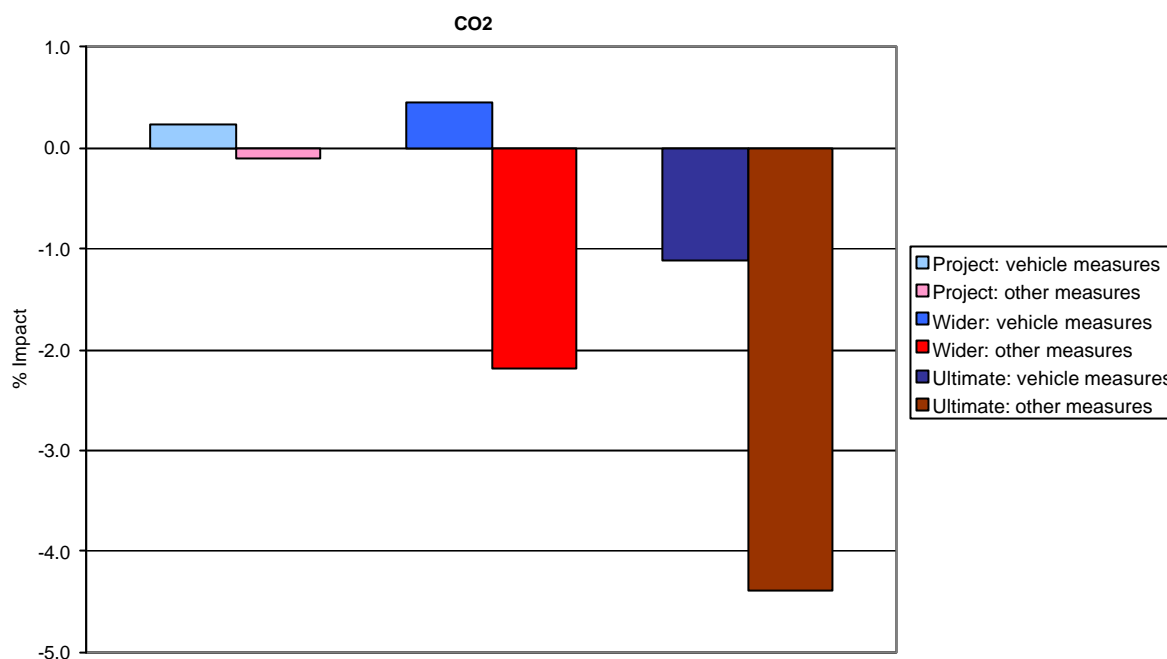


Figure A.8: Percentage Change for Project Scenarios Compared to the End-of Project Do Nothing Scenario: Carbon Dioxide.



Figures A.4 - A.8 are useful in clearly identifying that the vehicle measures have more impact in reducing NO_x and particulate emissions, which are the pollutants of most concern in respect of local air quality in Liverpool because they address the large-engined diesel vehicles that contribute significantly to these pollutants. However, the other measures appear to have a greater potential to address CO₂ emissions, which are of course closely linked to climate change.

The ultimate scenario for the vehicle measures shows itself to be over twice as effective in terms of the potential reduction in NO_x and 50% more effective in terms of the potential reduction in NO_x it offers, but is considerably more expensive as it involves the purchase of complete new hybrid vehicles rather than merely retrofitting particulate traps and EGR systems.

2. Relevance for environmentally significant issues or policy areas

(e.g. industries/ sectors with significant environmental impact, consistent with 6EAP or important env. principles etc.)

The transport sector figures prominently in the EU's Sixth Environment Action Programme (6EAP) and Sustainable Development Strategy. At its June 2001 summit in Gothenburg, the European Council singled out the transport sector as one of the four priority areas where sustainability policy development has to be put on a faster track. Achieving progress requires better integration of environmental considerations into all areas of transport policy-making.

The second report from the EU's transport and environment reporting mechanism² shows that transport in the EU is becoming less and not more environmentally sustainable. Transport contributes to damage to the environment and human health by emitting significant levels of toxic pollutants and greenhouse gases, generating wastes and noise and fragmenting the countryside.

The TERM report warns that current trends point away from achieving the EU's recently-announced objectives of breaking the link between economic growth and growth in transport. As a shift towards greater use of cars and planes continues, passenger and freight transport is growing at a faster rate than the economy as a whole, bringing increasing threats to the environment and human health. Furthermore, growth in energy use and greenhouse gas emissions from transport is jeopardising the EU's ability to meet its targets under the Kyoto Protocol on combating climate change.

There are some positive trends, mainly due to advances in technology and fuels that have made new road vehicles less polluting. A significant improvement in urban air quality has resulted, although in many cities air quality still poses health risks and further improvement is needed. The energy efficiency of car transport has improved slightly over the past two decades, although low occupancy rates and the use of heavier and more powerful vehicles have partly offset fuel efficiency gains in new cars.

The TERM report argues that better integration of environmental considerations into all areas of transport policy-making is required to achieve progress towards a more environmentally sustainable transport system.

CATCH has aimed and succeeded in addressing many of these issues, in particular that of urban air quality, which has an impact on the health of so many people within Europe.

Air Quality

Air pollution has been one of Europe's main political concerns since the late 1970s. European Union policy on air quality aims to develop and implement appropriate instruments to improve air quality. The control of emissions from mobile sources, improving fuel quality and promoting and integrating environmental protection requirements into the transport and energy sector are part of these aims. Motor vehicle emissions are regulated by Directive 70/220/EEC (light vehicles) and 88/77/EC (heavy vehicles) and amendments to those directives. A whole series of amendments have been issued to gradually tighten the limit values.

Road transport is a major source of most of the local air pollutants covered by the EU Directives. Pollutants from road transport are particularly important in busy, urban areas where meeting the Strategy's objectives is likely to prove most challenging. Road transport is responsible for a significant proportion of nitrogen dioxide and particles (PM₁₀) – the pollutants for which the Strategy's objectives will be hardest to meet. Cutting road transport emissions is therefore a key part of local air quality management.

Emissions are clearly falling because of these measures, even though traffic volumes continue to rise. The implementation of the Auto-Oil Programme will result in further improvements in urban air quality. Stricter limit values on the emissions of carbon monoxide (CO), Volatile

² TERM 2001: Indicators tracking transport and environment integration in the European Union



Organic Compounds (VOC), nitrogen oxides (NO_x) and particles will be implemented for light vehicles in 2005 (Directive 98/69/EC) and for heavy duty vehicles in 2005 and 2008 (Directive 1999/96/EC).

In addition to advancements in the environmental performance characteristics of vehicles, a number of experiments and demonstration projects have been undertaken with alternative fuels such as Liquid Petroleum Gas, Compressed Natural Gas, biodiesel, methanol/ethanol, as well as battery-electric, hybrid and fuel cell drive trains. The operational performance of alternative fuel vehicles has, however, been mixed and their market penetration continues to be poor. Further demonstration projects are required to give operators confidence in the technologies, and manufacturers a platform on which to build the market.

Climate Change

The European Union (EU) is at the forefront of international efforts to combat climate change, one of the greatest environmental and economic threats facing the planet and a top policy priority for the EC's Environment Commissioner. The Earth's average surface temperature rose by around 0.6°C during the 20th century and evidence is getting stronger that most of the global warming over the last 50 years is attributable to human activities, such as burning fossil fuels and deforestation, which cause emissions of carbon dioxide (CO₂) and other 'greenhouse' gases.

The EU wants all industrialised countries to take urgent action to reduce or limit their future greenhouse gas emissions in view of the consensus projection by the Intergovernmental Panel on Climate Change that global average surface temperatures will rise by 1.4-5.8°C by the end of this century if 'business as usual' continues. This temperature increase could trigger serious consequences for humanity and other life forms alike, including a rise in sea levels of an estimated 9-88 cm over the period that could flood coastal areas and small islands, and greater frequency and severity of extreme weather events.

The latest monitoring data indicate that the European Union has delivered on its long-standing commitment to stabilise emissions of carbon dioxide (CO₂) - the main greenhouse gas responsible for man-made global climate change - at their 1990 level by 2000. In March 2000 the Commission launched the European Climate Change Programme (ECCP) to prepare additional policies and measures, as well as an emissions trading scheme, to ensure that the EU achieves the 8% cut in emissions by 2008-2012 to which it is committed under the Kyoto Protocol.

Regarding CO₂ emissions from passenger cars, the EU's aim is to reach - by 2010 at the latest - an average CO₂ emission figure of 120 g/km for all new passenger cars marketed in the Union. However, TERM 2001 warns that the trend of continuing growth in car use remains a problem if the Kyoto targets are to be met.

The Urban Dimension

Around 80% of the European Union's population lives in cities and towns. Urban areas are therefore the places where environmental problems most affect the quality of life of Europe's citizens. Urban areas also create environmental problems in their own right due to the high density of activities that take place there. This high level of urbanisation within Europe means that there is a strong urban dimension to many of the Community's environmental policies. In addition, the urban environment is increasingly discussed as a subject in its own



right as reflected in the requirement in the 6th Environmental Action Programme to prepare a [Thematic Strategy on the Urban Environment](#).

For urban local authorities, the [Sustainable Cities and Towns Campaign](#) brings together a series of 10 networks of cities involved in different aspects of sustainable urban development. The objective is to encourage and support local authorities working towards sustainability at the local level through initiatives such as Local Agenda 21 and the Aalborg Charter. The Campaign is the principal source of information for information on sustainable urban development issues for urban authorities. Any local authority (including city, town or network of local authorities from any part of Europe) may join the Campaign.

Health

Although much progress has been made in improving the quality of air, water and soil, the situation remains far from satisfactory. Today, there is evidence that factors such as particulate matter in the air, noise and ground-level ozone damage the health of thousands of people every year. Thousands of man-made chemicals, including pesticides, persist in the environment, accumulating over time and we do not know enough about their long-term effect on our health. Although a range of specific policy actions are being taken to address those problems, by themselves they are not sufficient to deal with the complex, cumulative interaction between our environment and our health.

Many acute environment and health related problems have been solved, but much remains to be done, in particular with respect to the health implication of chronic exposures, as reported by organisations such as the European Environmental Agency, WHO and a number of national organisations. They indicate that the interaction between environment and health is far more complex than is commonly understood. In particular, little attention has been paid to the interaction of different pollutants in the human body as well as in the environment. Even low level exposure over a period of time to a complex cocktail of pollutants in air, water, food, consumer products and buildings is likely to contribute significantly to the health status of European citizens.

It is estimated that around 20% of the burden of disease in industrialised countries can be attributed to environmental factors, with the bulk of this affecting children and vulnerable groups. The magnitude of the problem is also perceived by the majority of Europeans: in a recent survey, some 89% are worried about the potential impact of the environment on their health. Furthermore, new technologies, changing lifestyles, work and life patterns, present new and sometimes unexpected impacts on the environment and its influence on health.

The Community Action Programme on public health (2003-2008) takes the environment as a major health determinant, while the EU Research Framework Programmes have included specific actions on this issue. The overall objective of the strategy is to reduce the disease burden caused by environmental factors in the EU, to provide a healthy environment and to prevent new environmental health threats. This will require an integrated approach at European level ensuring the integration of environment and health concerns into other policy areas.

Low levels of activity contribute to obesity, which has been identified as a growing problem in European society. Health inequalities in obesity among children are a particular concern in Liverpool. Physical activity may favourably affect body fat distribution. By increasing energy expenditure, regular physical activity contributes to weight maintenance and weight



reduction. UK research shows that obesity prevalence among children aged 2 – 10 is highest in inner-city areas and, in particular, in those areas ranked the highest in deprivation indices (Dhrit et al, 2005). Liverpool contains wards that fall into the ‘most deprived’ category in national statistics. Rates of obesity across Liverpool are higher than the average for England, and there are significant differences within Liverpool (Sefton & Liverpool PCTs, Lifestyle Survey).

CATCH has been working to address this issue through direct and indirect means:

- **Providing infrastructure in the city centre to enable healthy travel:** The City Centre Movement Strategy (CCMS) is a comprehensive long term programme to improve transport infrastructure in Liverpool. Integral to the project is the reduction of road traffic in the city centre, the improvement of conditions for pedestrians and the upgrading of infrastructure for public transport. CATCH added value to the CCMS by strengthening partnership and funding a detailed design study aimed at making access to an important commercial district easier for sustainable modes of transport such as walking or cycling. Following this a number of measures have been approved including “all red” pedestrian areas and better pedestrian crossings, better infrastructure for buses, footpath improvements and improved cycling lanes and cycling parking provision.
- **Promoting healthy travel through various initiatives:**
 - **Healthy Travel Promotion:** This technique, developed from commercial marketing and public sector campaigns, produces information on travel options targeted and customised for individuals’ own requirements. Organisational stakeholders interviewed for this HIA say they believed that CATCH enabled the project leaders to try new techniques to address psychological aspects of travel behaviour and enabled them to refine their marketing techniques.
 - **Calorie Maps:** Calorie Maps were produced as part of CATCH to encourage people in Liverpool to walk more in the city. A number of routes were mapped out with points of interest and the estimated calories burned for each route included. Stakeholders interviewed for this HIA had a very positive reaction to the Calorie Maps.
 - **Cycle Training Initiative:** A pilot project was launched to provide cycle training to adults and young people in a variety of settings. This project was launched in the last months of CATCH. The project included liaison with the local health sector to identify practices keen to ‘prescribe’ cycle training to patients and instructors were trained.

B. Long-term sustainability

1. Long-term / qualitative environmental benefits

(e.g. long-term sustainable technology, from product to functional focus; from end-of-pipe to prevention; high visibility for env. problems; spin-off effect in other environmental areas etc)

An emissions analysis of the wider application of measures in Liverpool has been conducted, focusing on two elements - clean vehicle technologies and community initiatives aimed at changing travel behaviour.



Clean Vehicle Technologies

The evaluation within CATCH shows that currently environmental concerns are not a primary reason for mode choice, even for a service such as the city centre shuttle bus where the product is overtly branded as being the environmental alternative. Given the commercial operating environment in the UK, this reduces the commercial incentive for bus operators to invest in this type of technology, particularly as the UK government grant programmes that have provided part funding for such technologies are currently frozen due to the need to wait for approval in relation to European state aid rules.

However, particulate traps and exhaust gas recirculation have been shown to be effective in making substantial reductions in emissions from the existing vehicle fleet. Given that there is not a significant direct incentive for bus operators to take the lead on this issue, Merseytravel has already commissioned a further study to investigate the cost effectiveness of these technologies in comparison to a fleet renewal programme as a way of improving air quality in Liverpool. It should be noted that Merseytravel does not currently have powers to require the use of particular types of technology on bus services except for those non-commercial services that it supports on the basis of social need. However, it is considering applying to take stronger control through the use of powers that would enable it to establish a programme of quality bus contracts - powers which would allow it to specify minimum environmental standards for whichever commercially operated services came under this banner.

The study showed that although the biggest improvement in air quality came from replacement of old buses with new vehicles that meet the latest Euro IV emissions standards, doing this on purely environmental terms was not as cost effective as the implementation of retrofit technologies on existing buses, although there are many other reasons for fleet renewal. Hence, if the financial investment to implement a more widespread environmental improvement programme on Liverpool's buses is to come from the public sector it is most likely to come through the use of retrofit technologies.

Hybrid buses have the potential to represent a further step towards the ultimate clean urban bus, and indeed have been widely documented as an interim technology step towards the ultimate goal of a zero emission vehicle. However, the state of development of the vehicles is currently limited to being a niche market vehicle for suitable urban routes where the drive cycle is suited to hybrid operation and where low emissions performance is a driver, such as in an air quality action area. If the expected fuel consumption benefits are confirmed, then heightened prominence to addressing global warming could provide an additional incentive to the uptake of hybrid vehicles. This would, in turn, be likely to result in increased numbers of production vehicles above current numbers (which resemble prototype production runs) leading to a reduction in what are currently prohibitively high costs for the commercial (or even supported) market.

The impacts of technology uptake could be substantial. Table A.2 showed the total emissions reductions due to the CATCH measures (actual and those possible from wider technology take up) within the project area of central Liverpool. If the whole of Merseyside is considered then the emissions reductions become more significant, both for the project and in the case of wider uptake of the CATCH vehicle measures. (This is a more realistic way of viewing the emissions savings than limiting them to the formal project impact area, because the CATCH buses are not restricted to operating within the central area of Liverpool, but in fact travel on routes to the perimeter of the city.) Table B.1 expands this further and shows the total



emissions savings that could be achieved over the whole of Merseyside in the ultimate take up scenario for CATCH measures.

Table B.1: Reductions in Pollutant Emissions as a Result of Vehicle Measures (Project and Ultimate Scenarios) Compared with the Do Nothing Scenario

	Reductions in Emissions Compared to Do Nothing Scenario (Tonnes per year)				
	Vehicle Measures within Central Liverpool			Vehicle Measures across Merseyside	
	Project	Wider	Ultimate	Project	Ultimate
CO	-4.1	-21.5	-31.9	-24.3	-247.0
NO _x	+0.4	-35.9	-103.3	-3.8	-920.9
VOC	-1.0	-5.7	-9.3	-5.8	-63.1
TPM	-0.5	-3.2	-4.8	-3.2	-36.5
CO ₂	+148.1	+289.3	-722.6	+352.4	-7639.5

Community Initiatives

The healthy travel promotion is widely applicable in any local community setting, and providing the necessary transport options and support infrastructure are available can be expanded from targeting merely local journeys.

The expected impact of working with developers is more likely to be concentrated around a small number of locations which become more spread out in the more peripheral areas of a city.

The wider impact of this type of measure is difficult to estimate with a high degree of accuracy as it depends on many factors, for example the level of support infrastructure for walking and cycling, the quality and extent of public transport options, the information already available to the information providers working on a individualised market project.

In the calculation here we have assumed that it would be accompanied by a degree of local infrastructure support, as per that seen in Liverpool city centre through the CCMS measures supported in CATCH, but not by a widespread upgrade to public transport services. However, the impact of this type of measure also has the possibility of influencing emissions over a much wider area. For example, if someone is persuaded to change their transport behaviour by a local initiative for a regional trip then the impacts will be felt over the whole of that journey, even in a city many miles away.

Table B.2: Reductions in Pollutant Emissions as a Result of Behavioural Measures (Project and Ultimate Scenarios) Compared with the Do Nothing Scenario

	Reductions in Emissions Compared to Do Nothing Scenario (Tonnes per year)			
	Behavioural Measures within Central Liverpool			Behavioural Measures across Merseyside
	Project	Wider	Ultimate	Ultimate
CO	-1.5	-29.9	-59.8	-1097.9
NO _x	-0.1	-2.0	-4.1	-82.6
VOC	-0.1	-1.9	-3.9	-76.4
TPM	0.0	-0.1	-0.2	-3.4
CO ₂	-73.0	-1429.9	-2859.8	-43299.9

2. Long-term / qualitative economic benefits

(e.g. long-term cost savings and/or business opportunities with new technology etc, regional development, cost reductions or revenues in other sectors)

CATCH has supported several new technologies and techniques, including:

- Hybrid buses
- Exhaust Gas Recirculation (EGR) equipment
- Innovative pollution monitoring equipment
- Community Healthy Travel Promotion initiative
- Adult cycling training

Hybrid Buses

The CATCH trials have demonstrated the potential capabilities of hybrid buses. They would appear to have significant potential to reduce pollution and save fuel, hence having a positive effect on operating costs. They have proved acceptable to operating personnel and to passengers alike. However, it is clear that more development and evaluation work will be necessary to help the product develop from a niche market with small, one-off orders to a larger, more continuous production base with lower purchase and maintenance costs.

Exhaust Gas Recirculation

To our knowledge the EGR trial was the first sizeable trial of EGR equipment on vehicles already in service (as opposed to new vehicles that had been designed with EGR fitment in mind). The technology has shown itself to have significant potential to reduce NOx emissions levels from the vast majority of vehicles in service which were not manufactured to the latest emissions standards and which are likely to remain in service for many years to come.

Innovative Pollution Monitoring Equipment

The detailed results show that the particulate monitoring systems provide ostensibly reliable results, as witnessed by the production of calibration curves with approved pollution monitoring systems. The technique has been shown to be viable and capable of providing area-wide particulates results based on a networked data acquisition system. However, as the new system is not in itself formally approved this hurdle would need to be overcome before widespread use of the system will be possible.

Community Healthy Travel Promotion Initiative

The Healthy Travel Promotion has produced good environmental results with a total reduction in car kilometres, (and associated emissions) of 129420 per year by participants. This type of initiative shows promise for application in other areas of Liverpool, and could have even greater impacts if more time were allowed to establish strong contacts between the information providers and the public in the target area. It is likely that further development of this and other individualised marketing systems will continue as consultancies look to sell their services to public sector clients.

Adult Cycling Training

The benefit of the cycle training initiative is based on the typical discrepancy between cycle ownership and cycle use in the UK (typically 33% of adults own a bicycle but only 1% use them regularly). Provision of cycle infrastructure alone has been shown to be ineffective in addressing this issue and other persuasive schemes are needed in order to ensure that any



infrastructure which is implemented is actually used. Hence, the aim of the cycle training was not only to ensure that people were trained to cycle safely, but that they were also informed of dedicated cycle routes that they could use for journeys which are of practical use for their daily lives. This helps to support the community mobility plan activities of the project in Liverpool and aims to make best use of the city council's investment in cycle infrastructure and priority measures that are being implemented through the CCMS. The cycle training also promotes cycling as an activity at a time when measures to tackle obesity have widespread national coverage in the UK which supports the health message of CATCH. Again, It is likely that further development of this technique will continue as suppliers look to sell their services to public sector clients.

3. Long-term / qualitative social benefits

(e.g. positive effects on employment, health, ethnic integration, equality and other socio-economic impact etc)

Two sets of interview-based surveys were conducted during the CATCH project, both in the early stages of the project and also towards the end of the project, in order to assess the impact CATCH has had on the awareness, attitudes and acceptance of the people active in the project's target area. One pair of surveys was conducted with residents of the area and the other pair of surveys was conducted with a cross section of the people who were active on the street. (The latter group could be residents or people who have come to Liverpool as visitors, to study, to work or for shopping etc.)

Some of the key findings in relation to the respondents' awareness of and attitudes to transport and environment issues are explored.

Traffic Levels and their Influence on Journeys

Respondents to the household survey were asked to describe the traffic levels in the specific area where they live. Respondents to both the household and on-street surveys were asked to describe the traffic levels in central Liverpool as a whole. Liverpool city centre residents felt that traffic levels had increased slightly over the duration of the project local to their residences. In both surveys there was a general shift in opinions of traffic levels in central Liverpool from low towards the higher end of the range suggesting that traffic is becoming perceived as more of a problem.

During the course of the project there was also an increase in the proportion of people who stated that traffic levels in the Liverpool Air Quality Management Area would affect whether they choose to use the car to make a journey. This observation suggests that respondents are becoming more influenced by traffic levels as traffic levels are perceived to increase. In the household before survey a high proportion of residents indicated that traffic levels also influenced whether they walked within the Liverpool Air Quality Management Area. This figure decreased dramatically in the after survey, suggesting that traffic levels are now considered less of a problem in preventing people making a journey on foot and that the Liverpool Air Quality Management Area is becoming a more acceptable area for walking. This may be due to the ongoing work to improve infrastructure and environment for walking in the city centre, although there is no hard evidence to back this up. A similar pattern of responses was found for the impact of traffic on the time that people would make journeys by different modes.



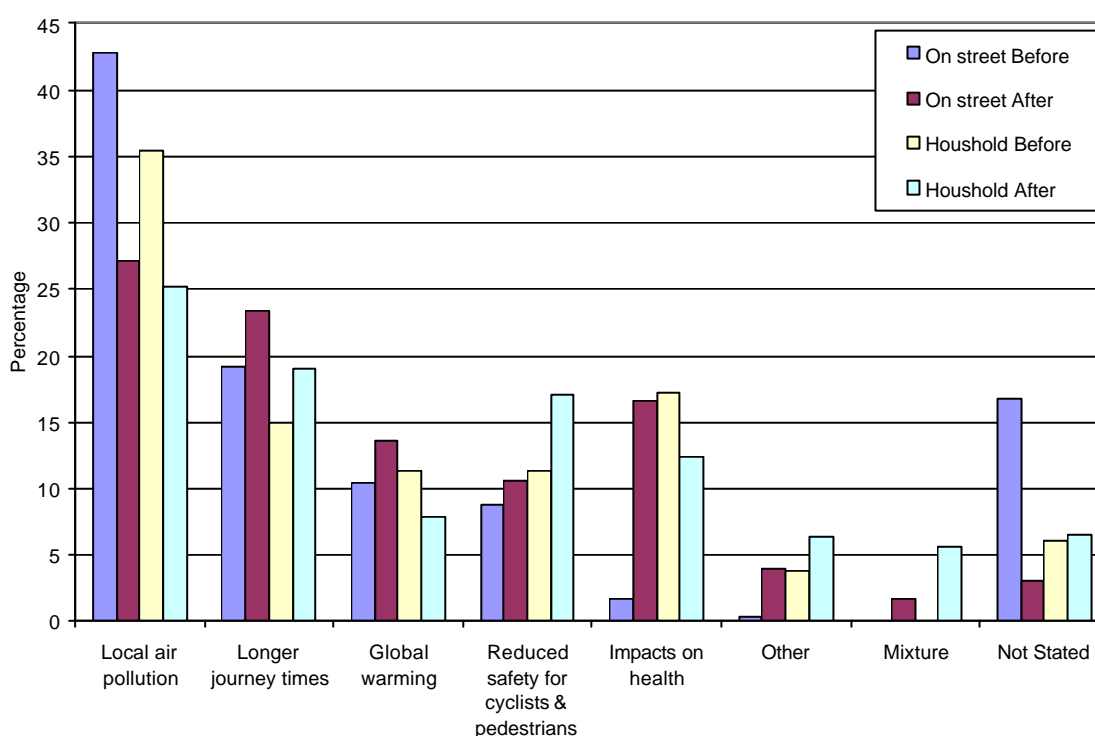
Public Transport

Public transport was considered to offer a suitable option for some or even all journeys in both the before and after surveys of the on-street and household surveys. The response was slightly better for respondents to the on-street survey, 40% of whom suggested that it would be suitable for all trips. The balance of respondents to both surveys felt that the quality of public transport had improved within the last three years, and in the case of the household surveys there is an indication that this improvement has accelerated during the course of the project.

Consequences of Congestion

Respondents' opinions of the consequences of road traffic congestion were investigated in both surveys to find out which generates the greatest concern amongst residents and city users. The results (shown in figure B.1) indicate that air pollution is still considered the greatest consequence of road traffic congestion amongst Liverpool residents and city centre users. Other increasing concerns are with longer journey times, reduced safety for pedestrians & cyclists and impacts on health, which are gradually becoming more of an issue for some within the Liverpool Air Quality Management Area.

Figure B.1: Respondents' Selection of the Most Important Consequence of Congestion.



Air Quality Perceptions, Information and Reactions

Respondents are in strong agreement that poor air quality can affect their quality of life (see Figure B.2). A sizeable minority in both sets of surveys indicated that they suffered from some form of breathing problem.

Opinions were split as to whether the air quality in Liverpool is good. On balance more people agreed than disagreed with the statement that "Air quality in central Liverpool is good". In the after on-street survey the responses suggest that respondents perceive air

quality in central Liverpool to have improved during the course of the project (Figure B.3). However, there seems to be a high level of uncertainty about what measures are being undertaken by the local authorities to target the issue of air quality (Figure B.4). This suggests that the CATCH message has not been as successful as we would like and that once the air quality action plan is formally approved it, and the measures within it, should be accompanied with a widespread information / publicity campaign.

Figure B.2: The Degree to which Respondents Agreed with the Statement “Poor air quality can affect quality of life”.

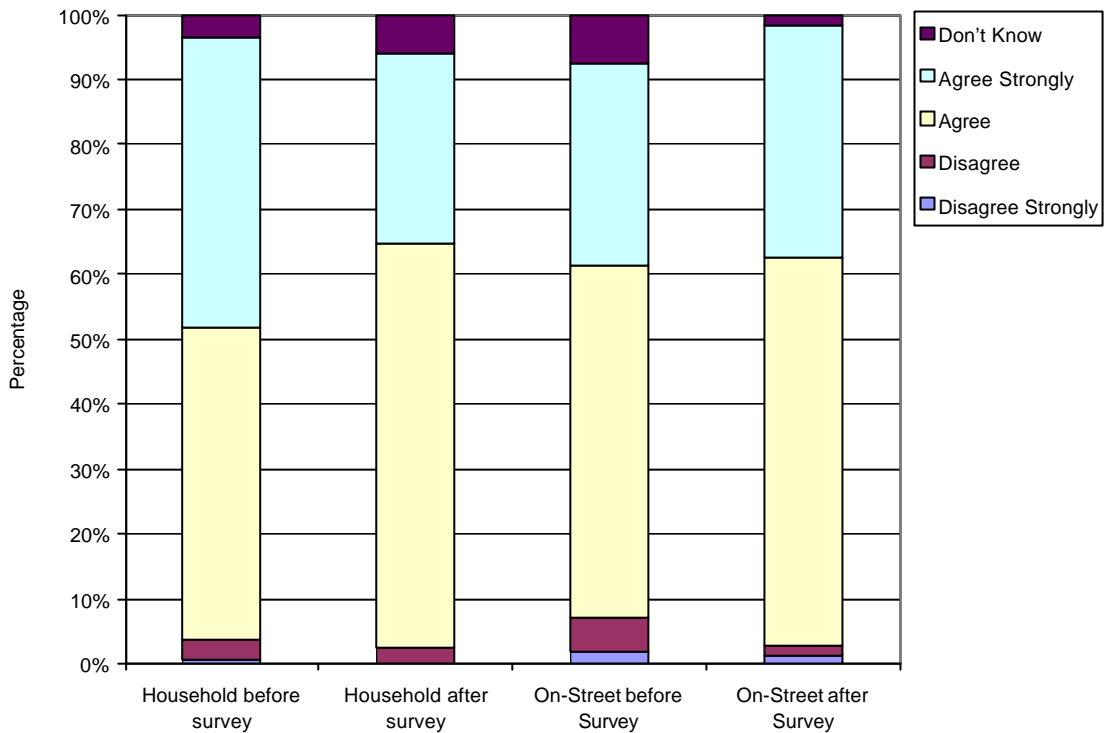


Figure B.3: The Degree to which Respondents Agreed with the Statement “I think air quality in central Liverpool is good”.

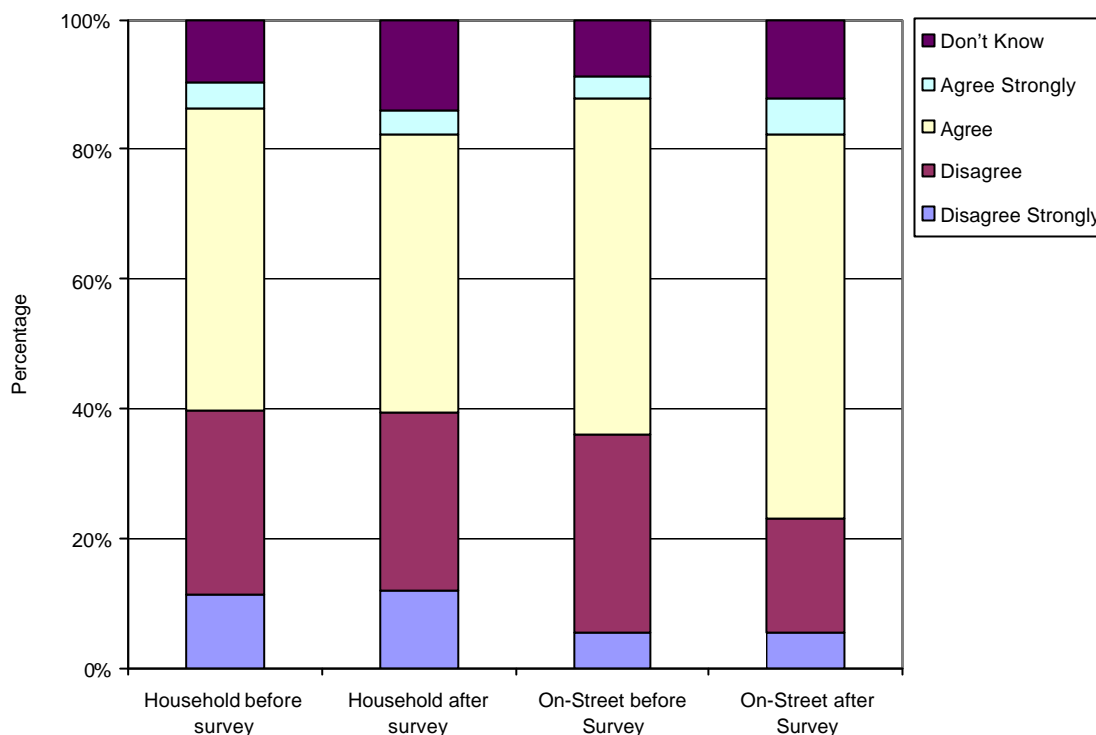
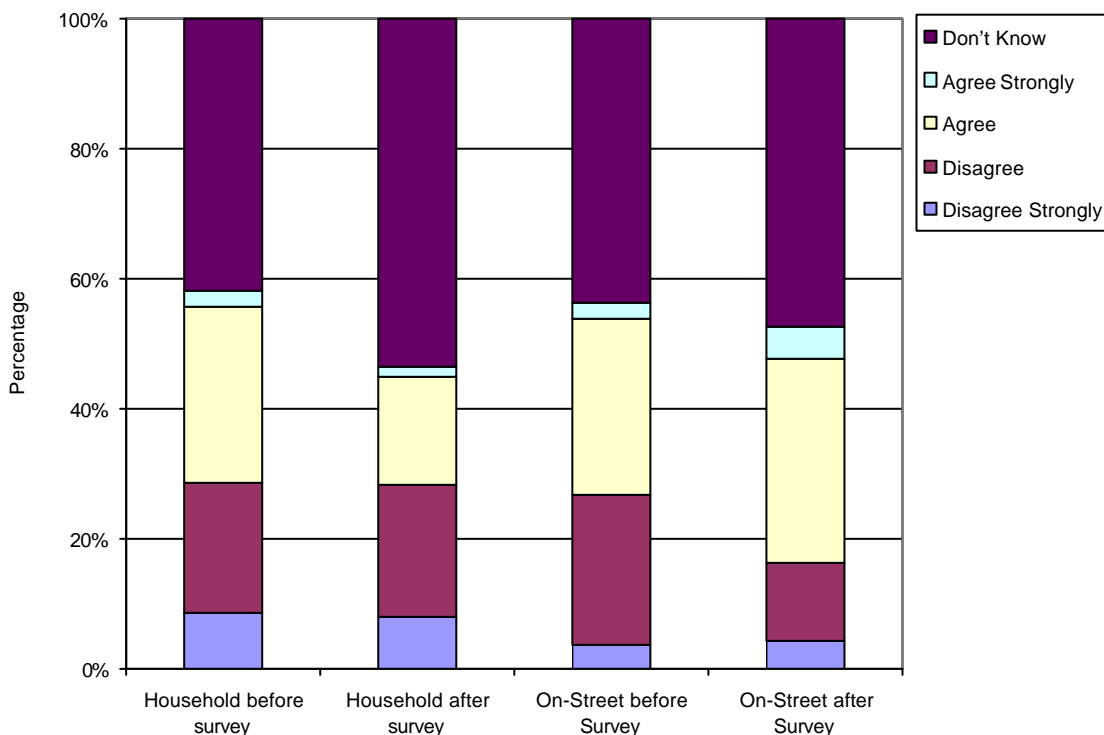


Figure B.4: The Degree to which Respondents Agreed with the Statement “The local authorities are doing a lot to improve the local air quality”.



Respondents’ interest in receiving more information about air quality in central Liverpool was mixed. In both before surveys a greater proportion of the respondents agreed that they would like more information than disagreed. However, in the after on-street survey this situation



was reversed, possibly because a greater proportion of this group considered the air quality in central Liverpool to be good.

There was a relatively constant proportion of people, around 25%, who agreed with the statement that they would change their travel patterns if they knew the air quality to be poor. This corresponds to the findings of many surveys which are that environmental factors are not the main determining factor in people’s transport choices. However, there was stronger support for some of the other suggestions made in relation to linking transport choices and measures to the air quality situation, with a majority in favour of traffic reduction measures and an even split supporting the banning of cars from the city centre when air quality is poor.

This slightly contradictory situation can be summed up by saying that people are becoming more aware that poor air quality can affect their health and the quality of their lives and that cars contribute significantly to poor environmental conditions. Traffic reduction measures are seen as good idea for improving air quality but at present the number of people who do not want to give up using their own car or change their travel patterns to help improve air quality within the city is still relatively high.

Figure B.5: The Degree to which Respondents Agreed with the Statement “I would choose to change my travel patterns on days when I know air quality was poor”.

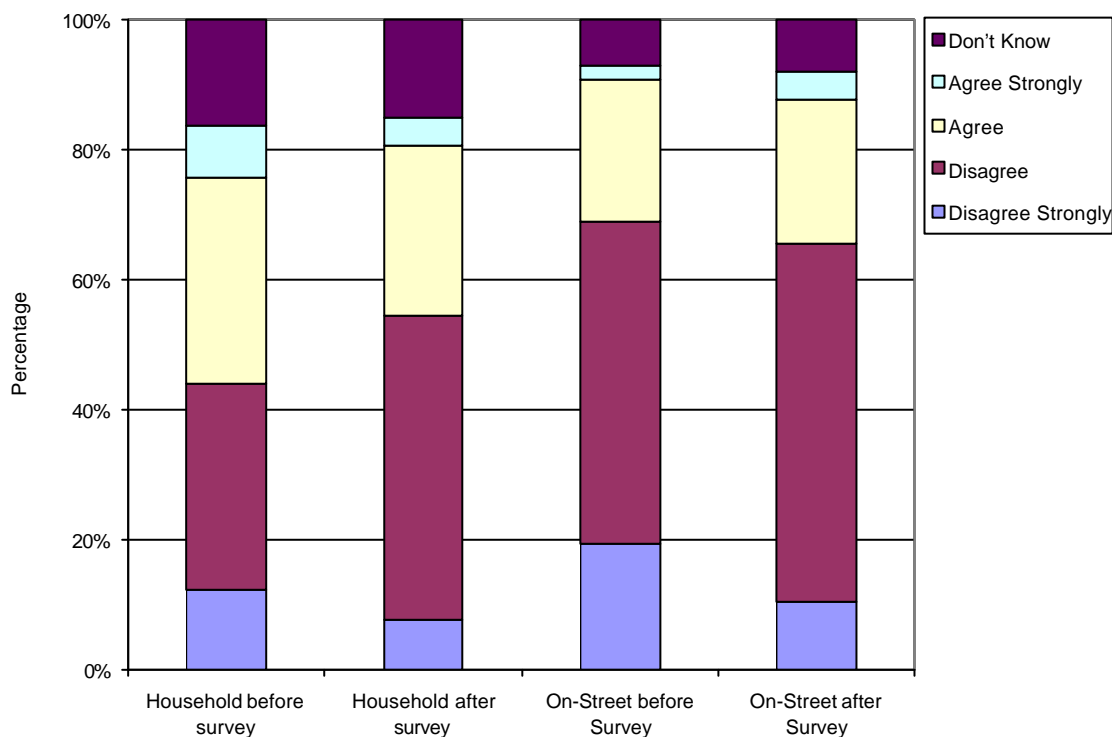


Figure B.6: The Degree to which Respondents Agreed with the Statement “I would walk or cycle more if the air quality in Liverpool improves”.

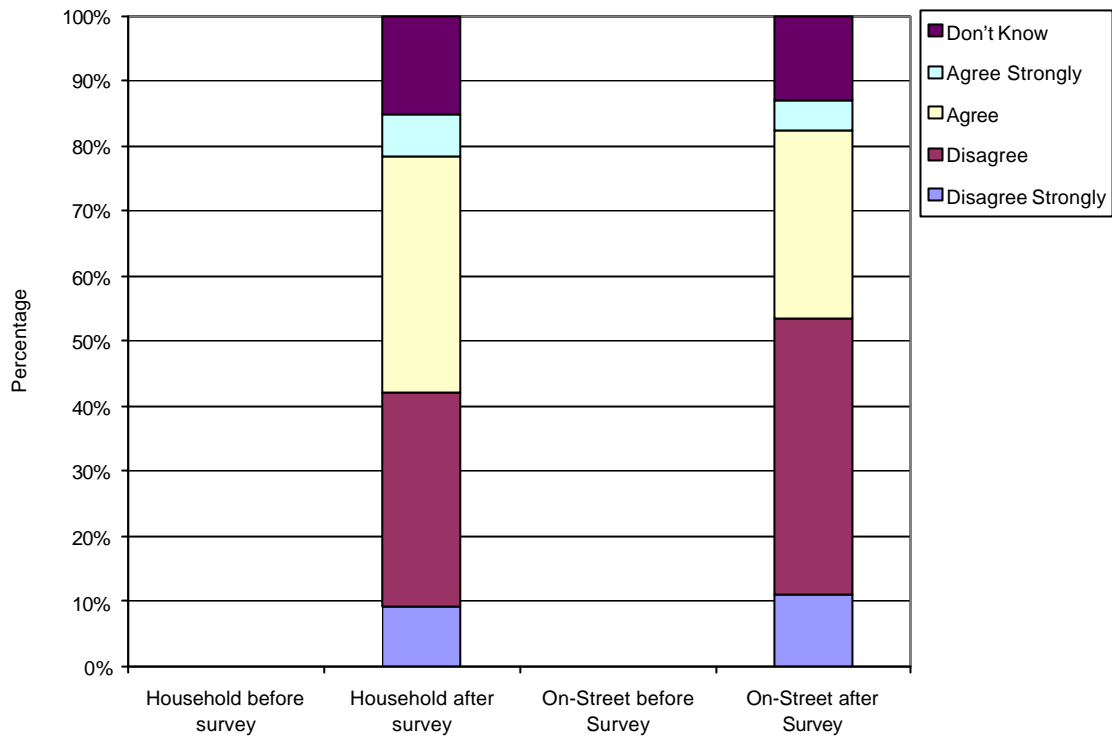


Figure B.7: The Degree to which Respondents Agreed with the Statement “I would like to see traffic reduction measures introduced to improve air quality in the city centre”.

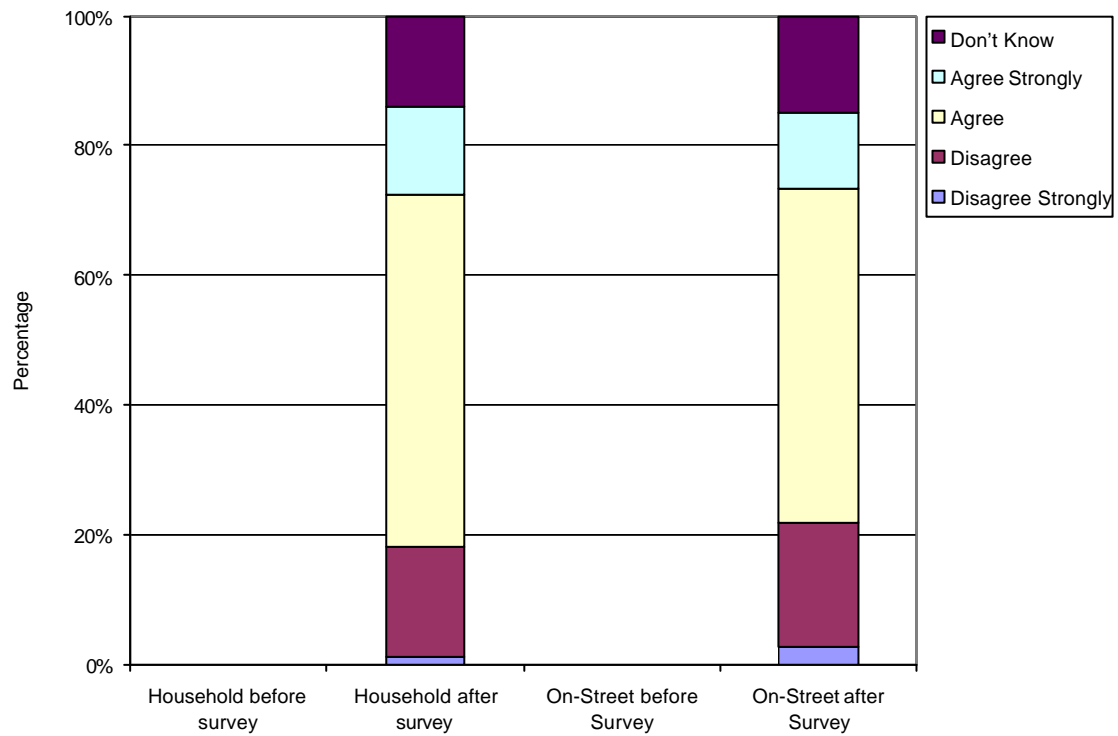
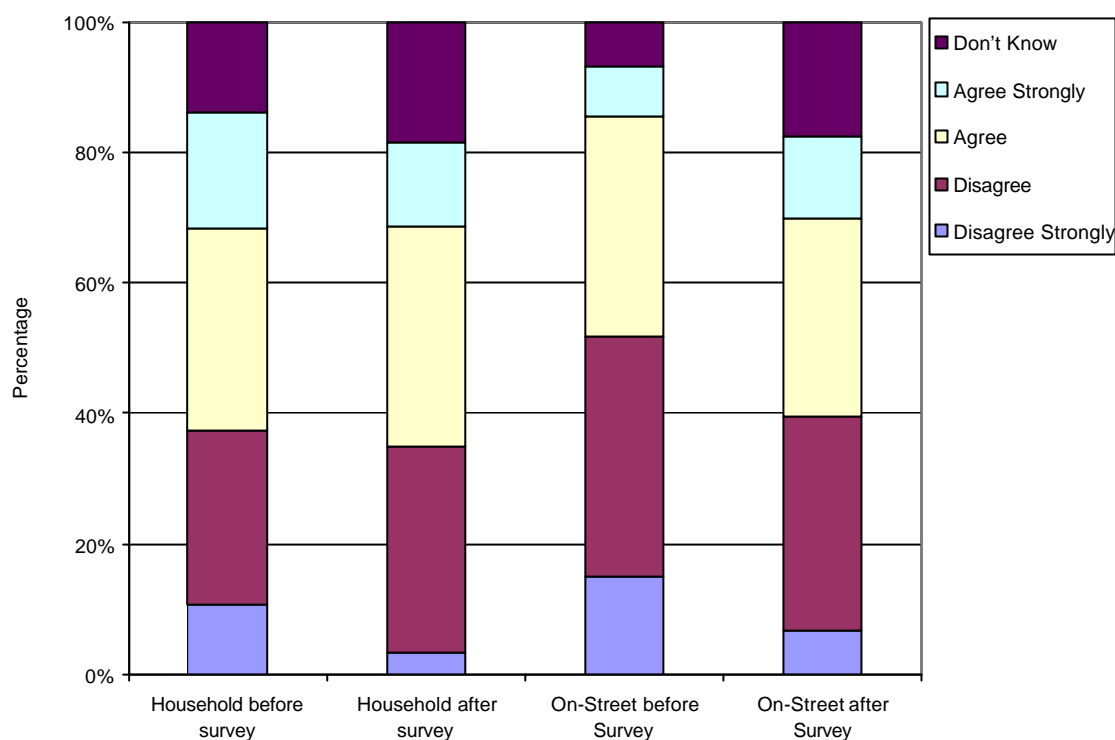


Figure B.8: The Degree to which Respondents Agreed with the Statement “I think cars should be banned from the city centre when air quality is poor to help improve the situation”.



Regeneration / Accessibility

It was paramount that the new city centre shuttle service route designed for Liverpool should provide an essential transport service, be environmentally sustainable and ultimately be of commercial interest, which will ensure its long-term sustainability. The brief for the new route was to link key areas and developments not currently served by the existing public transport network and ensure good fit within the overall context of changes to traffic circulation patterns as proposed by the City Centre Movement Strategy. It was particularly designed to link all the main public transport 'gateways' in the City Centre (including Lime Street main line rail station, the main long distance coach station at Norton Street, and Queen Square bus station which is one of the main city centre hubs of the local bus network), with a range of key regeneration sites and developments, supporting the existing regeneration strategies and improving accessibility for existing residents in some relatively poor neighbourhoods.

Health

The project's impact on the health of the population has been a prime focus of the objectives as was demonstrated by the incorporation of a Health Impact Assessment (HIA) within the evaluation. The HIA concluded that CATCH was a demonstration project that has shown how better air quality and healthier travel behaviour can be achieved at a local level.

CATCH tested and refined a range of methods to reduce Nitrogen Dioxide (NO₂) and Particulate Matter (PM) emissions from vehicles. The reduction of these pollutants will benefit those groups particularly vulnerable to the effects of poor air quality, including people with cardio-respiratory diseases, unborn and very young children, older people, those

suffering socio-economic deprivation and those exposed to relatively high levels of pollution due to where they live. The likely health impacts for the population generally and these groups in particular from improved air quality are:

- *reduced mortality*
- *possible reduced infant mortality*
- *better health for people with respiratory diseases*
- *reduced hospital admissions*
- *reduced medication usage*

CATCH's Individualised Marketing approach and cycle training will have a direct impact on the levels of physical exercise of the people signed up to those projects. The production of Calorie Maps and an improved environment for pedestrians and cyclists will encourage others to take more exercise. In addition the lessons learned about the strengths and weaknesses of the approaches piloted in CATCH can be passed on to others through effective dissemination of findings throughout Liverpool and other European cities. The following health impacts resulting from increased exercise through healthier travel are likely:

- *reduced mortality*
- *reduced obesity*
- *decreased risk of cardiovascular diseases*
- *decreased risk of colon cancer*
- *decreased risk of non insulin dependent diabetes mellitus*
- *better muscle strength and skeletal development*
- *reduced risk of falling*
- *better mental health*
- *better health-related quality of life*
- *reduced mortality and morbidity from road traffic accidents*
- *better access to health services*
- *social support – reduced traffic volumes are likely to increase social contact*

To address the social determinants of health it is important to incorporate health protection into decision making in all policy areas and partnership working for health is key to achieving this goal. CATCH provides an example of how partnership working for health can be achieved on the ground. The dissemination of the findings in this report will provide a valuable demonstration of both the tangible achievements of partnership and the challenges or barriers that need to be addressed for partnership working to succeed. The health impacts of partnership working in CATCH identified are:

- *experience of partnership working through CATCH increased the partners' awareness of health and the wider social determinants that cause poor health - this awareness will have a longer term legacy by encouraging them in the future to explicitly consider health*
- *CATCH linked in with large scale policies across the city (especially the City Centre Movement Strategy and the Air Quality Action Plan) - this has the dual advantage of adding an explicit health dimension to larger policies and helping to ensure a longer term legacy for CATCH achievements*
- *CATCH demonstrated to local politicians that tangible action on the ground is possible to improve health and they are keen to publicise its achievements to other politicians*



- *CATCH brought together partners that may not otherwise have been brought together*

C. Replicability, demonstration, transferability, cooperation

1. Transferability and Potential for Commercialisation

(including cost-effectiveness compared to other solutions, benefits for users (e.g. improved health & labour conditions, less nuisance to others), drivers and obstacles for replicability/reproducibility, market conditions, pressure from the public, potential degree of geographical dispersion, specific target group information, high project visibility (eye catchers) etc.)

The problems caused by atmospheric pollution from road traffic in urban areas are common throughout the world. The degree of interest in these issues can be judged by the number of local authorities from across Europe that have signed up to the objectives of various initiatives (e.g. ALTER-Europe and the Aalborg charter) and programmes (e.g. the TTP demonstration projects of the THERMIE programme, CIVITAS initiative etc.) over the past 12 years.

The issues that need to be addressed in these and many hundreds of other cities are in no way unique, although the local situation and combination of policy and institutional frameworks in place mean that specific local solutions made up of appropriate measures from the list of possible options are often the answer.

The measures demonstrated in CATCH are, in general, widely applicable across Europe. Many of the influencing factors for wider transferability will differ from city to city depending on the country in which they are located because national policies and legislation can have a strong influence on methodology and outcome. It is beyond the scope of this report to review all the necessary transport policy structures in order to conduct a systematic review. Instead policy makers should be aware of the context in their own country / region and consider the issues at a more general level, for example:

- sources of funding;
- levels of public (and political) awareness and acceptance;
- employment;
- the methods used for public participation;
- legislative, policy and cultural barriers to implementation;
- timescales for consultation, planning and implementation.

Some of the barriers we have encountered in the implementation of CATCH, as well as some possible solutions, are contained within the CATCH Best Practice Recommendations report. The participation of follower cities in southern and eastern Europe has demonstrated both the relevance and applicability of the CATCH measures throughout Europe and provides a basis for further transfer of ideas and measures in the future.

The CATCH project will have a significant legacy. In particular:

- The technology implemented within the project has a significant life expectancy. Particulate traps (Liverpool and Suceava) and EGR systems (Liverpool) are expected to last a minimum of five years. New vehicles (buses in Liverpool and LPG cars in Suceava) are expected to last a minimum of fifteen and ten years respectively.



- There is potential for commercialisation of the innovative pollution monitoring equipment.
- The CATCH city centre shuttle service is being operated on a five-year contract and it is hoped that at the end of that period it will have demonstrated that it can operate on commercial basis. (If not it will be up to Merseytravel to decide if it wishes to retain the service as a one of its supported services, which seems likely at this stage.)
- The investment in retrofit technologies has already led Merseytravel to commission a further review of future bus pollution reduction options as part of their future public transport strategy development.
- Liverpool's AQAP which is well respected within the UK and which will be backed up by a package of resources to see it implemented effectively.
- City centre infrastructure in Liverpool (cycling and walking support infrastructure) and Suceava (permanent, pedestrianised low emission zone)
- Support for further adult cycle training programmes in Liverpool building on the pilot initiated in CATCH.
- The development of the ECOtravel bureau through partnership working has led to the bureau co-ordinator's position being made permanent and having an expanded remit for work across the whole of Merseyside. The Suceava information point in the city hall will also remain open after the formal end of the project.
- The Supplementary Planning Document and developers protocol will be adopted and when combined with new working practices and co-operation between transport and land use planners will mean that there will be greater control of future city centre residential developments in Liverpool.
- Plans are being formed for individualised marketing campaigns building on the work of and lessons from the healthy travel promotion project in Liverpool
- Efforts are being made to discuss the innovative particulate monitoring technology to understand the steps that will be necessary for it to become approved as a tool for monitoring air quality to statutory air quality standards

D. Innovation

1. Level of innovation

(incl. technology, processes, methods & tools, organisational & co-operational aspects)

The main innovation of CATCH was related to the organisation and co-operation aspects of the project as it aimed to promote sustainable mobility through an innovative, partnership-based approach to transport-related environment policy. This resulted in the successful development of new processes and methods and some new technology. In particular the partnership-based approach and the new processes and methods will be applied in the future work of the partners.

Processes, Organisational and Co-operational Aspects

A wide range of complementary issues are covered by all the CATCH measures, which resulted in the involvement of a large number of stakeholders in order to complete the project. Separation of responsibilities, even within an individual organisation, can lead to lack of knowledge and understanding of linked issues which can reduce the chances of meeting an overall objective. At its worst a lack of understanding and co-operative working can lead to direct conflict between participating organisations as they single mindedly pursue their own objectives. This can be overcome through common working, developing an understanding of



the issues of importance to others and the framework within which they are expected to work and the production and use of cross disciplinary guidance notes where appropriate.

This has been achieved by ensuring that all relevant actors were included within the project's decision making structure and allowing enough people to participate in discussions about topics to which they would otherwise not have been able to contribute, safe in the knowledge that there was political support for this approach. In this way CATCH has enabled cross-sectoral dialogue between:

- public transport authority transport planning team
- public transport authority environmental strategy team
- the Liverpool City Council Air Quality team
- Liverpool City Council highways management
- Liverpool City Council land use planning
- Liverpool City Council fleet management
- Liverpool City Council street safety (CCTV) team
- Liverpool University
- The area's main (commercial) bus operator

In some cases the links between the work of these organisations have been formalised in a forum that did not exist previously or through specific working procedures such as:

- The development of supplementary planning documents designed to set minimum standards for the provision of cycle parking and sustainable travel information provision in new developments at the planning stage
- The incorporation of the Air Quality Action Plan within the 5-year Local Transport Plan (a UK government requirement)

The current deregulated public transport market in the UK is not helpful to the integration of environmental considerations into the mainstream transport options. The passenger transport authorities (Merseytravel in the case of Liverpool) are currently only empowered to set environmental standards on a limited number of non-commercial services which they subsidise on the basis of meeting a social need. Hence, within the current framework the integration of environmental considerations into the bus market is dependent upon individual operators recognising its importance and making the necessary investment of time and expertise; i.e. it costs bus operators money to reduce pollution but in the commercial environment it does not increase their revenues. Alternative frameworks such as re-regulation or the provision of quality bus contracts would enable passenger transport authorities to specify a minimum environmental standard for particular areas / routes and so ensure that environmental considerations are integrated into the standard service provision. This would have additional impacts of risk management in terms of implementing new technology and providing long term security for those operating new technology if the contract was written to allow for, say a five year period (subject to satisfactory performance). Merseytravel plan to investigate a range of alternative frameworks in partnership with the local bus operators with a view to improving the local regulatory framework for the benefit of all.

Methods and Tools

CATCH has been in the forefront of using two tools which have come to prominence during the course of the project:



- At the start of CATCH the use of formal Health Impact Assessment techniques for transport projects was almost unheard of. Now, however, they are becoming more common and are often included within a wider strategic environmental assessment framework.
- Personalised travel planning, also known as individualised marketing has also seen a significant increase during the course of the project. CATCH has taken this concept and used it to develop a variation on the standard methodologies, by aiming to spread the message through the use of community stakeholders and focusing the message around the health of the individual. The use of trusted members of the community to spread the message as part of their daily activities is able to provide additional synergies and value for money compared with the traditional approach taken in other such studies.

Technology

The hybrid buses demonstrated in CATCH formed the first fleet of hybrid buses put into operation in the UK (as opposed to one-off test vehicles which had been run for a limited amount of time in Manchester and Bristol). The fact that the hybrid buses were effectively still prototypes, with development work still to be done whilst in service on the CATCH project, has led to problems at two levels - problems related to new technologies and systems and problems related to low production volumes which require bespoke solutions / procedures which are not tested. The CATCH demonstration has identified nothing which fundamentally stands against the concept of hybrid vehicles. (Hybrid cars are now entering the mass car market and there is no fundamental issue that would prevent development of a hybrid bus.) However, CATCH has identified several issues which hybrid vehicle manufacturers must overcome if hybrid buses are to develop into a part of the mainstream bus fleet. In particular, in order to make a significant breakthrough into the market hybrid buses will need to prove:

- o that battery equalisation, requiring overnight vehicle connection to a special mains electrical supply is not necessary,
- o that fuel consumption benefits demonstrated under laboratory conditions can be replicated under real-world operations,
- o total life costs must be no more than those for a conventional vehicle,
- o and that no special start up procedures are necessary in order for the vehicle to function.

The pollution monitoring system is highly innovative. It uses a chromatic modulation methodology adapted from its normal uses to investigate the concentration and size distribution of particulates within the atmosphere. The equipment has been developed in two forms: a portable, hand-held unit and a fixed site system that ties in to the existing CCTV security cameras operating in Liverpool.

The UK Department of Environment, Fisheries and Rural Affairs has described the equipment as 'a very innovative idea' and 'very relevant to our current needs at DEFRA' although they also state that 'there is not enough performance evidence as yet for it to be of use for DEFRA'. As the new system is not in itself formally approved this hurdle and the need for further testing will need to be overcome before widespread use of the system will be possible.

