

Active Travel Toolbox

# The Role of Active Travel in Improving Health

Toolkit Part 2: Improving air quality by walking and cycling



Delivered by Sustrans in partnership with:



Toolkit Part 2: Improving air quality by walking and cycling  
Health And Wellbeing Toolkit  
Active Travel Toolbox

Written by Sustrans with support from Dr Adrian Davis, The TAS Partnership Limited and Living Streets.



# About Sustrans

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Sustrans is the charity making it easier for people to walk and cycle.

We are engineers and educators, experts and advocates. We connect people and places, create liveable neighbourhoods, transform the school run and deliver a happier, healthier commute.

Sustrans works in partnership, bringing people together to find the right solutions. We make the case for walking and cycling by using robust evidence and showing what can be done.

We are grounded in communities and believe that grassroots support combined with political leadership drives real change, fast.

Join us on our journey. [www.sustrans.org.uk](http://www.sustrans.org.uk)

Head Office  
Sustrans  
2 Cathedral Square  
College Green  
Bristol  
BS1 5DD

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Registered Charity No. 326550 (England and Wales) SC039263 (Scotland)  
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# This is the second part of the Active Travel toolkit on The Role of Active Travel in Improving Health.

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## **The Active Travel toolkits aim to help LEPs and their local delivery partners to:**

- 1 Develop your business case for investment in walking and cycling schemes.
- 2 Link walking and cycling schemes to your strategic economic growth priorities, housing growth and planning, and public health.
- 3 Support the planning and delivery of walking and cycling schemes in your local area.

## **This toolkit will cover the following areas:**

- 1 The impacts of poor air quality on human health
- 2 The benefits of modal shift from short car trips to walking and cycling
- 3 Approaches to improve air quality that encourage modal shift

A slide pack on *improving air quality by sustainable transport* can be downloaded separately. It summarises the key evidence base and statistics to help you prepare presentations, funding bids and reports.

## **Our key messages include:**

- 1 Air pollution is damaging our environment and our health. Up to 40,000 early deaths are attributable to air pollution each year in the UK and road transport is responsible for 80% of the pollution where legal limits are being broken.
- 2 The pollutants of main concern in connection to motor vehicle use are particulate matter (PM10/2.5) and Nitrogen Oxides (NOx).
- 3 Strategies to reduce vehicle use, especially for short trips and for the most polluting vehicles in cities will help to reduce pollution.
- 4 The Avoid (align transport and urban development), Shift (modal shift to active travel and public transport) and Improve (use technology to reduce emissions) approach is a useful framework for reducing air pollution.

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# 1. The impacts of poor air quality on human health

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## 1.1 What is air pollution?

Air pollution is the term given for a number of different substances suspended in the air that are harmful to human, animal and plant life as well as the built environment.

The pollutants of main concern in connection to motor vehicle use are particulate matter (PM10/2.5) and Nitrogen Oxides (NOx).<sup>1</sup>

### Particulate matter (PM10/2.5)

A wide variety of airborne particulate matter exists. The most concerning of all airborne particulate matter are PM10 particles (the fraction of particulates in air of very small size ( $<10 \mu\text{m}$ )) and PM2.5 particles ( $<2.5 \mu\text{m}$ ). These particles are small enough to penetrate deep into the lungs and so potentially pose significant health risks to people exposed to them. Larger particles meanwhile, are much harder to inhale, and are removed relatively efficiently from the air by a process called sedimentation.

The principal source of airborne PM10 and PM2.5 matter in European cities is road traffic emissions, particularly from diesel vehicles. EU limit values are very often exceeded in many European cities.

### Nitrogen oxides (NOx)

NOx is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). They are inorganic gases formed by combination of oxygen with nitrogen from the air. NO is produced in much greater quantities than NO<sub>2</sub>, but oxidises to NO<sub>2</sub> in the atmosphere. NO<sub>2</sub> causes detrimental effects to the bronchial system.

NO<sub>2</sub> concentrations frequently approach, and sometimes exceed air quality standards in many European cities. NOx is emitted when fuel is being burned from a wider variety of sources e.g. in transport, industrial processes and power generation.

## 1.2. How does air pollution damage health?

Air pollution is damaging our environment and our health. Up to 40,000 early deaths are attributable to air pollution each year in the UK and road transport is responsible for 80% of the pollution where legal limits are being broken.<sup>2</sup>

Air pollution has a number of health consequences and has particular consequences for some demographic groups:

- Air pollution has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia.<sup>3</sup>
- Air pollution particularly effects children and older people because of their age as well as those with existing respiratory conditions.<sup>4</sup>
- Air pollution contributes to health inequalities, because deprived communities are often in areas with higher levels of pollution or near busy roads and people who can afford to do so tend to choose to live in quieter streets.

Research shows that improvements in air quality lead to reductions in death and illness.<sup>5</sup> As the Royal College of Physicians has noted, however continued focus on controlling urban air pollution through technical measures to abate vehicle exhaust provides less benefit for public health than focusing on measures that increase sustainable transport - active travel and public transport (where active travel is often part of the journey).<sup>6</sup> It is however important to realise that unless roadspace freed up by the shift to active travel is removed from use by the motor car it is likely to fill again due to release of suppressed demand for relocation.

When weighing long-term health benefits from physical activity against possible risks from increased exposure to air pollution, research finds that promoting cycling and walking is clearly justified in UK traffic conditions.<sup>7</sup> It should also be acknowledged that studies have suggested people in vehicles can experience greater levels of pollution than walking or cycling in the same environment<sup>8</sup>. This finding is confirmed in a recent review of the evidence which found that pedestrians were consistently the least exposed while car users tended to be the most exposed<sup>9</sup>.

## 2. The benefits of modal shift to sustainable transport for short trips

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### 2.1 Why focus on short trips?

The majority (68%) of UK trips undertaken are under 5 miles, with 19% of trips being less than 1 mile in length. These short trips are amenable to walking and cycling for most people and are particularly relevant areas of focus for improving air quality as they contribute disproportionately to emissions. This is due to engines starting from cold and hot soaks or evaporative emissions due to engine heat that persist after the vehicle has stopped operating.

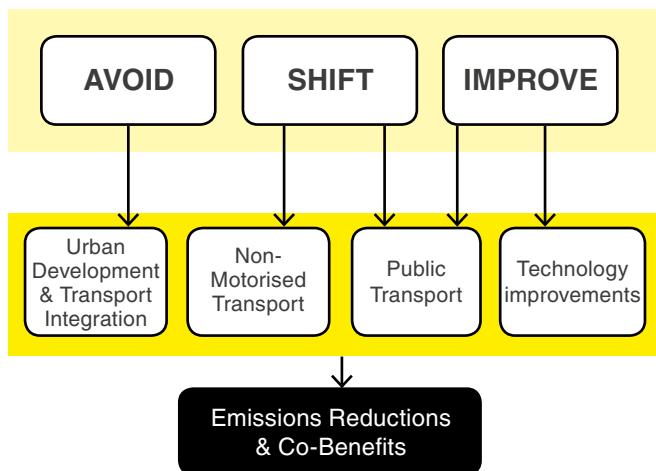
It is also of note that analysis of climate change driving forces has found motor vehicles to be the greatest contributor to atmospheric warming worldwide. Cars, buses, and lorries release pollutants and greenhouse gases that promote warming, while emitting few aerosols that counteract it.<sup>10</sup> Strategies to reduce vehicle use – not least short trips - are therefore needed to mitigate both urban air pollution and climate change.

## 3. How can we encourage modal shift?

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An effective approach to prevent ill-health resulting from transport related poor air quality can be summarised by the Avoid – Shift – Improve (ASI) approach (Figure 1).<sup>11</sup> The range of co-benefits from the ASI approach are many, even when only focusing on changes in travel mode for journeys under five miles.

### AVOID-SHIFT-IMPROVE (ASI) APPROACH



*Figure 1: The Avoid – Shift – Improve Approach, sourced from the World Resources Institute.*

### 3.1 Avoid

Compact urban forms are acknowledged to be the most effective urban system for encouraging sustainable transport and reducing dependence on private motor vehicles (see *Linking Housing Growth and Sustainable Transport Toolkit*).<sup>12</sup> Compact urban places can reduce private motor vehicle miles travelled by around 30% for compact walkable settlements in comparison to lower density developments.<sup>13</sup> Studies have shown more sprawling places can aggravate PM10 annual average values and increase exceedances to the daily limit value. Conversely however exposure to air pollution is worse in compact cities due to more people living in areas with the highest concentration levels.

Land-use planning which enables provision of services in locations accessible by sustainable transport, with further measures to encourage a shift to sustainable transport (e.g. fiscal, promotional, restraint) including public transport, are key and can be supported through technological advances (e.g. real time bus information at bus stops and car club and public transport apps for smart phones). Compact settlements on their own are likely to be insufficient without additional measures to promote sustainable transport, such as:

- complementary incentives to reduce trip length
- provision and encouragement of use of public and non-motorised transport
- and/or increase the adoption of lower emitting vehicle technologies<sup>14</sup>

Research finds that people living in more walkable neighbourhoods (characterised by mixed use, connected streets, high residential density, and pedestrian-oriented retail) did more walking and biking for transport, have lower Body Mass Index's, drive less, and produced less air pollution than people living in less walkable neighbourhoods.<sup>15</sup> Populations living in grid pattern streets had a mean population weight six pounds less than populations living in loop and lollipop designs.

### 3.2 Shift

Research undertaken in Edinburgh has reported that with all other factors remaining constant, for short trips, motorists are more likely to walk than drive in response to an increase in parking costs and a reduction in the provision of car parking space.<sup>16</sup> Whilst these policy measures can constrain motor car usage such measures should be balanced with incentives to encourage sustainable transport that is attractive, convenient and direct. Examples to encourage walking include:

- improving the pedestrian environment
- working with freight operators to reduce emissions
- developing car-free zones
- improving signal timings for pedestrians

Studies that have modelled modal shift from cars to cycling, have reported significant benefits for both health and the economy.<sup>17,18</sup> Evaluation of the Department for

Transport funded Sustainable Travel Towns project, for example, demonstrated a significant shift from car to more sustainable modes including walking, cycling and bus use.<sup>19</sup> The potential for active travel policies to deliver significant health benefits and very high value for money are documented in other government reports too.<sup>20,21</sup>

Policies aimed at increasing the acceptability, appeal, and safety of active urban travel, whilst discouraging travel in private motor vehicles, provide larger health benefits than policies that focus solely on lower-emission motor vehicles. An increase in the safety, convenience, and comfort of walking and cycling, alongside a challenge to the attractiveness of private motor vehicle use (speed, convenience, and cost) are essential to achieve the modal shifts required.<sup>22</sup>

There are a number of common approaches to achieve modal shift that can also improve air quality.

## Road pricing

### Case Study: Stockholm Congestion Tax trial

*This research explored the impact of a trial congestion tax in Stockholm on emissions, air pollutants and health. The congestion tax was found to reduce total road use by 15% within the taxed area. Calculations suggested that a permanent congestion tax system (now implemented) would reduce average PM10 concentrations by 7%.*

EU legislation on air quality sets limits for Member States for air pollutants including NOx and the PM10. Meeting the limit values of PM10 is proving challenging for EU Member States. Measures such as congestion taxes could help meet these targets.

In 2006 a trial congestion tax road pricing system designed to reduce motor traffic levels was implemented. This trial took place between January and July 2006 and charged vehicles entering and exiting a congestion area. The amount of the charge varied, but was highest during rush hour, with the maximum charge at 60 Swedish Kronor (about €6) per day.

Research findings from the trial indicate a:

- 8.5 per cent decrease in nitrogen oxide (NOx) emissions
- 13 per cent decrease in coarse particle (PM10) emissions in the congestion zone

Improvements of this level could avoid 27 premature deaths due to road traffic emissions a year for Stockholm.

Based on measured and modelled changes in road traffic, the researchers estimated that the tax reduced total road use by 15% within the charge area. Calculations indicate that a permanent congestion tax system would reduce the annual average NOx concentrations for the streets with the densest traffic by up to 12% and for PM10 by 7%.

Despite this improvement in air quality, the EU limit requirements for both NOx and PM10 were not achieved on streets with the heaviest traffic.

Total population exposure to NOx emissions in the area of Greater Stockholm was

estimated to drop by 0.23 micrograms per m<sup>3</sup> during the trial. The researchers estimate that this reduction would avoid 27 premature deaths each year. To compare these figures with traffic accident data, the total number of people killed in traffic accidents in the Stockholm region has averaged at 54 per year for the period 1998–2008.

The study demonstrates that even modest improvements in air quality can lead to health benefits, and the researchers argue that it is important to make quantitative estimates of health impacts in order to justify actions to reduce air pollution.

The Stockholm city congestion charge has now become permanent and more successful and popular every year. A new study shows that since the introduction of the congestion charge in 2006, overall motor traffic levels have been reduced by 29%, with no rise in levels reported on roads just outside the charging zone. In 2006, the congestion charge was supported by only 36% of the city's residents, but in 2013 acceptance was up to 70%.<sup>23</sup>

## Low Emission Zones

A low-emission zone (LEZ), also known as a Clean Air Zone, is a defined area where access by certain polluting vehicles is restricted or deterred with the aim of improving the air quality. LEZs are designed to improve air quality in geographical areas with the highest PM10 exposure and have been implemented across a range of cities across the world in order to improve air quality.

For example, LEZs were introduced in 2008 in Munich aiming at a reduction of motor traffic emissions contributing to particulate matter.<sup>24</sup> Post implementation analysis of routinely collected PM10 data showed statistically significant reduction of PM levels at a monitoring site located in the direct vicinity of a busy road and to a lesser extent at a monitoring site located in the urban background. Similarly, in Lisbon after the implementation of LEZs from 2011 by 2013, there was a reduction in the annual average concentration of PM10 of 23% and NO<sub>2</sub> annual average concentrations of 12%, compared with the year 2011.<sup>25</sup> The London Low Emission Zone came into operation in 2008 and covers most of Greater London charges vehicles that do not comply with emission standards set. Owners of vehicles that do not meet the requirements can either:

- fit a filter
- replace the vehicle
- reorganise their fleet to only use compliant vehicles in London
- convert to natural gas
- pay the charge (from £100 to £200 for each calendar day that the vehicle travels within the zone)<sup>26</sup>

There are a number of LEZs in the UK however most of them only affect local buses. Only the LEZ in London affects general vehicles. There are also a number of charging schemes, for example Durham and London although these are not strictly focusing on emissions but limited vehicle use in general.

## Case Study: The benefits of LEZs in Germany

*In a study of 25 German cities with LEZs, researchers reported significant decreases in urban PM10 levels that can be attributed to their introduction.<sup>27</sup>*

This study reviewed the impact of LEZs across Germany. They found three types of LEZs:

- Type 1 LEZs only ban very high-emitting vehicles from entering the zone
- Type 2 LEZs ban high-emitting and medium emitting vehicles
- Type 3 LEZs only grant access to low-emitting vehicles

In all three stages of LEZs, certain exceptions apply, for example for vehicles on medical emergency calls, the police and fire brigades.

The study found that more stringent (Type 2) zones reduced PM10 concentrations more than three times as much as Type 1 zones.

The researchers translated these changes in PM10 levels into health impacts using a concentration response function, which they applied to the 3.96 million inhabitants of the 25 LEZ-cities of their sample. The mean health benefits amounted to £912 million in the year 2010 if all LEZ-cities are assumed to have implemented Stage 1 zones. The total mean health benefits are £2.8 billion for Stage 2 zones, if assumed to be applied in all 25 cities.

## Consolidation of urban freight

The Urban Freight Consolidation Centre (UFCC) concept emerged to reduce the negative impacts and undesirable economic effects caused by freight transport in city centres, whilst ensuring efficient freight distribution.

Whilst freight transport and distribution may underpin the social and economic development of urban areas often many delivery vehicles are not full or empty on return journeys. UFCCs relieve congestion through a process which involves the goods destined for the city centre are delivered to a remotely-located UFCC outside the city where they are consolidated into a single delivery which is made by a single, well-filled vehicle. In this way, the number of heavy goods vehicles (HGVs) circulating in the urban area is cut and as a result energy consumption is reduced and fewer pollutants emitted.

This has the advantage of:

- reducing congestion by reducing the overall number of freight trips within cities
- reducing air pollution as freight traffic uses relatively large vehicles and therefore is an important contributor to pollution
- improving road safety, especially for vulnerable users including pedestrians and cyclists
- reducing disturbance due to noise especially journeys made during the night or early morning

Taken together, these effects reduce the quality of life for people that live in and visit urban areas and the attractiveness of cities for businesses to invest.

There are also advantages for participating retailers in the UFCC, because it can provide them with high value services in addition to the delivery service:

- improved staff productivity and safety
- the provision of pre-retailing services and recycling of packaging
- checking consignments for breakages

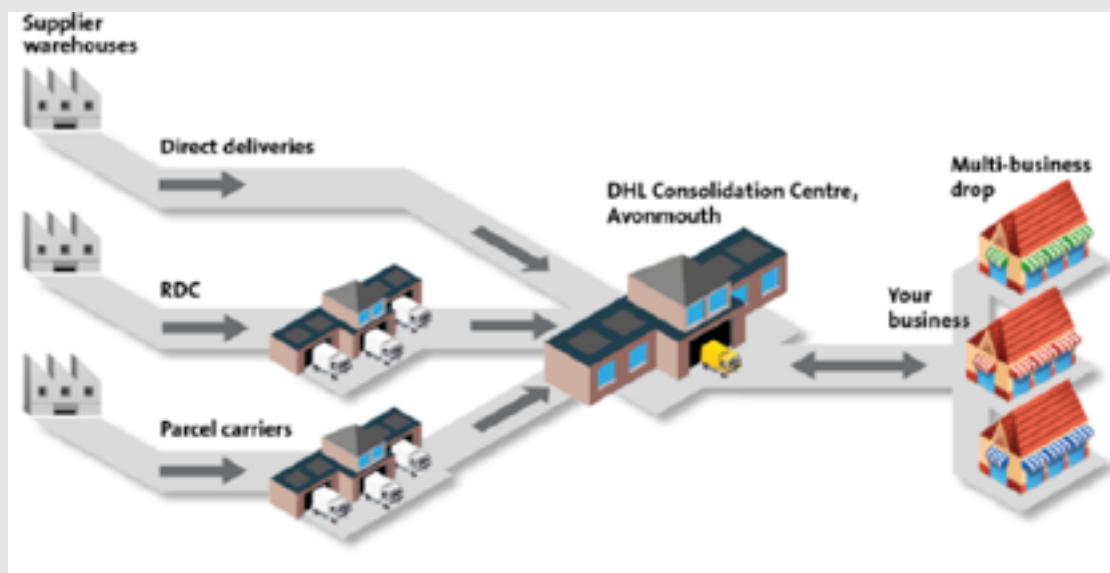
Suppliers can also be clear beneficiaries from UFCC schemes:

- reduction in the number of vehicles required to deliver to the city centre, saving time and money

### Case study: Reducing freight impacts: Bristol Bath Urban Freight Consolidation Centre

*An evaluation of the deliveries to Bristol City Centre from the Bristol Bath Urban Freight Consolidation Centre (BBUFCC) demonstrated a reduction of 74% of delivery trips in the city.*

Since 2004 businesses in Bristol and Bath have been using Freight Consolidation to manage their deliveries more effectively through the BBUFCC. This consolidation service is a partnership between the courier service DHL, Bristol City Council and Bath and North East Somerset Council.



Bristol Bath Urban Freight Consolidation Centre (sourced from Travelwest)

An evaluation of the deliveries to Bristol City Centre from the BBUFCC between January 2011 and May 2012 showed that:

- for every 100 Heavy Goods Vehicle deliveries to the Freight

Consolidation centre on 26 consolidated distribution trips were necessary. This equates to 74% of the delivery movements being avoided altogether and the others made with a smaller, cleaner vehicle

- deliveries to Bath city centre from the BBUFCC showed a clear economic benefit for the freight operators in terms of fuel costs avoided
- a health benefit to the wider public in terms of reduced emissions

The BBUFCC has proven to be a service valued by its more than 100 customers, however, encouraging wider participation has required significant efforts with limited results. In addition the operation of the BBUFCC requires significant subsidy.

### 3.3 Improve

Improving technology also has an important part to play to reduce emissions and improve air quality from vehicles in cities across England. It is important to note however that there are fewer co-benefits from this approach than other approaches realise, for example improving health and reducing congestion.

One example is the European ECOSTARS scheme.

#### Case Study: Edinburgh ECOSTARS

*The City of Edinburgh is using the ECOSTARS scheme to incentivise and support fleet operators in the city to improve environmental performance including air quality.*

ECOSTARS is a European standard administered by local authorities that fleet operators can apply to. Fleet operators receive tailored support to improve environmental performance and must meet criteria to receive the EUROS TARS standard.

All ECOSTARS schemes across Europe apply common scheme standards and are based on engine EURO standards plus alternative fuels use and operational enhancement. This allows national companies to be a member of ECOSTARS Edinburgh and the six other UK ECOSTARS schemes currently in operation.

Along with other councils in the UK, Edinburgh has air quality targets to meet. A significant proportion of pollution in Edinburgh originates from diesel-engined road vehicles. This led Edinburgh Council to set up the fleet recognition scheme ECOSTARS.

ECOSTARS Edinburgh rates vehicles and operating practices using star rating criteria to recognise levels of environmental and energy savings performance. Operators then receive tailor-made support to ensure the fleet is running as efficiently and economically as possible, and to help them progress to higher ratings within the scheme.

ECOSTARS provides the city with a method of engagement with operators of freight and passenger fleets of HGVs, buses, coaches and vans. The scheme promotes more efficient and cleaner freight and passenger transport by providing recognition,

guidance and advice to operators.

24 fleet operators have been recruited within the first 18 months of the scheme. This translates to over 2,500 registered vehicles. Members derive from all transport sectors including freight and passenger transport, although the majority of these operators transport goods. 15 operators have attained the highest possible 5-star rating.

Edinburgh's ECOSTARS team hold regular meetings with members to discuss topical issues and learn how the operators feel they could work with the Council to best improve their environmental performance in the city. To stimulate discussion, presentation and discussion sessions are developed to enable sharing of best-practice and provide a forum to discuss current key issues.

ECOSTARS is allowing Edinburgh to engage more meaningfully with fleet operators on a voluntary basis. It has demonstrated its effectiveness in securing fleet improvements that will benefit air quality in Edinburgh. Through workshops with fleet operators the City of Edinburgh Council has gained an insight into the world of fleet operators, their needs and priorities. Feedback about the scheme and meeting outcomes are shared with the Council's Transport and Environment Committee, so providing a way to improve cooperation between the local authority and operators.

## 4. Acknowledgements

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This toolkit was written by Adrian Davis, Independent Consultant on Health and Transport and Sustrans, in partnership with Living Streets and The TAS Partnership. The toolkit was peer reviewed by Stephen Watkins, Director of Public Health at Stockport Council.

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