The Economic Benefits of Sustainable Urban Mobility Measures

Independent Review of Evidence: Summaries
This report has been developed within the European project, Evidence of the Proven Economic Benefits of Sustainable Transport Initiatives to Facilitate Effective Integration in Urban Mobility Plans (EVIDENCE), co-funded by the European Union and the following partners who have delivered the project: Arcadis (UK), Contemporary Transport (UK), INTERACTIONS Limited (IE), LUXMobility (LU), Urban Planning Institute of the Republic of Slovenia (Sl), RHV Erasmus University Rotterdam (NL), TAEM Urbanistai (LT), University of the West of England (UK), Wuppertal Institut für Klima, Umwelt und Energie GmbH (DE)

Deliverable 3.2

For more information
European Platform on Sustainable Urban Mobility Plans
www.eltis.org/mobility-plans
E-mail: enquiries@mobilityplans.eu

European Commission
Directorate-General for Mobility and Transport
Unit C.1 - Clean transport & sustainable urban mobility
Rue Jean-André de Mot 28
B-1049 Brussels

The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

Contract: Funded through the Intelligent Energy Europe programme - Grant agreement IEE/13/549/ SI2.675162.

Title: The Economic Benefits of Sustainable Urban Mobility Measures: Independent Review of Evidence: Summaries

Version: March 2016

Editor: Shergold, I. & Bartle C. University of the West of England: Bristol
Email: ian2.shergold@uwe.ac.uk Web: http://evidence-project.eu/

Layout: FGM-AMOR

Cover picture: Ian Shergold

The Economic Benefits of Sustainable Urban Mobility Measures: Independent Review of Evidence
EVIDENCE Measure Summaries

EVIDENCE has reviewed a range of material exploring the economic benefits of ‘more sustainable’ mobility-related interventions with potential to be deployed in urban areas\(^1\). This document brings together short summaries of the results of that exercise for each of twenty two categories of intervention, or measure as they are termed here. The ‘Measure Summaries’ contained here cover the following topics:

Table 1 Themes and measures explored by EVIDENCE

<table>
<thead>
<tr>
<th>Theme</th>
<th>Measure No</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean vehicles and fuels</td>
<td>1</td>
<td>Electric Battery and Fuel Cell Vehicles</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Cleaner Vehicles</td>
</tr>
<tr>
<td>Urban freight</td>
<td>3</td>
<td>Urban freight</td>
</tr>
<tr>
<td>Demand management strategies</td>
<td>4</td>
<td>Access restrictions</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Roads space reallocation</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Environmental zones</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Congestion charges</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Parking</td>
</tr>
<tr>
<td>Mobility management</td>
<td>9</td>
<td>Site-based travel plans</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Personalised travel planning</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Marketing and rewarding</td>
</tr>
<tr>
<td>Collective passenger transport</td>
<td>12</td>
<td>Public transport enhancements</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>New public transport systems</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Integration of modes</td>
</tr>
<tr>
<td>Transport telematics</td>
<td>15</td>
<td>e-ticketing</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Traffic management</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Travel information</td>
</tr>
</tbody>
</table>

\(^1\) Sustainable mobility describes a set of choices for resolving the travel needs of individuals and organisations in less energy intensive and less polluting ways than at present. This might include different modes of transport, alternative fuels, alterations to infrastructure and the built environment, or changes in behaviours.
Content of the summaries

Each summary page contains a graphic illustrating the headlines from the review process – a score for the strength of economic benefit and for the amount of evidence readily available, as well as indicating the time frame that you should expect to see the benefits in. This is supported by the key messages relating to the economic aspects of the measure, as well as concise information on the wider benefits that might flow from deploying the intervention and the factors that could help a city to deploy the measure successfully.

EVIDENCE documentation

This document is a companion to the EVIDENCE project report\(^2\), which presents the overall results of the project. The detail of the review process followed, and how the different interventions have been grouped can be found in the EVIDENCE method\(^3\), whilst the twenty-two full ‘Measure Reviews’ are also available, both individually and as a combined, single document\(^4\).

---

Electric Battery and Fuel Cell Vehicles

Measure No.1: Activities fostering the use of vehicles that use electricity to power an electric motor.

The Evidence: Key messages

- Electric vehicles currently meet the needs of a range of users - but not yet all users.
- Electric vehicles (EV) can be cost-effective for owners and operators under specific conditions.
- Cost-effectiveness depends on economies of scale. The more vehicles are produced, the more the production costs per unit decrease.
- Any Cost Benefit Analysis (CBA) is heavily dependent on the assumptions used, (for example fuel and carbon costs) and national/local circumstances (such as subsidy levels for example).
- Societal benefits of investments into electric vehicles can be less clear than other technological change in vehicles.
- Electric vehicles can reduce local air pollution, benefitting human health and the urban environment.
- Effects on greenhouse gas emissions will depend on the technology deployed and the source mix for electricity generation.

Electric vehicles in use:

- Milan (Italy): Electric delivery vans were introduced, with a range sufficient for daily use. Lower operating costs balanced the higher costs of initial investment.
- Vienna: (Austria): Electric microbuses were integrated into the bus network. These were more expensive than diesel buses to purchase, but had lower operating and maintenance costs.

Context & Background:
Interventions include
- Electric cars, trucks and buses.
- EV in municipal fleets, or in city-owned public transport.
- Implementations of charging infrastructure.
- Support via regulatory measures (where at city level)
- Local financial incentives

Our Evidence sources:
- EV are subject to on-going research around technology improvements and externalities. Predictive and model-based studies dominate at present.
- Results are quickly out-of-date with regard to cost-efficiency or ability to meet user demands, due to rapid technology and price development. Only studies that have been published after 2010 are included here.
- Limited evidence was found for fuel cell EV.

See source material at: EVIDENCE-PROJECT.EU
Electric Battery and Fuel Cell Vehicles

Lessons for successful deployment of this measure

- For private motorized modes and urban freight, it is important to explore electric vehicles in the wider urban transport context and not as a stand-alone measure.
- Local city authorities usually have the necessary responsibilities and regulative power to promote the deployment of electric vehicles in the municipal fleet or in public transport. They can also promote private or commercial electric vehicles through (free) parking policies, exemptions from access restrictions, lower or no city tolls, support for the installation of charging infrastructure etc.
- However, national incentives such as tax policy and energy prices also play a major role.
- Local conditions, such as existing infrastructure may also play an important role.
- It is important to note that significant market penetration will be required before observable benefits will be realized. For example in respect of changes in air quality.

Additional benefits...

- **Air Quality:** Although the environmental impact of electric vehicles is largely determined by the electricity mix in a particular country, benefits to the urban environment and public health from the reduction of local air pollutants from vehicle tail pipe emissions are independent from the location and thus transferable across cities and countries.
- **Noise pollution:** A further societal benefit of electric vehicles is reduced noise pollution. Although this benefit is rarely monetised in the evidence, one Danish study found that an electric vehicle driven an annual average distance of 18,000 km, would generate an annual cost from noise pollution of less than one third the cost generated by a diesel vehicle.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu
Cleaner Vehicles

Measure No.2: Innovations or interventions that aim to improve the environmental performance of vehicles — such as enhancements to engine and vehicle technologies or improved fuels.

The Evidence: Key messages

- Policy measures such as fleet emission regulations foster economies of scale, and thereby contribute to reducing the production cost of new technologies. This, in turn, supports the consumer’s decision to purchase these technologies.

- For public bodies, implementation of regulatory measures is cost-effective, whereas upfront investments for the purchase of new public transport fleets may exceed direct cost savings occurring over the lifetime of that asset.

- From the perspective of the owner and transport operator, enhancements are cost-effective only under specific conditions, dependent on retail and fuel costs.

- From a societal perspective, the health, built environment and ecosystems benefits of investments into air quality abatement technologies (such as engine enhancements) should outweigh the economic costs. However, such benefits tend to be excluded from benefit–cost calculations of individual users.

Cleaner vehicles in use:

- Barcelona (Spain): Compressed natural gas buses were introduced and the transport operator was able to establish a strategic partnership with a natural gas company, which took over parts of the maintenance cost. This strategy meant that the return on investment was less than 5 years.
At the local level, the reduction of local emissions (noise, NOx, etc.) provides an important incentive to implement policy measures fostering the enhancement of ICE technologies.

Local policy measures such as low emission zones may also significantly improve the uptake of new technologies without imposing significant costs on public bodies.

It is important to note, however, that the benefits of more energy-efficient vehicle technologies may be neutralised by growth in size and power of vehicles.

Successful deployment is facilitated by national and EU policy road maps for cleaner vehicles and fuels that provide a clear and predictable course for technology and fuel adoption by private and public stakeholders. Measures stipulated in a SUMP are of a supportive nature.

Policies supporting technology enhancements include vehicle emission standards, fuel quality standards, scrappage programmes, and tax incentives. These may accelerate technological development and increase the market share of energy efficient vehicles.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Most evidence focuses on Urban Freight Consolidation Centres (UFCCs), showing positive impacts, in terms of cost savings and better service to logistics operators and final customers.

Where cost-benefit analysis (CBA) was conducted, positive values for net present value (NPV) were found, with a range of socio-economic and environmental impacts identified.

UFCCs can be particularly effective if there are congestion and/or pollution problems within the area to be served, or where they are targeted to compact geographical locations, or areas with delivery-related problems.

UFCC Interventions are often small-scale with few impacts at city scale.

Better economic assessment of schemes will require greater understanding of supply chain costs and benefits associated with urban freight measures. Commercial sensitivities, the lack of standardized evaluation and the experimental nature of some freight initiatives can make assessment more difficult.

**Urban Freight initiatives in use:**
- Padova (Italy): Fewer freight trips in the city, leading to reduced pollution, and positive returns on investment.
- Nijmegen (Netherlands): reduction in freight vehicle kilometres, stops and routes in the city centre, as well a reduction in large freight vehicle movements.
- Bristol (UK): One consolidated trip replaces five freight trips, with very high customer satisfaction.
Urban Freight

Lessons for successful deployment of this measure

- Successful deployment requires a clear understanding of the local needs and logistic patterns where measures are to be implemented. A partnership between public and private stakeholders is needed. To attract users, schemes need to be cost and time efficient and must provide an equal or better service than traditional methods.

- The area served by a UFCC should not be too large, to maintain efficiencies of centralised distribution.

- UFCCs are most likely to be successful in specific and clearly defined geographical areas such as historic town centres, especially those undergoing a ‘retailing renaissance’ and characterised by a transport infrastructure that would be unable to cope with the resultant increase in freight.

- Urban freight schemes cannot be successfully delivered in isolation from the wider transport system planning/delivery, and, importantly, require a favourable regulatory environment. Most of the reviewed schemes benefitted from the existence of spatial and/or temporal restrictions, for example a Low Emissions Zone, in which loading/unloading operations, or even access, is allowed only to specific vehicle categories.

Additional benefits...

- **Environmental improvements**: There is the potential for local environmental benefits in the areas where goods are being delivered, as a result of fewer vehicles passing through. The improvements in respect of noise can be particularly significant when electric vehicles (or bike-freight) are deployed as last-mile services.

- **Facilitating economic activity**: Provision of UFCC and last-mile delivery services such as bike-freight, can mean that economic activities can now be considered in areas of a city that through poor access, or restrictions on conventional freight vehicles, might have not been feasible before. This might have benefits in respect of access to services and goods for the citizens living there, as well as creating employment opportunities.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu
Pedestrianisation and access restrictions can bring considerable benefits to towns and cities - although the range of quantitative evidence is limited.

Pedestrianising shopping streets tends to increase retail revenues and the value of property on those streets.

Road closures do not cause ‘traffic chaos’ as critics often fear; drivers adapt their behaviour in ways that are not yet fully understood, but which avoid the worst consequences of congestion.

Benefits include: improvements to the urban environment, reduced traffic in central areas, reduced air and noise pollution and modal shift towards sustainable mobility.

There will normally be some increased traffic on surrounding streets. The extent of traffic displacement depends upon the existence of ‘spare capacity’ on the surrounding streets.

The Evidence: Key messages

- Pedestrianisation and access restrictions can bring considerable benefits to towns and cities - although the range of quantitative evidence is limited.
- Pedestrianising shopping streets tends to increase retail revenues and the value of property on those streets.
- Road closures do not cause ‘traffic chaos’ as critics often fear; drivers adapt their behaviour in ways that are not yet fully understood, but which avoid the worst consequences of congestion.
- Benefits include: improvements to the urban environment, reduced traffic in central areas, reduced air and noise pollution and modal shift towards sustainable mobility.
- There will normally be some increased traffic on surrounding streets. The extent of traffic displacement depends upon the existence of ‘spare capacity’ on the surrounding streets.

Access restrictions in use:

- Hong Kong (China): Pedestrianisation added 17% to rateable values in the street concerned.
- Cambridge (UK): Road closures led to reductions in traffic in city centre and an increase in cycle commuting.
- Burgos (Spain): City centre pedestrianisation led to reductions in traffic and pollution, and greater use of alternatives.
Cities which embark on a gradual process of pedestrianisation and filtering may experience not just short-term effects, but also a long-term decline in urban traffic volumes, coupled with modal shift.

The main barriers to implementation relate to local opposition, particularly from shop owners and motorists who perceive that road closures will increase congestion, journey times and/or journey distances. However, there are very few examples of such measures being reversed or judged to have failed.

Involving stakeholders in scheme designs may help to alleviate some of those concerns, although there is also evidence that brave decisions and successful implementation are the best ways of overcoming opposition.

Additional benefits...

- **Improved street environments**: Reducing traffic levels can lead to the creation or improvement of ‘street life’, through community activities and events such as street parties or other street events.

- **Community cohesion**: More people using streets, and interacting with neighbours and other pedestrians can help create greater social cohesion within a community, in itself reinforcing the more communal street environment.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Schemes in which general traffic lanes are re-allocated to alternative uses can be expected to reduce traffic volumes, improve journey times for the modes given additional priority (e.g. bicycles or buses), increase the use of non-car modes and reduce casualty numbers.

However, little credible evidence was identified on the monetized costs and benefits of road space re-allocation schemes. This may be a result of such schemes often forming part of a wider package of measures which are then appraised as a whole.

Journey times for general traffic (cars, vans etc.) may increase, although in some cases road space reallocation has not led to the anticipated increases in congestion. Therefore, it is possible to remove road space and improve conditions for users of other modes and the public realm without worsening conditions for general traffic.

Accordingly, modelling exercises of road space reallocation under different scenarios indicate that Benefit-Cost Ratios for road space re-allocation schemes are likely to be positive in cases where the benefits of increased person throughput or modal shift outweigh the dis-benefits of delays to general traffic.

**The Evidence: Key messages**

- Schemes in which general traffic lanes are re-allocated to alternative uses can be expected to reduce traffic volumes, improve journey times for the modes given additional priority (e.g. bicycles or buses), increase the use of non-car modes and reduce casualty numbers.

- However, little credible evidence was identified on the monetized costs and benefits of road space re-allocation schemes. This may be a result of such schemes often forming part of a wider package of measures which are then appraised as a whole.

- Journey times for general traffic (cars, vans etc.) may increase, although in some cases road space reallocation has not led to the anticipated increases in congestion. Therefore, it is possible to remove road space and improve conditions for users of other modes and the public realm without worsening conditions for general traffic.

- Accordingly, modelling exercises of road space reallocation under different scenarios indicate that Benefit-Cost Ratios for road space re-allocation schemes are likely to be positive in cases where the benefits of increased person throughput or modal shift outweigh the dis-benefits of delays to general traffic.

**Examples of road space re-allocation:**

- Brighton (UK): one lane of a two-lane dual carriageway was converted into a bus lane, incorporating a widened cycle lane. This successfully reduced general traffic volumes and increased the use of both cycling and buses on the route.

- New York City (USA): a two-way street was converted to one-way with a parking lane protecting the kerb-side cycle lane. This led to a reduction in collisions and traffic speeds, and increased cycling volumes.

**Context & Background**

Interventions include:

- Re-allocation of general traffic lanes to other modes (bus, cycle, etc.)

- Reallocation to high occupancy vehicle lanes (including tolled) lanes;

- Carriageway narrowing to improve public spaces.

**Our Evidence:**

- Draws on case studies from Europe, New Zealand and the USA.

- Usually applies to road space reallocation along a single corridor in an urban area, but with some city-wide examples of the introduction of bus lanes.

- Does not quantify economic benefits/costs of re-allocation schemes in isolation from other measures.

See source material at: EVIDENCE-PROJECT.EU
Road Space Re-allocation

Lessons for successful deployment of this measure

- Successful deployment requires the support of the public and other stakeholders early on in scheme development.
- Support needs to be garnered from lobby groups which may be opposed to road capacity reduction e.g. motoring organisations, local media.
- The introduction of lanes that are unlikely to be heavily used should be avoided as these are likely to lack public support. Similarly, re-allocated lanes should have the potential to be used by more than one mode.
- The wider traffic management requirements of road capacity reductions should be carefully considered.
- Local communities need to be informed of changes in lane allocation and use (particularly for High Occupancy Vehicle lanes, which are less familiar to road users).
- Where possible, priority lanes for buses and cyclists should be contiguous. This will help to avoid delays caused by vehicles navigating into and out of intermittent deployment of such space for priority modes.
- Complementary measures, such as improvements to public transport, will influence how far road space reallocation will succeed in reducing levels of car-use.

Additional benefits...

- **Environmental benefits:** These can flow from road space re-allocation when reduced volumes of motorised traffic result in air quality and noise reduction improvements.
- **Health benefits:** Reduced traffic volumes could be an encouragement for higher levels of cycling and walking, with resultant health benefits. Reductions could also lead to fewer road casualties.
- Such benefits are dependent, however, on traffic congestion not increasing; some evidence shows that air quality deteriorated after road space re-allocation, which was attributed to increasing congestion and slower vehicle speeds.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
There is evidence that speed restriction ‘zones’ using road engineering and other physical measures can reduce vehicle speeds, injuries and fatalities. The studies did not find evidence of traffic collisions ‘migrating’ to surrounding streets.

Compared with speed restriction zones, schemes which rely on sign-only low speed limits are much less expensive to implement on an area-wide basis, although they lead to far smaller reductions in average speed.

Lower speed zones were found to be cost-effective in areas with high numbers of casualties, but not so in areas which already had low levels of casualties. (Although the study authors did note some issues with the quality of data behind this finding. The UK also has relatively low casualty levels compared to some other nations).

Low Emission Zones can be beneficial in reducing emissions of harmful pollutants, from transport although there are uncertainties due to other pollution sources that can affect measurements of air quality.

Low Emission Zones can help local authorities comply with European limit values and thus avoid fines.

The Evidence: Key messages

- There is evidence that speed restriction ‘zones’ using road engineering and other physical measures can reduce vehicle speeds, injuries and fatalities. The studies did not find evidence of traffic collisions ‘migrating’ to surrounding streets.
- Compared with speed restriction zones, schemes which rely on sign-only low speed limits are much less expensive to implement on an area-wide basis, although they lead to far smaller reductions in average speed.
- Lower speed zones were found to be cost-effective in areas with high numbers of casualties, but not so in areas which already had low levels of casualties. (Although the study authors did note some issues with the quality of data behind this finding. The UK also has relatively low casualty levels compared to some other nations).
- Low Emission Zones can be beneficial in reducing emissions of harmful pollutants, from transport although there are uncertainties due to other pollution sources that can affect measurements of air quality.
- Low Emission Zones can help local authorities comply with European limit values and thus avoid fines.

Environmental zones in use:

- London (UK): traffic speeds reduced by 14 kph in two 32kph (20 mph) zones, reducing injury frequency by 42% and collision frequency by 53%.
- Amsterdam (Netherlands): LEZ led to reductions of traffic contributions to concentrations of NO₂ (4.9% decrease), NOₓ (5.9% decrease) and PM₁₀ by 5.8%.
Environmental Zones

Lessons for successful deployment of this measure

- The geographical extent of low speed limits may be important: if they are applied across a large area, this conveys the message that this is an appropriate speed in residential areas. However if they are only applied in small areas, so that a cross city trip encounters a number of different speed limits, then the same message will not be conveyed.

- The impact of low speed limits may be increased if accompanied by supporting measures aimed at public support and compliance. These include communication campaigns, asking businesses and other employers of drivers to encourage compliance and other awareness strategies. In the UK, these speed limits are intended to be self-enforcing as driving at lower speed becomes the social norm.

- Lowering speed limits can achieve high public acceptance among residents because of the wider benefits it brings.

- Countries with high concentrations of air pollution are likely to have air quality plans which provide a helpful context for implementing LEZs.

Additional benefits...

- **Road Safety:** Reducing traffic speeds creates a better street environment, where it is safer for children to play.

- **Health:** Arising from increased walking and cycling due to perceptions of (and actual) improvements to road safety.

- **Environmental improvement—Air quality:** The main gains from lower pollution in LEZs are for human health, although these can be unevenly distributed as concentrations of pollutants such as PM$_{10}$ can vary even within a small urban area. It is possible, however, that the greatest benefits from LEZs will be enjoyed by those suffering the worst air quality impacts, thus making the distribution of benefits a fair one.

- **Environmental benefits - Noise:** Reduced traffic speeds could reduce local noise levels.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
The economic effects of the introduction of a congestion charging scheme are influenced by the attractiveness of the city as a destination; i.e. attractive enough to continue to draw sufficient people into the congestion zone to support economic activities.

Time savings are considered the main benefits for road users, but there is a large variety in the value of travel time savings from congestion charging.

Economic benefits can also be derived from reduction in CO₂ and other emissions, and reduction in road casualties.

Due to uncertainties in the existing evidence regarding economic benefits, the decision on whether or not to introduce a scheme has been ultimately a political one.

In the short term, congestion charging reduces car traffic within the charge zone, but effects may diminish over time.

Congestion charging on its own, without supporting measures such as the availability of alternative modes of transport to the car (with enough capacity), has a low probability of generating substantial benefits.

**The Evidence: Key points**

- The economic effects of the introduction of a congestion charging scheme are influenced by the attractiveness of the city as a destination; i.e. attractive enough to continue to draw sufficient people into the congestion zone to support economic activities.
- Time savings are considered the main benefits for road users, but there is a large variety in the value of travel time savings from congestion charging.
- Economic benefits can also be derived from reduction in CO₂ and other emissions, and reduction in road casualties.
- Due to uncertainties in the existing evidence regarding economic benefits, the decision on whether or not to introduce a scheme has been ultimately a political one.
- In the short term, congestion charging reduces car traffic within the charge zone, but effects may diminish over time.
- Congestion charging on its own, without supporting measures such as the availability of alternative modes of transport to the car (with enough capacity), has a low probability of generating substantial benefits.

**Congestion charges in use:**

- **Stockholm (Sweden):** Congestion charging delivers multi-million euro time savings, greater journey reliability and increased public transport patronage.
- **London (UK):** Congestion charging has the potential to contribute positive net revenue from the scheme to the city. Substantial CO₂ savings are being obtained.
Congestion Charges

Lessons for successful deployment of this measure

Factors supporting successful implementation of schemes include:
- Strong political commitment. For example, the Mayor of London introduced congestion charging despite public opposition (which later diminished).
- A legal framework that provides local government with the necessary competences to introduce such a scheme.
- Careful consideration of the technology necessary to operate the scheme, from both a technical and financial perspective.
- The availability of alternative modes of transport to the car (with enough capacity) is a key factor for success.
- Even when similar technology is used, implementation costs can differ between locations, and this can have a strong influence on the economic viability of a scheme. In Stockholm, for example, the implementation costs were relatively low, mainly because the congestion area is limited to the inner-city island which has a limited number of entry points.

Additional benefits...

- **Environmental benefits**: Where congestion charging succeeds in reducing traffic, the wider benefits include: improved air quality, noise reduction, health benefits, and an improved street environment.
- **Road safety**: The evidence suggests that congestion charging schemes have had a positive effect overall on road safety, although traffic calming measures may also need to be put in place in parallel.
- **Public transport patronage**: This measure can contribute to increased public transport use (although it is difficult to establish causality, as public transport services are often improved as part of congestion charging schemes).

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu
Evidence is unanimous on the importance of parking to manage car travel demand in urban areas, with parking issues strongly influencing the decision-making process for travellers.

Parking management schemes do not usually require large investment (compared with public transport infrastructure), and can be realized in a relatively short time.

Restrictive parking policy measures (i.e. parking pricing) are not seen to have detrimental effects on the local (retail) economy.

Effective parking management can actually increase the attractiveness of a city centre and its economic vitality.

Parking policies can contribute to reducing car commuting. Giving commuters the choice between free parking or its equivalent cash value (‘parking cash-out’ policies) have proved to be very effective in reducing car commuting.

Parking management, and increasingly technology-based ‘smart-parking systems’, can reduce search time, or ‘cruising’ by drivers looking for parking spaces. This can bring significant benefits in fuel use, air quality and congestion.

The Evidence: Key points

- Evidence is unanimous on the importance of parking to manage car travel demand in urban areas, with parking issues strongly influencing the decision-making process for travellers.
- Parking management schemes do not usually require large investment (compared with public transport infrastructure), and can be realized in a relatively short time.
- Restrictive parking policy measures (i.e. parking pricing) are not seen to have detrimental effects on the local (retail) economy.
- Effective parking management can actually increase the attractiveness of a city centre and its economic vitality.
- Parking policies can contribute to reducing car commuting. Giving commuters the choice between free parking or its equivalent cash value (‘parking cash-out’ policies) have proved to be very effective in reducing car commuting.
- Parking management, and increasingly technology-based ‘smart-parking systems’, can reduce search time, or ‘cruising’ by drivers looking for parking spaces. This can bring significant benefits in fuel use, air quality and congestion.

Parking interventions in use:

- San Francisco (USA): Sensors in on-street parking bays provided real time information to drivers on occupancy rates and dynamic fees, leading to dramatic improvements in parking availability, reductions in cruising time and distanced travelled by car. Net parking revenue increased slightly, while the average hourly fee rate fell.

- Nottingham (UK): City Council is the first local authority in Europe to have introduced a Workplace Parking Levy, which it is estimated will reduce traffic growth in Nottingham from 15% to 8% by 2021.
Parking

Lessons for successful deployment of this measure

- Parking is a politically sensitive issue, with schemes often facing strong opposition from lobby groups and the public. Retailers are particularly susceptible to concerns that reduced parking will mean reduced business, but studies have shown a large gap between retailers’ perceptions of the proportion of their customers arriving by car (prior to implementation of parking restrictions), and the (lower) numbers who actually do so.

- Parking cash-out policies – i.e. giving commuters the choice between free parking or its equivalent cash value to stimulate alternative modes of travel – have proved to be very effective in reducing the percentage of commuters traveling by car. For example, case studies from California found that commuting by car fell by between 5% and 24% when this policy was introduced.

- New technologies such as parking space sensors, and real-time information on parking availability can offer opportunities for sophisticated parking management.

Additional benefits...

- **Improved access:** Greater number of people able to access the area being actively managed. Evidence from North America suggests also that solo drivers are more likely to search for cheaper kerb parking because they cannot share the cost of off-street parking with passengers. Therefore, under-priced parking fees tend to allocate scarce urban space (parking) to solo drivers, which may mean that fewer people can visit the city centre.

- **Environmental benefits:** By reducing the time people spend ‘cruising’ for a parking space, the efficient management of parking brings wider benefits such as improved air quality, reduced casualties, and an improved street environment.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu
Site-Based Travel Plans

Measure No.9: A mobility management strategy for an organisation and its site/s, which seeks to reduce single occupancy car-use to, from, and around a site, and to increase use of alternative modes.

The Evidence: Key points

- By seeking voluntary behaviour change among travellers to a particular site, Travel Plans tend to achieve high levels of public and political acceptability, whilst the inclusion of ‘smarter choice’ measures can make them relatively cheap and swift to introduce.
- The evidence suggests that single-occupancy commute trips to employers with Travel Plans could be reduced by between 4% and 18%, depending on the intensity of measures, and external ‘push factors’ such as levels of traffic congestion in surrounding areas.
- Parking restraints and/or financial incentives for giving up parking voluntarily are strongly associated with the degree of car reduction which can be achieved through Travel Plans, in addition to the improvement of alternative travel modes.
- Often the amount of money spent by an organisation did not relate directly to the degree of change achieved, or the overall ‘end’ level of car use. The more important factor was the appropriateness of the measures and overall strategy.
- Travel planning is affected by the national or regional institutional context in different countries, particularly in the case of workplace travel plans, which can be strongly influenced by labour legislation and tax regimes.
- More significant benefits were seen for the packages of measures including these interventions.

Site-based Travel Plans in use:

- Darlington, Peterborough and Worcester (UK ‘Sustainable Travel Towns’): Site-based plans led to reductions in commuter trips by car, reduction in school journeys by car, and more journeys by walking, cycling and public transport.

Context & Background:
Interventions include
- Travel plans are not so much a ‘measure’ in themselves as a strategy for other mostly transport-focused measures.
- Site users, such as employees, students, visitors, customers are encouraged to travel in a (more) sustainable way, for commuting to work; attending school or college; visiting a hospital, retail park, attraction or entertainment event).
- Organisations may be required by local planning law to develop a Travel Plan.

Our Evidence sources:
- Relate to workplace travel plans and school travel plans;
- Draw predominantly on 3 detailed UK datasets, collected between 2002 and 2010.

See source material at: EVIDENCE-PROJECT.EU
Some best practice in workplace travel planning is attempting to influence the wider context in which individual travel to work takes place. For example, some employers may:

- aim to employ local staff by recruiting in areas close to bus routes serving the site.
- provide training courses for local people, to facilitate their employment on the site.
- allocate staff to shifts according to postcodes, in order to facilitate more sustainable travel (e.g. car-sharing, buses).
- offer flexible working and teleworking.

Commuting costs are treated differently by tax-regimes across the world. This influences whether incentives can be provided by employers without them being subject to personal taxation.

General ‘success factors’ include: senior management support for travel plans; a dedicated travel plan coordinator; travel plan targets and a written plan of action; and partnership working with, for example, local authorities and bus operators.

Persuasive messages about the health benefits of cycling and walking (on its own or combined with public transport use) may offer an effective approach to motivating mode shift amongst employees.

**Lessons for successful deployment of this measure**

- Commuting costs are treated differently by tax-regimes across the world. This influences whether incentives can be provided by employers without them being subject to personal taxation.
- Some best practice in workplace travel planning is attempting to influence the wider context in which individual travel to work takes place. For example, some employers may:
  - aim to employ local staff by recruiting in areas close to bus routes serving the site.
  - provide training courses for local people, to facilitate their employment on the site.
  - allocate staff to shifts according to postcodes, in order to facilitate more sustainable travel (e.g. car-sharing, buses).
  - offer flexible working and teleworking.

### Additional benefits...

- **Health benefits**: Travel plans can encourage the use of more active modes of travel such as cycling, helping to improve the health, fitness and welfare of employees and students.
- **Staff welfare**: Measures taken by employers to improve the experience of the commute can boost the morale of employees, indirectly contributing to staff motivation and productivity.
- **Student / Pupil welfare**: Travel planning at schools may have wider potential impacts, for example in terms of children’s independence and citizenship education.
- **Road safety**: Reductions in traffic at sites could help reduce road accidents, which is particularly important around schools.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Personalised Travel Planning (PTP)

Measure No.10: A targeted marketing technique involving the provision of travel advice to individuals, with the aim of encouraging them to make more sustainable travel choices.

The Evidence: Key points

- Evidence worldwide suggests that PTP projects are successful in reducing both the number of car driver trips and car-driver mode share. Reduction in car driver trips is typically between 8% and 12%, whilst car-driver mode share has typically fallen by around 5-7%.

- Economic benefits have been calculated on the basis of packages of measures, but not PTP in isolation. PTP is most successful when implemented as part of a comprehensive package of sustainable transport measures.

- Recent evidence from integrated UK programmes including PTP have shown Benefit-Cost Ratios of 1.4 to 4.5, based on economic benefits from reduced traffic congestion.

- PTP can be introduced relatively cheaply and swiftly. The voluntary nature of such measures at the level of the individual renders it politically and publically acceptable.

- Qualitative evidence about residential PTP gives confidence that this is a type of scheme which does contribute to increasing the use of sustainable modes, despite a lack of consensus over the scale of impacts.

Personalised Travel Planning in use:

- Perth (Australia): six PTP projects led to reductions in car driving mode share of 4–14%, with corresponding increases in walking, cycling and use of public transport.

- England (UK): Across eight urban areas with a residential PTP programme, the number of car driver trips fell by an average of 11%.

- Japan: In 18 areas with a residential PTP programme, car use fell by an average of 12.1%, whilst public transport use increase by an average of 38.6%.
Lessons for successful deployment of this measure

- More significant benefits were seen for packages of measures including these interventions.
- PTP schemes are more successful in encouraging mode shift when householders agree to pledge to reduce their car-use either individually, or through community-based activities.
- The shift to more sustainable modes can be even greater when intensive support and incentives are offered to householders.
- Evidence from Japan showed that if individuals set ‘behavioural goals’, such as pledging to reduce car-use by a certain amount, the average reduction in car-use was 20%, compared with 10% when there was no explicit goal setting.
- Other factors found to contribute to an effective and cost-efficient delivery process include:
  - Effective media planning to prepare householders for when travel advisers call.
  - Repeated attempts by travel advisers to contact householders (e.g. different times of day).
  - Effective database management systems to process information requests.
  - Engagement with bus companies.

Additional benefits...

- **Social inclusion:** Can contribute to social inclusion in a community, through new awareness of ways of reaching services, facilities, and leisure / social activities (and the ability to use them). Also perhaps via increased engagement with others on shared modes of transport (bus, train etc.). In both instances the greater engagement could impact beneficially on the quality of life of participants.
- **Support to sustainable mobility programmes:** Exposure to the PTP process was seen to contribute to the effectiveness and public acceptance of other sustainable transport measures, as well as helping to recruit individuals as ‘travel champions’ in programs. For example, in Scotland, PTP was thought to help make the delivery of an integrated ‘smarter choices’ programme more dynamic and responsive.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Marketing and Rewarding

Measure No.11: Marketing, social marketing and rewards-based schemes encouraging greater use of more sustainable modes and travel

The Evidence: Key points

- Marketing ‘campaigns’ appear to deliver their intended purpose successfully, with positive effects seen for interventions relating to road safety, cycling and travel mode.
- Individual travel marketing interventions can, by definition, deliver more focused actions.
- Reductions in car-driver trips ranging from 5%-15% have been seen from individual travel marketing while the costs are described as ‘low’.
- Rewarding schemes for public transport usage are able to increase the number of customers and to achieve high customer loyalty.
- ‘Eco-driving’ programmes appear to be a cost-effective way of reducing CO₂ emissions. From a business perspective, eco-driving training can achieve pay back through fuel savings.

Examples of marketing and rewarding schemes:
- Copenhagen (Denmark): a price promotion in the form of a free one month travel card offered to car drivers led to a doubling in the use of public transport for commuting (from 5% to 10%); a positive effect remained six months after the intervention.
- The Netherlands: The Dutch national eco-driving programme, “Het Nieuwe Rijden”, proved to be highly cost-effective, with the cost of reducing emissions calculated at less than €10 per ton of CO₂ avoided.
Marketing and Rewarding

Lessons for successful deployment of this measure

- Marketing and rewarding should be shaped to address specific target groups. The more focused an approach, the more successful it is likely to be. The campaigns directed at specific target groups are seen to be more successful.
- Marketing campaigns are seen to have a stronger effect on reducing accidents when personal communication or roadside media are part of a delivery strategy.
- Marketing schemes need to be supported with ‘hard’ policy measures such as infrastructure schemes to be the most effective. Bundling of such measures appears to be a successful strategy.
- Interventions which provide information about sustainable mobility solutions and complement this with ‘persuasive motivation’ to act accordingly, may significantly reduce car usage of the participants.

Additional benefits...

- **Personal rewards**: ‘Social benefits’ are likely to accrue indirectly from the measures being marketed, rather than the marketing campaigns themselves. Rewards for public transport use may accrue social benefits for the individuals receiving them.
- **Safety Benefits**: Changes in driving styles and approach that follow from promoting Eco-driving may also bring about safety benefits, as well as reduced noise and less stress for drivers.
- **Community benefits**: The mode shift from car to public transport brought about by campaigns has the potential to bring wider air quality and noise benefits to communities.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Quality improvements are likely to have a positive effect – albeit more related to existing passengers than those choosing to change their mode of travel.

Effects of enhancements are likely to be more significant in the longer – rather than the shorter-term.

Interventions are often delivered as part of a package of changes, making it more difficult to isolate the effects of specific features such as low-floor access or Wi-Fi.

Increased public transport ridership can be encouraged by low(er) cost travel passes, but this may come at an unsustainable cost to operators and municipalities.

Success may not be a simple matter of encouraging additional passengers, as this may come at a revenue cost which is not sustainable over time, possibly confounding short-term calculations of cost-benefit.

‘Free travel’ can help new services to gain momentum, but free public transport can be a costly policy, particularly if patronage levels increase significantly.

<table>
<thead>
<tr>
<th>Economic benefit</th>
<th>Evidence found</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Less ⇔⇔ More)</td>
<td>(Less ⇔⇔ More)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Short Term</th>
<th>Medium Term</th>
<th>Long Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

**The Evidence: Key messages**

- Quality improvements are likely to have a positive effect – albeit more related to existing passengers than those choosing to change their mode of travel.

- Effects of enhancements are likely to be more significant in the longer – rather than the shorter-term.

- Interventions are often delivered as part of a package of changes, making it more difficult to isolate the effects of specific features such as low-floor access or Wi-Fi.

- Increased public transport ridership can be encouraged by low(er) cost travel passes, but this may come at an unsustainable cost to operators and municipalities.

- Success may not be a simple matter of encouraging additional passengers, as this may come at a revenue cost which is not sustainable over time, possibly confounding short-term calculations of cost-benefit.

- ‘Free travel’ can help new services to gain momentum, but free public transport can be a costly policy, particularly if patronage levels increase significantly.

**Public transport enhancements in use:**

- **Madeira: (Portugal):** New services and buses led to increased patronage and revenue, as well as lower costs.

- **Melbourne (Australia):** Expansion of local bus services had positive Benefit-Cost Ratios across a city-wide programme of bus enhancements (new services / more frequent services).

- **Switzerland:** Introduction of multi-operator season passes led to increased patronage.

**Context & Background:**

Interventions include:

- Basic service improvements such as: additional services; increased frequency; and new routes.

- Qualitative enhancements, such as: quality improvements (better vehicles, better seats, Wi-Fi etc.); more accessible vehicles; concessionary fares; and integrated ticketing.

**Our evidence sources:**

- There is extensive evidence, particularly with regard to ‘elasticities of demand’ in response to particular enhancements.

- There is little detail on monetised costs and benefits of service improvements. Economic benefits are mainly judged on revenue from fares as a result of increased patronage.

See source material at: [EVIDENCE-PROJECT.EU](http://evidence-project.eu)
Public Transport Enhancements

Lessons for successful deployment of this measure

- Understanding the underlying elasticity of demand relating to supply and quality of service allows a more nuanced response to changes in service provision.
- Whilst service-level enhancements can be deployed at the level of an individual route with a reasonable expectation of positive change, some of the integrated ticketing interventions seem to be best deployed at a larger scale.
- Political will and funding are required if fare reduction schemes or free travel are offered as a way of increasing patronage levels. Whether the required level of support is justified may well depend on other financial benefits for local/national authorities. For example, in Tallinn, Estonia, citizens were offered free bus travel if they were registered for income tax.
- Public transport enhancements are more successful if accompanied by demand restraints on use of the private car.
- Ticketing integration can become more effective if it is extended beyond the urban area.

Additional benefits...

- **Social Inclusion:** Enhancing public transport can bring social inclusion benefits by providing new or additional services to areas not previously well-served, as well as improving accessibility levels for less able travellers. Free and concessionary fares can also help address affordability issues for some groups in society.
- **Air Quality:** There are also claims for improvements in levels of emissions and air quality from moving to newer, higher quality public transport vehicles.
- **Congestion / Modal Shift:** Free travel is claimed to have led to reductions in congestion and some transfer from car use in the cities that have implemented it (although there is limited evidence at present to support this.)

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
New Public Transport Systems

Measure No.13: Light Rail Systems, Bus Rapid Transit (BRT) systems and Demand Responsive Transport (DRT) systems.

Light rail (LRT) and Bus Rapid Transit (BRT) systems can increase passenger carrying capacity, increase use of public transport, and deliver land use strategies; e.g. regenerating former industrial areas, intensification around transport nodes or increased economic activity in central areas.

Bus Rapid Transit (BRT) can meet similar objectives to LRT, but at a much lower cost. It can also be delivered in a much shorter timescale.

Economic analyses are available for LRT and BRT schemes. For LRT they were more likely to be projections before scheme implementation, with positive benefit-cost Ratios (BCRs) ranging from 2-3. However, no evidence was identified to validate these BCRs post-implementation so they must be treated with due caution.

Post implementation analysis of BRT schemes produced positive BCRs ranging from 1-3.

LRT and BRT have a positive effect on land values near stations, but can negatively affect values near routes.

Urban Demand Responsive Transport (DRT) systems can be an effective means of providing transport to the ‘mobility poor’ at a lower cost than alternatives (such as subsidised single ride taxis). They will normally require subsidy however.

Examples of new public transport systems:

- Nantes (France): New Light Rail helped attract employers to the city centre, and contributed to increasing rental values.
- Los Angeles (US): New BRT line reduced congestion and encouraged modal shift (18% of riders had switched from car).
- Istanbul (Turkey): Passengers saved 50 minutes per day on average following implementation of the Metrobüs BRT.

The Evidence: Key points

- Light rail (LRT) and Bus Rapid Transit (BRT) systems can increase passenger carrying capacity, increase use of public transport, and deliver land use strategies; e.g. regenerating former industrial areas, intensification around transport nodes or increased economic activity in central areas.
- Bus Rapid Transit (BRT) can meet similar objectives to LRT, but at a much lower cost. It can also be delivered in a much shorter timescale.
- Economic analyses are available for LRT and BRT schemes. For LRT they were more likely to be projections before scheme implementation, with positive benefit-cost Ratios (BCRs) ranging from 2-3. However, no evidence was identified to validate these BCRs post-implementation so they must be treated with due caution.
- Post implementation analysis of BRT schemes produced positive BCRs ranging from 1-3.
- LRT and BRT have a positive effect on land values near stations, but can negatively affect values near routes.
- Urban Demand Responsive Transport (DRT) systems can be an effective means of providing transport to the ‘mobility poor’ at a lower cost than alternatives (such as subsidised single ride taxis). They will normally require subsidy however.

Context & Background:
Interventions include:
- ‘Light rail’ - electrified, local, urban rail systems that are able to run on-street.
- BRT systems - defined by the use of significant sections of fully segregated bus lanes.
- DRT - A non-private transport mode offering flexible routes and timings in response to changing passenger demand.

Our Evidence sources:
- BRT systems are presently of great interest, and are being deployed across the world. Hence, international evidence is available.
- Light rail systems also attract research interest.
- There are few sources on urban DRT, reflecting limited application.

See source material at: EVIDENCE-PROJECT.EU
New Public Transport Systems

Lessons for successful deployment of this measure

- Conventional public transport services should be reorganised to feed, rather than to compete with, Light Rail and BRT systems.
- The planning of high quality public transport networks should be integrated with land use strategies as a matter of course.
- Good public transport systems should be available as new developments are built so that transit-oriented behaviours become established amongst the local population from the outset.
- Likewise, new BRT and Light Rail systems need to be located in areas of economic activity and high-density residential areas if they are to deliver strong patronage growth.
- As DRT systems generally serve lower density areas, they require some level of subsidy.
- DRT are most successful when serving a small number of activity centres within a contained geographic area (10-15km²).
- Complementary measures are also required to achieve modal transfer and traffic reductions.

Additional benefits...

- **Social Equity**: A comparative study of four BRT systems showed that most users came from lower to middle income groups, demonstrating potential to meet social equity aims. This is in contrast to light rail systems which were observed to be less successful in serving lower income groups.
- **Improved mobility for disadvantaged groups**: DRT systems also offer social benefits such as improved mobility options for disadvantaged groups, for example those without access to a car and living in areas where conventional public transport is less cost-effective.
- **Wider social benefits**: Estimated monetised social benefits of light rail systems in the USA, based on a calculation of ‘consumer surplus’, found that 10 out of the 12 systems tested produced net social benefits.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu
Integration of Modes

Measure No.14: Passenger inter-modality schemes to facilitate and streamline journeys that involve use of more than one mode.

The Evidence: Key messages

- The main benefit of Park and Ride (P&R) is to remove car trips out of a city centre, with the potential for economic (e.g. increased retail activity), and environmental benefits.

- The expense and convenience of the P&R site and the overall expense of the service are important factors for success.

- Reducing city centre parking capacity, or increasing the price to make it more expensive are factors that will increase the attractiveness of P&R.

- Improved access to public transport is seen to lead to improved ‘customer satisfaction’. Transfer facilities such as cycle parking and cycle hire are also viewed positively - albeit with continuing debate over how effective they might be.

- Studies of improving access to stations suggests that such improvements can provide ‘good value for money’, better in fact than improving the rail service itself. This is an area of emerging evidence still, so this finding is at present based on a relatively limited number of sources.

- Measures to promote cycle-bus integration could be particularly beneficial for riders with low incomes, as well as increasing the area from which bus passengers can be drawn. Such schemes could offer positive returns for operators, although estimating costs is seen to be problematic.

Mode integration in use:

- UK: Over half of P&R users surveyed in the cities of Bath, Oxford and York would have otherwise travelled into the historic cities by car.

- Netherlands: The PT-bicycle hire scheme at railway stations had led to modal shift from car use.
Integration of Modes

Lessons for successful deployment of this measure

- Strong, supportive political will is an important driver of success for P&R.
- The public popularity of P&R is important; its attractiveness will depend on how it compares with the other modes available to access a city centre.
- Care should be applied to the location of P&R, avoiding sites too close to a destination. If possible services should build on existing bus routes to reduce air quality issues arising from servicing the P&R site.
- Physical proximity is essential for effective inter-modality. Distances between train station/bus stop and bicycle parking or between train station and bus stop, should be small.
- Success will also significantly depend on the quality of the transport services being 'connected'. Poor-quality, expensive, infrequent or poorly routed services and stations that are unattractive will limit potential increases in patronage. There is a case for investing into stations with high levels of services and big local populations.
- For both P&R and access improvements, it is important to consider whether trip makers might migrate from existing public transport to use new or improved options. Where possible, pricing and incentives should be used to manage this carefully.

Additional benefits...

- Improved access: P&R can improve access to a city. This can be particularly important in towns which need to provide good tourist access whilst preserving an attractive city centre. This may also help facilitate other changes such as pedestrianisation schemes – with potential benefits for businesses and for air quality in a city centre.
- Modal shift: P&R may attract some new users to public transport by raising awareness and by offering a high-quality service which may encourage car drivers to change to P&R and then change to public transport.
- Customer satisfaction: Accessibility to and from railway stations can influence customer satisfaction with the overall journey and hence rail patronage.
- Increased patronage: Cycle facilities at stations and or related to bus travel may also lead to increased use of these modes by now facilitating a combined journey which previously would not be possible by public transport alone.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport. This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Major cities (such as London and Hong Kong) have implemented e-ticketing solutions that are used by millions of travellers, and smaller scale implementations are commonplace.

Traveller aspirations in this area are high.

There are potential cost savings to be made by operators from efficiency gains, fraud reduction and reduced ‘dwell time’ at stops, although there is less clear evidence for increased patronage.

Initial costs can be high, particularly where none of the necessary infrastructure is already in place. Costs include hardware, software and consultancy for scheme design, with integrated schemes particularly cost intensive, requiring different applications to be connected.

Cost-benefit analysis (CBA) does not generally have a positive outcome in respect of returns from additional travelers alone.

Implementation of e-ticketing is rarely done in isolation; it is likely that some changes will also occur to ticketing arrangements (pricing, cross-operator, multi-mode) at the same time which may also impact on customer choices.

e-ticketing technology is developing rapidly – which brings consequent risks of early obsolescence.

**The Evidence: Key points**

- Major cities (such as London and Hong Kong) have implemented e-ticketing solutions that are used by millions of travellers, and smaller scale implementations are commonplace.

- Traveller aspirations in this area are high.

- There are potential cost savings to be made by operators from efficiency gains, fraud reduction and reduced ‘dwell time’ at stops, although there is less clear evidence for increased patronage.

- Initial costs can be high, particularly where none of the necessary infrastructure is already in place. Costs include hardware, software and consultancy for scheme design, with integrated schemes particularly cost intensive, requiring different applications to be connected.

- Cost-benefit analysis (CBA) does not generally have a positive outcome in respect of returns from additional travelers alone.

- Implementation of e-ticketing is rarely done in isolation; it is likely that some changes will also occur to ticketing arrangements (pricing, cross-operator, multi-mode) at the same time which may also impact on customer choices.

- e-ticketing technology is developing rapidly – which brings consequent risks of early obsolescence.

**E-ticketing interventions in use:**

- **Trondheim (Norway):** New smartcard ticketing delivers positive cost-benefit outcomes and reduces boarding times – offering more reliable journeys and cost savings for operators.

- **Sydney (Australia):** Moving from cash-based to smart card ticketing could offer greater benefit then implementing bus priority measures on a route.

---

**Measure No.15: The introduction and use of new ticketing technologies on public transport systems, generically termed ‘smart ticketing’ or ‘e-ticketing’**

[![Evidence Project EU](https://evidence-project.eu)](https://evidence-project.eu)

---

**Context & Background:**

Interventions include:

- Transport tickets which are sold and stored in electronic devices, such as smart cards or mobile phones.

- ‘Contactless’ ticketing (including cards issued by financial institutions).

**Our Evidence:**

- Studies consider schemes from around the world.

- Relatively little evidence evaluates e-ticketing independently from wider changes; therefore it is difficult to corroborate the potential benefits claimed for the technologies.

- Economic benefits arise from reduction in ‘dwell time’ or passenger loading time. Patronage, passenger satisfaction and simple return on investment calculations are also used.

See source material at: **EVIDENCE-PROJECT.EU**
Lessons for successful deployment of this measure

- Smart ticketing systems do not usually experience problems of public acceptance, although effective communication with travellers is important to ensure this. Complementary measures that can help with this include 'ticket simplification' and 'integration' of ticketing across operators and/or modes.
- Ongoing maintenance and availability of support for hardware and software need to be considered and planned for. It is also important to consider wider technical strategies for e-ticketing, at regional and national scales. Economies of scale may flow from adopting technologies and standards already in use, or planned at these larger scales.
- Experience from the CIVITAS II programme suggests that the following factors are also important for extensive implementation: gaining political support; willingness from operators to accept the new approach (particularly resolution of revenue sharing issues); ensuring sufficient finance to deploy e-ticketing; resolving the interaction with other systems (where necessary); and that there is common purpose between all the relevant parties in the implementation process.

Additional benefits...

- **Delivery of additional services:** The introduction of e-ticketing opens the door to other add-on services using the same payment mechanisms, including access to other modes of transport such as bike hire or car-share schemes.
- **Information on travel behaviours:** E-ticketing provides a rich source of data about travel habits and behaviours, useful in better planning of services, and in understanding existing (and potentially future) transport demand.
- **Promotional opportunities:** Data collected from e-ticketing solutions can also provide operators (and cities) with a marketing tool – and the opportunity to deliver more personalised travel solutions to travellers.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport. This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Urban Traffic Control systems (UTC) can be expected to improve network efficiency by reducing delays to vehicles. This can have additional benefits in reducing fuel use and emissions (although evidence here is limited).

Economic benefits are calculated mainly on the basis of time savings. These savings may be specifically for public transport users, cyclists, or for general traffic.

Providing priority to public transport or bicycles through UTC can contribute to significant journey time savings without compromising journey times for other road users.

Automatic systems to monitor bus lanes and signalized junctions have been shown to improve journey times, reduce infringements and reduce collision rates at junctions.

Investment payback periods for bus priority measures are seen to range from 3 months to 2 years in the examples reviewed.

Variable Message Signs (VMS) can divert some traffic (although they are less likely to be effective in heavily congested networks).

VMS has the potential to contribute to time savings in public transport corridors, but evidence is currently limited here.

Traffic Management

Measure No.16: Applications of technology that are commonly used to manage the movement of people (and vehicles) in urban areas.

The Evidence: Key points

- Urban Traffic Control systems (UTC) can be expected to improve network efficiency by reducing delays to vehicles. This can have additional benefits in reducing fuel use and emissions (although evidence here is limited).

- Economic benefits are calculated mainly on the basis of time savings. These savings may be specifically for public transport users, cyclists, or for general traffic.

- Providing priority to public transport or bicycles through UTC can contribute to significant journey time savings without compromising journey times for other road users.

- Automatic systems to monitor bus lanes and signalized junctions have been shown to improve journey times, reduce infringements and reduce collision rates at junctions.

- Investment payback periods for bus priority measures are seen to range from 3 months to 2 years in the examples reviewed.

- Variable Message Signs (VMS) can divert some traffic (although they are less likely to be effective in heavily congested networks).

- VMS has the potential to contribute to time savings in public transport corridors, but evidence is currently limited here.

Traffic management in use:

- Toronto (Canada): Traffic flow improved following implementation of UTC; travel time reductions of 8% were seen.

- Cardiff (UK): Bus priority at signalled junctions improved journey times by 14-15%.

- Copenhagen (Denmark): Priority at signalled junctions reduced cyclist journey times (with little impact on other vehicles).

Context & Background

Interventions include:

- Urban traffic control systems.

- Traffic signals that respond to specific modes (e.g. buses or cyclists).

- Cameras used to enforce the protection of dedicated bus / cycle or high-occupancy lanes or used to manage junctions to ensure free-flow.

- Variable message signs giving dynamic instructions to vehicles.

Our Evidence sources:

- Draw mainly on studies which report the impacts of a single intervention employed in a case study city.

- Most examples are EU cities, although results from the USA, Japan, New Zealand and Australia are also discussed.

See source material at: EVIDENCE-PROJECT.EU
Traffic Management

Lessons for successful deployment of this measure

- Care needs to be taken that UTC systems are not designed to prioritise the movement of private cars at the expense of sustainability objectives and of improving the flow of people through cities. Selective vehicle priority at traffic signal controlled junctions are an effective means of improving conditions for public transport and bicycles.

- As UTC systems increase network capacity for private vehicles, it is likely that initial efficiency gains will tend to be eroded over time if traffic levels continue to increase. This emphasises the importance of using UTC in combination with ongoing policies to encourage the use of modes other than the car.

- Bus or cycle lanes on approaches to traffic signals are required if priority measures at traffic signals are to be effective; otherwise buses or bicycles become delayed in general traffic queues. Automated enforcement of bus priority measures can be effective if cameras are highly visible and penalty notices are efficiently served to maintain credibility amongst drivers.

- VMS systems are reliant on good real time data on traffic flows across a network in order to reliably estimate journey times on competing routes. Thus complementary traffic monitoring systems are required.

Additional benefits...

- **Traffic reduction**: By improving capacity via UTC in some areas, it is possible to reduce capacity in others, providing support for other measures aimed at reducing traffic in city centres.

- **Road safety**: Enforcement cameras at signalised junctions have been demonstrated to reduce collisions and injuries, and dedicated phases for bicycle traffic at signalized junctions to reduce conflicting movements, making the environment safer for cyclists.

- **Encouragement for alternatives**: VMS can be a useful profile raising measure when used in conjunction with other measures such as park and ride.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
The provision of travel information (especially real-time), is desired by travellers.

Access to real time travel information can be most valuable to users when uncertainty is highest (e.g. for buses more than trains, and for more congested cities).

The economic implications of information provision were generally viewed positively, although not quantified rigorously.

Some passengers would be willing to pay a higher price for bus services that included real-time information.

Deploying travel information via the internet can be less expensive than options such as public screens, and can benefit users before they reach a stop or station.

It is inconclusive as to what extent provision of information on its own may affect patronage or potentially modal shift.

Moves to deploy more information via the (mobile) web may exclude those who cannot access the technology (i.e. smartphones).

Reducing perceived waiting time with real-time information would be less expensive than increasing public transport frequency.

Measure No.17: Interventions that provide improved information for trip-makers, both pre-trip and during a journey. Information may be delivered through personal devices, or via on-vehicle or fixed displays.

The Evidence: Key messages

- The provision of travel information (especially real-time), is desired by travellers.
- Access to real time travel information can be most valuable to users when uncertainty is highest (e.g. for buses more than trains, and for more congested cities).
- The economic implications of information provision were generally viewed positively, although not quantified rigorously.
- Some passengers would be willing to pay a higher price for bus services that included real-time information.
- Deploying travel information via the internet can be less expensive than options such as public screens, and can benefit users before they reach a stop or station.
- It is inconclusive as to what extent provision of information on its own may affect patronage or potentially modal shift.
- Moves to deploy more information via the (mobile) web may exclude those who cannot access the technology (i.e. smartphones).
- Reducing perceived waiting time with real-time information would be less expensive than increasing public transport frequency.

Travel information in use:

- Helsinki (Finland): Electronic displays showing real-time information at bus / tram stops; Travellers found the displays useful, with some reporting more public transport use as a result.
- Chicago (US): Roll out of real-time information led to an increase in bus patronage (albeit slight).
- Tampa (US): Deployment of real time information reduced frustration and anxiety for bus users.

Context & Background:

Interventions include:

- At stop and online travel information and journey planning systems.
- Real time information displays at stops and online through the web / mobile web.

Our Evidence:

- Is mainly related to specific interventions.
- Many items relate to ‘apps’ and current technology, although other sources discuss technologies that are already becoming obsolete.
- Real-time information provision receives more attention than journey planners.
- The rapid advancement of technology in this area will ensure the topic receives ongoing attention.

See source material at: EVIDENCE-PROJECT.EU
Travel Information

Lessons for successful deployment of this measure

- An important decision to reach is which mechanisms might be used to deploy information provision. For example on public screens and/or via web and phone-based systems. The latter route may prove to be lower cost, and can benefit the rider even before they reach the stop or station, but may exclude those, for instance, who cannot afford appropriate technology such as smartphones.

- The impact of providing travel information can be maximised by effective marketing. This can make the public transport user aware of the information that is available, and can also be aimed at current non users of public transport. A further important aspect of information provision is that it should be understandable to the user.

- Whilst travel information is unlikely to achieve modal shift on its own, it may contribute to this if the measure is introduced as part of a package of measures that might, for example, also include improved bus priority, lower fares or increased quality of service.

Additional benefits...

- **Modal shift:** Some studies suggest that provision of travel information can help encourage modal shift, with one forecast suggesting 5% shift from car to public transport. This would lead to accident and air quality benefits. Reports from actual interventions indicate a much more modest effect.

- **Improved passenger satisfaction:** The evidence suggests a second major benefit of real-time information for public transport users is that it can reduce their actual and perceived waiting time. This is important as delays that occur before the arrival of the vehicle have the most damaging effect on public transport passenger satisfaction.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
There is strong evidence of positive effects of Carsharing schemes on vehicle kilometres travelled, CO₂ emissions, car ownership, the incidence of driving alone and the numbers of vehicles on the streets.

Free-floating Carsharing seems to have additional important advantages for larger urban areas (related to parking and one-way journeys), although evidence here is limited at present.

Carshare schemes are run on both profit and not-for-profit bases. The proliferation of carshare schemes across the globe, often run by private companies, indicates that they can be commercially viable.

Carshare schemes may be more expensive to operate in cities where parking spaces are expensive.

Carsharing offers users financial advantages in comparison to owning a private vehicle; e.g. avoiding maintenance costs and unpredictable repair bills.

Carpool schemes can reduce congestion, parking demand and fuel use/CO₂ emissions. However there is the possibility of induced trips replacing these.

The evidence reviewed does not give a clear indication of economic benefits to societies and municipalities of carpooling, instead focusing on benefits for the individual user.

Examples of new models of car use:

- Ulm (Germany): New free-floating car share attracted almost 10% of residents to be scheme members.
- San Francisco (USA): Car share members’ overall mileage reduced after joining the scheme. They were also more likely to commute by modes other than car, and not to drive solo.
New Models of Car Use

Lessons for successful deployment of this measure

- Good integration between carshare and public transport is important. These two forms of mobility can interact synergistically.
- It is beneficial to price the use of carshare vehicles carefully in relation to costs of taxis and car rental, and to implement schemes in suitable areas; for example where parking is scarce.
- Good marketing is also important.
- For carpooling, the number of potential members is important, as larger pools of members increase the likelihood of a user finding a suitable match for their journey. For this reason marketing and other strategies to raise public awareness of the scheme are important to success.
- Strong political interest can support implementation of carpool schemes. This can be motivated by the need to reduce single occupancy car commute use, and policy objectives to reduce congestion and emissions.
- Uptake of carpool use may be affected by factors external to the scheme (and outside of the control of a municipality), such as fuel prices, car ownership prices, and parking availability.

Additional benefits...

- **Access to mobility**: Carshare and carpool schemes can also provide a degree of auto-mobility and accessibility benefits for those on low incomes. This may provide access to the search for and take-up of jobs and education.
- **Land-take**: Carshare vehicles are seen to replace multiple private vehicles, suggesting that schemes could lead to the release of valuable land that otherwise would be needed for parking. This effect is intensified by carshare cars often being smaller than average.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Evidence suggests that increased walking can flow from improving the walking environment and/or targeting information at individuals.

Interventions to increase walking are often considered at a community or small scale geographic level, assuming walking journeys are shorter than trips made by other modes.

Most evidence focusses on the health benefits of walking to individuals. However, there is an expectation in some studies that local economies will benefit from more walking trips.

Walking interventions may require enhancements to urban design features and infrastructures. Such changes can potentially be expensive and difficult to justify purely from the benefits of additional walking.

Where cost-benefit analysis (CBA) of improving pedestrian facilities (installing pavements for example) has been undertaken, benefits are drawn from reduced car use and air pollution.

Businesses place more emphasis on the quality of the walking environment, or public realm. Investment here as opposed to walking itself is seen to provide economic benefits in respect of customers and rental values.

The Evidence: Key messages

- Evidence suggests that increased walking can flow from improving the walking environment and/or targeting information at individuals.
- Interventions to increase walking are often considered at a community or small scale geographic level, assuming walking journeys are shorter than trips made by other modes.
- Most evidence focusses on the health benefits of walking to individuals. However, there is an expectation in some studies that local economies will benefit from more walking trips.
- Walking interventions may require enhancements to urban design features and infrastructures. Such changes can potentially be expensive and difficult to justify purely from the benefits of additional walking.
- Where cost-benefit analysis (CBA) of improving pedestrian facilities (installing pavements for example) has been undertaken, benefits are drawn from reduced car use and air pollution.
- Businesses place more emphasis on the quality of the walking environment, or public realm. Investment here as opposed to walking itself is seen to provide economic benefits in respect of customers and rental values.

The Evidence: Key messages

- Evidence suggests that increased walking can flow from improving the walking environment and/or targeting information at individuals.
- Interventions to increase walking are often considered at a community or small scale geographic level, assuming walking journeys are shorter than trips made by other modes.
- Most evidence focusses on the health benefits of walking to individuals. However, there is an expectation in some studies that local economies will benefit from more walking trips.
- Walking interventions may require enhancements to urban design features and infrastructures. Such changes can potentially be expensive and difficult to justify purely from the benefits of additional walking.
- Where cost-benefit analysis (CBA) of improving pedestrian facilities (installing pavements for example) has been undertaken, benefits are drawn from reduced car use and air pollution.
- Businesses place more emphasis on the quality of the walking environment, or public realm. Investment here as opposed to walking itself is seen to provide economic benefits in respect of customers and rental values.

The Evidence: Key messages

- Evidence suggests that increased walking can flow from improving the walking environment and/or targeting information at individuals.
- Interventions to increase walking are often considered at a community or small scale geographic level, assuming walking journeys are shorter than trips made by other modes.
- Most evidence focusses on the health benefits of walking to individuals. However, there is an expectation in some studies that local economies will benefit from more walking trips.
- Walking interventions may require enhancements to urban design features and infrastructures. Such changes can potentially be expensive and difficult to justify purely from the benefits of additional walking.
- Where cost-benefit analysis (CBA) of improving pedestrian facilities (installing pavements for example) has been undertaken, benefits are drawn from reduced car use and air pollution.
- Businesses place more emphasis on the quality of the walking environment, or public realm. Investment here as opposed to walking itself is seen to provide economic benefits in respect of customers and rental values.
Community-based projects require commitment from community partners who are able to participate actively and drive the initiative within the community.

To this end, it requires time and effort to galvanise and motivate people, as well as sustain the activity over time, especially where volunteers are involved. Interventions need to be sensitive to the needs of diverse communities (e.g. ethnically diverse), and tailored facilitation is needed for each community setting.

Urban design and infrastructure improvements, such as installing a new bridge, are context-dependent in terms of generating pedestrian journeys. Design needs to be sensitive to the local setting. Infrastructure is a durable physical asset, and not necessarily reliant on community champions to promote its use for encouraging walking - as is seen in some other interventions discussed here, but it is reliant on maintenance to ensure long term usability.

Encouraging walking to school requires the school to be actively involved, particularly where walking promotion will link to the school curriculum.

**Additional benefits...**

- **Health Benefits**: The main benefits of walking are often seen in terms of improvements in health and fitness. Health benefits might be both physical and mental.
- **Community benefits**: Participation in community-based walking programmes can bring the added benefit of increasing participants' perceptions of social connectedness, and of being part of their community.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
Positive benefit-cost ratios (BCRs) are seen for networks of cycle paths, based on journey time savings and lower health and fuel costs.

Positive BCRs at the lower end of the scale derive benefits mainly from the value of time; health benefits contribute the additional value at the top of the BCR range.

Leisure-based networks can also bring benefits in respect of new job creation and additional economic activity.

Appropriate infrastructure provision for cycle traffic, forming comprehensive networks of routes, is essential to encourage cycling.

These networks need to be built up from components such as safe junctions and bridges which create suitably direct routes for cycle traffic. There is some lack of clarity, however, as to what specific links, or provision at junctions, would be deemed most suitable by users and potential users.

Some commentators argue that it is safer to separate cycle traffic from motor traffic, and that off-road paths are therefore required.

**The Evidence: Key messages**

- Positive benefit-cost ratios (BCRs) are seen for networks of cycle paths, based on journey time savings and lower health and fuel costs.
- Positive BCRs at the lower end of the scale derive benefits mainly from the value of time; health benefits contribute the additional value at the top of the BCR range.
- Leisure-based networks can also bring benefits in respect of new job creation and additional economic activity.
- Appropriate infrastructure provision for cycle traffic, forming comprehensive networks of routes, is essential to encourage cycling.
- These networks need to be built up from components such as safe junctions and bridges which create suitably direct routes for cycle traffic. There is some lack of clarity, however, as to what specific links, or provision at junctions, would be deemed most suitable by users and potential users.
- Some commentators argue that it is safer to separate cycle traffic from motor traffic, and that off-road paths are therefore required.

**Cycling Infrastructure in use:**

- Stockholm (Sweden): Bicycle paths were found to be ‘socially profitable’ (based on value of time of cyclists) at yearly average cycling volumes of less than 300 cyclists per day, which in urban contexts is very low.
- North Carolina (USA): A large scale programme over 10 years to create an extensive bicycle transportation system produced a return on investment of 9:1.

**Context & Background:**

Interventions include:

- Integrated networks of bikeways with intersections that facilitate cycling.
- Individual engineering improvements.
- Good quality bike parking at key destinations and public transport stations.

**Our Evidence:**

- Is plentiful from a range of countries across the world.
- Has mainly been published since 2008.
- Is mainly at an aggregate level, concerned with area or city wide effect; hence it is related to comprehensive treatments for cycle traffic based on cycle networks.

See source material at: [EVIDENCE-PROJECT.EU](http://evidence-project.eu)
Cycling Infrastructure

Lessons for successful deployment of this measure

- Parallel policies may increase the success of cycle infrastructure. For example, reducing free car parking, and introducing traffic-calming measures, could encourage individuals to cycle rather than drive for some urban journeys, especially over short distances.
- Other reinforcing interventions include:
  - bike sharing programmes;
  - convenient information and promotional events;
  - individualized marketing to target specific groups;
  - cyclist education and bike-to-school programmes;
- improved motorist training, and traffic enforcement;
- designing communities to be compact, mixed use and bikeable.
- Social and psychological factors also contribute to cycling levels; e.g. individuals are more likely to cycle if other family members cycle, and if there is a perception that a journey is both possible and easy by bike.

Additional benefits...

- **Health Benefits:** Evidence of the health benefits of cycling is well documented, through both improved fitness of those who cycle, and reduction in atmospheric pollutants which affect the health of the wider population (when cycle journeys substitute for journeys made by motorised transport).
- **Pedestrian environments (& walking):** Cycling infrastructure can also improve the environment for pedestrians, thus encouraging walking as a transport mode.
- **Community benefits:** In turn, more cycling and walking as an alternative to car-use offers wider community benefit, improving the ‘liveability’ of streets and communities, and potentially facilitating greater community cohesion through increased levels of contact between people living there.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.

Resources online evidence-project.eu

Co-funded by the Intelligent Energy Europe Programme of the European Union
The Evidence: Key messages

- The limited evidence available suggests that bike sharing can increase cycling levels when combined with appropriate supporting measures.
- While predominantly enabling a commuting function, bike sharing also allows users to undertake key economic, social and leisure activities.
- Bike sharing can enhance local economies, by connecting people to employment, retail and other places where economic activity takes place. US evidence also suggests a growth in retail activity near cycle docking stations.
- Bike share users benefit from reduced, and more reliable, journey times.
- Bike sharing can connect to, and substitute for public transport for some types of trips and some users, helping to manage public transport demand (benefitting users and transport operators).
- Most schemes are highly dependent on subsidy to operate.
- Successful schemes generate revenue that can reduce public funding and subsidy. However the readily available evidence on the financial viability of existing bike sharing systems is limited and predominantly qualitative in nature, partly due perhaps to commercial sensitivities.

**Bike Share in use:**

- Lyon (France): 13% reduction in travel time compared to using a car for the same journey, and in London, an estimated 20% average time saving for trips made using the shared bikes as opposed to the alternative modes used previously.
- Minnesota (US): Additional economic activity in the proximity of bike stations.
- Washington (US): Reduced stress and weight loss amongst users.

**Context & Background:**
Interventions include:

- Provision of a pool of bicycles at strategically positioned and fully automated ‘bike sharing stations’, typically distributed in a dense urban network.
- Accessible by different types of users (e.g. registered members or occasional/casual users) for short-term rentals.
- Schemes are referred to in different ways, e.g. ‘cycle hire’ in the UK, ‘public bicycle’ in China and ‘bicycle sharing’ in North America.

**Our Evidence:**

- Most studies measure impact on the travel behaviour of users, in particular mode substitution.
- Only one economic appraisal has been identified (London scheme) that takes into account a range of assessment indicators.

See source material at: EVIDENCE-PROJECT.EU
Bike sharing is dependent upon clear political and public support for sustainable travel and cycling in particular. The development of a positive cycling culture, growing cycling levels and supportive policy measures are important complementary factors that can sustain bike sharing during and after implementation. Bike sharing, in turn, has the potential to reinforce a positive image of cycling.

However, achieving success in terms of usage rates does not guarantee that BSSs are also socially inclusive. Bike sharing tends to attract a particular profile of user: male, white, employed. If promoters and operators of BSSs wish to achieve equity of access, then schemes need to be made available, attractive, accessible and affordable to a variety of social groups and types of users (registered members and casual users).

Shared bicycle flows have been shown to be dependent on BSS attributes, such as station location and capacity, and positively correlated with a number of variables specific to the area. These include the availability of cycle infrastructure, mixed land use, spatial accessibility, population and job density.

Additional benefits...

- **Health benefits**: Users can benefit through improved personal health, as well as potentially contributing to air quality improvements if changing from motorized transport.
- **Access to mobility**: BSS offer increased transport choice and convenience, reduced travel times, increased affordability of personal travel and potentially an improved travel experience for users.
- **Mode choice**: Bike sharing can influence and change the travel behaviour of users, but with differing results in different contexts. The ability of bike sharing to attract trips previously made by private vehicles remains a key challenge, with bike sharing predominantly replacing walking and public transport.
- **Cycling culture / road safety**: Bike sharing can contribute towards raising awareness and acceptance of cyclists, contributing to increasing road safety for cyclists.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.
These measures can reduce vehicle speeds, fatalities and collisions.

Traffic calming coupled with public realm improvements in mixed use shopping streets increases pedestrian flows on those streets. There are some indications that this might also benefit retailers in those streets.

‘Home zones’ also promote increased pedestrian use of streets, although that finding might vary according to national cultures and specific local contexts. The high cost of some interventions may have limited their wider application to date.

‘Shared space’ is likely to work best (i.e. favourable public perceptions and greater pedestrian use of road space) when vehicle flows and speeds are relatively low and pedestrian flows are relatively high.

The review found insufficient source material to confirm claims made about effects of any of the interventions on economic activity or modal choice.

Inclusive urban design in use:

- Ireland: Traffic calming schemes on major roads in villages and small towns led to a 13% reduction in collisions and a 52% reduction in fatalities, compared to the national trends. This was estimated to have generated a 46% annualised return on initial investments.

- UK ‘Mixed priority routes demonstration project’: Improvements to the public realm with elements of traffic calming on high streets with retail and other uses produced a 16% reduction in casualties above the national trend.
Inclusive Urban Design

Lessons for successful deployment of this measure

- Some interventions, particularly traffic calming, can work as a single intervention on a small or a large scale. However, there is a risk of possible displacement effects where drivers choose other routes.
- Home zones and shared space may require an appropriate legal framework to determine liability in the case of collisions or casualties. Depending upon the context in each country, measures to change driver perceptions and behaviour – to make drivers more aware of and ready to give way to – pedestrians and other vulnerable road users, could help to make home zones and shared space more successful.
- One review of UK pilot home zones suggests that benefits arise from involving local residents in the design of these zones. Although processes would differ between countries, that principle could be applied everywhere (at the possible cost of lengthening implementation timescales and requiring more staff).

Additional benefits...

- **Road Safety**: Most traffic calming interventions have succeeded in reducing collisions, injuries and/or fatalities.
- **Community benefits**: Home zones can create a better living environment, particularly for children, depending upon how traffic and parking are handled within them. Residents may also perceive that streets are safer to walk or cycle on.

The Evidence project has reviewed ‘evidence’ on the proven benefits of sustainable transport measures and initiatives. This is to help politicians and transport practitioners understand the economic return on investment that can be achieved through increasing expenditure on sustainable transport.

This knowledge will support effective integration of sustainable transport measures into urban mobility plans, helping to make them more ‘sustainable’ urban mobility plans.