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| | **VIAJEO PLUS** |
| **D2.4** | **Executive Implementation Plans** |



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| **Project** | VIAJEO PLUS – International Coordination for Implementation of Innovative and Efficient Urban Mobility Solutions | | | |
| **Date** | *Contractual:* | 30/04/2015 | *Actual:* | 04/05/2015 |
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| **Abstract** | This deliverable aims to provide an insight into how specially selected best practices can be successfully implemented in different cities. Six best practices were selected since these practices received a wide range of interests from European, Chinese and Latin American cities. The six cases cover all five topics the project addresses. The six cases are:<br>• Mobility Management: Verona Integrated Traffic Management<br>• Enabling Infrastructure: Guangzhou Tram Charging Infrastructure<br>• Innovative Public Transport Solutions:<br>  ○ Singapore Metro Travel Smart Scheme<br>  ○ Singapore Distance-based Fare Pricing (DFP) on BRT/Bus Systems<br>• Clean Vehicles: North East England Electric Vehicle (EV) Charging<br>• Urban Logistics: Gothenburg Stadsleveransen Micro Terminal and Freight Network<br>For each of the six practices, detailed description, assessment of transferability, benefits and key factors to be considered for implementation are provided. |
| **Keyword list** | Best Practices; Transferability |
| **Nature of deliverable** | Report |
| **Dissemination** | PUBLIC |

| Project financially supported by | |
| --- | --- |
| SEVENTH FRAMEWORK PROGRAMME | **European Commission**<br>**DG Research** |
| **Project number 605580**<br>**FP7- SST.2013.3-2** | |

## ***Document Control Sheet***

### Version history:

| Version number | Date | Main author | Summary of changes |
|---|---|---|---|
| 1.0 | 22.04.15 | Paul Batty | First Draft |
| 2.0 | 28.04.15 | Paul Batty | Leeds' contribution added |
| 3.0 | 30.04.15 | Paul Batty | Final editing |
| 4.1 | 04.05.15 | Yanying Li | Adding abstract |

### Approval:

| | Name | Date |
|---|---|---|
| Prepared | Paul Batty | 29.04.2015 |
| Reviewed | Yanying Li | 29.04.2015 |
| Authorised | Yanying Li | 04.05.2015 |

### Circulation:

| Recipient | Date of submission |
|---|---|
| EC | 04.05.2015 |
| VIAJEO PLUS Consortium | 04.05.2015 |

# Table of Contents

# 1. Introduction

One of the key aims of the Viajeo-Plus project is to identify best solutions for sustainable urban mobility, which can be included in the Online Best Solution Handbook, which can be found on the Viajeo-Plus website[1]. Additionally, those that are identified to be of the highest quality and simple to transfer to other cities are to be considered for further analysis, in the form of Executive Implementation Plans.

The purpose of these plans is to consider case studies of best practices for each of the five focus areas of the project: Mobility Management, Enabling Infrastructure, Innovative Public Transport Solutions, Clean Vehicles and Sustainable Urban Logistics. In each instance, it will be identified how best the solution can be implemented in different cities, be they in the same country, different countries or even different continents. This deliverable will consider six case studies, and assess the transferability of each. The six 'best practice' case studies are related to the five topics:

- **Mobility Management:** Verona Integrated Traffic Management
- **Enabling Infrastructure:** Guangzhou Tram Charging Infrastructure
- **Innovative Public Transport Solutions:**
  - Singapore Metro Travel Smart Scheme
  - Singapore Distance-based Fare Pricing (DFP) on BRT/Bus Systems
- **Clean Vehicles:** North East England Electric Vehicle (EV) Charging
- **Urban Logistics:** Gothenburg Stadsleveransen Micro Terminal and Freight Network

The six cases have received a wide range of interest from cities in Europe, Latin America and China that are considering implementing similar schemes and have therefore been chosen as the case studies to be given an executive plan regarding successful transferability of the scheme,

These topics are discussed in this order herein. Firstly, the best practice and the successes it has achieved are examined and analysed, before the transferability of the solution is presented.

[1] www.viajeoplus.eu

## 2. Integrated Traffic Management (Verona)

**Relevant work Package:** Innovative Integrated Network Management

### Introduction

Verona is a city in northern Italy, with a population of approximately 300,000 inhabitants, and is one of the busiest tourist destinations in the region. In recent years, Verona has developed a number of innovative urban mobility solutions, in line with the aims of the 2007 European Commission Green Paper entitled "Towards a new culture for urban mobility". The main aims of the urban mobility solutions implemented in Verona were to:

- Reduce overall traffic delays
- Reduce pollution generated by traffic congestion
- Improve driver/passenger comfort and safety
- Improve the quality of Public Transport service, through greater service frequency, quicker services and reduced operational costs

These are based around OMNIA; an ITS platform with an open architecture that allows the integration of various ITS systems. The overall OMNIA system and the areas it covers is described in Figure 1. In Verona the OMNIA platform has following subsystems.

- **The Urban Traffic Control (UTC) sub-system** is based on the UTOPIA system and controls more 70 traffic light intersections. This continuously monitors traffic conditions and optimises traffic signal plans (cycle length, offset and stages duration) to give priority to public transport (absolute priority vehicles and vehicles behind schedule) and to lower private transport travel times.
- **The Verona Traffic Management Centre (TMC)** is powered by the MISTIC subsystem; an integrated and modular solution enabling traffic monitoring, management and control, the supply of real-time information to multiple communication channels and the management of real-time and forecast traffic models.
- **The Public Transport Management (PTM) sub-system** ensures public transport regularity and commercial speed by means of the AVM system operated by Turin's public transport.
- Information is conveyed to transport users through a **variable message sign management system** based on the system COMPASS, which controls many

signs on the most important roads of the city. Current traffic conditions, problems, suggested roads and the availability of parking places are given to users in real-time.

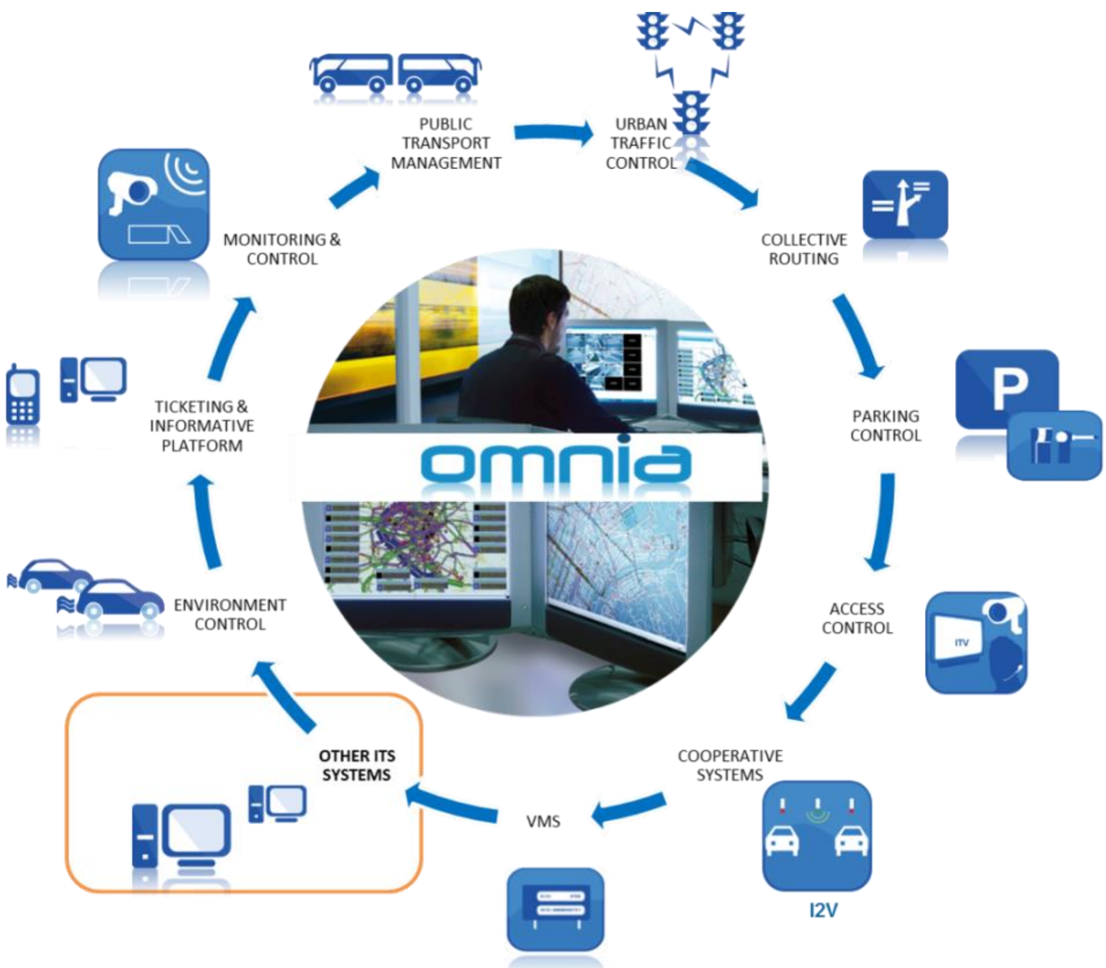


**Figure 1: The OMNIA Platform**

OMNIA allows data to be shared between different types of ITS application implemented within the same geographical area, to achieve a more efficient management of transport as a whole. Such a platform allows for:

- Network Monitoring: real time information on traffic across a road network (e.g. congestion, traffic flows represented on a cartographical form)
- Traffic forecasts;

- Monitoring of System Status: the operational state of ITS systems and equipment;
- Public Transport Monitoring: location of public transport vehicles, relationship to schedule (whether running on time, delayed, etc) and forecasts of arrival times at bus/tram stops;
- Traffic Control Status: information from the UTC system on signals, queues etc
- VIP/Emergency vehicle routes
- Support to maintenance (Fault / Work-Order management)
- Incident detection and Congestion Warnings

Various benefits can be derived through the implementation of OMNIA: for example, the data from different subsystems are shared in common databases, which can improve accuracy and improve the level of services, while costs can be reduced through the sharing of equipment, databases, and staff. Integrated Platforms can be very useful during large events since they can offer a harmonized transport management strategy and the ability to improve the quality of information provision. Given the inherent problem of the intensive and unpredictable movements of people associated with large events, this can be valuable in delivering the required transport provision.

Overall, a city using a centralised traffic management system such as OMNIA exhibits a 28.9% reduction in travel time and a 14% reduction in $CO_2$ emissions in comparison to a city with locally controlled systems (Pezzuto, 2012)

### Assessment of Transferability

While Verona can be regarded without doubt as a best practice, other European cities have also developed their own integrated traffic management solutions, many of whom use OMNIA. These include Prague, Torino, Trondheim, Berlin and Florence. In Florence, OMNIA was installed in order to integrate the 20 heterogeneous systems and provide the operator with the comprehensive tools to control all of the ITS system distributed in the Florence region through development of standard interfaces. These heterogeneous systems that were integrated into subsystems of OMNIA include Urban Traffic control, Parking management, Public Transport Management and CCTV. This level of integration also allows the operator to define area-wide strategies and to perform control measures at a tactical level, enabling emissions and travel times to be reduced. While the OMNIA solution has been successfully implemented in many cities across Europe, its implementation outside of the continent is less common, as the protocols that aid its implementation are less commonly in place. However, two notable successful examples are Astana, the capital of Kazakhstan, and Jundiaí, a medium-sized city in Southern Brazil, which are discussed further herein.

Astana has a population of 835,153 and during a six month period between 2013 and 2014, implemented the OMNIA platform in the main control centre in Astana – the Metropolitan Mobility coordination Centre (MMC). The MMC controls all of the ITS components, including the Adaptive Traffic management systems, the prioritization of special vehicles and the control of the 815 CCTV cameras, and can accommodate future extensions needed by the authority with ease. The integration of the ITS subsystems was chosen by the Astana public authority to deliver significant enhancements on issues directly perceived by citizens (e.g. travel times, accurate information and fuel consumption). This investment in the MMC was considered as important strategic decision with both short and long term effects on mobility, including more effective management and planning, higher effectiveness of the existing and new future ITS applications and lower costs of new deployments. This has helped to significantly improve the overall quality of the transport system in Astana and demonstrated the ease with which the OMNIA platform can be transferred to non-European cities.

**Figure 2: The Metropolitan Mobility coordination Centre (MMC) in Astana**

Jundiaí is a medium-sized city in southern Brazil with a population of 393,120. In 2012, the city authority in Jundiaí deployed an advanced Transportation Management System which incorporated a centralised control and management platform (OMNIA), 20 intersections equipped with adaptive traffic signal control and 130 inductive detector loops, with the aims of improving traveller safety , mobility, network capacity and throughput, and system efficiency. The adaptive traffic signal control systems were installed as a subsystem of the overall integration platform. This subsystem coordinates and controls the traffic flow on arterials across the wider Jundiai metropolitan area, and continually adjusts signal timing parameters based on current traffic volumes.

This was successfully implemented due to a successful collaboration between the traffic and transport department of Jundiai City and third-party providers. The tendering process began in 2009 and was completed with the award of contract in 2010 after 12 months. The implementation phase lasted 24 months until 2012, which required the installation of the intersection infrastructure and the communication network, the renewal of numerous traffic signal controllers, the implementation of traffic detectors and the procurement of central hardware systems. The installation, configuration and commissioning of the centralised software took a further 12 months and, while the system is in its infancy, it is currently on track to meet its expected aims of bringing about a reduction in fuel consumption and environmental pollution, optimising travel time and mobility on the main axes of the traffic network and developing a higher quality public transport service.

### Challenges to transferability

The main challenges to the successful transferability of this solution to different cities are organisational and technical. The organisational layout in cities influences the way in which the ITS systems are set up, which can affect their successful implementation; in certain cities different ITS systems are implemented vertically, with each area working independently from the others, leading to unreliable information, the duplication and weakness of technical solutions and the use of different protocols/standards.

### Guidelines for stakeholders looking to implement the solution in their own city

Where local authority officials are looking to implement such a solution as OMNIA in their own city, it is advised that they first conduct technical visits in places where the system has already been implemented, to understand the nature of the system and how it operates. Detailed cost effectiveness analyses, such as the cost-benefit analysis should also be undertaken in this phase. However, if these measures are insufficient (due to the host and uptaking city exhibiting too dissimilar characteristics, then the interested city should consider implementing the system on a small scale as a pilot project, whereupon if success is achieved, the solution can be given full-scale deployment. Pre-agreements with the different stakeholders involved in such a project should be developed beforehand, to ensure organisational problems are mitigated in advance and a successful technical implementation is guaranteed.

## Summary of key factors required to deploy this solution:

- Understand nature of system through site visits and detailed dialogue with those that use it
- Undertake a detailed cost-benefit analysis. Many costs and benefits can be monetised using market prices, but for those where this is not possible, the use of other valuation methods, such as the contingent valuation method (CVM), the conjoint analysis method (CA), or the hedonic pricing method (HPM) should instead be used
- Where uncertainty regarding transferability it too great, a pilot scheme can be used to trial the system at a smaller scale

## 3. Charging Infrastructure for a Supercapacitor Tram (Guangzhou)

**Relevant work Package:** Enabling Infrastructure

### Introduction

Guangzhou is the third-largest Chinese city and the largest city in South Central China, with a population of approximately 12.7 million. Guangzhou has a huge public transport system to provide accessibility for all in this megacity, which includes the second largest BRT system in the world and a 9-line metro system with a total route length of over 260km (which by 2020 will reach over 500km). In 2014, the city's first tram line was built – the 7.7 km 11-station Haizhu Line between Canton Tower and Wanshengwei, shown in Figure 3. The tram line is a part of the government strategy to increase the public transport modal share to 70% of the toal number of trips. The current modal share of public transport in Guangzhou is 60%. The tram line has also been planned to have added benefits as a tourism attraction, to help attract more visitors to the area.

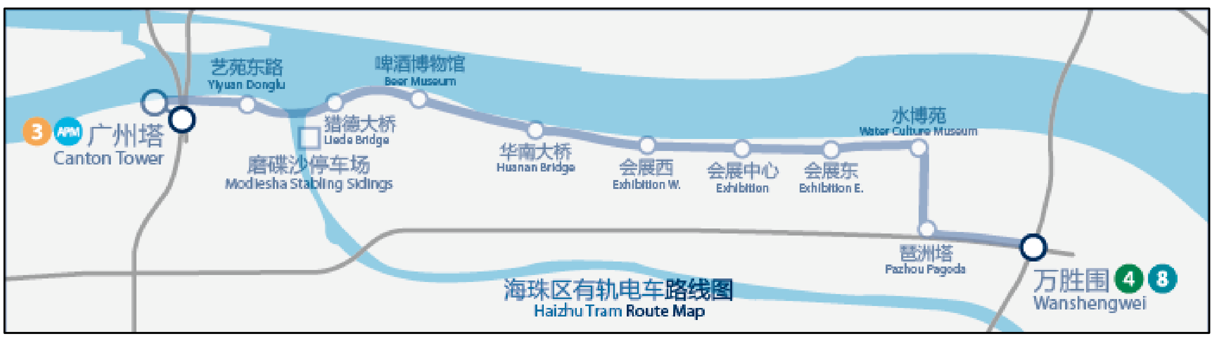


**Figure 3: A Map of the 11 stations on the Haizhu route**

This line, Tram Haizhu 1 (THZ1), is operated using seven 100% low-floor trams, each with four sections and a total capacity of 360, and is shown in Figure 4. The most notable detail of this tramline is in the design of the trams themselves; the tram is completely powered by supercapacitors on-board the tram itself, negating the need for a continuous power source above or beneath the tram line. Instead, these supercapacitors can be automatically charged from a ground-level power supply at each station (which takes between 20-30 seconds, depending on the initial state of charge) and can provide sufficient energy to allow for 4km of operation.

**Figure 4: Two of the seven supercapacitor trams operating on the Haizhu Line**

This project was the product of a joint venture between the Guangzhou Metro Corporation and the China South Locomotive & Rolling Stock Corporation Limited (CSR), which started in November 2012. The planning stage ran until June 2013, with a test section developed by November 2013, and the full implementation being completed by December 2014. The total overall investment including the technology, the charging infrastructure and the test line is approximately £900 million, of which £150 million is attributed to the test section in the city. The super capacitor is one of the most highly regarded forms of energy storage, due to its extremely high charge and discharge rates and durability (its life cycle is over one million cycles meaning an expected design life of 10 years. Per tram, the supercapacitors weigh approximately 4,800 kg. In comparison to the other most commonly used energy storage system, lithium-ion batteries, the supercapacitor has a superior charging speed, life cycle, weight and safety characteristics. To reduce the negative effects in the potential case of charging point faults at stations, mobile charging vehicles can be mobilised.

The use of such a tram powered only by supercapacitors has numerous benefits. For example, the removal of the need for a catenary vastly reduces the capital costs of the power network construction, and also the visual pollution of the tram system. Furthermore, line voltage drops and undesired power peaks can also be removed, while electromagnetic interference with the wider built environment (such as stray currents and leakage currents) can also be reduced.

## Assessment of transferability

The transferability of such a scheme is relatively simple; the charging technology at the stations can be implemented with ease throughout the world, while on-board energy storage systems have been commonplace on-board trams and other urban rail systems for over ten years. The maximum distance that the supercapacitors on-board the trams in Guangzhou can power the tram is approximately 4km, although this can vary by ± 1km depending on additional characteristics (loading, gradients, track adhesion etc). While most tram systems do not have such large distances between stations, where there is uncertainty regarding the capacity of the supercapacitors to power the tram, additionally modelling can be undertaken to verify it.

A similar solution also using supercapacitors and charging stations and developed by CSR has been successfully implemented in Huai'an City in Eastern China (completed in March 2015), demonstrating the success and replicability of the Guangzhou line.

Additionally, there are several examples of charging infrastructure for buses powered by supercapacitors; for example, buses in Shanghai and Sofia. While a much more refined technology is needed in the case of a tram to transfer a much higher amount of energy to the on-board supercapacitors in the same amount of time, such examples demonstrate that supercapacitor charging stations can be implemented both in other cities in China, and in cities across the world.

**Summary of key factors required to deploy this solution:**

- Assessment of the power network to determine the capacity for such charging stations
- It is vital that there is a good dialogue between all stakeholders, including the operators, infrastructure owners, and the tram, charging infrastructure and electricity suppliers
- To ensure that if the system fails, mobile charging stations should be located at strategic points across the network to minimise disruption

## 4. Travel Smart Scheme (Singapore)

**Relevant work Package:** Innovative Public Transport Solutions

### Introduction

The city state of Singapore is an island country in South-East Asia, lying off the southern tip of the Malay Peninsula. It is renowned for its high population density (approximately 7,750 people per $km^2$), for its highly efficient public transport system (3.9 million public transport trips per day), and low car ownership (18%). However, in recent years, the public transport network has come under tremendous strain as the population growth has outstripped infrastructure growth; in the last five years travel demand in Singapore has increased by more than 10%. This has led to increased severe overcrowding, especially during the morning peak period where around 60% of commuters travel on public transport. It is believed that this is the main contributing factor in the drop in overall satisfaction of Singaporeans with public transport from 90.3% in 2011 to 88.5% in 2013. Given that 74% of businesses state their employees working hours currently start between 8.30 and 9:29, the Singapore Land Transport Authority (LTA) developed the TravelSmart scheme to address these issues.

The main objectives of this venture were to move travellers out of the peak period between 8:30 and 9:00, either by encouraging them to make their journey to work earlier/later than they would do otherwise, or to encourage teleworking. This involved working with businesses and their employees to facilitate in the introduction or enhancement of flexible working arrangements (FWA).

Participation in the TravelSmart Pilot Programme was limited to 12 organisations who were invited to participate on the basis of size, industry type, sector and geographical location. In order to understand the Travel Smart measures most appropriate for each organisation, an audit of the facilities that impact on travel and access to the workplace was undertaken, accompanied by a review of the flexible working policies and health/wellness policies to understand how they may influence the travel behaviour of employees. The programme involved the development of TravelSmart Action Plans for participating organisations, which took approximately 9-12 months to implement.

This scheme involved numerous aspects to encourage FWA, including:

- Developing **training and guidelines for managers** managing employees who wish to take-up FWA
- Providing **free breakfasts** at work for those travelling in before the morning peak period.

- The instigation of a **pre-peak free travel trial** on the Singapore Metro system. This was implemented from June 2013 and offers free MRT travel to passengers exiting any one of 18 designated city-centre stations before 07:45 on weekdays. Alternatively, if passengers exit one of the stations later, between 07:45 and 08:00, a 50 cent discount on the fare is given

- The Incentives for Singapore Commuters (INSINC) scheme, which provides **credits to commuters travelling outside the peak period**, who can win prizes and apply for cash rebates

- The 'Sunrise in the City' initiative, which aims to **highlight the benefits of travelling earlier** to those commuters who may not be able to formally change their work start time, such as going to the gym before work and having a much greater chance of a seat on the train.

The main aim was to improve the travel experience of the passengers, in terms of a quicker, more comfortable journey, which would then reflect well on the operators (LTA).

The scheme achieved a notable level of success in its aims: in particular, the number of travellers working staggered business hours rose from 24% in the initial baseline survey to just over 40% in the final survey. Furthermore, the number of citizens actively telecommuting increased from 18% to 45% in the final survey.

This led to a net reduction of over 9% in morning peak trips, recorded through the various surveys. This reduction can be subdivided into the respondents shifting their travel to off-peak periods (7% percent reduction in peak trips) and those reducing their need to travel by telecommuting (2% reduction in peak trips).

In organisations where the programme was fully implemented and the employees experienced a high level of senior management support, the reported peak trip reduction ranged from 20%-30%. Such employees who received personalised journey planning that was provided to certain groups as part of the scheme were found to be over twice as likely again to have moved their journey out of the peak time travel period. The change in travel time was found to impact travellers in a number of different ways, which are listed in Table 1.

**Table 1: The effects of the Travel Smart project on a number of variables**

| Impact of Change in Travel Time | |
|---|---|
| **Able to avoid overcrowding** | 73% |
| **Enables time savings** | 71% |
| **Increased productivity** | 70% |
| **Reduced stress levels** | 67% |
| **Improved perception of organisation** | 66% |
| **Lower costs** | 55% |

The main barriers to further success were found to mainly relate to organisational issues, such as:

- Employees found it difficult to obtain the approval from their manager to actively engage in FWA
- The need to attend meetings in the office
- They prefer to work at the same time as the rest of their team
- It isn't seen as acceptable by colleagues
- Starting earlier would not mean finishing earlier, often due to evening meetings
- They prefer to or need to work in the office

TravelSmart surveys indicated that a change in working culture was needed for notable success to be achieved, to encourage a more accepting approach towards FWA. With regard to the feeling that FWA are not accepted by colleagues, it is likely the approach to relaxed dress codes in Japan could be used; to save energy, many corporations lowered their air conditioning during the summer months, asking their employees to dress more casually. However, until the high-level managers and other important figures were seen to be actively engaged in this initiative, most employees were highly reluctant to take part. The same principle can be observed here, necessitating strong, top-down support from all areas of the organisation to highlight their acceptance of FWA.

## Review of any other similar existing solutions

The most notable example to move travellers out of the peak period was during the London Olympics in 2012, whereby Transport for London established the Travel Advice for Business (TAB) programme to ensure that the forecasted 20 million additional trips during the Games could be accommodated on the often full-to-capacity London Underground, London Buses and other transport networks. The areas of highest travel demand were identified, and the employers within them engaged in the programme, numbering approximately 200,000 participating organisations in total (Moraillon, 2014). The employers were encouraged to:

- Reduce the need for employees to travel during the Games;
- Re-time journeys to travel earlier or later, avoiding busy periods;
- Re-mode, primarily mode shift from public transport to walking and cycling; and
- Re-route trips to less busy routes on road and public transport networks.

The programme, was a significant success, with approximately 42% of London businesses allowing their employees to work from home during the Games, 85% of which planned to keep FWA in place after the Games had finished. Indeed, many employers in central London believe the introduction of FWA is one of the greatest legacies of the Games.

### Assessment of transferability

Since the problems experienced in Singapore exist in many large cities worldwide, the transferring of the package of measures exhibited in Singapore as part of the TravelSmart project to other cities could prove highly beneficial, both in Eastern Asia and worldwide. However, different measures may be able to be transferred with different levels of ease; the policy-based measures and the greater discussions with employers to promote FWA arrangements would be easy to implement in other cities, as has been demonstrated by the successful facilitation of FWA in London during the Olympic Games, which has been retained by a large number of companies since. However, one of the key drivers – the free/subsidised public transport journeys before the peak of the morning rush hour, which were highlighted by those interviewed as being a critical factor in encouraging them to change travel habits, may be more difficult to implement in other cities, where public transport is operated by private companies. Given that a scheme such as TravelSmart delivers benefits to a number of stakeholders, including the operator (better public perception of the system), travellers (less stress, more chance of a seat, etc) and business (improved productivity of employees who engage in FWA), it is more difficult for privately-owned operators to provide free transport when the benefits are on a more global, societal scale. A subsidy provided by the local authority or perhaps jointly with local businesses could possibly ameliorate the situation.

The transferability of the methods discussed to cities with different working cultures should be relatively straightforward, as the measures are able to be adapted with ease, since the underlying principles remain the same. Furthermore, the methods are able to be scaled both up and down with ease depending on the level of overcrowding on public transport – exiting at 18 central metro stations ensures the morning pre-peak journey is free, although this could be lowered or expanded to achieve the appropriate level of journey time shifting. Additionally, since the TravelSmart scheme only focussed on 12 companies in the project, a more notable shift could be achieved by working with a greater number of companies.

Neither the climate nor the culture would pose any major barriers to successful transferability of the scheme, although smart ticketing and the associated infrastructure is necessary. Good cooperation and communication between the public transport operator, the local authority, those responsible for the TravelSmart scheme itself and the relevant ports of call within the organisations that formed part of the scheme was also noted as a major reason for the success of the scheme.

**Summary of key factors required to deploy this solution:**

- Subsidies from the local government to aid such schemes as the free breakfasts for those entering work earlier, and the free/subsidized travel for those who finish their commute before the morning peak.

- Good dialogue between all stakeholders has been noted to be crucial, especially between the local authorities and the employers. Ensuring that the employers fully back such schemes is a vital aspect of the success of the scheme.

- The need for reducing peak period travel, and the benefits it brings to commuters, employers, operators and society as a whole should be communicated to those that the scheme is focused on.

## 5. Distance-based Fare Pricing (DFP) on Bus Systems (Singapore)

**Relevant work Package:** Innovative Public Transport Solutions

### Introduction

In addition to the innovative methods to change mobility patterns in Singapore, the city is also well-known for the fare pricing on its bus system, prior to which fares were regulated by the Public Transport Council (PTC). In 2005, it was decided that such a new fare review mechanism would provide greater clarity and be more responsive to prevailing economic conditions, leading to the decision to adopt it. The PTC had two main goals when they changed the fare adjustment formula: firstly, to secure to the Public Transport Operators (PTOs) profits and secondly, to guarantee fare affordability.

In 2002 Singapore had suffered from a weak economy and in order for operators to make a profit, an increase in bus fares beyond socio-economics affordability was being debated. The new formula made it possible for the operator to keep running their business and for the commuters to be able to pay for the fares. This was achieved by changing the Price Index formula, that included Consumer Price Index (CPI) (which represented maintenance, fuel and energy costs) and Wage Index that in the time the formula was elaborated, held half of the operating costs. Additionally, the PTC, in collaboration with the government, divided the productivity gains between the PTOs and the commuters. The formula to calculate the fare cap is shown below:

**Fare cap = 0.5(cCPI) + 0.5(WI) – 0.3%**

(cCPI = Change in core Consumer Price Index; WI = Change in Wage Index)

The distance-based fare pricing scheme was introduced in 2010 in order to remove fare penalty associated with transfers between transport modes, due to the integration of buses and trains in 2005. The bus fares are determined by a universal fare structure and a nonlinear function of travel distance, as shown in Figure 5. There were 5 different services types due to different operating costs and service quality. In 2013 the Fare Review Mechanism Committee (FRMC) proposed an adjustment to the fare formula to recognise that “energy costs have increased faster than fares, thus putting a strain on the long-term financial viability of the industry”. Indeed, energy costs have taken up a larger proportion of the operating costs of the PTOs. The adjustment is void from 2013 to 2017 and the Productivity Extraction was set to 0.5%.

**Fare Adjustment = 0.4 cCPI + 0.4 WI + 0.2 EI – Productivity Extraction**

(EI = the change in Energy Index; Productivity Extraction = 0.5% (valid until 2017)

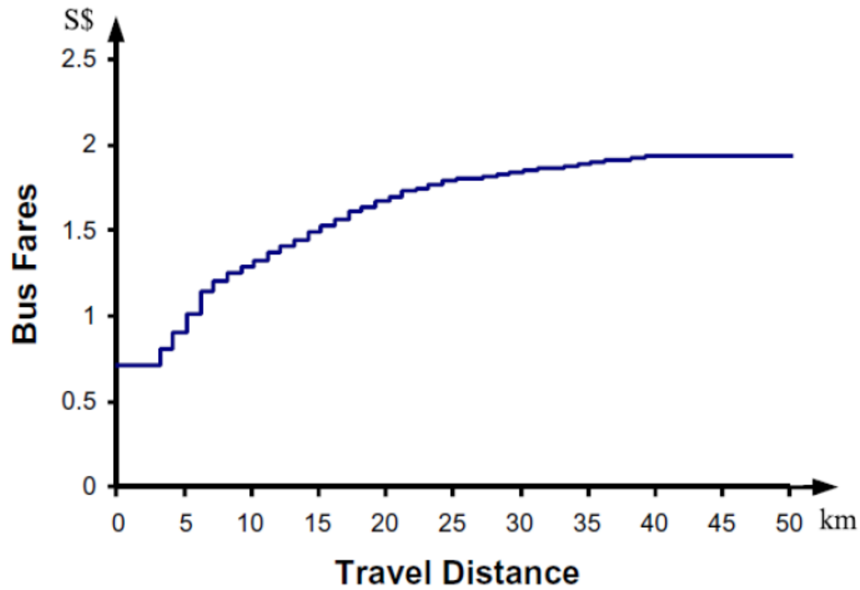


**Figure 5: The relationship between bus fares and the trip distance (Meng et al, 2012)**

## Similar schemes worldwide

Numerous BRT systems across the world have similar DFP schemes, including Amsterdam (The Netherlands), Brisbane (Australia), Cape Town and Johannesburg (South Africa)

Ahmedabad has a population of approximately 5.8 million in its metropolitan area. In 2008, Ahmedabad Municipal Corporation presented their plans to integrate fares within the operator of the bus service in Ahmedabad (AMTS – Ahmedabad Municipal Transport Service). The fares can be classified into three categories: Distance-based single journey tickets; Period tickets (e.g. a Rs 20 day pass allows unlimited travel on all AMTS routes) and concessionary fares, such as monthly passes offer a 50% discount for travel on a single pre-registered roundtrip sector. The AMTS uses a modelling system program called EMME to derive a simplified fare rule based on a linear regression of the AMTS fare stages for single-journey tickets as given below:

$$0.74 + 0.5 * \text{distance (km)}$$

In the EMME model, passengers pay a single Rs 0.74 base fare (for the average in-vehicle travel time), regardless of the transfers, and the distance portion of the fare (Rs 0.5 per km) is added to the in-vehicle travel time. The fixed portion of the fare is subsumed into the overall boarding penalty for each mode.

Cape Town is the second most populous city in South Africa, with a population of almost 4 million. It is a dense city with high levels of traffic congestion due to the low quality of public transport. As with other South African cities, private car ownership is such that it affects the country's productivity and efficiency. A three-stage 13-year action plan was proposed in 2007 by the South African government, to end in 2020 aimed at rejuvenating the public transport system.

In May 2011, the first network of the Integrated Rapid Transit (IRT) system was launched as part of the integration plan for public transport modes in the city, called MyCiTi IRT, and by November 2013, Cape Town's Fare Policy for Contracted Road-Based Public Transport was changed to accomplish this new policy's vision. This involved distance-based fares using a stepped function in which the fares would increase with an associated distance band until the maximum fare is reached. This is described in Figure 6.

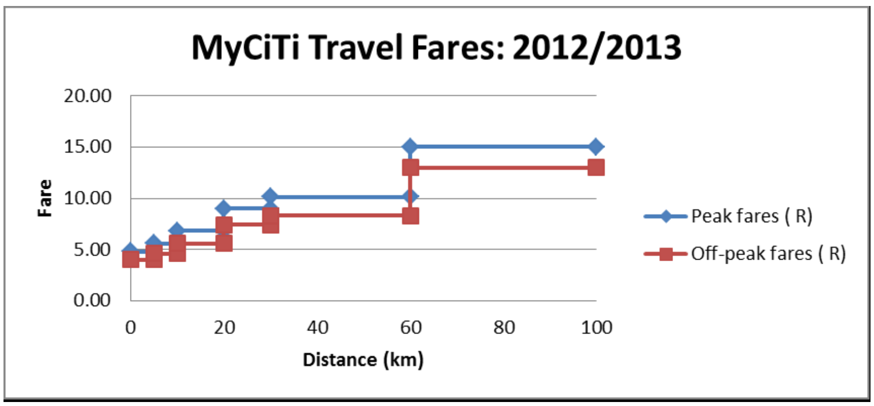


**Figure 6: Diagrammatic illustration of distance-based fare structure for the MyCiTi scheme**

## Assessment of Transferability

There are a number of factors which influence the successful implementation of the distance-based fare pricing solution, such as population/employment density, the size of city centre, the spatial structure of city, the availability and competitiveness of alternative travel modes (e.g. car running costs, parking and congestion) and the regulatory environment. Singapore is a monocentric city built around a strong Central Business District, and has developed a sophisticated distance-based fare pricing solution with 39 levels of price, reflecting the relative cost of the mode, route or location of service (e.g. price per kilometre in the city centre is much higher than in suburbs). The solution was introduced in 2010 to bring about a more integrated fare structure that allows commuters to make transfers without incurring additional cost, thus offering greater choice and flexibility in how they plan their journey.

The solution is seen as a key element in network integration which is one of the top priorities identified in the Land Transport Masterplan, and is best achieved with the active intervention of Government. The scheme receives both financial and political support from the central government, who contribute to between 40-60% of operating costs, despite the Rapid Transit System and bus operating costs being recouped through system revenue, which includes fares, property and advertising.

As the formula of the Singapore distance-based fares is centred on transport operators' costs and productivity, energy costs, core inflation and wages, a key issue about the transferability of the solution is the degree to which the transport demand factors and elasticity values it describes are transferable to other times and places. This issue needs to be carefully and thoroughly addressed in a feasibility study of the solution prior to its implementation.

The distance-based fare solution requires the right political structure and institutional context to operate at its fullest potential. These would include the central government, the local authority, transport operators, service providers etc. Nevertheless, it has already been implemented under different local conditions including culture, climate or level of existing infrastructure, as discussed previously.

In comparison to time-based fare pricing, the distance-based fare solution may require some form of receipt indicating the location of the fare transaction or the valid length of trip based on the fare paid. For example, on rail lines, a barrier would be required to enforce payment of appropriate distance-based charges.

### Summary of key factors required to deploy this solution:

- Close attention should be given to all the relevant variables, including the energy index, the consumer price index and the change in wage index to ensure that the price being charged is suitable for both the operator and the passengers.

- Ensuring that the system is sufficiently ‘gated’ such that passengers will pay the correct distance-based fare for their journey, regardless of where they start or end is crucial is the system is supposed to be for integrated transport modes rather than just buses.

## 6. Electric Vehicle Charging Infrastructure (England)

**Relevant work Package:** Deployment of Clean Vehicle Solutions

### Introduction

All 12 local authorities in the North East of England are committed to reduce carbon emissions by 20% by 2020, and as such, Electric Vehicles (EVs) are now promoted by many governments as an important means of reducing the environmental impact of transport. This necessitated a greater understanding of consumer behaviours.

One aim of the Charge Your Car (CYC) project (2010-1013) was to feed back the experience gained by developing EV charging infrastructure into future policy decisions at regional and national levels. This included the development of standards, evaluation of technologies, harmonisation of local incentives and understanding users' behaviour. CYC aimed to create a connected EV charging network in public, workplace and domestic areas, but needed strong support to move from a novel concept to an actual system. By 2013, 1,163 charging points had been installed across the region, which included 12 quick chargers, which enable EVs to be recharged to 80% in just 30 minutes.


**Figure 7: Examples of the EVs used in the CYC scheme**

CYC was funded by the Regional Development Agency 'One North East' (£3.8m), The UK Office for Low Emission Vehicles (£2.9m), along with grants from public and private partners (£1m), and was part of a wider regional initiative to develop a leading electromobility sector in the North East of England. Significant collaboration and co-operation between a range of stakeholders was required, with over 60 partners in the North East, including all 12 Local Authorities, private businesses, transport providers, academia, fleet operators and electricity suppliers. The UK government kick-started the deployment of the charging infrastructure, initially subsidising 50% installation costs. Other incentive schemes have included electric vehicle purchase grants of 25% (up to a maximum of £5000) – guaranteed until 2017, exemption from vehicle excise duty, free parking, exemption from congestion charges, and free home charge point installation.

This project has enabled the region to develop its electromobility sector and become one of the knowledge leaders in this area. CYC operates by providing a single charge point management system to which charge point owners can connect charge points, making the posts visible to all EV drivers via the CYC live status map. CYC enables charge point owners to set the tariff for each charge point, collect payment for usage, and provides alerts to charge point maintenance teams in the event of a fault. CYC simplifies travel across the UK using an EV, with the CYC app allowing EV drivers to find and use charge points. However, finding suitable locations and hosts for 50 kW quick chargers proved more difficult, and necessitated a 100% grant plus a five-year maintenance service before hosts adopted taking on this asset.

The scheme has been attributed as one of the main reasons behind the selling of over 15000 EVs and plug-in hybrid vehicles in 2014, in comparison to 3800 the year before. It should be noted that for mass-ownership to be successful, the capacity of the electrical grid should be considered in depth; many countries would need a significant upgrading of their entire electrical infrastructure to cope with such an increase in demand. The redistribution of pollution from point of use to source should also be considered, and the effects of such a change.

**Figure 8: One of the charging posts installed in Newcastle under the CYC scheme**

## Similar Solutions

An additional seven UK PiPs ("Plugged-in Places") were developed at the same time as the North-East PiP. These included the East of England, Greater Manchester, London, the Midlands, Milton Keynes, Northern Ireland and Scotland. CYC has since become a successful private company with national coverage and over 3000 members. The simplicity with which the scheme was implemented in these areas demonstrates the ease of transferability of the concept within the country. However, transferability on an international basis requires a careful market analysis and may necessitate similar stimulus measures to start the process. In 2013 the European Union announced a €10 billion public works programme to kick-start the deployment of an EV charging network across the continent.

## Assessment of Transferability

Until recently EV charging network solutions have predominantly been focused on urban/regional locations where it is possible to deploy a dense infrastructure of charge points and focus on shorter trips (e.g. commutes). However, attention is now turning to rural areas to look at appropriate deployment, in particular a rapid charging network to make longer, inter-urban EV trips more feasible.

The political structure nationally in the UK has had a positive effect on the EV charging network since 2009, with cross-party consensus achieved, and funding made available, despite the economic recession, for projects that aim to reduce carbon emissions and pursue green solutions to transport such as electro-mobility. Political and financial backing (including incentives for end users) has been critical in the success of the scheme, and is considered a vital aspect of any future schemes, especially given the recent lowering in price of fossil fuels which may make attracting citizens to electromobility more challenging in the short/medium term.

**Summary of key factors required to deploy this solution:**

- Support from government, both in terms of political and financial support to provide the subsidies to aid the takeup of the electric vehicles, and to provide more certainty in the market.

- To achieve success, the collaboration between a number of stakeholders is vital, including charge point manufacturers; charge point operators (including retail areas, workplaces and the public sector); EV driver user groups/car sharing companies, local authorities and highway owners.

## 7. Stadsleveransen Micro Terminal and Freight Network (Gothenburg)

**Relevant work Package:** Sustainable Urban Logistics Solutions

### Introduction

The Stadsleveransen project involves the consolidation of numerous small deliveries by ICE-powered vehicles destined for the city centre in micro-terminals, which are then distributed over the 'final mile' using zero-emissions vehicles. This helps to reduce congestion, noise levels and emissions. These terminals serve a limited geographic area, number of shippers and transport operators. As such, they can help make more efficient usage of transport resources, by reducing the mileages of Heavy Goods Vehicles (HGV) with low average loads. Stadsleveransen also picks up outgoing goods from the businesses in the city centre for export.

**Figure 9: One of the Stadsleveransen electric delivery vehicles**

Stadsleveransen started in 2012 with a small-scale six-month pilot. Ten shops were initially contacted and asked to redirect their goods through the consolidation centre, which was operated by the retail trade association in the city centre. The pilot was mainly financed through project funding, the local authority and the retail trade association. Choosing the location and operations of a micro-terminal should take into consideration many varying factors, necessitating that local authorities, trade associations and individual business owners all play a prominent role in the coordination of such a project.

At present, approximately 400 companies use the consolidation centre. Stadsleveransen receives 300-400 packages daily at the consolidation terminal near the city centre, which is then consolidated and delivered by two electric distribution cars, and two cargo bikes. During this phase, additional funding of the demonstration was raised through selling advertising space on the vehicle, which formed an important part of the business model for Stadsleveransen. The aim is to consolidate all small volume deliveries bound for the city centre during the daytime, since larger shipments generally arrive early in the morning in fully-loaded trucks, where no notable benefits would be derived from consolidating such shipments.

The effects of the Stadsleveransen project are notable, including reduced congestion, emissions and noise levels and improved traffic safety and general attractiveness of the city. Stadsleveransen has almost eliminated the emissions from the last mile distribution of the goods handled by the service, and has cut the driving distances of heavy goods vehicles from the streets in the city centre by approximately 50%. There are also significant improvements regarding the handling time for the goods. This success can be attributed to a number of factors, including strong political support in the form of exemptions from regulations, and funding support, with further funding coming from development projects, real estate owners and advertisements on the vehicles used by the scheme. Its success is also attributed to the fact that it is a neutral solution, in that it is a business operated by a joint organisation, owned by the merchants and the real estate owners.

The delivery companies obtain the largest benefits from such a scheme, on account of the time savings derived from delivering the packages to a single point outside the city centre, rather than delivering the goods in a time-consuming manner to each individual receiver.

### Similar solutions

As part of the European Commission-funded project Smartfusion (2011-2015), the city of Newcastle upon Tyne (UK) is demonstrating collaborative approaches for urban interurban shipment planning and execution among shippers, logistics service providers and local government. This has resulted in the development of a pilot for consolidating goods deliveries in a single location outside of the city centre for onward delivery to their final destination in the University in an electric vehicle, shown below in Figure 10This project has so far proved highly successful, and succeeded in its initial aims of reducing the number of commercial vehicles travelling to and around the University campus, helping to improve the quality of the campus for students and staff.


**Figure 10: The Smartfusion Electric Vehicle for last-mile delivery from the consolidation centre to the Newcastle University campus**

### Assessment of transferability

The basic operations of Stadsleveransen are relatively straightforward to transfer to different cities, although the prerequisites for establishing the business may vary much, relating to, for example, the stakeholders in the area, the existing infrastructure, local regulations etc, in addition to the opportunities to obtain a financially sustainable business model. The layout of the city centre and the regulations in place will have a notable effect; if it is difficult to deliver goods to the city centre, especially using conventional heavy goods vehicles, then there will be more demand for specialised transport solutions including consolidation.

While it is possible to implement the solution at both a smaller and larger scale, it may be difficult to achieve economic viability on a smaller scale, and so the service could instead be combined with other services in order to be more efficient at such a level. In order to achieve a successful implementation of the scheme the municipality, delivery companies, the real estate owners, the business/shop owners, and especially the joint organisations in the private sector (transport, trade, real estate owners) should be involved and communicating from an early basis, to then enable the creation of the physical networks, the cooperation between the stakeholders, and for feasibility studies to be undertaken. The development of a robust financial model and business plan is key to ensuring that the scheme is a success beyond the initial pilot phase; one common problem is the lack of financial resources after the pilot has been undertaken. It may also be important to have a “neutral” operator/owner running such a business like Stadsleveransen, since there may be resistance among delivery companies to transfer parts of their transport assignments to direct competitors.

**Summary of key factors required to deploy this solution:**

- A sufficiently-sized area at the edge of the city where HGVs can easily unload their packages and the low-emissions final-mile delivery vehicles can be stored overnight.
- Such a solution will give the greatest benefit in cities where the final mile delivery is the most difficult.
- Delivery companies, the real estate owners, the business/shop owners, and the joint organisations in the private sector (transport, trade etc) should be involved and communicating from an early basis

## 8. Conclusions

This aim of this deliverable was to take six of the most promising case studies of the best practices of sustainable urban mobility that have been identified during the Viajeo-Plus project thus far, and provide a comprehensive description of the practice itself, and how it can best be implemented in other cities, be they in the same country, the same continent, or different continents.

As such, six plans have been developed: two for the work package “Innovative Public Transport Solutions”, and one for the work packages “Innovative Integrated Network Management”, “Deployment of Clean Vehicle Solutions”, “Enabling Infrastructure” and “Sustainable Urban Logistics Solutions”. These best practices, and solutions similar to them, originate from five continents, and demonstrate the global approach that is used by Viajeo-Plus when attempting to best disseminate the high quality innovative sustainable urban mobility solutions to new cities. The summary of the 6 plans, their host locations, main benefits and key points to consider for a successful implementation are shown in Table 2 below:

**Table 2: Summary of Execeutive Plans**

| Solution | City | Main benefits | Summary of main things to consider |
|---|---|---|---|
| **Mobility Management** | Verona | Reduces travel times, emissions and costs. Allows for greater traffic forecasting and control | Interested parties should visit existing systems<br>Undertake a detailed CBA |
| **Electric Vehicle Charging Infrastructure** | North-East England | Improves air quality, perceptions of electric vehicles and ability to charge electric vehicles. Reduces noise pollution. | Financial subsidies to encourage takeup of Electric Vehicles and installation of charging posts are vital.<br>Collaboration between main stakeholders is also highly important |
| **Travel Smart scheme** | Singapore | Improves traveller comfort and productivity, increases capacity and reduces traveller stress levels and travel time | The benefits can be greatly increased if government subsidies are provided<br>The need for, and benefits of the scheme, should be communicated clearly to all commuters during |

| | | | |
|---|---|---|---|
| | | | the programme |
| **Distance-based Charging scheme** | | Provides a more accurate and fair pricing scheme that can be changed given the global conditions that affect the cost of travel provision | Need to ensure that the infrastructure exists such that travellers leaving the system pay the appropriate fare for the distance travelled.<br>Relevant financial indices should be considered |
| **Supercapacitor Tram Charging** | Guangzhou | Negates need for catenary. Reduces visual pollution and cost of tram system. Provides onboard ESS to recoup braking energy. | Sufficiency of power network should be determined<br>Good stakeholder communication is essential<br>Mobile charging points for trams should be available as backup |
| **Micro-terminal and freight network** | Gothenburg | Removes need for HGVs in city centre leading to reduced congestion, emissions and noise levels. | This solution will deliver the most benefits in cities where the final mile delivery is most difficult.<br>A suitable area at which the terminal can be built is necessary. |

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