GrowSmarter
Transforming cities for a smart, sustainable Europe

IMPLEMENTING SUSTAINABLE URBAN MOBILITY IN EUROPEAN CITIES – EXPERIENCES FROM GROWSMARTER

D4.3. IMPLEMENTATION REPORT WP4

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EXECUTIVE SUMMARY

This report describes the implementation of 17 measures addressing Sustainable Urban Mobility in the GrowSmarter project and its three "Lighthouse Cities" of Barcelona, Cologne and Stockholm.

The report begins with a general introduction and overview of the measures, before proceeding with short case studies describing the implementation of each measure; its main stakeholders and business model; key activities, achievements and challenges; and lessons learnt.

Each measure forms part of 12 "Smart Solutions" within the GrowSmarter project. In Chapter 3, the lessons learnt per measure are collated and discussed with reference to each Smart Solution and several overlapping thematic challenges. These findings inform the general conclusions of this report, which include the identification of challenges and opportunities related to:

- Administrative processes, laws and regulations (within countries, and in terms of variation between countries);
- The use of public and private space;
- Business models and issues related to gathering, use and ownership of data;
- User behaviour

Key conclusions include a need to use public spaces in more creative and flexible ways to enable prioritisation of sustainable mobility and the emergence of new transport services. To achieve this, cities should be empowered with new regulatory powers and resources to ensure Europe's transition to sustainable urban mobility.

The report thus provides readers with information on lessons learnt per measure and per Smart Solution, along with thematic and general conclusions emerging from the implementation phase of GrowSmarter. In doing so, the report provides key insights into the practical steps taken to implement measures and replicate good examples from GrowSmarter in other cities and contexts.

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1 INTRODUCTION

Across Europe, cities are embracing the pursuit of smart and sustainable development. Transformative action is required to, for example, reshape processes and practices influencing the design, construction and end-use of urban infrastructure.

In this context, the "Lighthouse Cities" of Barcelona, Cologne and Stockholm, together with a diverse group of public and private sector partners, formed the GrowSmarter project. The "Lighthouse Cities" are cutting-edge practitioners of sustainable urban development, whose measures shine a light on both the potential risks and benefits of different approaches.

GrowSmarter seeks to integrate, demonstrate and stimulate the uptake of '12 smart city solutions' in energy, infrastructure and transport, to provide other European cities with insights and create a ready market to support the transition to a smart, sustainable Europe.

This report presents experiences from the implementation of smart city solutions addressing Sustainable Urban Mobility in GrowSmarter. The report is based on analysis of interviews with measure leaders and other project participants, along with project reports and other relevant source material. In total, experiences from 17 measures are described to inform key conclusions and recommendations to policy-makers.

2 SUSTAINABLE URBAN MOBILITY IN GROWSMARTER

Sustainable urban mobility is the focus of measures in GrowSmarter's Work Package 4 (WP4). The overall objective of WP4 is to introduce and demonstrate smarter solutions through measures that may be replicated in follower cities across Europe and beyond.

To achieve this aim, WP4 includes a diverse range of public and private organisations that, during the period 2015-2017, have developed, procured and implemented processes and technologies to advance sustainable urban mobility in the Lighthouse Cities. This report presents the experiences of participating actors in this implementation phase and offers conclusions and recommendations to cities aiming to replicate measures.

This Chapter begins with Table 1, providing an overview of the measures, the city and partners implementing them and contact information. Thereafter follows a presentation of each Solution and Measure, including a description of the implementation process, lessons learnt and recommendations per measure. Subsequently, the general conclusions and recommendations per Solution are discussed in Chapter 3.

Table 1: Overview of the Smart Solutions, measures, cities and partners involved in WP4, along with the page number on which each measure is presented in this report. City names are abbreviated to BCN (Barcelona), COL (Cologne) and STO (Stockholm).

Solution	Measure	City	Partner(s)	Contact person(s)
SS2. Smart building logistics and alternative fuelled vehicles	2.1 Integrated Multi-modal Transport for construction materials/logistics centre in Årsta	STO	Skanska, Carrier	Rasmus Linge, rasmus.linge@cslogistics.se Ary Zanganeh, ary.zanganeh@skanska.se
SS9. Sustainable delivery	9.1 Integrated multi-mode transport for light goods	STO	Carrier, Stockholmshem	Rasmus Linge, rasmus.linge@cslogistics.se Åsa Stenmark, asa.stenmark@stockholmshem.se
	9.2 Micro distribution of freight	BCN	Cenit, I2CAT, Barcelona city council	Jaume Roca Guitart, jaume.roca-guitart@upc.edu Marisa Catalan, marisa.catalan@i2cat.net
SS10. Smart Traffic management	10.1 Traffic management through MFD	BCN	Cenit	Jaume Roca Guitart, jaume.roca-guitart@upc.edu
	10.3 Travel Demand management	STO	KTH	Markus Robért markus.robert@abe.kth.se
	10.4 Traffic control system for passenger vehicles	STO	Insero	Jens Christian Lodberg Høj, jclh@insero.com
	10.5 Traffic signals synchronized to prioritize certain vehicles movement of goods	STO	Carrier, City of Stockholm	Rasmus Linge, rasmus.linge@cslogistics.se
SS11. Alternative fuel driven vehicles for decarbonizing and better air quality	11.1 Developing charging infrastructure	BCN, COL & STO	City of Barcelona City of Cologne: RheinEnergie City of Stockholm, Fortum	BCN: Gonzalo Cabezas Ruescas, gcabezasr@bcn.cat COL: Christian Remacly, c.remacly@rheinenergie.com STO: Eva Sunnerstedt, eva.sunnerstedt@stockholm.se STO: Ahmad Karnama, ahmad.karnama@accenture.com
	11.2 E-mobility management system	BCN	City of Barcelona, IREC	BCN: Gonzalo Cabezas Ruescas, gcabezasr@bcn.cat
	11.3 Charging infrastructure for electric tricycles	BCN	Cenit, I2CAT	Jaume Roca Guitart, jaume.roca-guitart@upc.edu

	for micro distribution			Gonzalo Cabezas Ruescas, gcabezasr@bcn.cat
	11.4 Setting up refuelling facilities for alternative heavy duty fuels fuel	STO	City of Stockholm	Per-Erik Österlund, per.erik.osterlund@stockholm.se
	11.5 Smart guiding to alternative fuel stations and fast charging	STO	Fortum, KTH	Markus Robért markus.robert@abe.kth.se Ahmad Karnama, ahmad.karnama@accenture.com
SS12. Smart mobility solutions	12.1 Green parking index in combination with car sharing pool with EV	STO	Stockholmshem, Fortum	Åsa Stenmark, asa.stenmark@stockholmshem.se
	12.2 Electrical and cargo bike pool	STO	Stockholmshem	Åsa Stenmark, asa.stenmark@stockholmshem.se
	12.3 Mobility station	COL	City of Cologne, KVB, Cambio, Ampido, RheinEnergie	Carsten Rickers, carsten.rickers@stadt-koeln.de Holger Kahl, holger.kahl@hk-org.de Thomas Bischof, thomas.bischof@kvb-koeln.de Tanya Bullmann, Tanya.Bullmann@cambio-carsharing.de Steven Pakasathanan, steven.pakasathanan@ampido.com Christian Remacly, c.remacly@rheinenergie.com
	12.4 Electrical and conventional car sharing	COL	Cambio (e-car-sharing), KVB (e-bike-sharing), RheinEnergie (charging infrastructure)	Tanya Bullmann, Tanya.Bullmann@cambio-carsharing.de Thomas Bischof, thomas.bischof@kvb-koeln.de Christian Remacly, c.remacly@rheinenergie.com
	12.6 Smart taxi stand system	BCN	Cenit, Cellnex, Urbisapp	Jaume Roca Guitart, jaume.roca-guitart@upc.edu Gonzalo Cabezas Ruescas, gcabezasr@bcn.cat Carmen Vicente, <carmen.vicente@cellnextelecom.com>

2.1 Smart Solution 2: Smart building logistics and alternative fuelled vehicles

Smart Solution 2 demonstrates how to reduce the volume of heavy goods transport in the construction sector in urban areas, thereby enabling reductions of greenhouse gas emissions and pollutants as energy savings are achieved and less fossil fuels are used. To do so, a construction freight consolidation centre has been introduced in Stockholm, demonstrating what types of goods can be consolidated and what impacts on the local transport market occur as a result of implementation.

Measure 2.1. Integrated Multi-modal Transport for construction materials/logistics centre in Årsta

Introduction

The construction consolidation centre aims to increase the efficiency of logistic flows during construction projects such as renovations. Inbound deliveries are directed to the consolidation centre, which groups delivery of different product types into single deliveries and distributes materials to the construction site at the right moment, thereby avoiding multiple deliveries by various suppliers. Waste can then be taken from the construction site and disposed of. This reduces congestion and risks (e.g. damage or loss of materials, loss of working time searching for lost materials) in and around construction sites whilst providing wider economic and environmental benefits.

Implementation

In Stockholm, it was envisaged that the measure would involve deliveries between the consolidation centre (located close to a railway) and two sites in the Årsta Living Lab area (Valla Torg and Slakthusområdet) using alternatively-fuelled vehicles. However, the implementation of the consolidation centre proved challenging for Skanska, the company managing the renovation of residential buildings at Valla Torg. Whilst construction consolidation centres are not new concepts and have been used in several urban development projects in Stockholm for new buildings, their use in renovation projects with tight schedules is new. The combined challenge of integrating new working methods to ensure freight consolidation whilst implementing the building renovations according to the project timetable has been problematic.

Carrier have established the consolidation centre, but it has been difficult to make systematic use of it, as the necessary organisational routines for planning orders and deliveries have not been fully established at the construction site. Pre-existing supply agreements with third parties proved difficult to amend to redirect deliveries via the consolidation centre. In addition, a major supplier of materials for the renovation is located at a site closer (and in the opposite direction) than the consolidation centre, reducing potential benefits of consolidation. In a move indicating the need for consolidation (to improve organisation and reduce losses on site), Skanska implemented a tent solution for warehousing incoming goods on site.

As a result of these issues, deliveries have occurred on a more ad-hoc basis than was planned. The partners are working to address these challenges and aim to achieve full

demonstration (either at the Valla Torg site or another site close to Årsta) through the consolidation centre for some product groups during early 2018.

Stakeholders & Business Model

The main stakeholders for a construction consolidation centre are the site/property owner who demands the service (in the case of Valla Torg, this is Stockholmshem), the building contractor (Skanska) receiving deliveries and its sub-contractors who make and/or receive deliveries, and the logistics company providing the consolidation service (Carrier).

Achievements

Carrier have established the consolidation centre and acquired experience in delivering consolidation services through the measure, enabling them to provide this service to other construction sites in the Stockholm area. The "tent solution" adopted by Skanska at Valla Torg indicates a potential area for service development – "pop-up consolidation centres" – which could be integrated into a wider business model for consolidation centre services.

Lessons Learned

Implementation of a proven concept may be difficult in a new context. Establishing a system does not automatically lead to implementation, as organisational and behavioural changes require time and resources. The scale of a construction project, along with its geographic location, influence the extent to which consolidation centres can deliver cost, environmental and other benefits. The organisation procuring the construction project must be engaged and proactive in demanding adherence to the consolidation service (e.g. by imposing requirements on suppliers to ensure compliance).

Recommendations

Consolidation centres offer clear benefits when implemented at larger, complex sites (e.g. multiple construction projects, many actors operating, diverse range of deliveries). The extent to which small-scale projects offer benefits varies greatly depending on the local context and pre-conditions. An increased range of benefits for smaller sites are likely to emerge if, for example, new efforts are made to introduce or expand environmental zones for heavy vehicles or delivery vans. Regulatory authorities such as municipalities should explore how to ensure consolidation services are available for logistics services in their territories, and make use of opportunities – such as construction projects – to demonstrate consolidation services.

2.2 Smart Solution 9: Sustainable delivery

Smart Solution 9 aims to demonstrate last mile delivery services using sustainable forms of mobility to retailers and residences. The Smart Solution comprises two measures, each of which delivery services operating with electric cargo cycles.

Measure 9.1 Integrated multi-mode transport for light goods

Introduction

The aim of this measure is to improve quality of life and reduce the number of journeys by car by improving residents' access to delivery services. In Stockholm, an innovative new service has been implemented in a multi-residence building in the Årsta Living Lab area. In the original project plan, it was envisaged that service boxes would be installed in residential housing at the Valla Torg site, enabling tenants to collect parcels using sms pin codes, rather than waiting at home for deliveries or having to travel to collection points.

However, during the implementation phase, it proved difficult to select a suitable location for service boxes (e.g. the buildings have insufficient foyer space for service boxes). One possible space was identified, but this was in a building due for renovation in a later phase of the project. To meet the project's requirements for demonstration, a new alternative was required. At this point, the partners developed the idea of a "delivery room". Instead of installing service boxes of fixed size, parcels could be delivered to a secure room. This means delivery of a wider range of parcels is possible, as the full space of a room can be used for storage, as opposed to the fixed dimensions of a service box.

Implementation

To enable delivery to the room, a number of steps were required. First, agreements were made between Stockholmshem, Carrier and the cycle delivery company Move-By-Bike to ensure last-mile delivery from Carrier's depot to the delivery room. Second, a "care of" (c/o) address was registered to ensure that residents purchasing goods from the internet can send their delivery to the Carrier depot, from where it is dispatched to the delivery room.

Third, residents must install an app and register as users of the delivery room (the security system is provided by a third party, Qlocx). They then receive sms notifications with a pin code when a parcel is delivered, which they use to enter the room and collect their parcels. Residents will also be able to register parcels for return and leave these in the delivery room for collection.

Stakeholders & Business Model

The stakeholders are those described above – the property owner, two logistics companies, security system provider and end users. If new services are added to the delivery room, such as food deliveries, the range of potential stakeholders will expand.

Achievements

This measure has involved improvisation, learning and problem-solving, as the partners have adapted plans and proactively identified new solutions to ensure implementation. As

noted above, starting the measure and finding an arrangement enabling implementation was a key challenge. The measure now needs to be demonstrated to ensure the business model will work and can evolve – in its current design, the model involves the loss of a small area which could theoretically be hired out, something which may be problematic in other contexts.

Once the service is launched and operating, it may be possible to add additional functions, such as delivery of refrigerated goods or other services residents demand, and to transfer some costs to other stakeholders, such as residents or retailers. Functions could be developed to support the "circular economy" with sharing of e.g. machine tools, ladders, cycles, etc. Moreover, there is strong interest in this measure from other sites in Stockholm, and it is possible to imagine that, if the practice develops, in the future direct deliveries may be made to the delivery room and the c/o solution may no longer be necessary.

Lessons learnt

It is important to identify physical space for a service box or delivery room early in a renovation project. Such space should be accessible for residents and couriers, yet also not compete with other functions (e.g. commercial spaces, cycle garages, laundry rooms etc.). A variety of possibilities exist and the relative advantages or disadvantages should be evaluated on a case-by-case basis to ensure a sound business model. Early dialogue with Move-By-Bike and Qlocx helped in the preparation and implementation of the measure, as these companies provided expertise and see potential spin-offs that complement the actions in GrowSmarter.

Recommendations

This measure is possible to implement in a variety of contexts and forms. Early dialogue with stakeholders is recommended to ensure various approaches are discussed and considered prior to selection of the ideal option for the local context.

Measure 9.2 Micro distribution of freight and Measure 11.3 Charging infrastructure for electric tricycles for micro distribution

Introduction

The aim of this measure is to facilitate last-mile delivery services through demonstration of micro urban consolidation centres for deliveries by electric tricycles in a designated area, the old city of Barcelona. In this district, traffic restrictions mean cars and trucks can only make deliveries in the morning, whereas cycle delivery is possible throughout the day. The measure also involves the provisioning of charging infrastructure for the electric tricycles and on-bike sensors to assist with routing, monitor the service and environmental conditions along the routes.

Implementation

As with Measure 9.1 "Integrated multi-mode transport for light goods", this measure has involved significant learning and improvisation. The original plan was to implement the

measure in the San Martí Living Lab area, but in early 2016, an evaluation of the potential service demand in this area indicated a low level of parcel turnover. Discussions continued throughout 2016 as the partners attempted to identify an alternative location for the demonstration. During this period, premises at a site close to the Estació de França railway station were identified.

As the demonstration is a pilot, rather than procuring services the City Council granted an agreement to use the premises to a delivery company (Vanapedal) serving the city's historic centre Ciutat Vella and to a lesser extent Eixample and other areas of the city for the duration of the project. The lease was granted on the condition that the company agrees to deliver parcels for other companies, meaning that the operator should be market-neutral. However, the city has no influence over the terms and conditions of such commercial arrangements. Once the project period ends, the city council will decide whether to tender a concession or find a new model to support microdistribution platforms.

The service was launched in January 2017. The monitoring sensors, developed during 2016, were installed on three of the tricycles, enabling data collection over a two-year period. The sensors are powered by the tricycle battery and were installed under the tricycles to minimize the risk of robbery or vandalism. External antennas with long cables were used to enhance the coverage of the GPS and the communication links. A GPRS interface was also included in order to provide an alternative communication interfaces if the Wi-Fi corporative network of the city council is not reachable. In 2017, it was agreed that a small contract would be prepared to pay the delivery company for project tasks such as data gathering or compensation for the time invested in providing support for the installation and maintenance of the sensor units.

Stakeholders & Business Model

The stakeholders are the municipality (which promotes a sustainable delivering service by leasing a public space), the cycle courier company providing the service, along with the companies using their service and the recipients of parcels.

Achievements

As noted above, identifying a suitable location for the service, agreeing the terms of operation, and ensuring a suitable installation (reaching a trade-off between robustness, safety and functionality) of the sensor units were the main challenges and achievements.

Lessons learnt

Demand for last mile deliveries in Barcelona is increasing rapidly – one major user of the demonstration has recently left the service and has established itself as a competitor.

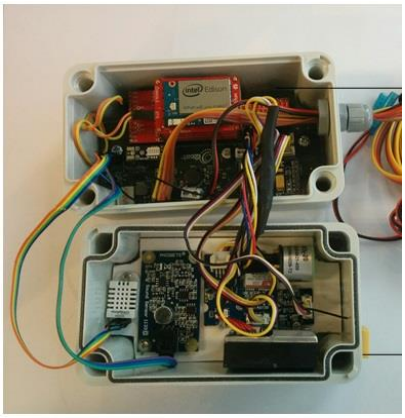
Recommendations

Last mile delivery is an emerging market segment which needs creative support from city administrations, in terms of e.g. designating a zone for deliveries with a dense population and high turnover of parcels; mandating actors to deliver within the zone and monitoring non-compliance; and – in this case – identifying premises and agreeing a tenancy

arrangement to enable implementation. Cities need flexible spaces that can be used as premises for emerging businesses and the shared economy.

Municipal processes may need to speed up to keep pace with markets and clarify issues – such as the formal relationships between service providers, data ownership or the need for additional support mechanisms, such as restrictions on delivery times or use of delivery bays – in order to creatively change framework conditions in favour of sustainable parcel delivery.

Pictures: images of the sensor units implemented and the detail of the installation below the vehicles.



Pictures: the microdistribution platform and the vehicles used.

2.3 Smart Solution 10: Smart Traffic management

Smart Solution 10 demonstrates how different traffic management systems can be used to ensure smooth flow of traffic and reduce the number of unnecessary stops. Measures also aim to improve user choice and behaviour through use of IT facilities and services.

Measure 10.1 Traffic management through MFD (Macroscopic Fundamental Diagram)

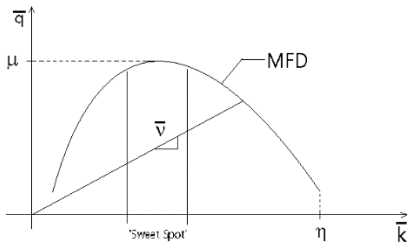
Introduction

The measure aims to test a theoretical model for MFD as a traffic management tool to assist traffic managers in urban areas when making decisions on congestion avoidance. It is hoped that, through application of this model, congestion can be alleviated with resultant positive impacts in terms of e.g. reduced energy consumption or emissions. In contrast to the other measures in this report, this measure is primarily a research initiative than an empirical demonstration. The measure will be completed during 2018 and, if successful, results will be shared with traffic managers at the city council for a possible validation.

Implementation

The implementation phase consisted in building the model of the city quarter that is going to be studied. All traffic lights times have been introduced, as well as the direction of the flow of each street and the number of lanes. The department of mobility has provided CENIT with the required data. The implementation phase also considers the estimation of the origin-destination matrix.

The main challenges of this measure are to define the different traffic scenarios and the active solutions to minimize traffic density. One of the analysed options is to increase red time at the perimeter of the district when reaching a density above the maximum in which stable flow occurs (picture below) but this has severe limitations due to traffic congestion around access points to the district. The solution researched will be to split the area into smaller areas and manage traffic lights so that vehicles take different routes, diminishing the average congestion.



Applying such measure would diminish the entry of vehicles at the congested sub-area hence reducing the traffic density and possibly increasing the traffic flow. The main challenge is to cope with increased queues generated in the surroundings of the district and analyse the impact of these in the city traffic.

Stakeholders & Business Model

Traffic planners are foreseen as the end users of the approach, which – if offered as a commercial service by, for example, a software company or consultants – could be procured by municipalities or other customers to facilitate improved traffic management in congested areas.

Achievements

The measure will be completed during 2018.

Lessons learnt

Up to this point the main lessons learnt are the high time needed to perform such simulations and specifically, the time needed to introduce in the simulation software the large amount of data required.

Recommendations

More information will be given once the measure is completed and validated.

Measure 10.3 Travel Demand management and Measure 11.5 Smart guiding to alternative fuel stations and fast charging

Introduction

The original plan for GrowSmarter included two measures in Stockholm in which smart phone applications were to be developed and implemented. Measure 10.3. "Travel Demand Management" envisaged the development of travel demand management tool that would help users plan journeys and provide feedback on travel patterns. Measure 11.5. "Smart guiding to alternative fuel stations and fast charging" aimed to develop a service that could inform drivers with information on the location and services of, and prices at, alternative fuel stations and fast charging points in the city.

Implementation

During the preparatory phase of the project, it became clear that there was significant overlap between these measures. In each case, the measures aimed at "nudging" citizens towards more informed, conscious decisions about their travel. Rather than develop separate applications, it was decided to integrate the two services into one. Thus, instead of offering one application providing assistance for journey planning, and another offering information on where to refuel/charge vehicles, the combined service offers an integrated multi-modal portal promoting sustainable travel choices.

The application was designed and programmed during 2016 and a BETA version was tested by users at the City of Stockholm and KTH. Tests indicated a need to integrate GPS functions to improve the simplicity of use and reduce drain of the phone battery. Scrum-based approaches to design and test the application were used to improve the application ahead of

its launch. Demonstration is planned to occur when a significant number of residents have moved back into the renovated residences at Valla Torg.

Stakeholders & Business Model

In addition to the project partners and developers, the main stakeholders are the user groups of the service. An important challenge will be to establish the application and develop its user base, as many residents of Årsta are pensioners who don't travel so much (according to the baseline survey made in early 2016) and may be unaccustomed to using applications or unwilling to use some of the application's functions. Project partners have discussed different approaches to attract users and the business model for the measure is being developed on an incremental basis.

Achievements

Developing and integrating new services and implementing them in a user-friendly app with multiple functions.

Lessons learnt

When developing application, it is important to have a clear idea of which market niche and target group(s) they will serve, and which business model and communication actions are appropriate to ensure market adoption. Iteration processes are time-consuming and rival products emerge on a regular basis, meaning it may be necessary to rethink and redesign applications on a repeated basis. Issues such as data ownership and management should be considered.

Recommendations

Development of appropriate local or national incentive systems can support nudging towards sustainable travel choices.

Measure 10.4 Traffic control system for passenger vehicles

Introduction

In this measure, open traffic information data is used to find the optimum speed along routes to minimise queues and reduce emissions. The measure involves communication between the traffic control systems steering traffic lights and smart systems in vehicles which receive signals and indicate to drivers when red lights will change to green. A specific route in Stockholm with eleven traffic lights was chosen to demonstrate the technique.

Implementation

Started in September 2016 with the development of guidelines and adaptation of system requirements to enable the demonstration. The implementation process was complex and involved both strategic and technical discussions. Several vehicle manufacturers discussed joining the project, and the costs of Swarco – the company delivering traffic control

management systems in Stockholm – were not covered by the project budget. In sum, administrative, legal and technical discussions took much longer than anticipated.

The technical implementation comprised a number of key steps. First, data quality and the quality of prognosis at each traffic light along the test route was checked. Such data is critical to ensure the information received by vehicles is accurate and reliable. Once data was tested, links between different servers were established to enable the vehicles included in the test to receive updates from the traffic control system. The implementation phase enabled participating stakeholders to acquire knowledge on how to implement the system, for example by indicating what kind of system conditions may be more or less appropriate for demonstration.

Stakeholders & Business Model

The stakeholders included the City Traffic Office, the company operating the traffic control management systems and vehicle manufacturer participating in the test.

Achievements

Technical challenges include resolving the issues of data quality to ensure high confidence in traffic light prognoses. Similarly, participants gained important insights into the complexity of issues such as the price of systems and costs-benefits for different stakeholders. Many of these findings were supported by the preliminary results of demonstrations during summer 2017.

Lessons learnt

The implementation phase indicated that the proposed system would work in cities under certain conditions, namely traffic control systems with longer periods of prognosis security than in Stockholm. This reflects partly the fact that many traffic lights in Stockholm are programmed to change if pedestrians wish to cross the street, but also the presence of fixed pre-programmed time intervals that determine the system responsivity. Another important lesson is that the decision to implement such systems is basically one for cities, and thus cities have important leverage over the ways in which such systems may be used. This means cities must acquire knowledge about systems and match them to physical and institutional contexts in order to get the desired results.

Recommendations

Further testing of this approach is recommended.

Measure 10.5 Traffic signals synchronized to prioritize certain vehicles movement of goods

Introduction

This measure aims to synchronise traffic signals to prioritise freight distribution using HVO-fuelled heavy vehicles. The measure aims at reducing environmental impacts and improving safety by improving traffic flow and reducing the number of starts and stops.

Implementation

The key steps involved the definition of a test route, guidelines and adaptation of technical systems to enable the demonstration. This process has been quite complex. A pre-study on the first proposed test route indicated negative impacts for other road users. Whilst a new route was being identified, Carrier relocated their premises to a new site. This meant there were fewer traffic lights between the new premises and the Valla Torg site, reducing the potential utility of the measure. It was thus decided to identify a new route from Carrier's terminal to the city centre island of Södermalm, a route with significant volumes of freight traffic.

Then, in an unrelated action, the City administration introduced "no left turn" signs at several junctions on the route. This occurred around the time implementation was due to start, causing a slight delay as the route had to be modified – along with the technical systems and evaluation criteria for the route. Specially-adapted mobile phones have been programmed and installed into the vehicles testing the route, enabling data collection. Carrier have incorporated HVO-fuelled heavy vehicles into their fleet. Evaluation itself is a complex challenge for this measure, as it depends on accurate data collection using a variety of technical systems.

Stakeholders & Business Model

The stakeholders are the City Traffic Office, the company operating the traffic control management systems and logistic companies (and their customers) that could benefit from improved traffic conditions.

Lessons learnt

It is important to thoroughly investigate routes and impacts on all kinds of road users. Implementation may, even when relatively straightforward, proceed slowly due to capacity constraints on the actors involved.

2.4 Smart Solution 11: Alternative fuel driven vehicles for decarbonizing and better air quality

Smart Solution 11 demonstrates a variety of ways to promote and support increased use of vehicles using alternative fuels or electric propulsion systems. This includes the introduction of normal and rapid charging points for electric vehicles and complementary IT systems, and refuelling infrastructure for alternative fuels including ED95 (bioethanol), CNG (compressed natural gas) and CBG (compressed biogas), and HVO (hydrated vegetable oil) in light and heavy vehicles.

Measure 11.1 Developing charging infrastructure

Introduction

The aim of this measure is to reduce consumption of fossil fuels in transportation by increasing access to alternatives through provision of charging infrastructure for electric vehicles. In order to support the transition away from fossil fuels, each of the Lighthouse Cities is establishing their own network of charging points for electric vehicles. This measure implements normal and rapid charging points in various forms.

Picture: public charging infrastructure in Stockholm

Stockholm

Implementation: The key steps during implementation are the identification of suitable locations (in terms of possible demand for charging, physical space and the technical feasibility of installation). This influences decisions about the type of chargers to be installed and whether payment solutions are required and informs discussions with the electricity network manager prior to installation. Once these steps have been taken, permits can be applied for and works commence.

In Stockholm, one rapid and eight normal charging points have been implemented by Fortum. The rapid charging point was installed at a roadside McDonald's during autumn 2016. However, delays with the grid connection process meant that the charger was first operational in March 2017. The eight normal charging points located at Valla Torg and consist of four poles each equipped with two connections. These charging points will serve users of the car pool service (measure 12.1 "Green parking index in combination with car sharing pool with EV") and smart home application, along with the general public.

Achievements: The main challenge was to identify the precise location for chargers and conduct the necessary site surveys to ensure grid connections and groundwork were carried out. Skanska and Stockholmshem decided upon the location of charges at Valla Torg as part of the wider renovation process. There were also extensive discussions about the possibility of installing chargers in Slakthusområdet, yet ultimately it was decided to focus on other locations. As noted, once chargers were installed, grid connection has taken longer than expected due to lack of capacity in the network management company – this is a general problem in Stockholm that is not specific to GrowSmarter and not only related to the network management company, as the city is experiencing a construction boom.

Barcelona

Implementation: In Barcelona, five rapid charging points serving private vehicles and taxis (see also Measure 12.6 "Smart taxi stand system") and an innovative form of Vehicle-to-Building charging have been implemented. Whilst Measure 11.1. "Developing charging infrastructure" concerns the infrastructure for these systems, Measure 11.2. "E-mobility management system" addresses the management systems.

Four rapid charging points were installed during the first year of the project, with the fifth installed in 2016. Since then, implementation has focused on integrating the new chargers into the City of Barcelona's management systems and its GrowSmarter platform for project-level city-wide data collection. One challenge has been that grid capacity is limited, meaning the city has lots of normal chargers but only around 25 rapid chargers. The City administration has thus attempted to locate the rapid charging facilities at strategic locations in the city, around 2 kilometres from each other (or six minutes by car).

Achievements: Once the ideal locations were identified, site meetings with local authorities and industrial partners were conducted to identify those places where installation was actually possible, and then to acquire permits for installations at these sites. With responsibilities split between different departments of the municipality, a lot of meetings were required to gain approval for each installation. Moreover, the City administration needed to agree upon ownership of the chargers with Endesa prior to installation. This

meant that Endesa owned the chargers for two years, after which the City used its option to retain the chargers and keep them public under city ownership.

It was originally envisaged that Vehicle-to-Grid (V2G) charging may be possible, but it was not possible for Endesa, the partner originally responsible for this action – and for developing the management systems for charging infrastructure – to contract a car fleet compatible with the V2X chargers. Implementation of the measure requires use of specific types of vehicles which Endesa, due to pre-existing contractual arrangements, were unable to acquire. In addition, Spanish law prohibits feed-in to the electricity grid, meaning the V2G concept was redundant. To resolve this, Nissan have joined the project to implement an alternative approach known as Vehicle-to- Building (V2B) charging. Implementation of this action will start in January 2018 and will be finished by summer 2018.

Picture: public charging infrastructure in Barcelona.

Lessons learnt: The implementation of measures, such as the V2X, that provide really innovative services are often not well aligned with local regulations. Vehicle to grid services are not yet regulated and therefore can be very difficult to find real use cases without the participation of energy distribution companies. Vehicle to Building alternatives provide more flexible solutions that are easier to implement from a legal point of view.

Cologne

Implementation: Public charging stations have been implemented at six of ten GrowSmarter mobility station sites. Once a site was identified as interesting, RheinEnergie assessed the infrastructure capacity. If sufficient capacity existed at the site, hardware was selected. The RheinEnergie then installed the grid connection and hardware (including ground and construction works).

Achievements: As in the other cities, the main implementation challenges for charging infrastructure on public land relate to the planning processes and permits required to install

privately-operated infrastructure. In addition, Cologne is exploring the possibility of using existing traffic light systems to install charging points. Please refer to measure 5.2 in the WP3 implementation report regarding the retrofitting of existing lampposts with charging stations.

Stakeholders: In addition to RheinEnergie as the energy supplier and charging point operator, further stakeholders were construction companies, electricians, and hardware manufacturers.

Picture: First GrowSmarter charging station

Picture: Charging station detail

Lessons learnt (shared)

When installing infrastructure for public use, it is more complicated to install this on publicly-owned land. Partners that own their own land and electricity grid connection may be able to install charging infrastructure more rapidly. Having clear ideas and agreements about complex issues such as data management, maintenance, costs and revenues are important. When installing publicly-owned infrastructure, this means not only aligning actions with city strategies, but also finding new ways of accounting for measures which may not have obvious economic benefits, but offer direct benefits related to reduced CO2, noise, etc.

Incentives such as free parking for electric vehicles, or free electricity, may help stimulate markets but must form parts of coherent long-term strategies for sustainable urban mobility. Another observation is that, whilst political priorities may change rapidly and affect the possibility to implement measures, legislation tends to be more robust and influences what is possible (or not) in different national contexts. The inclusion of complex actions

such as V2G charging in the absence of a supportive legal context have, in hindsight, proven to be over-ambitious. Thus, even in the competitive context of a European Call for Projects where ambition is rewarded, more cautious project planning and pre-evaluation of measures may be necessary (e.g. in the form of in-built flexibility, longer implementation periods, etc.).

Recommendations

A simple process is recommended for most cities when installing infrastructure:

(1) Develop a strategy for locating installations;

(2) Identify property owners (e.g. ground, infrastructure);

(3) Investigate grid connection capacity and ensure grid integration is possible;

(4) Use safe and certified hardware that will not need replacing in the near future.

Measure 11.2 E-mobility management system

Introduction

This measure aims to support the management of the charging infrastructure introduced in Barcelona and described in Measure 11.1 "Developing charging infrastructure". However, fast chargers and V2B chargers have different requirements and have to be managed by two independent systems.

The fast charging stations installed in public space were connected and integrated into the City E-mobility management system that administrates the Mobility Department. This system enables monitoring and data collection for all the charging stations in the city. The V2X-Chargers deployed in Measure 11.1"Developing charging infrastructure" will be managed by the Nissan Management System using the Energy Management System developed by IREC and integrated into the GrowSmarter platform for an overall management. The Nissan EV carpool fleet will also be integrated into the EMS.

As described previously in Measure 11.1 "Developing charging infrastructure", the measure has been partially implemented. While the fast chargers are already managed and integrated by the City E-management system, the issues related to V2G/V2B deployment have caused some delays in the implementation of the measure.

Measure 11.4 Setting up refuelling facilities for alternative heavy duty fuels fuel

Introduction

This measure aims to reduce the use of fossil fuels by supporting the expansion of Stockholm's refuelling network for alternative fuels used in heavy duty vehicles. Like buses,

heavy duty vehicles required different facilities in fuel stations to cars and light vehicles, with high-capacity pumps and larger bays.

This measure builds upon work started in the LIFE+ project CleantTruck by installing more alternative fuel pumps in Stockholm, increasing the availability of renewable fuels such as ED95 (bioethanol), CBG (biomethane) and HVO (biodiesel). CleanTruck helped establish and stimulate a market in which freight transport companies became familiar with alternatively-fuelled heavy vehicles and fuel pumps were installed at two forecourts outside the city. The measure thus supports a rapidly developing market for these fuels in public and private fleets.

Implementation

In the measure, ten new fuel stations (either at individual sites or as pumps co-located at the same facility) are planned to be implemented. To do this, the City of Stockholm works with industrial stakeholders to identify appropriate sites and assist with necessary planning applications and secure permits. In addition, the City spreads information about the expanded network through its CleanTruck network and in other fora.

The first three pumps were opened in May 2016 in Kallhäll (north of the city), supplying ED95, CBG and HVO. Seven more locations have been identified and, at the time of writing, are in the process of being installed. These includes co-location of pumps for ED95, CBG and HVO at two sites (Årsta and Farsta/Larsboda, south of the city) and an HVO pump in Bromma (west of the city). The implementation process is slightly delayed in Årsta, due to the complexity of adjusting the city's detailed plans for the site (which include road sections controlled by the Swedish Transport Administration). Whilst approval of changes to detailed plans is considered a formality, the need for additional consultation and approval processes delays the launch of pumps at this facility.

Stakeholder & Business Model

This measure is a fully commercial operation involving fuel suppliers and distributors. None of the industrial partners installing fuel pumps is a partner in the project and as such, are not reimbursed for installations or data collection. As such, some aspects of data collection are sensitive for the companies involved. Special agreements have been reached to resolve this issue.

Achievements

This measure demonstrates that there is demand for use of alternative fuels in heavy goods vehicles on a fully commercial basis.

Lessons learnt

Even though this measure expands the scope of a previous project and demonstrates proven techniques, important lessons have been learnt. Installation of new pumps on existing facilities located on privately-owned land is relatively uncomplicated, in the sense that installations are made on a commercial basis. However, installation takes much longer if detailed plans have to be changed, particularly if more than one public sector organisation has ownership of the road infrastructure. Another important lesson concerns the need to

reach agreements with partners about data collection, either on a voluntary basis or as part of formal environmental inspection procedures.

Recommendations

Dedicated infrastructure is required to enable distribution using heavy goods vehicles operating on alternative liquid and gaseous fuels. Cities need to work strategically in partnership with relevant stakeholders to ensure such infrastructure is established and support users in making a transition to alternatively-fuelled heavy goods vehicles.

2.5 Smart Solution 12: Smart mobility solutions

Smart Solution 12 demonstrates a range of different smart mobility solutions that complement the existing public transport network to offer a broad palette of sustainable mobility alternatives. These measures will encourage citizens to choose alternatives to private cars and help improve the environmental quality and attractiveness of the Lighthouse Cities.

Measure 12.1 Green parking index in combination with car sharing pool with EV

Introduction

Stockholm has a green parking index which enables property owners to reduce the number of parking spaces in new constructions in exchange for offering alternative mobility services, such as carpools. In GrowSmarter, this approach has been implemented this approach in the context of renovation to assess its impacts and pave the way for wider adoption across the city.

Implementation

In this measure, a carpool with electric vehicles was launched at the Valla Torg site in December 2017. This carpool will serve residents living in the area, including those whose buildings were renovated as part of the project and a number of new residential buildings which Stockholmshem will construct alongside the existing buildings. Access to the carpool service will enable Stockholmshem to comply with the green parking index rules and is likely to result in construction of fewer indoor parking spaces, thereby promoting sustainable mobility and reducing building costs.

The process of identifying possible partners and solutions was time-intensive for Stockholmshem. A carpool service provider, MoveAbout, has been contracted by Stockholmshem to provide the vehicles, run the booking service and carry out maintenance during the demonstration period. The service should make use of two charging points installed as part of Measure 11.1 “Electric charging infrastructure”.

Stakeholders & Business Model

Residents of Stockholmshem’s buildings will not be obliged to pay a membership fee to use this service during the demonstration period, although Stockholmshem is paying for both the parking places and electricity used. At the end of 2019, the agreement will be evaluated. It is unclear to what extent local residents want or will use the service. The demonstration phase will indicate to what extent the business model is viable.

Achievements

The measure has introduced a new mobility service that may challenge existing patterns of transportation in a district with high levels of private vehicle use.

Lessons learnt

This measure would not have been possible without EU funding, which enabled a cluster of stakeholders to convene and form a new constellation. One consequence of this is that not all arrangements are considered ideal (e.g. Stockholmshem paying the electricity costs of using the system both for their own residents and non-residents). More extensive consultation with local residents in the planning phase may have also resulted in different outcomes. Top-down planning ensures that services are put in place, but may not ensure their use. However, a key lesson is that it is possible to negotiate and implement this kind of solution and potentially pave the way for new types of mobility services in both new and existing residential areas.

Recommendations

Municipalities seeking to introduce such services should try to carry out in-depth market analysis and attempt to align the interests of different stakeholders early in the development process.

Measure 12.2 Electrical and cargo bike pool

Introduction

This measure implements an electric cycle and electric cargo bike pool at the Valla Torg site in Årsta, thus offering a complement to the electric vehicle carpool of Measure 12.1 "Green parking index in combination with car sharing pool with EV". Electric bicycles have greater range than conventional cycles, making it possible to travel further and with greater comfort. Electric cargo bikes offer a practical solution for families without cars or individuals shopping or making other large purchases.

Implementation

During the implementation phase, it was determined to focus on electric cargo bikes. Stockholm's city bike system is located at sites across the city and (due to a later decision) will introduce electric cycles into the hire system from 2018. In addition, there has been rapid growth in sales of electric bikes and the Swedish Government has recently decided to subsidise consumer purchases of electric cycles and electric cargo bikes with a 25% rebate from 2018. For these reasons, a pool of conventional electric cycles was considered unnecessary.

Stockholmshem thus tried to identify an actor willing to implement an electric cargo bike pool, and held discussions with a range of stakeholders. This process took some time, in part because cargo bike pools are an emerging service in Sweden and, where they exist, are often run by voluntary associations or located close to large shops or public facilities such as libraries. None of these alternatives was possible at Valla Torg, and for this reason, the business case for commercial cargo bike pools was unclear.

The service will be launch after winter in March-April 2018, and it is yet to be determined if the service will be publicly-accessible (located outdoors, in a secure storage unit accessible only to those that book the bikes) or indoors and only accessible to tenants of Stockholmshem. One idea was that technicians working on the renovation project could

make use of the cargo bikes during the remainder of the renovation. Although this proved impractical in Årsta, Stockhomshem thinks the approach may be trialled in other locations in Stockholm's outer suburbs.

Stakeholders & Business Model

The stakeholders are the same as for Measure 12.1 ""Green parking index in combination with car sharing pool with EV". As noted above, the business model for this measure is still under development and would vary in differing contexts both within Stockholm and elsewhere.

Achievements

As noted above, identifying an operator and terms of operation was complex and time-consuming. Choosing a suitable bike model is also a difficult process and requires sound knowledge of potential users and their needs.

Lessons learnt

As noted above, this measure is timely, as the Swedish Government has recently decided to subsidise consumer purchases of electric cycles and electric cargo bikes with a 25% rebate. This decision is expected to boost interest in cargo bikes and makes it possible that more users will want to make use of the pool. Moreover, the decision may lead to establishment of more electric cargo bike pools in other locations by new or existing companies, perhaps offering a range of services. The implementation of the measure suggests key issues to resolve when implementing cargo bike pools include the issues of maintenance and storage, along with the business model for concessions, membership, etc. However, the same process was considered rich and informative, and likely to produce ripple effects across different sites in the city.

Recommendations

Develop a clear idea of the service and user needs early in a development process.

Measure 12.3 Mobility station

Introduction

Cologne's mobility stations (hubs) are central to the city's work for sustainable urban mobility. A mobility station includes electric car-sharing, conventional car-sharing, dynamic pricing of parking spaces, timesharing of private and for the runtime of the project even public parking spaces as well as conventional bike-sharing and e-bike-sharing. Customers can now pay for public transport as well as car-sharing using a mobility card. It is potentially possible to offer other services in the future, such as parcel collection or cargo bikes, as part of or in proximity to mobility stations.

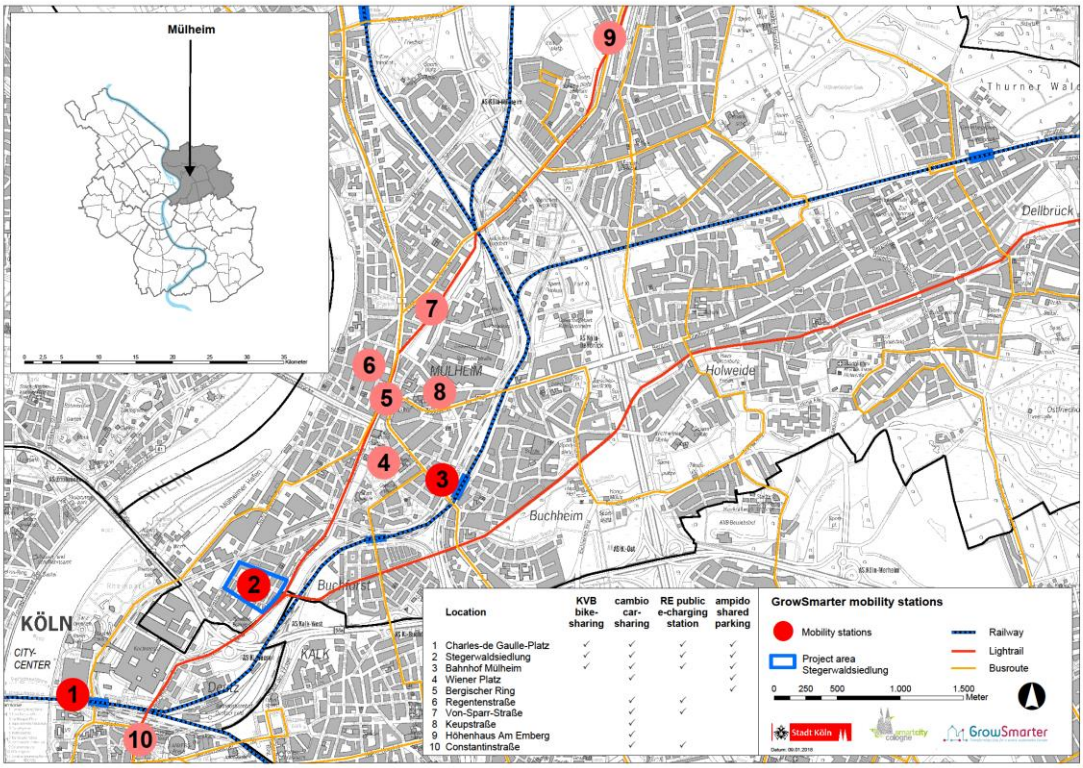
Implementation

In this measure, ten mobility stations were implemented in various formats, including (at the time of writing) electric vehicles, conventional cars, charging stations, and designated

reserved parking spaces on public land. The mobility stations include charging points for cars and will include them for cycles, and are linked to the local energy network of renewable energy. The key steps taken to establish mobility stations include identification of possible locations, securing permits, preparing parking spaces and installing equipment, and preparing customer interfaces such as ticketing systems and signage.

Stakeholders & Business Model

Mobility stations are platforms enabling provision of a range of public and privately-operated mobility solutions. Service providers and customers represent the main stakeholder groups.



Map showing location of mobility stations in the project area Cologne-Mülheim.

Achievements

The implementation of this complex measure has illustrated a number of challenges. For example, the context of each mobility station is unique. Construction of mobility stations on semi-public land (such as at Charles de Gaulle-Platz, where the City of Cologne owns the land) mean that each service provider must sign contracts with the City administration and pay monthly fees to use the space. Similarly, German cities are only able to offer small spaces on public streets to private enterprises on three-year concessions, and German courts do not allow parking space-sharing in public spaces.

In contrast, the City has no influence over pricing arrangements on private land and mobility stations are subject to the demands of private companies. For example, Ampido was not

allowed to operate in the spaces at the Mülheim train station (land is owned by the national rail company Deutsche Bahn), because Deutsche Bahn is the owner and operator of a rival company that is contracted to provide an equivalent parking service.

In this case, the City of Cologne asked its region for special dispensation from the law for Ampido to operate in public spaces near the Mülheim station for the duration of the project. The region referred the case to the Federal State of North Rhine-Westphalia, who approved the dispensation, a so called experimental clause, in order to allow ampido's parking-sharing concept on public land.

Implementation has thus been complex and occasionally delayed by legal and bureaucratic barriers. Time for explanations and education on all sides as well as people willing to test this model has made it possible to allow ampido on public land in this project.

In addition to implementing the measure, the conversation between the City of Cologne and the state legislation regarding unified coordinated signage for the mobility stations throughout the state started to take shape in 2015. This development is unique and has influenced cities and communities of the region in using the same language of signage in their development of mobility stations.

Picture: First signage with involved partners at the Charles-de-Gaulle Platz, Cologne

Lessons learnt

A variety of approaches are needed if mobility stations are to function in their local contexts. A range of administrative challenges make it difficult to implement a uniform concept and it is particularly important to understand who owns the land on which mobility stations will be stationed. In addition, new private mobility operators are establishing themselves on the market on a continuous basis, adding to the complexity of developing business models for service providers.

Recommendations

Mobility stations provide valuable services for cities. When developing them, investigate issues such as land ownership and relevant regulations that may limit or expand the range of possible service offerings.

Picture: Ampido and kvb bikes at the Charles-de-Gaulle Platz

Measure 12.4 Electrical and conventional car and bike sharing

Introduction

This measure aimed to establish e-car-sharing as well as e-bike sharing to serve a variety of users and functions. The measure is partly integrated within Measure 12.3. "Mobility station" as part of Cologne's multi-modal mobility service, with charging infrastructure delivered by Measure 11.1.

Implementation

This measure began in 2016 and was completed in late 2017 with nine car-sharing locations, six of which including e-charging. Three locations include e-bikes. These are located at the mobility stations mentioned above (mobility stations in M12.3). Key steps included the identification of suitable locations for e-car-sharing as well as e-bike-sharing locations and the development and formalisation of agreements with the City administration and private stakeholders to ensure installation of the facilities. Cambio, the KVB and the City administration signed contracts to enable the use of parking spaces for e-car-sharing as well as e-bike-sharing services. With agreements in place, equipment and vehicles were purchased and installed. In parallel, software development took place to enable the launch of KVB and Cambio's eTicket mobility service, which provides an integrated platform for public transport and car-sharing.

Stakeholders & Business Model

This Measure provides commercial services with their own business models, and share similar stakeholder groups as Measure 12.3 “Mobility station”, please refer above.

Achievements

As with many mobility measures, the process of identifying sites at which services may be located was time-consuming. Physical implementation is usually not a challenge, but is of course contingent on site identification and agreements between a variety of stakeholders. In terms of operation, the optimal sites for mobility stations (Measure 12.3 “Mobility station”.) may not necessarily be the ideal sites for carpool operators (this issue will be explored and evaluated in the demonstration phase). Another challenge relates to ticketing: customers with KVB public transport tickets can purchase an add-on eTicket to use Cambio’s carpools, but still need a Cambio card to access the vehicles. Similarly, there is a need to integrate and align ticket sales systems to ensure fast transactions. Again, the existence of possible (real or perceived) barriers to access is another issue to evaluate in the demonstration phase.

Lessons learnt

Car-sharing services must be located in optimal locations to ensure financial viability of operations and significant shifts in citizen behaviour (with resultant environmental benefits). This is best achieved through long-term planning and cooperation.

Recommendations

As this is still a new way of thinking in Mobility as a Service-terms (MaaS), City administrations could explore ways to streamline processes, which currently depend on

engagement of actors across a range of municipal departments to, for example, grant permits for parking spaces. Mobility stations can serve as "shop windows" for a range of services and can therefore be useful in marketing. They can also be supported with integrated ticketing platforms in which public transport tickets can be "topped up" with other services (or vice versa), such as here in Cologne.

Measure 12.6 Smart taxi stand system

Introduction

This measure aimed to reduce congestion and unnecessary use of fuel by demonstrating a new form of information system for taxi users and taxi drivers in Barcelona. A mobile application was developed to enable users to check availability of taxis at taxi stands located around Barcelona, thus enabling a reduction in the number of taxis cruising for customers (something that is not prohibited in Barcelona, in contrast to other cities such as San Sebastian-Donostia, where taxis have to use taxi stands).

Implementation

Implementation involved installation of sensors at taxi stands to monitor the number of waiting taxis in real-time. These sensors communicate with the GrowSmarter IT platform and publish information via the application that taxi users and drivers can access. A number of taxi stands were evaluated, to assess the extent to which magnetic fields were detected (the sensors monitor changes in magnetic fields and thus require strong signals) and whether possible influences on the strength of magnetic fields were located at the site (e.g. pipes).

Discussions with the Regulatory Institute for Taxis were held and taxi operators were informed about the measure and the temporary closure of taxi stands during installation of the sensors (one day per site). A driver survey indicated strong support of the measure. However, the physical implementation of the measure – installation of sensors into road surfaces and repainting of road markings at taxi stands to ensure accurate parking – was considerably less complex than the data management issues related to the measure (see below).

Stakeholders & Business Model

The main stakeholders are taxi drivers and users, along with the Regulatory Institute for Taxis and the project partners. The measure aims to support commercial business models.

Achievements

Inaccurate parking by taxi drivers and the layout of taxi stands impacts upon the amount and quality of data received by the IT system. The availability of a communication link to send the data also varies in different districts, meaning not all sites that were identified as theoretically possible for implementation were actually viable. As with other measures, the process of obtaining permits for physical works may take time. Similarly, the costs of network access and system use, and issues related with data costs (free for the City administration during the project phase) must be resolved in the long-term. Another challenge is that, from the time the GrowSmarter proposal was written, there has been a

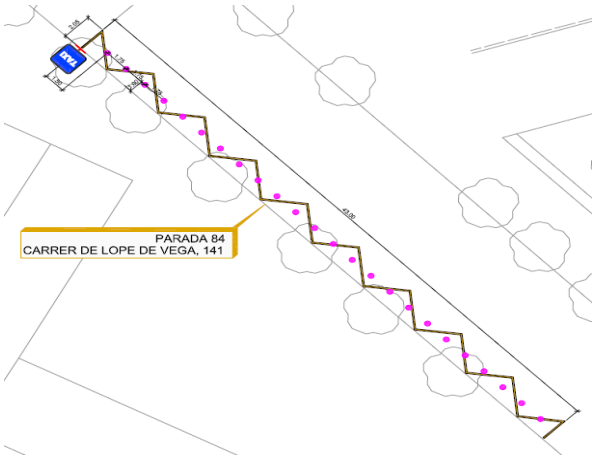
rapid increase in the use of proprietary applications by taxi companies, meaning customers increasingly prefer to be collected at, for example, their residence or office. Thus, the impacts of the measure of taxi use may be hard to discern - this challenge will be evaluated in the demonstration phase.

Lessons learnt

A range of lessons have been learnt concerning how and where to place sensors, which types of taxi stands are appropriate for sensors, and the type of issues related to data communication between the sensors and the data management system. Another lesson is that behaviour and technology can change rapidly – what was envisaged in the application phase is no longer the case – suggesting that projects may need to address deeper structural issues, rather than introduce technological responses to system failures. For example, rules enforcing use of taxi stands may be necessary to reduce cruising and, thereby, clarify the potential business benefits of a sensor system.

Recommendations

Cities should have coherent long-term strategies that take into account the implications of technologies (e.g. maintenance, maturity, etc) as well as their desirability.



Pictures showing the sensor installation and the sensor plan

3 LESSONS FROM IMPLEMENTATION

The previous Chapter presents experiences from the implementation of smart city solutions addressing Sustainable Urban Mobility in the GrowSmarter Lighthouse Cities. In Chapter 3, the lessons from each measure are collated and discussed with broader reference to the five Smart Solutions they relate to. This discussion will inform the final conclusions and recommendations of this report.

3.1 Lessons per Smart Solution

Smart Solution 2: Smart building logistics and alternative fuelled vehicles

The implementation of a construction consolidation centre in Valla Torg, Stockholm, has highlighted important challenges and opportunities for smart building logistics. The consolidation centre in GrowSmarter is operational and functioning. However, it has not yet been used for the Valla Torg site as extensively as hoped.

Construction consolidation centres have previously been demonstrated in large-scale construction projects for new districts in Stockholm. Due to their scale and unique characteristics, it is possible to realise a variety of economic and environmental benefits. Private construction companies and their suppliers have adapted to use consolidation centres in the knowledge that all companies operating in the district operate under the same terms and conditions.

The circumstances of the renovation of residential properties at Valla Torg are, however, quite different. With a single construction contractor managing the site, it has been proven challenging to identify goods flows that can be delivered using the consolidation centre in a cost-efficient manner. In addition, the warehouse of a major supplier of the renovation located closer to the site than the consolidation centre.

Consolidation works well when multiple buyers order goods from a range of suppliers which can be delivered to a central point and sorted for efficient onward to delivery to the respective purchaser. However, a single purchaser can get (some or all) of this service directly from their suppliers. Similarly, the location of a consolidation centre is important – ideally it should be close to and, in the eyes of delivery companies, en route to the site.

Adopting and integrating consolidation into the planning and day-to-day practice of construction operations also requires resources and sustained effort. Behavioural and organisational changes take time. Nevertheless, the acquisition of knowledge and experience of working with consolidation centres provides a niche service offering for construction and logistics companies alike – a niche that, with the right blend of regulatory provisions, could be scaled-up to establish a new norm for construction projects.

Smart Solution 9: Sustainable delivery

In cities within and outside of GrowSmarter, there is increasing interest and demand for sustainable last-mile delivery services. The measures implemented in GrowSmarter highlight several important lessons for cities seeking to initiate or facilitate emergence of such services.

Cities need to work creatively to clarify and change framework conditions to enable sustainable delivery services to thrive. Regulatory powers and other instruments can be used to, for example, designate delivery zones, introduce traffic prioritisation or restrictions, grant concessions and to include flexible spaces in urban planning (e.g. locations/premises for shared economy services). It is important to identify physical spaces – both for premises and, if necessary, the geographic zones requiring regulation – early in the development of a service.

The experiences of GrowSmarter indicate that last-mile delivery services and collection points such as service rooms are either commercially viable or offer potential – through integration of multiple service offerings, including mobile repair services, food delivery, shared economy functions – to become commercially viable in the near future. The market is developing fast and the potential for future growth is huge, with an increasing range of actors and – due to internet retail – a seemingly ceaseless surge in demand for parcel delivery services, Cities must develop strategies to anticipate and manage increased traffic flows arising from such logistics flows and make use of multiple instruments to ensure future growth is smart and sustainable.

Smart Solution 10: Smart Traffic management

The experiences from implementing Smart Traffic management systems in GrowSmarter suggest that such systems can be used to make transport more efficient. This may reduce the environmental impacts of traffic in cities and provide value for drivers by for example reducing waiting times at junctions. However, the relative performance of traffic management systems depends on complex system interactions which are different both between and within contexts.

Significant efforts must be made to plan, demonstrate and evaluate the functionality and viability of different technical solutions. However, there may be a tendency to discount the probability and costs of human factor influences – such as small decisions concerning e.g. the introduction of left turns or pedestrian crossings – when making assumptions about project planning for technical systems.

Similarly, the development of smartphone applications to facilitate behavioural change is technically possible, yet complex and subject to contextual variations. Experiences from other projects suggest that, with a plethora of apps available in a rapidly-changing market, it is challenging for new apps to provide clear added-value for users. Incentives (in the form of discounts, prizes or similar) may be required to stimulate adoption of apps, yet these may be hard to incorporate into a sustainable business model.

Smart Solution 11: Alternative fuel driven vehicles for decarbonizing and better air quality

The implementation of similar measures in the three "Lighthouse Cities" highlights recurring challenges relating to the issue of land ownership. Public land is often more complicated to use than private land, and the planning and permitting processes that must be completed to initiate works are often convoluted and time-consuming. Improved coordination within municipal organisations may help speed up planning and permitting processes.

In the checklist below, we propose some simple steps for municipalities seeking to install charging infrastructure:

1) Find out what equipment needed to charge an electric vehicle – in Stockholm, consumers are advised to charge using 230V and 16A, one-phase, mode 3, type 2 fixed chargers for normal charging at ordinary parking facilities. Three-phase chargers are suggested for daytime charging. Some vehicle models have different requirement, as does rapid charging.
2) Identify where the vehicle should be charged – different solutions are available, and preferable, for different user groups. Charging boxes, ideal for indoor installation in garages, are cheaper than on-street charging points. Permits may be required.
3) Consider who is likely to use the charging infrastructure and if payment solutions will be required, and to differentiate between conventional and fast charging options.
4) Contact the electricity network manager to check there is sufficient grid capacity for new charging infrastructure.
5) Take in offers including, if necessary, operation, maintenance and support equipment. Commission cable works and establish an electricity supply subscription.

Smart Solution 12: Smart mobility solutions

The five measures highlight a number of interesting Smart mobility solutions. In each case, these solutions exist in the wider context of rapidly-developing mobility markets. The emergence of new actors and services may complicate development and establishment of business models, but provides exciting opportunities for further diversification and integration of "non-mobility" services into conventional mobility solutions.

As with the other Smart Solutions, implementation indicates that administrative and bureaucratic processes, particularly concerning use of public land and permitting, can slow the progress of implementation. Regulations in many countries are not adapted to support use of electric vehicles and renewable fuels (e.g. it may not be possible to dedicate parking spaces for electric vehicles, car-sharing, etc). Cities are encouraged to involve residents early in planning to help develop strategic approaches and address structural barriers to implementation. National and local incentives can help support and accelerate the adoption of new approaches or installation of new infrastructure.

3.2 Lessons for cross-cutting themes

In the previous section, the lessons per Smart Solution were discussed. This section aims to elaborate on a couple of cross-cutting themes affecting several of the Smart Solutions.

Public and private spaces: planning for slow planning

A recurring theme is the challenge of implementing measures in public and private space. For on-street installations or other works on publicly-owned land, implementation can be time-consuming, particularly if detailed plans need amendment or many parts of the public administration are involved. In general, many "delays" due to planning and permitting are unsurprising and can be anticipated. Thus, it is important at an early stage in planning for implementation of new mobility services to quickly ascertain which public bodies are stakeholders in a process and how they affect, and are affected by, the process. For municipalities, this may mean developing process maps or procedures to ensure all internal stakeholders are involved and working in streamlined processes.

Another lesson links "Smart Solution 10: Smart Traffic management" to "Smart Solution 2: Smart building logistics and alternative fuelled vehicles" and "Smart Solution 9: Sustainable delivery". In each case, GrowSmarter identifies a need for cities to introduce and regulate (public) spaces or platforms in which a range of (public or private) service providers can compete neutrally. These spaces are: geographic zones in which consolidation of logistics services (for e.g. construction) are mandatory for all projects; last-mile service zones, in which companies seeking to provide last-mile services should operate on a non-exclusive basis so as to prevent discriminatory market practices or a "race to the bottom" among courier services; and open traffic management systems, in which all vehicles and other road users can access data. A related issue – which is common for many measures – concerns the issue of costs. Who should pay for access to systems and who gets the benefits?

Nudging users in new directions: who pays? Who owns?

The relative of impact of new technologies and services is always dependent on the user groups, yet it is not always easy to predict who will use services or how. Many of the measures seek to influence user behaviour and promote voluntary consumer choices to enable shifts to sustainable mobility. Such "nudging" represents an important part by raising awareness of alternatives and facilitating their adoption. Nevertheless, there is a risk that too much nudging may be unappreciated by consumers, or that nudging may be counterproductive if the new services do not meet consumer expectations.

In a number of measures, the question of costs and ownership arise. For example, should a city invest in a system that primarily benefits a private vehicle owner or should a vehicle owner pay surcharges for access to that system? Who owns the data that is gathered from such systems? Who should have access to that data? There are not necessarily clear answers to such questions, but they are important to keep in mind when seeking to implement the five Smart Solutions presented in this report.

4 CONCLUSIONS AND NEXT STEPS

In sum, GrowSmarter has achieved the implementation of five Smart Solutions comprising a total of 17 measures in three cities. The implementation of the measures has revealed a number of important lessons for cities and other actors seeking to replicate them and promote sustainable urban mobility. These lessons are described in Chapter 3 and, in general terms, address challenges relating to administrative processes, laws and regulations; the use of public and private space; business models and data; and user behaviour.

In particular, we recommend more creative use of public space, through e.g. establishment of regulated spaces in which sustainable mobility is prioritised and a wide range of new mobility and transport services can emerge and flourish. Such spaces could address single topics – such as consolidated delivery services using sustainable last-mile providers – or address more comprehensive travel concepts including mobility stations and other offerings. To achieve this, cities should be empowered with new regulatory powers and resources to ensure Europe's transition to sustainable urban mobility.

In the next phase the project, each of the measures will be demonstrated and evaluated. In many cases, this means a wide variety of new user groups will make use of GrowSmarter's Solutions and Measures. The demonstration of these measures contributes to an exciting period of transformation in Europe's city and in late 2019, we will report again on how GrowSmarter can contribute to sustainable urban mobility in European and world cities.

5 SOURCES / REFERENCES

List of key GrowSmarter project documents		
Name of document	**Link**	**Finalised**
Fact sheets	http://www.grow-smarter.eu/solutions/	2016-2017
Technical and management reports, D1.3, D1.4, D1.5, D1.6	http://www.grow-smarter.eu/inform/reports/	Feb 2016, June 2017, Dec 2018, Dec 2019
Lighthouse cities market introduction, D6.2 Economic validation and assessments, D6.3 Smart city market introduction, D6.4	http://www.grow-smarter.eu/inform/reports/	Feb 2018 Jan 2019 Sep 2019

Reports on results of technical, economic and social validation, D5.3, D5.4	http://www.grow-smarter.eu/inform/reports/	Dec 2018 Aug 2019
Data management plan, D1.2	http://www.grow-smarter.eu/inform/reports/	First version 2015
Concluding reports, D2.4, D3.4, D4.4, D2.6, D3.6, D4.6	http://www.grow-smarter.eu/inform/reports/	Feb 2019 Oct 2019
Recommendations for policy makers and practitioners, D1.7	http://www.grow-smarter.eu/inform/reports/	Nov 2019
Project brochure, D8.3 Project result Brochure, D8.10	http://www.grow-smarter.eu/inform/press-corner/	Update 2017, Nov 2019

GrowSmarter
Transforming cities for a smart, sustainable Europe

About GrowSmarter

GrowSmarter (www.grow-smarter.eu) brings together cities and industry to integrate, demonstrate and stimulate the uptake of '12 smart city solutions' in energy, infrastructure and transport, to provide other European cities with insights and create a ready market to support the transition to a smart, sustainable Europe.

GrowSmarter project partners

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