SHARINGCITIES

Improving urban mobility: E-bike sharing

A SHARING CITIES PLAYBOOK

2020 V.1

CONTENTS

This playbook is produced by Sharing Cities, a major international smart cities project. It addresses some of the most pressing urban challenges cities face today across ten replicable solutions.

Click on the buttons to navigate through this document

Introduction
How to use this playbook and introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

WHAT IS THIS PLAYBOOK?

This guide gives an overview of how Sharing Cities rolled out e-bike schemes in its three 'lighthouse cities' – Lisbon, London and Milan. The aim was to address challenges in each city context and share the experience so other cities can learn from it.

This playbook will:

○ Help you understand what solutions were tested in the Sharing Cities lighthouse cities and what urban challenges they address.

○ Help you understand the value proposition of the solution, in economic, social, environmental, and financial terms.

○ Offer practical guidance so city officers have all the information they need to rollout out the solutions in their city, including:
  - Strategic and technical design
  - Ownership structures
  - Business models
  - Financing options and routes to market
  - Stakeholder engagement and communications
  - How to safeguard citizen interests

○ Answer common questions and concerns you may have about these solutions.

○ Sum up the key challenges, recommendations, and lessons learned from testing these solutions. Other cities can then use these insights to guide their own schemes.

TOOLS & RESOURCES

The playbook also includes references to a range of tools to support your development and delivery plans. If you'd like the source files for these tools, email: Sharing Cities **pmo@sharingcities.eu** or tweet us **@CitiesSharing**

Introduction
How to use this playbook and introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

Sharing Cities tested a range of technologies across various sectors, including mobility, data platforms, infrastructure, and energy systems. Many of these technologies complement each other. Some even directly work together to produce better results. This table shows how different Sharing Cities technologies relate. You may find it useful to cross reference materials in other playbooks.

RELATED TECHNOLOGIES TESTED IN SHARING CITIES

	e-bikes sharing schemes	e-Car Sharing	e-Vehicle Chargers	e-Logistics	Smart Parking	Digital Social Market	Building Retrofit	Sustainable Energy Management Systems	Smart Lampposts
e-bikes sharing schemes	✖		✔			✔			
e-Car Sharing		✖	✔			✔	✔		✔
e-Vehicle Chargers	✔	✔	✖	✔	✔		✔	✔	✔
e-Logistics			✔	✖	✔				
Smart Parking		✔	✔		✖				
Digital Social Market	✔	✔				✖	✔	✔	
Building Retrofit	✔	✔				✔	✖	✔	
Sustainable Energy Management Systems			✔				✔	✖	
Smart Lampposts		✔	✔						✖

Introduction
How to use this playbook and introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

WHO IS THIS GUIDE FOR?

We created this guide with three key audiences in mind:

1

City officers, governments and public authorities who are considering or are in the early stages of rolling out an e-bike sharing scheme. They want to find out about the range of business models and governance choices around such a framework.

2

Lighthouse city members of Sharing Cities looking for a way to sustain their e-bike sharing schemes post-funding from Horizon 2020.

3

Follower cities in Sharing Cities who may be in the process of developing strategies to rollout e-bike sharing schemes.

LIGHTHOUSE CITIES

LISBON   **LONDON**   **MILAN**

Introduction
How to use this playbook and introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

SHARING CITIES: A TESTING GROUND FOR INNOVATION

Sharing Cities aims to change forever how we think about the role of digital technology in our cities. We want to clarify how we all can benefit from and contribute to this transformation process. Led by the Greater London Authority, we have run 10 smart city projects in each of our lighthouse cities of Lisbon, London, and Milan. Our aim is to test how innovative technological solutions can address some of the most pressing urban challenges cities face. These include in mobility, energy efficiency, data management, and citizen engagement.

Our vision is of a more agile and more collaborative smart cities market. This would dramatically increase both the speed and scale at which we can rollout smart solutions across European cities. We wish to engage citizens in new ways too, so they can play an active role in transforming their communities. We want to share solutions, practices, experiences and results, and improve the way we manage city data and infrastructure. By doing so, we will co-create a better living environment and reduce our energy costs.

About Sharing Cities

The Sharing Cities 'lighthouse' project is a testbed for finding better, common approaches to making smart cities a reality. By fostering international collaboration between industry and cities, it will develop affordable, integrated, commercial-scale smart city solutions with high market potential. Project partners also work closely with the European Innovation Partnership on Smart Cities and Communities (EIP SCC01 – Lighthouse Projects).

In addition, Sharing Cities offers a framework for citizen engagement and collaboration at a local level. This strengthens trust between cities and communities. The project draws on €24m in EU funding. It aims to trigger €500m in investment and have a long-term impact on the smart cities' marketplace.

Part of the European Horizon 2020 programme, Sharing Cities includes 34 European partners from across the private, public and academic sectors. Together the group works to deliver near-to-market solutions, such as:

○ **Smart lampposts** – integrated smart lighting with other smart service infrastructures (electric vehicle (EV) charging; smart parking; traffic sensing; flow data; wifi etc).

○ **Shared e-mobility** – a portfolio of linked initiatives supporting the shift to low carbon shared mobility solutions. Specifically: EV car-sharing; e-bikes; EV charging; smart parking; e-logistics.

○ **Integrated energy management system** – rollout system to integrate and optimise energy from all sources in areas of cities (and interface with the city-wide system). This includes demand response measures.

○ **Urban sharing platform (USP)** – a way to manage data from a wide range of sources including both sensors and traditional statistics. The platform uses common principles, open technologies and standards.

○ **Digital social market (DSM)** – an approach to encourage citizens to engage with and use sustainable smart city services. The aim is to shift perceptions and change behaviours through rewards in exchange for continued and improved citizen engagement.

○ **Building retrofit** – install energy efficient measures in existing public, social, and private building stock. This will link to other solutions like the integrated energy management system to optimise energy performance.

Packaging tested smart city solutions across Europe

Sharing Cities has captured the experiences from deploying these solutions and lessons learned along the way in a series of playbooks. Our programme partners and other cities can use this research to reduce barriers, speed up processes and ensure a consistent approach.

We want to provide a set of 'packaged' mobility solutions and document the replicable parts of a smart city solution. This will help cities and suppliers better navigate the challenges of delivering fresh, cross-sectoral solutions to improve the urban environment. Making these solutions both cheaper and quicker to come to market will boost the confidence of buyers and investors alike.

Our playbooks use the EU Smart Cities Cluster's emerging 'packaging concept'. This captures (I) societal needs (II) technical components (III) business models and financing options. This one is concerned with mobility, specifically the electric bike (e-bike).

For more information on the EU Smart Cities Clusters projects, visit EU Smart Cities Information System (SCIS).

Introduction
How to use this playbook and introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

1 Electric bikes and the urban mobility challenge
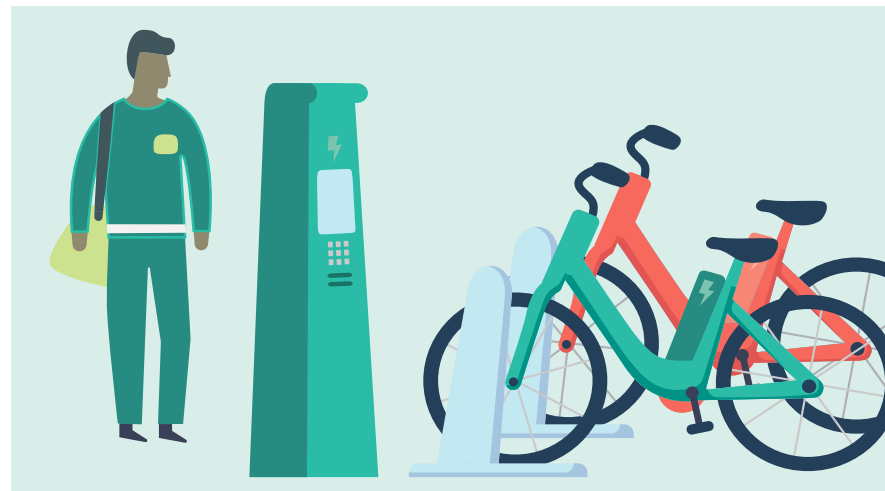
The urban mobility challenge

Emerging mobility trends in cities present challenges both for local authorities and citizens alike. These can have negative impacts including worsening congestion, poor air quality, increased likelihood of collisions and a lack of parking spaces. All these factors can impact the quality of life in cities. Innovations like Uber and Lyft have given consumers more travel options. Yet they've also put more cars on the road, adding to congestion.

Cycling is a vital part of any mobility strategy. Its benefits go far beyond reducing motor vehicle traffic. A recent Transport for London (TfL) study found that if Londoners cycled for just 20 minutes a day, it would save the NHS £1.7bn (Telegraph, 2017). Encouraging uptake of e-bike schemes alongside other e-mobility solutions (like shared EVs), improving vehicle charging and cycling infrastructure, can help cities meet this challenge. Together this can reduce congestion, improve local air quality, make the streets safer and lessen the impact of transport on climate change.

A recent Transport for London (TfL) study found that if Londoners cycled for just 20 minutes a day, it would save the NHS £1.7bn (Telegraph, 2017)

Electric bike share – a key cog in a city's mobility plan

Sharing Cities tested city-led docked electric bike share schemes (e-bikes) and a rental model. E-bikes are fitted with an electric motor which allows for power assistance while you pedal. They are a key part of a sustainable and holistic mobility solution in cities. E-bikes can be integrated with regular bike share, or as flexible, longer-term rental schemes to encourage modal shift from cars. Private sector companies have been rushing to introduce 'dockless' (or free-floating) e-bike/bike sharing schemes into cities. However, these schemes can sometimes be short lived. City-led, docked e-bike schemes can provide a longer-term solution to mobility.

Introduction

Challenge & Solution
Electric bikes and the urban mobility challenge

Insights

Benefits

Implementation Toolkit

The vital parts of an e-bike scheme

E-bike sharing schemes come in many shapes and forms. They also vary, depending on the specific urban challenges and needs of different cities. However, there are some common components of all e-bike sharing schemes. You'll find more on the technical details of these in **Section 4 (How to rollout out an e-bike scheme)**. All e-bike sharing schemes include:

DOCKING STATIONS (if a docking-based scheme). This is either a rack or a kiosk. It should be easy to operate and strong enough to require minimum maintenance. For e-bikes, it should include a charging mechanism.

A FLEET OF E-BIKES – designed for easy use in the city, ideally with a distinct brand to increase visibility. The bikes should be heavy and robust to minimise accidental damage, decrease maintenance costs and deter vandalism or theft.

BUSINESS MODEL – an e-bike sharing scheme needs to have enough funds to be properly managed. There are several ways to generate revenue and financing, depending on a city's funding requirements.

PERSONNEL AND STAFF – to operate and ensure high quality service levels to the scheme (for example, maintenance and reallocation).

MANAGEMENT SYSTEM – typically software. It should be able to monitor e-bikes and docking station status, inform the operator about redistribution and maintenance operations, and control payment and billing.

ACCESSIBLE AND SAFE CYCLING INFRASTRUCTURE – an extensive network of safe routes should be in place or planned alongside the rollout of an e-bike scheme. If people don't feel safe cycling, the e-bike scheme will not be widely used.

USER INTERFACE – getting this right is vital. This is the main point of contact and helps create a direct relationship between the operator and the user. As such, it should be simple, intuitive and easy to understand.

Introduction

Challenge & Solution
Electric bikes and the urban mobility challenge

Insights

Benefits

Implementation Toolkit

You must account for all these elements when planning an e-bike sharing scheme. Each can have an impact on the scheme's success, as well as the business and financial models used. Sharing Cities' three lighthouse cities tested a variety of e-bike schemes:

LISBON / Creating a cycling culture from scratch

The Portuguese capital rolled out its first bike sharing scheme in 2017 through Sharing Cities to help realise its new city strategy for mobility. As Lisbon lacks a cycling culture or tradition, it was vital to plan and deploy the scheme carefully. The pilots proved a big success however, so the scheme, called GIRA, was rapidly expanded to across almost the entire city. It is owned and run by EMEL, the municipal mobility company that also manages the city's parking infrastructure. The scheme now has 810 bikes, around 50 per cent of which are e-bikes, and 81 docking stations. Lisbon plans to expand the scheme further, especially in the residential suburbs. As an indirect result, the city has increased bike lanes too, with provision expected to double (to almost 200km) by 2022.

LONDON / Understanding local cycling needs

Launched in July 2017, this scheme allowed residents in the Royal Borough of Greenwich to borrow an e-bike for a month for just £10 (to cover insurance). This gave them a chance to see how an e-bike could help them to travel further and more sustainably. Residents who wished to buy the e-bike were offered discounts once the loan period was over. There were e-bike loan sessions held every month, with a fleet of 30 bikes available on site. These gave local people the chance to pick-up or return a bike (before it is then serviced and passed on to the next resident). Priority was given to car owners who didn't currently cycle. This maximised the opportunity to encourage modal shift away from cars. To understand how the bikes were being used, and behaviour change, riders tracked their journeys via an app or in a diary.

Greenwich plans to link-up the e-bike share scheme with its cycle training programme.

MILAN / Adding e-bikes to the bike sharing network

As a leader in e-mobility, Milan started testing an e-bike sharing scheme in 2016. With a large conventional bike sharing scheme already in place, adding e-bikes to the mix presented some challenges. For example, the existing docking stations infrastructure couldn't be used to recharge e-bikes. So instead, the scheme requires vans to circulate between docks to swap the e-bikes batteries. The vans are also used to reallocate bikes where needed, using an intelligent algorithm. It guarantees that bikes are available in all stations of the network. To attract parents of young children, e-bikes with child seats are now being tested.

Comune di Milano plans to increase the areas covered by station-based bike sharing services. Sharing Cities will contributed to this overall strategy by rolling out this service in Porta Romana – Vettabbia.

Introduction

Challenge & Solution
Electric bikes and the urban mobility challenge

Insights

Benefits

Implementation Toolkit

2 How do I know e-bikes are right for my city?

The EU Cycling Strategy[1] views bike sharing as part of any multimodal transport system and an enabler of innovation at city level. It is clear that cycling has many benefits and as such is a vital part of a city's mobility plan. Around the world, cities have put in place many different schemes and initiatives to encourage their citizens to cycle.

There are many different options available, in terms of types of bike, cycle schemes and operating models. This can make it hard to determine what's best for your city – whether your goals are sustainability, better air quality or improving public health. The set of questions below are based on cities' experiences of rolling out e-bike schemes. They'll help you think through the major issues and opportunities, potential challenges and work out what type of scheme will suit your city.

Docked or dockless models – which one is better?

In the last few years, dockless bike sharing schemes have become increasingly common. Free-floating bikes offer several advantages to docked bikes, including lower infrastructure costs, larger geographical coverage and proximity to users. For cash-strapped local authorities, dockless bike share is an opportunity for private companies to run these schemes. However, bikes are at risk of vandalism and theft, which can lead to broken bikes littering city streets. Badly parked bikes can also block pavements and other pedestrian spaces, roads and shop entrances. Local authorities are starting to address some of these issues, by for example, introducing designated parking spaces for dockless bikes. Other cities are fining bike operators for improperly parked bikes. A city-led docked e-bike scheme can also be a reliable mobility solution for residents and visitors to use.

Do e-bike schemes compete or complement other mobility options?

Rolling out an e-bike scheme may impact other transport options such as regular bikes, rail, bus and car sharing schemes. However, as their populations increase, cities need more ways for their citizens to get around. The 'micro-mobility' market has flooded cities with shared mobility solutions, like e-scooters and e-pedals. This brings fresh challenges including damaged assets, poor parking, safety issues, and more competition for space between drivers and pedestrians. One thing larger, more congested cities should consider is that the uptake of e-bikes may reduce car use. They can also complement public transport systems, as they focus on the 'first' or 'last mile' journeys.

Is my city too big or too small for an e-bike share scheme?

It is easy to adapt the scheme to suit the scale of your city. Your main goal is to ensure a uniform distribution across the area. During the design phase you should consider the scheme's demands, accounting for factors like size, number of residents, need, and traffic flows. All of these will have an impact on your investment costs.

> **"The (e-bike) strategy clearly recognises the health and congestion benefits of e-bikes and highlights that, unlike registered vehicles, they pay no tax or insurance and are very inexpensive to run."**
> Department for Transport, United Kingdom. Read more here

Introduction

Challenge & Solution

Insights
How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

Is cycling safe in cities?

Safe mobility is a concern for all cities. Several factors impact the safety of cycling, including the quality of cycling infrastructure and the cycling culture. Drivers are usually more aware of cyclists in cities with higher levels of cycling. By putting more cyclists on the streets, a bike sharing scheme can help make cycling and mobility in general safer. Studies of several European cities, have shown that over the long term, higher cycling rates reduces accidents and collisions. To understand if e-bikes will have a positive or negative impact on safety over time, depends on the city context. You should plan e-bike use for the long-term and consider developing new infrastructure to protect cyclists.

Why invest if people have their own bikes?

For cities, bike sharing can be a useful extra transport option, even though people may have or use their own bikes. Such schemes allow cities to offer a sustainable, competitive and flexible point-to-point transport alternative. E-bikes can help to reduce overall car trips, by making cycling more comfortable, easier and more accessible. It can allow more people to go longer distances by bike. In hilly cities, like Lisbon, e-bikes make even more sense.

To assess whether an e-bike scheme is feasible in a city, you must also understand people's behaviour. Consider things like: How many people use or own bikes in your city? How do people feel about electric mobility? What are the main advantages and disadvantages of e-bikes? Answering these questions will help you to assess demand, what people need and design a sustainable scheme.

How do I manage the high cost of relocating and recharging e-bikes?

Whether you use a dockless or docked model, you need to carefully manage the relocation and recharging of e-bikes. If you don't, the scheme may prove unprofitable. It is vital to analyse traffic flows, both in terms of demand and the redistribution capacity of the system. There are several proven models to solve these problems. One way Lisbon is trying to cope with relocation cost is to offer credits to users who move bikes to suggested locations. In California, Bird Scooters piloted giving people a chance to recharge the battery in exchange for some money in a bid to reduce costs.

How can a city fund the high start-up costs of an e-bike sharing scheme?

It's true that a bike sharing scheme, whether regular or electric, has a high investment cost. Yet they are typically cheaper to fund than other public transport, such as rail and bus networks. These options also take longer to rollout. In addition, there are several ways to support the initial investment. In Lisbon, for example, part of the parking revenue was allocated for this purpose. Investment and maintenance costs are far lower for regular bikes, so a scheme which offers both electric and normal bikes can be far cheaper. You'll find more detail on revenue models in *Section 4* (*How to rollout an e-bike scheme*).

What are the main impacts and benefits of an e-bike sharing scheme?

E-bikes offer a green mobility option which can directly help to improve traffic congestion, air quality, noise and safety. In addition, e-bikes lower barriers to active transport by making cycling more accessible to more people. This can help encourage behaviour change and a shift towards healthy and active lifestyles. From an economic perspective, e-bikes can also help make cities more attractive, boost tourism, increase property values and reduce healthcare costs. We further explore the benefits of e-bike schemes in *Section 3*.

Introduction

Challenge & Solution

Insights
How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

City context considerations

Transport and mobility challenges are likely to differ depending on the city context. This includes a city's size, location, political and legal frameworks, climate, social and cultural behaviours. As such, there is no one-size-fits-all solution. The differing context of each of the three Sharing Cities pilots mean that schemes were deployed in different ways. At the same time, cities do share common characteristics. Carefully considering your city's political, environmental, and social context, will help you design a scheme that suits your goals.

Climate and geography/topography

A city's geography and topography can affect take up of the scheme. People living in hilly cities may be less keen to cycle, for example. Use tends to be higher in flatter areas. This creates unidirectional movements from one to the other, so requires further redistribution efforts. In such cases, e-bikes are a good solution. Local climate conditions can also influence scheme use and demand, and it varies according to season. Average temperatures are key to this and have a big impact on use curves. Being aware of these seasonal fluctuations can help inform decisions around cost. For example, you could carry out maintenance activities at 'slow' times of year when use is lower.

Lisbon is an old city with many historic districts. This makes it difficult to create high-quality cycling infrastructure. It is also very hilly, meaning a traditional bike scheme is out of the question. The city's topography also makes it expensive to redistribute bikes. As a mature technology, e-bikes were the best option to address these constraints.

Social and cultural behaviours

E-bike sharing schemes are meant to improve connectivity and mobility in a city. Yet if you don't put your citizens' needs at its heart, the scheme may fail. Awareness of how social norms and culture affect how people travel will help you understand the needs of your local community. This will allow you to design a solution that's likely to be both successful and supported by local people. It may also reveal any social inequalities within the scheme. For example, private e-bike schemes that charge by the minute often attract professionals commuting to work. However, this option is likely to be beyond the means of someone earning the minimum wage. In London, like many large cities, regular cyclists are far more likely to be male, white, in work and non-disabled.[2] E-bikes can reduce barriers to cycling. By so doing, they encourage a wider range of people to cycle.

Studies have found that people travel twice as much on an e-bike (both in distance and frequency of use). This increase was seen to be greater with women.[3] Old habits are hard to change too. Traditionally car share has been more successful in shifting attitudes towards car ownership in small cities. In larger cities, high availability of public transport has encouraged people to use it. Having a good understanding of modal share offers insights into the culture and patterns of how people prefer to travel.

Political and legal conditions

To a large extent, bike sharing depends on strong political will. It plays a key role in deciding which solutions a city should choose and deploy. It also helps ensure funding, resolves issues around land use and rights, and enables different city departments to work together.

Introduction

Challenge & Solution

Insights

How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

Political leadership and governance are thus key to getting schemes off the ground. Local mobility policies, strategies and/or plans can also help to catalyse political leadership. The city's experience on data and smart city projects can be influential too.

Cycling infrastructure

To encourage people to use the bike sharing scheme, good quality cycling structure is vital. The higher the quality, the better the results, as people will feel safer and use the scheme more. When assessing the quality of cycling infrastructure, you must consider two things:

i)   the availability and maintenance of cycle lanes or paths, signs, as well as safety measures where cyclists interact with other road users

ii)   the connectivity offered by the existing cycling network. It should provide accessibility to key city areas including high-density housing, central business districts, university and high-school campuses. Otherwise it will lose its functional value.

Political and legal conditions in the city were favourable for rolling out bikeshare. The City Council was keen to shift from private transport (especially cars) to public and/or sustainable modes. There was particularly strong support for active and low carbon modes of transport, including cycling. Lisbon already had several privately run dockless e-bike schemes. However, some have since been banned for safety and accessibility reasons. They are also more expensive to use than the city's GIRA scheme.

Technological and market context

Bike sharing schemes are not new. London's cycle hire scheme launched in 2010 (now Santander bikes), Velib (Paris) in 2007 and Milan's BikeMI in 2008. Since the start of this century, there has been a sustained growth in bike sharing schemes. In recent years, this growth has been turbocharged with new business models (like dockless bikes) bringing even more interest to this market.

Global rise of bike sharing[4]

E-bike sharing systems are growing too, both as part of a regular bike sharing and as full e-bike schemes. Electric schemes are a great way to encourage modal shift from cars especially in hilly cities (like Lisbon) and large cities (like Milan and London).

The city of Lisbon has been rapidly building, improving and extending bike paths and lanes in recent years. **Cycling infrastructure is expected to increase from just 10km of bike lanes 10 years ago, to 90km in 2019 and 210km by 2021.** Legally, apart from the dedicated paths, bicycles have the same rights as other vehicles on a public road. For example, they have the right to be on the pavement. If they come from the right side of an intersection, they have priority. And they have priority on roundabouts too.

Better infrastructure, more availability of e-bikes and low costs of use has encouraged people to take up cycling, alongside other low carbon transport modes.

Data collected from the city's EMEL scheme in 2019 show that there were 2.4 million trips made that year. As the cycling infrastructure network expands the number of trips are expected to increase further.

Introduction

Challenge & Solution

Insights
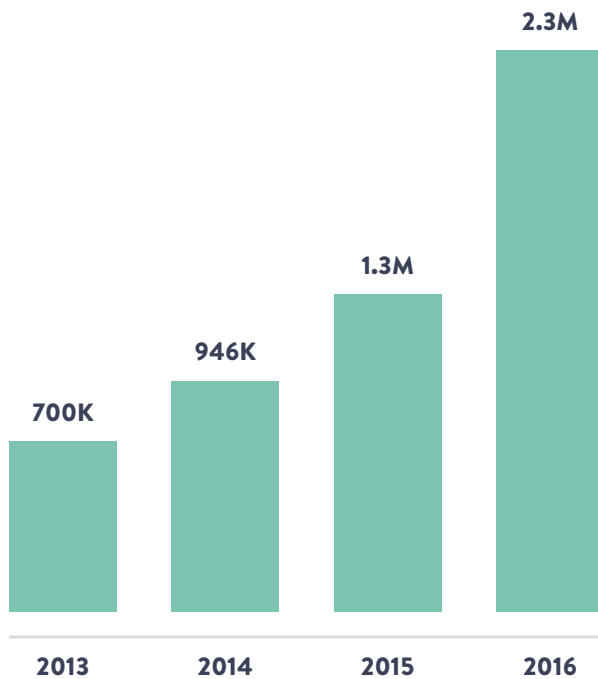How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

City size and demography

Bike sharing can work in cities of any size. The scheme just needs to be adapted to the scale of the city. Your main goal is to ensure that bikes are available where they are required. Think about things like the number of residents, visitors, population density and season changes. Studying traffic flows will help you understand and identify current problem areas in your city. This will help inform your design decisions and improve potential demand.

Number of public use bicycles in the world

2013	2014	2015	2016
700K	946K	1.3M	2.3M

Top 5 countries by number of public-use bicycle programs, 2016
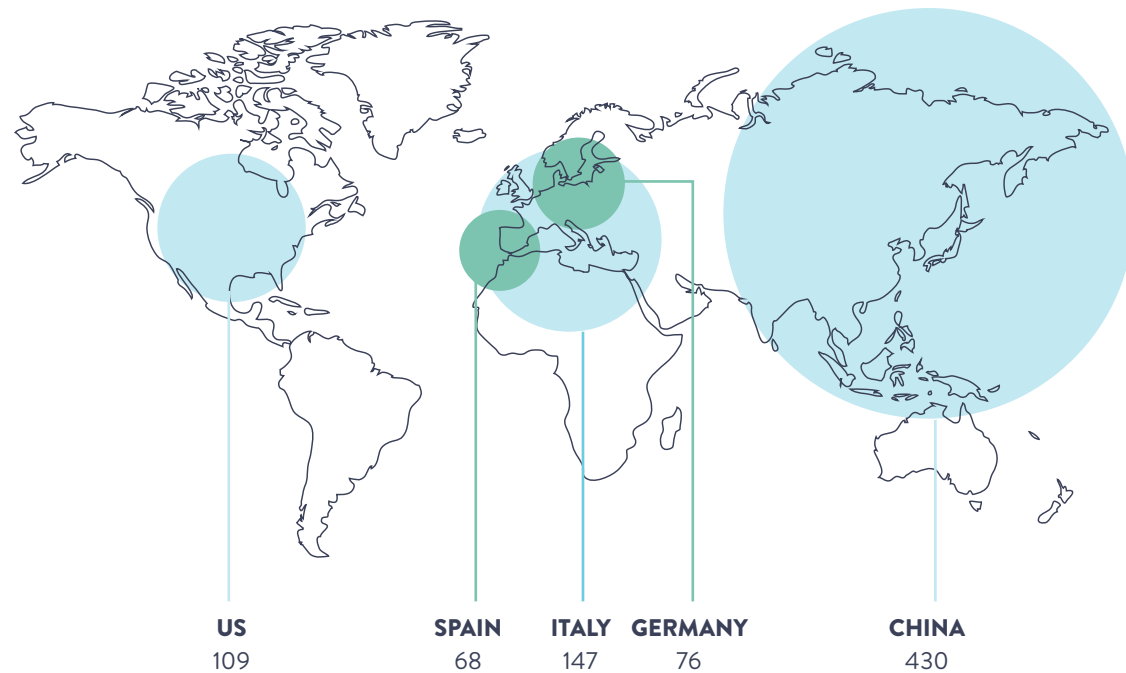
US	SPAIN	ITALY	GERMANY	CHINA
109	68	147	76	430

Introduction

Challenge & Solution

Insights

How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

Recommendations from the lighthouse cities experience

When launching e-bike share schemes, the lighthouse cities of London (Greenwich), Lisbon, and Milan encountered a range of issues and challenges. We've captured the main barriers and what steps you can take to address them in the table below.

Critical issues/barriers	Recommended actions	Lighthouse experience
Choosing the right business model is vital to ensure the smooth operation of an e-bike scheme.	Look at different business models and explore ways to collaborate to ensure the scheme is fit for purpose. Having a high-level strategy from the start will help you determine if the scheme is commercially viable. It will also help you work out the value proposition. Consider making the scheme cheaper to use during the colder months and off-peak when demand fluctuates. This will help encourage use at these times.	In Lisbon and Milan, the costs of running and managing the scheme represented much of the total (70 per cent). Therefore, it's crucial to think long-term while defining your business model. In Greenwich, a loan-based scheme has proven a successful alternative. This will also help you avoid unnecessary expenditure.
Choosing where to locate bikes and docking stations is hard. This is particularly for a new city exploring bike share for the first time.	Doing a demand analysis helps you understand where there is most need for the scheme. It allows the city to visualise how best to locate bikes and docking stations and boost scheme uptake.	Greenwich was unsure where to run the scheme, so it carried out a comprehensive analysis of demand.
Engaging political leaders and local communities is key to getting support for an e-bike project.	Political leaders can act as catalysts to achieve your goals. They can help speed up decision-making, make funding available, sort lands rights use issues and ensure different city departments work together. Understanding the community's needs and interests can help you define the strategy for rollout. The service must be user-friendly and offer, for example, different ways to pay.	Lisbon carried out a pilot in a restricted area to assess and collect user feedback on the scheme's features. In London, following demand analysis, a successful loan-based scheme was determined to be the best fit based on resident needs.
Allow time to define the right mechanisms, collect and assess data	The ability to collect and retrieve reliable data, especially GPS data, is vital in monitoring the operation and evaluating the impact of bikeshare. Ownership of data can be a problem if the scheme has multiple stakeholders . You should create and sign data sharing contracts if private operators are involved.	In Milan, all private operators who want to run schemes must share data with the city. In Greenwich, a data privacy notice was included in the loan agreement, notifying participants that GPA data would be shared with project partners.

Introduction

Challenge & Solution

Insights

How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

Critical issues/barriers	Recommended actions	Lighthouse experience
In most cities, bureaucratic 'red tape' delays decision-making and rollout of schemes.	It's thus important for project leads to understand these processes in depth. They should work alongside all government agencies who need to be involved right from the start. This will help ensure support from all stakeholders involved in decision-making and approvals.	Public tendering can be very time-consuming. This can cause costs to spiral and slow down rollout. In Lisbon, the scheme management had to terminate the contract due to non-compliance issues and retender.
It's hard to find sustainable funding channels and mechanisms to ensure a pilot e-bike scheme can be scaled up citywide.	Bike sharing is expensive to set up. Both regular and e-bike schemes require high investment costs. However, these are far lower than other public transport investments, which also take much longer to rollout.	Lisbon offers users subsidised fares to encourage greater uptake. The city supports its e-bike schemes with extra funding streams such as from municipal car parking charges. In Milan some of these costs were covered by advertising revenues.
Carefully consider the relocation, management and recharge mechanisms otherwise your scheme may not be financially viable.	Having a proper management system and data collection mechanisms will show you how the e-bikes are being used. The aim of reallocation should be to maximise use and ensure the system is balanced.	Lisbon gives credits to users who relocate e-bikes in all its locations. All docking stations are able to recharge e-bikes, and can be used by both e-bikes and standard bikes. In Milan, empty batteries are swapped out by operators that manage the reallocation of the bikes – both traditional and e-bikes.
It is hard and costly to ensure scale and expand the scheme across the city.	Think about running pilots in restricted areas. This will give you a chance to fine tune the scheme and iron out any operational and design issues. It will help you be confident about the scheme's future impacts. Spring or summer is the best time to launch a scheme.	All three lighthouse cities found use of the bikes increases during warmer periods of the year.

Introduction

Challenge & Solution

Insights

How do I know e-bikes are right for my city?

Benefits

Implementation Toolkit

3 What is the value of an e-bike scheme? Understanding the benefits and impact

E-bike sharing schemes have different characteristics and bring different results depending on a city's size and geography. Each city will also have different aims, modal shares and demands. Together, these create the context in which to design a scheme that will meet the city's needs. The benefits of e-bike sharing will vary from city to city. This is reflected in the three Sharing Cities schemes, which were all quite different.

E-bikes' health benefits are well documented. Studies[5] show that:

- e-bikers take longer trips by e-bike and bicycle, compared to cyclists

- e-bikers and cyclists show similar benefits in terms of physical activity

- by substituting all car trips with e-biking, a person's energy use will increase by 550 MET (metabolic equivalents) min/week

- e-bikers who switch from less active modes make big gains in physical activity

- e-bikers who switched from regular bikes ended up travelling longer distances.

Here are some other benefits an e-bike scheme can offer:

E-bikes can have an impact by:	Benefits to health and wellbeing	Benefits to the environment	Benefits to local economy
Increasing access to transport by providing extra ways to travel (from cars)	A shorter commute and more convenient transport can improve wellbeing More independence to travel (especially for women, young people)	Reduced carbon emissions as e-bikes replace car journeys	Reduced commuting times improves productivity More vibrant town centres with higher footfall around shops/high streets
Reducing congestion	Reduced commuting times improves wellbeing	Reduction of cars and traffic jams reduce carbon emissions	Reduced commuting times improves productivity
Reducing air pollution	Improved air quality improves health	Improved local air quality	Improved health reduces burden on health services
Encourages physical activity	Improved physical and mental health		Reduces burden on health services
Creates jobs			Contributes to cycle tourism, retail, manufacturing

Introduction

Challenge & Solution

Insights

Benefits
What is the value of an e-bike scheme?

Implementation Toolkit

In London and Milan, cycling was already a popular way to commute. Both cities also had extensive existing cycling networks and public transport systems. However, more could be done to encourage people to try cycling. In Lisbon, there was no cycling culture as the city is very hilly and most people commute by car. Each city therefore had a different set of local challenges which the e-bike sharing scheme sought to address.

LISBON / A way to combat congestion

Portugal has one of Europe's lowest rates of cycling, and car ownership is very high. In Lisbon, this posed problems in terms of traffic congestion, air quality, safety and noise etc. The aim was to invest in and rollout a low-carbon, active form of transport to change behaviours.

With its hilly, narrow streets and unpredictable weather, Lisbon has not been a popular city for cycling. In this context, the e-bikes offered a range of environmental and social benefits such as:

- reducing traffic congestion by encouraging people to cycle instead of drive

- improving air quality by providing people with a sustainable way to travel

- encouraging uptake by providing e-bikes which make it easier to manage the city's challenging topography

- reducing reliance on fossil fuels by encouraging people to switch from driving to e-bikes.

MILAN / Making bikes more accessible

Milan's transport system is well designed, from underground and trams to car sharing, scooter sharing and bike schemes. There are also dockless bikes which complement the public bikeshare scheme.

As a city, Milan is well connected. However, it also an old and historic city. Many roads are paved with cobblestones which can make cycling difficult. Some cycle paths do exist, but only cover a small part of the city. It can also be challenging to change infrastructure in the city's historical districts.

In this context, Milan's e-bike scheme was rolled out as part of a city-wide e-mobility strategy. The overall aim is to reduce car ownership and enable the transition to electric modes of transport. E-bikes were added to the city's existing BikeMi regular bike scheme. Benefits include:

- reducing traffic congestion by encouraging people to cycle instead of drive

- improving air quality by providing people with a sustainable way to travel

- reducing car ownership and fossil fuel use by encouraging people to switch from driving to e-bikes

- increasing take-up by improving accessibility, expanding the existing scheme to a larger part of the city and providing bikes with child-seats.

Introduction

Challenge & Solution

Insights

Benefits
What is the value of an e-bike scheme?

Implementation Toolkit

Here are the main benefits of e-bike schemes for potential user groups:

Value for residents	Making more e-bikes available will likely lead to higher property values, improved neighbourhood health, and a more vibrant urban realm. This will also benefit the local environment and economy.
Value for students	Students like e-bikes for their flexibility, sustainability, fun, convenience and modernity. It helps them to identify with the city and the university.
Value for organisations & universities	It's a clean, green form of transport, which can boost image, and feed into mobility strategies and local stakeholder networks.
Value for commuters/ employers	It offers possible partnerships with employers to sponsor the scheme and allow their employees to take advantage of it.
Value for tourists	Partner with hotels to make registration as simple as can be. E-biking is a sustainable and fresh way for tourists to discover the city.

MILAN / Predictive algorithm

One of the main issues to be tackled in vehicle sharing services, particularly for bike sharing schemes, is reallocation. Sharing Cities' partner, Poliedra, is developing a new predictive algorithm to reallocate e-bikes in its BikeMi scheme.

The aim is for better bike distribution, in line with spatial and hourly demand, and improved reallocation strategies between stations. It uses three models: demand forecasting, spatial imbalance between supply and demand estimation and micro-simulation of reallocation.

Demand forecasting is a moving-average model which considers factors (strikes, holidays, weather conditions) to estimate demand using historical data. Around reallocation, an operator-based strategy has been deployed. This means that bikes are reallocated by employees. It is now testing a new user-based approach that aims to offer incentives to users to control the balance of the fleet.

Introduction

Challenge & Solution

Insights

Benefits
What is the value of an e-bike scheme?

Implementation Toolkit

4 How to rollout an e-bike scheme

Each of the three lighthouse cities introduced e-bikes to help address a range of different challenges. This section outlines what each city went through to roll out their scheme. After, we sum up those parts of the process that were common to all cities. These may be relevant to other cities considering an e-bike scheme. This section covers some of the tools, processes and examples from the lighthouse cities. If you would like further details, get in touch.
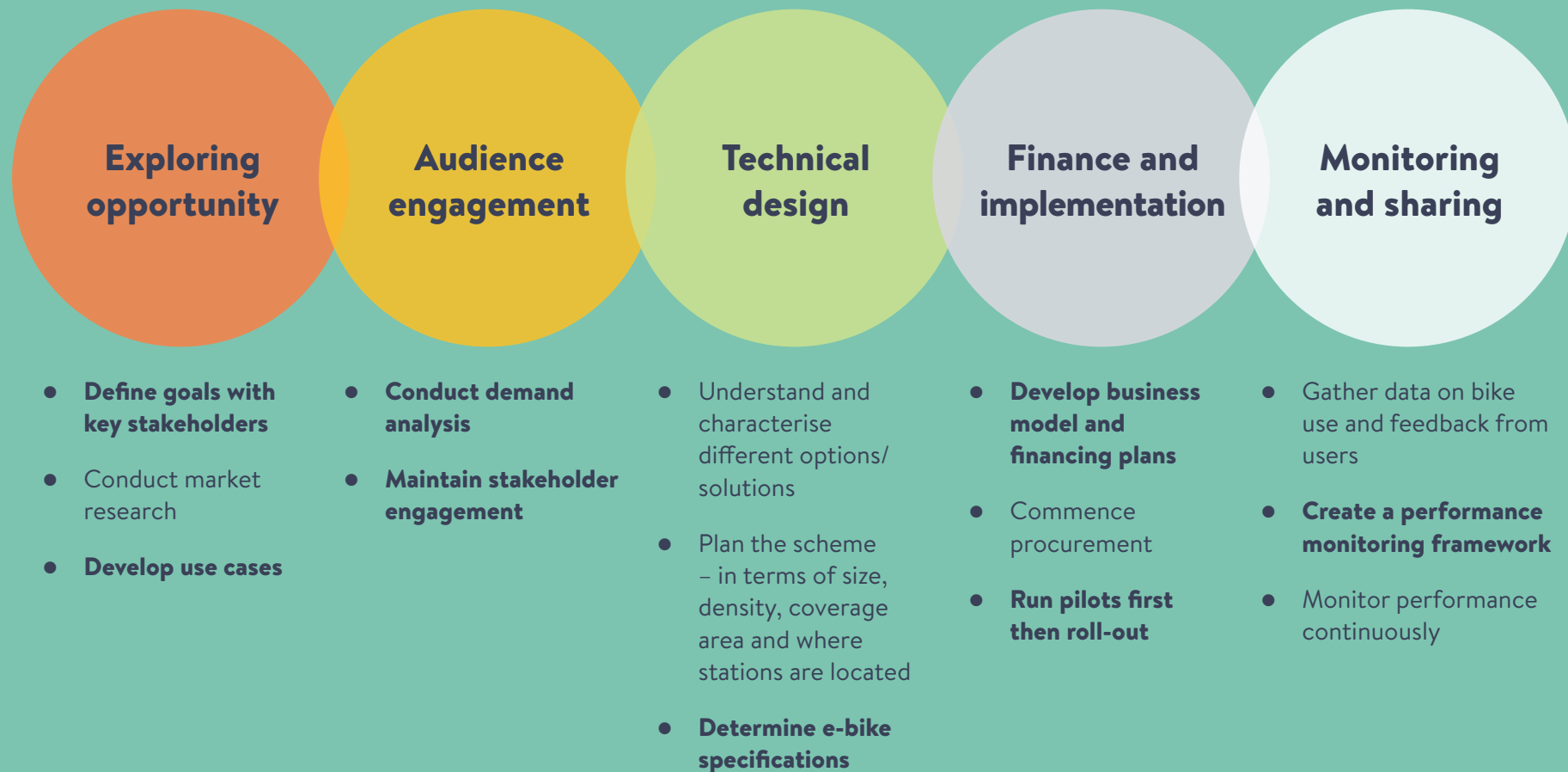
Exploring opportunity

- **Define goals with key stakeholders**
- Conduct market research
- **Develop use cases**

Audience engagement

- **Conduct demand analysis**
- **Maintain stakeholder engagement**

Technical design

- Understand and characterise different options/ solutions
- Plan the scheme – in terms of size, density, coverage area and where stations are located
- **Determine e-bike specifications**

Finance and implementation

- **Develop business model and financing plans**
- Commence procurement
- **Run pilots first then roll-out**

Monitoring and sharing

- Gather data on bike use and feedback from users
- **Create a performance monitoring framework**
- Monitor performance continuously

Exploring opportunity

Before starting service design or planning, you must define the scheme's goals with the key stakeholders involved in deployment. Impact mapping is the best way to do this. This is a collaborative process that brings together assessors, developers, project staff, stakeholders and end users. You can also produce logic models to reflect different stakeholders' views and the likely impacts of a project. You can create these for the whole project, or just individual parts with specific aims and targets.

For blank templates or more information about the tool, email Sharing Cities: **pmo@ sharingcities.eu** or tweet us **@CitiesSharing**

You should start impact mapping before a project is launched if possible. However, it can be useful at any stage in the project lifecycle (before, during or after rollout). Impact mapping incorporates the views of developers, stakeholders and end users. This is combined with data about the current context, lessons learned from previous similar case studies, and relevant research evidence.

What follows is a guide to running an impact mapping exercise.

Define the proposed solution and context, including economic, environmental and social factors

The city must understand the objectives and approaches in simple terms. You can do this by reviewing existing documentation and consulting stakeholders involved in planning, development or rollout. You should assume the perspective of an 'interested outsider' or member of the public to help you consider potential unforeseen or unintended consequences. To do so, you must address and answer a number of key questions and express the results in a non-technical way.

- What problem(s) is the e-bike sharing scheme trying to solve?

- What is the overall aim or objective of the e-bike sharing scheme?

- How will it be designed, delivered and deployed?

- What will success look like from the point of view of stakeholders? Consider for example, what success looks like to the city and to residents. If there is another stakeholder, such as business, what would it look like to them?

To help you address these questions, you can:

- Review planning documentation and the local situation.

- Investigate and describe the context of the project – the story of the place and community.

- Create a social profile (age, gender, ethnicity), as well as a description of the environment and local economic characteristics of the setting.

Identify and involve stakeholders

Consider all individuals and groups who are involved in the project or will be affected by it. These may include key organisations or people with a stake in the scheme. (For example, funders, policymakers, developers or staff, those involved in management/delivery, and end users/their representatives).

Identifying stakeholders and their views on project impacts may prompt city leaders to do more detailed and structured stakeholder analysis and a management plan.[6] This promotes better understanding of stakeholders' objectives, interests and needs.

It also highlights the relationship dynamics (such as conflicts of interests, power influences) between them.[7]

Key questions to ask are:

- Who's been involved in conception and development, and who will be involved in rollout (this may include commercial partners and local authorities)?

- Who will or might be affected?

- Who will access and use the e-bike sharing scheme? Everyone in a defined geographical area? Just a specific sub-group of users such as those within a neighbourhood? Or even those who use a certain service?

We recommend you do the following in this context:

- List all the project stakeholders.

- Consider vulnerable stakeholders. The project might have potential unintended negative impacts on particular sub-groups (women, young people, older people, low income

families). Alternatively, it might not be accessible to them.

- Narrow the list to focus on the more relevant and significant groups of stakeholders. Consider the impact of anticipated changes on their experience.

- Engage with stakeholders through focus groups, interviews or observation methods. This will promote greater understanding of the project and its current context. It also encourages stakeholders to engage with the planned DSM (design structure matrix).

Prepare and develop the project logic model

The logic model aims to understand how an e-bike sharing scheme will lead to outputs and outcomes. It then works out how these will in turn lead to the intended impacts.

There is no 'correct' logic model for a given project. The key is to ensure that the logical flow is credible, intuitively correct, and meaningful to principal project stakeholders (even if causality cannot be shown at every

step). In addition, the flow must cover all the mechanisms connecting outputs to impacts. Using theory and research on the topic is a way to sustain those links.[8]

Invite key stakeholders to a workshop with the aim of creating a model of how the e-bike sharing scheme will work. Explain that that this in turn will help in designing an effective evaluation strategy.

The logic model template encourages project leaders to think about how the scheme addresses a problem or gap in the market. How does this rationale link to economic, social and environmental outcomes? These can be divided into immediate, medium and long-term outcomes. The inputs and outputs are the key activities of the e-bike share operators that will lead to the desired outcomes.

Consider the following questions when completing this impact mapping exercise:

1. **Rationale**

- **Issue and context** – What activity is being proposed? What is the frequency? What market gap does the e-bike sharing scheme address?

- **Aims** – What are your ultimate quantifiable objectives? What barriers is the activity meant to address?

- **Why it should exist** – What are the key reasons for this scheme to be set-up or continue to operate?

2. **Inputs**

- **Activities** – What is going to take place and how will it happen? Why are those activities key to the scheme?

- **Timeframe** – What are the timeframes for short, medium, and long-term outcomes?

- **Who are the stakeholders** – Who will be carrying out the key activities?

- **Resources** – What physical, financial, intellectual and human resources are needed?

3. **Outputs**

- **Beneficiaries/users** – Who will be impacted by the e-bike sharing scheme?

- **Product/services** – What are the key products made or services offered?

4. **Outcomes**

- What are the expected economic, social and environmental outcomes, from short through to longer term?

- **Short term** – What immediate outcomes or benefits are there?

- **Medium term** – What outcomes will take a few months to realise and measure?

- **Long term** – What impacts will either be measured over years, or are harder to measure in the shorter term? These will be linked to metrics that measure the shorter-term outcomes.

Logic Model Tool

1. RATIONALE

Issues & Context

Aims

Why it should exist

2. INPUTS

Activities

Stakeholders (The people/organisations who will be working to make the DSM a reality)

Resources (Physical, financial, intellectual and human)

3. OUTPUTS

Beneficiaries / Users

Output products / services

4. OUTCOMES (ECONOMIC, SOCIAL AND ENVIRONMENTAL)

Short term
Immediate

Medium term

Long term

Introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

How to rollout an e-bike scheme

Stage 1
Exploring opportunity

Stage 2
Audience engagement

Stage 3
Technical design

Stage 4
Finance and implementation

Stage 5
Monitoring and sharing

As the project continues, stay in touch with key stakeholders to maintain their support for the scheme. Potential stakeholders may include:

Within local government:

- Transport department.

- Planning or land use management.

- Environment department.

- Community engagement and Communications teams.

- Smart City lead.

- Chief Technology Officer.

- Policy advisers.

- Politicians.

Others:

- Local community representatives.

- Local business owners.

- Funders/financiers/sponsors.

- Service operations and maintenance providers.

Develop use cases

To effectively plan for an e-bike sharing scheme you must understand how it will be used. An e-bike sharing scheme will have many types of users too and will likely include a wide demographic. There's also an ecosystem of actors, or stakeholders, that will be involved in making the scheme run effectively. This includes maintenance staff, commercial partners and data providers.

Developing a set of use cases can help you identify different user types and their reasons for using the e-bike scheme. This will enable you to design a service that considers all the necessary functions and technical specifications to fulfil user needs. To help you with this activity, Sharing Cities has created use case templates, see example on the next page.

Email **pmo@sharingcities.eu** or **tweet @ CitiesSharing** for blank templates or more info on this tool.

Use case title	User-based bike reallocation with rewards
User insight/ need the use case responds to	• The user/citizen wants a bike to be available whenever and wherever they want. • Specific users may seek to get discounts or generate extra income through the system.
Actors involved (stakeholders)	End-user; Bike sharing scheme operator(s); External data and events providers; Commercial partners; Technology providers.
Incentive for citizens	• Better level of service and availability of bikes upon request. • Rewards and discounts for those who actively participate in the use case.
Description (narrative)	To make more bikes available without increasing costs, bike sharing scheme operators can offer real-time incentives. For example, by creating offers for users who move bikes from busy to empty docking stations to meet forecast demand.

Functions	A lower threshold in the ratio between available bikes and forecast demand. This can predict there will be a failure to meet demand at a given location in 10 minutes (for example).
	• The threshold is reached and the operator (automatically) sends an offer to users:
	• The following users get an offer:
	  - Scheme users currently riding bikes who often visit the destination station.
	  - Idle users that are within a certain radius from the destination station and a 'full' station.
	  - Users that have registered for all pending alerts.
	• The user must accept the offer.
	• If the user does not reach the destination station in less than, 10 minutes (for example), the reward is not given.
	• If the user reaches the destination in time, they will automatically get the reward.

Pre-conditions	
Policy	Sustainable mobility that focuses on light and low carbon forms of transport.
Legal & regulation	You must ensure data privacy around individuals tracking legislation.
People	The scheme depends on citizen engagement since the use case is driven by end-users' willingness to collaborate.
Operational	• The operator must know in real-time how many bikes are available at all stations. • The operator needs to be able to generate and communicate offers in real-time to scheme users. • The operator must have a forecasting algorithm for bike demand in each area and for a given time scale. • The user requires a smartphone with the app installed and GPS location enabled.
Process	The system will use the forecasting algorithm to forecast demand in each area, and real-time data from stations on bike availability.

Data	• Bikes per docking station
	• Bikes location and tracking
	• 'User' location
	• Others to include in forecasting algorithm
	  - weather and weather forecast
	  - events that may influence demand

Technology	• Advanced CRM • Connectivity devices/gateways • GPS sensors on bikes
Assets	Shared bikes, docking stations, mobile app
Performance / criticality	Nice-to-have/relevant proof of concept for improving the quality and replicability of Sharing Cities pilots.

Audience engagement

Demand analysis

A demand analysis will help you to understand the needs of end users and better plan your e-bike sharing scheme.

It is worth noting, however, that demand analysis and identifying appropriate locations did not always translate into delivery sites. This is due to several reasons, including political and regulatory factors. The long list was reduced to a short list and the public was then consulted on those locations.

Maintaining stakeholder engagement

The key stakeholders and beneficiaries of the scheme were identified in the first stage – exploring opportunity. During rollout, it's vital to ensure you continue to engage with all stakeholder groups. Some may not be aware of the scheme or be misinformed about it. Others may not want to engage with it. For all these cases, it is important to understand their views and clearly communicate the scheme's value. This will help you make a balanced and united decision.

LONDON / Understanding the local community's needs

London has a highly developed transport system, that is shifting towards multimodal public and sustainable options. However, the city still suffers from poor air quality and congestion with large numbers of cars on the roads. This problem is exacerbated by ride-hailing companies such as Uber, and delivery and logistical vans.

The city is taking steps to address this through the Ultra-Low Emission Zone (ULEZ) and Healthy Streets Plan. Bikes and e-bikes support London's goals of reducing pollution, encouraging active transport to improve health and moving to cleaner fuels.

Greenwich is far from the city centre and is less well served by the cycling network and infrastructure. There are 11,500 regular bikes available at 750 docking stations across central London through the Santander bike scheme. It does not include e-bikes or cover Greenwich, and there is no existing local bike scheme. Private companies recently started to introduce regular and electric dockless bike sharing schemes to the area. However, there is not at present an integrated, city-wide e-bike share scheme in London.

There were concerns that a docking station model of e-bike share would fail and demand would be too uncertain to plan such investment. Instead, Greenwich decided to first explore the local community's demands and needs, and whether these could be met by an e-bike scheme. Greenwich carried out extensive demand analysis before rolling out any measures. This meant local people were engaged and the solution was appropriate for their needs. Greenwich offers an open platform where local people can express their interest in electric mobility solutions such as e-bikes. They can also suggest ideas for where to have e-car clubs and charging structures installed. Citizens were also asked to justify the pros and cons and reason for their choices.

You can use stakeholder mapping and management tools to help determine which stakeholder groups to engage. Stakeholders can be broadly put into three categories of importance to help you assess their views of the scheme. Understanding why they feel that way and taking appropriate action, can help align the various stakeholders to the scheme's purpose. See example below:
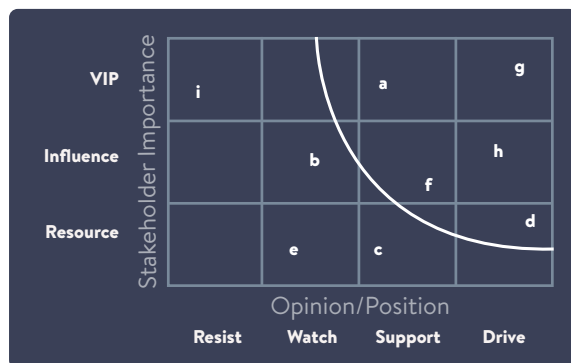
Stakeholder Importance chart:
- VIP: i, a, g
- Influence: b, f, h
- Resource: e, c, d

Opinion/Position (horizontal axis): Resist, Watch, Support, Drive

Contact Sharing Cities: Email **pmo@sharingcities.eu** or reach out to us on Twitter **@CitiesSharing** for blank templates or more information about this tool.

Technical design

Each city will introduce an e-bike scheme slightly differently, depending on the context and challenge it needs to address. At the same time, all e-bike sharing schemes have common features. In addition, there are some basic technical criteria for e-bikes all schemes share. (Please note, these differ from the vital components of the e-bike scheme described in the introduction. The elements described here refer only to the physical bikes).

Determine e-bike specifications

Bicycles have different features and characteristics that can (and should) be adapted to the city's context. As such, it can be hard to consider all solutions and options around bike specifications available in the market.

Our lighthouse cities' experiences show this is a complex task. The key is finding the right balance between bike quality, usability and costs. Bikes must be of a decent standard and durability to keep them in circulation. If not, they'll get damaged too often. This poses major risks to the operator's ability to keep enough bikes on the streets at a reasonable cost. At the same time, you must not compromise on usability in terms

Robust frame	It should be resistant to physical damage and designed for intensive, frequent use in all weather. Bikes on sharing schemes are used far more often than private bikes. A strong frame will reduce maintenance needs (making the scheme cheaper to run) and help to minimise damage by vandalism.
Lightweight frame	E-bikes need to be fairly light, as batteries are still quite heavy at present. The e-bike should not weight more than 32kg, as otherwise it will reduce scheme use and attractiveness.
Battery range	E-bikes need enough range to service customers for a decent amount of time before they need recharging. E-bikes have the potential to significantly boost cycling, particularly in hilly cities. This is both by attracting new users and increasing how often people ride. However, you should assess these in the context of further costs and possible concerns about safety and speed limitations. Battery autonomy is an essential feature which can be easily fixed depending on the average distances that users are expected to travel. You can determine this through a demand analysis.
Bike-locking system	E-bikes must be easy to lock and unlock with appropriate authentication. They must also be resistant to theft and unauthorised unlocking. It's vital to have a proper unlocking system, regardless of whether this is done through an app or a user card. When e-bikes are recharged directly at stations, you must ensure this correlates with its characteristics and requirements.
Public safety	The EU's standards for e-bikes[9] recommend they operate on the road with lights on permanently. Therefore you must ensure that lights are automatically activated when the bike is in use.
Design and appearance	The design and appearance of bikes is a key part of the overall scheme branding. This includes the colour, appropriate reflectors, bells, and lights for night riding. All must meet local safety regulations. To reduce theft, many operators develop custom bike parts and parts with proprietary tools that make it hard to remove.

of weight, user-friendliness and comfort. Variations in these characteristics impacts on costs, in particular around upfront investment, but also maintenance. You must therefore carefully weigh up these two key costs actors as they will both impact on the scheme's profitability.

The next section details technical specifications of the following parts of the docked e-bike sharing scheme:

- Bike frame
- Bike ancillaries
- Docking stations
- Service access/infrastructure
- Control system
- User Interface

Bike frame

This table shows which suppliers the three lighthouse cities used for their bikes and their respective weights.

		LISBON	LONDON	MILAN
Weight	Electric	25.8 kg	21.2 kg	30.5 Kg
	Conventional	25.8 kg	-	27 Kg
Supplier	Electric	Órbita	Raleigh	Clear Channel

Pictures of e-bikes from Lisbon, London and Milan

LISBON

LONDON

MILAN

Bike ancillaries

This table shows which suppliers the three lighthouse cities used for their bikes and their respective weights.

		LISBON	**LONDON**	**MILAN**
Battery	Electric	12,5 Ah	300 W	250 W
	Charging time	4 hours		3-4 hours with solar panels
Autonomy	Electric	~70 km	148 km	60 Km
Wheel	Electric	26´´	700c	26´´
	Conventional	26´´	-	26´´
Tires	Electric	Anti-bore gel	Schwalbe Energizer Life, 40-622 Reflex	Reinforced
	Conventional	Anti-bore gel	-	Reinforced
Brakes	Electric	Shimano de rolete	Raleigh V-Brake	One disc brake One drum brake
	Conventional	Shimano de rolete	-	Both drum brake
Lights	Electric	Security light always on	Pulse COB USB rechargeable lights	Security light always on
	Conventional	Security light always on	-	Security light always on
Gears	Electric	Shimano Nexus 7	9 Speed 11-34 cassette	No
	Conventional	Shimano Nexus 3/7	-	Yes, 3
Lock system	Electric	Frontal physical lock to the dock	External security lock	Frontal physical and electronic lock to the dock
	Conventional	Frontal physical lock to the dock	-	Frontal physical and electronic lock to the dock

		LISBON	LONDON	MILAN
Bike basket	Electric	Yes	Raleigh double pannier set	Yes
	Conventional	Yes	-	Yes
Pedals	Electric	Anti-slippery	Anti-slippery	Anti-slippery
	Conventional	Anti-slippery	-	Anti-slippery
Saddle	Electric	Adjustable, foamed	Selle Bassano Volare M3 Comfort Zone Plus	Adjustable, sprung
	Conventional	Adjustable, foamed	-	Adjustable, sprung
Bell	Electric	Mechanical	N/A	Mechanical, integrated
	Conventional	Mechanical	-	Mechanical, integrated
Childs' seats	Electric	N/A	N/A	Yes
Connectivity	Electric	GPS/GPRS and BLE	Rewire WeTrackLite GPS system	GPS
	Conventional	GPS/GPRS and BLE	-	
Supplier	Electric	Órbita	Raleigh	BikeMIBIKEMI

Determine docking station specifications

Docking stations often make up the largest capital costs of a bike sharing scheme. However, they can also have a big impact on reducing the operating costs – particularly around bike redistribution. In general, their design will depend on demand (amount required), space available, desired visual impact and IT requirements. Likewise, the bikes themselves and their costs will will influence the overall investment needed.

The experience of our lighthouse cities shows that there are three main considerations when choosing a station type:

○ Fixing systems

This is a basic thing to consider. It can determine and influence other things like the docking stations' size, height, distance between docks, etc. As they are so closely linked, these should be defined alongside the bike specifications. For e-bikes, you must also ensure there are electrical connections so that the battery can be recharged. Otherwise, you'll require teams on the ground to exchange the bike batteries.

○ Lock and unlock system

The lock and unlock system must be defined alongside the bike specification. This will depend on the service design as the system may be manual or automated. Despite being more complex, most schemes prefer to use automated lock and unlock systems. This is because they can make the scheme more usable and safer for operators and users alike. However, manual systems still exist where the bike is checked in and out by an attendant at the docking station. These are cheaper to start up than automated systems, but the long-term operating costs are usually far higher.

○ Docking stations modularity

There are two main types of stations: modular and permanent. Both offer pros and cons. Permanent stations are more robust and reliable. However, modular stations can be a good solution for less mature cities keen to explore appetite for bike share. They are also easy to move and relocate to where there is higher demand.

Both Milan and Lisbon's bike share schemes are station-based. This means that a user can pick up and drop off the bikes at a dedicated station. In both cases, the docks can receive both conventional and e-bikes. However, only in Lisbon, do they provide enough power to charge batteries, as the scheme was built from scratch. In Milan, e-bikes are charged by circulating vans, which swap the batteries and reallocate the bikes where needed.

	LISBON	MILAN
Lock/unlock system	• Electronic Via app	• Electronic Card RFID
Ability to charge e-bikes	Yes	No
Informative panel	• Marketing space	• Digital • Marketing space
Supplier	Órbita	BikeMI

Pictures of bike sharing docking system: Lisbon (modular docking stations) and Milan (permanent docking stations)

Service access

The service access represents how users interact with the scheme. As such, it is critical to the success of any bike sharing scheme. In terms of main principles, you must ensure that users are able to register, subscribe and make payments. Schemes should also include functions to make complaints or inform about defective equipment.

The service access is usually made up of two main components: an interface with user and a scheme management system.

On the public side, the front end should allow users to register or subscribe to the bike sharing scheme. Registration needs to be quick, simple and convenient. It should only include the information necessary for the operator-customer relationship. In addition, this front-end component should give users the ability and instructions to make payments. There are several viable and easy options you can use today such as credit / debit card, PayPal, ATM, etc.

The payment system must fulfil two main functions. During registration, taking a deposit can give the operator some protection against bike theft and damage. During operation, it must be able to collect payment for use of the

bike. The prices of both these functions vary significantly and should be adapted to the local context. In practice, they must serve two main user groups:

- long-term users, which use the scheme frequently; and

- casual users, who may use the system just once or for short periods of time (such as tourists).

Depending on these two purposes, service access may be based on different solutions. The most common is to use RFID card technology, such as smart cards or magnetic cards, or user codes to collect and return bikes. However, recent developments in data communications, mean that many of these systems can now lock and unlock the bikes remotely.

Service availability is another important part of service access. Daily service availability concerns the scheme's operating hours, while seasonal availability is influenced by climate and weather patterns. In colder cities, there is usually less demand in winter, while in hot cities demand tends to fall in summer. It's important to consider these variations in demand. They can be a good time to carry out maintenance or perhaps even close the scheme for certain periods of time. In the

case of privately operated schemes, it's thus vital to include agreements in the contract around scheme availability.

For most bike sharing schemes, the front end consists of websites and/or apps. The following sections explore the user interface in more detail.

On the operator's side, the management or back-end system, receives and processes registration and billing information from the user. This system usually embraces several other areas of data required to operate and manage the scheme. These include station monitoring, algorithms for redistributing bikes, faulty bikes and maintenance issues.

	Purpose	Main functions
Front-end	Interface with user	User registration, service subscription, payment, information on scheme assets and availability, customer service.
Back-end	Managing the scheme	Customer data management, billing, defective bikes and maintenance management, station and bike monitoring, redistribution planning, customer communications processing.

	LISBON	LONDON	MILAN
Subscription	App	E-Z Cycle Cycle scheme, operated by the Charlton Athletic Community Trust (CACT) via a website: https://cact.org.uk/courses/ez-bike-loan-scheme-	App Website Public transport information points Phone line
Payment method	ATM Paypal	One off payment	Credit card
Prices	Day – 2€ Mont – 15€ Year – 25€	£10/4weeks	Day – 4,5€ Week – 9,0€ Year – 36€
Access (pickup and drop-off)	App	Users collect/return e-bike in person at induction session	RFID card Codes Samsung Gear S3 with NFC
Age limitations	Over 18	Over 18	Over 18 (those aged 16-18 need parents/legal permission)
Service availability	Mon-Sun 6am-2am	24/7	Summer: Sun-Thu 7am-2am; Fri-Sat 24h/24h Winter: 7am-1am
Supplier	EMEL	Charlton Athletic Community Trust (CACT)	ATM and Clear Channel

Control system

Bike sharing schemes use two main types of control system: traditional / less automated and fully automated.

The **less automated schemes** are the simplest and easiest to run. They include fully manual schemes with no automation (requiring an attendant at every station recording the user's information and checking bikes in and out). They also include schemes with some automation (users can check bikes in and out using smart / magnetic cards and/ or paying electronically). Despite their simplicity, these schemes can be easy and cheap to maintain. In addition, they can improve customer service, boost service levels and reduce theft and vandalism. They also create jobs. However, while the initial costs are low compared to automated schemes, longer term they are higher due to the need for staff.

The **fully automated schemes benefit** from technological integration and recent developments in ICT. In practice, they represent the application of the Smart Cities concept in a real context. They offer a chance to explore how technology can be used both to manage the scheme and communicate with users. In such cases, the control system is a way to share and exchange information between all the scheme assets. For example, by allowing bikes and stations to communicate with the management and control centre. It also, to a large extent, enables communication with the customer through an app or website.

In terms of data transmission and communication, you should ensure your system integrates with those that may already exist in the city.

Despite higher start-up costs, automated schemes are far cheaper to operate in the long run. However, they also depend on a permanent communication system. If this fails, it can have a hug impact on service levels.

	LISBON	LONDON	MILAN
Bike to docks and vice versa	M2M connection proximity technology with RFID reading	NA	M2M connections, proximity technology with RFID reading and confirmation of the presence of metal via the coupling controllers
Dock/totem user	App	NA	RFID/ App
Bike device and dock to specific platform	SIM in e-bike battery	Google fit or manual tracking.	VPN for docks; SIM in the e-bike battery. The data is sent every minute, or every 50 metres travelled. Data transmitted charge level and GPS position
Specific platform to USP	API rest – HTTPS	API	API
Supplier	Tekever	None	Clear Channel

User interfaces

This is one of the main components of a bike sharing scheme. It is the main point of contact for a direct relationship between the operator and the user.

The concept of user interface varies hugely among bike sharing schemes. However, its main purpose is to make the interaction as simple as possible. The interface will depend on the scheme's aims and the context in which it operates. Consider using a range of information channels to communicate and raise awareness of the scheme. This will be shaped by which channels are most popular with your target customers.

Bike sharing schemes have always used channels like websites, advertising, newsletters, service centres and call centres. These may be a viable option for smaller and less automated schemes but can be costly to run as staff must update them.

More recently, some fully automated schemes have started using mobile apps which rely on real-time information. This gives the user a simple, interactive and convenient experience. Unlike traditional channels, it also allows access to a host of other useful information. For example, nearby docking stations, local availability of bikes, battery level, route planning etc – all depending on the user's location. In terms of costs, while apps may be expensive to develop, they're usually very cheap to run.

Each lighthouse city developed its own app to provide users with these services, with three main features:

1. People can find and look for available bikes nearby

This is a must-have and should be as easy as possible, so users can always find a bike.

2. The bike can be unlocked automatically

Unlocking the bike should be simple and take only a few seconds. Current solutions range from scanning a QR code on the bike to tapping the "unlock" button in the app.

3. Payment is simple and secure

This is vital for a user-friendly experience. You must also consider security issues such as personal credit/debit card data.
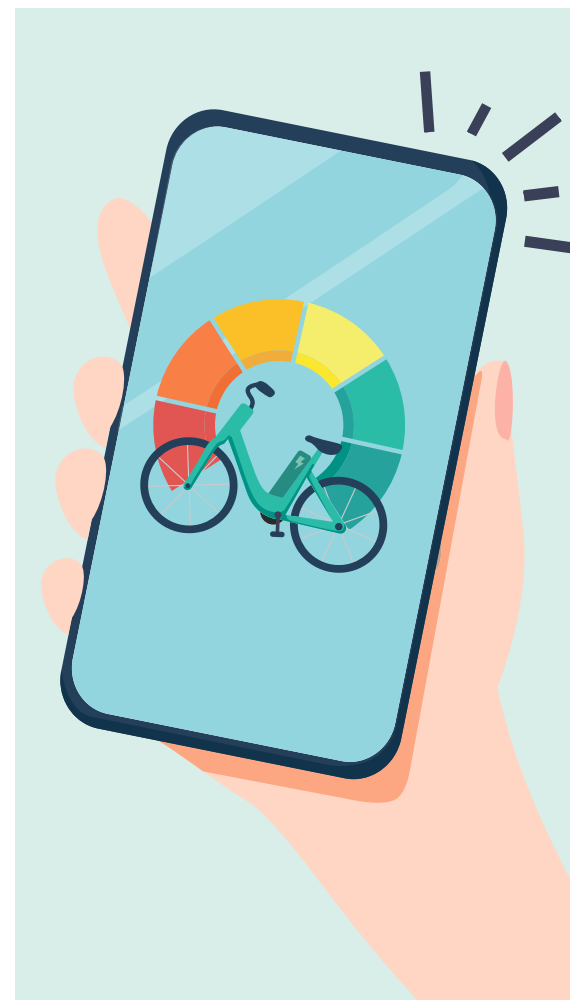
LISBON

GIRA developed an app for users to find available bikes through a map. It also offers a 'five star' rating system so users can feedback about the bike's condition. In addition, the app can be used as a google map to find out costs and when to go to a specific location.
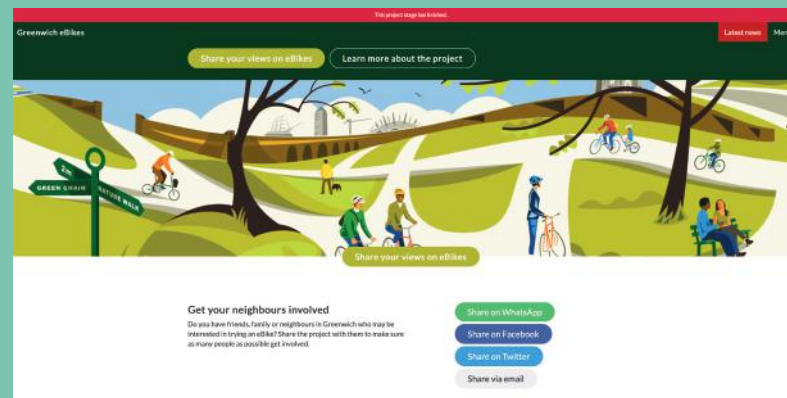
Screenshot of Lisbon's bike sharing appdocking stations
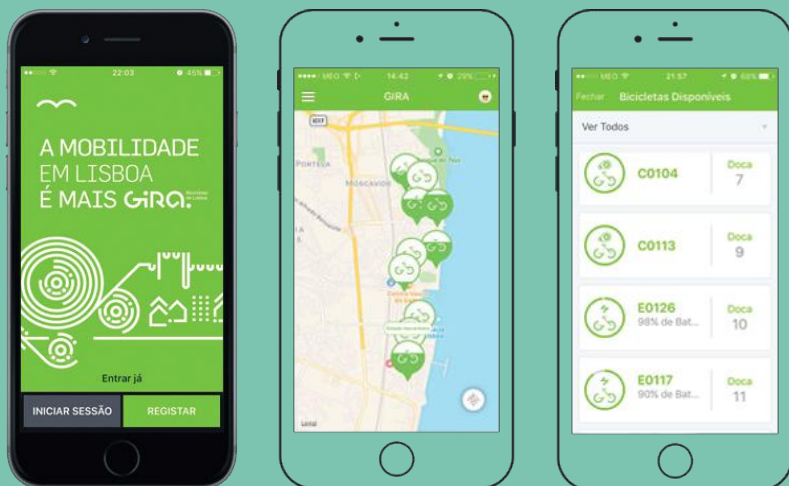
LONDON

Users can book bikes directly via the Greenwich.gov website. They also provide feedback on the council's commonplace platform which allows residents to have their say on local schemes and projects.

Greenwich portal for e-bikes

Greenwich e-bikes reviews on the commonplace platform

MILAN

The digital interface with users is through a website and smartphone app similar to Lisbon's.

Screenshots of Milan's bike sharing app and website
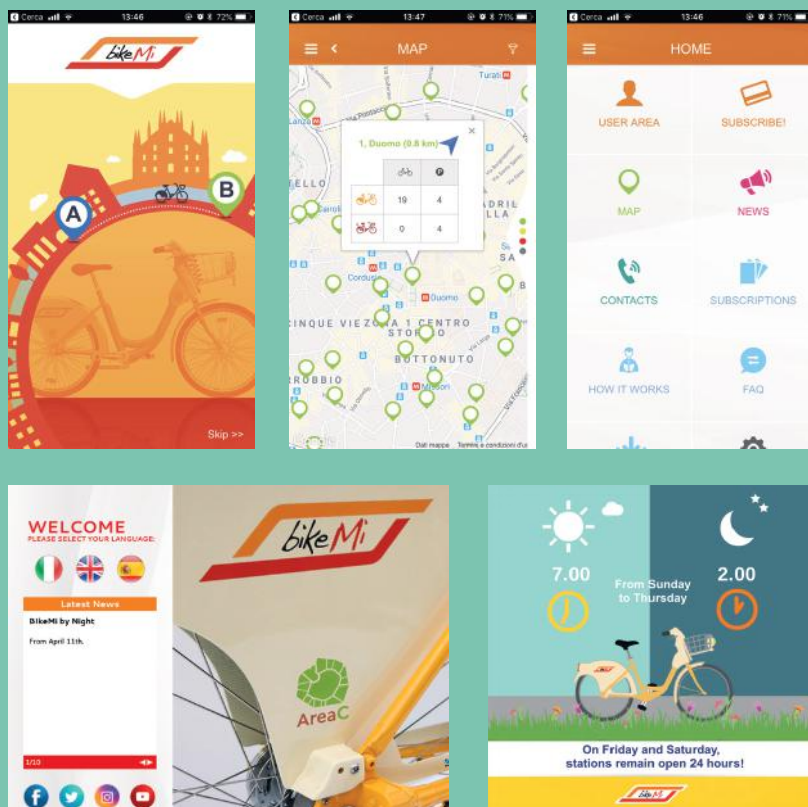
Finance and implementation

A range of business models have evolved for developing, operating and funding bike sharing schemes. Over the years, traditional public schemes, used to support public transport systems, have paved the way to private ownership of the schemes. More recently, public-private partnerships have developed which have shown to be even more successful. However, deciding which parts of the scheme should be public or private is not easy. This will depend on various factors including the city's specific needs, the context in which it operates and existing local structures. All need to be considered at the planning stage.

This section gives an overview of the existing business models and financing options for e-bike sharing schemes. It outlines the main things you should think about while preparing and defining a business plan.

Recommendations for developing a business model

The lighthouse cities' experience highlights several key recommendations, as follows:

Build and maintain strong relationships with your stakeholders early on:

Having close relationships with your stakeholders will make it easier to roll out the scheme. More importantly, it's vital to establishing contracts and agreements around data sharing, asset/network performance and actuation. These are all essential parts of a successful bike sharing scheme. By getting stakeholders involved as soon as possible, you can make best use of their know-how.

Use questions for the most relevant aspects you want to address:

Decision makers will want to know what options have been looked at before they make their decision. Posing questions can help you better understand the different existing options, and think critically about them. Lighthouse cities asked considered questions like:

- ✎ What policy outcome is being addressed?

- ✎ What customer problem or challenge is being addressed?

- ✎ Who is the target customer?

- ✎ What value is being delivered?

- ✎ How to understand, access, engage, encourage participation, and keen customers?

- ✎ How to define and differentiate the proposition? (vital in today's world)

Use templates to capture and collect information from everyone involved.

As well as engaging stakeholders, you must capture any lessons learned. Using templates can help you to collect a consistent and standardised set of data for different options. Templates should be simple and should focus on the core factors of the business model. These include asset scope, scheme scale, ownership, contracting considerations, service/infrastructure operating model, finance, funding, ROI, business model preferences.

Sharing Cities has reviewed the business model and financing approaches taken by these projects as well as other lighthouse programmes. We've created Business Model and Finance (BM&F) templates to help you outline the plans for each measure. See the next page for an example from London.

To contact Sharing Cities, email: **pmo@sharingcities.eu** or tweet **@CitiesSharing** for blank templates or more info about this tool.

Initiative Scope

	New	Existing
Hard Infrastructure	X	
'Soft' Infra	X	None
Digital Infra	X	

Asset Ownership

Current	Future
	RBG
None	RBG
	RBG

Operating Model

Current	Future
None	Public Run / Maintain

Initiative Scale

	Ph 1	Ph 2
Block		?
Community	15-20	same
District		
Pan-City		
City-Regn-City		

Life cycle Structuring

	D	P/C	I	O
	Design	Procure/Commiss	Install	Operate
Time	Mos	Mos	WKS	MONTHS
Phase 1	3	3	4	10

Business Model

Public Own/Operate	X
EPC	
PPP	
Concession	
Other	

Stakeholder RoI

	Invest't	Return
RBG	Funds	Cover Costs
Individual	Use/Data	
Actor 3		
(NB incl Value types)		

Finance Sources

EU grant/Str	€55,000
Natnl Public	
City Budget	In house
Loan	
PPP	Phase 1 funded under Mayr's LEN fund. Ph 2 will be ShC
Crowd	
Totals	Phase 1: €55,000

Funding Streams

Asset/Debt Transfer	
Public efficiencies	
Perform. Payments	
Revenue stream	£10/one-off user fee
Other	

Other Considerations

Investable model required if scale-up desired (not scope of Ph1).

Current model intended to cover costs in order to test the propensity of car users to shift to eBike.

Adoption requires MarComms

Minor data privacy issues (GDPR) require treatment (user locations)

SAMPLE

This captures key information around how the city aims to rollout the measure from a business model and financial perspective. It addresses:

- What will change between existing and planned measure implementation?
- What scope, ownership, operating model, scale is intended?
- How will the city go about design, procurement, rollout and operation and how much money (if known) does it plan to spend?
- What business model is (or options are) anticipated?
- Where the returns stream(s) will come from to pay back investments?
- The various stakeholder investments and returns (of all forms)
- Other considerations that may or may not be relevant for the city/measure combination.

What is a business model?

A business model is a high-level strategy to determine commercial viability. The key part is the value proposition. As with any product or service, the goal is to balance service provision – revenues and benefits – with resource allocation – capital and operational costs. So when planning a business model for bike share, you need to consider the scheme's desired utility alongside robustness, financially stability and risk mitigation. Your model should be both flexible to maximise potential for different sources of funding, and agile – able to adapt to changing circumstances.

In addition, it's also crucial to align the social needs, technical solutions with the business model and financing.

Which business model is best for my city?

There is no one size fits all model for e-bike schemes. However, it's important both to explore options, and have different options available for the city. Cities may also to lack the skills or market (investor) confidence. This can lead to otherwise good options being closed off. That is why this should be an iterative process. In other words, one that can / should be revisited and adapted over the next stages.

When developing a business model for a bike sharing scheme, you should consider three main elements: organisational structure, assets ownership and contracting structure.

❍ The scheme organisational structure

The organisational structure sets the relationship between all parties involved in the scheme's rollout and operation. Usually, this is created by the implementing entity (agency that makes bike share available), and the operator involved in the ownership, oversight, financing, operating and managing the scheme.

The implementing entity may be public, private, or a combination of the two, such as a public-private-partnership (PPP). However, regardless of the local authority's role, it should be actively involved at all stages of the project. That way it can influence decision making, define service levels and prioritise the scheme's utility to the city context and community. After launch, the implementing agency is usually responsible for managing and evaluating the operator's performance according to the defined service levels.

The operator is responsible for handling the daily operations of the e-bike sharing scheme. Its activities and duties include:

• managing and maintaining the e-bike sharing scheme

• ensuring availability of e-bikes and stations, namely by redistributing bikes whenever necessary to comply with service levels, and

• depending on the contract, may also handle customer service, payment processing, marketing, and general brand management.

There are cases in which a single entity (namely the local authority) plays both these roles. In such instances, it's vital to ensure that the local authority has the capability to do so. It is well known that public operators can be less cost efficient than private operators. At the same time, it's important to remember that private companies are primarily concerned with profitability. This focus can potentially hinder user and city needs.

○ Ownership of the scheme assets

Choosing an effective ownership model is key to rolling out an e-bike sharing scheme. This is because it is closely linked to control of the e-bike sharing scheme. There are various different ownership models available. The scheme assets (e-bikes, docking stations, IT systems, etc.) may be completely owned, shared, transferred, or licensed by the implementing entity. In practice it is the asset owner who determines the investment, and thus quality of the scheme.

Usually, the implementing entity defines ownership of the scheme assets. All e-bike sharing schemes are closely linked to the use of public space. As such the local authority must play an active role in this process, whether as implementing or regulatory body. Based on Sharing Cities' experiences, we recommend that the local authority always plays a role in the scheme.

The contracting structure

Decisions made around the scheme's organisational structure and assets ownership will shape its contracting structure. The three main types are show in the table below. These models may overlap depending on variations in ownership, scheme administration, and operation. Regardless of structure, the local authority should oversee the scheme rollout and monitor levels of service.

Bear in mind the type and the scope of contracts may also vary hugely. Putting all the contracts together means implementing entity only needs to deal with and manage a single contract and procurement process. On the other hand, separate contracts for different parts of the scheme may help to mitigate the risks of non-compliance. This is because the scheme will not depend on a single body.

Contracting structure	Provider(s)	Business model	Examples
Publicly owned and operated	• Local authority • Public agency • Public transport operator	A public agency or local authority plans, designs, rolls out and runs the scheme. This entity is responsible for all scheme assets, and the financial risk lies only with the city.	Aarhus Bycykel (Denmark) Call a Bike (Germany) Bicing (Spain) OV-Fiets (Netherlands) Vélos jaunes (France) Bicibur (Spain) E-Z Cycle (Greenwich)
Public transport operator	• Local authority • Advertising company	A public agency or local authority owns the assets and is responsible for funding and managing the scheme. Day to day running is contracted to a private entity, usually through a fee-for-service model or in exchange for advertising rights.	Bicincittà (Italy) Cyclocity (France) Onroll (Spain) ITCL (Spain) GIRA (Lisbon) Clear Channel (Milan)
Publicly owned and privately operated	• Private company	A private entity plans, designs, rolls out and runs the scheme. The local authority grants the rights to public space, with assets and running costs owned by the operator.	Nextbike (Germany)

Contract length is another import thing to consider as it can have a big impact on the scheme's efficiency and service quality. The contract shouldn't be too long. This will give the implementing entity flexibility to find a new operator in case of poor performance. Neither should the contract be too short. This will ensure the operator is motivated to procure high-quality assets. The main problem with the latter, is that assets depreciate quickly, and this may compromise the return on investment. The result is that the operator may choose cheaper solutions affecting the service quality. For this reason, the length of contracts should be closely linked to the lifespan of the chosen assets.

	LONDON	MILAN
Contract duration in lighthouse cities (in years)	The Royal Borough of Greenwich, owned the bikes and equipment, and contracted an external party to deliver and manage the loan scheme. This includes a total of 30 bikes. The contract will run for two years.	The first e-bike contract was signed in February 2015 to expire in April 2017, then renewed until October 2020.

It is clear there are pros and cons to each of the contracting structures and business models. These are summed up in the following table >

Contracting structure	Advantages	Disadvantages
Publicly owned and operated	• Complete control of legal and public assets needed to make the scheme a success. Motive is only to run a high-quality system. Puts the user and utility of the scheme first.	• Potential lack of expertise in establishing bike sharing scheme. • Frequently financially constrained. • Normally below-average business focus.
Public transport operator	• All logistics handled by the private sector partner. • Public owned and substantially controlled during the main stages of project. • Reduced performance risk and operation details. • Retained control of public spaces.	• Risk of public backlash to increased levels of advertising. • Difficult to enforce performance standards.
Publicly owned and privately operated	• All logistics and operation details handled by the private sector. • Usually achieves a high level of efficiency.	• Profit-oriented, potentially hindering user and city needs. • Limited ability to push for policy and planning changes. • May reduce its efficiency due to financial constraints or suboptimal contractual conditions. • Loss of potential revenues from advertising.

Below is a summary of the operational models used by the three lighthouse cities:

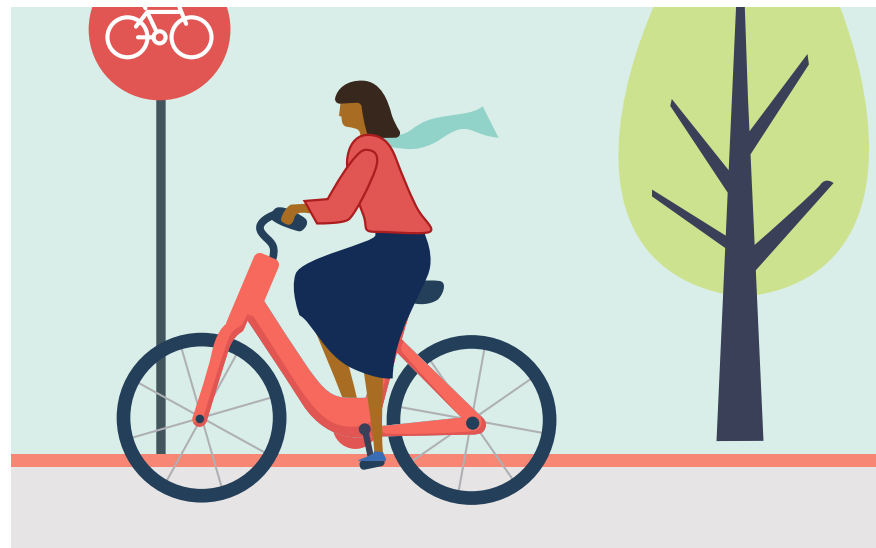|	LISBON	LONDON	MILAN
Contracting structure	Publicly owned and privately operated	Publicly owned and privately operated	Publicly owned and privately operated
Implementing entity	EMEL – the Lisbon Mobility Municipal Company	Royal Borough of Greenwich	Commune di Milano/Azienda Trasporti Milanesi
Operation	Private operator	Private operator	Private operator
Operation model	Fee-for-service model	Fee-for-service model	Fee-for-service model
Asset ownership	Implementing entity	Implementing entity	Implementing entity
Assets supply	Private operator	Private operator	Private operator
Maintenance	Made by the private operator	Made by the private operator	Made by the private operator
Contract management	Performance based on minimum requirements and service levels defined in the contract	Performance based on minimum requirements and service levels defined in the contract	Performance based on minimum requirements and service levels defined in the contract

How to calculate the scheme financial costs and revenues?

The costs of launching a bike scheme can vary hugely depending on its size, the desired services and the chosen technical solutions. Regardless, you must assess the scheme profitability, by quantifying costs and identifying the best approaches to revenues.

Generally, there are two main types of costs a bike sharing scheme must consider:

- Capital costs – representing the initial investment required for the scheme assets and components.

- Operational costs – representing all costs related to the management, administration and operation of the scheme.

When quantifying these costs and revenues, you need to consider the following:

	Component	Description
Capital costs	Bikes	Despite being usually a small part of the total capital costs, bikes costs vary significantly. This will depend on several factors including the local environment and the scheme's technical requirements. In addition, a city may require specific solutions from the branding point of view. For instance, you may need to create a strong identity to differentiate the scheme from others. All these aspects add to costs. A single bike can vary in price from 100€ to as much as 2,000€.
	Docking stations	Docking stations often represent the largest share of the total capital costs of a scheme. Small schemes tend to use low-tech (without significant monitoring devices) and cheap to install docking stations (without elaborate groundworks). However, these schemes can be more expensive to run in the long term, in particular regarding the bike's redistribution costs.
	Software	While not mandatory, the software can significantly boost scheme use, at the frontend, and operation, at the backend. It can be either bought, developed or licensed. Each option will have a different impact on the capital costs.
	Operation resources	The operational resources represent all assets needed for the scheme's proper operation. Depending on the design and specifications, these can include: • control centres, where bike sharing scheme management activities are based • bike depots to store the bikes while being repaired • mobile maintenance units to quickly respond to malfunctions or repairs • redistribution vehicles to move the bikes.
Operational costs	Staff costs	These include all personnel costs around the control, management, maintenance, redistribution, and customer service of the scheme. There is an economy of scale, with staffing costs far lower when running more automated schemes.
	Maintenance costs	This is usually a big part of the operational costs, but is also key to the scheme's reliability. As such, you should plan both preventative and corrective maintenance activities as it can be a good way to reduce costs.
	Redistribution costs	If not considered properly, redistribution or relocation management can substantially increase operational costs. As a result, this can impact the scheme's profitability. Usually, it represents around 30 per cent of the operational costs. It is also critical to the scheme's viability from the customer's viewpoint.
	Customer service costs	Customer service costs depend highly on the type of service the scheme provides. Usually, fully staffed models are a huge operational cost burden. However, they may provide for more appraisal and personalised services.

	Component	Description
Operational costs	Marketing and communication costs	Scheme marketing and comms campaigns range from simple printed materials to elaborate multi-channel campaigns across media. It is usual to provide a website and social media for the scheme to support user engagement.
	Insurance costs	Insurance against accident and theft are an essential part of any bike sharing scheme. Given the potential risk of legal liability, the scheme should imply a contractual relationship between user and operator.
Revenues	Use fees	These are the fees charged to use the scheme and bike. This can vary significantly depending on the scheme's strategy. As such, it's important to carefully plan the pricing models and consider its benefits and potential impacts or disadvantages. Several schemes have different pricing options according to time periods (hour, day, week, month or year). This encourages use at off-peak times. Some schemes have a subscription fee, requiring the user to first register before they can use the scheme.
	Sponsorship	This is about sharing image, name and/or scheme branding with a sponsoring entity. Individual assets can be valued differently and separated. The sponsoring entity may even be the owner of the asset. However, this may limit the potential income from advertising – which can be more profitable in certain cases.
	Advertisements	Bike frames and parts, as well as the docking stations provide visible spaces which can be used for advertising.

Introduction

Challenge & Solution

Insights

Benefits

Implementation Toolkit

How to rollout an e-bike scheme

In both Lisbon and London, the schemes' costs are distributed as follows:

LISBON

LONDON

- Maintenance
- Stations and bikes acquisition and installation
- Management and relocation costs

- Maintenance
- Assets
- Relocation Management

Scheme costs are distributed as follows in Milan, Lisbon and London:

100   100
                    80

        20

LISBON   LONDON   MILAN

- Usage fare
- Advertising

What funding sources are available?

There are several types of funding resources. Cities may also take different routes to raise and structure financing for e-bike sharing schemes. This will vary according to volume, geography (which my favour certain models) and the technical solution chosen.

Below are examples of the type of financing mechanisms cities often use when it comes to rolling out bike share. It's important to remember that regardless of the source of funding, it must be part of a long-term commitment to the scheme.

○ Public funding

Public funds are often used to cover capital costs in cases where the local authorities own the scheme assets. They often use national, regional or local governments funds that are earmarked for sustainable development activities, innovative ideas or even specific mobility solutions. The nature of these funds can vary according to place and time. Their source may also be related to the negative impacts of other forms of transport. So for example, funds may be raised from parking fees, congestion charges or advertising. In addition, e-bike sharing schemes generally cannot cover all operating costs through membership and use fees alone. As such, public funding mechanisms may be attractive, particularly when local authorities actively participate in the whole process.

○ Loan financing

Loan financing is offered by many of the market players. This includes banks and lenders, but also equipment manufacturers, vendors or contractors. Loans are commonly used to cover the initial investment costs, particularly for e-bike schemes run by private entities. In these cases, revenue models musts be designed to also cover debt servicing.

○ Private investment

The private sector owns several assets in a city. As such, private finance can be used to create new assets or change existing ones. Importantly, public sector policy can influence when, how and on what such money is invested. These instruments include regulation, fiscal mechanisms, grants, and standards. All can be used to achieve sustainable policy outcomes. Private entities may also be willing to contribute to the e-bike sharing scheme capital costs, for instance to ensure stations on or near their premises. Good examples are universities or property developers who are willing to increase the development's marketability. However, the most common private investment in the bike sharing schemes realm is through advertising. In such models, the scheme is completed or partially contracted with the city's outdoor advertising. This means running costs are subsidised by advertising revenues.

○ Grant funding

This is relevant in the public sector (as it was for Sharing Cities) with project costs being partially covered by public funds. This is typically used to stimulate action in priority policy areas. The drawback is it can lead to the market relying on 'free' money. This can inhibit innovation and fail to account for the full asset lifecycle.

○ Crowdfunding

This is a very different model to the above. It means getting public backing (via funding pledges) to finance a scheme or initiative they support. Through digital engagement, this process can be simple and so is becoming more common. Crowdfunding is often match-funded by city/public investment.

What are the main factors influencing the scheme profitability?

There are three main key factors to take into account:

○ Location of stations

Where stations are located is vital to ensure the scheme is well used and financially viable. As previously mentioned, station-based schemes have several advantages, such as high visibility in public space, use readiness and bike availability. Stations should be located so that they are at regular and convenient intervals across the city. They should also be in places that will generate use throughout the day. City topography is also an important factor, as elevated sites are often used as a source for a ride rather than the destination. For this reason, you should also plan location according to the continuous need for redistribution.

○ Maintenance costs

Maintenance costs are usually a big part of the operational costs. As such, you must plan both preventative and corrective maintenance activities (repairs) as this can be a good way to cut costs. It's important to consider these at the planning and design stage too, especially when choosing the bike and station specifications. Investing in better quality and maintenance processes may cost more, but over the long term it can be cheaper. This is due to longer lifespan and lower maintenance costs. Your decision should be based on a trade-off between purchase costs and maintenance costs over the lifespan of the scheme assets.

○ Bikes redistribution management costs

Managing redistribution and recharging batteries can be expensive. This can make the scheme unprofitable if you don't get it right. Both types of bike share model will lead to unbalanced demand. That means

to ensure maximum use, the operator must relocate bikes to where they are needed. Redistribution costs can represent around 30 per cent of the overall operational costs.

LISBON / Real-time incentive-based system

To improve the level of service around bike availability, Lisbon developed a user-based bike reallocation system based on monetary rewards. This real-time incentive-based system generates offers for users to start trips from busy stations/areas and end trips where docking stations are empty. In turn, this reduced running costs.

Implementation – pilots and large-scale rollout

Once you've determined the specification of the e-bike sharing scheme, you can procure services for the pilot and roll-out stages.

Get in touch with Sharing Cities for more details on procurement procedures and example documentation from the lighthouse cities: email: **pmo@sharingcities.eu** or tweet **@CitiesSharing**

This section sums up the pilots and large-scale rollout of the three lighthouse cities e-bike sharing schemes.

LISBON / Building on a traditional public scheme

Pilot description: The scheme now has 810 bikes, 50 per cent of which are e-bikes, and 81 docking stations. Lisbon plans to expand the scheme further, especially in the residential suburbs. Bikes are reallocated using vans. Incentives are offered for users to drop-off their bikes in at least 70 per cent free docking stations (or pick-up from at least 70 per cent full stations). Users can check bike availability and station occupancy rates through the app. They are rewarded with points that are then transferred and 'banked' as minutes for using the bike sharing scheme. To ensure the service is affordable to all, the price is fixed for the first 45 minutes, and increases after.
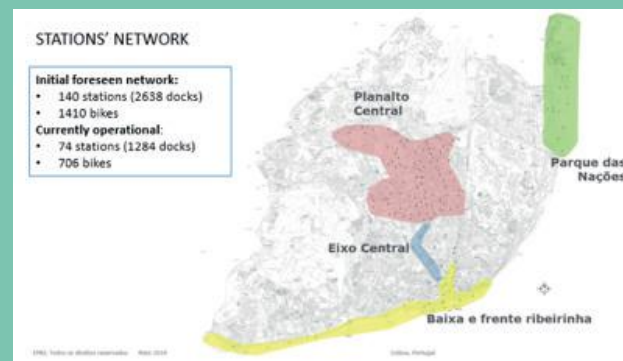
Figure 13 Lisbon bike sharing: map of stations' network. Source: EMEL

Future plans: Lisbon wants to further expand e-bikes across the city, especially in the suburbs. There was a substantial extension of bike lanes over the last decade and these are expected to double (to almost 200km) by 2022.

LONDON

Pilot description: As Greenwich developed its e-bike share, several dockless bike share schemes were launched in London. The borough believed this showed that dockless was the business model of the future for e-bike share. Dockless operators provide bike share systems at zero cost to boroughs, with no need for fixed infrastructure which requires space and maintenance. Greenwich was concerned that a docking station model for e-bike sharing would fail. That is why Greenwich chose to run an e-bike share scheme in two phases so as to better explore user demand and needs.

Phase 1 ran for 12 months and required the supplier to provide both capital assets and project management for the scheme. Both were evaluated from a quality perspective, accounting for 70 per cent of the overall score, while the remainder was price. Four bids were received, and the winner was London Cycling Campaign.

Residents borrowed an e-bike for one month for just £10 (to cover insurance). This gave them a chance to see how it could help them to travel further and more sustainably. Residents had the chance to buy an e-bike at a discount after their loan period ended. A fleet of 16 bikes were made available for residents who could collect or return their bike at monthly e-bike loan sessions. To maximise the opportunity of modal shift from driving, priority was given to residents with cars who did not currently cycle. Data on use was collected via a journey tracking app, or by users recording their trips in a diary. This provided insights into their behaviour change.

Future plans: Greenwich is developing a phase 2 e-bike share project. The borough had originally wanted to pursue a docked mode. However, the emergence of dockless e-bike share showed there was a smarter, more flexible and cost-effective solution. The borough plans to boost the current fleet to 30 e-bikes and expand the scheme to cover a wider geographical area. E-bike share will also be linked to the borough's cycle training programme.

## MILAN / Building on a traditional public scheme

Pilot description: Milan used its regular bike sharing scheme to test e-bikes. In the scheme, users take a bike from one dock and nominate drop-off at another through the BikeMi app or BikeMi card. Bikes are reallocated using vans. The aim is to ensure the service is available from all the stations in the network (by providing bikes at peak hours for empty stations and moving bikes from full stations so users can find empty docks to leave bikes). Docks do not directly recharge e-bikes. Instead, the vans carry charged batteries as they circulate between docks.

In 2016, some 86 per cent of bikes picked up were regular and 14 per cent were e-bikes (with a fleet of 3,650 normal bikes and 1,000 e-bikes). On working weekdays, the number of pick-ups is fairly constant. However, this tends to fall at weekends. This shows the service is mainly used for daily commuting/trips during weekdays (and working hours). As such, it's an effective solution for daily mobility rather than leisure activity. The city has bought 150 e-bikes with a child seat to encourage parents with young children to use the scheme.

The below map details the scale of the Sharing Cities pilot in Milan. Green squares indicate where dock stations were installed as part of the Sharing Cities pilot. Red squares indicate further expansion plans by the municipality, and red circles highlight stations already active in the pilot areas.
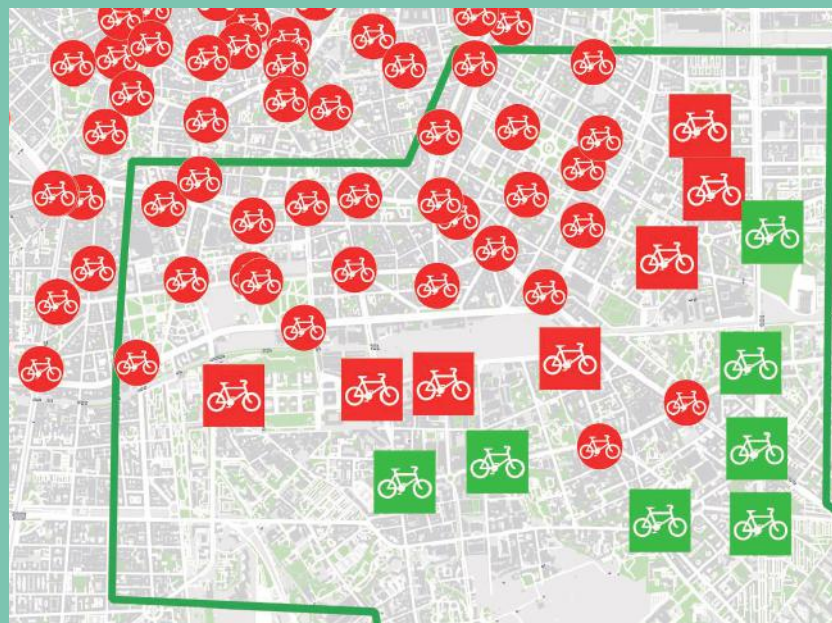
Map of bike sharing stations in the Porta Romana - Vettabbia district of Milan

Monitoring and sharing

Putting in a good monitoring framework at the start of rollout will help ensure the scheme provides value through its operation phase. Data collected locally can inform methods and allow you to understand, quantify and evaluate the scheme's impacts. These insights can be used to boost performance and highlight areas for improvement.

How you carry out performance monitoring, depends largely on the scheme's sensing capability and features. For example, if a scheme uses docking stations, e-bike movement can be indirectly monitored by collecting docking station data. Conversely, for dockless schemes, e-bikes location is monitored via GPS. Gathering movement data, can help an operator improve the running features of a scheme. For example, demand patterns can be linked to a specific location and a specific time. An operator can increase use of e-bikes by providing enough bikes where and when demand is anticipated. However, travel demand patterns tend to differ between weekdays and weekends and change as new activities appear in a city. It is therefore vital to follow this dynamic nature of travel demand. This is also closely linked to the reallocation capability of e-bikes, expansion strategies, and strategies for e-bike recharging.

In addition, good monitoring will offer insights into popular travel routes and travel features. E-bikes encourage users to merge with other traffic. But they are used more when riders feel safe. Identifying popular e-bike routes (which typically differ from conventional bike routes) highlights where improvements can deliver most value.

Common monitoring framework

Adopting a common monitoring framework means you can compare metrics with other similar schemes globally, and easily identify where performance can be improved. CITYKeys is a performance monitoring framework funded by the EU's HORIZON 2020 programme. It has worked with cities to create and validate key performance indicators and data collection procedures. By so doing, CITYKeys has enabled common and transparent monitoring and easy comparison of smart solutions across European cities.

Find out more at: **www.citykeys-project.eu/citykeys/project**

Sharing Cities also developed a common monitoring framework to evaluate performance of all its smart city projects. In terms of e-bikes, this framework is looking at the following themes:

○ Technical characteristics that focus on levels of scheme use, and its operational characteristics both from use and operator standpoint. Technical metrics include:

- the numbers of enrolled and active users

- the daily hires and distance travelled

- the average trip distance and speed

- frequency of vehicle / docking station maintenance required.

Most technical characteristics data can be collected automatically via platform monitoring, docking station sensors and/or bike GPS sensors. Technical evaluation is key as these datasets also mean that

mobility patterns can be tracked using scheme vehicles. These can provide insights into locations of high demand and popular routes, thus enabling the scheme's optimal operation.

○ User and citizen attitudes and behaviours are very dynamic in a city environment. They also continuously change as citizens engage with new transport modes and services or as new activities appear. This category aims to identify and track citizen and user concerns around e-bike use such as safety and address them. It also means the operator can better understand where the scheme is encouraging modal shift and the rate at which this is being achieved. In order to analyse the attitudes and behaviours of users and citizens, you must first understand their mobility patterns. This knowledge typically extends beyond the scheme. There are an increasing number of digital tools available to capture individual mobility patterns. However, this is mainly measured through surveys and travel diary questionnaires.

○ Wider systemic and economic impacts focus on a high-level analysis of a scheme's performance. This includes in terms of financial viability, road safety, travel congestion, air quality and reductions in emissions. Monitoring such impacts is typically not part of an e-bike scheme but done in collaboration with other city functions. It's important to monitor the e-bike scheme's impacts within each of the above categories. For instance, when capturing road safety, vehicle classification should include e-bike (or at least bike).

○ Institutional and social impacts are increasingly significant for cities. You can monitor an e-bike scheme's impact on accessibility and social inclusion by linking the number of users (or level of use) to socio-economic indicators (like individual or household

income). These statistics are typically available at borough level, so technical characteristics data needs to be similar so it is comparable.

○ Other independent variables like the length of the road network, roadworks and weather conditions may also influence the scheme's operation and performance. As such, it's useful to keep track of these factors as they might explain user and citizen mobility and/or behavioural patterns.

Get in touch with Sharing Cities: Email **pmo@sharingcities.eu** or reach out to us on Twitter **@CitiesSharing** for blank templates or more information about this tool.

Key metrics for an e-bike sharing scheme

Six themes have been identified for evaluating an e-bike scheme:

- Cycling (participation) to modal split.

- Carbon emissions reduction.

- Road incidents.

- Traffic congestion/travel speed and travel speed by mode.

- Length of cycling network.

- Cost and revenues.

- City image.

A complete list of indicators used by the Sharing Cities pilots is in the table on the next page.

KPI	Theme	Aggregation level
User participation/vehicle (or infrastructure) use	Technical	Scheme
Vehicle maintenance	Technical	Scheme
Level of mobility	Technical	Citizen, Scheme, City
Level of green mobility	Technical	Citizen, Scheme, City
Level of shared mobility	Technical	Citizen, Scheme, City
Level of public transport use	Technical	Citizen, Scheme, City
Level of incentivisation	Technical	Scheme
Type of incentivisation	Technical	Scheme
Accessibility to parking	Technical	City
Fleet utilisation/management	Technical	Scheme, City
User (mobility) satisfaction	Attitude	Scheme
Stakeholder/User satisfaction	Attitude	Household, Building, Scheme
Travel purpose	Attitude	Citizen, Scheme
Local weather	System	City
Modal split	System	City
Cost of travel	System	Scheme, City
Speed of travel/Travel time	System	Scheme, City

KPI	Theme	Aggregation level
Travel safety	System	City
Healthy living	System	Citizen, City
Financial viability/ costs and revenues	System	Household, Building, Scheme
Solution replication	System	City, Global
Carbon emissions	System	City
Procurement mechanism	Institutional/ Social	City
City image	Institutional/ Social	City
Authorities engagement	Institutional/ Social	Scheme, City
Accessibility of green mobility	Institutional/ Social	Scheme, City
Accessibility of shared mobility	Institutional/ Social	Scheme, City
Accessibility of public transport/ Length of network	Institutional/ Social	City
Local topography	Independent	City
Road network size	Independent	City
Population density	Independent	City

References

1   https://ecf.com/sites/ecf.com/files/EUCS_full_doc_small_file.pdf

2   http://content.tfl.gov.uk/attitudes-to-cycling-2014-report.pdf

3   https://www.sciencedaily.com/releases/2015/05/150520083254.htm

4   http://www.businessinsider.com/the-bike-sharing-market-is-growing-charts-2018-4

5   Cairns et al., Physical activity of electric bicycle users compared to conventional bicycle users and non-cyclists: Insights based on health and transport data from an online survey in seven European cities

6   Norton, P., & Hughes, M. (2017). Public Consultation and Community Involvement in Planning. Abingdon: Routledge.

7   Mayfield, P. (2013). Practical People Engagement: Leading Change Through the Power of Relationships (illustrated ed.). Elbereth Publishing.

8   British Standards Institution, 2017

9   SNV-SN EN 15194+A1 Cycles – Electrically power assisted cycles – EPAC Bicycles

Acknowledgements

Photography

SUPPORTED BY

MAYOR OF LONDON

ROYAL borough of GREENWICH

LISBOA CÂMARA MUNICIPAL

Comune di Milano

AGENZIA MOBILITÀ AMBIENTE TERRITORIO

ATM

CEiiA

emel

CATAPULT Future Cities

Imperial College London

LISBOA e-nova AGÊNCIA DE ENERGIA E AMBIENTE DE LISBOA

UrbanDNA innovate incubate accelerate