European Platform on Sustainable Urban Mobility Plans

TOPIC GUIDE:

ELECTRIFICATION

Planning for electric road transport in the SUMP context

Imprint

About:

This Topic Guide has been developed within the framework of the SUMPs-Up project, funded under the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 690669

Citation:

Polis, and Rupprecht Consult - Forschung & Beratung GmbH (eds). 2019. Topic Guide: Electrification- planning for electric road transport in the SUMP context.

Authors:

Thomas Mourey, Polis; Henning Günter, Wolfgang Backhaus, Rupprecht Consult

Contributers:

Ivo Cre, Sergio Fernández Balaguer, Michael Glotz-Richter, Geir Rossebø, Lucy Sadler, Jillian van der Gaag

Reviewers:

Zlatko Kregar, Piotr Rapacz, Fabio Tomasi, Isabelle Vandoorne, Alexander Verduyn, Axel Volkery, Reggie Tricker

Acknowledgement:

This publication is made possible thanks to the contributions made by organisations involved in the SUMPs-Up project, all of whom are credited for their respective contributions.

Design and Layout:

Saydrina Ann Govender

Contacts:

European Commission

Directorate-General for Mobility and Transport

Unit B4 - Sustainable & Intelligent Transport

Rue Jean-Andre de Mot 28

B-1049 Brussels

September 2019

Contents

"Integrating electric mobility in a sustainable urban mobility planning strategy does not equate to simply replacing diesel and petrol vehicles with their electric counterparts."

Guide to the reader

This document provides guidance on a specific topic related to Sustainable Urban Mobility Planning (SUMP). It is based on the concept of SUMP, as outlined by the European Commission's Urban Mobility Package1 and described in detail in the European SUMP Guidelines (second edition)2.

Sustainable Urban Mobility Planning is a strategic and integrated approach for dealing with the complexity of urban transport. Its core goal is to improve accessibility and quality of life by achieving a shift towards sustainable mobility. SUMP advocates for fact-based decision making guided by a long-term vision for sustainable mobility. As key components, this requires a thorough assessment of the current situation and future trends, a widely supported common vision with strategic objectives, and an integrated set of regulatory, promotional, financial, technical and infrastructure measures to deliver the objectives – whose implementation should be accompanied by reliable monitoring and evaluation.

In contrast to traditional planning approaches, SUMP places particular emphasis on the involvement of citizens and stakeholders, the coordination of policies between sectors (transport, land use, environment, economic development, social policy, health, safety, energy, etc.), and a broad cooperation across different layers of government and with private actors.

This document is part of a compendium of guides and briefings that complement the newly updated second edition of the SUMP Guidelines. They elaborate difficult planning aspects in more detail, provide guidance for specific contexts, or focus on important policy fields. Two types of documents exist: While 'Topic Guides' provide comprehensive planning recommendations on established topics, 'Practitioner Briefings' are less elaborate documents addressing emerging topics with a higher level of uncertainty.

Guides and briefings on how to address the following topics in a SUMP process are published together with the second edition of the SUMP Guidelines in 2019:

- Planning process: Participation; Monitoring and evaluation; Institutional cooperation; Measure selection; Action planning; Funding and financing; Procurement.

- Contexts: Metropolitan regions; Polycentric regions; Smaller cities; National support.

- Policy fields: Safety; Health; Energy (SECAPs); Logistics; Walking; Cycling; Parking; Shared mobility; Mobility as a Service; Intelligent Transport Systems; Electrification; Access regulation; Automation.

They are part of a growing knowledge base that will be regularly updated with new guidance. All the latest documents can always be found in the 'Mobility Plans' section of the European Commission's urban mobility portal Eltis (www.eltis.org).

1 Annex 1 of COM(2013) 91

2 Rupprecht Consult - Forschung & Beratung GmbH (editor), 2019 Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition.

NB: Recharging is the term used in the Directive 2014/94/EU on the deployment of alternative fuels infrastructure. In this topic guide and most widely in the technical literature the term *charging* is well established and is used as a synonym for recharging.

Executive summary

Urban road traffic and the use of conventionally-fuelled vehicles account for a large part of the harmful emissions of air pollutants, greenhouse gases and noise. These problems are a major concern for many European local authorities as they have a severe impact on public health and cause thousands of deaths; contribute to climate change; and undermine the quality of life in our cities. To decrease these emissions, mobility planning authorities need to promote and enable a shift towards collective, shared and active mobility modes.

The electrification of road vehicles complements the necessary modal shift by enabling a cleaner form of mobility.

Electric vehicles (EVs) for the transport of both passengers and goods have the potential to substantially cut the above-mentioned emissions from road traffic.

Because of these specific reasons, this Topic Guide focuses exclusively on the electrification of road transport, understood as the use of battery electric vehicles and hybrid vehicles. The use of other alternative fuels, and in particular hydrogen which provides similar benefits to battery-electric vehicles, are considered as complement to electric vehicles (EVs). Other alternative fuels will be covered in future SUMP guides.

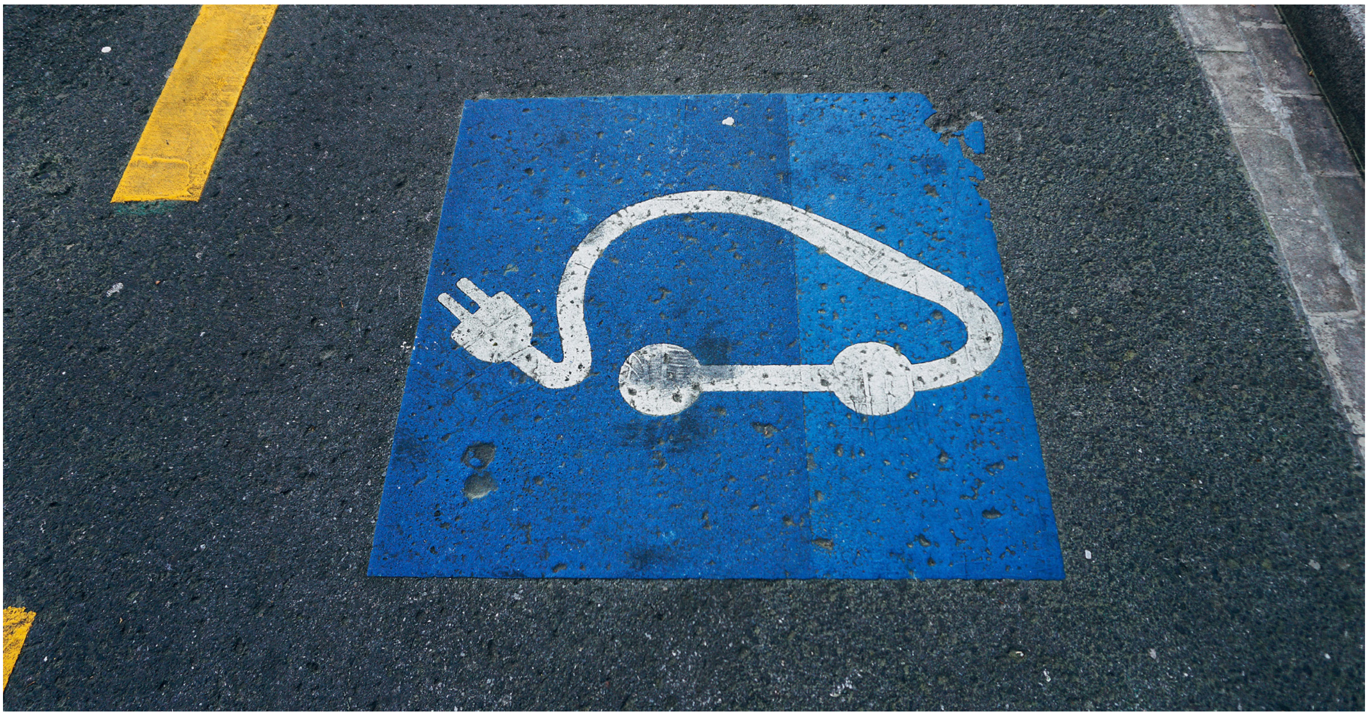
This topic guide is intended to support authorities in planning electric mobility solutions as an intergral part of a SUMP process.

It is not intended to be a technical guide to the deployment of Alternative Fuels Infrastructure (AFI). Rather, its aim it to guide mobility planning authorities in the process of how the electrification of road transport can be carried out in accordance with the eight main SUMP principles following the different steps of the SUMP cycle.

The guide covers a variety of topics including the planning for charging infrastructure, planning for the electrification of various fleet types and vehicles as well as guidance on regulatory and policy measures that can be implemented by mobility planning authorities to support a wide electrification of road transport.[3] The guide also gives examples of tools and methods as well as a selection of good practices from leading European cities in e-mobility.

[3] The Topic Guide does not cover urban rail mobility due to the very different requirements and operational conditions.

"Exclusive focus on the electrification of road transportation."



1. Introduction

1.1 Urban road transport's effects on air and noise emissions

The transport sector and, in particular, urban road traffic is a major contributor to the emissions of pollutants and noise in Europe. According to the European Commission, the transport sector is responsible *"for almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities"*[4]. Additionally, the European Environment Agency (EEA) states that road traffic *"is by far the largest source of noise pollution in Europe"*[5]. A large part of these emissions and noises are created by conventionally-fuelled vehicles which represent the large majority of vehicles in operation in European cities.

1.1.1 Transport, air pollution and public health

Air pollution is an important issue in the European Union Air pollution is an important issue in the European Union as it is estimated to have a significantly negative impact on public health. In particular, the emission of fine particles which are less than or equal to 2.5 microns in diameter, also known as $PM_{2.5}$, have a particularly negative impact on human health. According to the EEA, the emissions of $PM_{2.5}$, together with the emissions of NO_2 and O_3 are responsible for more than 480,000 premature deaths annually[6].

Most of the particulate matters and other pollutants are emitted by burning fossil fuel, for different economic activities, including transport. The emissions of the urban road traffic sector are particularly harmful as they are affecting areas where the population is concentrated and therefore more exposed to air pollution. A study of the International Council on Clean Transportation (ICCT)[7] shows that in European countries like France, Italy or Germany, between 70% and 75% of the deaths caused by the emissions from the transport sector are due to road transport in particular. Conventionally-fuelled vehicles consuming fossil fuels (i.e. petrol and diesel) and used for passenger and goods transport are the main source of pollution. . Diesel emissions are identified as particularly harmful for human health and are responsible for two thirds of transport-related deaths in the above-mentioned countries. In this context, the European Union has adopted directives to reduce the emission of pollutants. Directive 2008/50/EC on ambient

[4] European Commission, Transport emissions, https://ec.europa.eu/clima/policies/transport_en#tab-0-0

[5] EEA Briefing, Managing exposure to noise in Europe, 2017, https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-in-europe-updated-population-exposure

[6] EEA Report, Air quality in Europe — 2018 report, 2018, https://www.eea.europa.eu//publications/air-quality-in-europe-2018

[7] Anenberg, S.; Miller, J.; Henze, D.; Minjares, R., A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015, 2019, https://www.theicct.org/sites/default/files/publications/Global_health_impacts_transport_emissions_2010-2015_20190226.pdf

air quality and cleaner air for Europe[8] sets objectives regarding the maximum concentrations of air polluting substances, including e.g. $PM_{2.5}$, NO_2 and O_3. Furthermore, Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants[9] requires that all member states develop and adopt national air pollution control programmes and monitor and report regularly the emissions of these pollutants.

1.1.2 Transport, greenhouse gases and climate change

Alongside the emission of previously-mentioned air pollutants, the transport sector is also responsible for the emissions of greenhouse gases which contribute to climate change. In 2016, this sector accounted for 27% of the total greenhouse gas emissions in the EU. Road transport accounts for 72% of the greenhouse gas emissions of the whole transport sector. Furthermore, transport is the only sector which has not seen a decline in its CO_2 emissions, compared to 1990. According to the EEA, the emissions of greenhouse gases of the transport sector in the EU have increased by 28% between 1990 and 2017[10].

The emission of greenhouse gases is the main reason for climate change. It is estimated that if emissions are not cut substantially by the end of this century, global warming will exceed 2°C and could reach 5°C as compared to the pre-industrial era.

In this context, and even more since the signature of the Paris agreement[11], the European Union works to reach ambitious goals to limit global warming to a maximum of 2°C. The EU intends to decrease its emissions by 20% by 2020, by 40% by 2030 compared to the emission levels of 1990[12] and calls for a carbon-neutral Europe by 2050[13]. Given its contribution to the total emissions of greenhouse gases, transport is one of the key sectors which must take action and decrease its emissions.

At the local level, the EU encourages municipalities to participate in the Covenant of Mayors for Climate & Energy[14]. By signing the agreement, municipalities commit to adopt a Sustainable Energy and Climate Action Plan (SECAP) in which they determine the measures to be taken at the local level to decrease the emissions by 40% by 2040.

1.1.3 Transport, noise and quality of life

In addition to the above-mentioned air emissions, road transport contributes significantly to noise emissions. According to the EEA, it is estimated that over 100 million Europeans are exposed to harmful levels of noise (i.e. above 55 dB). The urban road transport activities alone are affecting more than 75,000 residents in the EU[15]. The noise emitted by urban road traffic depends not only on the type of engines but also on the type of road surfaces, the traffic volume or the traffic speed. In urban areas where the average speed is generally low and vehicles are often static, the noise emitted by engines accounts for a substantial share of the total noise created by traffic.

Noise pollution has a negative impact on the quality of life in cities for both residents, workers and tourists. For residents who are exposed to sound pollution over long periods of time during days and nights, *"road noise is linked to a wide range of health issues including sleep disturbance, annoyance and negative effects on the cardiovascular system and metabolism."*[16]

The European Union has adopted the Environmental Noise Directive (Directive 2002/49/EC)[17] which requires Member States to publish noise maps and noise management action plans every five years, for the most critical areas, including urban agglomerations above 100,000 inhabitants.

---

[8] Directive 2008/50/EC on ambient air quality and cleaner air for Europe, 2008, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1486474738782&uri=CELEX:02008L0050-20150918

[9] Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants, 2016, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32016L2284

[10] EEA, Greenhouse gas emissions from transport, 2018, https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-11

[11] European Commission, Paris Agreement, https://ec.europa.eu/clima/policies/international/negotiations/paris_en

[12] European Commission, EU Climate Action, https://ec.europa.eu/clima/citizens/eu_en#tab-0-0

[13] European Commission, 2050 long-term strategy, https://ec.europa.eu/clima/policies/strategies/2050_en

[14] Covenant of Mayors website, https://www.covenantofmayors.eu/en/

[15] EEA, Population exposure to environmental noise, 2018, https://www.eea.europa.eu/data-and-maps/indicators/exposure-to-and-annoyance-by-2/assessment-3

[16] EEA, Electric vehicles from life cycle and circular economy perspectives, 2018, https://www.eea.europa.eu/publications/electric-vehicles-from-life-cycle

[17] Directive 2002/49/EC on the assessment and management of environmental noise, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002L0049

1.2 Adapting our mobility patterns to the challenges posed by air and noise emissions

1.2.1 How to address climate, air and noise issues caused by transport

To address the issues caused by air and noise emissions in urban areas, mobility planning authorities must encourage the use of cleaner and quieter modes of transport. To achieve this, planning authorities can choose among a wide-range of solutions which are complementary, and reinforce each other for reaching the goals of a cleaner air, decarbonisation and an improved quality of life.

In this context, the modal shift of passenger transport from individual motorised vehicles towards active mobility (i.e. walking and cycling[18]), public transport and other forms of shared mobility[19] may deliver an alternative to using a private car. Additionally, car sharing is an alternative to owning a car. This could for instance be encouraged by expanding pedestrian zones, improving cycling lanes within cities and investments in better and more public transport.

Likewise, for urban logistics, a shift from conventionally-fuelled cars, vans and trucks to less polluting and noisy vehicles (e.g. cargo bikes, electric vans, electric trucks) or to rail-based transport can help to mitigate the issues related to the emissions of pollutants, greenhouse gases and noise. This shift could, for instance, be encouraged through the implementation of low emission zones or urban vehicle access regulations[20] (e.g. setting specific limits for vans and trucks).

A modal shift must also be reinforced by the improvement of the environmental footprint of the remaining vehicles in urban areas. In this respect, the use of alternative fuels is particularly relevant, and electricity and hydrogen in particular offer the advantages of producing zero tailpipe emissions and emitting less noise. Therefore, the use of these alternative propellants contribute greatly to the reduction of emissions. Current diesel and petrol engines' air and noise emissions would not be produced by e.g. electric engines.

1.2.2 The electrification of transport in a SUMP context

The electrification of urban transport is developing rapidly in European cities and emerges as a major trend in the urban mobility sector. This trend is accompanied by the creation of a market which is developing quickly and makes the electrification of transport a reality.

Given its rather recent development, e-mobility was not specifically addressed in the original version of the SUMP guidelines (2013) and deserves to be covered in the present guide. Although e-mobility is a cross-cutting topic, covering public transport, urban freight, shared mobility, private mobility, micro-mobility and even active mobility (e.g. electric bicycles or scooters), integrating e-mobility in a sustainable urban mobility planning strategy does not equate to 'simply' replacing diesel and petrol vehicles with their electric counterparts.

A number of issues and specificities must be tackled, including the provision of charging infrastructure, the cooperation with a wide range of stakeholders, the procurement of new fleets by public authorities and transport operators, adapted parking regulations and the management of regulations and privileges for EV users. Urban rail transport is not specifically addressed in this guide as this sector deals with different vehicle requirements and operational specifications.

This guide will highlight the main issues related to the introduction of e-mobility in the urban road transport sector and on the deployment of the related charging infrastructure. Guidance given in this guide covers an area which is relatively recent, which develops rapidly and for which still many uncertainties exist regarding potential benefits, costs and the development of the market.

1.3 Overview and market situation of e-mobility in Europe

The development of e-mobility still varies widely across Europe, depending on vehicle type and region. On the one hand, the share of EVs in newly registered passenger cars is still very low in most EU Member States. In 2018,

---

[18] Further guidance on planning for cycling can be found in the practitioner briefing: Supporting and encouraging cycling in sustainable urban mobility planning
https://www.eltis.org/guidelines/second-edition-sump-guidelines.

[19] Further guidance on planning for shared mobility can be found in the topic guide: Integration of shared mobility approaches in sustainable urban mobility planning
https://www.eltis.org/guidelines/second-edition-sump-guidelines.

[20] Further guidance on vehicle access regulation can be found in the topic guide: Urban Vehicle Access Regulations and sustainable urban mobility planning
https://www.eltis.org/guidelines/second-edition-sump-guidelines.

EV sales– including both Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs)– represented a 2% market share in the EU. On the other hand, the positive effects of a targeted promotion of EVs, such as in Norway and Sweden, are already clearly visible. Norway is the leading European market for EVs (49% of new vehicle sales). Other top European markets include Sweden (8%), the Netherlands (6.7%), Finland (4.7%) and Portugal (3.4%)[21].

While the average share of EVs remains rather low, the market is expected to increase rapidly in the coming years, starting from 2020 when many car manufacturers will introduce new EV models on the market. To accelerate this process, the EU regulation 2019/631 introduces an incentive mechanism for the production of zero- and low-emission vehicles (ZLEVs are vehicles emitting less than 50g of CO2 per km). This regulation sets thean objective for every manufacturer to sell at least 15% of ZLEVs (cars and vans) yearly[22].

According to a study by Transport and Environment, the EV share is even expected to increase up to 22% of new vehicle sales in 2025 (13% BEVs and 9% PHEVs). Additionally, thanks to technology improvements, the capacity of batteries is growing and the range of EVs is expanding, making fully electric BEVs more attractive for consumers and relevant for an increasing number of trip types and context conditions. Therefore, among EVs, fully electric BEVs are expected to represent a majority of vehicles sold by 2025, compared to 41% in 2019.[23]

Cities must plan sufficiently in advance for this advent of EVs and especially BEVs, as it will require a significant increase in the deployment of charging infrastructure. It is expected that there will be about 220.000 publicly accessible chargers available in the EU by 2020, at a ratio of 10 vehicles for every single publicly accessible charging point[24] (in 2019, there is a ratio of 9:1)[25]. A distinction needs to be made between fast and slow charging which is based on the charging capacity and type. The charging power currently ranges from 3 kW to 350 kW with the potential of higher charging powers (e.g. up to 450kW) currently being explored in European research projects[26].

Generally, chargers are divided into two types, AC and DC. In AC charging technology, the energy is transferred by alternating current, in DC by direct current. The charging technology primarily affects the charging time of a vehicle. AC systems provide power up to 43 kW. DC systems achieve charging capacities of 50 to 350 kW today, and likely much more in the future, e.g. for heavy-duty applications. If the vehicle's battery allows the charging time per kilowatt hour (kWh) can be significantly reduced at high charging capacities. The charging times range from approx. 8 hours at domestic AC sockets (slow charging) to a few minutes at DC charging stations (fast and ultra-fast charging).

Whereas charging of electric cars mainly occurs with plug-in cables, certain models now also propose inductive or wireless charging. Moreover, new charging technologies are available or being explored for charging of electric buses (overhead charging) and heavy-duty vehicles, including charging with the help of pantographs (going-up, going-down, pantograph below vehicle) and also inductive charging while driving, through a charging rail built into the road. These technologies will have specific requirements and, therefore, impacts for urban planners.

While 80% of bus fleets in Europe are still running with diesel engines, the share of battery-electric buses is expected to grow substantially in the coming years with 19% in 2020 and 35% in 2025.[27] The recently revised Clean Vehicles Directive[28] sets minimum procurement targets for each category of vehicle and for each Member State. For buses, individual Member State targets range from 29 % to 50 % (2025) and from 43 % to 75 % (2030). Accordingly, many European cities have already announced ambitious plans to electrify their bus fleets. Even if electrification is stimulating the development of

[21] Transport & Environment, 2019, Carmakers' electric car plans across Europe 2019-2025

[22] Regulation (EU) 2019/631 on CO2 emission performance standards for new passenger cars and for new light commercial vehicles, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0631

[23] Transport & Environment, 2019, Carmakers' electric car plans across Europe 2019-2025

[24] Transport & Environment, 2018, Roll-out of public EV charging infrastructure in the EU. Is the chicken and egg dilemma resolved?

[25] EAFO, https://www.eafo.eu/countries/european-union/23640/summary

[26] ASSURED project: https://assured-project.eu/

[27] ZeEUS eBus Report, 2017, https://zeeus.eu/uploads/publications/documents/zeeus-ebus-report-2.pdf

[28] Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, https://eur-lex.europa.eu/eli/dir/2019/1161/oj

new industries and the growth of existing ones, a higher production capacity by the manufacturers is still needed[29].

As regards commercial and heavy-duty freight vehicles, the market of electric vehicles is expected to increase globally, and mostly in Europe, on a mid-term horizon. The overall market for electric vans and trucks could reach 21 to 29% of new sales by 2030.[30] However, this take-up is initially expected to concern primarily the vans sector with a much slower predicted uptake of heavy-duty vehicles (>16t), in particular those operating on long-haul routes. This is mainly explained by the lack of available models in that segment.

E-bike sales including e-cargo bike sales are showing strong growth in parts of Europe[31] and this trend is expected to continue as the availability of e-bikes becomes more widespread and commonplace in bike retailers. Use of private e-bikes largely relies upon users disconnecting the battery from the vehicle and charging it remotely, although there are some examples of on-street charging and dedicated charging points within shops and restaurants emerging as well as a few examples of multi-modal charging stations. Shared e-bike mobility operators provide either charging at fixed docking locations, or alternatively rely on vehicle collection or battery swapping. The management of battery swapping itself for example in maintaining shared e-scooter fleets, can be a significant source of vehicles emission in itself depending on the standards of the collection vehicles used.

[29] ELIPTIC Policy Recommendations, 2018, http://www.eliptic-project.eu/sites/default/files/ELIPTIC%20Policy%20recommendations_FINAL_LowRes_0.pdf

[30] Tryggestad, C.; Sharma, N.; van de Staaij, J.; Keizer, A., 2017, New reality: electric trucks and their implications on energy demand, https://www.mckinseyenergyinsights.com/insights/new-reality-electric-trucks-and-their-implications-on-energy-demand/

[31] GreenCharge, Electric mobility in SUMP, 2018, https://www.greencharge2020.eu/wp-content/uploads/2019/06/leaflet_GreenCharge_e-mobility_and_SUMP.pdf

2. The 8 SUMP principles in the context of the electrification of transport

The European SUMP guidelines are based on eight key principles which underpin the Sustainable Urban Mobility Planning approach. These eight SUMP principles are listed below:

1. Plan for sustainable mobility in the 'functional city'
2. Develop a long-term vision and a clear implementation plan
3. Assess current and future performance
4. Develop all transport modes in an integrated manner
5. Cooperate across institutional boundaries
6. Involve citizens and relevant stakeholders
7. Arrange for monitoring and evaluation
8. Assure quality

These principles must apply to the different facets of a SUMP, including the electrification of transport.

2.1 Plan for sustainable mobility in the 'functional city'

Sustainable urban mobility plans must cover areas corresponding to the actual mobility patterns and activities of residents. The definition of this zone should be made according to an analysis of mobility data. The 'functional city' does not necessarily correspond to the boundaries of the administrative local authority and includes residential areas and/or activity centres which must be linked to the core of the city. This is particularly important as it is especially commuters from the urban hinterland who rely heavily on using their own car to get to work and thus contribute significantly to congestion and air pollution in urban areas.

This principle relates to the fact that traffic emissions do not stop at administrative borders and e-mobility must therefore be implemented at the scale of the functional city. The analysis of air and noise pollution should help to identify the priority areas for the measures which primarily aims at making air cleaner. For instance, the electrification of buses should be done in priority on bus lines which run through heavily-polluted and/or densely populated areas. Additionally, the network of charging[32] infrastructure must be extensive enough to allow for a trip all across a functional city.

Relevant questions for planners:

- How do institutional and governance structures in local authorities the need to plan for e-mobility and electric charging infrastructure?
- At which institutional level(s) does e-mobility need to be addressed in order to effectively respond to the urban mobility challenges?

2.2 Develop a long-term vision and clear implementation plan

The development of a clear implementation plan for the short to medium term is the first step to reach longer-term objectives and goals, informed by a mobility vision for the city. This reflects the need for both effective actions on the short term and for efficient policies on the longer term.

When planning for the electrification of transport, the mobility planning authorities must clearly identify in its long-term vision the main objective(s) that are intended to be reached through corresponding measures. It should be clear that e-mobility is a means to an end and not a goal in itself. In most cities, the main reasons for implementing e-mobility solutions are the improvement of air quality, a reduction of noise, a decrease in greenhouse gas emissions or a combination of those. Therefore, a holistic and comprehensive mobility vision should be developed of which e-mobility can be one integral element only.

The implementation plan must set the ground for the installation of the e-mobility basis and indicate clearly the plan for the first measures, responding to the most urgent issues.

Relevant questions for planners:

- How does the introduction of e-mobility align with different institutional goals and a city's vision?
- What are the first steps to take to set the ground for the introduction of e-mobility?

[32] Recharging is the term used in the Directive 2014/94/EU on the deployment of alternative fuels infrastructure. In this topic guide and most widely in the technical literature the term *charging* is well established and is used as a synonym for recharging.

2.3 Assess current and future performance

It is important to define clear performance objectives as well as performance indicators to be able to measure achievements. The measurement of emissions of pollutants, greenhouse gases and noise is essential to assess improvements. It is important to include some indicators that are strictly related to e-mobility to assess both its contribution to certain goals and its impact on the overall mobility situation (e.g. parking, space usage, congestion).
Most digital tools that are used to measure and monitor impacts (e.g. air quality) include fleet composition parameters, translating the presence and use of EVs directly into modelling outcomes.

Relevant questions for planners:
- How to assess the effects of EVs on urban mobility and environmental goals?
- Which type of indicators should be selected?

2.4 Develop all transport modes in an integrated manner

The fourth SUMP principle states that *"Sustainable Urban Mobility Plans foster a balanced and integrated development of all relevant transport modes, while encouraging a shift towards more sustainable modes."*[33] This principle applies for the transport of both goods and passengers.

E-mobility is a cross-cutting topic covering a wide range of urban road modes and has the potential to support the shift to new sustainable modes. The electrification of buses has a huge potential for decreasing the emissions of the public transport sector. Likewise, the electrification of vans and trucks can reduce the current high emission levels of urban logistics.

As more models become available on the market, car, bike and scooter-sharing operators increasingly integrate EVs in their fleets. E-mobility can even make some active modes more accessible to certain groups of people. Electrically assisted bicycles allow older people and commuters to cycle and/or extend the average distance travelled by bicycle, especially in hilly areas.
As not all trips can be replaced with shared vehicles or public transport, the electrification of privately-owned vehicles is a crucial policy step in achieving a significant electrification of urban transport and reaching the associated benefits.
However, it should be borne in mind that advancing e-mobility may have negative impacts on other modes: e.g. public charging infrastructure might (but should be designed not to) decrease the space allocated to walking and cycling, and additional costs may arise from providing charging infrastructure for electric buses, etc. Such issues should be openly discussed with relevant stakeholders and the general public.

Relevant questions for planners:
- How to ensure a consistent electrification of the different transport modes and that the development of a charging infrastructure network is beneficial to all modes?
- What synergies between different modes can be found when planning for charging infrastructure, e.g. between different heavy-duty vehicles (buses, trucks, etc.)?

2.5 Cooperate across institutional boundaries

An integrated approach with a high level of cooperation and consultation between different levels of government and relevant authorities is required to implement a sustainable urban mobility plan. By its nature, this encompasses different fields of activity and is implemented at the scale of the 'functional city'. That is why cooperation must be carried out both on a horizontal (i.e. across sectoral departments of the planning authorities) and a vertical level (i.e. with smaller, larger and/or neighbouring authorities).

While the regulation of the use of vehicles is mainly managed by the mobility department, the regulation and management of issues related to the electricity grid – including for charging purposes - depends on the department responsible for energy. Likewise, although the measures are implemented by the mobility department, the main benefits of those measures (i.e. a decrease of emissions) primarily concerns the targets of the environmental department.

Therefore, the development of new cooperation methods and frameworks (formal or informal) with the departments for energy and the environment, at all stages of the planning process is crucial for the

[33] Further information about the SUMP principles can be found in the second edition of the European SUMP guidelines, https://www.eltis.org/guidelines/second-edition-sump-guidelines

successful implementation of e-mobility measures. Cooperation with additional departments needs also be sought for other aspects, e.g. urban planning/land use (for the deployment of charging infrastructure), finance (for the taxation system), etc.
A close cooperation with neighbouring municipalities, the inner-city districts and the provincial and/or regional authorities is necessary to plan and implement an extensive and regional charging network.
(for the taxation system), etc.
A close cooperation with neighbouring municipalities, the inner-city districts and the provincial and/or regional authorities is necessary to plan and implement an extensive and regional charging network.

Relevant questions for planners:

- Which institutions and departments must be involved in e-mobility planning?
- How do institutional structures in local/regional authorities need to change to address planning for e-mobility? What are the most adapted cooperation methods and/or frameworks?
- How can a consistent approach towards the development of a regional charging network be ensured?

2.6 Involve citizens and relevant stakeholders

Sustainable urban mobility planning is a fundamentally participative process as SUMPs are implemented to better respond to the mobility needs of people and stakeholders. Citizens and relevant stakeholders must therefore be involved at the different stages of the SUMP cycle for consultation purposes but also to create a feeling of ownership on the process. Citizens and stakeholders from various sectors and fields are able to provide support and services in the implementation of measures.
As air quality, climate change and quality of life are increasingly important for citizens and non-government associations - to the degree that they opt for legal action against authorities that are considered not to be taking enough action against air pollution - their consultation and involvement allows to present the SUMP as a key process to decrease emissions. Information, consultation and involvement of citizens can be achieved in a dedicated and recognisable e-mobility framework.
As much as it is required to involve the energy department of the municipality, a cooperation with stakeholders of the energy sector should be ensured for the successful deployment of e-mobility. Energy and mobility have, by and large, been two worlds apart due to little overlaps. A much closer cooperation needs to be ensured now at all stages of the SUMP process. Stakeholders from the energy sector include, among others, grid operators, energy producers, utility companies and charging infrastructure operators.
Citizens and stakeholders cannot only contribute to the design of policies but also be involved in the implementation of these. In the end, they will be the ones (co-)owning e-mobility assets (i.e. vehicles and charging infrastructures) and using (shared) e-mobility services.

Relevant questions for planners:

- How should authorities engage with relevant stakeholders and citizens? How to ensure this in a framework?
- How can cities facilitate a participatory dialogue about a topic with still many uncertainties?

2.7 Arrange for monitoring and evaluation

Monitoring and evaluation are regular activities to assess "*the progress towards the objectives of the plan and the targets*"[34]. The monitoring activity is very much dependent on the availability of data and statistics. The evaluation can then be made in analysing the evolution of the indicators, towards the completion of goals.
E-mobility must be carefully monitored and evaluated; the impact of e-mobility (the measure) on air quality, decarbonisation of transport and noise pollution (the long-term goals) must be assessed so that the mobility planning authority can modify its e-mobility strategy accordingly.

Relevant questions for planners:

- What are the right Key Performance Indicators (KPIs) for monitoring the performances of e-mobility measures?
- How should the effects of e-mobility be measured and assessed, knowing that there still is a high degree of uncertainties?

2.8 Assure quality

Quality assurance is required to make sure that the local SUMPs are built in accordance with the sustainable urban mobility planning concept and that they are

[34] Further information about the SUMP principles can be found in the second edition of the European SUMP guidelines, https://www.eltis.org/guidelines/second-edition-sump-guidelines

delivering the expected measures and results. This process can be completed by an external body to allow for more objectivity and transparency.

The quality assurance process must of course be applied to the electrification of transport. This control also provides a necessary pressure on the mobility planning authority and ensures that the electrification of transport is responding to all the above-mentioned SUMP principles and is well-integrated in the overall planning approach.

Relevant questions for planners:

- How to plan effectively and make informed decisions on an uncertain and still developing topic?
- How to plan for innovations (even before their deployment)?

3. Sustainable urban mobility planning steps for the electrification of transport

Planning for and advancing the electrification of transport is a cross-cutting activity which cannot be allocated neither to a specific quadrant of the SUMP cycle nor to certain steps. This process must follow the entire SUMP cycles and its steps.

This chapter highlights how to integrate the electrification of transport in some of the SUMP cycle phases and steps which are identified as particularly relevant or complex for e-mobility. In addition, relevant activities regarding the planning of charging infrastructure, as an essential prerequisite for the larger uptake of e-mobility solutions, are highlighted.

Figure 1. The SUMP Cycle (SUMP 2.0). A planner's overview of the 12 steps of Sustainable Urban Mobility Planning

3.1 Preparation and analysis

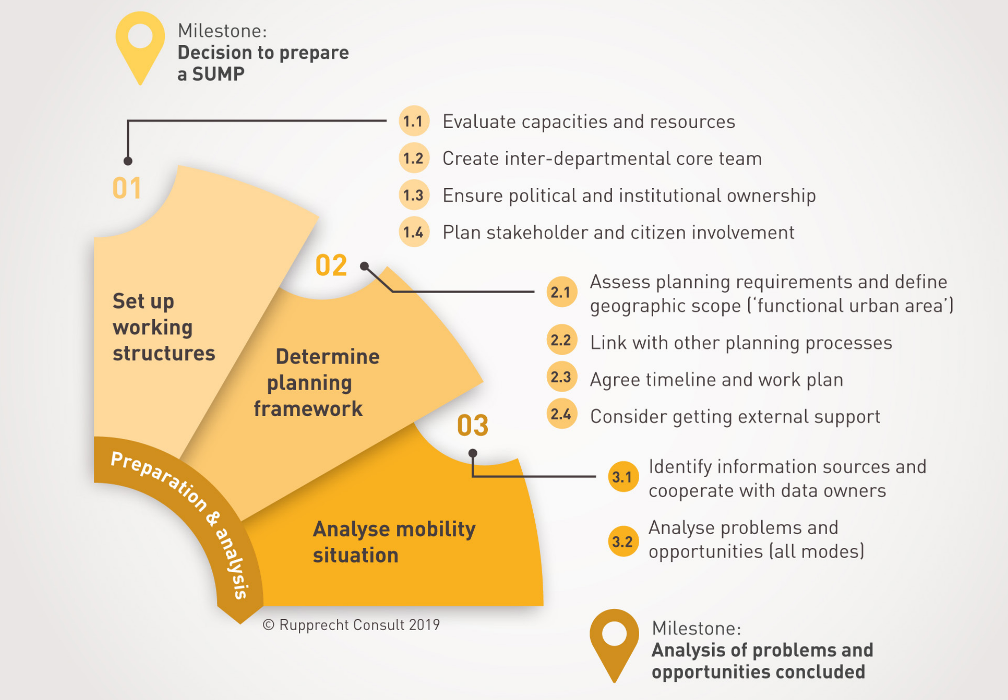


Figure 2: Phase "Preparation and analysis" (SUMP 2.0)

The first quadrant of the SUMP cycle starts with the decision to prepare a (new) SUMP and should conclude with the clear definition of the mobility problems and opportunities. This is the phase during which the mobility planning authority prepares the ground for the development and implementation of the SUMP.

Planning for e-mobility often starts with the need for improving air quality and reducing greenhouse gas emissions in urban areas. The identification of road traffic emissions as an issue for the city is often made by analysing air quality data (**steps 3.1 & 3.2**) and the comparison of data with the WHO (2005)[30] and EU standards (2008)[31] . Electrifying transport is a solution among others to tackle these issues.

Mobility planning authorities should identify - both internally and externally - the relevant entities which are able to provide the necessary capacities, skills and experience that are currently missing in the mobility planning team (step 1.1). This especially holds true for those entities that are related to the management and operation of the energy grids. In other words, the mobility "ecosystem" must be associated with the energy "ecosystem" in order to plan in an integrated manner.

Internally, the cooperation with the energy department is necessary. Other capacities and entities can be involved as well, such as the environmental department which has the necessary skills and tools to assess the impact of e-mobility on the decrease of traffic emissions (**step 1.2**), the urban-planning department for planning the deployment of infrastructure, or the finance departments for the tax issues. Cooperation frameworks between the transport and energy departments (and others if relevant) include the integration of a representative of the energy department in the SUMP core team, regular ad-hoc meetings (e.g. bi-weekly) between the departments, or the co-ownership on an e-mobility platform or strategy. Externally, the involvement of entities in charge of managing and operating the electricity grid and the charging infrastructure should be ensured from the very beginning of the SUMP process (**step 1.4**). The following stakeholders are often involved: energy producers, grid operators, utility companies and charging infrastructure operators, public transport operators, transport companies (i.e. freight operators, taxis drivers), EV manufacturers and the public, especially drivers, EV users and their representatives (e.g. consumer associations and EV associations). In addition, the involvement of representatives of neighbouring municipalities and the regional (or national) level is required to ensure a consistent implementation of e-mobility solutions for e.g. commuters, visitors or simply residents for their

[35] World Health Organisation, WHO Air Quality guidelines, for particulate matter, ozone, nitrogen, dioxide and sufur dioxide, 2005

[36] DIRECTIVE 2008/50/EC on ambient air quality and cleaner air for Europe, 2008.

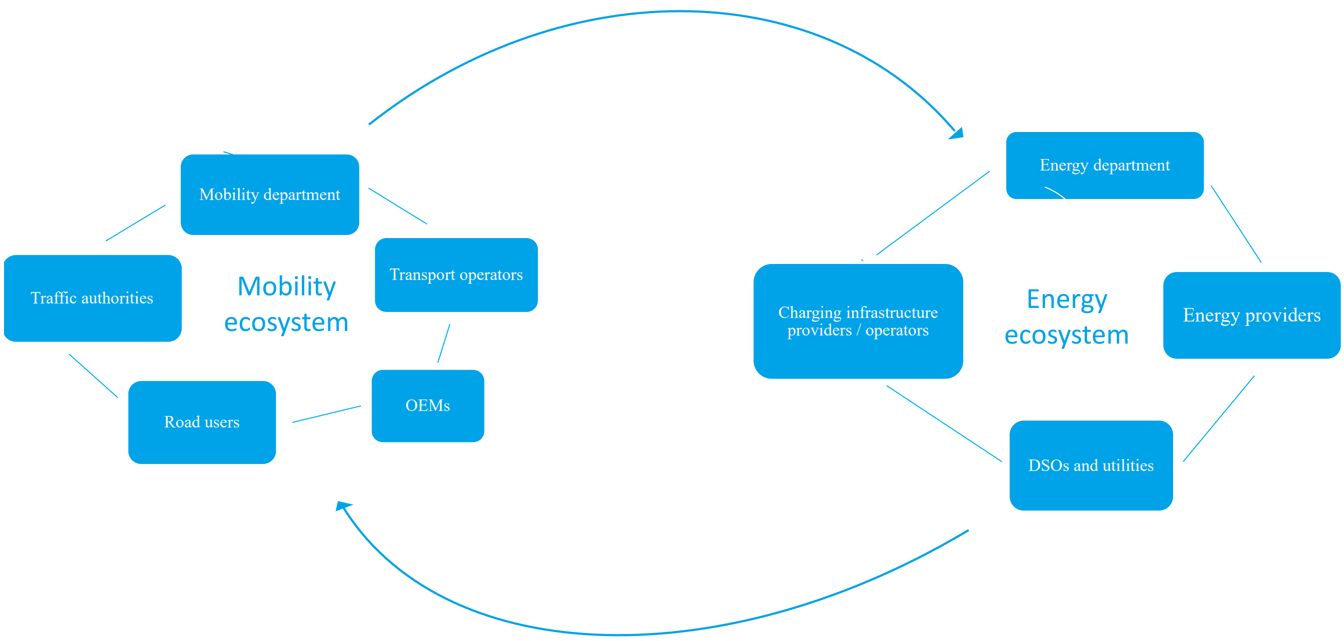


Figure 3: The e-mobility ecosystem

occasional trips outside the city. To facilitate the discussions, the involvement of stakeholders can be made in the framework of a dedicated e-mobility strategy which is clearly identifiable and which complement the SUMP (more information in section 3.3).In particular, analysing the users' needs is a crucial element of e-mobility planning, especially for charging infrastructure. So far, designing and planning of e-mobility solutions has been primarily technology- and cost-driven. However, to reach a critical mass of EV uptake, it is important to comprehensively understand the (objective and subjective) needs, preferences and concerns of potential mass users of e-mobility.

Important measures to be taken at this stage are:

- To identify the relevant stakeholders in order to improve the planning process in the context of the demand of different user groups;
- To characterise the mobility demand of different user groups' habits and needs for a better understanding of relevant aspects in the planning of charging infrastructure locations today and in the future;
- To estimate the charging needs of the different user groups for an increased availability of the user-demanded charging infrastructure to improve the acceptance of e-mobility;
- To develop a simplified model approach for defining a strategical approximation of the needed charging infrastructure.

A good user experience when interacting with vehicles and charging infrastructure will accelerate widespread usage of e-mobility solutions. For instance, depending on user needs and potential locations for charging infrastructure, different types of charging infrastructure should be installed: "slow-charging" infrastructure is most suitable in residential areas where individual EV users charge their vehicles overnight or in business areas and "company" parking lots where vehicles are parked during working hours while the installation of fast chargers caters more to the central parts of the city where EVs stay generally for a shorter period and where the turnover of vehicles to charge is high. It can also reduce the range anxiety of certain EV users such as taxi drivers or freight operators which can use these points for top-up charging during their operation. This also applies to chargers installed on highways and expressways. Categorizing users according to their needs opens the door for future e-mobility needs (that may not yet exist) to also be incorporated into e-mobility development. The following table shows an exemplary categorisation of user group and respective charging needs.

User Group	Description	Objective
 Commercial Fleets	Taxis, logistics, & company or municipal vehicles are used by different drivers for business & private purposes. They operate in Functional Urban Areas (FUAs) primarily in dense cores often for first & last mile mobility of workers, tourists, & freight delivery. They have short but irregular driving profiles & thus require both options of fast charging & slower overnight home charging.	Ensure widespread availability & improved utilisation of fast-charging during operating hours & convenient solutions for overnight charging at home
 Users of Shared e-mobility services	eMaaS vehicle use is characterized by shared or multimodal trips of different electric vehicles. eMaaS users need multiple charging options that is widely and quickly available, similarly to fleet users. As a last-mile solution, charging facilities close to public transport nodes are likely prevalent. The demands on charging convenience are high because the user is often not a regular driver. Pricing transparency and payment convenience is important.	Develop easy-to-use & highly-integrated payment & reservation systems incl. transparent pricing schemes reflecting users' specific preferences
 Urban residents without own parking	Urban residents particularly in dense cores of FUAs, who live in multi-storey buildings rely on a combination of parking & charging facilities. Charging sessions can be longer (overnight or over the day at the work place). Personal preferences (e.g. renewable energy sources/ attractiveness of the charging location) are more important to residents than other user groups. Both professional & leisure trips need to be provided for.	Provide convenient charging possibilities at non-residential points; slow overnight public charging and models that optimize scarce space in dense-urban areas
 Long range commuters	This group requires interoperable charging infrastructure & payment schemes that are available & accessible along TEN-T networks & at borders of urban cores where transition to public transport can occur. Reliability & prediction of availability, & range after charging are important to users. Time spent at gas stations should be comparable to charging times to match the user's experience of total journey times.	Ensure wide availability of rapid chargers interoperable between national and EU regions to allow users to quickly top up their EVs.

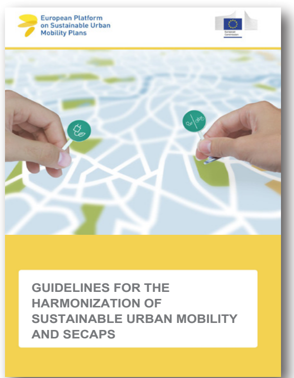
Figure 4: Example of user's catagorization

In parallel, an overview of the existing or ongoing urban planning processes can highlight the need to align the SUMP process with other planning processes such as the SECAP (**step 2.2**). The SECAP (Sustainable Energy and Climate Action Plan) is a key document within the Covenant of Mayors in which cities define activities and measures for reducing greenhouse gas emissions according to given targets.

SECAPs and SUMPs are local initiatives with common aspects when it comes to electrifying transport as both planning processes follow similar schemes and address the same stakeholders and measures.

Further guidance on the harmonisation of SUMPs and SECAPs can be found in the **Topic Guide Guidelines for the harmonization of sustainable urban mobility planning and SeCAPS**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).



Preparation and analysis of the requirements for charging infrastructure planning

Level of public and private involvement

First, it needs to be ensured that an inter-departmental core team (see step 1.2 above) is created and the capacities of such a team (including the tools and equipment at hand) are evaluated systematically. This is necessary to get an idea of the available financial resources (step 1.1). As charging infrastructure deployment is generally a larger scale investment, a critical question that needs to be addressed at the outset is to discuss the ownership and responsibility of operation of the charging infrastructure; public or private companies (step 1.3). Both models have their respective advantages and disadvantages:

<u>Public companies:</u>

+ Complete control for the municipality: e.g. quantity, quality, design, etc.
+ Possibility to create new revenue streams through the development of new services
+ Data, services and skills all in one hand
- Public authorities, in particular in smaller cities, may lack the resources and technical capacities to run such a network.
- The development of a charging infrastructure network requires a high upfront investment, with a potentially negative business case in first years.

<u>Private companies:</u>

+ May have better know-how regarding the latest technological developments and therefore offer more adequate service for customers.
+ Potential to benefit from economies of scale.
+ No burden/risk on municipal balance sheets.
- If development is left entirely to market players who are focused on developing their own net works, this can potentially result in less interoperability.
- Lack of control on data generated by the charging activities. The control over the quality or the service is also less easily controllable. Clear requirements must be fixed in the concession tenders to avoid these issues.

Even if municipalities decide to leave the deployment to private companies, they can avoid vendor lock-in and ensure suitable prices and services in the following ways:

Through detailed concession tenders, with clear deployment requirements and including quality requirements such as minimum uptime / availability requirements linked to a penalty of bonus / malus system; use of open standards (e.g. for back-office protocols); limited duration of concessions (e.g. 5 years), to avoid being locked into longer contracts with one company and to maintain competition.

By fostering competition and organising different concession tenders for different city districts. However, this requires ensuring for the interoperability of the infrastructure (e.g. use of same Radio-Frequency Identification (RFID) cards) throughout the city – ideally even region or country). Additionally, municipalities should pay specific attention to the transferability of charging equipment (and back-end systems) from an operator to another at the end of a concession period, to avoid sunk investments and/or lengthy and costly transfer periods, with possible downtime of the chargers.

*By setting infrastructure design standards in local regulations, e.g. d*etermine space that must be left on pavement for pedestrians; and create designated areas for charging infrastructure.

Alignment with other plans and strategies

Based on a user needs analysis, further steps are to assess the planning requirements (step 2.1) and link the charging infrastructure planning with other planning processes (step 2.2), in particular with energy and land use planning. For example, it is crucial to identify legal, tax, and regulation-based barriers during the planning process for charging infrastructure: e.g. energy laws, implementation of charging infrastructure in public space or clear billing and payment processes.

Furthermore, in addition to spatial requirements of charging infrastructure, the energy requirements need to be taken into consideration to better plan for users' charging needs. Historically, the power grid and electricity systems were not designed for the large-scale use by e-mobility. Therefore, it is necessary to assess the existing national, regional and local commercial electricity market limitations and opportunities systematically as an important pre-condition for a ramp-up in the deployment of charging infrastructure, considering existing limitations of power grids and electricity systems. Grid impacts need to be analysed and assessed by developing energy profiles for all potential scenarios, including for simulating smart charging options. Additionally, the location of charging sites should be identified to best optimise grid capabilities and should provide a potential for scalability according to the different stages of EV penetration and local grid conditions.
Important measures to be taken at this stage are:

To qualify and quantify the impact and potential of charging infrastructure for the electricity grid, ad dressing different stages of EV penetration.
To enable the seamless integration of various charging infrastructure solutions with the power grid.
To ensure the harmonisation and interoperability of charger-to-infrastructure communication considering smart grid implications from the beginning.

Getting expertise and knowledge

Planning for charging infrastructure is a complex issue and needs technical expertise. External expertise can offer a target-oriented support (step 2.4). Several external experts provide concepts, methodologies and tools for planning charging infrastructure. This includes census, point of interest and/or demographic data-based concepts and leads to the localisation of potential charging points, which can be displayed e.g. by heat maps.
In addition, there are numerous sources of information on the state of the art in charging technology, which can already be consulted as available expertise and lessons learned (step 3.1). For example, the EAFO platform (www.eafo.eu) offers an overview of "alternative fuel station map" for EU-countries. Furthermore, a cooperation with owners of data should be made to make sound decisions regarding charging infrastructure planning and deployment.

3.2 Strategy development

During the second phase of the SUMP cycle, the mobility planning authority has the responsibility to assess the different mobility options which will allow to adopt a clear mobility vision for the future which translates into a series of targets.e-mobility solutions for e.g. commuters, visitors or simply residents for their occasional trips outside the city. To facilitate the discussions, the involvement of stakeholders can be made in the framework of a dedicated e-mobility strategy which is clearly identifiable and which complement the SUMP (more information in section 3.3).

Figure 8. Implementation and monitoring phase (SUMP 2.0)

In a first step, the development of the scenarios and potential futures (**step 4.1**) must show how e-mobility can be integrated in a wider mobility system. Further promoting and advancing e-mobility should not be put in competition with other ways of decarbonising transport such as a modal shift towards cleaner modes (e.g. public transport, active mobility). This vision is based on the idea that the electrification of transport relies only on a technological change and therefore would not tackle the larger mobility situation, including a necessary modal split.

On the contrary, e-mobility should be understood as a means to accompany the improvement and decarbonisation of modes (e.g. electrification of public transport, private mobility, shared mobility services, etc.). Therefore, within an e-mobility strategy framework for instance, citizens and stakeholders should not be consulted on the choice between e-mobility and other ways of decarbonising transport. Instead, they should be asked to define the extent to which electrification should take place (and how to finance this) and what modes should primarily be targeted (**step 4.2**).

The adoption of a vision, in cooperation with the population, should help determine the level of electrification of different mobility modes. For instance the visions of a carbon-neutral city at a mid-term time horizon (e.g. 2030), a safe and liveable city for people (with e.g. car-free centres) or an emission-free city by a mid-term time horizon (**step 5.1**) require different levels of electrification combined with different levels of modal shift and traffic space re-allocation (**step 5.2**).

The targets to be adopted must cover both the implementation of measures (1) and its results (2). Therefore, it is recommended to adopt targets – measured by the relevant indicators – (**steps 6.1 & 6.2**) regarding the actual implementation of e-mobility measures (1) as well as the impact of these measures on the improvement of air quality, the decrease of greenhouse gas emissions and the reduction of noise emissions (2). Those indicators can include e.g. (1) the number of EVs (also per vehicle category), the number of EVs per 100 vehicles, the number of charging points, the number of charging points per 100 EVs; and (2) CO2 emissions, pollutant emissions (NOx, PM10), noise emissions and number of residents impacted by pollutant and noise pollution. The use of the second type of criteria must be made carefully as the direct impact of e-mobility on those is not necessarily direct (other emission sources, etc.).

Strategy development: requirements for charging infrastructure planning

The needed charging infrastructure should be analysed for the different e-mobility scenarios (step 4.1) and discussed with citizens and stakeholders (**step 4.2**). The planning and installation of charging infrastructure is a continuous process for which the cooperation with citizens and stakeholders is crucial for planning of both public and private infrastructure. A certain amount of public charging infrastructure is necessary to operate public electric fleets and to reduce range anxiety for potential private users of EVs, i.e. electric cars, light-electric vehicles, etc.

As mentioned by the directive 2014/94/EU[37] , a minimum number of publicly available charging points needs to be available in urban areas. The directive states that *"[...] an appropriate number of charging points accessible to the public [must be] put in place by 31 December 2020, in order to ensure that electric vehicles can circulate at least in urban/suburban agglomerations. [...] The number of such charging points shall be established taking into consideration, inter alia, the number of electric vehicles estimated to be registered by the end of 2020 [...]. Particular needs related to the installation of charging points accessible to the public at public transport stations shall be taken into account [...]."*
The directive also asks Member States to establish national policy frameworks in which they include their national targets and objectives. With regards to this obligation, a cooperation of local with national authorities is particularly recommended. It is then the responsibility of the planning authority to decide on the locally relevant share of public and private infrastructure.
Another important objective at this stage is to decide where to place publicly available charging infrastructure. This can either be on street (or close to street) or off street (e.g. in underground parking). By opting for the installation of charging infrastructure on street, especially at 'strategic' places, the planning authority gives a greater visibility to e-mobility in the city and potentially convinces more citizens and stakeholders to switch to EVs.

In many European cities, SUMPs include measures to give more space to people and not vehicles. Many mobility planning authorities therefore favour off-street parking to not further clutter public space.
The location of charging points (either off-street or on-street) next to mobility infrastructure (e.g. P+R parking, train stations, public transport hubs) is a way of promoting both the electrification of transport and the modal shift towards more sustainable modes. This is also in line with the SUMP principle to integrate all modes in a balanced manner.

Stockholm's charging Master Plan (**box 1**) is a good example for how to develop a charging strategy that oversees the infrastructural development for EV charging in order to ensure that it is effectively meeting user needs rather than just covering popular hotspots. It also helps investors and charging point operators getting an overview of where the planning authority expects charging infrastructure to be built and therefore sets clear expectations.

Planning aspects such as charging locations should be based on transparent decision criteria. Additionally, criteria for interoperability should be included in procurement terms and conditions to avoid lock-ins to certain service providers and to enable a multimodal and multipurpose use of charging infrastructure.
In addition, KPIs for charging infrastructure usage linked to sustainable mobility objectives should have the benchmark to provide a similar or even better mobility experience for EV users than for users of fossil fuel vehicles. New EV users that might have little experience only in the interaction with e-mobility infrastructure will compare this experience with the usage of infrastructure set up for conventional vehicles, i.e. gas stations. Even though the user experience is very individual and might differ for specific user groups and encompasses a wide range of aspects, a few KPIs should be identified and respected e.g. accessibility or charging speed.

[37] Directive 2014/94/EU on the deployment of alternative fuels infrastructure, 2014, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0094

Best Practice Example

Box 1: Stockholm's Charging Master Plan

To develop Stockholm's charging Master Plan several working groups and high-level round tables were set up to ensure the plan effectively meets the needs of all users, including businesses. The charging strategy is based on several pillars:

- Offering charging possibilities on city-owned parking facilities, both for short time use and with individual contracts for private car owners, renting their own parking lot for long-term from the city's parking company.
- Providing know-how and information about charging technology and installation requirements to private parking companies, shopping mall owners, private companies, housing companies and house owners.
- Providing spots for "charging streets", i.e. clusters of 4-10 chargers in a row on strategically chosen streets to partners willing to finance and operate on-street chargers. The city does not operate on-street chargers.

With the aim to provide 1 public charging unit per 10 EV, and the number of EVs estimated at 15,000 by the year 2020, the city needs in total 1,500 public charging units by 2020. The goal is to install 500 units on public streets at about 50 locations with 10 charging opportunities per site.
A study resulted in many possible locations for on-street charging. The results are indicated on a publicly accessible dynamic map which shows existing as well as planned charging sites. Charging point operators interested in setting up charging infrastructure can consult this map and apply to get a five-year contract for one or several of these spots. The contract is awarded following a set of requirements that have been pre-defined.
https://civitas.eu/sites/default/files/sto_6.6.pdf

TABLE 2. Indicator set for the assessment of charging infrastructure and charging processes

AREA OF USER EXPERIENCE	EXPLANATION	INDICATORS
1. Availability and accessibility	Concern the way from the decision to charge to the actual charging point	Adequate accessibility of chargers (distance, location, waiting time, connector types); match with user parking habits; reliability/ prediction of availability incl. reservation options; availability of alternatives to preferential location
2. Charging demand	Considers the experience when charging	Range after charging (state of charge); time spent on charging; transparency/ predictability of charging times
3. Pricing	Captures the experience with pricing levels, transparency and flexibility	Price perception; transparency of payment system; price modelling (fixed, variable, connection); flexible + interconnected payment systems; tariffs for special charging solutions (compensations for reservations, schedules charging, V2G, etc.)
4. Convenience of the charging process	Addresses the smoothness of the charging process	Useful time spent at location; physical convenience (cable handling); availability of other facilities/ services at site; distance to final destination
5. Specific preferences and concerns	Addresses user's specific charging preferences and perceived	Meeting user preferences on electricity supply; attractiveness of site (spatial/ design/ pleasant environment); perceived safety at charging point

3.3 Operational Planning

After the strategy and targets have been adopted, the mobility planning authority must develop its actual Sustainable Urban Mobility Plan. The third quadrant of the SUMP cycle concludes with the formal adoption of the SUMP. During this SUMP phase, measures must be listed and selected (steps 7.1 & 7.2).

Although the electrification of transport can be a major axis of a SUMP, it relates to and covers a wide range of measures/ measure packages, including the procurement of vehicles and infrastructure, parking policies, urban vehicle access restrictions, installation of infrastructure, etc. The electrification of transport must therefore be planned carefully, considering all relevant measures.

Consequently, it can help to develop a distinct e-mobility strategy. A strategy can also help to further describe the measures (step 8.1) and create a framework in which the relevant stakeholders can agree on their responsibilities and a timeline (step 8.3) and in which funding aspects are clarified (step 8.2). Instead of replacing it, this strategy would rather complement the SUMP. All e-mobility elements must be included in the adopted version of the SUMP (step 9.1) which can include the e-mobility strategy as an annex or complementary strategy (Box 2).
 of e-mobility on those is not necessarily direct (other emission sources, etc.).

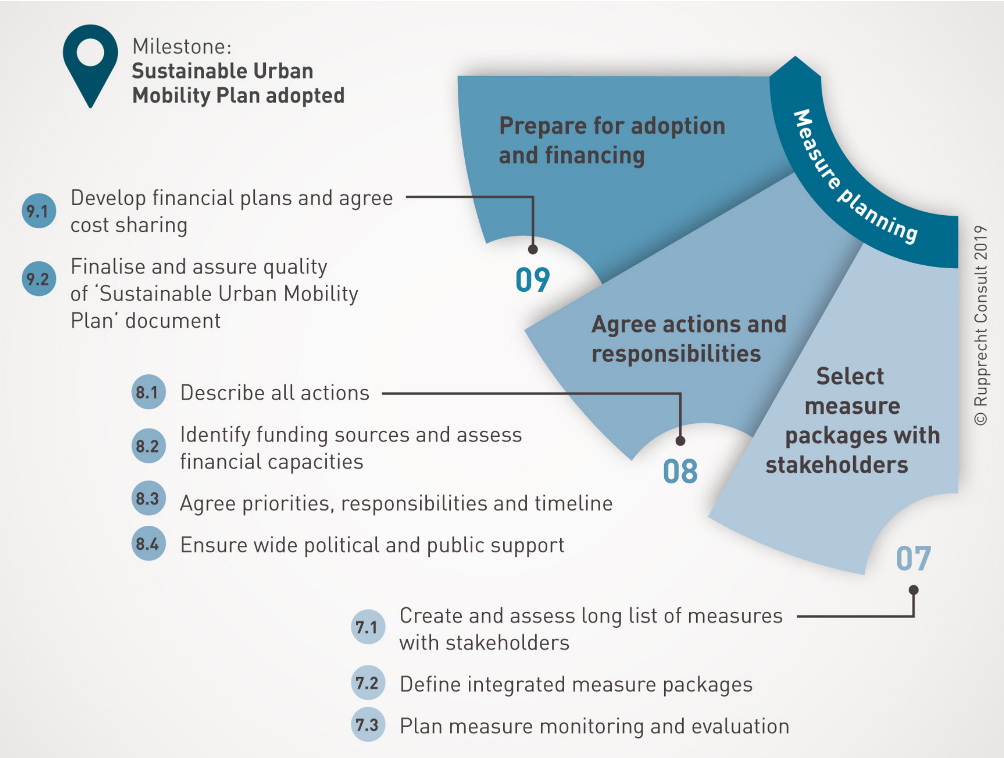


Figure 7. Measure planning phase (SUMP 2.0)

Best Practice Example

Box 2: Development of an e-mobility strategy

Because of its transversal character, e-mobility cannot always be a distinct chapter of a SUMP. When the electrification of transport is a major axis of a SUMP, it can touch upon several objectives and be present in a large number of measures. Developing a separate e-mobility strategy can therefore help gathering all relevant SUMP measures directly.

A separate strategy must be seen as a complement (or annex) to the SUMP and follow the same principles. It aims at clearly identifying those measures which are contributing to similar objectives, which will require the involvement of the same stakeholders and have a potential for synergies.

For instance, the Municipality of Barcelona has adopted an Electric Mobility Strategy in 2018 which sets the main priorities for the development of e-mobility in the city for the period 2018 – 2024. A clear reference to the local SUMP and how e-mobility can help reaching the goals of the SUMP is made in the very beginning of the document.

Reference: Estratègia de MOBILITAT ELÈCTRICA, Plenari del Consell Municipal, March 2018, (in Catalan) https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/109244/1/180309_MG%2Estrat%C3%A8gia%20VE_CEUM.PDF

Operational planning: requirements for charging infrastructure planning

The availability of charging infrastructure is a basic and essential prerequisite for the advancement of e-mobility. A joint priorisation process with all relevant stakeholders (**step 7.1**) on the location and operation of chargers needs to be part of the definition process of integrated measure packages (**step 7.2**). A cooperation with infrastructure providers and managers is crucial for the successful use of the charging points. In addition, it is important to develop a clear cooperation framework between the planning authorities and relevant stakeholders to ensure a sound measure evaluation and monitoring (see next phase) based on the charging infrastructure performance.
Among others, the following aspects should be considered:

- Data management: In exchange of the permit for operating the charging infrastructure, operators can be asked to provide charging data to the mobility planning authority. This allows planning authorities to better assess the advancement of e-mobility and to, potentially, adapt policies and measures.
- Interoperability: Several operators might manage jointly the network of publicly available charging points. In order to encourage the electrification of transport and make the experience of EV users as simple as possible, the mobility planning authority can define in cooperation with the operators a set of common features to be offered to users, including integrated payment methods, certain charging standards, a common branding, etc.

To enable the smooth implementation and operation of charging infrastructure, the needed activities during the measure planning phase need to be described in detail for this part (**step 8.1**). This includes in particular the estimation of costs (step 8.2) for the needed charging infrastructure, the allocation of responsibilities for the implementation and an agreement on the timeline (**step 8.3**). Experiences from cities across Europe show that it can take several months for the installation of charging infrastructure. Delays that are due to regulatory barriers need to be borne in mind.

As the deployment of charging infrastructure is costly, the estimation of costs and political support and the development of a clear financial plan with an agreed cost sharing (**step 9.2**) are of critical importance to finalise a SUMP (**step 9.1**). Identifying and ensuring funding and financing sources for charging infrastructure deployment is therefore a crucial element to ensure wide political and public support.

Funding and financing sources on European level can be found on the EAFO website. In addition, several EU countries have national and regional support programmes to help with the implementation of charging infrastructure. Several EU countries have established contact points that provide information to promote the deployment of charging infrastructure in their respective countries. An example for a nationally-coordinated information contact point – established across several relevant ministries, i.e. transport, environment, energy and economy - for the funding of e-mobility measures including charging infrastructure is the German *"Lotsenstelle Fonds Nachhaltige Mobilität"* [38].

[38] Website of the Lotsenstelle Fonds Nachhaltige Mobilität https://www.bmvi.de/SharedDocs/DE/Artikel/DG/lotsenstelle-fonds-nachhaltige-mobilitaet.html

3.4 Implementation and monitoring

Figure 8. Implementation and monitoring phase (SUMP 2.0)

After the formal adoption of the SUMP, the last quadrant of the SUMP cycle focuses on the implementation and monitoring of the measures included in the sustainable urban mobility plan.

A separate e-mobility strategy can provide for a dedicated framework for the relevant stakeholders to discuss and agree on a detailed implementation plan and for the coordination of the implementation process (**step 10.1**). Procurement[39] (**step 10.2**) is an important topic for the electrification of transport as the procurement of EVs and charging infrastructure represents a major investment for local authorities. This concerns public fleets such as public transport, service vehicles (e.g. garbage collection vehicles) as well as the needed charging infrastructure for these vehicles.

Whether the electrification of transport will be successful or not, largely depends on the uptake and usage of EVs by citizens and companies. In addition to providing e-mobility solutions, vehicles and infrastructure, local authorities must also communicate about EVs toward citizens and companies (**step 11.2**) to increase the acceptance of these. Communication campaigns raising the awareness on existing offers and the advantages associated with the use of EVs, both for the society in general as well as for individuals and companies (e.g. privileges), help further promoting and advancing e-mobility in the city/ region. Monitoring the advancement of e-mobility and the corresponding impact on environmental targets must happen on a regular basis and based on a set of well-defined indicators (**step 11.1**), defined beforehand (step 6.1). If the use of EVs delivers the expected results, e-mobility can be further promoted and supported in order to reach set environmental targets. If it does not (or only partially), the SUMP framework must be flexible enough to allow for changes. For instance, priorities might be shifted towards highly polluting vehicles (i.e. buses and trucks) or areas which are more impacted by air and/or noise pollution (**steps 12.1 and 11.1**).

Although the shift towards electric vehicles can help to decrease the transport emissions, challenges such as congestion or a car-oriented allocation of public space remain. It is therefore important to monitor the impact of EVs on the overall mobility system so that complementary measures can be taken – either in the current or next SUMP cycle (**step 12.3**).

[39] Further information about procurement can be found in the topic guide Public procurement of sustainable urban mobility measures, https://www.eltis.org/guidelines/second-edition-sump-guidelines

Implementation and monitoring: requirements for charging infrastructure planning

The availability of charging infrastructure is a basic and essential prerequisite for the advancement of e-An essential activity in the implementation of charging infrastructure is the procurement of goods, i.e. vehicles, necessary charging infrastructure and service equipment needed (**step 10.2**). Information about the market situation of charging devices and services and a dialogue with the potential technology providers before the process are beneficial for both tenderers and bidders. The procurement process should for example ensure the delivery of high-quality charging infrastructure at acceptable investment costs, user-friendliness and safety as well as easy connectivity to back-end systems[40].

Furthermore, authorities should also inform and engage citizens and stakeholders during the implementation and operation phase of charging infrastructure deployment (step 11.2). They should emphasise the provision of flexibility and comfort to users in achieving the ambitions for charging infrastructure take-up. Provider-neutral and independent information should be provided to users such as static and dynamic information regarding availability of charging stations through apps, online platforms, signs, and others. In addition to providing information to users, these tools allow to monitor the progress of planned measures and to adapt and revise measures accordingly (step 11.1). Static information could include the location, charging speed and current type (AC, DC), type of plug and name of the operator. Dynamic information would give users the possibility to check the current (real-time) status of a recharger, for example, whether it is available or not.

Besides the deployment of publicly available charging infrastructure, public authorities also have a role in promoting the deployment of private charging infrastructure to foster a change towards sustainable mobility in their cities and regions. They can adopt rules that make it easier for co-owners of a condominium to install home EV rechargers in a shared garage, e.g. not requiring the approval of all co-owners for such works.
Moreover, public authorities can also promote the creation of a comprehensive charging network by enabling owners of home EV rechargers to make them publicly accessible to other people in the neighborhood and opportunity rechargers. This can be stimulated through the creation of a platform where owners of home EV rechargers are able to indicate when their home EV-recharger is available to others.

Finally, there is constant change in the field of e-mobility. Charging technology and EVs are rapidly evolving which is why many uncertainties still exist. Thus, the analysis of successes and failures (**step 12.1**) as well as sharing results and lessons learned (**step 12.2**) are important steps to improve the impact of e-mobility measures in a SUMP. This also helps identifying new challenges and solutions for the next planning and implementation cycle. Consequently, charging infrastructure should be planned and implemented as flexible and adaptable as possible so to allow for upscaling and retrofitting, e.g. in terms of charging power, additional rechargers or the integration of new services at charging stations.

[40] Idem

4. Transport sector-specific recommendations for advancing e-mobility in your city/ region

The electrification of transport is very specific depending on the kind of vehicle, mode and charging solution. The following chapter therefore gives sector and vehicle-specific recommendations to further advance e-mobility across Europe.
The electrification of certain fleets is particularly important as certain categories of vehicles often contribute relatively more to air and noise emission than other vehicles. This is explained by the fact that they are operating for long periods of time every day (e.g. taxis [box 3], buses, etc.) and/or are composed of heavy vehicles (e.g. buses, trucks and vans) which are emitting relatively more than smaller vehicles.

4.1 Public transport

Promoting the use of public transport as an alternative to private cars has the potential to reduce the number of vehicles on European streets and therefore decrease air and noise emissions. However, currently buses primarily run on diesel or petrol and are heavily emitting.
Therefore, the electrification of public transport has a huge impact on air quality and other related environmental targets (box 4). Additionally, the introduction of electric buses is a good way of promoting e-mobility as they are operating in the whole urban area, are highly-visible and easily- recognisable by citizens. Electric buses show the efforts made by the local authority and also demonstrate vividly advantages of e-mobility such as the reduction of noise and (visible) pollution.
In cooperation with the public transport authority and/ or the public transport operator, some crucial decisions must be taken regarding the introduction of electric buses:

Bus models: The specifications of the tender must be precise enough to correspond to the needs of the public transport operations and must also be realistic enough and correspond to the status of the market which is still developing. Conducting demonstrations and/or tests of

Box 3: Promoting and incentivising zero-emission taxis in London

Best Practice Example

As much as buses and urban freight vehicles, taxis are operating over long periods of time every day and thus contribute proportionally more to the air and noise emissions than private cars. For instance, in London, it is estimated that taxis emitted 16% of the NOx emissions in the city centre, before the introduction of new measures.

In this context, Transport for London (TfL) has adopted a set of regulations and incentives to encourage the use of "Zero-Emission Capable" (ZEC) vehicles (e.g. electric, hybrid or hydrogen vehicles). Since 1 January 2018, taxis presented for licensing for the first time must be ZEC. These taxis must have the capacity of operating in a zero-emission mode for a minimum of 30 miles.

In addition to the regulation, TfL proposes some incentives and advantages. TfL is installing a network of 300 fast charging points, which includes charging points reserved for taxis. ZEC taxis also have free access to certain private parking areas to recharge their cars. Additionally, TfL contributes to a national fund which provides taxi drivers with a grant (up to £7,500) for the purchase of a ZEC vehicle.

Reference: Transport for London,
https://tfl.gov.uk/info-for/taxis-and-private-hire/emissions-standards-for-taxis#on-this-page-1

vehicles can help the local authorities to get familiar with the existing offer.

Charging strategy: Several ways of charging an electric bus are available: overnight charging at depot, fast charging at line stops and/or terminals or even on-route charging for buses operating partly under the trolleybus infrastructure. The charging method determines the capacity of the electric battery needed. The more frequent the charging, the smaller the battery and thus the larger the space available for passengers. The use of existing public transport electric infrastructure might also be considered to charge buses and maximise the use of those infrastructure (box 5). On the other hand, larger batteries allow more flexibility in operation and the use of cheaper off-peak electricity.

Selection of lines: From a local perspective, the introduction of electric buses makes a greater contribution to the improvement of public health and quality of life if these are introduced in bus lines which are passing through the most polluted and/or most densely populated areas. Consequently, the cooperation with the public transport authorities and/or operators and the involvement of the environmental and health departments is required.

Several European projects (e.g. ZeEUS[41]) have proven that the use of different types of electric buses in combination with different types of charging methods for daily operation is feasible. ZeEUS has produced an eBus report in which a large number of examples of electric bus implementation activities and tests in Europe are presented[42].

Studies showed that the lifecycle costs of electric buses (including relevant charging infrastructure) are comparable to those of diesel buses. The costs of electric buses can even be cheaper with the optimisation of certain criteria[43] , including, e.g.:

- Bus lifetime (longer service life of the technical components of electric buses);
- Optimised use of charging infrastructure (economies of scale achieved by e.g. reducing the number of charging points required per bus).

Box 4
Factor 100: the impact of electrifying buses

Best Practice Example

The EU project ELIPTIC
looked at the electrification of public transport in cities and advocated for providing more funding for the electrification of buses. The main message of the campaign was that the impacts of the electrification of one (18m) e-bus equals the impacts of the electrification of 100 e-cars – but there is not 100 times the funding for e-buses as for e-cars.

This argument was based on the fact that buses are operating 12 to 16 hours per day (against less than an hour for cars), the fleet of buses is currently quasi exclusively running on diesel engines (against 50 to 60% for cars). Due to the size of the engine, buses are consuming on average 40,000 l of fuel (mainly diesel) per year, against 500 l for cars.

Reference: Factor 100 brochure, http://www.eliptic-project.eu/sites/default/files/Faktor100_Folder_EN_RZ_web.pdf

Box 5
Using existing electric infrastructure for bus charging

Best Practice Example

The ELIPTIC project investigated the possibility to use the existing public transport electric grids (i.e. metro and tramway) to charge buses and other EV types.
The demonstrations showed the technical feasibility of the solution. In Oberhausen (Germany), buses are recharged at a line terminal with the electricity of the tram electricity grid. Charging other kinds of electric vehicles (e.g. e-cars, e-vans) is also possible. However, selling the energy to external parties currently still faces legal and regulatory hurdles.

Reference: ELIPTIC use cases in Oberhausen http://www.eliptic-project.eu/eliptic-use-cases/oberhausen

4.2 Urban freight and logistics

Urban logistics has a huge impact on the mobility patterns of our cities. Therefore, the transport of goods must be integrated into a SUMP. The electrification of urban freight shares similarities with the electrification of public transport.

The vehicles used for logistics operations in cities are heavy polluters. For instance, in Rotterdam, vans represent only 9,9% of the total number of kilometers travelled but are responsible for 25% of the NOx emissions, 26% of the PM10 emission and 16% of CO2 emissions. The numbers are even more staggering for heavy-duty trucks as they represent only 1,3% of the total traffic but account for 37% of NOx, 13% of PM10 and 18% of CO2 emissions[44]. Therefore, the electrification of these vehicles would result in a substantial cut in the emissions of the urban road transport sector.

Similar to the situation of electric buses, the market of electric vans and especially the market of electric trucks is very small. The large vehicle manufacturers have not entered fully the market yet. This results in a low number of electric models available, at a much higher price than their diesel counterparts. In contrast to public transport however, the mobility planning authorities have less control over the urban freight fleet as this is mainly in private hands and spread across a number of operators.

The experience of early pilots in European projects (e.g. FREVUE[45]) shows that the use of EVs is adapted to urban logistics operation. The limited range of vehicles that are currently available is long enough for deliveries in urban areas where distances are typically short. In addition, and despite the high procurement costs, in FREVUE it could be demonstrated that a positive business case is possible within a depreciation period of approximately five years for smaller vans while this is more complicated for larger trucks [46].

Mobility planning authorities can take several measures to encourage local operators to switch to electric vans and trucks. Such measures can be discussed, agreed upon and promoted together with the relevant stakeholders (i.e. local freight operators) in dedicated cooperation frameworks, such as Freight Quality Partnerships.

Economic and financial measures: Advantages given to electric freight vehicles such as the exemption from congesting charges and other road charging schemes or free parking can help private operators to reach a positive business case (box 6).

Regulatory and operational measures: Other measures (i.e. non-financial ones) can make the daily operation of electric freight operators more simple and give them a comparative advantage vis-à-vis the other operators. Such measures include: access to zero-emission zones, preferential treatment in traffic limited zones, longer access (including peak period) in restricted areas, exclusiveness of certain areas to electric vehicles, privileged (un)loading areas reserved for electric operators, etc.

Charging infrastructure: Although the current range of batteries is normally good enough for most of the urban operations, opportunity charging is sometimes required to complete longer operations or simply to decrease the range anxiety. Therefore, local authorities can make their public (fast-) charging infrastructure available to operators, in particular via a priority reservation system.

Leading by example: The local authorities often manage a small fleet of vans and trucks for a variety of activities such as waste removal. By electrifying this fleet, the local authorities can send a consistent message to the private operators while contributing to the reduction of emissions.

[41] ZeEUS website, http://zeeus.eu/

[42] ZeEUS eBus Report, 2017, https://zeeus.eu/uploads/publications/documents/zeeus-ebus-report-2.pdf

[43] ELIPTIC Final Business Cases, 2018, http://www.eliptic-project.eu/sites/default/files/ELIPTIC%20D4.2%20Final%20Business%20Cases%20%28for%2each%20use%20case%29%20for%20further%20take-up%20%20implementation_0.pdf

[44] Kok R et al., Towards Zero-Emission City Logistics, 2017

[45] FREVUE website: www.frevue.eu

[46] FREVUE Results and Guidance for Local Authorities, 2017, https://frevue.eu/wp-content/uploads/2017/09/FREVUE-Results-and-Recommendations-for-Local-Authorities-v_09.pdf

Box 6: Giving advantages to electric freight operators in Milan

Best Practice Example

In Milan (Italy), regulations apply to the access to the centre of the city – also called Area C. The access to this zone is limited and can be forbidden for the most polluting vehicles or chargeable for less polluting ones. For electric vehicles, the zone is even free of access.

Like all electric vehicles, electric freight vehicles can access the Area C of Milan for free. In addition, while the access to this zone is forbidden to all delivery vehicles after 8:00 am, electric delivery vans were granted an operational advantage and can access the Area C during a time window extended to 10:00 am.
This combination of measures provides electric freight vehicle operators both with financial and operational advantages as compared with non-electric competitors.

Reference: City of Milan,
https://www.comune.milano.it/servizi/area-c-accesso-nella-fascia-oraria-8-00-10-00-e-deroghe

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Topic Guide **Sustainable Urban Logistics Planning**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).

4.3 Shared mobility services

Shared clean mobility is one solution to reduce air and noise emissions and tackle issues such as congestion, and the use of public space by reducing the total number of cars used in the city as well as the total number of kilometres driven. The introduction of shared bicycles and scooters aims at a modal shift from the car to alternative modes. The electrification of car-sharing helps further reducing emissions and can attract more people switching from owning a car to using car-sharing only. Ideally, the roll-out of e-car-sharing happens in combination with other sustainable modes of transport, so to allow for multi-modality (see Box 7).

The electrification of shared bicycles and the introduction of electric kick-scooters can potentially convince people who used to take more emitting vehicles or modes (e.g. private mobility or even public transport) to switch to more active mobility modes or extend the distance they travel with these modes. However, the first studies carried out on this issue show mixed messages regarding the modal shift taking place. Nonetheless, given that these mobility solutions are very recent, uncertainties still remain and benefits in terms of modal shift can take place at a later stage.

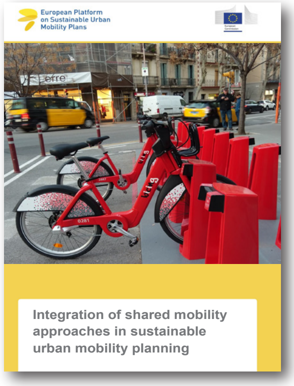
Battery management is an important aspect to consider in the SUMP process, as well as municipal policies for the siting and management of Light Electric Vehicles and compliance with local road regulations regarding their use. This requires careful liaison with operators and pro-active planning on the part of the local authority.

In the context of a SUMP, integrating the above-mentioned shared and electric modes (ideally, in one mobility platform) is also a consistent message to the population and an encouragement to multimodality.

To secure the benefits of shared mobility, especially in terms of the improvement of noise and air emissions, the mobility planning authorities can take regulatory measures and install a cooperation platform to inform the shared mobility service providers of the effects they would like to see achieved by the introduction of such schemes.

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Topic Guide **Integration of shared mobility approaches in sustainable urban mobility planning**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).



4.4 Private transport

The current discussion around e-mobility is strongly car-focused. However, from a SUMP point-of-view it is important to treat all modes equally and not focus only on the electrification of cars. There are different ways for cities to encourage and incentivise people to switch to EVs but it should be ensured that policies are integrated as much as possible with measures to reduce congestion and parking to not additionally promote trips by car and car-ownership. The below is framed around the challenges for electric cars, however similar aspects should be borne in mind for other forms of electric personal transport such as e-bikes and e-cargo bikes[47] which have their own distinct parking needs and patterns.

Privileges for EVs

In many European countries legal frameworks are in place that allow for cities to give privileges to EV users, such as reserving parking spaces with charging points for exclusive use, reducing or completely waiving parking fees, exempting EVs from certain entry and passage restrictions or allowing these to use bus lanes. The decision on what privileges to implement, should be discussed with relevant stakeholders and citizens at the local level and very much depends on the take-up of EVs. For instance, EV drivers were stripped of their right to drive in bus lanes in Oslo in 2015 after the take-up of EVs soared and led to increased congestion on bus lanes.

Installing and supporting the development of charging infrastructure for private EVs

When planning for the roll-out of charging infrastructure, it is important to consider the fundamental differences between private, semi-public and public areas. These determine the extent wo which the city can influence and regulate the installation of charging infrastructure as well as the need for action from other actors.

Private spaces without public access are of high relevance for the development of e-mobility, as charging infrastructure will mainly be demanded there. Charging an EV will mostly take place at home (overnight charging) or at work (day charging)[48] where users can safely assume that they have access to a charger for several hours so to recharge their battery. Therefore, charging at home and/or at work is considered by users the most convenient form of charging. Study results show that EVs are currently predominantly purchased by people who have access to such a personal charging station. Although private areas are largely outside the city's sphere of influence, the city can still support the development of charging infrastructure in private areas by adapting local building codes, giving advice, making information publicly available and subsidies. For instance, in the London Plan 2016, it is stated that all new *"developments in all parts of London must ensure that 1 in 5 spaces (both active and passive) provide an electrical charging point to encourage the uptake of electric vehicles."*[49]

In addition, the Directive 2018/844 on the energy performance of buildings (article 8) obliges Member States to facilitate the deployment of charging points in new and existing residential and non-residential buildings. It also sets obligations regarding the installation of a minimum number of charging points and ducting infrastructure allowing for the future installation of charging points in new or renovated buildings, with a minimum number of parking spaces.[50]

[47] Please refer to the SUMP practioner briefing on Supporting and encouraging cycling in sustainable urban mobility planning, https://www.eltis.org/sites/default/files sump2.0_practitioner_briefing_cycling_v2.pdf

[48] See Figure 4.

[49] Mayor of London, 2016, The London Plan, https://www.london.gov.uk/sites/default/files/the_london_plan_2016_jan_2017_fix.pdf

[50] Directive (EU) 2018/844 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG

Semi-public spaces such as customer car parks are also outside the municipality's direct sphere of influence. However, businesses should be encouraged to offer their customers access to charging infrastructure in order to build up a comprehensive, interoperable and attractive charging network in the city. In this way, it is possible for EV users to park their vehicles at important locations such as retail centres and supermarkets while pursuing their respective activities during the charging process.

Public spaces offer the greatest regulatory influence for the development of charging infrastructure. As public space is generally very limited in dense urban environments, various functions compete with each other and conflicts of use may arise. Consequently, interests need to balanced and assessed on a case-by-case basis. Cities have the possibility to integrate the charging infrastructure development in various planning frameworks such as parking regulations, building and zoning codes as well as land use and development plans. For example, cities can define the number of charging stations that are required per parking place (e.g. one charging station per ten parking spaces) within building codes.

In addition, when building or allowing the installation of a new charging point, public authorities should provide or impose the installation of at least two connectors. The charging point should be located between or close to two or more parking places to allow its use by additional EV users and thereby foster further uptake of electric vehicles by other residents in the neighbourhood.

In Amsterdam[51], for instance, the installation of charging points is (partially) demand-driven. EV users with no access to private parking can request the installation of a charging point near their home. After an evaluation of the possibilities for installing a charging point and connecting it to the grid, according to different criteria (e.g. existence of charging points, walking distance, etc.) by a contractor, the municipality may allow the installation of a charging point.

Many European cities have also developed separate e-mobility/charging infrastructure plans which detail the development of public charging infrastructure on the local level.

Planning for a public charging infrastructure network

For the planning of a public charging network, it is important to bear in mind that charging will mainly take place at home and at work places. Recent results suggest that public chargers are only used for about 5% of charging events, including on-street city charging, car parks and fast charging along road corridors[52]. However, it is assumed that the visibility of public charging opportunities is still an important psychological factor in encouraging drivers of conventionally-fuelled vehicles to switch to EVs, especially for people who do not own a garage.

It is yet to be seen how much public charging infrastructure will actually be needed once EVs are taken up at a higher rate. Uncertainties also remain as to how charging speeds will develop and what kind of charging approach works best and in what context, e.g. (fast-) charging hubs vs. (slow-charging) comprehensive network.

The Joint Research Centre (JRC) has developed an easy-to-use methodology for mobility planning authorities in order to identify and allocate public charging infrastructure for EVs in cities and regions[53]. The methodology can serve as a good starting point for cities to get a quick overview of where charging infrastructure could be built, using data that is readily available to mobility authorities. Data that is taken into consideration include residential statistics, the road network, existing parking areas, the electric power distribution network, public transport stations, public buildings as well as shopping and retail areas.

[51] INTERREG Europe EV Energy, https://www.interregeurope.eu/policylearning/good-practices/item/1699/amsterdam-s-demand-driven-charging-infrastructure/

[52] Transport & Environment, Roll-out of public EV charging infrastructure in the EU, 2018

[53] JRC, Optimal allocation of electric vehicle charging infrastructure in cities and regions, 2016.

5. Policy measures to support the electrification of transport

5.1 Urban Access Vehicle Restriction (UVAR)

There are over 700 Urban Access Vehicle Restriction schemes (UVAR) implemented in Europe and they have a range of type of objectives. For instance, a congestion-charging scheme aims firstly at the reduction of congestion while a Low-Emission Zone (LEZ) is installed to solve the problems of air quality.

The existence or the implementation of such schemes – although it is not an e-mobility measure - have the potential to develop it. The schemes which are based on the progressive ban of the most polluting vehicles from certain areas such as LEZ, ULEZ (Ultra Low-Emission Zones) and Zero Emission Zones (ZEZs) can help encourage EVs. As they do not emit any tailpipe emission, they are likely to always be allowed in these restricted areas, especially where these are being developed into Zero Emission Zones (Box 8). The planning authority must then define what is considered as an electric or a 'zero-emission' vehicles. Depending on the cases, hybrid vehicles might be considered as such. Usually, an electric autonomy of c.a. 40 km (to cover urban distances) is required to qualify as 'zero-emission' vehicle.
Likewise, granting a free (or discount) access to EVs to zones protected by a congestion charge scheme – on a temporary or permanent basis, for all or certain type of EVs (e.g. freight vehicles) provides a comparative advantage to EV drivers and operators.

Traffic Limited Zones can give preferential treatment to EVs, giving them unrestricted access, either automatically or on application. This is particularly the case for delivery focused UVARs, where there are time windows for deliveries, or where delivery vehicles are licenced or need to gain permission to operate. More flexibility can be offered to EVs, which can be phased over time to become a ZEZ for freight/delivery
Applying the rules to all sectors, including public transport, urban logistics or taxis helps operators of electric fleets to make their business cases positive and give them a comparative advantage, compared to their non-electric competitors.

Box 8: EV-friendly UVAR - the Low-Emission Zone in Madrid

Best Practice Example

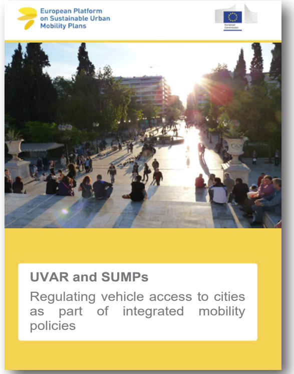
The local authority in Madrid (Spain) approved the new Air Quality and Climate Change plan of the city in September 2017 (the so called "plan A"). The first measure of Plan A was the deployment of an environmental zone, which was implemented by the end of November 2018 under the name of "Madrid Central". Covering most of the central district of Madrid, it has a surface of 472 hectares, the LEZ is fully opened only to ZERO emission vehicles (hydrogen, electric vehicles and plug-in hybrids with a range of more than 40 km) and ECO vehicles (other plug-in hybrids, conventional hybrids and some alternative fuel vehicles such as natural gas vehicles) according to the national labelling scheme.

More pollutant vehicles have progressive restrictions either for accessing and/or parking (including on-street and off-street parking). For zero-emission vehicles, parking in the LEZ is free of charge and not limited in time. The LEZ uses plate reading cameras for enforcement. During the first months of functioning the measure has shown its effectiveness with very significant reductions both in traffic and emissions, without generating border effects. Nevertheless, in September 2019 the city is still assessing further improvements and complementary initiatives to better cope with mobility challenges and reach set environmental targets.

Reference Madrid Municipality: http://bit.ly/2EqvMRT

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Topic Guide **Urban Vehicle Access Regulations and sustainable urban mobility planning**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).



5.2 Parking

In a SUMP context, parking policies have the potential to encourage a modal and/or technology shift away from the conventional car to more sustainable modes and technologies, including EVs.

This encouragement to use EVs can be made via favourable fees for EV parking. Granting free parking or reduced fees to zero-emission vehicles is a strong incentive for EVs. However, planning authorities must implement such as policy very carefully as the EV market rapidly develops and plan for a progressive increase of fees for EV parking. The introduction of emission-based parking and variable parking tariffs is a possible alternative to this policy.

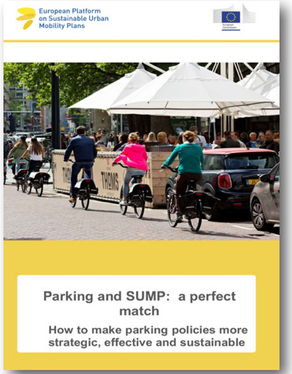
Local authorities can also decide to place publicly available EV parking spots (with charging infrastructure) either on-street (or close to street) or off-street (e.g. in underground parking). While on-street EV parking gives more visibility to e-mobility, especially in visible and strategic areas, it also takes space away from other modes, especially walking and cycling. Therefore, a balanced use of both on-street (for visibility and promotion) and off-street (for public space management) must be found and adapted to the different types of urban areas. For instance, on-street parking is often more adapted to less dense residential areas and off-street parking rather to dense city-centres. The inclusion of charging infrastructure specifics (e.g. number, types, design, management, etc.) is an element to be included in the contract signed with the operators. The provision of on-street EV parking can be made on a demand-based basis, as this is made in several Dutch cities, including Amsterdam, where citizens have the possibility to make requests online.

Additionally, parking spots and their location at strategic places, e.g. next to intermodal platforms (e.g. public transport stations or P+R parking) and close to low- or zero-emission city centres encourages multimodality and covering the whole trip with several electric modes; like e.g. e-taxis, electric (shared) bicycles, electric public transport, etc. These parking spots can also be used by logistics operators for reloading delivery vehicles (e.g. cargo-bikes or e-vans) for the last mile delivery and decreasing range anxiety.

Finally, for large off-street parking areas, especially when they are managed by municipal companies or through a municipal concession tender, municipalities can prescribe a minimum number of chargers to be installed and to reserve the related parking places for EV drivers. Additionally, these large off-street parking allows for a more sustainable energy management at a large scale. A large number of EVs increases the benefits of smart charging and allows for Vehicle-2-Grid (i.e. V2G; bidirectional energy transfer). This can be combined with the use of renewable energy e.g. from photovoltaics installed on parking roofs.
automatically or on application. This is particularly the case for delivery focused UVARs, where there are time windows for deliveries, or where delivery vehicles are licenced or need to gain permission to operate. More flexibility can be offered to EVs, which can be phased over time to become a ZEZ for freight/delivery
Applying the rules to all sectors, including public transport, urban logistics or taxis helps operators of electric fleets to make their business cases positive and give them a comparative advantage, compared to their non-electric competitors.

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Practitioner Briefing **Parking and SUMP: a perfect match**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).



5.3 Funding/ Financing

The advancement of e-mobility entails extra upfront costs, e.g. for the additional installation of charging infrastructure, the purchase of (currently more costly) clean vehicles and the adaptation of infrastructure assets to these technologies. Therefore, identifying revenue sources, which can be used to fund e-mobility measures, forms an important component to an effective delivery of a SUMP.

As charging infrastructure deployment is generally a larger scale investment, public authorities, in particular in smaller cities, may lack the resources to run such a network. There is also the risk of a potentially negative business case in the first years. If cities do not want to put a risk on the municipal balance sheets and take the burden of providing charging infrastructure themselves, they can leave this to private companies (for the advantages and disadvantages of this model, see chapter 3.1).

In order to create new revenues and at the same time incentivise the use of EVs, cities have different measures at hand. Road pricing and congestion charges, for instance, aim at generating revenues, reducing traffic loads and congestion, and making cities more liveable. A congestion charge is a revenue mechanism and a mobility management strategy that surcharges users of public services as a result of excess demand. Advantages can be given to EVs such as the exemption from congesting charges and other road charging schemes or free parking can help private operators to reach a positive business case.

In addition to locally-sourced funding, member states provide grants and funding schemes for specific purposes, such as research and development or market diffusion of low-carbon technologies. A report of the ZeEUS project identified national e-mobility funding programmes in Germany, Italy Poland, Spain, Sweden, and the UK[54].

For example, in Germany both the Federal Government and various states have issued investment programmes for the development of charging infrastructure. The funding programme provided by the Federal Ministry of Transport and Digital Infrastructure (BMVI) for the expansion of the charging infrastructure network in Germany runs from 2017 to 2020 and aims to install nation-wide 15,000 publicly accessible charging stations. The funding programme makes € 300 million available to support private investors as well as cities and municipalities.

[54] ZeEUS eBus Report, 2017.

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Topic Guide **Funding and financing options for Sustainable Urban Mobility measures**

(https://www.eltis.org/guidelines/second-edition-sump-guidelines).

5.4 Procurement

Some vehicle fleets are owned directly by local authorities or operators which are related to local authorities. In addition, local authorities procure a large amount of services and goods to be delivered. Through the procurement of (1) public fleets, and (2) goods and services, local authorities have the capacity to contribute to the electrification of transport and lead by example.

Public fleets

Vehicle fleets, when they are procured by local authorities or entities providing public service contract must respect the Clean Vehicles Directive (CVD)[55] which aims at encouraging the use of clean and energy-efficient road transport vehicles.

This directive applies to all public procurement of vehicles, which represents a large share of all new vehicle registrations. This is estimated to be 3.4 % of new cars, 2.8 % of new vans, 6.4 % of new trucks and 75 % of new buses in 2012-2014.

According to this directive, a minimum share of clean vehicles must be procured by the public sector (i.e. organisations falling under public procurement rules) at the national level, in each Member State by 2025 and 2030. The original directive (2009) has been revised in 2017-2019. The new directive sets targets for a minimum share of clean vehicles to be procured by the public sector (i.e. organisations falling under public procurement rules) at the national level, in each Member State by 2025 and 2030. The proportions of clean vehicles that need to be reached vary from country to country (based on GDP and population) and the types of vehicles. In addition, for the specific sector of buses, zero-emission vehicles will have to represent half of the clean vehicles procured nationally. Public authorities are therefore encouraged to purchase EVs as they qualify as clean vehicles in all categories. For the specific sector of buses, a strong incentive is given by the sub-target for zero-emission buses. This also applies to small non-freight fleets such as the vehicles made available to administration employees.

Local authorities can also decide on procuring zero- (or low-) emission transport / delivery services.

Procurement of goods and services

Public procurement of goods and services is a large economic sector, representing 14% of EU GDP. Due to its size, this market is responsible for a substantial part of urban traffic and its related emissions. As demonstrated by the City of Oslo (Box 9), by introducing zero-emission criteria in public procurement tendering processes, public authorities can contribute to the uptake of zero-emission vehicles, including electric freight vehicles and thereby decrease traffic emissions.

[55] DIRECTIVE (EU) 2019/1161, amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L1161&from=EN

Box 9: Zero-emission procurement in Oslo

Best Practice Example

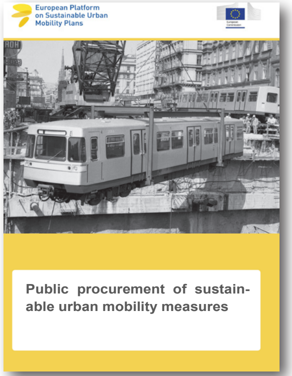
The City of Oslo has adopted guidelines to be used for all service and goods delivery contracts which involve an element of transportation. These guidelines recommend to set a minimum requirement (i.e. minimum Euro 6 / VI standard). In a second stage, points must be given according to the type of fuels – with the largest number of points given to electric and hydrogen vehicles and the starting date for using the specified fuel. To assure the quality of information provided, tenderers must also submit a list of the vehicles to be used, their fuel and their availability.

While keeping some flexibility and the possibility to use other type of vehicles, those guidelines are an encouragement for the electrification of the freight sector.

Reference: BuyZET Handbook
http://www.buyzet.eu/wp-content/uploads/2019/05/BuyZET-Handbook.pdf

Further guidance on the integration of sustainable urban logistics in SUMPs can be found in the Topic Guide **Public procurement of sustainable urban mobility measures**

[(https://www.eltis.org/guidelines/second-edition-sump-guidelines).](https://www.eltis.org/guidelines/second-edition-sump-guidelines)



5.5 Promotion and incentives

Depending to the overall objective of the SUMP, the objectives regarding the changes of mobility habits might differ and put the electrification of the private cars as a secondary goal, after an actual modal shift. Convincing people to change their private cars cannot be directly controlled by the mobility planning authority. However, the local authority has the capacity to convince citizens to replace their private vehicles with electric ones via a range of communication measures and incentives.

First of all, the consultation and cooperation with citizens throughout the SUMP process allow a direct contact with the population. This allows to better inform the population about the main mobility issues (e.g. air pollution and noise) and the solutions (e.g. the importance of e-mobility) as well as to create a feeling of ownership on the plan. This provides the basis for a communication with citizens but it is not always sufficient to trigger a decision among people and does not cover the whole population.

In addition to citizens, the SUMP process allows also to be in contact with employers (or employers' associations). This is an opportunity for promoting sustainable mobility management and the inclusion of electric solutions within the mobility offer provided to their employees, like e.g. the electrification of the company's fleet, the possibility to try or use an electric bicycle, etc.

The information phase can be complemented by communication campaigns, using a recognisable brand (box 10), and different channels which are targeting the relevant target groups, i.e. the current (and potential / future) car users. The messages should rather focus on the direct benefits for the users (e.g. reasonable lifecycle costs, easy access to charging infrastructure, access granted to the city-centre, free or reduced parking fees, etc), rather than on the benefits for the society (e.g. public health, environment, etc.) which are less immediate. Nonetheless, the recent rise of attention for global warming and environmental issues can be used to further promote the use of EVs, especially towards certain categories of the population (e.g. younger generation, young parents, etc.). Working with an independent association, for instance an association of EV users can help to better spread the message.

The local authority should make widely known all the existing benefits and incentives. These can include the financial subsidies which are distributed by the different levels of governments which people are entitled to, as well as the practical advantages given to EV drivers (e.g. access to Zero-Emission Zones, free parking, free charging, etc.). The allocation of a financial subsidy by the local authority – to complement of a regional and/or national subsidy – can obviously influence positively car users in their decision. To trigger the purchase of EVs, the local authority can provide or encourage companies to provide free trials of e.g. e-cars, e-(cargo)bikes, e-vans. A practical use of EVs will show the actual feasibility of using and charging them.

The identification of a contact person within the administration or in an electric automobile club to coordinate the campaign and to give an identifiable face to answer the questions of the public can make the campaign more efficient.

Best Practice Example

Amsterdam elektrisch

Box 10: Branding e-mobility in Amsterdam

The City of Amsterdam has been particularly good at branding e-mobility. For the Dutch municipality, the best advertisement for e-mobility is to enhance its visibility in the city streets by creating a logo.

The "electric plug" logo was first launched by the municipality of Amsterdam and can now be found on many devices and vehicles in the city: charging stations, information signs, cars, trucks and even river boats – both public and private.

The municipality encourages all users and promoters of e-mobility to display this logo. Many companies and other Dutch (and foreign) cities and regions have already adopted and adapted the logo. While the red logo is the symbol for "Elektrisch Amsterdam", other logos have been created to give visibility to e-mobility in other places.

Reference: Municipality of Amsterdam,
https://www.amsterdam.nl/parkeren-verkeer/amsterdam-elektrisch/logo/

References

List of related SUMP Topic Guides

- EU SUMP Guidelines, SUMP 2.0, 2019
- Harmonization of energy and sustainable urban mobility planning, 2019
- Sustainable urban logistics planning, 2019
- Public procurement of sustainable urban mobility measures, 2019
- Integration of shared mobility approaches in sustainable urban mobility planning, 2019
- Linking transport and health in sustainable urban mobility planning, 2019
- Urban Vehicle Access Regulations and sustainable urban mobility planning, 2019
- Supporting and encouraging walking in sustainable urban mobility planning, 2019
- Supporting and encouraging cycling in sustainable urban mobility planning, 2019
- Parking and sustainable urban mobility planning, 2019

EU legislation and policy

Alternative Fuels Infrastructure Directive

Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094

Clean Vehicles Directive

Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, https://eur-lex.europa.eu/eli/dir/2019/1161/oj

Directive on the energy performance of buildings

Directive (EU) 2018/844 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG

European Commission, Transport emissions, https://ec.europa.eu/clima/policies/transport_en#tab-0-0

European Commission, EU Climate Action, https://ec.europa.eu/clima/citizens/eu_en#tab-0-0

Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0631

EU initiatives and projects

ASSURED: https://assured-project.eu/

BuyZET: http://www.buyzet.eu/

- *Clement S., Nesterova N., Lozzi G., The BuyZET Handbook, 2019, http://www.buyzet.eu/wp-content/uploads/2019/05/BuyZET-Handbook.pdf*

CleanMobilEnergy:http://www.nweurope.eu/projects/project-search/cleanmobilenergy-clean-mobility-and-energy-for-cities/

CIVITAS: https://civitas.eu/

- *Clean fuels and vehicles: https://civitas.eu/TG/clean-fuels-and-vehicles*

- *Hauw N., CIVITAS Insight 13 - E-mobility: From strategy to legislation, 2016, https://civitas.eu/sites/default/files/civitas_insight_13_e-mobility_from_strategy_to_legislation.pdf*
- *Cré I., CIVITAS Insight 19 - E-mobility: Make it happen through SUMPs!, 2016, https://civitas.eu/sites/default/files/civitas_insight_19_e-mobility-make_it_happen_through_sumps.pdf*
- *Barrera G., Cancellara P., Hauw N., CIVITAS Insight 20 - Cities' role in introducing clean vehicles and using alternative fuels, 2016, https://civitas.eu/sites/default/files/civitas_insight_20_cities_role_in_introducing_clean_vehicles_and_using_alternative_fuels.pdf*

Covenant of Mayors: https://www.covenantofmayors.eu/en/

EAFO: https://www.eafo.eu/

EfficienCE: https://www.interreg-central.eu/Content.Node/EfficienCE.html

ELIPTIC: http://www.eliptic-project.eu/

- *Günter H., Koch H., ELIPTIC Policy Recommendations, 2018, http://www.eliptic-project.eu/sites/default/files/ELIPTIC%20Policy%20recommendations_FINAL_LowRes_0.pdf*
- *Factor 100 brochure, 2017, http://www.eliptic-project.eu/sites/default/files/Faktor100_Folder_EN_RZ3__0.pdf*
- *Meishner F., Final Business Cases, 2018, http://www.eliptic-project.eu/sites/default/files/ELIPTIC%20D4.2%20Final%20Business%20Cases%20%28for%20each%20use%20case%29%20for%20further%20take-up%20%20implementation_0.pdf*

Eltis: http://www.eltis.org/

EV Energy (INTERREG Europe): https://www.interregeurope.eu/evenergy/

FREVUE: https://frevue.eu/

- *FREVUE Results and Guidance for Local Authorities, 2017, https://frevue.eu/wp-content/uploads/2017/09/FREVUE-Results-and-Recommendations-for-Local-Authorities-v_09.pdf*

GreenCharge: https://www.greencharge2020.eu/

- *Electric mobility in SUMP, https://www.greencharge2020.eu/wp-content/uploads/2019/06/leaflet_GreenCharge_e-mobility_and_SUMP.pdf*

INTERREG Europe EV Energy, https://www.interregeurope.eu/policylearning/good-practices/item/1699/amsterdam-s-demand-driven-charging-infrastructure/

MEISTER - Mobility Environmentally-friendly, Integrated and economically Sustainable Through innovative Electromobility Charging infrastructure and new business models: https://meisterproject.eu

SEEV4City: https://northsearegion.eu/seev4-city/about/

SIMPLA - Sustainable Integrated Multi-sector PLAnning: http://www.simpla-project.eu/en/

- *SIMPLA Guidelines: http://www.simpla-project.eu/en/guidelines/*

ZeEUS: https://zeeus.eu/

- *ZeEUS eBus Report #2, 2017,* https://zeeus.eu/uploads/publications/documents/zeeus-report2017-2018-final.pdf

Other studies

Anenberg, S.; Miller, J.; Henze, D.; Minjares, R., A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015, 2019, https://www.theicct.org/sites/default/files/publications/Global_health_impacts_transport_emissions_2010-2015_20190226.pdf

EEA Briefing, Managing exposure to noise in Europe, 2017, https://www.eea.europa.eu/themes/human/noise/sub-sections/noise-in-europe-updated-population-exposure

EEA Report, Air quality in Europe — 2018 report, 2018, https://www.eea.europa.eu//publications/air-quality-in-europe-2018

EEA, Greenhouse gas emissions from transport, 2018, https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-11

EEA, Population exposure to environmental noise, 2018, https://www.eea.europa.eu/data-and-maps/indicators/exposure-to-and-annoyance-by-2/assessment-3

EEA, Electric vehicles from life cycle and circular economy perspectives, 2018, https://www.eea.europa.eu/publications/electric-vehicles-from-life-cycle

JRC, Optimal allocation of electric vehicle charging infrastructure in cities and regions, 2016: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101040/allocatechargingpoints_sciencepolreport_eurreport_online.pdf

Kok R et al., Towards Zero-Emission City Logistics, 2017

Transport & Environment, Roll-out of public EV charging infrastructure in the EU. Is the chicken and egg dilemma resolved?, 2018: https://www.transportenvironment.org/sites/te/files/Charging%20Infrastructure%20Report_September%202018_FINAL.pdf

Transport & Environment, Carmakers' electric car plans across Europe 2019-2025, 2019: https://www.transportenvironment.org/sites/te/files/publications/2019_07_TE_electric_cars_report_final.pdf

Tryggestad, C.; Sharma, N.; van de Staaij, J.; Keizer, A., 2017, New reality: electric trucks and their implications on energy demand, https://www.mckinseyenergyinsights.com/insights/new-reality-electric-trucks-and-their-implications-on-energy-demand/

Annexes

Tools and guidance support for planners

BuyZET Handbook
This guide is designed to assist city administrations to use their public procurement activities strategically to help reduce traffic in urban areas, and promote the use of zero emission vehicles in urban logistics.
The BuyZET Handbook is available at: http://www.buyzet.eu/wp-content/uploads/2019/05/BuyZET-Handbook.pdf

JRC planning methodology for the optimal allocation of electric vehicle charging infrastructure in cities and regions
A geospatial analysis of EV charging infrastructure allocation within a city and a region, based on open source GIS tools, is described. A methodology was developed to provide optimal locations of electric vehicle infrastructure (charging stations) within a spatially extended region. Two different cases were identified: placement in a city network (urban road network) and in a regional or national network (rural roads and highways). For a city and a regional network, the methodology identifies high-potential areas for the installation of charging station. In contrast, for a highway network the methodology provides explicitly the suggested locations: the charging stations should preferably be placed in already built areas, gas stations or rest areas, to minimize additional investment costs. A pilot study was made for the city of Bolzano/Bozen (city road network) and the province of Alto Adige/Südtirol (rural and highway network).
The planning methodology is available here: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101040/allocatechargingpoints_sciencepolreport_eurreport_online.pdf

E-Bus Decision Support Tool
The E-Bus Decision Support Tool was developed with the intention to help public transport authorities and operators in the electrification of bus lines. The tool allows to compare local bus line parameters to the data collected within 150 different use cases, including the experiences made within the ELIPTIC project. Based on a similarity index, the tool helps to determine which technology is appropriate in a specific situation based on a specific operational profile and specific city context. After entering the local input parameters into the search mask a ranking list of comparable, already electrified bus lines is automatically generated, placing the most similar lines at the top of the list. One can then select the individual use cases to obtain more detailed information on the various electrification components. For the ELIPTIC use cases, additional information on results and lessons learned is provided.
The tool is available at: https://www.e-bus-support.eu/

ELIPTIC Policy Recommendations
The ELIPTIC policy recommendations are a summary of the lessons learnt around ELIPTIC's main research question on how to make more efficient use of the existing public transport infrastructure for the charging of non-rail-bound electric vehicles. They inform policy makers, operators and authorities about important challenges encountered within the project and gives recommendations concerning what is required to better allow for the multi-purpose use of public transport infrastructure. The document brings together the different results achieved across the various technological concepts looked at in ELIPTIC such as opportunity charging of electric buses through the use of existing local tram/metro grids, the operation of battery-equipped trolleybuses by making use of a, so called, in-motion charging (IMC) approach or charging of electric car fleets outside of public transport's peak times to make more efficient use of the grid's capacities. The policy recommendations provide a checklist for public transport operators who would like to make more efficient use of their grids and provide energy for the charging of other, non-rail-bound vehicles
The ELIPTIC policy recommendations are available at: http://www.eliptic-project.eu/sites/default/files/ELIPTIC%20Policy%20recommendations_FINAL_LowRes_0.pdf

FREVUE Results and Guidance for Local Authorities
Electric vehicles are one of the key options to reduce road freight emissions. These guidelines support public authorities in developing an understanding of how they can support the future uptake of electric vans and trucks.
The FREVUE Results and Guidance for Local Authorities are available at: https://frevue.eu/wp-content/uploads/2017/09/FREVUE-Results-and-Recommendations-for-Local-Authorities-v_09.pdf

SIMPLA Guidelines
The SIMPLA guidelines highlight the possibilities of harmonisation between SUMP and SECAP processes. The Sustainable Energy and Climate Action Plan (SECAP) is a planning instrument adopted by local authorities, signatories

of the Covenant of Mayors for Climate and Energy. When adopting this document, local authorities are committing to the implementation of measures which aim at the reduction of CO2 emissions and the adoption of an approach to tackle mitigation and adaptation to climate change. The SECAP's aim is the reduction of CO2 emissions by 40% by 2030.
The SIMPLA Guidelines are available at: http://www.simpla-project.eu/en/guidelines/

Glossary

A SUMP Glossary is available and gives definitions of the terms associated with SUMP development, the SUMP cycle and different steps. The terms below are specifically referring to the present guide.

Term	Definition
Emissions (or Air and Noise emissions)	In this guide, emissions must be understood as a generic term combining the different emissions of transport: greenhouse gases, air pollutants and noise.
Conventional / conventionally-fuelled	This term applies to all vehicles which use fossil fuels: diesel and petrol vehicles.
Alternative fuels	Non-fossil fuels, it includes electricity and several other fuels, such as hydrogen, biogas.
Car-sharing	Car sharing means shared ownership of cars – mainly professionally provided. In the UK often called car club

Acronyms

Term	Definition
AFI	Alternative Fuel Infrastructure
AFID	Alternative Fuel Infrastructure Directive
AFM	Alternative Fuel Mobility
BEV	Battery Electric Vehicle
CVD	Clean Vehicle Directive
DSO	Distribution System Operator
EAFO	European Alternative Fuel Observatory
E-mobility	Electric mobility
EV	Electric Vehicle
FUA	Functional Urban Area

Term	Definition
LEZ	Low Emission Zone
KPI	Key Performance Indicator
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
RFID	Radio-Frequency Identification
SECAP	Sustainable Energy and Climate Action Plan
SUMP	Sustainable Urban Mobility Plan
UVAR	Urban Vehicle Access Regulation
V2G	Vehicle to Grid
ZEC	Zero-Emission Capable
ZEZ	Zero-Emission Zone

www.eltis.org