TOPIC GUIDE:
DECARBONISATION OF URBAN MOBILITY
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Introduction and target group

Decarbonisation of urban transport will enable cities to mitigate the climate change impacts of urban mobility. It requires a set of measures that will significantly impact personal behaviour and living patterns. Effective greenhouse gas (GHG) reduction requires changes in how we live, particularly regarding the role of the private car. These changes will require political commitment, at least public acceptance, and have to be based on constant and decades-long dialogue with a broad range of stakeholders. Setbacks along the way are inevitable.

Decarbonisation of urban mobility is one of the most challenging areas in the fight against climate change. While some progress has been achieved in many cities, the broader picture so far shows a steady increase in the absolute and relative GHG emissions from transport (including urban transport).

This guide aims to help planners and decision-makers responsible for tackling climate change and for developing transport plans, at all levels, to understand which measures to introduce within Sustainable Urban Mobility Planning (SUMP) and the types of impact that are to be expected from those measures, to achieve the relevant GHG emissions reduction targets. It focuses on personal mobility.

This guide is based on the methodology of the general SUMP guidelines with a focus on climate change mitigation. Where necessary it refers to the general SUMP guidelines or relevant topic guides. It aims to be self-explanatory. The guide presents or refers to available state-of-the-art knowledge in this field.

Planning for mobility and decarbonisation towards climate neutrality is not always in harmony. The SUMP has to address a wider range of challenges and objectives, including social, economic and environmental objectives such as accessibility, traffic flow, congestion, noise, traffic safety etc., and it would promote measures to enhance mobility services and provide for a wide range of mobility options. In contrast, decarbonisation requires a focus on transport measures packages that are effective and efficient to reduce GHG emissions. This guide takes the assumption that considered planning options along SUMP development should be aligned with climate objectives. A planning option (or package of measures) would need to be adapted accordingly, or they would need to be dropped and replaced by other means to coherently ensure all SUMP objectives.

The guide is developed for urban and regional mobility planners, or spatial planners who can influence the structure and morphology of cities and their functional urban areas. The guide will be of particular relevance for planners in larger cities and urban. The core information provided and the calculation schemes do on the other hand also apply to any urban agglomeration size. Beyond the relevant professionals in public administration, the guide also aims to provide valuable information to a wide range of interested stakeholder groups, including schools, universities, real estate developers and managers, public transport authorities and companies, commuters, civil society groups with a mission to reduce the carbon intensity of urban mobility and transport in general. Last but not least decision-makers at all levels should benefit from the guide and be able to find relevant examples and understand the core elements in planning the decarbonisation of urban mobility.
1. Planning urban mobility decarbonisation

1.1. Climate change mitigation and mobility challenges

The European Commission has set out a target for all sectors to be climate neutral (net zero) by 2050, including surface and air transport*. This is particularly challenging, as currently transport represents almost a quarter of Europe’s greenhouse gas emissions and is the main cause of air pollution in cities. The transport sector has not seen the same gradual decline in emissions as other sectors: emissions only started to decrease in 2007 and remain higher than in 1990 (see graph Figure 1).

According to Eurostat, CO2 emissions from transport accounted for 25.8% of all GHG emissions in the EU in 2019. Within this sector, road transport is by far the biggest emitter accounting for more than 70% of all GHG emissions from transport.

With the global shift towards a low-carbon, circular economy already underway, the European Commission’s low-emission mobility strategy, adopted in July 2016, aims to ensure Europe stays competitive and able to respond to the increasing mobility needs of people and goods.

Figure 1. Total greenhouse gas emissions trends by aggregated sector in Europe (source: European Environment Agency)**

The European Green Deal, in order to reach the objective of a climate-neutral economy by 2050, a reduction of 90% in transport CO2 emissions must be achieved, as explained later in this guide.

The Commission noted, in announcing the Mission for 100 Climate Neutral and Smart Cities by 2030, that “our urban areas are home to 75% of EU citizens. Globally, urban areas consume over 65% of the world’s energy, accounting for more than 70% of CO2 emissions. It is therefore important that some cities act as experimentation and innovation ecosystems to help all others (or: to help all other cities) in their transition to become climate-neutral by 2050.”

The scale of the challenge is unprecedented, but many cities have already re-engineered themselves to reduce their reliance on private cars, typically from a peak of 50% car use around 2000 to as little as 30% in 2018 and, in the case of Vienna, a more ambitious target has been determined in the near future.

Meeting the carbon-neutral mobility challenge will require a similar shift in policy strategies and professional and public mindsets, but on a larger and faster scale, working with a wide range of organisations and sectors. As set out in the EU Sustainable and Smart Mobility Strategy of 9.12.2020, a “shift of the existing paradigm of incremental change to fundamental transformation” is needed. This shift requires the development of a long-term transition strategy, implemented and updated through different SUMPs (i.e. normally with shorter-term implementation focus vis-à-vis those longer-term ones). Developing a long-term carbon-zero transition strategy will need to recognise the following:

- Currently, travel behaviour is commonly measured by trip rates and trip modal shares, but carbon emissions are directly linked to the number, length of trips and emission rates of different modes – the rarer, longer car trips contribute disproportionately more carbon than the more frequent, shorter ones.
- Carbon neutrality represents a fixed end goal, but there are many different strategies and mixes of policy measures among sectors that can be adopted to achieve that common goal – according to local conditions and capabilities.
- While targets focus on end goals, the important factor to limit climate change is the total CO2-equivalent emissions in the atmosphere, so early actions to reduce emissions have a greater cumulative impact than later ones.
- The preferred transition strategy should be implemented through more specific policy measures, throughout several SUMP cycles.
- The role of modelling switches from forecasting futures (predict and provide) to assessing which strategies and policy mixes will deliver the desired end state (vision and validate).

Carbon reduction as a goal cannot be considered in isolation from other transport and environmental objectives (safety, biodiversity, air quality, etc.), and should adequately consider transport-related social challenges. The transformation to carbon-zero requires both, the mobility transition (e.g. shift to biking, walking, public transport) and the energy transition (e.g. electric vehicles) of the transport sector – all to be done as fairly as possible i.e. also considering social aspects of the change.

Planning the transition may be based on a comprehensive local climate strategy (including one based on the Sustainable Energy and Climate Action Plans (SECAP) methodology proposed by the Covenant of Mayors), that may cover 20 to 30 years. The mobility component may then be specified through a transport sector plan, delivered through a succession of SUMPs – that usually cover a time span in the range of 10 years.

In the case where an overarching climate strategy or general local climate regulation does not exist, the contribution from urban mobility has to be determined directly through the development of a long-term carbon mitigation strategy mobility strategy, delivered through a series of SUMPs.

Decisions and actions taken at the SUMP level are critical and are the main drivers to translating long-term climate mitigation strategies and goals into concrete measures to reduce GHG emissions from transport, enabling a city to achieve the full climate change mitigation potential of a transport system. Once each measure is selected, its overall impact depends largely on the fact that it is part of a plan, i.e., its full benefits will only be achieved when the set of complementary actions and factors foreseen in the plan are also implemented.

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*Source: Eurostat, CO2 emissions from transport accounted for 25.8% of all GHG emissions in the EU in 2019. Within this sector, road transport is by far the biggest emitter accounting for more than 70% of all GHG emissions from transport. With the global shift towards a low-carbon, circular economy already underway, the European Commission’s low-emission mobility strategy, adopted in July 2016, aims to ensure Europe stays competitive and able to respond to the increasing mobility needs of people and goods.**

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1. PLANNING URBAN MOBILITY DECARBONISATION

A robust SUMP process developed consistently with the relevant long-term climate change mitigation strategies, and in synergy with cross-sectoral, especially spatial development planning, can optimise mobility patterns and promote the usage of public transport and smarter mobility solutions. For example, it provides an opportunity to locate residential/productive areas, hospitals and schools within 15-minute neighbourhoods, or on major public transport corridors, and to promote organisational arrangements for study and work (e.g. telework) that reduce the need for travel and redistribute demand peaks. The combination of such measures has the overall effect of reducing the frequency, length and duration of trips and promotes the use of softer modes, through the development of micro-mobility options including walking, cycling and usage of "last-mile" connections for passenger and freight traffic based on electric propulsion where appropriate.

1.2. Strategies to deliver climate mitigation

An effective mix of strategies and policy measures to reduce/eliminate carbon emissions can be developed by using the ‘Avoid – Shift – Improve’ paradigm.

Avoid

Spatial and land-use planning and carbon-reduction business service delivery models are key cornerstones, having possibly the biggest long-term potential for GHG emissions reduction. The effectiveness of the transport system and hence its impact on climate change mitigation and adaptation is greatly influenced by long-term decisions taken regarding the patterns of land use which it serves:

• Location and access (to the strategic / higher rank public transport networks);
• Land use designation [quantum, density, mix of functionalities]; and
• Design (urban street typology).

The potential for climate change mitigation at this level of decision-making is significant by reducing the frequency and length of trips and promoting non-motorised or public transport modes which are more suitable for certain trip lengths and spatial configurations. Therefore, the SUMP\[^\text{14}\] should be carried out in parallel and synergy with the land use/spatial plan where possible.

In addition, more public and private sector organisations are signing up for carbon reduction targets and auditing their operations. Those that are adopting ‘scope 3’\[^\text{15}\] accounting are measuring the transport carbon that their activities generate – and taking responsibility for reducing them. This may involve developing new service delivery models that move some services fully or partly online (e.g. teleworking), or through localising physical service provision.

Shift

An essential role is played by the modal split, i.e. the higher the usage of public transport and other modes with lower emissions and energy consumption per pass-km - including walking, cycling, etc. - in comparison to private cars, the lower the level of emissions and energy consumption of the transport system operation overall. While land use policies play a significant role in influencing modal choices, the focus here is on the characteristics of the transport systems provided (rail, bus, walking, cycling...), in terms of the density and quality of networks, service frequency and fares; and, in the case of car use, the cost and availability of parking spaces, and any disincentives to car driving (e.g. access restrictions or road pricing). The balance between these influences the modal choice i.e. the shift from more to lower carbon intensive-modes (e.g. from private cars to public transport or active modes), as per the considerations above.

Improve

Promoting the renewal and technological transition to low and zero-emission vehicles can also contribute to the reduction of emissions, same to improving the traffic regime. The choice of a technical solution for urban mobility investments may equally contribute to reducing the carbon footprint.

Implementing fully the whole “package” of measures developed in the SUMP (including the softer ones) is essential for the achievement of the agreed climate change targets. The impact of the implemented package needs to be fully monitored, both to learn lessons about any implementation issues (process evaluation) and to assess the overall effectiveness in reducing CO2 emissions (and other high-level policy objectives). This information then feeds back into the long-term carbon reduction strategy, which may need modifying to meet the final zero-carbon target.

\[^\text{14}\] Here it refers to SUMPs where it also applies to a wider type of Plans – Transport and others.

\[^\text{15}\] See chapter 3.1, page 20 in the explanation of the EIB carbon footprint methodology.
The transition toward carbon-free urban mobility will span over more than one SUMP period. The “European Green Deal” has determined the net zero carbon objective across all sectors until the year 2050. The “Fit for 55” package has determined interim objectives until 2030 of a net 55% carbon reduction across all sectors against 1990. The 55% objective is supported by a package of legislative and political measures across relevant sectors. The general net zero objectives cannot be achieved in every sector individually. In the transport sector (urban mobility applying on a per capita basis) the basis is not 100% of 1999 but more than that and would thus have to go down from that level to 45% in 2030, which will only be achievable where substantial progress has already been made. Meeting the 2030 target requires an ambitious reduction of private motorised transport in urban areas from an average of 44% modal share in 2019 to 20% in 2030.

In most cities, the path towards zero carbon emissions from urban mobility will be long and filled with challenges. The actual impact of certain policy areas can be determined from a longer-term perspective. The achievement of a long-term zero-carbon transition strategy can be viewed in the following terms in Figure 3.

Starting from the current position of an urban mobility system that is highly carbon-dependent in the bottom left, the goal is to arrive at the top-right part of the figure, when the target of 100% carbon-free urban mobility has been reached. This will require the development of a mix of strategies, introduced at different times and with varying durations of implementation. Recognising that progress may well be a ‘bumpy road’, depending on political and funding cycles.

**Figure 3. Developing a full-length Transition Strategy**
(Source: UCL, ‘SUMP-Plus’)

The sustainable urban mobility transition in European cities could lead to net benefits of up to €177bn by 2030. Of these net benefits, saved costs from reduced CO2 emissions, pollution, noise, and fatalities (externalities) amount to €79bn in 2030. This means that on average, each euro invested in the transition can generate up to €3.04 by 2030.

**Box 1. The eight SUMP principles to mitigate climate change**

The SUMP Guidelines spell out eight principles that build the cornerstones of every Sustainable Urban Mobility Plan which are equally and easily applicable also to mobility decarbonisation throughout the SUMP cycle. 16

1. Plan for sustainable mobility in the “functional urban area.”
2. Cooperate across institutional boundaries.
3. Involve citizens and stakeholders.
5. Define a long-term vision and a clear implementation plan.
6. Develop all transport modes in an integrated manner.
7. Arrange for monitoring and evaluation.
8. Assure quality.

**References:**


17. Others include the importance to secure political support from local authorities in the wider area and to facilitate appropriate data collection and analysis, measure planning and implementation.

18. As an example: Ensuring the delivery of benefits for non-resident commuters from suburban or rural areas in terms of time/money saved will help gather a critical mass of support and avoiding a typical win-lose antagonism.

2. THE PATH TO DECARBONISATION OF URBAN MOBILITY

The process for developing a long-term transition strategy feeds into the start of a SUMP cycle, during which the high-level strategies are turned into specific policy mixes that drive the selection of actual measures (e.g. a strategy to reduce car use by 10% is translated into specific active travel and public transport improvements, and traffic restraint policies, such as parking restrictions). The resulting (groups of) measures are implemented, monitored and evaluated. Their effectiveness is fed back into the high-level transition strategy, which may well need to be modified. Where a long-term transition strategy has not been developed or clear mobility goals toward climate neutrality target not yet envisaged, the SUMP preparation process already represents a step in this regard and a tool for carbon emissions reduction.

The main outputs from the tool emphasise a key message that is likely to be applicable everywhere:

- They are experts in their own fields (e.g. from electricity distribution to bus service operations);
- There will be a need to have a common understanding and agreement on targets and measures and general support;
- The implementation of many of the measures (e.g. online service delivery) will fall onto other stakeholders.

2.2. Carbon Zero Strategy Analysis

The research project ‘SUMP-PLUS’ has been working with some of its partner cities on developing a long-term transition strategy to carbon zero and has developed a “Carbon Zero Strategy Analysis Support Tool” to help them explore the effectiveness of different mixes of Avoid-Shift-Improve strategies. The tool and its application aim at:

- Establishing a good baseline of information, on travel patterns, sources of electricity generation/storage over time, etc. to develop a realistic carbon zero strategy
- Providing a basis for examining different strategy mixes, to explore how effective they would be in the local context in meeting target outcome levels or an overall city carbon budget, the resulting decarbonisation strategy then feeds into the SUMP.
- As part of the process, identifying strategy components which are likely to be effective and feasible, during the next SUMP cycle, recognising that it will not be practical to introduce certain components at this time, due to funding, capacity or administrative reasons; but such barriers (e.g. need for legislative changes) need to be identified so that they can be addressed in time for measure implementation in the subsequent SUMP cycle.

It is not possible or advisable to achieve ambitious climate change targets simply by implementing “improve” strategies to electrify the vehicle fleet combined with a “shift” to renewable electricity generation. Firstly, such a transition takes time and cumulative emissions build up to unacceptable levels in the interim. Secondly, simply focussing on improving fuel emissions and switching from one fuel source to a less polluting source does not help cities achieve other objectives in relation to congestion reduction, safety, enhancing accessibility or promoting equity and social inclusion. The tool suggests that a more balanced mix of avoiding, shifting and improving is required, with an emphasis on the three variations according to area types and context.

The tool itself is presented in more detail in Annex 6.2. A link to the tool is also provided. The excel based instrument can support the relevant professionals in the development of a long-term decarbonisation strategy (i.e. transition strategy), and identify which strategies can be translated into specific sets of measures and successfully implemented within the next SUMP cycle.

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Figure 4. Interrelationships between Transition Strategy and SUMP cycles (Source: UCL, ‘SUMP-Plus’)

Over time, in most cases, there will need to be a build-up of institutional capacity and financial resources. Achieving the long-term carbon goals will require a symbiotic relationship between the formulation of this long-term transition strategy and its implementation, via a sequence of SUMP cycles, as illustrated in Figure 3.

The tool itself is presented in more detail in Annex 6.2. A link to the tool is also provided. The excel based instrument can support the relevant professionals in the development of a long-term decarbonisation strategy (i.e. transition strategy), and identify which strategies can be translated into specific sets of measures and successfully implemented within the next SUMP cycle.
3. Sustainable urban mobility planning steps for climate change mitigation planning

The established SUMP concept provides the short- to medium-term planning and implementation framework to reduce the carbon footprint of urban mobility. Where possible, this should be based on the development of a long-term climate change mitigation strategy (also referred to as “long-term transition strategy” or “Transition pathway”) across sectors or specifically for urban mobility (see chapter 2). In other words, linking climate change mitigation planning with their SUMP should help cities to plan and deliver specific low and zero-carbon emissions mobility solutions.

To do this systematically, it is necessary to “weave” climate change mitigation strategies into the established SUMP process. This chapter provides guidance, including suitable methods, tools and activities, on the way toward achieving a sustainable and low-carbon city. It aims at integrating what is detailed in the general SUMP guidelines with a focus on integrating climate change mitigation strategies and goals in the SUMP process. It constitutes stand-alone guidance on the topic and therefore, a coherent complement to the general SUMP guidelines.

Because cities might be at very different starting points, there is no single ideal way to tackle this. It is highly dependent on the specific situation and the status of the local SUMP, the existence and quality of local climate action plans and the availability of a long-term mobility transition strategy.

- If your city does not yet have a SUMP but is in the process of kicking it off, it is a great opportunity to also integrate climate change mitigation planning and delivery, from the start. This guide will offer a practical framework for such a combined approach.

- If your city already has a SUMP in place, climate change mitigation planning can still be integrated. A reflection and update of a SUMP, considering evaluation results, public acceptance issues and recent developments is always a good idea.

- If your city already has a climate action plan established, then this guide can support the planning process as they will bring together a plurality of stakeholders and actors.

The SUMP cycle is a simplified and idealised representation of the overarching SUMP planning logic, broken down into four separate phases with smaller steps within each. It has proven very helpful for planners to structure and keep track of a complex process. The four phases are:

1. Preparation and analysis
2. Strategy development
3. Measure planning, and
4. Implementation and monitoring.

Depending on the local and regional situation, certain steps and activities can be adapted and skipped (if equivalent results are already available, e.g., from a related planning process) or repeated at a later stage. Such adaptation to the specific situation must be carried out by the local and regional actors themselves.

3.1 Phase 1: Preparation and analysis

Set up working structures and climate change governance

The urgency of working across sectors and boundaries, as described in step 1 of the general SUMP guidelines, increases when preparing a low-carbon SUMP. Some stakeholder engagement activities will be required to develop a long-term transition strategy (as mentioned in chapter 2), so it may be that many of the same people and groups can be invited to collaborate in the development and implementation of the SUMP.

Practitioners need to define a core working structure and set up a strong basis for cooperation between different departments within the city and, if encouraged by national policy or if governance structures exist, between local authorities at the Functional Urban Area (FUA) level. Even if the SUMP cannot be established for the entire FUA, the reduction of the GHG footprint of mobility requires a detailed understanding of transport and urban development interdependencies at the level of the FUA. Climate change mitigation requires relevant stakeholders and municipalities to at least cooperate in the respective area to gather and analyse data.

The existence of institutional fora, where such regional issues can be discussed may provide an initial institutional basis for that. In most cases, there is no need to establish such structures from scratch. Rather, identify and connect with related existing activities, platforms and associations. They might not always already have a focus on mobility but they can open the door and provide a basis on which SUMP-related topics can be productively discussed.

Vertical integration

Cities are in charge of important levers to speed up climate change mitigation, especially in the area of mobility and spatial planning. However, many other levers are beyond the sphere of influence of cities. The decarbonisation of all aspects of life, including mobility, has to be addressed at all geographical and political levels, the higher the stronger its impact. Urban Mobility practitioners need to consider higher integration at the regional and national level which includes coordination, negotiation, lobbying or conflict regulation. By bringing key representatives on board from the start, practitioners may ensure stronger political support from the start at both the local, FUA, regional and national levels, facilitating an alignment of objectives, goals and measures.

Depending on the intensity of cooperation required and the incentives provided at the regional and national level, practitioners could aim for formal cooperation agreements between the city level, formal agreements on association or cooperation with each municipality within the FUA.

Involving the public, citizens and mobility users

More than most other sectors decarbonisation of urban mobility impacts the live styles of citizens and requires behavioural change (work, leisure, shopping, family life, etc.). Citizens and grass root community organisations already active in requesting and promoting those changes need to take part in the process from the start. These actors can contribute actively throughout the Climate Action Planning and the SUMP process. Involving them from the start will ensure their buy-in to the project and facilitate the acceptance of less popular measures.

Horizontal integration

Setting up working structures and cooperation mechanisms is also necessary at the local and regional level with other departments, such as land-use planning, energy, environment, etc. These cooperation mechanisms will be used throughout the planning process as they will bring together a plurality of competencies and secure a diversity of capacities and
resources. Interested private sector and stakeholders could also be involved from the start. They can be beneficial for creating public-private partnerships early on to gain support and encourage innovative pilot measures. Working closely with the private sector, including electricity generators and distributors (TCOs/DCOs), electromobility providers and charging point operators, potentially ride-sharing companies and fleet managers, as well as key trip-generating sectors, will enable practitioners to follow an integrated approach for their SUMP and have an impact on land use to promote decarbonized mobility.

In practice, cooperation can manifest in different ways, for example, through regular meetings, the exchange of newsletters, work shadowing, written cooperation agreements, the establishment of data sharing IT infrastructure, data standard conventions, the creation of a joint glossary etc. In all of these cases, there is a component of trust between human beings. The importance of personal encounters should therefore not be underestimated.

Once the vertical and horizontal working structures and collaborations have been discussed and set, practitioners may be able to assess the capacities and skills already available, but also identify the gaps they have and may need to fill by hiring additional staff or learning new skills that are indispensable for climate mitigation planning. At the end of this first step, clear organisational arrangements should be in place.

Examples of some of the stakeholder groups that need to be involved in the implementation of Avoid-Shift-Improve strategies are illustrated in Figure 6.

### Practice Example

**Setting up working structures and climate governance: Budapest, Hungary – revision of the SUMP under development based on the city’s SECAP and with institutional, professional and public consultation**

A revision of the Budapest Mobility Plan 2019 is currently under development, based on the city’s SECAP adopted in 2021. The revised SUMP will put more emphasis on environmental aspects, which are the main evaluation criteria for the assessment of mobility development projects included in the plan. To do so, BKK (Budapest Centre for Transport) has invested in internal capacity building and upskilling processes of its staff which resulted in the creation of an expert team working together with a newly formed expert consulting forum established by BKK’s CEO, the Budapest Centre for Transport. This forum is a key instrument that helps the municipality tackle the climate change issue in its work.

**Institutional consultation:** The Balázs Móricz Committee is a regular expert consulting forum established by BKK’s CEO, the largest public transport company in Hungary. The committee consists of representatives of the stakeholder organisations that had taken part in the preparation and implementation of transport development projects: Municipality of Budapest/Mayor’s Office, Ministry of Innovation and Technology, Centre of Key Government Investments, Municipality of Pest County, Budapest Közút Zrt. (Road Manager), BKV Zrt., National Infrastructures Development Mav Zrt., MAV-HEV Zrt., NAV-START Zrt., Budapest and Pest County Chamber of Engineers.

**Professional consultation:** The Balázs Móricz Committee is the middle level of partnership, which is a professional consultation forum with NGOs, planners and other external/internal experts.

**Public consultation:** BKK used a questionnaire to survey the opinion of Budapest residents regarding the uncovered problems and the objectives. The most important result of the survey was that more than 87% of respondents agreed with the most important strategic goals defined by the BMT: that the number of environmentally friendly means of transport should be increased by 2030.


### Determine the low-carbon planning framework

This step is one of the key steps of the process to fully integrate climate change mitigation planning in your future SUMP as it is an opportunity to assess all relevant planning from multiple sectors, and align with their goals and objectives as well as timelines. This step will result in having a comprehensive understanding of the strategies already in place in terms of climate mitigation at the local and national levels while also considering strategies of other sectors such as land use and energy.

**Define the geographical scope**

A low-carbon SUMP should cover the functional urban area as longer trips in the FUA may represent few of the total urban trips but produce higher amounts of CO2 than shorter urban trips. In addition to securing political support from local authorities in the area, defining the FUA as the main scope of your SUMP will ensure appropriate data collection and analysis and measure planning and implementation at the FUA level. Therefore, a SUMP that covers the entire urban agglomeration will be much more effective at reducing GHG emissions than one that covers only part of it.

Based on the traffic analysis, the functional urban area can cover an area where the large majority of commuting trips take place. Other threshold criteria can be applied depending on the specific focus and indications. Practitioners could identify within these boundaries the modes that would be potentially impacted by the SUMP and would have a relevant impact on GHG emissions as a result of their respective modal share.

### Assess existing plans

The SUMP needs to be coherent with and contribute to other plans and strategies from the EU, national, regional and local levels that have an impact on urban planning, land use planning, air quality, environment, energy, innovation and research & development. These plans should cascade the objectives of the main international agreements, such as the Paris Agreement, into more sectoral and area-specific targets, namely for GHG reductions. The National Energy and Climate Plans (NECPs) sets the frame of minimum objectives, Regional or local Climate Action Plans under whichever title may specify the objectives and some concrete measures.

Certain plans could be assessed (Table 1).

### Align with existing plans

Existing plans need to be aligned in two important ways. Firstly, they need to be free of contradictions or, ideally, mutually reinforcing and informing. This is not always the case, for example, if a housing shortage is being tackled with new single-family homes outside existing strong public transport corridors. Secondly, existing plans need to be synchronized in the sense that they work towards compatible time horizons because only plans that are coordinated can be coherent.

To align the work within the city and the timelines for the preparation of the two plans, SUMP & Climate Action Plan, bringing departments together is crucial.

### Table 1. List of existing plans that can be assessed

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<thead>
<tr>
<th>At the European level</th>
<th>At the national and regional level</th>
<th>At the city level</th>
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<tbody>
<tr>
<td>EU Green Deal and EU Climate Law</td>
<td>National Energy and Climate Plans (NECP) &amp; National and/or Regional Adaptation Strategy</td>
<td>City’s environmental, climate or resilience or adaptation strategy</td>
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<tr>
<td>Fit for 55 package</td>
<td>National and regional climate change mitigation policies</td>
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<tr>
<td>EU Smart and Sustainable Mobility Strategy</td>
<td>National and regional environmental plans</td>
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<tr>
<td>Energy Governance Regulation</td>
<td>Sustainable Energy and Climate Action Plans (SEAP)</td>
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<td>2030 Climate &amp; Energy Framework</td>
<td>Sustainable Energy and Climate Action Plans (SEAP) or other national and regional energy plans</td>
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<td>EU Taxonomy and its Delegated acts</td>
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<tr>
<td>Climate Financing Plans</td>
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26 It is however noted that some of these NECPs might not already be aligned with EU climate neutrality target and this will be object of upcoming revisions in near future.

25 If you see inconsistencies in regional or local climate action plans, give some recommendation and try to change those documents.
3. SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

3. DECARBONISATION OF URBAN MOBILITY

3.1. Climate change mitigation

The analysis should address, among others, the following questions, which are of particular importance regarding climate change mitigation:

- What has been the evolution of transport-related GHG emissions in recent years? How are emissions expected to evolve in the following years in the base scenario (i.e. scenario without considering SUMP planned measures)?
- What is the availability of motorized individual traffic (ownership, car sharing, etc.)?
- What is the availability of public transport, bike and pedestrian infrastructure and sharing services?
- What is the average trip distance?
- What are the primary energy sources for the transport system? What has been the evolution in recent years and how are they expected to evolve in the base scenario?
- What are the main drivers for the historical increase of emissions? The models are rapidly expanding their possibilities and could be used more frequently. Their principal limitation is that usually they do not consider transportation demand for SUMP would generally include the preparation of an appropriate implementation plan for climate goals in SUMP.


![Emissions (in TCO2) = Transport activity data (e.g. veh-km, train-km, tonnes-km, ...) x Emission factor gCO2/veh-km, train-km, tonnes-km, ...)](https://www.example.com/eq)

Emission calculation in SUMPs) describes the “core” calculation of CO2 emissions, both at the level of the project corridor and area (plan). Annex 6.1. [GHG Emission calculation in SUMPs] describes the “core” considerations for the calculation of GHG emissions in the SUMP preparation process.

For smaller cities and cities which do not yet dispose of an ex-ante estimation of transport demand, it is recommended in general to develop such a tool possibly in conjunction with a group of surrounding/bordering other cities in the context of a FUA. In the interim period, a simpler transport demand assessment could be considered, based on readily available and ad-hoc collected data (e.g. starting from origin-destination, etc.), so that analyses, hypotheses and measures are developed based on actual data and not purely on qualitative assumptions.

Overall, cities implementing a SUMP to decarbonise their mobility need to have a minimum amount of data available to assess the current situation. Cities can make the best use of existing information available in addition to the SUMP as the starting point. For smaller cities and cities which do not yet dispose of a transport demand assessment, a more detailed and accurate process could be employed. For smaller cities and cities which do not yet dispose of a transport demand assessment, a more detailed and accurate process could be employed. Generally, the principles for this calculation can be summarised simply:

- What is the availability of motorized individual traffic (ownership, car sharing, etc.)?
- What is the availability of public transport, bike and pedestrian infrastructure and sharing services?
- What is the average trip distance?
- What are the primary energy sources for the transport system? What has been the evolution in recent years and how are they expected to evolve in the base scenario?

This step presents simple but robust calculation methods of GHG emissions focused on transport strategies (including SUMPs). The calculation is based on EIB Project Carbon Footprint Methodologies. As per above, fundamental factors to accurately estimate GHG [CO2 equivalent emissions are traffic data - current and predicted – including, particularly, modal shift assumptions/predictions.

A sound analysis of transport demand for SUMP would generally include the preparation of an appropriate implementation plan for climate goals in SUMP.

3.2. Phase 2: Strategy development

Develop a low to zero vision and related objectives with stakeholders

The SUMP vision will be aligned to the low carbon planning framework, as referred above, to the long-term transition strategy and/or relevant goals in the sector/ country and will be translated into general and specific objectives. The vision might look also into the long-term goals (i.e. till 2050) and shorter terms ones (e.g. within the time horizon covered by the SUMP measures implementation).

Therefore, the SUMP-related objectives for climate mitigation would derive from both the analysis undertaken in both policy level strategies (including climate change strategies available at different administrative/sector levels referred to in the previous chapters) as well as the transport-specific analysis carried out.

Those objectives can be quantifiable to the extent possible and appropriate and translated into indicators (see below) within the relevant time horizon.

- Climate change mitigation (i.e. decarbonisation) objectives and their related KPIS – in particular those on GHG/CO2 reduction - should be included among the set of strategic objectives driving the choice of measures identified in the SUMP.
- SUMP objectives can also be transparently cross-referenced with those specific to the environment deriving from the SEA process.

In alignment with SUMP principles, it is expected that those climate mitigation objectives will provide complementarily and consistency with other main objectives of the SUMP, for example, aiming at increasing the use/share of Public Transport.

Box 2. Path to decarbonisation

Often specific mobility planning interventions (e.g. a new tramway) dominate the agenda in the political process. Nonetheless, decision-makers need to keep in mind mitigation targets going beyond the planning interventions and the path to decarbonisation. This means to think in a succession of SUMP cycles. The following questions are intended to explain this sequential process:

Where are we now? Identifying the actions and measures already taken and implemented in the city and at the FUA level to decarbonise mobility. Evaluates how those actions and measures are going and how impactful they are to achieve the goals.

What will our plans achieve before 2030? Identify clear goals to achieve and which can be monitored during the SUMP implementation.

Where do we want to be in 2030? Identify overarching goals from the region, national or European level and identify how the city’s vision can align with those overarching goals.

Ambitious targets in SUMPs, an appropriate set of measures, and a solid monitoring structure are essential to define, approach and verify the path.

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3.3. SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

It is noted that transport models developed and/or used in the context of the overall SUMP preparation process (i.e. understanding and assessing transport demand of different modes and respective impacts including its forecasting) might benefit from already existing models at regional or national level as well as relevant mobility data/needs of the area.

In certain cases, e.g. for smaller area plans such as those concerning mainly the optimization of circulation schemes or the deployment of “soft measures”, notably intelligent transportation system (“ITS”)/traffic management, it is recommended to use microsimulation models. These models enable a more detailed and accurate modeling of traffic behavior and traffic/circulation characteristics, such as “stop & go” situations that strongly affect the level of emissions. The models are rapidly expanding their possibilities and could be used more frequently. Their principal limitation is that usually they do not enable modeling of public transport, so they will almost have to be used in combination with more traditional models for this purpose.

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A low to zero vision and related objectives with stakeholders: Vienna, Austria: The use of a strategic framework to achieve long-term climate-related smart city goals

The City of Vienna aims at finding a way to achieve its climate neutrality with the implementation of a strategic framework. This strategy pursues three main objectives: quality of life, resource conservation and innovation. The City of Vienna focuses on a high quality of life, life satisfaction and social inclusion by adapting its policy designs and administrative activities. With the help of resource conservation, per capita greenhouse gas emissions are to be reduced by 50% by 2030 and by 100% by 2040. In the same period, the per capita final energy consumption is to be reduced by 40% by 2030 and by 70% by 2040. The share of journeys in Vienna by eco-friendly modes of transport is to raise to 85% by 2030 and well over 85% by 2040.

The city of Vienna also sees its opportunity for climate neutrality in the area of innovation. One objective of this strategy is to be an innovation leader in 2030 and to be Europe’s digitalisation capital in 2050.

Setting targets and indicators including GHG emissions indicators

Setting targets and indicators for GHG emissions refers to the methodologies, considerations and calculation principles presented in Annex 6.1, as well as the calculation scheme presented in Annex 6.2 which supports the long-term transition strategy. The indicators related to the most relevant objectives, in particular those deriving from high-level policies (i.e. long-term carbon-zero transition strategies at national/regional or sectoral level as available), should be considered as SUMP KPIs.

Since the objective is to decrease absolute emissions when compared with current levels, it is recommended to incorporate the following core indicators:

1. **Current Absolute Emissions** = total emissions produced in the base year, associated with operations of all the modes considered relevant within the considered boundaries.

2. **Absolute Emissions** = total emissions produced in the selected SUMP Scenario, also associated with operations of all modes considered relevant within the considered boundaries – for a given/selected future time horizon (year). Based on these two indicators, the main indicator of (relative) Emissions for the SUMP can be calculated:

3. **Current vs Plan Emissions**31 = difference between Current Absolute Emissions and Absolute Emissions for the defined SUMP time horizon and scenario/option.

This last indicator in particular could become one of the key KPIs of the SUMP. The target value for this indicator should be derived from the relevant national (for example Denmark: 70% reduction until 203032 and European level policy choices (“Fit for 55”, see chapters 1.1 and 3.1) or other sectoral or regional/local policy decisions that might be developed in the context of long-term transition strategies. In the case of GHG emissions, the main references at the national level are climate strategies and/or legislation and the National Energy and Climate Plans (NECPs), which could have been “cascaded” down to the sectoral and local levels. A further step in this direction could be based on the reverse extrapolation of the level of GHG emissions to the 1990 levels, to ensure the SUMP objectives are defined based on the comparison with 1990, i.e. the base year of the Paris agreement (as well as EU and national objectives).

Further work might be needed to establish the appropriate value for the KPIs at the SUMP level from the above-referred climate targets. These values may have been defined in consultation with national authorities where GHG reduction targets per sector and specific administrative divisions are set. Where this is not the case, the team working on the SUMP should aim at engaging with local authorities to agree on a methodology to determine objectives and appropriate target values. This could include a simple “pro-rata” split of a combination of different factors such as surface area, population, density, GDP (total/pro-capita), the sector’s or area’s current and forecast contribution to GHG production, etc.

Another element to consider in a more detailed level of analysis is what could be referred to as micro-areas.33 The main objective in a micro-area is to eliminate direct emissions from traffic (e.g. NOx, particulates etc.), independently from the “global” GHG impact (e.g. in certain “protected” pedestrian areas, historical centres, nearby hospitals, schools, etc.). This level would not be covered by the indicators and would not be considered when selecting the SUMP scenario/option but would play a role in guiding the selection of the lowest impact measures for these specific cases.

The total set of SUMP indicators should include also those associated with a wider set of objectives, in particular those deriving from high-level policies. Some examples of SUMP indicators [KPIs], including those relevant to urban mobility decarbonisation and climate change, include:

Table 2. Set of indicators for a decarbonised urban mobility

| Strategic/general objective | Measurement / indicator calculation | Definition of target values and sources (other plans, Laws, Policies, etc. – EU/national/regional/metropolitan/…)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Climate change mitigation</td>
<td>1.a. % of reduction of emissions of greenhouse gases, measured in tons of CO2 equivalent</td>
<td>calculated following the EIB carbon footprint manual.</td>
</tr>
<tr>
<td>1.b. Reduction of energy consumption</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
<tr>
<td>1.c. Use of renewable energy or share of renewable energy in transport</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
<tr>
<td>2. Climate change adaptation</td>
<td>2.a. Climate risk reduction (qualitative assessment)</td>
<td>calculated following the EIB carbon footprint manual.</td>
</tr>
<tr>
<td>3. Compliance with the environmental thresholds</td>
<td>3.a. Polluting emissions of NOx, CO, PM10 and PM2.5, etc.</td>
<td>calculated following the EIB carbon footprint manual.</td>
</tr>
<tr>
<td>3.b. Noise and vibration</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
<tr>
<td>3.c. Potential additional elements</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
<tr>
<td>4.b. Serious injuries</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
<tr>
<td>5. Metropolitan accessibility</td>
<td>5.a. % travel time reduction between municipalities by PT</td>
<td>calculated following the EIB carbon footprint manual.</td>
</tr>
<tr>
<td>6. Financial sustainability</td>
<td>6.a. % increase in ratio income from tariffs/DEM costs for public transport services</td>
<td>calculated following the EIB carbon footprint manual.</td>
</tr>
<tr>
<td>6.b. optional: Total transportation costs for citizens / commuters</td>
<td>calculated following the EIB carbon footprint manual.</td>
<td></td>
</tr>
</tbody>
</table>

31 This is the proposed revised way of calculating relative emissions for plans (SUMPs) in comparison to the standard methodology for projects as per the EIB carbon footprint manual.

32 The Climate Act, approved by the Danish Parliament in June 2020, sets legally binding targets of a 70% reduction in GHG emissions by 2030 (compared with 1990) and climate neutrality by 2050 at the latest. In addition, the government must set sub-targets every five years.

33 For example a stretch of road or an area along which certain car emission categories (e.g. below Diesel Euro 5) are not admitted or a low emission zone with the same type of restriction.
3. SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

The use of Indicators in a SUMP toward climate mitigation: Barcelona, Spain and its implementation of the SUMI indicators.

During the SUMP project (2017-2019) an indicator focusing on Greenhouse gas emissions of passenger and freight mobility within urban areas has been defined. The indicator is evaluated in terms of well-to-wheels GHG emissions per capita (t CO2 eq/ cap per year) and can be estimated by filling out the related calculation spreadsheet.1 The key data for the estimation of this parameter is related to transport performance by mode (i.e. in terms of distance driven by transport mode and vehicle type) and vehicle fleet composition by mode and fuel technology, complemented with the related energy consumption factors and CO2 emissions coefficients by fuel type. The estimation of GHG emissions is based on carbon content related to energy consumed by fuel type, taking into account mobility in the urban area. With this respect, energy consumption factors and vehicle fleet composition are applied to transport performance to estimate the overall energy consumption by fuel type. The emissions are estimated taking into account both passenger modes2, freight road transport modes (HGV and LDM) and specific fuel technologies considered for the vehicle fuel.

The indicator related to GHG emissions has been successfully estimated during the project for 14 urban areas, out of the 46 urban areas testing the whole SUMI indicator set. Among them, the metropolitan area of Barcelona filled the required input based on data reported in the Metropolitan Plan For Urban Mobility 2019-2024. The document includes information on vehicle fleet composition and transport performance, resulting from a transport network modelling tool which was used for the evaluation of the measures of the Metropolitan Plan. AMB developed an integrated model of intra-urban mobility to assess population exposure to traffic emissions and health impacts. The model was used in the Strategic Environmental Assessment of the Barcelona Metropolitan Mobility Plan (PAMM). For the calculation of the SUMI indicator, some difficulties were reported about having updated data on vehicle fleet composition in circulation and disaggregating some vehicle categories (for instance, LOV vehicles categories). Nevertheless, the current monitoring system of LEZ (ZBE Rondes Barcelona) and the data of the Working Day Mobility Survey (EMEF) would allow for improving the availability and reliability of data about this issue.

The energy consumption factors and CO2 emissions coefficients by fuel type used for the estimation were the default values available in the calculation spreadsheet. The availability of transport models has been reported as a key aspect of cities to provide the required data. In some cases, the data gap is difficult to close (i.e. a lack of fuel consumption data for specific vehicles), and to make an estimation it is necessary to use proxy data sources (e.g. simplified aggregated models) or preferably use open source solutions, open data and EU-wide geodata repositories (in coordination with national and regional data authorities). The experience of the metropolitan area of Barcelona underlined also the importance of updating regularly the available transport network modelling tool and recalculating the assessment indicators. With this respect, the fine-tuning of the indicator calculation methodology is currently taking place in the SUMI project, taking into account the SUMI project’s Final Recommendations. The revision of the indicator is expected to be completed by the beginning of 2023.

The final choice of the SUMP “planning (operational) option [scenario]” among the X admissible ones (if more than one) will be made including other criteria related to the (main) SUMP objectives and other identified KPIs, such as safety, financial sustainability, improvement of accessibility/reduction of overall travel times, etc. Figure 8 shows a sequence of backcasting process to select options/scenarios.

Build and jointly assess planning options/scenarios

To reach identified objectives, a series of possible measures (i.e. constituting different planning options)36 could be identified and developed at the level of:

- Infrastructure: extension, capacity increase/decrease, increase/decrease of (design) speed, rearrangement of stops and stations, etc.
- These measures could be subject to a qualitative and interdependency comparison to identify a set of reasonable measures. They should be grouped to define operational options, i.e. planning options which could be assessed against the SUMP-defined objectives. Therefore, this will require the assessment of the planning option(s) in relation to the relevant climate change mitigation objectives (i.e. KPIs for specific time horizon(s) as described above). The assessment of GHG emissions reduction for a certain year(s) in relation to the current/reference year will require assessing/forecasting the relevant transport activity data at the time horizon specified. Those calculations and analyses should be based on a sufficiently robust and adequately representative traffic model and/or based on an adequate transport demand assessment for the specified time horizon(s).
- If the minimum established targets of the related KPI(s) (i.e. a certain level of GHG emissions reduction as per the KPI “Current vs Plan Emissions”) is not reached by the considered planning option, a new round of measures assessment can be undertaken. This could include more stringent measures increasing the use of lower emission modes, starting from a higher modal shift from private cars to public transport and low/zero emission modes, and policies to set the right incentives/ remove barriers for the purchase/lease and use of zero-emission vehicles. In many cases, stricter measures may be needed, including implementation of active travel, public transport priority corridors, reallocation of road capacity reducing the space used for on-street parking, etc. SUMPs will also need to consider policy measures to avoid traffic working with stakeholders outside the transport system to reduce the number/length of the trips.

Practice Example

Source: F. Fermi (TRT Trasporti e Territorio)
Image: SUMI

2 Car, bus, coach, PTW/Motorcycle, Motorised 3-wheeler, metatraff/trolybus, light rail, train, inland waterways ferry

Box 4. Use of backcasting approach to set targets and to select options/scenarios

To plan for decarbonised mobility to address the climate crisis, cities will need to switch planning approaches and outcomes: from extrapolating existing mobility trends and increasing road capacity (predict and provide), to starting with the end vision, including net zero transport carbon emissions and using backcasting to identify sustainable policy packages that will deliver the intended outcomes (vision and validate). The main question to be answered by practitioners will be what measures and packages can most efficiently reduce CO2 emissions in mobility to the required level. This could, for example, translate into setting an allowable annual CO2 budget that is reduced over time, leading to the decarbonisation of mobility by a set target date. For that, a procedure is suggested that can be described as a six-step model.

Figure 8: Sequence of a backcasting process to select options/scenarios

Source: INFRAS, 2021, Overview of Urban Mobility Climate Strategies and Climate objectives in Urban Mobility Plans (SUMPs)

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### 3. SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

#### 3.3. Phase 3: Measure planning

**Identify CO2 reduction intervention areas**

Overall, studies have found that cities can avoid a great amount of their greenhouse gas emissions through action at the local level. The most important areas of intervention at the city level include a better integration of land use development and transport to avoid traffic; the incentivisation of work organisation systems that allow decreasing the number of commuting trips (e.g., telework), the promotion of alternatives to the individual car through improved public transport, the (substantial) improvement of cycling conditions and other forms of active mobility, the re-allocation of road and other transport dedicated urban space to other than car modes and all types of smart transport services, barrier-free stations and vehicles, but also for active mobility, a high-quality public transport service i.e. to reduce the carbon footprint of individual motorised space to other than car modes and all types of smart transport services and timetables may not be efficient, or shared micro-vehicles could serve as first- and last-mile connections in districts where the density of public transport stops are low. Thus, integrating the most often privately operated new mobility services with existing mobility systems can strengthen public transport as an alternative to private motorised transport.

Parking regulations and the conversion of car parking slots into parking zones for shared micro-vehicles which are mandatory to use are a means to limit the clustering of vehicles on sidewalks. Pricing inner-city private car use is one of the most common approaches to reducing motorised individual transport and generating revenues for the city budget. Parking management is a widespread measure among European cities. As a measure for a city to support the energy transition, benefits for electric vehicles (e.g. free parking, where cars with combustion engines have to pay) could be added.

A growing number of cities recognised the need to provide more space for active mobility and public transport. Re-allocating space from car use towards safe active mobility (i.e. the provision of protected bike lanes) and speeding up public bus transport is a means to increase the competitiveness of sustainable mobility. The reallocation of scarce public space at the expense of car infrastructure can imply time-consuming decision-making, planning, and construction processes that may be contentious; but the H2020 MORE project has developed processes and tools for stakeholder co-creation of street designs that enhance public acceptability.

An ambitious reduction of transport-related CO2 emissions will not be achieved without an energy transition in urban mobility. Although a phase-out of private vehicle use in cities is highly desirable from a climate and quality of life perspective – including e.g. private cars’ severance effect and impact on the safety of circulation - cars will remain part of the mobility system in the coming decades. This means that the remaining car fleet needs to gradually shift to zero tailpipe emission (to be necessarily complemented by reducing the carbon footprint of charging power generation). While the main framework conditions for the switch to e-vehicles are set at the national and European levels (fleet emission standards, taxation, premiums), more and more cities contribute to accelerating this shift through local measures. City governments can actively push for changing framework conditions at the national level and publicly announce to their citizens their willingness to introduce Internal Combustion Engine (ICE) car bans. Due to the long product lifetime of motor vehicles, this decision could be announced for several years before the planned introduction to allow citizens to factor in an ICE vehicle ban when purchasing a new car.

A longer list of types of individual measures/actions to contribute to achieving decarbonisation objectives is introduced in chapter 4.1 and included in annex 6.3.

**Box 5. Electrification of vehicles as a city’s intervention area**

Cities could support the electrification of individual vehicles through public procurement, e.g., through a strategy to electrify bus fleets or vehicle fleets of city administrations (as determined by the Clean Vehicles Directive yet beyond the ratios required therein). Vehicle fleets which are run based on local concessions or other forms of public authorisation, e.g. tax fleets and vehicles used for ride-sharing services, may equally be subject to electrification requirements. Finally cities can support the electrification of private vehicles through the provision of publicly accessible charging points or the procurement of charging point operator (CPO) services.

Can be supported by facilitating the exchange between key players, including energy providers, energy network operators, large housing companies, or supermarkets, whose parking spaces could be equipped with semi-public charging points. Local authorities can also encourage private homeowners to combine PV-powered electricity production with charging rights or charging points, which may then also be offered to third-party charging. Since the installation of roadside charging infrastructure can be an urban issue that is dedicated to car use, charging infrastructure development plans need to be aligned with urban road use planning.

**Figure 9. Example of concrete spatial co-location and synergy of measures**

Source: [Supporting measure CPO service](https://www.roadspace.eu/results/).

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25 Not all measures can be decided and implemented at the local level and the remaining emissions are within the competence of the national (and European) level. For example, a largest share of costs related to car use and ownership, e.g., is usually determined at the national level. This includes vehicle-related taxes or fuel taxation. Complementary measures at the local level comprise parking management – including adequate pricing both for short-term parking and residential parking permits. Moreover, national-level laws may reduce a city’s room for maneuver; for example, cities in some member states are not allowed to raise congestion charges or to introduce zero-emission zones.

better-streets-for-better-cities-summary-and-key-recommendations.

Agree on low-carbon actions and responsibilities for package implementation

Following the agreement on measure packages, operational planning must break the packages down into actionable tasks for each of the departments and institutions that are in charge of their implementation. Based on detailed action descriptions, practitioners will identify cost estimations, clear responsibilities, implementation priorities and timelines to be agreed upon with other actors. This will help practitioners allocate their resources according to the needs during the implementation.

The timing of the implementation of a policy measure is often linked to the introduction of other measures and factors, as indicated in the Figure 11. This figure shows interdependencies between enabling actions, such as legislation, some SUMP transport policy measures, and measures in other sectors that are required to deliver the carbon reduction targets (e.g. fossil-free electricity generation and better co-ordinated housing policies).

Based on the institutional cooperation agreed upon during the definition of long-term transition strategies (see chapter 2) and at the beginning of the SUMP process in Phase 1, involved actors should agree on responsibilities, timelines and resources available to use all available skills and capacities, as well as ensuring that skills within each department are used accordingly. A template action table can be found in Activity 8.3 of the SUMP guidelines.

Each measure package and measure could be clearly defined to develop a thorough financing plan. Practitioners should start by identifying all the available funding and financing streams available within the institutions and departments cooperating on the development of this SUMP, as well as assess the abilities of the organisations involved to access or capture these funding streams. Ideally, each measure could be linked to a specific regulation or administrative process to ensure its implementation.

Clear communication with the most affected stakeholders, often the general public, and key political decision-makers is essential to ensure further support for the acceptance of certain measures and to anticipate potential blockages. Practitioners can continue communicating regularly on the vision, objectives and measures selected to strengthen wide political and public support around decarbonised mobility. Communication on less popular measures should be particularly emphasised, through increased awareness of the topic and its impact at different levels as well as including citizen collaboration and participation during their implementation.

Practice Example 4. Example of measure packaging in Vitoria Gasteiz, Spain: Combination of “Superblocks” with public transport expansion & good communication and participation

Vitoria-Gasteiz is implementing a superblock scheme to transform the city into a more liveable and safer place. Firstly, the city introduced speed-reducing measures, roadblocks and changes in traffic circulation. Furthermore, road space was redesigned to encourage active and sustainable travel. Pavements were widened and pedestrian priority zones, cycle lanes and bus/lram priority lanes were installed, and the city is planning more developments in the future. Some kiss-and-ride spaces are planned to be introduced in school areas as well. Also, the city plans to introduce parking charges (fixed price, based on emission standards and from on-street to off-street). Vehicle access in certain areas is planned to be restricted based on the emission level of the vehicles and the trip purpose of the road user, more specifically delivery vehicles and through-traffic will be regulated. Travelling, parking and planning conditions in the superblocks will also be regulated using permits. Lastly, to mitigate the impacts of the interventions, exemptions will be introduced and mobility options will increase.

Practice Example

<table>
<thead>
<tr>
<th>UVAM group</th>
<th>UVWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial interventions</td>
<td>Not adopted</td>
</tr>
<tr>
<td>Pricing aspects</td>
<td>Adopted</td>
</tr>
<tr>
<td>Regulatory measures</td>
<td>Planned</td>
</tr>
<tr>
<td>Complementary measures</td>
<td>No longer planned</td>
</tr>
</tbody>
</table>

Figure 10. UVAR in Vitoria-Gasteiz (source: ReVeAL project, 2022)


Figure 11. Policy measures’ timing of implementation. Source: ‘SUMP-PLUS’

Analyzing interdependencies

Institutional & legislative frameworks

Governance in the city region

Funding & financing mechanisms

Time

Cycling

Spatial transformation

Energy transition

DECARBONISATION OF URBAN MOBILITY

3. SUSTAINABLE URBAN MOBILITY PLANNING STEPS FOR CLIMATE CHANGE MITIGATION PLANNING

Prepare for SUMP adoption and financing

After preparing a thorough cost estimation and the elaboration of a financial plan at the SUMP level, practitioners need to develop specific financial plans for all actions. This financial scheme can then be included in the SUMP itself or part of a separate process. As decarbonisation of urban mobility requires practitioners to prepare, long, medium and short-term investment plans for different types of measures, a specific emphasis needs to be put on funding opportunities for climate change mitigation and their economic impacts. Climate change mitigation and decarbonisation processes implemented by the SUMP can grant access to specific financial opportunities associated with climate action. Planning for contingencies to help achieve resilience against potential changes in the funding stream can be secured by finding different streams.

As the decarbonisation of transport may require the implementation of innovative measures or living labs, existing funding schemes may be inadequately aligned with the needs of pilot measures, which are seen as key to building acceptance to change and participation. Going beyond the awareness level towards action, a continuous dialogue among stakeholders and sectors can prove to have tremendous benefits in gaining political buy-in for controversial measures, prioritisation and packaging of measures, as well as in evaluating their impacts. By creating a common understanding of the fact that climate change affects everyone and that all should act together in coordinating efforts, funding streams can be channelled effectively. In addition, securing public-private partnerships or using innovative procurement processes may help to fill a gap in funding/financing of innovative and pilot measures.

Finding funding for decarbonized mobility will be easier for SUMP-defined at the EU level and where different departments and institutions have been cooperating from the start. The main reason is the financial volume, also due to a larger number of users. To finance pilots or test innovative solutions, practitioners may use a public-private partnership to fill the gaps in funding. Several challenges often arise for smaller cities to achieve long-term financial support to ensure their strategic planning which is why they should be embedded in a process covering the wider functional urban area they are part of.

3.4. Phase 4: Implementation and monitoring

The fourth phase focuses on implementing the measure packages and related actions defined in the SUMP, integrating systematic monitoring, evaluation and communication.

Manage implementation to ensure achievement of low carbon and other SUMP objectives

Once the measures’ package has been agreed upon and the SUMP is adopted, the implementation phase starts. Each measure package has been broken down into clear actions which now need to be defined as clear implementation tasks and taken over by the relevant departments. The implementation of the SUMP is not usually performed by the core “SUMP team”, but by the responsible technical departments. Having involved stakeholders from different departments from the start, they will be able to follow and guide the implementation of these measure packages, following a coherent approach. Therefore, institutional cooperation with other departments and local authorities is key to managing successful implementation.

In addition, specific coordination with the overarching climate change mitigation strategy needs to take place under this step, to ensure the integration of decarbonisation processes within the SUMP implementation.

A crucial part of the implementation is the procurement of goods and services necessary for the measures and actions. Tendering for innovative projects or “green procurement” will be essential in the implementation of decarbonised mobility to enable innovative products and services to be implemented while minimising the negative social and environmental impact of certain measure implementations. Additional information on procurement can be found in the SUMP topic guide on procurement.

Different implementation strategies can be adopted at this stage in relation to certain policy measures, depending on local requirements. They can take the following shapes:

• Full-scale implementation. This introduces popular measures or measures well-known for their impact at their full scale, without implementing testing or scaling up phases.

• Pilots. This introduces test measures to determine whether widespread adoption of the measures is likely to achieve the GHG emissions objectives and targets previously agreed upon and/or to achieve public acceptability. It remains essential to have a concept of how to make this measure permanent.

• Living labs. This key implementation strategy aims to boost the uptake of innovative sustainable urban mobility solutions that accelerate the decarbonisation of mobility by scaling up and making the measures available to a larger public.

• Pop-up implementation. This has been a successful approach to the implementation of measures that are not yet established. This strategy works best for potentially successful measures or very innovative measures to test public and governmental acceptance.

Managing implementation to ensure achievement of low carbon and other SUMP objectives: Helsinki, Finland and its on-demand autonomous electric boat service

Helsinki has ambitious goals when it comes to implementing low-carbon mobility solutions. One example is the on-demand autonomous electric boat service, Calibots. The electric boats can be booked on-demand in a user-friendly way via a specially developed app and provide connections from the southern Helsinki city area to offshore islands (Harkka and Pohjois). The electric boats have been designed and engineered to be particularly environmentally friendly, being powered by the sun during the day, while not emitting harmful exhaust gases during their operation. The Calibots have been designed for a minimal environmental impact. The slender hulls cross the water effortlessly without waves leaving the marine environment unharmed.

Source: Calibots, 2022, https://callboats.com/

Figure 12. Helsinki on-demand autonomous electric boat service (Source: Calibots)

Communication about the measures plays a key role in the success of their implementation. Practitioners who have first implemented more visible and tangible measures through the improvement of traffic safety or the implementation of traffic calming in school areas have found it easier to convince citizens to implement other measures related to GHG emission reduction. Framing the measure positively can also help and can prevent more negative narratives. Practitioners can also highlight the costs of inactions and paint an attractive picture of a future with a more people-centric mobility system.

GHG emission monitoring process

Continuous monitoring is essential for the successful implementation of decarbonised mobility. Monitoring is designed to increase the efficiency of the process, respond rapidly to any problems arising during implementation and ensure the high quality of measure implementation. The monitoring of measure implementation processes and impacts throughout this phase of the SUMP has multiple benefits. Preliminary results can help practitioners move forward in implementing and readjusting the course of action to achieve the objectives and targets set and communicate the results to the public and stakeholders. This could further solidify buy-in of measures and show the positive impacts that citizens can achieve by changing their behaviour.

Decarbonisation of urban mobility should be measured through the monitoring of GHG emissions and reductions deriving from measures put in place, alongside the other indicators defined earlier in the process and agreed on with the collaborating institutions. The monitoring of GHG emissions has to accord with the calculation methods developed during the analysis of the mobility situation and with the targets and indicators set during the strategy development phase, and should therefore aim at collecting data needed for such calculations (see chapter 3.2 and Annex 6). Ideally, practitioners should follow a dynamic monitoring process with multiple interim goals to validate the progress of implementation, based on the key indicators.

In more practical terms, practitioners can more easily allocate resources from different departments to gather data and monitor the implementation of measures based on the cooperation agreements validated at the beginning of the SUMP process. Alternatively, practitioners can find multi-purpose data to reduce the resources necessary. Working at the FUA level is also beneficial for monitoring as it allows practitioners to allocate certain staff and resources from different municipalities in the evaluation process and improve the data quality in the process. In the end, measuring evaluation and monitoring should benefit practitioners by helping them justify staff and budget for the evaluation, which also is part of the evaluation plan.

Review and lessons

The SUMP process is a cycle because it presents a continuous development of policy and its implementation. As one cycle is completed, it is important to take a look at what went well and what did not. This review process is essential to continue improving the process, and to identify further steps and improvements.

During this final step, practitioners need to check the outputs of the SUMP and evaluate to what extent they meet the targets of the overarching climate transition strategy. They have to determine whether the decarbonisation of mobility is on the right path and identify further actions. It is essential here to review the results and compare them with the targets previously defined and identify what is left to do in the following SUMP cycles.

It is also a time to review the governance capabilities, capacities and resources of the “SUMP team” and to determine whether new organisational arrangements, legislation or funding streams are necessary to implement some of the future policy measures. Climate action is an evolving topic and institutions constantly improving on how to tackle climate change, new funding and resources may be allocated to departments and institutions in the future, which may contribute further to decarbonising urban mobility.

This review process is essential to ensure the alignment of the SUMP with the long-term transition strategies and to enable the creation of a new SUMP that continues (or realigns if needed) on the relevant transition pathway (see Chapter 2).
New technologies or business models for urban mobility can also help shift demand to options with a lower carbon footprint. For example, applications allowing the shared use of bicycles, electric cars or electric mopeds can provide solutions for many mobility needs and help avoid the need for car ownership. The integration and interaction of land use and transport planning can influence the use of private transport, hence GHG emissions, in existing and emerging urban areas. The urban form of a city has a direct effect on which measures would be more effective to achieve climate neutrality. A city’s compactness and population distribution influence the potential for the development of a sustainable public transport network and also for the shift to active modes such as walking or cycling. Planning future urban development taking into account public transport needs (i.e., Transit Oriented Development, TOD16) can ensure that mass transit solutions have the critical mass required to provide an alternative to car use. Improving walkability and providing safe and segregated cycle lanes in a city can encourage more active transport. It is important to design decarbonisation policies that are coherent with the diverse city typologies. Local authorities should be aware of commuters coming every day from residential areas located outside of the administrative boundaries to coordinate the decarbonisation measures with the surrounding local administrations and propose alternative travel means while working with employers to incentivise new behaviours.

The term “types of action” used in the list includes measures, policy approaches, investment projects etc. as referred to in different parts of this guide and in local and academic practice. The list aims at highlighting a diverse set of possible actions and their classification. The order of actions presented starts with different types of comprehensive planning, smart city data governance, spatial, mobility, climate action and other general planning approaches, ideally at the level of the functional urban area or at least covering the core city. It continues in the order of types of actions which can all be determined at the local (ideally metropolitan/ agglomeration, i.e. FUA) level and in an order of gradually increasing implementation challenges and financial weight. Categories include:

1. Cross-sectoral, spatial and sectoral planning. The integration and interaction of land use and transport planning can influence the use of private transport, hence GHG emissions, in existing and planned development. The urban form of a city has a direct effect on which measures would be more effective to achieve climate neutrality. A city’s compactness and population distribution influence the potential for the development of a sustainable public transport network and also for the shift to active modes such as walking or cycling. Planning future urban development taking into account public transport needs (i.e., Transit Oriented Development, TOD16) can ensure that mass transit solutions have the critical mass required to provide an alternative to car use. Improving walkability and providing safe and segregated cycle lanes in a city can encourage more active transport. It is important to design decarbonisation policies that are coherent with the diverse city typologies. Local authorities should be aware of commuters coming every day from residential areas located outside of the administrative boundaries to coordinate the decarbonisation measures with the surrounding local administrations and propose alternative travel means while working with employers to incentivise new behaviours. In this sense, different work organisation/ business models that decrease the number of commuting trips in a reference period (e.g. - among others – telework a certain number of days per week and/or per year). Consistent data management and improving, i.e. reducing the carbon footprint of urban mobility. All policy/financial/organisational, operational and infrastructural measures contribute to avoiding, shifting and improving urban mobility.

The SUMP sets several goals and identifies key areas of action that have different implications for cities. Relevant types of actions should both be sustainable and contribute to achieving decarbonisation goals. The final zero emission objective (to be reached as early as possible, latest close to 2050) requires a diverse set of actions. The list included in annex 6.3 aims at providing a structured overview of types of actions/measures. Types of action include better integration of land use and transport planning to avoid traffic caused by the many decades of spatial disintegration, and different work organisation/business models that decrease the number of commuting trips in a reference period (e.g. - among the others – telework a certain number of days per week and/or per year). Consistent data management and improving, i.e. reducing the carbon footprint of urban mobility.

The types of actions included in the list are not weighted in terms of their potential impact on decarbonisation because this impact will differ in relation to the degree of ambition and implementability at the local level. Chapter 4.2 highlights actions considered to achieve a potentially big impact. Whatever the expected potential individual impact is, isolated implementation, not based on a comprehensive urban mobility plan, may even lead to counterproductive impacts in other parts of the urban and regional area. The list should therefore not be used as a box-ticking type of planning and approval exercise.

While all actions have the potential to make tangible contributions to mitigate climate impacts of urban mobility many do also contribute to several other strategic transport objectives. Several SUMP guides have emphasised specific aspects of the actions in the list, namely: Health, SECAP/SUMP integration, Urban Sustainable Logistics Planning, ITS, MaSFM, Public procurement, Micromobility, Parking, Analytics15, Cycling and Urban air mobility.14

The order of actions presented starts with different types of comprehensive planning, smart city data governance, spatial, mobility, climate action and other general planning approaches, ideally at the level of the functional urban area or at least covering the core city. It continues in the order of types of actions which can all be determined at the local (ideally metropolitan/ agglomeration, i.e. FUA) level and in an order of gradually increasing implementation challenges and financial weight. Categories include:

- Cross-sectoral, spatial and sectoral planning. The integration and interaction of land use and transport planning can influence the use of private transport, hence GHG emissions, in existing and planned development. The urban form of a city has a direct effect on which measures would be more effective to achieve climate neutrality.

- A city’s compactness and population distribution influence the potential for the development of a sustainable public transport network and also for the shift to active modes such as walking or cycling.

- Planning future urban development taking into account public transport needs (i.e., Transit Oriented Development, TOD16) can ensure that mass transit solutions have the critical mass required to provide an alternative to car use.

- Improving walkability and providing safe and segregated cycle lanes in a city can encourage more active transport.

- It is important to design decarbonisation policies that are coherent with the diverse city typologies.

- Local authorities should be aware of commuters coming every day from residential areas located outside of the administrative boundaries to coordinate the decarbonisation measures with the surrounding local administrations and propose alternative travel means while working with employers to incentivise new behaviours.

- In this sense, different work organisation/ business models that decrease the number of commuting trips in a reference period (e.g. - among others – telework a certain number of days per week and/or per year).
4. PORTFOLIO OF EFFECTIVE MEASURES AND THEIR POTENTIAL CONTRIBUTION TO MITIGATING CLIMATE RISKS OF TRANSPORT

4.2. Big levers for climate mitigation

The definition of measures based on a SUMP guarantees that challenges and options are understood systematically as urban mobility requires a holistic and comprehensive approach. It is important to think and act based on a combination of measures, which complement each other.

Certain combinations of measures or approaches have been proven in many different cases to reduce transport-related carbon emissions significantly. These are understood as “big levers”. Some approaches have proven to be more effective in reducing carbon emissions than others. Their effectiveness can be maximized if they are pursued as part of a wider overall strategy like a SUMP.

This subchapter, therefore, presents seven approaches, common to most cities, considered to have an important impact on reducing carbon emissions from urban mobility and to be implementable through local decisions. Their effectiveness depends on local circumstances. Therefore, approaches should not be taken by practitioners as a checklist to be done as circumstances differ.

Re-organisation of space

This approach focuses on the necessary shift towards the de-carbonisation of space to allow for other measures contributing to a long-term change in people’s movement and engagement with public space. While the re-organisation of space may seem like secondary measures resulting from other mobility measures in some cases, it can also work as a catalyst or have a complementary effect on specific measures. For example, the reallocation of urban space from car use to active modes can both be a result of restricted car use or as a means towards its restriction.

Improving public / collective transport

This approach highlights the need for measures to maximise local public transport’s potential by creating an accessible service that is fast, reliable, accessible and convenient alternative to the private car. It also highlights the need for additional collective transport, through shared and on-demand means, in planning to restrict the use of private vehicles. For public/collective transport to contribute to decarbonising urban mobility, all transport modes need to be integrated into planning, from buses to sharing options that can easily step in to fill supply gaps. Public and collective transport must continue to be the backbone of mobility in cities and its region. This usually works best if put in conjunction with the following point on private car usage.

Facilitating active mobility

This approach highlights the measures that aim to get people out of cars and walking and cycling instead. This approach covers various topics such as safe and secure infrastructure for active modes. Active modes are an essential part of all journeys and thus enabling safe active mobility is fundamental to achieving integrated mobility systems and ensuring its uptake in detriment to polluting modes. Active mobility is a simple and cost-effective way of achieving the decarbonisation of mobility as well as contributing to achieving noise reduction and the recommended physical activity levels for personal health and well-being. It also makes urban mobility systems more inclusive by having the potential to reduce inequalities due to its accessibility, affordability and social equity.

Re-organisation of urban logistics

This approach emphasises measures regarding the implementation of sustainable urban logistics solutions. The competitive nature of the sector often leads to fewer interventions from city authorities and therefore policy response is often slow and fragmented leaders to few improvements made to the current state of cities’ urban logistics systems. Decarbonising measures for urban logistics promote the use of cleaner freight vehicles but also the further implementation of last-mile logistics. The latter may require land use interventions to manage delivery spaces and make way for inter-city last-mile logistical hubs.

UAV and other types of restrictions on private vehicles

This approach aims at bringing to light the different restrictions on private vehicles cities may implement but also how cities should consider the possible synergies or contradictory effects of private vehicle restrictions would have on the use of other modes. It is essential to think of rebound effects – and prepare to counteract them – when planning private vehicle restrictions. As mentioned above this should be done in conjunction with PT improvement and e.g. with the rest of the measures on facilitating active mobility. [See box on Urban Vehicle Access Regulation p37-38]

Fewer and cleaner private and company cars

This approach highlights the measures that contribute to reducing the use of private and company cars as well as replacing all vehicles with cleaner alternatives. This approach includes measures to adapt the urban grid to provide alternative fuelling charging infrastructure, to promote the implementation of mobility management at company levels as well as measures to discourage car ownership (e.g. car clubs, residential parking restrictions, Zero-Emission-Zones).

Table 3. Description of the big levers for CO2 reduction

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-organisation of space</td>
<td>• More space for active mobility (from parking, road lanes etc) • 15min city • Urban development along PT corridors (Transit-oriented development) • Integrated land use and urban planning • Integrated land use and transport planning</td>
<td>A part of the reorganisation of space can only happen if commuters are attracted to collective and active modes to the detriment of private vehicles. As a specific measure to implement the many actions listed in annex 6.3 the reorganisation of delivery zones and timed access may contribute to achieving the necessary shift.</td>
</tr>
</tbody>
</table>

56 As part of the category “cross-sectoral, spatial and sectoral planning” of annex 6.3
55 As part of the categories “cross-sectoral etc, educational etc., mobility services, mobile assets and infrastructure” of annex 6.3
56 As part of the categories “cross-sectoral etc, educational etc., mobility services, mobile assets and infrastructure” of annex 6.3
57 As part of the categories “cross-sectoral etc, educational etc., financial/financial, mobility services, mobile assets and infrastructure” of annex 6.3
58 As part of the category “policy and regulatory” of annex 6.3
59 As part of the category “policy and regulatory” of annex 6.3
60 As part of the category “educational/capacity building” of annex 6.3
61 The table highlights the comprehensive and holistic nature of the approaches selected, equity has not been declared as a separate approach as it is an overarching imperative that should be integrated to all approaches.

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### Approaches

<table>
<thead>
<tr>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• New/improved services</td>
<td>Public transport has an inevitable “first and last mile” problem. This makes it necessary to consider multimodality, in particular the connection between walking and cycling.</td>
</tr>
<tr>
<td>• Increased capacity</td>
<td>The attractiveness of public transport is always relative to the attractiveness of other modes, especially the car. This requires access regulation and other “push” measures as complementary elements.</td>
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<tr>
<td>• Better connection between suburban/rural and urban area</td>
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<td>• Clean buses</td>
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<tr>
<td>• e-Ticketing</td>
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<tr>
<td>• Shared (micro)mobility</td>
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<tr>
<td>• Multimodal ticketing &amp; charging</td>
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<tr>
<td>• CCAM</td>
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<tr>
<td>• MaaS for multimodal integration</td>
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</table>

### Increasing public transport access

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cycling</td>
<td>Active modes currently have limited urban space compared to other modes which would require a shift in the distribution of urban space for mobility, especially to increase accessibility to active modes and ensure the safety of vulnerable users.</td>
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<tr>
<td>• Walking</td>
<td></td>
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<tr>
<td>• Micromobility</td>
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<tr>
<td>• Integrate e-bike charging infrastructure</td>
<td>A sustainable urban logistics system is directly linked to and dependent on the organisation of space (e.g. location of sources and destinations), the availability of clean energy or the regulation of access for such vehicles.</td>
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</table>

### Facilitating active mobility

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Smart logistics hubs</td>
<td>Good practice examples of access regulations show that they are best combined with a range of complementary measures to avoid negative equity implications (e.g. exemptions), facilitate trip alternatives and, overall, boost their effectiveness. Access regulations should therefore always be designed as bundles of mutually reinforcing measures.</td>
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<tr>
<td>• Drones and drones delivery systems</td>
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<td>• Electric freight delivery (e-vehicles)</td>
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<tr>
<td>• Zero emissions last mile delivery (cargo bikes)</td>
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### Re-allocation of urban space

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low Emission Zones</td>
<td>Restricting private car use at both the individual and company level can only be effective transport modes are offered as an alternative.</td>
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<tr>
<td>• Ultra Low Emission Zones</td>
<td>The attractiveness of cleaner vehicles is also relative to the available charging infrastructure in the public and company spheres.</td>
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<tr>
<td>• Zero Emission Zones</td>
<td>As a specific measure to implement the many actions listed in annex 6.3 policies in the B2B sector to encourage shift among employees may contribute to achieving the necessary shift.</td>
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<td>• Superblocks</td>
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<tr>
<td>• Spatial interventions</td>
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<tr>
<td>• Parking fare structure - facilitating residents (and possibly rotation), impeding long-term congestion</td>
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<tr>
<td>• Congestion parking schemes</td>
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<td>• Road pricing</td>
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### UVARs and other types of urban vehicle access restrictions

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Vehicles Charging Policy with clean energy incentives</td>
<td>Good practice examples of access regulations show that they are best combined with a range of complementary measures to avoid negative equity implications (e.g. exemptions), facilitate trip alternatives and, overall, boost their effectiveness. Access regulations should therefore always be designed as bundles of mutually reinforcing measures.</td>
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<tr>
<td>• Adaptation of local building code requirements</td>
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<td>• Disincentives for company cars</td>
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<td>• Public zero-emissions vehicle fleets</td>
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<td>• Mobility management</td>
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<td>• Parking policy and management</td>
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<td>• Car sharing</td>
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### Space and cleaner private and company cars

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<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Telework</td>
<td>Reorganisation of local health, commercial etc. services</td>
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<tr>
<td>• Reorganisation of activities can only take place through cross-sectoral agreements to ensure an integrated approach</td>
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<tr>
<td>• Differentiation of school opening hours</td>
<td></td>
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<tr>
<td>• Mobility restrictions</td>
<td>As a specific measure to implement the many actions listed in annex 6.3 the adaptation of delivery times to reduce congestion may contribute to achieving the necessary shift.</td>
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</table>

### Activity re-organisation

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Measure Examples</th>
<th>Importance of systems thinking &amp; risk of isolated approach</th>
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</thead>
<tbody>
<tr>
<td>• Mobilisation of a local health</td>
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<td>• commercial etc. services</td>
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### Why UVARs?

There are many good reasons to regulate urban vehicle access in cities.

- Pollution kills over 7 million people each year, especially the vulnerable, the elderly and those with pre-existing health conditions. It also causes lung disorders such as asthma in children and costs us 4.8% of global GDP.
- Congestion in cities makes journeys and deliveries less reliable; in Europe, congestion costs 1% of GDP.
- Urban quality of life can be improved by converting road space into recreation or commercial space. In the 1970s, the central squares of many European cities were filled with parked cars. Now, that space is used for outdoor dining and recreation.
- Space allocation is a question of equity; people with limited incomes often have no car. This means the vulnerable in society subsidise the use of road space for those who drive.

The need to reduce climate emissions towards the Paris Agreement is also an increasing driver of UVARs. While national policies can improve the general conditions for lower-emitting options, UVARs can help facilitate faster change in urban areas.

But as “stick” measures such as UVARs are much less popular than “carrot” measures among citizens, it’s important for each city to find the right measures, approach and complementary measures for its local context. The EU ReVeAL project helps by structuring the measures, systematising the process and providing guidance on implementation.

### Building blocks, measure fields and cross-cutting themes

To understand what a complete UVAR “package” consists of, ReVeAL analysed a wide range of UVAR schemes to identify their constituent components. 33 UVAR building blocks were identified that can be combined to create an UVAR package. The building blocks are categorised into three measure fields: 1) spatial interventions (e.g., a pedestrian zone), 2) pricing aspects (e.g., a congestion charge) and 3) regulatory measures (e.g., a low-emission zone). Building blocks can be combined within or across the measure fields to create an UVAR package.

For each building block, ReVeAL developed a fact sheet providing a definition, a description of its use, building blocks it works well with, an example, implementation tips and links to the ReVeAL guidance.

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62 World Health Organisation. (n.d.). Air pollution. from https://www.who.int/health-topics/air-pollution#tab=tab_2
ReVeAL also identified four cross-cutting themes that are relevant to all UVARs. Complementary measures ensure access of people, goods and services, while maintaining the goals of the UVAR and minimising equity issues or undesirable impacts. User needs and public acceptance acknowledge the needs of citizens and try to develop a shared commitment to a common goal, knowing that understanding the purpose of the UVAR makes people more willing to adapt their behaviour. Governance and finance look at decision-making processes, regulatory structures and how to finance UVARs and ensuring compliance makes sure that people are aware of the scheme and follow the rules put in place.

For more details, check out the ReVeAL toolkit:
1. The ReVeAL building block fact sheets
2. Online UVAR guidance addressing cross-cutting themes that are relevant for all or several UVAR building blocks
3. The online UVAR decision support tool which supports cities’ critical thinking around UVAR packages. Using a short questionnaire, it offers a prioritised list of 5-10 UVAR building blocks to explore, an example for each building block and guidance for developing an effective and equitable package of UVAR measures
4. ReVeAL recommendations for cities

Figure 14: The ReVeAL project structures UVARs into categories of measures (measure fields) and cross-cutting aspects that are relevant to UVARs from any measure field (image: ReVeAL project).

5. List of references and contributions

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SUMP-PLUS, 2022, https://sumplus-plus.eu/


5.2. Contributions to the Stakeholders’ consultation

We would like to thank the following stakeholders for their presentations during the three consultation workshops we held as part of the creation of this topic guide (following in the order of their presentations): Cătălin Frangulea-Pastor (Transport Authority Brasyor, Romania), Kalle Toivonen (City of Helsinki, Finland), Irina Rotaru (City of Saint German-en-Laye, Paris metropolitan area, France), Armin Langweg (Dept of Transport, City of Aachen, Germany), Alexander Scholz (City of Vienna, Austria), Peter Jones (Professor of Transport and Sustainable Development, UCL), Maria Perkuszeswka (Polish Ministry of Infrastructure), Marcin Wolek (City of Gdynia, Poland), Tünde Hajnal (Centre for Budapest Transport, Hungary) and Maximilian Hebel (Rupprecht Consult) for putting together the practice examples.

For reviewing the document and providing feedback, we would like to thank Michal Babicki (Wolanski), Antonio Carrarini (EIB), Andres Gavilan (ICLEI), Henrik Guumundsson (CONCITO), and Yoann Le Petit (EIT Urban Mobility).

And the 93 participants for sharing their experiences during the three consultation workshops.
6. Annexes

6.1. GHG Emission calculation in SUMP

Core considerations for the calculation of GHG emissions as referred to in chapter 3.2, and as described in chapter 2 on the planning framework.

The traditional data gathering needed for the analysis stage of SUMP should be sufficient for the needs of the climate change mitigation analysis, i.e. including a complete set of data on demand and supply described below.

As per the basic principles presented in chapter 3.2, the emission factors of different transport modes (and vehicles) covered in the SUMP will be determined based on detailed data on the characteristics and composition of the vehicle fleet, both for private and public transport (buses, rail, etc. – depending on the context this might be based on a specific survey or might be already available from existing studies and/or official statistics64). Data should also include vehicles used for freight distribution and their operational modalities and limitations. The characterisation of the current fleet for GHG emissions includes aspects such as the following (up to the available extent and relevance): vehicle category, type of fuel, year of production, EURO class, energy efficiency, etc. Practitioners will also need to define the realistic and planned evolution of the fleet (and/or of these characteristics). This evolution should reflect on the most recent forecasts regarding penetration of electric vehicles and/or other low and zero-tail-pipe emission vehicles, including an estimate of the share of veh-km run with such vehicles. For electric-powered modes and vehicles, it will be necessary to determine the so-called grid factor for the country.

This information should be complemented with existing inventories of GHG emissions for transport in the area to its possible extent and other relevant data available.

64 Example of sources: relevant publications at national level for calculation of GHG emissions of transport investments, COPERT (Emissions calculation tool produced by EEA), EIB Project Carbon Footprint Methodologies provides some default reference values for EU, etc.

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Box 5. Best practice/tool/method/lessons learned for data collection & GHG emissions calculations

The European Commission’s Technical guidance on the climate proofing of infrastructure in the period 2021-202767 refers to the assessment of GHG emissions of projects and allows for the assessment of:

- **Absolute emissions**: total emissions produced by the project in a typical operating year (tCO2e);
- **Relative emissions**: incremental emissions (increase/reduction) between investment and non-investment options considered in the CBA in a typical operating year (tCO2e).

The full details on the principles of this assessment are described in the above references, below the focus is on its application in transport:

![Diagram showing GHG emissions calculation - project boundaries](source: own based on EIB Carbon Footprint Methodologies)

**Project boundaries**

**Scope 1** - Direct GHG emissions: emissions physically occurring from sources that are operated by the project within the project boundary - e.g. emissions produced by the combustion of fossil fuels (normally not applicable in transport infrastructure projects as there are not usually direct emissions associated with the operation of the infrastructure).

**Scope 2** - Indirect GHG emissions: account for GHG emissions from the generation of electricity produced outside the project boundary (i.e. at the power plant level) that is consumed by the project. These indirect emissions are attributed to the project as the level of consumption is determined by the project (and can be reduced through various measures e.g. energy efficiency).

**Scope 3** - Other indirect GHG emissions: consequences of the activities of the project but which occur from sources not operated by the project.

The current practice is that GHG emissions assessment of transport infrastructure projects mainly refers to the consequences of the project’s activities (Scope 2 and Scope 3 - indirect GHG emissions), i.e. the relative impact of vehicles using the physical transport infrastructure. The related relative GHG emissions are calculated based on the displacement of passengers from one mode of transport to another (modal shift effects), changes in travel patterns (alternative routes, time of travel) and the induced increase in traffic (passengers and freight). If the project also includes the replacement of rolling stock, the related savings in emissions should also be taken into account. This can be both direct - e.g. Scope 1 when replacing obsolete buses running on combustion engines with new vehicles, or indirect – e.g. Scope 2 when replacing obsolete trams with new rolling stock.

Specific considerations should be developed to consider in the calculations the impacts of “softer” measures such as those on organizational measures and minor operational changes (e.g. they might be contributing to a share of modal shift, limitation and redirection of mobility patterns, etc.). This is particularly relevant in the case of SUMPs.

Calculation principles for transport projects

For each project option, multiply the yearly transport activity data by the respective emission factors:

- **Road modes:** transport activity in total vehicles-km by the emission factors which are: dependent on fuel consumption and therefore on the vehicle category, engine technology (including ZEV technology), speed, road condition and road geometry, inter alia.
- **Public Transport:** transport activity (vehicle-km or train-km) for consumption/emissions.
- **Rail modes and trolleybuses/electric buses:**
  - The power consumption rate per electrical vehicle or train (in KWh/veh-km or KWh/train-km);
  - The CO2 grid emission factor (lCO2/KWh).
- **Buses:**
  - Same calculation as for road modes.

GHG emissions Calculation – the approach for SUMP

The climate change impact of a SUMP in terms of GHG emissions can be calculated with an analogy to that of a project. Therefore, the assessment of the input data on transport/demand activity will generally require a multimodal traffic model (1) which estimates the flows and conditions of circulation on the entire network considered in the reference area of the SUMP, also referred to as “boundaries” (see previous chapters).

The first step is therefore to correctly identify the boundaries. Once these are defined, the second step is to identify the relevant modes that pertain to the SUMP and the related area – and that would be potentially subject to changes due to the SUMP.

The calculation method should follow the same logic as for a single project carbon footprint estimate:

For all private modes (including private vehicles, taxis, mopeds/motorcycles, taxis, freight, and car-sharing): for each link of the network in the SUMP area, data to be used are still those concerning flows, circulation regime (depending on the level of traffic model accuracy/detail - V/C ratio, average speed, fleet composition – type, age, fuel/technology).

For public transport: for each considered mode/type, data in terms of total yearly production (veh-km, train-km), fleet composition (type, age, consumption) and fuel/technology should be used – for the totality of each (relevant) public transport mode considered in the Plan and reference area:

\[
\text{Plan Emissions Volume} = \sum_{i=1}^{n} \text{Traffic volume sect. i (AADT, veh/day) \times Length of road sect. i (km)}
\]

\[
\text{Emission factor} = \frac{(\text{CO2eq/kg})}{(\text{CO2eq/vehkm})}
\]

\[
\text{Energy consumption} = \sum_{i=1}^{z} \text{Total Service production (Veh-km or Train-km) \times Energy consumption (kWh/veh-km or KWh/train-km)}
\]

\[
\text{Emission factor (Trans/Trolleybuses: Buses: lCO2/litre) = Plan CO2/litre}
\]

(data on a yearly basis)\(^6\).

The following main indicators can be defined and calculated at the SUMP level (see also definitions and details in section 3.2):

- **(SUMP) Current Absolute Emissions** – total emissions produced in the base year, associated with operations of all the modes considered relevant within the considered boundaries.
- **(SUMP) Absolute Emissions** – total emissions produced in the selected SUMP Scenario, also associated with operations of all modes considered relevant within the considered boundaries – for a given/selected time horizon (year).
- **Based on this these two indicators, the main indicator of (relative) Emissions for the SUMP can be calculated:**


SUMP (relative Emissions) calculated as Current vs Plan Emissions represent (should represent) the main climate change mitigation indicator, providing an estimate of the extent to which the SUMP:

- Accommodates the needs and trends in future mobility;
- Ensures that this future demand does not increase emissions, but rather ensures a decrease in absolute emissions when compared with current levels, as per objectives set at the SUMP level, in line with policy targets (see specific sections in the Guide). This would not have been possible by using a SUMP Relative Emissions indicator calculated along the lines of that for a project (i.e. only considering the difference between emissions levels in future scenarios – i.e. with and without the project).

Further details and recommendations on defining related SUMP indicators on GHG emissions are provided in Chapter 3.2.

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6 For electric vehicles see rail modes and related footnotes. The same apply to Hydrogen-Fuel cells vehicles for hydrogen generated through electrolysis. For Methane Steam reformer – generated Hydrogen the full LCA emissions have to be taken into account (reducing the CO2/COU rate, potentially). For Hydrogen generated through biogas solely the fugitive emissions counts – for more details refer to the Renewable energy Directive Delegated acts on Hydrogen and RBFNs.

6\(^1\) The calculation should also take into account the presence of electric vehicles in the road traffic mix. For these the total consumption of electric energy should be calculated and transformed into CO2eq emissions through the electric grid emission factor (same steps as for electric buses).

7 Unless specific arrangements to use greener electricity through purchase / storage are in place.

8 The level of complexity for the multimodal traffic model might go from more simple demand assessments to more advanced 6+ stage demand models depending on the scope and conditions defined for the transport demand assessment of the given SUMP.

9 In the formulas hereunder, “Plan” is equivalent to “Strategy” or SUMP.

10 As mentioned, transport models might already provide the calculations of the CO2 emissions of the transport systems covered for time horizon and option/scenario considered.

\([^6\) Total public transport service production is normally a combination of road-based and rail-based services (veh-km & train-km).\]
"Mobilise Your City (MyCi)"75, which has worked with more than 100 cities of the developing world has provided a simplified calculation tool, still in line with the principles presented above, which allows for evaluating the current mobility CO2 footprint and the impact of proposed measures. Their Mobilise Your City Emissions calculator is based on an Excel tool. The calculation tool and user manual are listed and hyperlinked below:

- MobiliseYourCity GHG Emissions Calculator [Tool]76
- User Manual for the MobiliseYourCity GHG Emissions Calculator77

In any case, it is recommended that in due time an accurate data set and quantitative analysis is developed, including if possible and relevant a traffic model, covering the adequate reference geographical area e.g. the FUA. It will enable the assessment of GHG emissions of planning options (ultimately measures/packages) to be compared to the GHG emissions reduction target(s) set.

6.2. The Carbon Zero Strategy Analysis Support Tool*

Climate change and the need for dramatic carbon reduction from transport-related activity is a particular aspect of city planning that has become increasingly important in policy decision-making in recent years. The transition to achieve net-zero carbon targets by 2050 requires a radical and urgent change to existing policies. However, cities often lack the knowledge and expertise to understand how different scales and timings of policy strategies impact carbon emissions, especially when dealing with such long timescales up to 2050.

The Carbon Reduction Strategy Support Tool tries to fill that knowledge gap and assist cities in identifying a suitable mix of high-level policy strategies, and their timings, that will achieve carbon targets while also respecting and supporting the other objectives that cities are looking to deliver. It does not replace a SUMP nor a robust data-based GHG emissions calculation but is rather complementary/propaedictic to it. It is a useful tool for cities for stakeholders and a political engagement, to help inform discussions and decision-making when developing long-term policy strategies and defining transition pathways to net-zero carbon. In this sense, it can also represent support in orientating decision-makers and practitioners when taking decisions for measures identification within the SUMP (which then have to be assessed within the SUMP process, including a rigorous GHG calculation).

Description of the tool

The tool provides a ‘backcasting’ frame to identify strategies needed to reach the desired future, rather than ‘forecasting’ from the current situation. Forecasting becomes laden with uncertainty the further into the future it is applied. Therefore ‘backcasting’ rather than forecasting78 might be used when in carbon transition strategies long-term and radical change is proposed, which is necessary if net-zero carbon targets are to be reached.

The Carbon Reduction Strategy Support Tool allows cities to explore different options for several broad strategies that impact carbon reduction related to the Avoid/Shift/Improve strategy areas to gauge their likely effectiveness. The user can select from different levels of uptake or levels of improvement they expect by a certain date that they provide. The strategies included in the tool are:

- **Avoid strategies**
  - Avoid the need to travel by substituting physical travel with digital access to services/home delivery
    - 1. commuting trips avoided due to home working
    - 2. personal trips (e.g. banking, health) avoided due to digital access to services
    - 3. shopping trips avoided due to home delivery
  Avoid the need to travel long distances through localisation
    - 1. daily trips for shopping, leisure, personal trips, education activities localised within 15-minute walkable neighbourhood

- **SHIFT strategies - Shift mode of travel from car to sustainable modes**
  - 1. 3km: promote shift from car to walk / cycle
  - 2. 3km-8km: promote shift from car to cycle / PT
  - 3. 8km: promote shift from car to PT / carpool

- **IMPROVE strategies - impact on average gCO2e/km**
  - 1. Improving fuel efficiency of conventional petrol/diesel engines
  - 2. Improving fuel emissions by switching vehicle fleet to battery electric
  - 3. Improving electricity generation by switching to renewables
  - 4. Improving energy efficiency of electric batteries

Related to these Avoid/Shift/Improve strategies, the user can select from different levels of uptake or levels of improvement they expect. The user can also adjust the timings of each strategy implementation.

The output displays the amount of carbon reduction related to each strategy input scenario in the form of waterfall charts at a point in time (e.g. 2030 or 2050) [see Figure 15] and stacked area charts showing the evolution of carbon reduction associated with each strategy scenario over time (see Figure 16). These enable the user to see how close their input choices bring them to the defined carbon reduction targets. The user can then explore the input scenarios required to reach the future target – this is done by adjusting levels of uptake/levels of improvement associated with different strategies.

Having obtained an initial mix of strategies that are likely to attain carbon reduction targets for future years, the resilience/robustness of the strategy choices can be stress tested in the face of alternative futures by exploring the impacts of changes in key external factors (population growth/decline, speed of renewable energy transition, speed of societal transition to digital technologies, cost of petrol/diesel/electricity etc.). The timings of strategy implementation can also be explored by viewing how changes to this can affect overall (cumulative) carbon emissions as well as contributions to intermediate targets before 2050. Finally, a framework for assessing the impact of carbon focussed strategy choices on other objectives is provided to ensure the carbon focussed strategy choices are rounded and reinforced rather than conflict with other non-carbon objectives.

The final output from the use of the Carbon Reduction Strategy Support Tool is a robust mix of policy strategies for achieving long-term and intermediate carbon reduction targets up to and including 2050. This strategy mix includes defined levels of uptake/improvement and timings for implementation of the ‘avoid, shift, and improve’ strategies within the mix. This provides cities with indicative quantification of the carbon reduction potential of possible strategic choices.

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75 Mobilise Your City are supporting cities and countries outside Europe, with technical assistance to develop scalable solutions to improve mobility in complex developing country environments. It is a consortium based on support from the European Commission’s Directorate-General for International Partnerships (INTPA), the French Ministry of Ecological Transition (MTE), the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the French Facility for Global Environment (FEM) and the Agence Français de Développement (AFD). Main implementing partners, the Agence Française de Développement (AFD) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).
78 The Carbon Reduction Strategy Support Tool was developed by Steve Wright - Principal Researcher at VECTOS / SLR. The Tool was developed within the EU SUMP PLUS project funded by the European Union’s Horizon 2020 research and innovation programme under grant agreement no 814881 and is available in Excel and free to use by any city. A more detailed description of the tool and user guide is available via https://sump-plus.eu/en/tools.
79 It is underlined that forecasting (in transport modelling) is recommended when analysing/appraising planning options and/or measure packages in order to assess travel pattern changes and related impacts vis-à-vis the targets that have been defined (i.e. using backcasting from overall national/regional/ sectoral targets). See chapter 3.1 of the guide and previous Appendix 6.1 for details.
6. ANNEXES

Outputs from the Tool

Results are presented in the form of a set of easy-to-understand dynamic diagrams/charts. These include:

1. Waterfall chart showing estimated % carbon reduction in 2050 (compared to 1990 levels) likely to be delivered by each strategy based on the strategy user input scenarios (see example output in Figure 15),

2. Evolution of carbon reduction between 2020 and 2050 for each strategy is presented as a stacked area chart illustrating the contribution from each strategy scenario to carbon reduction for every year between 2020 and 2050 (see example output in Figure 17),

3. Chart showing cumulative carbon emissions from 2020 up to 2050 for the selected strategy mix inputs (see example output in Figure 18).

Figure 16. Example output - Waterfall chart showing estimated % carbon reduction in 2050 (compared to 1990 levels) likely to be delivered by each policy strategy with adjusted user inputs

Figure 17. Example output - Evolution of carbon reduction between 2020 and 2050 for each strategy

The waterfall diagram shows the estimated % carbon reduction at a single point in time, in this case, 2050 (compared to 1990 levels), likely to be delivered by each strategy given the inputs (levels of uptake/improvement) specified by the user. It shows one possible mix of strategy scenarios (levels of uptake in avoid, shift and improve strategies input by the user) that are likely to achieve the Green Deal target of 90% reduction by 2050.
DECARBONISATION OF URBAN MOBILITY

6. ANNEXES

6.3. List of types of Actions

<table>
<thead>
<tr>
<th>Types of Actions to support decarbonisation of urban mobility</th>
<th>ASI - Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cross-sectoral, Spatial and Sectoral Planning</strong></td>
<td></td>
</tr>
<tr>
<td>Data Strategy / Governance</td>
<td>Avoid</td>
</tr>
<tr>
<td>Local Data Spaces Policy (starting with Energy, adding Smart Cities and Mobility later on)</td>
<td>Shift</td>
</tr>
<tr>
<td>Smart City Strategy and actions</td>
<td>Improve</td>
</tr>
<tr>
<td>Integrated land use and urban planning</td>
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<tr>
<td>Develop land use planning regulation</td>
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<tr>
<td>Sustainable Urban Mobility Plans (SUMPs)</td>
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<tr>
<td>Sustainable Urban Logistics Plans (SULPs)</td>
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<tr>
<td>Transit Oriented Development</td>
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<tr>
<td>Superblocks, 15/20 minute city concept, short-distance city principle</td>
<td>Shift</td>
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<tr>
<td>Sprawl containment</td>
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<tr>
<td>Promote densification</td>
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<tr>
<td>Increase pedestrian zones (including street design)</td>
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<tr>
<td>Mixed-use development</td>
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<tr>
<td>Local circulation plans</td>
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<tr>
<td>Road space redistribution to cycling and walking</td>
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<tr>
<td>School streets with very low speed (max 20 km/h) for pedestrian space/use</td>
<td>Improve</td>
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<tr>
<td>Reduction of on-street parking</td>
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<tr>
<td>Upgrade pedestrian connections</td>
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<tr>
<td>Expansion of car-free zones</td>
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<tr>
<td>City centre operation plan to reduce freight emissions (last mile)</td>
<td>Improve</td>
</tr>
<tr>
<td>Promote the use of digital Twin (Energy, mobility), to maximise synergies</td>
<td>Improve</td>
</tr>
<tr>
<td>Integrated climate and energy action plans (e.g. SECAPs)</td>
<td>Avoid</td>
</tr>
<tr>
<td>EU climate neutrality framework, pro rata “plus” contribution to NECP and other national frameworks to promote low-carbon targets</td>
<td>Improve</td>
</tr>
<tr>
<td><strong>Policy &amp; Regulatory</strong></td>
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<tr>
<td>Implement/extend 30km/h speed limit reduction and slow fluidification</td>
<td>Improve</td>
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<tr>
<td>Urban vehicle access regulation - low emission zone</td>
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<tr>
<td>Urban vehicle access regulation - zero emission zone</td>
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<tr>
<td>Urban vehicle access regulation - city toll, distinguished between emission categories</td>
<td>Improve</td>
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<tr>
<td>Parking policy prioritised for emission-free vehicles</td>
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<tr>
<td>Parking price increase for fossil cars</td>
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<tr>
<td>Teleworking Incentives for local employees</td>
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<tr>
<td>Enforcement of low-speed/air pollution emission limitation zones</td>
<td>Improve</td>
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<tr>
<td>Review procurement strategy and require greener fuels for the municipality</td>
<td>Improve</td>
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<tr>
<td>Ban petrol car registration</td>
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</table>

Figure 18. Example output - Cumulative carbon emissions from 2020 to 2050 for the selected strategy mix inputs

The blue line on the chart above represents the cumulative emissions estimated for the selected strategy mix inputs. The red dashed line reflects the do-nothing scenario and shows cumulative emissions if no improvements were made compared to 2020 rates of emissions (i.e., emissions remain at 2020 levels until 2050 and are only affected by changes in population). The green dashed line reflects the cumulative emissions limit if global temperatures are to remain within a 1.5°C temperature rise (i.e., achieving the ‘Fit for 55’ target by 2030 and the Green Deal target of 90% reduction in GHG emissions by 2050 compared to 1990 levels). In this chart, the cumulative emissions are indexed to the 2020 values of emissions as a % of 1990 levels. For the example in Figure 18, we see that by 2050 the selected strategy mix is estimated to produce cumulative emissions of around 13.5 times the 2020 emissions while the do-nothing scenario would have resulted in 30 times the 2020 emissions.

These two diagrams (Fig 17 and Fig 18) viewed together can help ascertain the optimal timings of strategy delivery to check that intermediate targets and milestones are being met and that cumulative emissions are within the prescribed targets needed to limit temperature rises to 1.5°C. The information in these charts can highlight the need to bring forward the commencement of a particular strategy, or the need for it to take full effect sooner. The tool allows the user to see the impacts of bringing forward or delaying the timings at which each strategy starts to take effect and/or takes full effect. This information helps establish the timings for strategy delivery needed to meet the expected targets up to and including 2050.
4. PORTFOLIO OF EFFECTIVE MEASURES AND THEIR POTENTIAL CONTRIBUTION TO MITIGATING CLIMATE RISKS OF TRANSPORT

<table>
<thead>
<tr>
<th>Educational/Capacity building</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
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</thead>
<tbody>
<tr>
<td>Car-free Sundays</td>
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<tr>
<td>Mobility consultancy (e.g. for new residents)</td>
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<tr>
<td>Communication campaigns for improved cycling, walking and micromobility infrastructure</td>
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<tr>
<td>Promote the use of smart cards for public transport</td>
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<td>Promote sustainable travel to school</td>
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<tr>
<td>Behaviour change, information and awareness campaigns</td>
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<tr>
<td>Workplace parking levy</td>
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<tr>
<td>“Job tickets” – financial incentives to increase public transport use among employees of larger employers</td>
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<tr>
<td>Mobility Management</td>
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<tr>
<td>Introduce incentives for shifting to ultra-low-emission vehicles</td>
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<tr>
<td>Campaigns to encourage phasing out machinery and heavy vehicles using fossil fuel</td>
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<tr>
<td>Promote and reward private sector initiatives to switch to zero-emission freight delivery</td>
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<tr>
<td>Promote e-cargo bikes (pilot)</td>
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<table>
<thead>
<tr>
<th>Financial/Fiscal</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
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<tbody>
<tr>
<td>Congestion pricing schemes</td>
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<tr>
<td>Provide support schemes for smart bilateral charging at home / at work, roadside, to use only decarbonised energy and to maximise renewables uptake</td>
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<tr>
<td>Increase parking fees</td>
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<tr>
<td>Carbon tax for households with more than 2 vehicles (or a ratio per adult household member)</td>
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<tr>
<td>Balance funding and operational budget between road and active travel modes</td>
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<tr>
<td>Pilot transport credits (give up your car)</td>
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<td>Free public transport or reduced annual public transport pass price</td>
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<tr>
<td>Incentives to businesses to encourage employees to commute by cycling</td>
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<tr>
<td>Oblige/enable/allow electromobility providers to provide services through chargers located in the FUA through roaming while optimising the cost of energy</td>
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<tr>
<td>Ensure full interoperability of the chargers enabling payment on-the-spot with bank cards</td>
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<tr>
<td>Temporary road toll exemption for zero-emission vehicles</td>
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<tr>
<td>Grants for the installation of e-chargers at home and businesses</td>
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<tr>
<td>Implement tax weighted to vehicles’ carbon emissions (or bonus-malus tax for cross-subsidise efficient cars) where this is possible at the local level</td>
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<tr>
<td>Develop financial incentives for Heavy Duty Vehicle efficiency</td>
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<table>
<thead>
<tr>
<th>Mobility Services</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
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</thead>
<tbody>
<tr>
<td>Increase the frequency of regional/metropolitan railway services</td>
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<tr>
<td>Review/Adjust the time schedule and increase the frequency of public transport</td>
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<tr>
<td>Smart cards for public transport integrated smart multimodal ticketing</td>
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<td>Maas at the local/regional level (possibly as a subsidiary of the local transport authority/ operator)</td>
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<tr>
<td>Real-time public transport information</td>
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<tr>
<td>Low/zero emission urban freight delivery / Last mile delivery</td>
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<tr>
<td>Car sharing scheme / car clubs / car pooling (including E Vehicles)</td>
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<tr>
<td>Increase and improve bike sharing offer</td>
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<tr>
<td>Develop systems for payment and charging for e-bikes</td>
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<tr>
<td>Concessions with e-scooter providers with parking obligations and, where possible, a concession fee</td>
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<tr>
<td>Parking management app, “Smart” Parking</td>
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<tr>
<td>Improve traffic signalling to give priority to public transport and to reduce queuing of cars which respects speed limits</td>
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<tr>
<td>Promote and consolidate e-mobility services (taxis, deliveries)</td>
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<tr>
<td>Implement multimodal ticketing and charging</td>
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<td>Ensure full interoperability of the chargers enabling payment on-the-spot with bank cards</td>
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<td>Provide support schemes for smart bilateral charging at home / at work, roadside, to use only decarbonised energy and to maximise Renewables uptake</td>
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<td>Allow electromobility providers to provide services through chargers located in the FUA through roaming while optimising the cost of energy</td>
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<tr>
<td>Develop a roadmap for freight decarbonisation</td>
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<tr>
<td>Incentivise the development and provision of low/zero emission last-mile delivery options, including cargo bikes, small and large e-trucks</td>
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<tr>
<td>Implement pilot fossil-free logistics in construction and other sectors</td>
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<tr>
<td>Require “green delivery” for goods and services procured by public authorities/ entities under the authority of the city</td>
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<tr>
<td>Support development, legal and institutional for zero-emission drone and droid delivery systems</td>
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<table>
<thead>
<tr>
<th>Mobile Assets</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
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</thead>
<tbody>
<tr>
<td>Acquisition of new, mostly electric, public transport rolling stock to intensify services</td>
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<tr>
<td>Modernise urban and underground rail rolling stock</td>
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<tr>
<td>Ban diesel fuel taxis and buses from 2025/2030</td>
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<tr>
<td>Gradual switch towards zero-emission buses (electric and fuel cell)</td>
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<tr>
<td>The gradual switch to zero-emission municipal vehicle fleets in all other sectors</td>
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<tr>
<td>Require/promote low/zero emission taxi and Uber fleets</td>
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<tr>
<td>Use procurement power to request the use of zero-emission vehicles by suppliers</td>
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<tr>
<td>Test drive e-vehicle campaigns</td>
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<tr>
<td>Electrify urban boat freight ferries</td>
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<td>Develop e-bike sharing pilot</td>
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<tr>
<td>Support the development of city traffic automation with e-cars</td>
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### 4. Portfolio of Effective Measures and Their Potential Contribution to Mitigating Climate Risks of Transport

<table>
<thead>
<tr>
<th>Infrastructure new/extension</th>
<th>Avoid</th>
<th>Shift</th>
<th>Improve</th>
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<tbody>
<tr>
<td>Develop new urban and suburban rail infrastructure/RER/subway/tram/BRT lines etc.</td>
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<tr>
<td>Extent/activate existing urban and suburban rail infrastructure/RER/subway/tram/BRT lines etc.</td>
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<tr>
<td>New urban rail stops</td>
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<tr>
<td>Upgrade railway stations</td>
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<tr>
<td>Develop smart mobility hubs around the rail, metro, tram or appropriate BRT stops</td>
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<tr>
<td>Park &amp; Ride facilities at all appropriate heavy rail, tram, BRT etc. stops at the entrance to the core city and outside</td>
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<tr>
<td>Separate bus lanes</td>
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<tr>
<td>Develop road-side e-charging infrastructure with sufficient charging space</td>
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<tr>
<td>Improve cycling, walking and micromobility infrastructure (including associated services)</td>
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<tr>
<td>Cycling lanes along all major and radial routes</td>
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<tr>
<td>Electricity rail links</td>
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<td>Develop electric road pilot</td>
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<td>Integrate renewable energy sources (e.g. solar roads, solar roofs for roads, PV-integrated noise barriers)</td>
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<td>Develop mobility house (parking and charging)</td>
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<td>Develop biogas stations</td>
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<td>Implement biofuel (new generation) and hydrogen refuelling station</td>
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<tr>
<td>Expand e-charging and hydrogen filling station</td>
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<td>Add renewable fuels to energy stations</td>
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<tr>
<td>Integrate EV/micromobility Charging Infrastructure</td>
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<td>Develop public changing infrastructure for EVs</td>
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<td>Develop cycling infrastructure and operations (ride to work, bike sharing, cycling incentives, etc)</td>
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<tr>
<td>Develop walking and micromobility infrastructure</td>
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<tr>
<td>Develop and implement passenger transport mobility hubs of different types at all relevant urban rail stops and stations as well as major BRT and bus stops</td>
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<td>Develop pilots for fossil-free mobility (in large companies, or neighbourhoods)</td>
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<td>Implement intelligent transport systems infrastructure</td>
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<td>Develop freight consolidation centres and local logistics hubs</td>
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