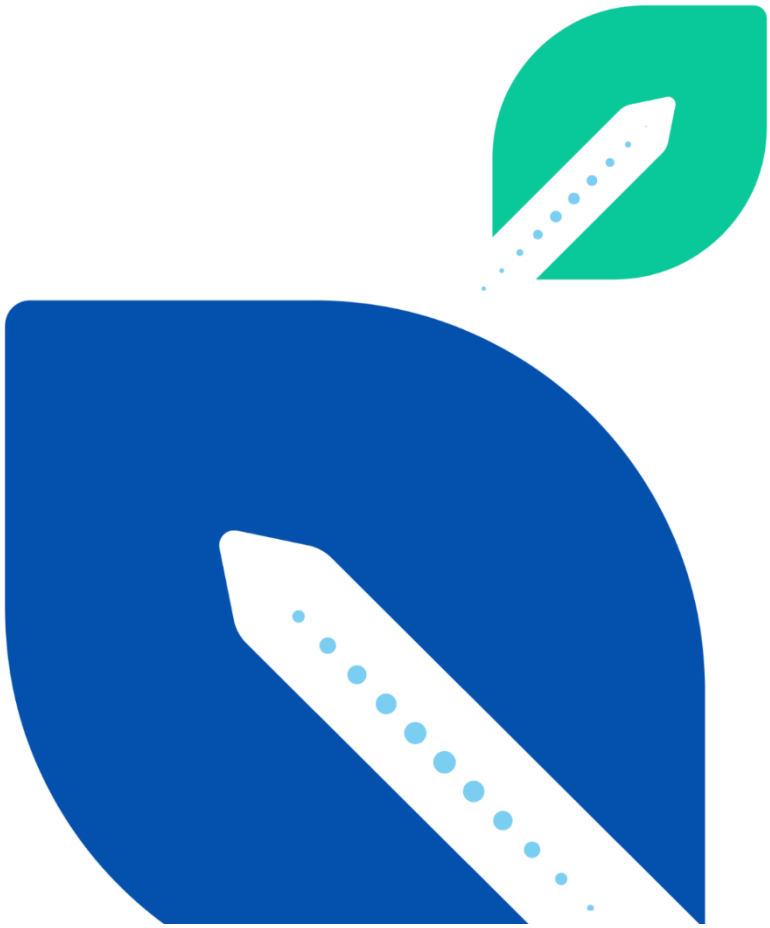
Urban Mobility Data Space

Deliverable 6.1



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Deliverable 6.1

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1 Executive Summary

The aim of this Deliverable is to describe and explain the SPROUT urban mobility shared data space. This data space collects and sorts quantitative and qualitative (raw) data, which are relevant for the SPROUT tools. Some of the data are used to calculate relevant indicators, which are in turn used by one of the SPROUT tools. By applying these tools, the user will receive crucial knowledge for their decision-making processes to guide mobility transitions sustainably. Both the data space itself and the SPROUT tools, which receive input from the data space, can be accessed via the SPROUT toolbox: http://sprouttoolbox.nuacampus.org/.

Similar to transition studies, SPROUT applies a perspective that distinguishes between different kinds of knowledge requirements of transformative actors, namely: system knowledge (current state of the urban mobility system), target knowledge (desired future state) and transformative knowledge (possibilities to achieve a desired future state).

In collecting data for different but similar purposes, the data space provides urban mobility data in a harmonised way. During the SPROUT project lifetime, it has already been populated with data from the SPROUT 1st and 2nd layer cities.

In this context it is important to note that the SPROUT data space is also able to collect data which is needed to calculate all of the European Commission's SUMI[1] (sustainable urban mobility indicators). That is, SPROUT tools use data which partly overlaps with SUMI data. In order to have a complete approach, the data space additionally allows to collect all other SUMI data. The SUMI are a useful tool for cities and urban areas to identify the strengths and weaknesses of their mobility system and to focus on areas for improvement. By collecting data for SUMI, European cities will increasingly harmonise data collection efforts.

SPROUT tools provide added value in two areas. First, we found that cities currently do not necessarily have sufficient data available to report under the SUMI framework. SPROUT therefore provides a simplified approach for all its project tools, using standard data complemented by qualitative self-assessments. Second, and more importantly, SPROUT focusses to assess not only the liveability (sustainability) of cities, but also their **innovation readiness**.

Table 1 on next page provides a short summary of indicators that are used in the three SPROUT tools "innovation readiness assessment", "liveability assessment", and "action tracking". It categorises these indicators according to the SPROUT ecosystem elements. Each of such elements of the urban mobility ecosystem corresponds to a specific field that is important to driving urban mobility innovation.

Whereas these three tools assess the liveability and innovation readiness of cities, SPROUT provides more assessments, namely

- a cost-based approach to assessing the impact of policies (SPROUT T5.2), and

[1] https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en

- an overview of the current and future mobility status (SPROUT WP2). This overview is used as input for the “liveability assessment” and “action tracking”.

All such data can be integrated into the data space.

Table 1 Data space integration (3 SPROUT tools)

Element	Innovation Readiness	Liveability	Action Tracking
Innovative governance and growth	Inter-departmental coordination Mobility planning Liaison Public investments	Planning investments	Integrated planning Sustainable urban logistics Push measures and redistribution of public space Funding Public fleets Targets
Climate and city typology	Openness Science & education	Sustainability	-/-
Smart & easily accessible	Transparency and accountability	Accessibility Affordability Availability	Public transport Sustainable urban logistics Availability, accessibility, and competitiveness of public transport
Safe and secure	-/-	Safety and security	Safety
Smart & Innovative Resources and Infrastructure available	Data availability Cities capacity	Efficiency Convenience	Cost Infrastructure Integration of MaaS and shared vehicles Sustainable urban logistics Push measures and redistribution of public space Availability, accessibility, and competitiveness of public transport
Innovative people & stakeholders	Culture Industry diversity	Behaviour and smartness	Push measures and redistribution of public space

2 Introduction

2.1 Aim of this deliverable

This deliverable provides the outline of the SPROUT Urban Mobility Shared Data Space. The data space establishes a basis for evidence-based decision-making in the SPROUT 1st layer cities and beyond. SPROUT work packages 2, 5 and 6 have collected a range of quantitative and qualitative data. Task of this data space is to structure the collected information and to allow a more targeted future data collection from SPROUT cities and beyond. More specifically, this deliverable pursues 3 purposes:

1. Collecting data which is necessary to feed **all SPROUT tools**. To allow a continuous update of the data space, actual data from SPROUT's 1st and 2nd layer cities (and beyond) are collected in individual files which are made available via the SPROUT website and via the toolbox. The SPROUT toolbox can be found online at: http://SPROUTtoolbox.nuacampus.org/. The relevant tools are listed in the subsequent chapter 2.2 ("How this deliverable relates to other deliverables).

2. Defining key performance indicators and a minimum set of data to drive urban policy making in general, and make informed decisions about the implementation of innovative urban mobility solutions in particular.

3. Describing, explaining and assessing relevant sources for data collection. That is, this report also aims at providing and disseminating a more nuanced understanding of indicators and data, and about their function in decision-making processes. The categorising and structuring of information on urban mobility ecosystem contributes to the identification of appropriate indicators and data for making informed decisions about the implementation of innovative urban mobility solutions and policy responses.

Where adequate and possible, the report links the data needs to agreed indicators such as the SUMI or the SDGs (Sustainable Development Goals) or refers to standard values or national data that cities can use in cases where no data is available ('data poor environments').

2.2 How this deliverable relates to other deliverables

The urban mobility data space receives input data from:

1) SPROUT's urban mobility transition inventory (D2.1). This is an inventory of the factors that are used by each of the SPROUT cities as a common framework to collect and integrate data in order to construct a comprehensive overview of their respective current and future mobility status, and to understand as well as to anticipate the urban mobility transition. Ultimately, some of the indicators in this inventory were also used to calculate the "Urban policy system dynamics model" under Task 5.2, as described in D5.2.

2) further data to calculate the "Urban policy system dynamics model" under Task 5.2, as described in D5.2.

3) the self-assessment tool for cities to measure their innovation readiness. This innovation readiness index is calculated and explained in D5.2 as well.

4) For the minimum set of data, SPROUT considers the KPIs from the CLDs of T5.2.

5) the self-assessment tool for cities to measure their liveability.

6) SPROUT's action tracker, which is part of Task 6.2 and D6.2. The data needed for the action tracker partly overlaps with data from urban mobility transition inventory (D2.1).

Finally, the data space is also able to receive input data from the "Sustainable Urban Mobility Indicators" (SUMI). SUMI are endorsed by the European Commission and will become an important part for cities' decision making in the future. Therefore, the data space foresees their inclusion. The complete set of the SUMI indicators is presented in Annex 9.3.

2.3 Structure of the deliverable

Chapter 3 explains the rationale of the SPROUT tools, in order to provide an overview and to distinguish their different purposes. This also provides an introduction as to why certain data have to be collected.

Subsequently, the document dedicates one chapter per each of the three main purpose of the deliverable as explained chapter 2.1:

- Chapter 4 provides an overview of the data which is necessary to calculate all SPROUT tools.
- Chapter 5 discusses the key performance indicators and a minimum set of data to drive urban policy making.
- Chapter 6 describes, explains and assesses relevant sources for data collection. It serves as an overview of what data can be aggregated and how the data can be placed in the overall structure of SPROUT and other relevant indicators such as SUMI and the Sustainable Development Goals (SDGs). It aims to fill knowledge gaps and draws attention to overlaps in the urban mobility transition data.

Finally, chapter 7 concludes this report.

3 Rationale of SPROUT tools

Evidence-based policy-making is facilitated by different kinds of indicators and data. Indicators and data are closely linked, still it is important to understand the difference between the two concepts: Data are any kinds of collected evidence. Indicators are tools or means to assess a state, an output, an impact, or characteristics of something, for example a system, a mobility solution, or a policy response. Indicators can also be used to describe policy goals or targets (i.e., desired states, outputs, or impacts).

Data for urban mobility decision-making

Urban mobility decision-making follows a sequence of stages, as ideal-typically described in the policy cycle or the SUMP cycle. Following this approach, policy-making involves problem definition, target setting, selection and implementation of adequate policy responses, monitoring and evaluation.

In a related way, transition studies distinguish between different kinds of knowledge requirements of transformative actors: system knowledge, target knowledge and transformative knowledge (Schneidewind, Singer-Brodowski, and Augenstein 2016). Figure 1 illustrates these three types of knowledge. The SPROUT tools are designed to bring about this knowledge in a comprehensive way, and they can be applied during the different stages of decision-making along the SUMP cycle.

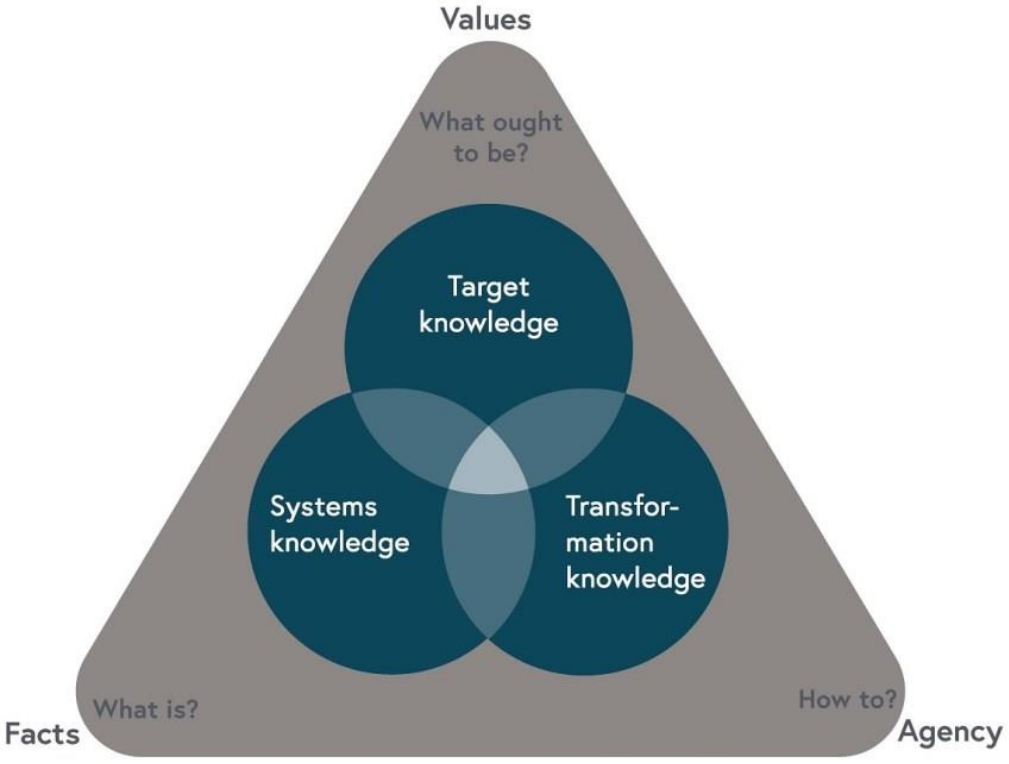

Figure 1 Three types of knowledge and the relationship with facts, values, and agency (created by Flurina Schneider and University of Basel New Media Center)

Systems knowledge provided by SPROUT tools

Systems knowledge comprises information about the current state of the urban mobility system, about resulting mobility patterns (often referred to as pressure or performance indicators), about trends that may influence the system in the future, and about related impacts. It can also provide orientation on the performance of one city's mobility system with those of other cities. Guiding questions related to systems knowledge comprise:

- what are the physical characteristics of the urban mobility system (in terms of infrastructure, vehicle fleets, public transport offer, etc.)?
- How does the urban mobility system (or elements of it) perform compared to other urban mobility systems (identifying strengths, weaknesses, and needs to act)
- which travel behaviour (and logistic operations) patterns results from those characteristics (those aspects are sometimes referred to as 'pressure indicators' or 'performance indicators')
- which trends may influence the system and mobility behaviour?
- which impacts on the urban and the natural environment and on human health result from the current mobility system, current travel behaviour, and identified trends?
- linked to system knowledge are basic indicators that are not directly related to the urban mobility system but influence the overall direction of change. That information comprises city size, urban development patterns, population density, or economic development. For example, a growing population, a sprawling city area, or increasing economic activity may contribute to a higher transport demand.

SPROUT provides a framework for collecting and integrating data to create a comprehensive overview of their respective current and future mobility status and to understand and anticipate the transition to urban mobility. The elements of the inventory are categorised as Key Performance Indicators (KPIs) and Drivers of Urban Mobility Change (see SPROUT D2.1). The selection of these elements is based on a review of different sources, in particular previous EU initiatives in the field of urban mobility and logistics. The input from these initiatives has been adapted to the specificities of SPROUT, using various EU and local policy documents as well as academic literature. Further information can be found in the Deliverable itself.

In order to calculate the KPIs, the data space provides an outline of required data, and cities can enter the respective information into the data space.

Target knowledge provided by SPROUT tools

Target knowledge about desirable state of a system and its impacts combines scenarios and normative values (e.g., policy targets, civil society opinions, stakeholders' wishes). Related indicators support the formulation of measurable and meaningful goals and targets. Since both system knowledge and target knowledge describe states of a system (current state vs. normatively desired state) they rely on similar sets of indicators.

Related questions comprise:

- How should the future mobility system look like?
- How should people travel and how should freight be delivered?
- Which negative impacts should be reduced, which positive impacts should be harnessed?

SPROUT's Action Tracker (D6.2) is a tool providing target knowledge. The Action Tracker can be used as a benchmark for cities to understand, how successful they have been so far in transforming their urban mobility sustainably. They can compare their success with other cities, too.

Transformation knowledge provided by SPROUT tools

Finally, transformation knowledge informs about how to achieve the desirable state. It deals both with the selection, implementation, monitoring and evaluation of appropriate policy responses, and with governance and agency issues, i.e. the capacity to act in a purposeful way (Buser and Schneider 2021). While systems and target knowledge can be translated into quantitative data relatively easily, there is a need to operationalise mostly qualitative information on transition knowledge into quantitative data. One option is to use Yes/No indicators (e.g., on the existence of a SUMP), another option is to use scales (expert opinion).

Transformation knowledge seeks to answer the following questions:

- Which measures can be taken in order to address changes in the state of the urban mobility system and to achieve the desired future state?
- How can the successful implementation of measures be measured (monitoring & evaluation)?
- Can the policy response be implemented in terms of legally feasibility, and administrative and financial capacities?

SPROUT provides transformation knowledge with the innovation readiness assessment (D5.2), the liveability assessment (D6.2), and the cost-based approach for assessing policy responses (D5.2). The SPROUT policy response harnesses the impacts of new mobility solutions in a way that makes them more attractive to the users and more sustainable for the society as a whole.

4 Data needs of the SPROUT tools

This chapter provides a summary of indicators that are used in the SPROUT tools, namely:

- innovation readiness assessment
- liveability assessment”
- cost-based approach to assess the impact of policies
- action tracker

In addition, the annex (chapter 9.2) provides summary tables of SPROUT D2.1 (urban mobility transition inventory), which is a common framework to collect and integrate data to provide a holistic and simplified overview of current and future mobility. All such data can be integrated into the data space. Figure 2 provides an overview of the tools’ data sources, the following sub-chapters explain details.

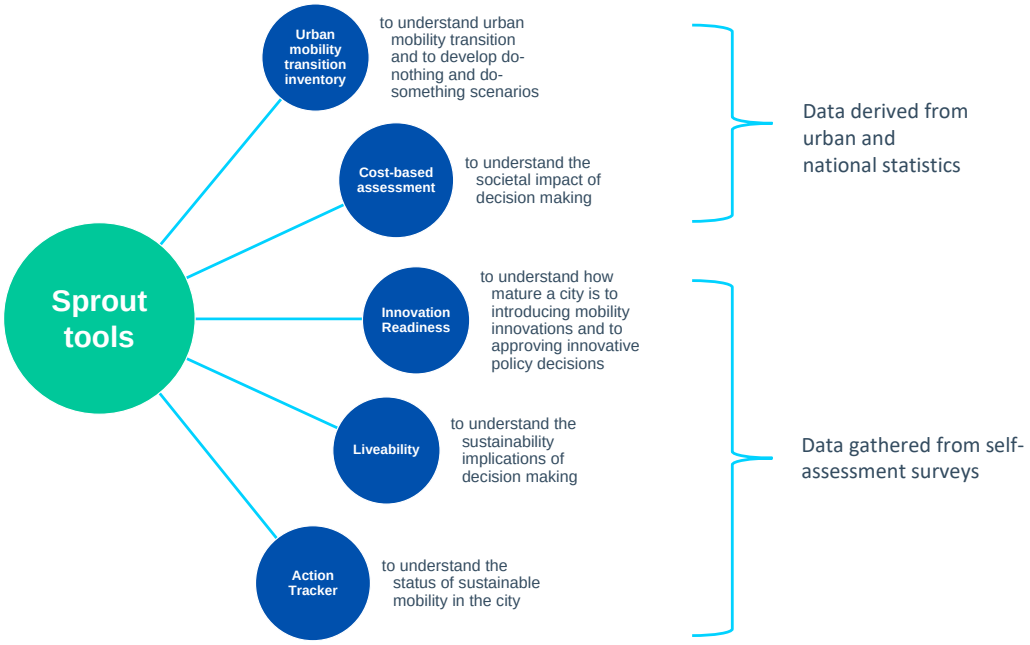

Figure 2 SPROUT tools, corresponding project aims and data sources

4.1 Innovation Readiness

In order to efficiently steer cities towards innovation, it is important to understand how mature a city already is in introducing mobility innovations and how ready it is to take innovative policy decisions. To this end, the SPROUT team developed a self-assessment tool which measures a city’s readiness for innovation and identifies strengths and weaknesses. This instrument is integrated into the data space and includes 21 questions expressing the 11 sub-elements capturing innovation readiness for the first and second level SPROUT cities. Each question can be answered on a scale of 0 to 5, with 5 being the highest and 0 the lowest score for an element. The final score per city is calculated taking into account the weighting of each element, sub-element and question previously assigned by the SPROUT experts.

The methodology used in WP5 requires a qualitative assessment of the current situation of the city in relation to the different sub-elements. No specific quantitative data are required to perform the innovation readiness assessment. While the self-assessment, at least for the capability elements, relies on expert judgements (usually using 5-step ordinal / interval scales), suggestions are provided which quantitative data could be used to guide and to support the qualitative assessment. References are made to established indicator systems and other statistics or data inputs of the European Union.

For this purpose, the following table has been adapted from D5.2 (cf. table 3, D5.2). The additional column on the right-hand side facilitates the cities' self-assessments on their innovation readiness.

Table 2 Innovation Readiness

Sub-elements		Description	Data that can be used for guiding the qualitative assessment
Innovative Governance & Growth			
R1	Inter-departmental coordination	Describes the structure and the dedicated departments of a city to better implement innovative mobility solutions	• Survey on the frequency of interdepartmental co-operation in form of a 5-step interval scale, e.g., from “no cooperation” to “institutionalized, regular cooperation”
R2	Mobility Planning	Depicts the current regulatory framework of the city against passenger and freight transportation (existence of Sustainable Urban Mobility Plan (SUMP) & Sustainable Urban Logistic Plan (SULP))	• Option 1: Determination via the SUMP self-assessment tool[2] • Option 2: Review of policy documents and strategies (see L1), e.g. SUMP/SULP with provision of targets and timetables
R3	Liaison	Shows the level of Public-Private Partnerships (PPP) and corporations taking part in the city	• Number of PPPs and private entities participating in mobility/mobility innovations
R4	Public Investments	Represents to what extent the city has ensured funding for innovative mobility solutions	• Public investments into innovative mobility solutions, e.g. shared mobility, automated mobility on-Demand (AMoD), Mobility-as-a-Service (MaaS)
Climate and City Typology			
R5	Openness	Concerns about the networking of the city by assessing the level of national and international synergies of the city’s institutes; e.g., via the participation in European or national research and implementation programmes	• Number of mobility-related European (Interreg, HorizonEurope, Horizon2020, etc.) and national research and implementation programmes in which the city has participated in the past 5 years

[2] https://www.sump-assessment.eu/

Sub-elements		Description	Data that can be used for guiding the qualitative assessment
R6	Science & Education	Constitutes the educational level of the inhabitants and the number of the research institutes and universities located in the city	• Share of population (aged 25-34) with tertiary education or higher, e.g. via Eurostat's Educational attainment statistics[3]
Smart & Easily accessible			
R7	Transparency & Accountability	Corresponds to the level of the transparency of governmental processes and the availability and the level of accessibility of urban mobility data	• Country level data via the "Corruption perception index"[4] or the Global Corruption Barometer, score for "Local government representatives (including mayors)"[5]
Smart & Innovative Resources and Infra available			
R8	Data Availability	Refers to how developed the data collection system is in a city	• Availability and level of accessibility of urban mobility data, e.g. physical surveys or infrastructure to observe
R9	Cities Capacity	Explains the level of capacity the city has to adopt innovation by using/providing specialists and having evidence-driven policy-making and to what extent the city has the infrastructure to help adopt innovative mobility solutions	• Number of staff members working on mobility innovation/population
Innovative People & Stakeholders			
R10	Culture	Shows the direction of the city and habitants towards innovation by assessing the city's previous experience of implementing Innovative Business models and the	• Use of ad hoc surveys, such as the Revealed Preference (RP) survey to collect current travel behaviour based on knowledge of and behaviour towards available travel options and the Stated

[3] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Educational_attainment_statistics#Level_of_educational_attainment_by_age
[4] https://www.transparency.org/en/cpi/2021
[5] https://images.transparencycdn.org/images/TI_GCB_EU_2021_web_2021-06-14-151758.pdf

Sub-elements		Description	Data that can be used for guiding the qualitative assessment
		acceptance/trend of the users towards green modes	Preference (SP) survey to collect future behaviour of travellers based on information about hypothetically available travel options.
R11	Industry Diversity	Identifies the smartness of the city's industry by considering the number of big innovators (start-up & high-tech companies) that are established in the city	• Share of start-ups and high-tech companies located in the respective cities of the past 10 years

4.2 Liveability

In terms of assessing the liveability, D5.2 identifies the 9 sub-elements to be integrated. In the following table (cf. table 7, D5.2), an overview of the liveability sub-elements as well as the associated PIs to measure each of them is provided. Similar to the self-assessment method for innovation readiness, questions were sent to the 1st and 2nd layer cities based on a scoring system, which is also captured in the data space.

As can be read from the table below, the data required for the liveability assessment is of quantitative nature, as opposed to the indicative questions for the readiness assessment. A third column has been added to the original table of D5.2 as well, to provide guidance for the quantitative assessment. The suggestions given are mainly limited to the SUMI indicators and the KPIs of WP2, from which the PIs of the liveability sub-elements were derived and might therefore be useful for orientation.

Table 3 Liveability

Sub-element		Indicative PIs	Data that can be used for guiding the quantitative assessment
Innovative governance and growth			
L1	Planning investments	• Levels of planning process transparency, • No. Master Plans and urban legislation	• Expert and stakeholder judgements (based on qualitative scale) • Availability of a SUMP and/or a SULP or other city strategies that provide targets for urban mobility (e.g. modal split targets). (Y/N); if 'yes', level of ambitions could be defined in relation to peer cities and a benchmark system could be derived (see D6.2)
Climate and city typology			
L2	Sustainability	• CO_2 equivalent or GHG emissions from transport (% of GHG emissions from urban transport) • European Air Quality Index • Noise levels	• SUMI-07 • SUMI-03 or EEA's European city air quality viewer[6] • KPI13 (D2.1) • SUMI-04

[6] https://www.eea.europa.eu/themes/air/urban-air-quality/european-city-air-quality-viewer

Sub-element		Indicative PIs	Data that can be used for guiding the quantitative assessment
Smart & easily accessible			
L3	Accessibility	• Access to mobility services (the ease with which all categories of passengers can use public transport) • Accessibility for vulnerable groups to mobility services (the ease with which vulnerable passengers can use public transport) • Share of inhabitants with mobile internet access (sharing services) • SDG - % population within 500 meters of a PT station • No. of Roads, highways, public transport stations	• SUMI-06 or using guidance in developing benchmark system as suggested by the Commission[7] • SUMI-02 or assessing presence of audio announcements, step free access to platforms, step free access from platform to vehicle • National data available via Eurostat[8]
L4	Affordability	• Urban deliveries prices (€/package) • Public transport prices • Parking prices • Monthly ticket cost per average income • Cost of a one km taxi ride as a percentage of average income	• KPI02 (D2.1) • SUMI-01
L5	Availability	• Share of public transport (%) • Share of car transport (%) • Share of micro-mobility (%) • Share of active transport (%) • Share of car-sharing transport	• KPI17, KPI18, KPI19 (D2.1) • SUMI-10 & SUMI-11

[7] https://ec.europa.eu/regional_policy/sources/docgener/work/2015_01_publ_transp.pdf
[8] https://ec.europa.eu/eurostat/databrowser/view/ISOC_CI_IM_I/default/table?lang=en&category=isoc.isoc_i.isoc_ici

Sub-element		Indicative PIs	Data that can be used for guiding the quantitative assessment
Safety and security			
L6	Safety and security	• Bikes/E-scooter accidents per 100000 inhabitants • Public transport accidents per 100000 inhabitants • Car transport accidents per 100.000 inhabitants • Share of urban mobility accidents involving on-demand bike/scooter deliveries • Fatalities including micro-mobility means	• KPI09 & KPI10 (D2.1) • SUMI-05 & SUMI-13
Smart & innovative resources and infrastructure available			
L7	Efficiency	• Share of urban space for public transport • Share of urban space for private/shared cars • Share of urban space for cycling/scooter lanes • Share of urban space for pedestrian areas • No. of autonomous PT services on dedicated lanes	• SUMI-17 • KPI05, KPI06, KPI08 (D2.1) • KPI20 & KPI21 (D2.1)
L8	Convenience	• Total passenger trips per day • The average journey to work in minutes • The average no. of vehicles entering the city daily • Congestion • User trips expected per day	• KPI11 & KPI12 (D2.1) and SDG 9.1.2 Passenger and freight volumes • SUMI-16 and KPI07 (D2.1) • KPI15 & KPI16 (D2.1) • SUMI-08
Innovative people & stakeholders			
L9	Behaviour and smartness	• The behaviour of users? E.g., implement access restrictions / regulate parking (No. parking violations) • Users' perception of micro-mobility devices • Users' perception of biking as dangerous • User perception of car use as expensive • Size of the population above minimum user age	• SUMI-12 & SUMI-18

The following figure (cf. Figure 7, D5.2) categorizes the different elements and sub-elements in a coherent overview to visualise the innovative mobility ecosystem.

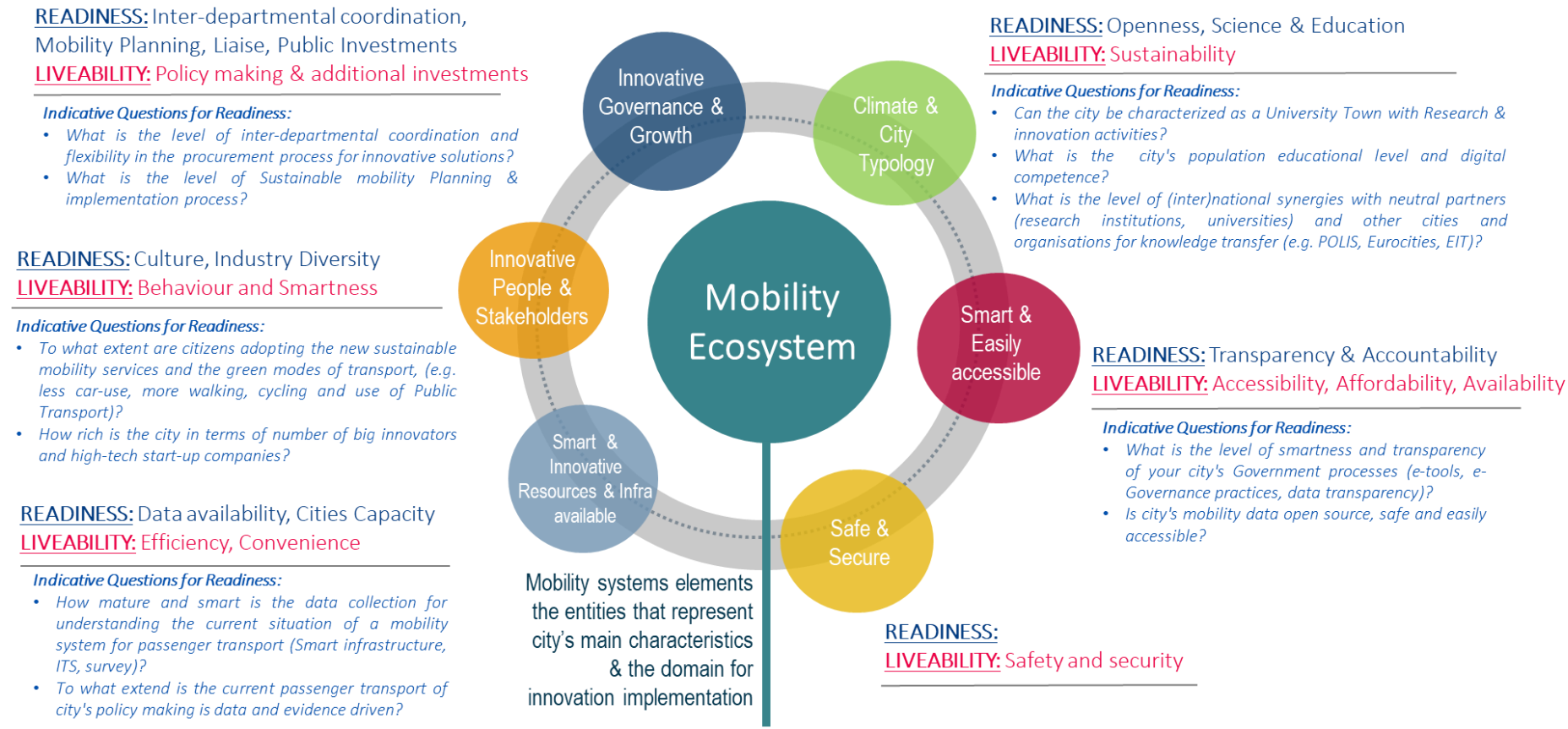

Figure 3 Mobility Ecosystem. Source: D5.2, Figure 7

4.3 Cost-based Approach for Assessing Policy Responses

In addition to the aim of assessing the degree of innovation readiness and liveability of cities, the core set of indicators and data discussed should also provide important input for assessing the impact of policies. As discussed in deliverable 5.2, a cost-based approach – guided by comprehensive causal loop diagrams, which mapped the interaction of the different variables based on the use case and responses identified in the demonstration cities – has been adopted by SPROUT.

The main outcome of this analysis is to calculate the costs incurred for each sustainability sector (economy, environment, community and mobility) of the first layer cities by the tested measure and a selected set of policy measures, and to compare these costs with the future mobility states estimated in the do-nothing scenarios developed in WP3.

The cost-based assessment is also included in the data space and its structure can be visualised as follows (cf. Figure 12, D5.2):

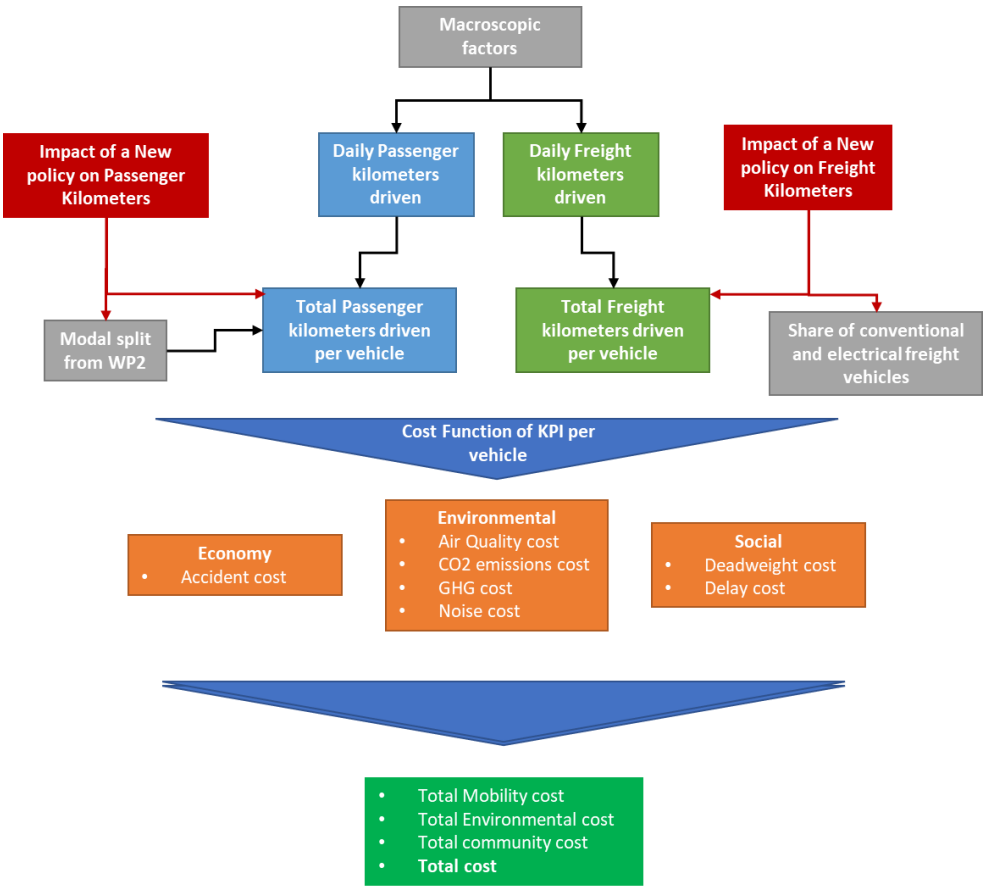

Figure 4 Cost-based assessment. Source: D5.2, Figure 12

4.4 Action Tracker

The previously described data-driven approach serves to identify weak signals or early indicators of emerging mobility changes, which can be used as trigger mechanisms for cities to review their policies and take corrective measures in the medium and long term.

The critical thresholds of specific KPIs in combination with knowledge about the mobility state of the city make it possible to identify anomalies in the respective urban mobility environment at an early stage.

The gathered data in the data space can be further used to track the progress of cities in achieving specific policy goals. For this purpose, an action tracker is designed to aggregate sub-elements according to the ecosystem elements as previously defined in the SPROUT project (see figure 3). For each (sub-)element, the tracker compiles systems knowledge about the current state of the mobility system and its impacts (e.g., on modal split or transport-related CO_2-emissions); target knowledge on specific mobility-related goals and targets for, among others, sustainable urban logistics, and transformation knowledge on key policy measures (as inter alia derived in D3.3 and D5.1). As can be seen in the following overview, the questions sent to the first and second level SPROUT cities therefore included both qualitative and quantitative data.

Table 4 Data and indicators used for the Action Tracker

Ecosystem Element: Innovative Governance and Growth	
Data and Indicators	Normalisation and representation
Existence of sustainable mobility plans	Y/N Direct comparison with peers. Compared to distribution of answers.
Existence of sustainable logistic plans and targets	Y/N Direct comparison with peers. Compared to distribution of answers
Inter-departmental coordination and cooperation	Self-assessment. Direct comparison with peers. Compared to distribution of answers.
Use of an integrated transport / urban planning tool	Y/N Direct comparison with peers. Compared to distribution of answers
Existence and ambition level of modal split targets	Y/N (ambition levels as below)
Modal split target for walking	Annual change (in %) from base year to closest target year. Direct comparison with peers
Modal split target for cycling	Annual change (in %) from base year to closest target year. Direct comparison with peers
Modal split target for public transport	Annual change (in %) from base year to closest target year. Direct comparison with peers
Modal split target for car use	Annual change (in %) from base year to closest target year. Direct comparison with peers
Environmental criteria in public delivery contracts	Direct comparison with peers. Compared to distribution of answers

Ecosystem Element: Climate and City Typology	
Data and Indicators	Normalisation and representation
Transport-related CO_2-emissions for the latest available year (except 2020 and 2021)	Direct comparison with peers (state indicator, not considered for score)
Transport-related $PM_{2.5}$ emissions (via SUMI3, depending on data availability)	Direct comparison with peers (state indicator, not considered for score)
PM_{10} and NO_2 concentrations (inner city)	Direct comparison with peers (state indicator, not considered for score)
Targets for transport-related greenhouse gas emissions	Average annual change between base year and target year
Share of BEV in existing fleet	Direct comparison with peers (state indicator, not considered for score)
Installed charging capacity (in kw)	Direct comparison with peers (state indicator, not considered for score)
Share of BEV (new registrations)	%, compared to peers (benchmark could be calculated using the share of required new registrations of BEV to achieve EU target)
Share of e-buses in the public transport fleet	%, compared to peers
Implementation of a low emission zone	Distribution of answers; compared to peers
Financial support programme for electrification of logistic fleets	Compared to peers

Accessibility, Affordability and Availability (collective transport)	
Data and Indicators	Normalisation and representation
Modal Share of public transport	Direct comparison with peers (state indicator, not considered for score)
Public transport vehicle-kms (latest available year, except 2020/2021)	Performance indicator; per inhabitant;
Number of public transport trips per month	Used as reference (not indicated)
Targets for the development of the public transport service offer (vkm)	Additional public transport service-kms (average annual change). Compared to peers.
Share of population living within 300m from public transport bus and tram stops and 500m from lightrail stations?	% of total urban population; direct comparison with peers
Length of public transport network	Direct comparison with peers (per capita / per km2 of urban area)
Availabiltiy of on-demand services in areas and times of low public transport offer	Y/N; distribution of answers.

Share of barrier-free public transport stations	in %, compared to peers (average value). Lowest share of the two indicators counts.
Share of barrier-free public transport vehicles	in %, Compared to peers (average value). Lowest share of the two indicators counts.
Price for a single trip by public transport	As share of monthly net income
Price for a monthly public transport pass	As share of monthly net income
Free public transport for all citizens or specific user groups (School kids, Senior citizens, poor groups)	Comparison with peers; distribution per user category
Average speed of public transport compared to average speed of road traffic	Ratio, compared to peer cities
Price for one hour of parking in the city centre compared to price for a single trip by public transport	As share of monthly net income
Cost of resident parking permits per year compared to price for a monthly public transport pass	

Ecosystem Element Safety and Security	
Data and Indicators	Normalisation and representation
Total number of transport-related fatalities per year	Per 1,000 inhabitants; as reference value
Number of transport-related fatalities per year for vulnerable road users	Per 1,000 inhab. or per 1,000 bike/walking trips; depending on data availaiblity
Total number of severely injured road users per	Per 1,000 inhab. or per 1,000 bike/walking trips; depending on data availaiblity
Number of cycling trips per year	As reference value
Targets for the development of safe cycling infrastructure	Targeted annual increase (%); compared to peer cities
Share of urban road-km with adequate cycling infrastructure	%, compared to average of peer cities
Share of urban roads with speed limit of 30km/h or less	%, compared to average of peer cities

Ecosystem element Smart and Innovative Resources and Infrastructure	
Data and Indicators	Normalisation and representation
Availability of new mobility services and shared vehicles	
Availability of shared-vehicles: Coverage of the city area	Scale; compared to peer cities, distribution of answers
Number of mobility hubs (public transport stations with safe bike stands and dedicated spaces for shared vehicles)	Per 1,000 inhab.; compared to peer cities

Number of local public transport vehicles that are equipped to provide real-time data that	Share of total public transport vehicle fleet; compared to peer cities
Share of smart booking on public transport	%; compared to peer cities (average)
Parking regulations for shared bikes and micro-vehicles	Y/N compared to peers, distribution of answers
Exchange between city admin and MaaS operators	Y/N; degree of institutionalisation. Compared to peer cities; distribution of answers
Are MaaS operators obliged to share data?	Scale relating to the legally binding nature of data disclosure; compared to peer cities, distribution of answers
Exchange between city admin and logistic companies	Y/N; degree of institutionalisation. Compared to peer cities; distribution of answers
Data collection on urban logistics	Multiple options; distribution of answers
Number of public parking spaces	Number / per capita. Compared to peers
Targets for the reduction of parking spaces?	Y/N (freetext)
Parking management for private cars: Coverage of urban area.	Scale (4 possible answers); compared to peer cities, distribution of answers
Systematic reduction of parking spaces	Y/N; compared to peer cities, distribution of answers (+text)
Restriction of parking spaces in building codes?	Scale (3 possible answers); compared to peer cities, distribution of answers
Exchange between city admin and logistic companies	Y/N; degree of institutionalisation. Compared to peer cities; distribution of answers
Implementation of micro-depots	Y/N; Compared to peer cities, distribution of answers
Data collection on urban logistics	Several possible answers: compared to peer cities, distribution of answers
Total public spending on mobility (public municipal budget)	Used as reference. Latest available year
Public municipal spending on walking	Per capita / compared to total municipal public spending on mobility, latest available year. Compared to av. of peers.
Public municipal spending on cycling	Per capita / compared to total municipal public spending on mobility, latest available year. Compared to av. of peers.
Public municipal spending on public transport	Per capita / compared to total municipal public spending on mobility, latest available year. Compared to av. of peers.

5 Minimum set of data and KPI

The SPROUT tools have different key performance indicators (KPIs), depending on the respective tools' data needs and explanatory approaches. Early in the SPROUT project, urban mobility transition drivers were identified through the PESTEL approach, resulting in a list of 27 key performance indicators that provided a comprehensive overview of the cities' current development status with regard to urban mobility and logistics (see annex, chapter 9.2). In a subsequent step, 1st- and 2nd- layer cities rated the level of importance of all urban mobility transition drivers identified in preparation for their do-nothing and do-something scenarios.

When the cities collected the data for their further project steps, it turned out that not all data for these 27 KPI was immediately available. From the 14 1st- and 2nd- layer cities, data was only available for 10-23 indicators, depending on the respective city's repository. In other words, data for 4-17 indicators was not immediately accessible.

In the same vein, SUMIs were developed on behalf of the European Commission as a tool for cities to identify the strengths and weaknesses of their mobility system. The 17 SUMI demand the collection of even more and more detailed data than the 27 SPROUT KPI to understand drivers of mobility transition. Only few pilot cities do so far collect the data which is necessary to calculate all SUMIs.

SPROUT has therefore developed an approach of data collection, which mainly relies on data from self-assessment surveys. This allows cities to apply the SPROUT tools even in data-poor environments. The innovation readiness assessment, the liveability assessment and the action tracker manage to mainly rely on such self-assessments, as illustrated in figure 2 (chapter 4). However, some components of the liveability self-assessment and the action tracker are enriched with input data from external sources and thus go beyond a pure self-assessment.

The cost-based assessment relies on a combination of local and national statistics. Again, limited data access is of minor importance, as the cost-based analysis essentially requires one main variable: the total distance covered of passengers or freight per mode in the respective city (measured in vehicle kilometres in both cases). This variable has to be found for the current state and for each policy scenario, be it a do-nothing scenario or the SPROUT policy response.

In case such data is not available for a given city, it can be derived with assumptions based on Eurostat data (https://ec.europa.eu/eurostat/web/main/home). The calculation of the total **passenger** kilometres driven is based on two main correlations (Eurostat, 2021): The correlation between the commuting distance and the size of the metropolitan area and the correlation between the population density of a country and the share of commuting distance per the total distance driven per person.

The data collected from Paffumi et al. (2018) can be used to estimate the total **freight** kilometres per day. This estimation is split into two parts. First part, the fleet size of a city is correlated with the population and second, the average daily freight kilometres driven per vehicle are correlated with the metropolitan size of a city.

Further details about these assumptions are provided in SPROUT D5.2 (Urban Policy System Dynamics Model, chapter 6.1.2).

5.1 The minimum set of data

The two main criteria to define a minimum set of data are

- relevance and
- availability.

In terms of relevance, the most important added value of the SPROUT tools is their ability to assess the innovation readiness of a city, and to assess the impact of the SPROUT policy response. Therefore, the a) self-assessment on innovation readiness and b) the cost-based assessment are crucial. As these two tools also rely on available data (as explained above), they can therefore be defined as minimum set of data.

As explained above, the liveability assessment and the action tracker partly rely on external data sources. City administrations are encouraged to collect as many data as necessary. Many such data should be available in-house. However, they can apply both tools by exclusively relying on self-assessments. Validity will be strengthened with an increasing amount of data. Table 5 below outlines the approach. The exact minimum set of data can be found below the table.

Table 5 Minimum set of data: 3-tiered approach

Minimum set of data, crucial and available	Additional data, generally available because of self-assessment	Additional data, available with effort
Questions from innovation readiness assessment	23 from 46 questions of the liveability assessment	23 from 46 questions of the liveability assessment
Data for cost-based assessment	8/37 questions from the action tracker	28/37 questions from the action tracker

The minimum set of data for the innovation readiness is (21 questions, score 1-5):

- Q1: What is the level of inter-departmental coordination and flexibility in the procurement process for innovative solutions?
- Q2: What is the level of Sustainable mobility Planning & implementation process?
- Q3: Does the city follow stakeholders' engagement practices for the co-creation and co-design of innovative mobility solutions?
- Q4: At what level your city has the competence for fundraising for innovation (PP schemes, ...) What is the level of public investments for smart innovative policy making?
- Q5: What are the level of (inter)national synergies with neutral partners (research institutions, universities) and other cities and organisations for knowledge transfer (e.g. POLIS, Eurocities, EIT)?
- Q6: Can the city be characterized as a University Town with Research & innovation activities?
- Q7: What are the city's population's educational level and digital competence?

- Q8: What is the level of smartness and transparency of your city's Government processes (e- tools, e-Governance practices, data transparency)?
- Q9: Is the city's mobility data open-source, safe and easily accessible?
- Q10: How mature and smart is the data collection for understanding the current situation of a mobility system for passenger transport (Smart infrastructure, ITS, survey)?
- Q11: How mature and smart is the data collection for understanding the current situation of a mobility system for Freight transport (Smart infrastructure, ITS, survey)?
- Q12: To what extent is the current passenger transport of the city's policy-making data-based and evidence-driven?
- Q13: To what extent is the current freight transport of the city's policy-making data-based and evidence-driven?
- Q14: What is the level of availability of multimodal passenger transport infrastructure & services offered in the city and which is the level of intelligent Transport & mobility infrastructure & services?
- Q15: What is the level of availability of multimodal freight transport infrastructure & services offered in the city and which is the level of intelligent Transport & mobility infrastructure & services?
- Q16: Does the city have a skilled workforce on innovative mobility solutions for passenger transportation?
- Q17: Does the city have a skilled workforce on innovative mobility solutions for freight transportation?
- Q18: To what extent are citizens adopting the new sustainable mobility services and the green modes of transport, (e.g. less car use, more walking, cycling and use of Public Transport)?
- Q19: Is the city open to deploying and testing new business models for passenger transportation? Is the triple helix for innovation applied to smart mobility solutions? (e.g., MaaS, Smart Parking, Traffic Management System etc.)?
- Q20: Is the city open to deploying and testing new business models for freight transportation? Is the triple helix for innovation applied to smart mobility solutions? (e.g., MaaS, Smart Parking, Traffic Management System etc.)?
- Q21: How rich is the city in terms of the number of big innovators and high-tech start-up companies?

The minimum set of data for the cost-based assessment is:

- Pkm of: car, e-car, motorcycle, public transport (combustion engine), public transport (electric)
- Tkm of vehicles with combustion engine and electric vehicles

5.2 Key performance indicators

KPIs to drive urban policy making vary with the city use cases, i.e., with the innovative urban mobility solutions. The KPIs are not designed to assess the innovation readiness of cities or the impacts of policy responses (as the minimum set of data do). They are rather designed to track a city's success to achieve its strategic goals with their policy responses.

The Urban Policy System Dynamics Model from D5.2 comprises a system mapping by following a system thinking approach and a qualitative analysis of the urban mobility ecosystem. Causal Loop Diagrams are used as visualization and system mapping tools, which are used to derive the KPI. The methodology to build a Causal Loop Diagram is explained in D5.2.

Example: SPROUT 1st layer city actions and corresponding KPIs

Valencia's Use Case concerns the provision of parking for private bikes in intermodal nodes. The policy responses selected to be implemented by the city for supporting the penetration levels of this measure are:

- **Policy 1:** Investment in Bike parking infrastructure in intermodal nodes and
- **Policy 2:** Investment in protected and well-maintained bike lanes/infrastructure.

KPIs are

1. Macroscopic data for the city: GDP and Population
2. The attractiveness of Public Transport (PT cost and private mode cost)
3. Modal split (% of use per mode)
4. Total Passenger kilometres per type of vehicle
5. Level of Multimodal Integration (i.e., the average distance in meters from metro stations to the three nearest bus stops as well as to other modes of transport; level of prices alignment among PT services; availability of MaaS)
6. Existing Infrastructure for micro-mobility and active modes (number of bike parking infrastructures available near intermodal nodes)

Further details about KPIs are provided in SPROUT D5.2 (Urban Policy System Dynamics Model, chapter 6.2).

6 Relevant data sources

As illustrated in figure 2 (chapter 4), the data which is necessary for the urban mobility transition inventory (D2.1, see annex, chapter 9.2) and for the cost-based assessment (D5.2, see chapter 3.2) is of quantitative nature and should be based on existing publicly available statistics. This chapter provides an overview of such data sources, how they are collected and where they can be derived from.

In some cases (depending on the contexts), the collection of data may not lie directly with the city authorities, but their inclusion is deemed important, as they remain critical, and cities may perhaps spark the impetus towards transforming how the collection of the data can be transformed towards capturing nuances being brought about by urban transport-related innovations. The data sets are categorized into the basic categories normally being employed in strategic transport modelling: transportation demand; transportation supply; and transportation infrastructure, as well as background and impact categories (socio-economic; safety; environment).

6.1 Socio-Economic

Population

This refers to the number of inhabitants in a specific area. While aggregated city-level data on population is normally available, at least population statistics at the zonal level should be available. Population data is needed for per-capita indicators or for extrapolating partial data (e.g., from a survey) to the larger target group (e.g., the entire population of a city or a district).

The following disaggregation dimensions would ideally be made available:

Table 6 Sample data on Population (own illustration)

Total population of city / region	Basis for per capita indicators	number
Total population of functional urban area (if applicable)	Basis for per capita indicators	number
Population density		%

Ideally, for data-rich cities, the data should be geo-spatially indexed, which would allow for aiding more detailed analyses (overall population developments, movements and patterns) at different geospatial levels[9].

[9] Additional info and data sources:
United Nations (2017): https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Principles_and_Recommendations/Population-and-Housing-Censuses/Series_M67rev3-E.pdf

6.2 Household-level

Household level data should ideally have attributes that reflect household structure, socioeconomic data, employment classification, occupations, geographical locations, and those parameters related to mobility (e.g. detailed trip diaries capturing the number of daily trips, destinations, trip purposes, lengths of trips, among others). Integrating data focusing on capturing access to new mobility services and innovations into household surveys would also be ideal.

Household size

Data reflecting the characteristics of households are crucial in urban mobility planning and policymaking. At the minimum, household size, disaggregated by income quartiles should be made available. This is the input data, for example, for SUMI 1 Affordability of Public Transport for the Poorest Group indicator.

Table 7 Sample data on Household size (own illustration)

Average household size		number
Average household of 25% poorest		number

Household income

As implied in the previous subsection (relevant to calculating SUMI 1), data on household income should be made available. Averages made available at the zonal level (or more detailed, geospatially indexed levels) would also be useful for various purposes such as evaluating mobility intervention locations, among others. Regarding the equity dimension of mobility and affordability of mobility for the poorest, data on monthly income of the poorest quartile should be used.

Table 8 Sample data on Household income (own illustration)

Net average income per household		€/month
Net average income 25% poorest per household		€/month

Household expenditures on transport

Household expenditures for transport per month should at least be collected through the same survey mechanisms that collect data for the household size and income. Disaggregated data that would integrate different modes and services would be ideal. For example, disaggregating monthly household transport expenditures on public transport, shared services, private vehicles, would be ideal as these would provide more detailed pictures of the state and trends. Moreover, cost structures tend to change depending on the income level. In high-income

countries, for example, higher costs for the purchase and operation of cars – as the most expensive kind of transport – tend to increasing the overall level of transport costs (ITF 2011).

The following disaggregation dimensions would ideally be made available[10]:

Table 9 Sample data on Household expenditures on transport (own illustration)

Cost of transport (p.a.)		
TCO of car purchase and operation (p.a.);	(comprises 3.1.5)	€ / month. Data via LeasePlan Car Cost index
Spending on public transport: Cost of a monthly public transport pass (regular fare)	Comprises: 3.4.2	€ / month
Spending on public transport: Cost of a monthly public transport pass (reduced / social fare, if available)		€ / month
Spending on other modes (p.a.)		€ / month
Share of income spent on transport		%
Share of income spent on car purchase and operation	(comprises 3.1.3)	%
Share of income spent on public transport	(comprises 3.1.3, 3.1.5, 3.4.2)	%
Share of income spent on other modes	(comprises 3.1.3)	%

[10] Additional info:
Car Cost Index 2021: https://www.leaseplan.com/-/media/leaseplan-digital/de/public-pages/images/news/2021_10_28/cci-2021---report.pdf/

6.3 Vehicles fleet composition

Vehicle stock

Vehicle stock data is a critical piece in enabling the calculation of KPIs relevant to overall vehicle activity (e.g. vehicle-kilometres travelled), as well as those related to externalities such as air pollution loading, and greenhouse gas emissions.

Vehicle registration data does not normally lie within the purview of city authorities. In the EU, vehicles are registered at the national motor transport authorities. These agencies can make available regional vehicle registration numbers. In addition, the European Environment Agency collects these national data to monitor compliance with Regulation (EU) 2019/631.[11]

National level statistics (e.g. fleet composition by fuel type and emission standards) would still be useful for deriving relevant indicators, and can be used as default values in certain applications (e.g. derivation of GHGs and air pollution loading). Private vehicle ownership can though be captured through household surveys which can then be combined with other accessible data captures the other types of vehicles in the city (e.g. public transport operators; shared systems operators, among others).

Normally, the existing data sets on vehicles (registration or ownership) have not yet integrated data on “newer” vehicles that had been associated with new mobility solutions such as electric scooters, pedal-assisted bicycles, or whether these vehicles are part of shared services, for example.

At the minimum, vehicle data sets should be disaggregated by vehicle type, emission standards category, fuel type (i.e. important for monitoring energy and emissions-relevant indicators). Tagging vehicles based on their use (passenger movement, goods movement, or both). Categorizations capturing whether vehicles are shared, is also important considering the emergence of such services. Furthermore, for public transport vehicles (categorized by each of the public transport operators) should ideally be tagged based on the presence of equipment related to accessibility (as per SUMI indicator 2: on-board signage; on-board audio announcements; step free access; designated space provision for the differently abled).

Ideally, the vehicles should be categories should reflect locally relevant emergent vehicle types (e.g. e-scooters). Further details on vehicle sub-types, weight, and other vehicle details (e.g. vehicle age) can be collected.

To better monitor the overall transformation of the vehicle fleet, new registrations should be reflected in the data. Ideally, de-registrations should also be accounted for.

[11] EEA data: https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-20
Regional data: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Stock_of_vehicles_at_regional_level#Regional_characteristics_within_the_EU

Table 10 Sample data on Vehicle registration (own illustration)

Car ownership (registrations)		number
Motorcycle ownership		number
E-scooter ownership		number

New registrations of vehicles

Available via national accounts, should be dis-aggregated into car categories and engine types to reflect the share of new e-vehicles in the fleet. Information about new registrations is important for determining the (future) composition of the vehicle fleet; which has also implications for the required number and spatial distribution of e-vehicle charging points.

Table 11 Sample data on new registrations (own illustration)

Number of newly registered cars		number
Number of newly zero-emissions vehicles		number

Vehicle Occupancy rates

Vehicle occupancy rates can be defined as the ratio between the transport performance (passenger or ton kilometres) and the vehicle kilometres (EEA, 2014). For public transport vehicles, these can directly be monitored through passenger trip data (see sections on ridership and vehicle kilometres). For private vehicles, this is normally gathered through observations, or surveys assessing the number of passengers per vehicle. Vehicle occupancy rates can be used to explain changes in levels of vehicle ownership, and to depict the changes in the overall efficiency of mass passenger transport (EEA, 2014).

The data should at the minimum be disaggregated based on vehicle type. In more advanced situations, further disaggregation (temporal, spatial) should ideally be aimed for.

Table 12 Sample data on vehicle occupancy rates

Total number of public transport trips		number
Public transport vehicle-kms		vkm

Vehicle energy intensities

Vehicle energy intensities are expressed in terms of unit of energy consumed per unit of vehicle activity (e.g. MJ/VKM). Such can also be expressed in terms of volumetric consumption of fuel per unit of vehicle activity (litre/VKM).[12] Such vehicle energy intensities are critical in informing the calculation of indicators related to energy consumption of the transport modes or system, in general. In combination with occupancy rates, vehicle energy efficiencies can be used for calculating energy consumption per unit of transport task performed (e.g. MJ/PKM or MK/TKM).

At the very least, vehicle energy intensity estimates should be available for different vehicle-fuel variants. The SUMI 9 Energy Efficiency provides default values for different vehicle-fuel variants as contained in Table 12. It is notable that other emergent vehicle categories are not captured in these default values.

Table 13 Sample data on Vehicle energy intensities (own illustration)

Vehicle Types	Fuels
Car (M1) Car (M2) Car (M3) Coach (M2/M3) Motorized Motorcycle Motorized 3-wheeler Train Trams / light rail Inland waterways Light commercial vehicles (N1) Heavy commercial vehicles (N2,N3)	Gasoline Diesel CNG LPG Ethanol Bio-ethanol Bio-diesel Electricity Gasoline hybrid Diesel Hybrid

More detailed analysis can be enabled by using detailed data that incorporates energy efficiency values for specific vehicles (e.g. through local studies that incorporate the local driving cycles and local environmental conditions). Maximum utility for such local values would be realized if the vehicle registration data would be able to capture the micro details of the vehicles operating in the city environment (e.g. make, model, variant, etc.).

Vehicle emission factors

Vehicle emission factors are expressed in terms of the unit of pollutant released (mass) per unit of vehicle activity (e.g. gram of pollutant/VKM). In the case of urban transportation, those pollutants that have critical health impacts include the following: Particulate matter; Carbon monoxide; Sulfur dioxide; Nitrogen oxides. The emissions of such pollutants are due to both combustion, and non-combustion process (e.g. tire and brake wear, road surface wear).

At the minimum, emission factors should be made available for major vehicle-fuel-emission standards sub-segments. SUMI 3 – Air Pollutant Emissions, provides default values for PM2.5 and NOx for the vehicle-fuel combinations.

[12] Converted values such as liter of gasoline equivalent are also being used (e.g. Global Fuel Economy Initiative) to standardize the values for different types of energy sources.

Similar to the previous section, local emission factor studies incorporating the local drive cycles and environmental conditions are ideal data sources for more localized emission factors, but these normally would only be available for specific vehicle types or vehicle sub-segments. More comprehensive default values for vehicle variants (vehicle type, sub-type, abatement technology/standard, fuel combinations) are also made available by the European Environmental Agency (2019), for example.[13]

Aside from criteria air pollutants, urban transportation also contributes to greenhouse gases (GHGs). The main GHG of concern is Carbon dioxide (CO_2) which can be estimated based on vehicle activity (disaggregated at the minimum by vehicle-fuel type, energy efficiencies (liter consumed/ and the associated CO_2 emission factors which are normally provided on a per unit of fuel or energy consumed (kgCO2/MJ) – as the release of CO_2 is a direct function of complete combustion, and is dependent on the Carbon content of the fuel used. In essence, CO_2 emissions is a direct function of the amount of fuel consumed. It is important to account for well-to-tank (WTT) emissions, particularly for electric vehicles. SUMI 7- GHG Emissions provide default values for type of fuel (both tank-to-wheel, and well-to-tank) emission factors, including national average CO_2 emission factor estimates for electricity grids. Similarly, the EEA (2022) provides national averages for grid emission factors.

Table 14 Sample data on vehicle emission factors (own illustration)

Transport-related CO_2 emissions per capita		tCO_2/cap
PM10 streetside		µg/m^3
NO2 streetside		µg/m^3

6.4 Transportation Services

Availability of Transport Services

Amidst the continued transformation of urban transportation systems, as accelerated by the entry of innovative mobility solutions, having a comprehensive view of the availability of transportation services allows for enabling better mobility planning, and the development of appropriate responsive, as well as pro-active policy responses.

For mass transport services, the minimum data should at least indicate the availability and frequency (departures/hour) by mode associated with the different public transport stations and stops. This data, together with the geo-spatially indexed population, would enable the calculation of public transport accessibility indicators such as SUMI 6- Access to Mobility Services. Ideally, general transit feed specifications (GTFS) data should be made available for transit modes.

New mobility services (e.g. shared services, vehicles, etc…) should also be accounted for. At the very least, the availability of such services (and units) should be known at the zonal level.

[13]EEA (2019): http://efdb.apps.eea.europa.eu/

Standardized data for shared transport services and vehicles would be ideal to be collected (e.g. General Bikeshare Feed Specifications; Mobility Data Specifications; General On-demand Feed Specifications).

Table 15 Sample data on transport availability

Number of shared bicycles		number
Number of shared cars		number
Total number of public transport vehicles		number
Number of mobility hubs		number
Number of public transport stops and stations		number

Prices

Prices of transportation services vary between cities and providers. Prices can be found at the respective providers' apps. In some cases, such as MaaS Madrid, public transport operators and private shared-mobility operators share their data to provide their users with integrated user experience. In these cases, prices are displayed for entire trips and trip chains.

Prices are usually staggered according to spatial and temporal criteria, which may differ considerably from city to city. Transit passes and flat prices are offered to frequent users. In order to facilitate comparisons of different cities, prices for minimum single journey tickets should be collected. Data should also reflect local purchasing power. This is possible by creating an index that adjusts local ticket prices with prices for local daily needs. That is, affordability may be measured as a percentage share of the cost of a single journey public transport ticket (paid in cash) to the cost of the daily food intake (of 2,400 calories) in each city.[14]

Since freight tariffs are normally not defined on the local level (but are similar to national tariffs, they will not be included here.

Table 16 Sample data on prices

Price for a single trip by public transport		Local currency
Price for a monthly public transport pass		Local currency

[14] Data can be obtained from www.numbeo.com. 2,400 calories is the daily recommended caloric intake for an average adult, see https://health.gov/dietaryguidelines/2015/guidelines/appendix-2/

6.5 Transport Activity / Demand

Vehicle kilometres

In an ideal scenario, comprehensive vehicle-kilometres (VKT) estimates can be derived from aggregated odometer recordings for the registered vehicle population, in cases where these are included during the regular vehicle inspection procedures, or during the recurring vehicle registration processes. If so, generating this data for different segments (e.g. by vehicle type, or by fuel type, or combination of these) would be feasible. For private vehicles, such data can be collected through household surveys, and for public transport vehicles, such can be collected from the operators. National level estimates for average annual VKT may be available for some vehicle types (e.g. Enerdata, n.d.).

Ultimately, from a city perspective, the VKT performed on the city's transportation network would be the main point of interest, and such can also be derived from traffic volume data (e.g. for road networks). The suggested minimum level of disaggregation is by type of vehicle.

Traffic Volume

The flow of vehicles in the transport network is a core input for models for traffic flow, and can also provide quick insights towards identifying bottlenecks in the network. SUMI 08-Congestion and Delays, also utilizes a related data input (number of car trips during peak hours on main road corridors).

SUMI 08 is based on similar indicators that are usually used to measure traffic volumes and transport network performance, which are (FGSV 2015):

- Delay is the additional travel time experienced by a traffic participant as compared to the minimum travel time (i.e., free flow). It is a measure usually used at an intersection, reported in seconds.
- Density is a measure of the number of persons or vehicles using a given space. It is a measure usually used to measure the traffic volume on a segment between two intersections, reported in vehicles per km per lane (details for different modes in FGSV 2015).
- Level of service (LOS) is an indicator that seeks to reflect the quality of service experienced by traffic participants under different levels of use of infrastructure. It is a measure usually used on a corridor which includes number of intersections and segments. It is reported in six different levels, from A to F.

Traffic volume can be measured by remote sensing, instrumented vehicles, induction loop detectors, Bluetooth detectors, cameras and similar devices.

Table 17 Sample data on traffic volume

Average number of private cars entering the city		Number/daily

Average number of trucks entering the city		Number/daily

Urban Passenger Trips

Within the framework of crafting proactive (or reactive) policy responses towards maximizing the benefits from novel mobility innovations, making data available regarding passenger transport trips (e.g. by household): trip rates, modal characteristics, routes, distance, time spent, costs. In an ideal scenario, these would be captured through household travel surveys and trip diaries which would elicit information on trips conducted on a typical day and would capture details such as trip purpose, time of departure and arrival, modes taken and transfers made, origin and destination, among other details. Having such detailed data would enable the estimation of critical indicators for planning and policy making such as overall passenger transport demand, mode split/mode share, average resources (time and money) spent on travel, among others. Similar to the other relevant data discussed earlier, it is important to capture the emergent urban mobility modes and services in such surveys.

Ridership: Public transport and New Mobility Services

Ridership values for modes that convey public transportation essentially represents the patronage for such modes. Monitoring the average daily ridership by the public transport, as well as the emergent mobility services (e.g. shared services) is essential for providing insights as to how such services are performing in relation to the overall demand for urban transport services.

6.6 Infrastructure

Land Use

Land use data essentially captures the socioeconomic human use of land and both captures and guides the essential processes of spatial development in urban areas.

Within the context of the SUMIs, data on land use is a direct input for SUMI 17 Mobility space usage indicator, which treats direct land use and indirect land use data (in hectares) as the main input. At the minimum, estimates of total land dedicated to these uses should be made available.

Table 18 Sample data on Land use (own illustration)

Mobility space usage per inhabitant		Km^2/capita
Residential land use (city area)		%
Industrial & business land use (city area)		%
Commercial land use (city area)		%
Urban cover of green spaces in the city		%
Number of public parking spaces		number
Designated delivery vehicle parking places in the city		number

Amidst the transformation of the mobility sector, there are nuanced information that needs to be integrated in such land use data sets such as the space dedicated to major emergent innovations such as automation, digitalisation, and electrification. A few suggestions are: parking space for EVs/zero emissions vehicles, or shared vehicles and mobility services, as well as allotted space for EV charging.

Aside from the space directly or indirectly used for mobility, land use data for other uses is also key inputs for urban land use-transport models which links the distribution of land uses and infrastructure, activities, accessibility, and spatial characteristics to transportation choice making, and thus towards more cohesive and integrated planning and policy making processes.

Transport Infrastructure

A detailed transport infrastructure inventory is a crucial part of planning, policy making, and asset management. At the very least, aggregated totals for the critical transport infrastructure (similar to the disaggregation discussed in the section on land use).

Infrastructure relevant to the major innovations in mobility should also ideally be captured, as well as those that generally supports sustainable modes of mobility (i.e. stocktaking of pedestrian and cyclist facilities). There are also additional attributes that should ideally be taken into account when conducting an infrastructure inventory, such as the ones proposed by the SUMIs as contained in the table below.

Table 19 Sample Data on Transport Infrastructure (own illustration)

	Description	Input Data
Active transport	SUMI 10 Opportunity for Active Mobility	Length of road network with pavements Length of road network with bike lanes Slow roads (<30 km/h) Length of pedestrian zones Total length of city road network (excluding motorways).
Public transport	PT network	SUMI 6 Access to Mobility Services
Major nodes and links	Agglomerations within major roads, railways, airports	SUMI 4 Noise Hindrance
	Presence of modes in interchanges	SUMI 11 Multimodal integration

Having geospatial transport network and infrastructure inventory data (combined with non-mobility related geospatial data) empowers the processes of planning, policymaking and monitoring amidst the innovation evolution. In case of cities which have not done such, open data sources (generated primarily through public contributions) would be a good place to start. For example, the Open Streetmap datasets (shapes, lines, point) can be downloaded and include mobility, and non-mobility categories and their associated attributes.

This is particularly important in calculating SUMI 15 Functional Diversity as it requires information on the presence of spatial functions that are available in the area (1km by 1 km) of interest. The configuration of SUMI 15 implies that a geospatial dataset containing information on spatial functions (and corresponding infrastructure, and points of interests) are available.

6.7 Externalities

Road Safety

Sufficiently detailed, and accurate safety data enables a better understanding of the safety challenges related to urban mobility. Such data is becoming more important, particularly during these times when cities are faced with potentially transformative mobility innovations whose safety impacts that are still relatively not well established. The minimum data should include the total number of fatalities due to traffic crashes, and non-fatal injuries. SUMI 5 Road Deaths requires that road deaths should be disaggregated based on the following categories: pedestrian, bicycle; moped; motorcycles; cars; LGV (<3.5 tons); HGV – trucks (≥3.5 tons); Bus; tram; other; unknown. Data for pedestrian and bicycle related deaths are also inputs for SUMI 13 Traffic Safety Active Modes.

Disaggregation towards capturing the emergent types of vehicles is ideal as it would enable more detailed monitoring of the safety impact of such. Other incidence-level attributes such as vehicle characteristics, incidence coordinates, date and time, characteristics of the location (e.g. road type, speed limit, junction control, light conditions, weather conditions, road surface, special conditions, among others) are ideally to be collected.

Table 20 Sample data on road safety

Fatalities - Pedestrian		Number
Fatalities - Bicycle		Number
Total number of transport-related fatalities		Number
Total number of transport-related fatalities for vulnerable users		Number
Severely injured vulnerable road users (pedestrians, cyclists, micro-mob.)		Number
Total number of severely injured road users		Number
Car accidents per 100,000 inhabitants		Number
Public transport accidents per 100,000 inhabitants		Number
Bicycle accidents per 100,000 inhabitants		Number
E-scooter accidents per 100,000 inhabitants		Number

Noise levels

Excessive noise can cause serious harm to human health and interferes with daily life. In 2011, the World Health Organisation (WHO) identified noise from transportation as the second most significant environmental causes of ill health in Western Europe, after particulate matter pollution exposure (EEA, n.d.) and the Environmental Noise Directive (END) has been adopted as the main instrument through which land-based noise emissions are to be monitored.

The END mandates EU Member States to submit noise maps and noise management action plans every five years for: agglomerations with more than 100,000 inhabitants; major roads (> 3 million vehicles/year); major railways (>30,000 trains per year); major airports (>50,000 movements a year). Official submissions are stored through the EIONET Central Data Repository.[15]

At the minimum, the population exposed to different noise band levels based on SUMI 04 Noise (consistent with the EU END) should be estimated which requires the noise maps (i.e. those submitted to the EU or if other local/updated maps are available) and the population maps.

Table 21 Sample data on Noise levels (own illustration)

Noise Bands	Locations
55-59 60-64 65-69 70-74 >75	Agglomerations and major roads Agglomerations and major railways Agglomerations and major airports

Air pollution levels

Transport remains to be one of the main sources of air pollution which had been directly linked with mortality, as well as respiratory and cardiovascular diseases (WHO, n.d.). Aside from the air pollution loading estimates required in SUMI 03 Air Pollutant Emissions, monitoring the air pollution levels (micrograms/cubic meter) provides information regarding the actual state of air pollution, as well as enable the identification of priority hot spots for specific interventions. At the minimum, annual means for priority transport-related pollutants (particulate matter, NOx) average daily levels should be collected. In the case of EU, the EEA provides an official air quality viewer, interactive up-to-date air quality data, and detailed statistics including those at the city level.[16,]

[15] EIONET Central Data Repository: https://cdr.eionet.europa.eu/de/eu/noise/df8/colvyu0cw/envvyu1zg/DE_BE_ag1_Aggair_Lden_map1.dbf/manage_document

[16] EEA data:
https://www.eea.europa.eu/themes/air/urban-air-quality/european-city-air-quality-viewer
https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/up-to-date-air-quality-data
https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statistics

7 Conclusions

The report demonstrates the importance of a strong database to enable cities with evidence-based decision-making. SPROUT tools identify strengths and weaknesses at an early stage of emerging mobility solutions and innovations. By applying these tools, cities can shape such innovations sustainably.

With the help of the data space, data can be collected continuously and easily for different contexts. Furthermore, the overview of indicators and data collection sources can be used to differentiate between the respective indicators and thus increase the effectiveness for informed decisions on the respective implementation of innovative urban mobility solutions and policies.

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9 Annex

9.1 Long list of data includable the data space

The overview below gives an extract of the data space as made accessible in the SPROUT toolbox.

The data space harmonises the inputs from the SPROUT tools described earlier and organises them into derived categories in order to calculate the respective indicators (see KPIs Liveability, Action Tracker, KPIs, Innovation Index and cost-based assessment) in subsequent individual charts.

The SUMIs are included in the structure to the extent that they could be used as a substitute or alternative input for certain categories, should the available data prove to be unsatisfactory.

Table 22 Extract from the Data space

Category	Description	Unit
QUANTITATIVE KPI DATA		
City data	Population of city	no. of inhabitants
	Population of functional urban area (FUA)	no. of inhabitants
	Population density	inhabitants per km^2
	Percentage of commuting distance compared to total	%
	Metrop. area	km^2
	Fleet size (No of vehicles)	no.
	LCV kms per day per vehicle	km
	Average household size	no. of hh members
	Average household size of 25% poorest	no. of hh members
	City area	km^2
	FUA area	km^2
	City GDP	local currency
	Residents' net average monthly income per person	local currency
	Residents' net average monthly income per household	local currency
	Residents' net average monthly income 25% poorest per household	local currency
	Number of shops	no.
	Number of supermarkets	no.
	Number of restaurants	no.
	Number of other type of establishments (specify type)	no.

Category	Description	Unit
	Urban functional diversity	see SUMI sheet 15
Price levels	Price for one hour of parking in the city centre	local currency
	Price for a single trip by public transport	local currency
	Price for a monthly public transport pass	local currency
	Average local price of one litre 95-octane petrol	local currency
	Cost of resident parking permits per year	local currency
Transport availability	Car ownership (registrations) / number of cars registered in the city	no. of vehicles
	Bicycle ownership	no. of vehicles
	Motorcycle ownership	no. of vehicles
	E-scooter ownership	no. of vehicles
	Satisfaction with public transport	see SUMI sheet 12
Cost and revenues	City government annual revenues from transport related charges	local currency
	City government annual operation costs related to city transport	local currency
Land use and Parking	Mobility space usage per inhabitant	km^2/capita
	Residential land use (city area)	%
	Industrial & business land use (city area)	%
	Commercial land use (city area)	%
	Recreational land use (city area)	%
	Urban green cover of green spaces in the city	%
	Number of public parking spaces	no. of parking spaces
	Designated delivery vehicle parking places in the city	no. of parking spaces
	Quality of public spaces	see SUMI sheet 14
Commuting	Average commuting distance	km
	Commuting travel time	minutes
Road types	Total length of city roads (excluding motorways)	km
	Length of road network with pavements (not if in a pedestrian zone)	%
	High-speed roads (>50km/h)	%
	Slow roads (<30 km/h)	%
	Length of road network with bike lanes (not if in a 30 km/h zone)	%
	Bus lanes	%
	Length pedestrian zone	%
Road Safety	Fatalities - Pedestrian	no. of fatalities
	Fatalities - Bicycle (including regular bicycle, e-bike, etc.)	no. of fatalities

Category	Description	Unit
	Total number of transport-related fatalities (p.a.)	no. of fatalities
	Total number of transport-related fatalities for vulnerable users	no. of fatalities
	Severely injured vulnerable road users (pedestrians, cyclists, micro-mob.)	no. of severely injured
	Total number of severely injured road users	no. of severely injured
	Car accidents per 100,000 inhabitants	no. of accidents
	Public transport accidents per 100,000 inhabitants	no. of accidents
	Bicycle accidents per 100,000 inhabitants	no. of accidents
	E-scooter accidents per 100,000 inhabitants	no. of accidents
Traffic volume	Average number of private cars entering the city on a daily basis	no. of vehicles
	Average number of trucks entering the city on a daily basis	no. of vehicles
	Congestion and delays	see SUMI sheet 8
Environmental impact of urban mobility	GHG from transport	see SUMI sheet 7
	Transport-related CO_2-emissions per capita	tCO_2/cap
	PM10 streetside	µg/m^3
	NO2 streetside	µg/m^3
	Air pollutant emissions	see SUMI sheet 3
	Noise hindrance	see SUMI sheet 4
Modal Split (within city)	Car	%
	Public transport	%
	Cycling	%
	Walking	%
	Other (taxi, motorbike, scooter, other)	%
Public budget for mobility	Spending on bike infrastructure (from public budget, latest available year)	currency
	Spending on walking infrastructure (from public budget, latest available year)	currency
	Spending on public transport (from public transport, latest available year)	currency
	Total transport related spending (from public transport, latest available year)	currency
	Mobility net public finance	%
Public transport	Total number of public transport vehicles operated in the city	no.
	Total number of public transport trips	no.
	Length of existing public transport network (latest available year)	km

Category	Description	Unit
	Public transport vehicle-kms (latest available year, except 2020/2021)	vkm
	Average speed of public transport vehicles (latest available year, except 2020/2021)	km/h
	Average speed of road traffic (latest available year, except 2020/2021)	km/h
	Number of mobility hubs	number
	Number of public transport stops and stations	number
	Share of population living within 300m from public transport bus and tram stops and 500m from light rail stations	%
	Share of barrier-free public transport stations	%
	Share of barrier-free public transport vehicles	%
Vehicle fleet and electrification	Number of newly registered vehicles (latest available year)	no.
	Number of newly zero emission vehicles	no.
	Total number of zero emission vehicles	no.
	Number of e-buses	no.
Availability of vehicle sharing	Number of station-based shared bicycles	no.
	Number of free-floating shared bicycles	no.
	Number of station-based bike sharing operators	no.
	Number of free-floating bike sharing operators in operation in the city	no.
	Number of e-scooters (per Capita)	no.
	Number of e-scooter operators in the city (per capita)	no.
	Number of station-based shared cars	no.
	Number of free-floating shared cars	no.
	Number of station-based car sharing operators	no.
	Number of free-floating car sharing operators in operation in the city	no.
Digitalisation	Number of local public transport vehicles that are equipped to provide real-time data that is released to passengers through real- time displays at stops or through online applications	%
	Number of trips making use of a contactless smartcard/credit card/mobile ticketing per year	%
Urban logistics transport	Number of delivery vehicle parking places	no.
	Average number of weekly deliveries per shop	no.
	Average number of weekly deliveries per supermarket	no.
	Average number of weekly deliveries per restaurant	no.
	Average number of weekly deliveries per other type of establishment	no.

Category	Description	Unit
	Average number of boxes (50x50x50 cm) per delivery per shop	no. (0.125 m^3 box)
	Average number of boxes (50x50x50 cm) per delivery per supermarket	no. (0.125 m^3 box)
	Average number of boxes (50x50x50 cm) per delivery per restaurant	no. (0.125 m^3 box)
	Average number of boxes (50x50x50 cm) per delivery	no. (0.125 m^3 box)
	number of freight capacity sharing (cargo consolidation) apps for urban delivery	no.
	number of transportation companies providing combined urban passenger & cargo delivery services by using spare (public or private) passenger transport capacity	no.
	number of transportation companies providing green urban delivery services (e.g. with cargo-bikes, bikes, electric vans)	no.
	number of companies providing on-demand next-hour to same-day delivery services (e.g. for delivering at home an order placed online to a store)	no.
	number of companies providing or testing delivery services using autonomous/automated vehicles	no.
Accessibility	Accessibility of PT for mobility-impaired groups	see SUMI sheet 2
	Access to mobility services	see SUMI sheet 6
	Multimodal integration	see SUMI sheet 11
INNOVATION		
Innovative Governance & Growth	Q1: What is the level of inter-departmental coordination and flexibility in the procurement process for innovative solutions?	score 1-5
	Q2: What is the level of Sustainable mobility Planning & implementation process?	score 1-5
	Q3: Does the city follow stakeholders' engagement practices for the co-creation and co-design of innovative mobility solutions?	score 1-5
	Q4: At what level your city has the competence for fundraising for innovation (PP schemes, ...) What is the level of public investments for smart innovative policy making?	score 1-5
Climate & City Typology	Q5: What are the level of (inter)national synergies with neutral partners (research institutions, universities) and other cities and organisations for knowledge transfer (e.g. POLIS, Eurocities, EIT)?	score 1-5
	Q6: Can the city be characterized as a University Town with Research & innovation activities?	score 1-5
	Q7: What are the city's population's educational level and digital competence?	score 1-5
Smart & Easy accessible	Q8: What is the level of smartness and transparency of your city's Government processes	score 1-5

Category	Description	Unit
	(e- tools, e-Governance practices, data transparency)?	
	Q9: Is the city's mobility data open-source, safe and easily accessible?	score 1-5
Smart & Innovative Resources and Infra available	Q10: How mature and smart is the data collection for understanding the current situation of a mobility system for passenger transport (Smart infrastructure, ITS, survey)?	score 1-5
	Q11: How mature and smart is the data collection for understanding the current situation of a mobility system for Freight transport (Smart infrastructure, ITS, survey)?	score 1-5
	Q12: To what extent is the current passenger transport of the city's policy-making data-based and evidence-driven?	score 1-5
	Q13: To what extent is the current freight transport of the city's policy-making data-based and evidence-driven?	score 1-5
	Q14: What is the level of availability of multimodal passenger transport infrastructure & services offered in the city and which is the level of intelligent Transport & mobility infrastructure & services?	score 1-5
	Q15: What is the level of availability of multimodal freight transport infrastructure & services offered in the city and which is the level of intelligent Transport & mobility infrastructure & services?	score 1-5
	Q16: Does the city have a skilled workforce on innovative mobility solutions for passenger transportation?	score 1-5
	Q17: Does the city have a skilled workforce on innovative mobility solutions for freight transportation?	score 1-5
Innovative People & Stakeholders	Q18: To what extent are citizens adopting the new sustainable mobility services and the green modes of transport, (e.g. less car use, more walking, cycling and use of Public Transport)?	score 1-5
	Q19: Is the city open to deploying and testing new business models for passenger transportation? Is the triple helix for innovation applied to smart mobility solutions? (e.g., MaaS, Smart Parking, Traffic Management System etc.)?	score 1-5
	Q20: Is the city open to deploying and testing new business models for freight transportation? Is the triple helix for innovation applied to smart mobility solutions? (e.g., MaaS, Smart Parking, Traffic Management System etc.)?	score 1-5
	Q21: How rich is the city in terms of the number of big innovators and high-tech start-up companies?	score 1-5
ACTION TRACKER (Qualitative)		

Category	Description	Unit
Public transport	Is public transport free for all users or specific groups? (several answers possible)	0 = No 1 = All citizens 2 = School children 3 = Senior citizens 4 = Poor groups
Integration of MaaS and shared vehicles	In which parts of the city area are shared bikes or micro-vehicles available? (one answer)	/ Not applicable (no shared bikes or micro-vehicles) 0 = No shared mobility offer 1 = Available in the city centre 2 = Available in the city centre and in certain areas outside city centre 3 = Available in the entire city area
	Has your city introduced parking regulations for shared bikes and e-scooters? (one answer)	/ Not applicable (no shared bikes or micro-vehicles) 0 = No parking regulations 1 = Memorandum of understanding with service providers on parking 2 = Parking regulations for shared e-scooters 3 = Parking regulations for e-scooters are in place and adequate parking is provided at the expense of car parkings

Category	Description	Unit
	Is an exchange mechanism between public administration and private MaaS operators / shared vehicle providers set up?	/ Not applicable (no shared vehicle providers active) 0 = No 1 = Informal, ad hoc exchange 2 = Formalised exchange between public and private actors (e.g. regular meetings)
	Are private MaaS operators / shared vehicle providers obliged to share mobility data with the public administration? (one answer)	/ Not applicable (no shared bikes or micro-vehicles) 0 = No Voluntary data provision, e.g. via 1 = Memorandums of Understanding 2 = Providers are obliged to share , e.g. via legal provisions in concessions
	Does your city offer on-demand public transport services integrated with the public transport system (e.g. via routes or ticket prices) in areas or at times when public transport is limited? (several answers)	0 = No 1 = Real-time travel information 2 = Ticketing for public transport 3 = Information on MaaS and shared mobility offers 4 = Integrated payment for MaaS and shared mobility offers
Integrated Planning	Do you use an integrated land use- transport model in the planning process? (one answer)	0 = No 1 = Yes

Category	Description	Unit
	How would you describe the cooperation between the mobility and the land-use planning department? (one answer)	0 = No cooperation 1 = Ad hoc arrangements, no systematic coordination 2 = Institutionalised exchange between departments (e.g. regular meetings, steering group) 3 = Joint planning urban and mobility planning department; or multi-departmental teams
Sustainable urban logistics	Does your city financially support the electrification of logistic fleets (e.g. premiums for e-vehicles, including cargo bikes)? (one answer)	/ Not applicable / beyond city's legal competence 0 = No 1 = Planning to implement 2 = Already implemented
	Does your city use environmental criteria in public delivery contracts (Bike delivery, e-vehicles, etc.)? (one answer)	0 = No 1 = Yes
	Has your city implemented weight- or size-based restriction for delivery vehicles? (one answer)	/ Not applicable / beyond city's legal competence 0 = No 1 = Planning to implement 2 = Already implemented

Category	Description	Unit
	Does your city collect data on urban logistics? (select all that apply)	0 = No 1 = Vehicle-kms from urban logistics 2 = Greenhouse gas emissions from urban logistics 3 = Emissions of air pollutants from urban logistics 4 = Share of zero emissions deliveries 5 = Vehicle load factor 6 = Composition of urban logistics vehicle fleet 7 = Number of parcels delivered 8 = Number of delivery points 9 = Other
	If other selected: then provide a free text option.	free text
	Does your city have micro depots for last-mile urban logistics? (one answer)	0 = No 1 = Yes, as experiments 2 = Yes, permanent
	Do you have an established exchange between city administration and urban logistic providers?(one answer)	0 = No 1 = Informal, ad hoc exchange 2 = Formalised exchange between public and private actors (e.g. regular meetings)

Category	Description	Unit
Push measures and redistribution of public space	Does your city have / does your city plan to implement a zero emission zone (in which only local emission-free vehicles are allowed)? (one answer)	/ Not applicable: beyond legal competence of the city 0 = No 1 = Planned and publicly announced 2 = Implemented
	Which part of the city area is covered by parking management? (one answer)	0 = No parking management 1 = Parts of city centre 2 = Entire city centre 3 = City centre + certain areas outside city centre 4 = Entire city area
	Does your city reduce or plan to systematically reduce public car parking spaces? (one answer)	0 = No 1 = Planned 2 = Yes
	If yes/planned: please provide more information (e.g. annual reduction rate, time horizon, etc.; free text, bullet points)	Free text
	Do your city's building regulations provide mandatory standards for car parking spaces per new-built residential unit (except for disabled people and shared vehicles) (one answer)	0 = No standard for car parking spaces per new-built residential unit 1 = Minimum numbers of car parkings per new-built residential unit 2 = Maximum number of car parkings per new-built residential unit
	Does the city's building code provide special requirement for bicycle parking? (one answer)	0 = No 1 = Yes
	Does the building code provide any special requirement for shared vehicle parking? (one answer)	0 = No 1 = Yes

Category	Description	Unit
ACTION TRACKER (Quantitative)		
Costs	Cost of resident parking permits per year	local currency
Infrastructure	Number of public parking spaces	no. of parking spaces
	Total length of city roads (excluding motorways)	km
	Length of road network with sidewalks (not if in a pedestrian zone)	%
Funding	What is the city's financial budget for transport? (latest available year)	currency
	What is the city's financial budget for cycling measures? (latest available year)	currency
	What is the city's financial budget for walking measures? (latest available year)	currency
	What is the city's financial budget for public transport? (latest available year)	currency
Public fleets	How many e-buses are in the public transport bus fleet (number of bus fleet)	no.
	How big is the public transport bus fleet (number of vehicles)	no.
Availability , accessibility, and competitiveness of public transport	What is the share of barrier-free public transport stations?	%
	What is the share of barrier-free public transport vehicles?	%
	How many mobility hubs (public transport stations with safe bike stands and dedicated spaces for shared vehicles) does your city have?	number
	How many public transport stations does your city have ?	number
	What is the share of population living within 300m from public transport bus and tram stops and 500m from lightrail stations?	% of urban population
	How long is the existing public transport network in the city? (latest available year)	km
	How many vehicle-kms are covered by public transport per year (latest available year, except 2020/2021)?	vkm
	What is the average speed of public transport vehicles in the city (latest available year, except 2020/2021)?	km/h
	What is the average speed of road traffic (latest available year, except 2020/2021)?	km/h
	How many trips are made by public transport (per year)?	no. tickets and passes issued
Safety	Please indicate the total number of transport-related fatalities per year (latest available year, except 2020/2021)	no. of killed road users
	Please indicate the number of transport-related fatalities per year for vulnerable road users (pedestrians, cyclists, micro-mob., latest available year, except 2020/2021)	no. of killed vulnerable road users

Category	Description	Unit
	Please indicate the total number of severely injured road users per year (latest available year, except 2020/2021)	no. of severely injured persons
	Please indicate the number of severely injured vulnerable road users (pedestrians, cyclists, micro-mob., latest available year, except 2020/2021)	no. of severely injured vulnerable road users
Targets	Does your city have targets for transport-related greenhouse gas emissions?	0 = No 1 = Yes
	If yes:	
	Please indicate the targets for transport-related CO_2 emissions (in t CO_2 or t CO_2eq)	tCO_2 CO_2 eq
	Please indicate the target year for the CO_2 emission target (e.g. 2027, 2030)	year
	Please name the base year	year
	Please indicate the transport-related CO_2 emissions for the base year.	tCO_2 CO_2 eq
	Does your city have a modal spilt target for walking?	0 = No 1 = Yes
	If yes:	
	Please name the target (in case of multiple target years, please indicate the closest year)	%
	Please name the closest target year	year
	Please name the base year	year
	Does your city have a modal spilt target for cycling?	0 = No 1 = Yes
	If yes:	
	Please name the target (in case of multiple target years, please indicate the closest year)	%
	Please name the closest target year	year
	Please name the base year	year
	Does your city have a modal spilt target for public transport?	0 = No 1 = Yes
	If yes:	
	Please name the target (in case of multiple target years, please indicate the closest year)	%
	Please name the closest target year	year
	Please name the base year	year
	Does your city have a modal spilt target for car use?	0 = No 1 = Yes
	If yes:	
	Please name the target (in case of multiple target years, please indicate the closest year)	%
	Please name the closest target year	year
	Please name the base year	year

Category	Description	Unit
	Does your city have targets for the development of safe cycling infrastructure?	0 = No 1 = Yes
	If yes:	
	Please name the target for the development of safe cycling infrastructure (in case of multiple target years, please indicate the earliest year)	km
	Please name the target year for the infrastructure target	year
	Please indicate the current length of available safe cycling infrastructure (in km)	km
	Does your city have other / additional targets related to infrastructure for active mobility?	0 = No 1 = Yes
	If yes, please specify	free text
	Does your city have targets for the development of the public transport service offer?	0 = No 1 = Yes
	If yes:	
	Please name the target (in case of multiple target years, please indicate the closest year)	free text
	Please name the target year	year
	Please name the base year	year
	By how many kilometres should the public transport network (bus, tram, light rail) be extended in the target year (in case of multiple target years, please indicate the earliest year)?	km
	Please name the target year	year
	Does your city have other / additional targets related to the development of the public transport offer?	Free text
	Does your city have targets for the development of publicly accessible charging infrastructure for e-vehicles?	Y/N
	If yes: please specify (e.g. mean annual increase in installed charging capacities in kw)	free text
	How much charging capacity for e-cars is publicly accessible in the city area? (installed kw at public and semi-public recharging points)	installed kW
Vehicle fleet	How many vehicles have been newly registered in your city per year (latest available year)?	no. (total)
	How many zero emission vehicles (BEVs and FCEVs) have been newly registered in your city per year (latest available year)?	no. (total)
	How many vehicles are currently registered in your city? (total size of vehicle fleet)?	no. (total)
	How many zero emission vehicles (BEVs and FCEVs) are currently registered in your city?	no. (total)
LIVEABILITY		
Climate and city typology	**Sustainability**	
	How much is GHG measured in your city?	Scale 1 - 5

Category	Description	Unit
	How much is PM10 and NO2 measured in your city?	Scale 1 - 5
Smart and easily accessible	**Accessibility**	
	What is the average commuting time?	Scale 1 - 5
	What is the mobility space usage of your city?	Scale 1 - 5
	What is the share of smart payment and booking method on local public transport?	
	Affordability	
	What is the price of monthly public transport pass (% of the monthly income)	Scale 1 - 5
	What is the price of one hour of parking in the city centre (% of monthly income)	Scale 1 - 5
	What is the average local price of one litre 95-octane petrol (% of monthly income)	Scale 1 - 5
	Availability	
	What is the number of micro mobility (bike & scooters) means per 1000 inhabitants?	Scale 1 - 5
	What is the number of shared cars?	Scale 1 - 5
	What is the number of freight trips per 1000 inhabitants?	Scale 1 - 5
Safe & secure	**Safety & security**	
	What is the number of fatalities in your city?	Scale 1 - 5
	What is the number of accidents regarding active modes in your city?	Scale 1 - 5
Smart and innovative resources & infra available	**Efficiency**	
	What is the proportion of micro mobility road type?	Scale 1 - 5
	What is the proportion of bus road type?	Scale 1 - 5
	Convenience	
	What is the parking space rate in your city?	Scale 1 - 5
	What is the delivery vehicle parking/1000 inhabitants?	Scale 1 - 5
	What is the average number of private cars entering the city on a daily basis per inhabitants?	Scale 1 - 5
	What is the average number of trucks entering the city on a daily basis per inhabitants?	Scale 1 - 5
	What is the share of real time travel information about PT?	Scale 1 - 5
Innovative people & stakeholders	**Behaviour & smartness**	
	What is the share of PT?	Scale 1 - 5
	What is the share of active modes (bike, scooter & walking)?	Scale 1 - 5

9.2 Urban mobility transition inventory

The urban mobility transition inventory from D2.1 distinguishes between KPI and transition drivers.

Table 23 Summary KPI

	Summary of KPIs
Urban population and economics	KPI01 - Residents' net average monthly income KPI02 - Price level of transport KPI03 - Vehicle ownership rate KPI04 - Mobility Net Public Finance
Urban land use and accessibility	KPI05 - Mobility space usage KPI06 - Distribution of land use types KPI07 - Commuting to work
Urban traffic and infrastructure	KPI08 - Proportion of road types KPI09 - Fatalities KPI10 - Urban mobility accidents KPI11 - Traffic volume of cars KPI12 - Traffic volume of freight vehicles KPI 13 – Environmental impact of urban mobility
Urban passenger & active transport characteristics	KPI14 - Rate of parking spaces KPI15 - Modal split for passenger trips within the city KPI16 - Modal split for trips for commuting to the city KPI17 - Availability of bike-sharing KPI18 - Availability of e-scooter sharing KPI19 - Availability of car sharing KPI20 - Availability of real-time travel information KPI21 - Availability of smart payment and booking methods on local public transport
Urban logistics	KPI22 - Commercial establishments KPI23 - Delivery vehicle parking KPI24 - Freight trips KPI25 - Goods delivery frequency KPI26 - Goods delivery volumes KPI27 - Urban logistics innovation

Table 24 Summary urban mobility transition drivers

	Summary of urban mobility transition drivers
Political	P1: Liberalisation P2: Political agenda P3: Transparency and corruption P4: Tax policy P5: Participation of citizens & economic actors
Economic	Ec1: New employment arrangements as a result of the sharing economy Ec2: Tourism Ec3: New business models Ec4: Economic growth and crisis Ec5: Transformation of retail
Social	S1: Migration S2: Urban structure S3: Demographic composition S4: Health consciousness S5: Changing behaviour towards car ownership S6: Environmental consciousness S7: Safety concerns S8: Security concerns S9: Individualisation S10: The requirement for on-demand delivery
Technological	T1: Electrification of mobility T2: Adoption of smart-city technology T3: Citizen & consumer-oriented digitalisation T4: Automation
Environmental	En1: Climate change En2: Local environmental quality
Legal	L1: Labour and employment laws L2: Consumer protection laws L3: Data and privacy laws L4: Health and safety laws

9.3 Sustainable Urban Mobility Indicators (SUMI)

Table 25 Sustainable Urban Mobility Indicators (SUMI) set (from https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en)

Sustainable Urban Mobility Indicators (SUMI)	
Indicator 1: Affordability of public transport for the poorest group Indicator 2: Accessibility of public transport for mobility-impaired groups Indicator 3: Air pollutant emissions Indicator 4: Noise hindrance Indicator 5: Road deaths Indicator 6: Access to mobility services Indicator 7: Greenhouse gas emissions Indicator 8: Congestion and delays Indicator 9: Energy efficiency Indicator 10: Opportunity for Active Mobility Indicator 11: Multimodal integration Indicator 12: Satisfaction with public transport Indicator 13: Traffic safety active modes	Core indicators
Indicator 14: Quality of public spaces Indicator 15: Urban functional diversity Indicator 16: Commuting travel time Indicator 17: Mobility space usage Indicator 18: Security	Non-core indicators