



Regulating Vehicle Access  
for improved Livability



## D2.3 Set of process parameters and indicators for ReVeAL measures

Ghent University

November 30, 2019



This project has received  
funding from the European  
Union's Horizon 2020 research  
and innovation programme  
under grant agreement No  
815008.

The sole responsibility for the content of this document  
lies with the authors. It does not necessarily reflect the  
opinion of the European Union. Neither INEA nor the  
European Commission are responsible for any use that  
may be made of the information contained therein.

## Table of Contents

|   |    |
|---|----|
| Summary sheet.....  | 3  |
| ReVeAL partners .....   | 4  |
| Document history .....  | 5  |
| List of acronyms.....   | 6  |
| ReVEAL overview .....   | 7  |
| <i>Smarter urban vehicle access regulations</i> .....   | 7  |
| Overview of Deliverable 2.3: Set of process parameters and indicators for ReVeAL measures ..... | 8  |
| <i>Describing urban vehicle access regulations</i> .....  | 8  |
| Process Evaluation Parameters.....  | 9  |
| <i>The ReVeAL Transition Framework</i> .....  | 9  |
| <i>The Transition Area datasheets</i> .....   | 11 |
| Impact Assessment Indicators .....  | 12 |
| Annex 1: Transition area datasheets .....   | 15 |
| Annex 2: Impact assessment datasheet .....  | 15 |

## Summary sheet

|   |  |
|---|--|
| <b>Deliverable No.</b>                    | 2.3  |
| <b>Deliverable name</b>                   | Set of process parameters and indicators for ReVeAL measures     |
| <b>Project Acronym</b>                    | ReVeAL   |
| <b>Full Title</b>                         | Regulating Vehicle Access for improved Livability                |
| <b>Grant Agreement No.</b>                | 815008   |
| <b>Responsible Author(s)</b>              | Daniel Guzman, Koos Fransen, Dirk Lauwers, Sidharta Gautama      |
| <b>Peer Review</b>                        | -  |
| <b>Quality Assurance Committee Review</b> | Bonnie Fenton, Rupprecht Consult                                 |
| <b>Date</b>                               | Nov 30 2019  |
| <b>Status</b>                             | Final  |
| <b>Dissemination level</b>                | Public   |
| <b>Abstract</b>                           | -  |
| <b>Version</b>                            | 1.0  |
| <b>Work Package No.</b>                   | 2  |
| <b>Work Package Title</b>                 | Reviewing UVAR options and building scenarios                    |
| <b>Programme</b>                          | Horizon 2020   |
| <b>Coordinator</b>                        | Stadt Bielefeld  |
| <b>Website</b>                            | <a href="http://www.CIVITAS-REVEAL.eu">www.CIVITAS-REVEAL.eu</a> |
| <b>Starting date</b>                      | June 1, 2019   |
| <b>Number of months</b>                   | 36   |

## ReVeAL partners

|    | Partner name                                    | Abbreviation | Country     |
|----|---|--------------|-------------|
| 1  | Stadt Bielefeld                                 | Bielefeld    | Germany     |
| 2  | Comune di Padova                                | Padova       | Italy       |
| 3  | Università degli studi di Padova                | UNIPD        | Italy       |
| 4  | Gemeente Helmond                                | Helmond      | Netherlands |
| 5  | V-Tron BV                                       | V-TRON       | Netherlands |
| 6  | Municipality of Jerusalem                       | Jerusalem    | Israel      |
| 7  | City of London Corporation                      | CoL          | UK          |
| 8  | Transport for London                            | TfL          | UK          |
| 9  | Centro de Estudios Ambientales                  | CEA          | Spain       |
| 10 | Sadler Consultants Europe GmbH                  | Sadler       | Germany     |
| 11 | TRT Trasporti e Territorio SRL                  | TRT          | Italy       |
| 12 | WSP Sverige AB                                  | WSP          | Sweden      |
| 13 | Polis   | Polis        | Belgium     |
| 14 | Universiteit Gent                               | UGent        | Belgium     |
| 15 | Rupprecht Consult – Forschung und Beratung GmbH | Rupprecht    | Germany     |

## Document history

| Version | Date     | Organisation | Main area of changes         | Comments |
|---------|----------|--------------|------------------------------|----------|
| 1.0     | 30/11/19 | UGent        | Construction of the document |          |

## List of acronyms

|             |                                 |
|-------------|---------------------------------|
| <b>KPI</b>  | Key Performance Indicator       |
| <b>LEZ</b>  | Low-Emission Zone               |
| <b>MFL</b>  | Measure Field Leader            |
| <b>PC</b>   | Pilot Coordinator               |
| <b>TA</b>   | Transition Area                 |
| <b>UVAR</b> | Urban Vehicle Access Regulation |
| <b>WP</b>   | Work Package                    |
| <b>ZEZ</b>  | Zero-Emission Zone              |



## ReVEAL overview

### Smarter urban vehicle access regulations

Despite urgent calls for “smarter urban vehicle access regulations” in the Urban Mobility Package and other high-level political commitments, very few decision makers are keen on going public with the idea of restricting car access (in time or space) in urban areas. ReVeAL will help to add Urban Vehicle Access Regulations (UVAR) to the standard range of urban mobility transition approaches of cities across Europe. Toward this end, the ReVeAL consortium will combine conceptual work and case study research with hands-on UVAR implementation in six pilot cities and systematic stakeholder interaction and professional communication activities.

The ReVeAL approach works along three different dimensions when considering the implementation of new UVARs:

- It looks at a range of UVAR measures, grouping them into *Measures Fields*.
- It looks at all measures through the lens of four *Transition Areas*, which need to be taken into account in any local setting (Governance and Financing, Mobility Services and Concepts, System Design and Technology, User Needs and Acceptance)
- It approaches all of these in the light of the stages of the change process, understanding that cities at different stages are capable of different levels of ambition.

These aspects are crucial to consider for the implementation of any kind of UVAR measure. ReVeAL will open and expand the UVAR toolbox through a dedicated work package (WP2 – UVAR Options and Scenarios), covering both established and cutting-edge approaches. The most important and new ones are Pathways to Zero-Emission Zones (ZEZ) as well as planning and design-related approaches for Spatial Interventions at district level such as superblocks. Also included is the broad array of Pricing Measures (e.g. dynamic road and curb space user charges, congestion charging, paid or regulated parking space) and radically novel approaches such as C-ITS-based strategies to control vehicle access through automated C2I communication or geo-fencing. ReVeAL includes world-leading experts in these four areas who can support the pilot cities during the design and implementation of their UVAR measures. Some of these approaches will be considered in more detail in scenario building activities which will take place in each of the Pilot Cities.

## Overview of Deliverable 2.3: Set of process parameters and indicators for ReVeAL measures

*This deliverable defines the process evaluation parameters and impact assessment indicators to characterise UVAR measures. The parameters and indicators determine the different dimensions of the context and the impact of the ReVeAL process in a city. They are developed within the scope of the Transition Framework (WP1) and the Evaluation Framework (WP4). The set of parameters and indicators is documented in WP2 as the underlying data structure to encode the information gathered during the pilots and research in a knowledge database to support cities making decisions about possible UVAR implementation. The main concepts needed to understand the set are summarised here. The full methodologies can be found in the deliverables in WP1 and WP4.*

### Describing urban vehicle access regulations

ReVeAL gathers and structures existing evidence, current trends and developments in the implementation of various UVAR measures in Europe and around the world. Evidence will be gathered in four ReVeAL Measure Fields, namely:

- Spatial Interventions
- Pricing Measures
- Pathways to ZEZ
- Future Options

The purpose is to construct a ReVeAL knowledge base that will serve as a basis for building UVAR-related scenarios for the six ReVeAL pilot cities as well as feed into the Process Advisor of the decision support tool for cities post-project.

The knowledge base is filled with best practices and experience of existing UVAR implementations and the observed processes in the pilot cities. Data will be collected and related to the three Measure Fields: Spatial Interventions, Pricing Measures and Pathways to ZEZ. Future Options are handled differently as due to its nature little known implementations exist yet.

Two types of UVAR activity will be collected:

- **City case studies**

A city case study is an extensive review of a city where implementation of measures in one or more Measure Field is taking place (e.g., a ZEZ by design in Amsterdam, a pollution charge in London or the circulation plan in Ghent). The case study looks into the change processes and give a connected view on UVAR implementation.

- **UVAR building blocks**

A measure in this context is a building block (e.g. a parklet) that moves in the direction of a larger implementation (e.g. superblock). Such measures may take the form of small or large-scale initiatives, or specific aspects of initiatives ranging across the different ReVeAL Transition Areas. These could include, for example, parklets, urban freight regulation, or successful methods to implement an aspect of a controversial LEZ (e.g. a logistics hub).

**The set of process evaluation parameters and impact assessment indicators developed in this deliverable relate to the city case studies.** It is meant to describe the process of implementation of larger UVAR implementations and the impact that has on urban indicators. The set of parameters and indicators has been developed by the Transition Framework (WP1) and the Evaluation Framework (WP4) and the reasoning was established in those work packages.

## Process Evaluation Parameters

*A large variety of factors can play a role in the success of an UVAR implementation. Many of these factors depend on the specific context of a city and need to be understood in order to identify if a specific practice is relevant for a city in question. Within the ReVeAL project, a transition framework is being developed in order to structure UVAR-related urban change processes. The framework aims to understand the context of a city and to identify the different urban variables affecting UVAR implementation. The purpose is to be able to support cities on possible pathways for successful implementations of UVAR and this based on 'learning by example' from existing cases. The framework is developed in WP1 and a full description can be found in the guidelines document (D1.1). In this section, the main concepts are summarized in order to understand the related process parameters.*

## The ReVeAL Transition Framework

ReVeAL will analyse and learn from existing UVAR implementation in cities worldwide and from its pilot cities' UVAR activities (**learning by example**). Focus is on describing the actual UVAR implementation and the processes that lead to a successful or unsuccessful implementation.

- For the UVAR measures, **a city implementation is analysed** with respect to the actual building blocks implemented, the scale of implementation, city spatial layout, main traffic flows, modal split, regional fleet distribution, etc.
- In addition, the dynamics of a city during UVAR implementation are also **analysed through the lens of four transition areas**. They identify the supporting conditions that can drive an implementation to success.

## LEARNING BY EXAMPLE



Figure 1. The UVAR implementation and the supporting processes in the four transition areas.

The ReVeAL transition framework groups the UVAR processes into four **transition areas**:

1. Governance and financing
2. User needs and acceptance
3. Mobility services and concepts
4. Technology and system design

Each of these areas captures independent dynamics in a city. These can couple with the activity of UVAR implementation, to strengthen, slow down or stop the implementation process or to drive it towards certain choices. Process evaluation focuses on the dynamics in these transition areas.

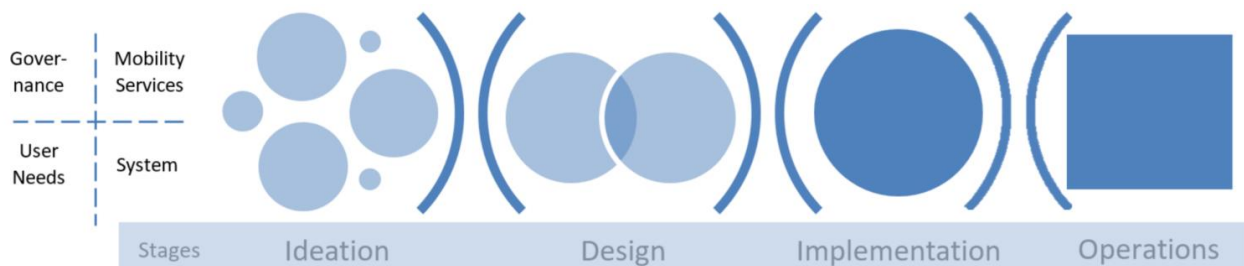


Figure 2. UVAR lifecycle.

To also assess the maturity of the city with respect to its UVAR implementation process, the ReVeAL transition framework divides the UVAR lifecycle (Figure 2) into a series of four phases. The UVAR phases correspond to different time periods involved in a set of activities and processes:

- **UVAR ideation phase:** Time span in which problems come to the attention of governments and possible solutions are discussed. It is characterised by the identification and definition of the problem. This stage ends when a problem is defined in such a way that solutions become concrete and feasible. The thought processes in this stage are on a conceptual level and the details of the scheme are not necessarily discussed in this phase.
- **UVAR design phase:** Time span in which UVAR solution designs are developed in more detail. In this stage, initial concepts are worked out. Multiple designs may be considered here including

alternative implementations, technologies etc. The dynamics in the four transition areas can influence strategic and technical choices for the UVAR implementation.

- **UVAR implementation phase:** Involves executing the UVAR options selected at the decision-making phase. This involves all the action necessary to put the UVAR measures into practice, including (if applicable): pilots, demos, referendum, communication, legal permits, etc.
- **UVAR operation phase:** Here all the activities following the launch of the UVAR implementation take place. This may include the monitoring and evaluation of the measure, the coupling with new UVAR measures, polling and fine-tuning.

The activity in the four transition areas is described in the context of this UVAR lifecycle because different types of activity can be expected in different phases of a city's UVAR process.

## The Transition Area datasheets

In the transition framework, each transition area is described by a set of questions that are meant to capture the process dynamics relevant for UVAR implementation. The focus is on gathering concise and structured information on the process of UVAR implementation in a city. Each area is covered by a datasheet of targeted questions, often with discrete answers. This structured approach was favoured to facilitate decision support using this knowledge base as it allows better clustering and matching of observed cases and the identification of good practices for new cities (i.e. learning by example). This approach risks the loss of information as some valuable elements may not yet be captured by the set of questions. This will be evaluated during pilot execution by the Measure Field Leaders and the Pilot Coordinators and the datasheets can be extended or revised based on their experience.

Regardless of possible needed adaptation, the principle remains the same: the datasheets capture the process information of UVAR implementation in its different stages. Each transition area is presented as a list of questions divided in two sections:

- (1) **General assessment:** this polls the current state of the city relevant for that specific transition area (e.g. the presence of enforcement technology or shared mobility);
- (2) **Phase-related questions:** questions that poll for specific coupling of transition area aspects on the procedures and development of UVAR implementation. Different questions are relevant in different phases in the UVAR lifecycle.

The datasheets will be processed further in WP4 for evaluating the process, but they encode the data describing the processes and can be considered as proxy for the evaluation parameters (see Annex 1 for the datasheets).

## Illustration of Datasheet Transition Area 'Technology and System Design'

| UVAR Technology (Enforcement)  |  | N/A | Under consideration | Exploratory | Operational |
|--|--|-----|---------------------|-------------|-------------|
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID<br>Global Navigation Satellite System / Cellular Networks (GNSS/CN)<br>Automatic bollards |  |     |                     |             |             |

| Curbside management (Parking) |  | N/A | Under consideration | Exploratory | Operational |
|-------------------------------|--|-----|---------------------|-------------|-------------|
| Payment                       | In situ (parking meter)<br>Mobile payment<br>In-vehicle (parking meter)<br>Prepaid payment |     |                     |             |             |
| Pricing                       | Time of the day/week<br>Demand (dynamic)<br>Zone/area                                      |     |                     |             |             |

*Example of general assessment questions that poll for the presence of certain technology options relevant for UVAR.*

| Selection drivers  | Operational costs | Investment cost | End-user cost | Reliability | Interoperability | End-user friendliness | Privacy | Previous experience |
|--|-------------------|-----------------|---------------|-------------|------------------|-----------------------|---------|---------------------|
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID<br>Global Navigation Satellite System / Cellular Networks (GNSS/CN)<br>Automatic bollards |                   |                 |               |             |                  |                       |         |                     |

*Example of phase-related questions that poll for the selection of enforcement technology during the UVAR design phase.*

## Impact Assessment Indicators

Impact assessment analyses the impacts that can be attributed to a measure, a package of measures, or a policy which has been designed to reach a certain objective. Broadly speaking, an impact assessment measures to what extent the well-being of the society has changed due to the implementation of a measure. It deals with understanding the practical/technical effects of measures within the city in contrast to process evaluation, which is concerned with understanding why measures implementation succeeds or fails.

For the assessment of an impact it is essential to collect and analyse the data from the site where an UVAR measure will be or has been introduced, developing a scenario without a measure being implemented (i.e. business-as-usual scenario) and with its implementation (i.e. measure scenario). The assessment of an impact can be carried either before or after the implementation of a measure. If the assessment is developed before (i.e., ex-ante), it can help to decide which measure will be best to solve the problem. If the assessment is developed after (i.e. ex-post), it can help to understand if a measure has been helpful, and to what extent, in tackling the identified problem.

Impact assessment is divided into five different impact areas. These are as follows:

1. **Economic impacts:** The economic impact focuses on the estimation of the benefits (or effectiveness) generated by a measure in relation to the resources used for ideation, design, implementation and operation. In economic terms, the balance between the costs a measure implies and benefits generated has to be evaluated in order to assess the extent to which it can contribute to the economic welfare of the residents of an urban area. It is important to remember that the economic impact is measured on behalf of the whole society, not from the perspective of a single individual.
2. **Energy impacts:** Energy impact concerns the effect of a transport measure on energy consumption, for example assuming the introduction of alternative fuels or changes in the mix of propulsion systems of the fleet of vehicles in the area where a measure is implemented. Other measures can also contribute to the reduction of the energy impacts by, for example, encouraging users to shift to less energy-consuming transport modes (i.e., collective transport, car sharing, bicycle, walking, etc.).
3. **Environmental impacts:** Environmental impacts consider transport measures that aim at improving the quality of the environment or, according to public economics, at reducing the external costs of transport. This objective can be achieved by using cleaner or less noisy vehicles, which in general create lower at-source emission levels. Environmental impacts can be quantified as variations of the volume of emissions of local pollutants (i.e. CO, NOx and particulate matter), greenhouse gases emissions (i.e. CO<sub>2</sub>) and noise level for affected residents. The emissions of pollutants also depend on the mix of vehicles and the assumed evolution of the fleet over time.
4. **Societal impacts:** Societal impact evaluation is focused on assessing the general acceptability of a measure and its effects on how easily people are able to travel around in a city (i.e. physical and economic accessibility), including their feeling about security. These may in turn have further effects on, for example, health and employment opportunities.
5. **Transport system performance impacts:** The transport system performance considers different aspects related to the implementation of a measure. The analysis of this type of impact aims to understand how much a measure could contribute to better urban transport.

For each area, a number of KPIs is defined. These are listed in Annex 2, together with a brief description and the data needed to carry out quantitative calculations or qualitative estimations. A full description of the evaluation methodology can be found in D4.1 (Process Evaluation and Impact Assessment Framework).



**Follow us!**

**Website: [www.CIVITAS-REVEAL.eu](http://www.CIVITAS-REVEAL.eu)**

** [CIVITAS\\_REVEAL](#)**

** [CIVITAS\\_REVEAL](#)**

## Annex 1: Transition area datasheets

1a: Governance and financing

1b: User needs and acceptance

1c: Mobility services and concepts

1d: System design and technology

## Annex 2: Impact assessment datasheet

Annex 1a: Governance and Financing - general assessment, financing

|  |   |
|--|---|
| <b>Decision making context</b>   |   |
| Who makes decisions? (political stream) Please provide the city's organigram /structure / 'chain of command'<br>Leading politicians in the UVAR project                                | <i>City Organigram</i><br><i>5 names</i>                      |
| Who formulates technical solutions? (Policy stream)<br>Leading technicians in the UVAR project within the city services<br>Leading external/contracted technicians in the UVAR project | <i>text</i><br><i>5 names</i><br><i>5 names + affiliation</i> |
| Leading opinionators/civil society and media voices on the UVAR project  | <i>5 names + affiliation</i>                                  |
| UVAR champion: who leads the process? (person or unit/organisation)  | <i>text</i>   |
| Electoral period   | <i>Timeline (Elections, beginning of campaign)</i>            |

## Annex 1a: Governance and Financing - UVAR phase questions, governance

|  |  |
|--|--|
| <b>Legal frameworks</b>  |  |
|  | Are <b>national legal frameworks</b> in place for: |
| the UVAR of your choice<br>Efficient enforcement (digital, ANPR, ...)<br>financial management of the UVAR<br>Personal data protection/privacy/GDPR<br>Tendering /procurement |  |
| Are <b>local regulations</b> needed to implement the UVAR?   |  |
| if Yes: what kind of local regulation  | <i>text</i>  |
| <b>Institutional setting and organisational arrangements</b>   |  |
| Does your city have full competence to <b>plan the UVAR</b> ?  |  |
| If Yes: which services are involved, what number of staff required?  | <i>text</i>  |
| if No: what other institutional actors need to be involved (national government, national police, regional gvt etc.)   | <i>text</i>  |
| Does your city have full competence to <b>deploy the UVAR</b> ?  |  |
| If Yes: which services are involved, what number of staff required?  | <i>text</i>  |
| if No: what other institutional actors need to be involved (national government, national police, regional gvt etc.)   | <i>text</i>  |
| Does your city have full competence to <b>operate the UVAR</b> ?   |  |
| If Yes: which services are involved, what number of staff required?  | <i>text</i>  |
| if No: what other institutional actors need to be involved (national government, national police, regional gvt etc.)   | <i>text</i>  |
| Does your city have full competence to <b>enforce the UVAR</b> ?   |  |
| If Yes: which services are involved, what number of staff required?  | <i>text</i>  |
| if No: what other institutional actors need to be involved (national government, national police, regional gvt etc.)   | <i>text</i>  |
| Which are the <b>accompanying measures</b> you are planning to deploy?   | <i>text</i>  |
| Does your city have full competence to <b>plan these accompanying measures</b> to make the UVAR a success?   |  |
| If Yes: which services are involved, what number of staff required?  | <i>text</i>  |

[illegible]

## Annex 1a: Governance and Financing - UVAR phase questions, governance

|   |   |
|---|---|
| <p>if No: what other institutional actors need to be involved (national government, national railways, etc.)</p> <p>Does your city have full competence to <b>deploy these accompanying measures</b> to make the UVAR a success?</p> <p>If Yes: which services are involved, what number of staff required?</p> <p>if No: what other institutional actors need to be involved (national government, national railways, etc.)</p> <p>Does your city have full competence to <b>operate these accompanying measures</b> to make the UVAR a success?</p> <p>If Yes: which services are involved, what number of staff required?</p> <p>if No: what other institutional actors need to be involved (national government, national railways, etc.)</p> | <p>text</p> <p>text</p> <p>text</p> <p>text</p> <p>text</p> <p>text</p> |
| <p>Are professional skills and knowledge available within these institutions to make the UVAR reality?</p> <p>Any missing skills and knowledge or knowledge?</p>  | <p>text</p>   |
| <p><b>Local policy frameworks</b></p>   |   |
| <p>Has the city implemented a SUMP or any planning instrument regarding mobility?</p> <p>If yes, at which stage is this SUMP? planned / under development / implemented / updated</p>   | <p>text</p>   |
| <p>Air Quality plan policy</p> <p>Sustainable Energy and climate Action Plan</p> <p>Public transport policy</p> <p>Congestion reduction strategy</p> <p>Accessibility policy</p> <p>Regional / local economy development plan</p> <p>Traffic management policy</p> <p>Land use policy</p> <p>Sustainability policy</p> <p>Innovation policy</p> <p>Cycling policy</p> <p>Cycle parking strategy</p>   |   |

[illegible]

## Annex 1a: Governance and Financing - UVAR phase questions, governance

|   |             |
|---|-------------|
| Urban planning policy   | <i>text</i> |
| Parking policy  |             |
| other   |             |
| Are UVAR objectives and policy objectives aligned?  |             |
| Has the UVAR measure been evaluated?  |             |
| Does the UVAR meet the objectives?  |             |
| Have the objectives of the UVAR been re-thought, and the potential adaptations of the UVAR planned?   |             |
| <b>Political context</b>  |             |
| Will the scheme be implemented within the electoral period of those deciding the scheme?  |             |
| In case the scheme won't be implemented within the electoral period of those deciding the scheme, will it have sufficient cross-party support to be implemented over several electoral periods? |             |
| <b>Citizen focus</b>  |             |
| Are complaints treatment available?   |             |
| Are information procedures in place?  |             |

|          |        |                |           |
|----------|--------|----------------|-----------|
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |

Annex 1a: Governance and Financing - general assessment, financing

| Financing of accompanying measures                               |  |
|--|--|
| Accompanying measures funded by UVAR implementing authority?     |  |
| Accompanying measures funded by Third parties?<br>if Y: by whom? |  |

*text*

Annex 1a: Governance and Financing - UVAR financing questions

| Funding of UVAR establishment  |                |
|--|----------------|
| Plan/study: estimated cost / payed by whom?  | €/ <i>text</i> |
| Installment of equipment: estimated cost / payed by whom?                          | €/ <i>text</i> |
| Communication and public involvement: estimated cost / payed by whom?              | €/ <i>text</i> |
| Enforcement: estimated cost / payed by whom?                                       | €/ <i>text</i> |
| Management and purpose of revenue streams  |                |
| earmarking?<br>regional/national government?<br>transparent allocation of revenue? | <i>text</i>    |
| Audit and oversight  |                |
| audit and oversight procedures in place?   |                |
| Procurement(*)   |                |
| Which items are you planning to procure?   | <i>text</i>    |

| Ideation | Design | Implementation | Operation |
|----------|--------|----------------|-----------|
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |

Annex 1a: Governance and Financing - UVAR financing questions

| (*) The procurement procedure (For each procured item) ** |  |   |              |
|---|--|---|--------------|
| Step 1: Preparation and planning                          | Procurement procedure prepared and planned | Defining the need in terms of functions<br>Open and restricted procedure (procurement method)<br>Competitive dialogue and negotiation<br>Using joint procurement    | text<br>text |
| Step 2: Definition of specifications and standards        | Specifications and standards specified     | Approaching the market: are relevant market actors involved?<br>Using performance based specifications<br>Additional specifications of products, services and works | text         |
| Step 3: Submission of tenders and selection of tenders    | Tenders submitted and selected             | Selection criteria (implementation of environmental management systems...)  | text         |
| Step 4: Valuation of tenders and award                    |  | Award criteria (e.g. specific or overall CO2 emissions, life cycle costing, ...)  | text         |
| Step 5: Contract implementation and management            | Contract implemented and managed           | Monitoring and reporting obligations: contracting authority/ supplier / third party<br>Quality standards and bonus/malus schemes applied                            |              |

\*\*The procurement procedure (EC, 2018) consulted in '*Topic Guide. Public procurement of sustainable urban mobility measures*', F. Rudolph and S. Werland (Wuppertal Institute), 2019.

## User needs and acceptance

### User needs

User needs captures the habits and preferences of users of a service or an environment. In understanding future user needs special attention should be paid to the differences among users regarding age, socio-economic and cultural background, preferences and abilities etc.

Within the ReVeAL context user needs are the degree to which users can understand how an UVAR functions. For example, do travelers understand what vehicles are allowed into a low-emission zone or how much they need to pay going into a congestion charging zone? How easy is it to pay? What is the process for getting an exemption?

Early in the ReVeAL process future user groups and their possible different user needs should be identified. During the whole process the importance of the different user needs should be assessed and monitored. In the latter phases of the process communication and engagement with the targeted user groups is essential to understand and explain the new situation.

### User needs: Template guidance.

The User needs-template should be answered and updated continuously during the process. Some questions are relevant in all four phases while other relate only to the early or the later phases. The template questions and their relevant phases provides a guidance to backtrack the availability of historical information. I.e. when are different user needs and their importance mentioned? When was an explicit user needs identification process in place? Have they performed a user-centered information campaign and if so when did it take place?

### User acceptance

User acceptance is the demonstrable willingness within a group to use a system or measure for the tasks for which it was designed. User acceptance is partly affected by the design characteristics of policy measures and partly by individual mechanisms. It relates also to political acceptance, and UVAR measures in general are controversial.

Understanding how user acceptance will develop over time is essential for creating political acceptance. Hence monitoring and measuring public acceptance should be performed periodically during the ReVeAL process. In doing this it is important to understand and address questions regarding equity, fairness and self-interest and how it affects level of acceptance in both policy design and communication. Equity refers to how the costs and benefits resulting from a measure are distributed over the population, whereas perceptions of fairness are individual. In the context of congestion charging self-interest has been shown to have substantial impact on attitudes towards the charges. The same pattern could be expected regarding other UVAR measures.

### User acceptance: Template guidance.

The User acceptance-template consists of four checklist questions, two desk study questions and two opinion poll questions. The first four questions are to be answered once early in the process. The two desk study questions could be answered through a continuous analysis of local media articles and news stories. The opinion poll questions should be answered by the local public. Since the nature of public acceptance is nonlinear, we recommend that they should be answered at least two and ideally four times during an UVAR life-cycle. How often and when is specific to each city, their UVAR and time frame. If answered twice

- 1 year to half-year before implementation (1)
- Half-year to 1 year after implementation (4).

If answered four times

- 1 year to half-year before implementation (1)

- 1-3 months before implementation (2)
- 1-3 months after implementation (3)
- Half-year to 1 year after implementation (4).

Both the desk study questions and the opinion poll questions require more resources (personnel and survey advertising),

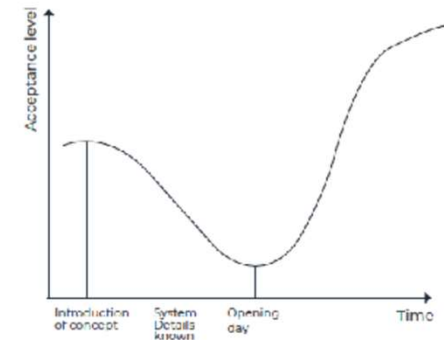


Figure 1. Typical Dynamic Pattern of Acceptance. Adapted from (Goodwin 2006) and (Schade, Seidel and Schlag 2004) and with recommended times for opinion polls.

If historical data about how user acceptance have been monitored and measured is lacking for the specific UVAR, some guidance to how the city handles user acceptance can be found in earlier similar processes.

| What is the importance of different user needs?  |  | Not important | Somewhat important | Important | Dominant | Ideation | Design | Implementation | Operation |
|--|--|---------------|--------------------|-----------|----------|----------|--------|----------------|-----------|
| Congestion reduction   |  |               |                    |           |          |          |        |                |           |
| Improved travel time reliability   |  |               |                    |           |          |          |        |                |           |
| Air quality improvements   |  |               |                    |           |          |          |        |                |           |
| Quality of urban space   |  |               |                    |           |          |          |        |                |           |
| Reduction of CO2 emission  |  |               |                    |           |          |          |        |                |           |
| Improved traffic safety  |  |               |                    |           |          |          |        |                |           |
| Noise reduction  |  |               |                    |           |          |          |        |                |           |
| Vibration reductions   |  |               |                    |           |          |          |        |                |           |
| Better public transit  |  |               |                    |           |          |          |        |                |           |
| Improved walkability   |  |               |                    |           |          |          |        |                |           |
| Improved bicycle opportunities   |  |               |                    |           |          |          |        |                |           |
| Affordability of travel  |  |               |                    |           |          |          |        |                |           |
| Improved health  |  |               |                    |           |          |          |        |                |           |
| Ease of finding parking space  |  |               |                    |           |          |          |        |                |           |
| Economic vitality of the city  |  |               |                    |           |          |          |        |                |           |
| Ease of use  |  |               |                    |           |          |          |        |                |           |
| Ease of understanding the policy   |  |               |                    |           |          |          |        |                |           |
| Privacy and anonymous travel   |  |               |                    |           |          |          |        |                |           |
| Role for public to particpate in design process  |  |               |                    |           |          |          |        |                |           |
| Transparant decision making  |  |               |                    |           |          |          |        |                |           |
| Public information on costs, benefits and alternatives                                     |  |               |                    |           |          |          |        |                |           |
|  |  |               |                    |           |          | Ideation | Design | Implementation | Operation |
| Is there an explicit process to identify user needs?                                       |  |               |                    |           |          |          |        |                |           |
|  |  |               |                    |           |          | Ideation | Design | Implementation | Operation |
| Is there an information campaign to explain how the new situation will work for travellers |  |               |                    |           |          |          |        |                |           |

| Have different user groups with different user needs been identified?  |  |
|--|--|
| <p>Frequent users</p> <ul style="list-style-type: none"> <li>Inhabitants in a zone (if applicable)</li> <li>Inhabitants outside a zone (if applicable)</li> </ul> <p>Non-frequent users</p> <ul style="list-style-type: none"> <li>Inhabitants</li> <li>Visitors</li> </ul> <p>Mode specific user needs</p> <ul style="list-style-type: none"> <li>Car drivers</li> <li>Public transit</li> <li>Walking</li> <li>Cycling</li> </ul> <p>Goods traffic</p> <ul style="list-style-type: none"> <li>Waste management</li> <li>Delivery vehicles</li> <li>Construction traffic</li> </ul> |  |

[illegible]

**Checklist questions**

|  |  |
|--|--|
| <b>Is your city monitoring media attention continuously?</b>                         |  |
| <b>If yes: What is the general tone in media with regards to the policy measure?</b> |  |
| Left<br>Neutral<br>Right   |  |

|   |                   |
|---|-------------------|
| <b>Is your city measuring public acceptability periodically?</b>                  |                   |
| <b>If yes:</b>  |                   |
| <b>What is the current level of acceptability for measure x?</b>                  | <i>Percentage</i> |
| <b>If no: What are the main barriers to measuring public acceptability issues</b> |                   |
| Costs<br>Personell<br>Political will  |                   |

|  |             |
|--|-------------|
| <b>Have different relevant interest groups been identified?</b>            |             |
| Car lobby groups<br>Climate groups<br>Bicycle and active modes<br>Other... | <i>text</i> |

|  |  |
|--|--|
| <b>Have you identified different vulnerable groups?</b>                    |  |
| Socio-economic<br>Ethnicity<br>Geographical<br>Age<br>Disability<br>Gender |  |

Desk study questions

|  |  |
|--|--|
| What are the main arguments of the opposition? |  |
| Fairness                                       |  |
| Affordability                                  |  |
| Measure costs                                  |  |
| Doubt effectiveness of measure                 |  |
| Anti-car                                       |  |
| Competitiveness                                |  |
| What are the main arguments of support?        |  |
| Liveability                                    |  |
| Congestion                                     |  |
| Revenue use                                    |  |
| Sustainable development                        |  |
| Competitiveness                                |  |
| Fairness                                       |  |

Opinion poll questions

|  |  |
|--|--|
| To what extent does the public think the measure will solve societal problems and meet objectives? |  |
| To what extent does the public understand how to use/travel in the new situation?                  |  |

#### Mobility services and concepts

"Mobility concepts" refer to innovative mobility schemes and services focused on the use of new technologies, vehicles and transport infrastructures also in combination with existing elements (e.g. active mobility, public transport or other UVAR measures) in order to accelerate, maximize or introduce significant changes in mobility patterns and landscapes or significantly mitigate negative impacts.

Within the ReVeAL's UVAR mobility services and concepts transition area, the mobility concept can be described as a set of coherent and organized actions and measures (both physical and intangible) able to support the ideation, design, implementation and operation of a specific (or a set of) UVAR measure(s) in a city/ metropolitan area.

Examples of mobility services inside a mobility concept are MaaS (Mobility as a Service), automated and/or electric shuttles, new public transport options, ride hailing platforms, application of C-ITS (Cooperative Intelligent Transport Systems), shared bikes, cars, vans and mopeds, (cycle) logistics schemes, etc.

| What are the existing sustainable mobility services in the city/metropolitan area?  |                    |
|---|--------------------|
| <p>Frequent urban public transport</p> <p>Extensive and continuous cycle network</p> <p>Park and ride schemes</p> <p>Park and walk/bike schemes</p> <p>Extensive charging network for e-vehicles</p> <p>Bike sharing</p> <p>Car sharing</p> <p>Van sharing</p> <p>Other sharing system (mopeds, scooters, etc.)</p> <p>Automated/electric shuttles</p> <p>C-ITS (Cooperative Intelligent Transport Systems)</p> <p>MaaS (Mobility as a Service)</p> <p>Ride hailing platforms/services</p> <p>Urban logistics platform/infrastructure</p> <p>Urban logistics schemes</p> <p>Cycle logistics</p> <p>Others</p> | <p><i>text</i></p> |

## Annex 1c: Mobility Services and Concepts - UVAR phase questions

|   |  |  |
|---|--|--|
| Ideation  |  |  |
| Design  |  |  |
| Implementation  |  |  |
| Operation   |  |  |
|   | <p><b>What are the mobility services that have been implemented in this UVAR phase?</b></p> <p><b>- (If "Implemented") Has their implementation already been planned, independently from the process of the specific UVAR measure?</b></p> |  |
| Public transport improvement/development<br>Public transport services (fleet, ticketing, infomobility, etc.) development<br>Extension of bus/tram lanes<br>Extention of cycle network<br>Park and ride schemes development<br>Park and walk/bike schemes development<br>Other new parking options<br>Extension of charging network for e-vehicles<br>Bike sharing system development<br>Car sharing system development<br>Van sharing system development<br>Other sharing system (mopeds, scooters, etc.) development<br>New automated/electric shuttles<br>Application of C-ITS (Cooperative Intelligent Transport Systems)<br>Introduction of MaaS (Mobility as a Service)<br>Introduction of ride hailing platforms/services<br>New urban logistics platform/infrastructure<br>Urban logistics schemes development<br>Cycle logistics development<br>Other urban logistics scheme/development<br>Cycle logistics development |  |  |

Annex 1c: Mobility Services and Concepts - UVAR phase questions

|  |  |  |
|--|--|--|
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Have ex-ante evaluation activities (transport models/ projections/ forecasts, both from a supply and a demand point of view) for the implementation of the mobility services been conducted? |  | Have the mobility services been already in operation in the past but currently failed or have they originally been planned but eventually not implemented? |
|  |  |  |

Annex 1c: Mobility Services and Concepts - UVAR phase questions

|  |   |   |
|--|---|---|
|  |   |   |
|  |   |   |
|  |   |   |
|  |   |   |
| -<br>(If different from "No") Why the mobility service has failed or has not been implemented? | Have the mobility services been included in plans or other strategies? Which one (the most important and pertinent prevails)? | Has the in-depth design (definition of technical features such as size, dimensions, model, format, energy and telematic necessities, etc.) been prepared for the mobility services? |
|  |   |   |

Annex 1c: Mobility Services and Concepts - UVAR phase questions

|  |  |
|--|--|
|  |  |
|  |  |
|  |  |
|  |  |
| Have the necessary management needs (in terms of provision of the necessary maintenance interventions to preserve a good operational level and provision of the necessary coordination within and between involved departments of the administrative bodies) been provided for the mobility services | Have mitigation elements in order to reduce unexpected and undesired effects of the mobility services been needed? Which ones? |
|  |  |

#### System design/technology

The system design/technology transition area focus on the availability, functionality, and status of UVAR-related systems – and the technologies that make up these systems – in a city throughout the UVAR life cycle. This transition area identifies five different clusters. These are:

*Curbside management (Parking):* Parking is one of the most commonly used means to regulate access to urban areas. When implementing UVAR, parking places, policy, control, and payment mechanisms should be aligned and supportive of UVAR. In the context of the System design/technology transition area, this cluster focus on the enforcement mechanisms, and the technological capabilities of the control entities with regard to (dynamic) pricing strategies.

*UVAR Technology (Enforcement):* This cluster provides an overview of the different technological options used for UVAR enforcement. Here we focus in the set of alternatives that are considered, not only during the design phase, but in any of the later UVAR phases. Especial attention is given to the main drivers for the selection of the alternatives (e.g. interoperability, reliability, privacy, etc.).

*UVAR Technology (Communication):* Communication and the use of information are crucial when implementing UVAR schemes. "Experience has demonstrated that effective information and communication can mitigate criticism and lead to successful and smooth implementation of an UVAR scheme, ensuring its long-term effectiveness" (Ricci et al., 2017). Communication in the system design/technology transition area relates to the different communication channels used and their purpose (one-way vs. two-way communication engagements).

*Traffic management systems:* This cluster covers the variety of data applications used for traffic management, grouping them from a functional point of view. These systems give support to the UVAR measure during its development. The capabilities of the installed systems reflect the awareness and control a city may have over its own mobility, which aligns the set of UVAR measures considered and the monitoring and evaluation of the implemented UVAR measure.

*Infrastructure:* The objective of infrastructure in the context of the system design/technology transition area is twofold. It refers to (1) dedicated infrastructure for targeted modes (EV charging stations), necessary to impulse a modal shift, in this case to cleaner technologies, and (2) dedicated infrastructure for communication (VMS) necessary for traffic information management and control, that in later stages of the UVAR lifecycle can also support the communication of the UVAR measure.

## Annex 1d: System Design and Technology - General Assessment

| UVAR Technology (Enforcement)   | Status |
|---|--------|
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID (GNSS/CN)<br>Automatic bollards<br>Other |        |

| Curbside management (Parking) |  | Status |
|-------------------------------|--|--------|
| Payment                       | In situ (parking meter)<br>Mobile payment<br>In-vehicle (parking meter)<br>Prepaid payment |        |
| Pricing                       | Time of the day/week<br>Demand (dynamic)<br>Zone/area                                      |        |

| Traffic management systems | Status |
|----------------------------|--------|
| (1) Traffic analysis       |        |
| (2) Traffic monitoring     |        |

|                         |  |
|-------------------------|--|
| (1) Traffic analysis    | These applications aim at understanding the urban traffic and mobility, for instance, by recognizing patterns, explaining typical situations, and by understanding atypical effects. |
| (2) Traffic monitoring  | This kind of applications focus on a derived analysis in which the focus is on the evolution of traffic in time, e.g., behavioral changes during peak hours, weekends, etc.          |
| (3) Traffic information | These applications focus on the collection and sharing of traffic information with mobility partners and/or with road users and citizens.  |

Annex 1d: System Design and Technology - General Assessment

|                         |  |  |                        |  |  |
|-------------------------|--|--|------------------------|--|--|
| (3) Traffic information |  |  |                        |  |  |
| (4) Traffic management  |  |  | (4) Traffic management | Applications capable of applying different measures to adjust the demand and capacity of the traffic network in time and space to better ‘match’ the traffic demand and supply (capacity). |  |

| Infrastructure           | Magnitude per UVAR area | Magnitude per city area |                        |          |
|--------------------------|-------------------------|-------------------------|------------------------|----------|
| Electric vehicle network | Number                  | Number                  | Charging stations/ km² | Used for |
| Variable message sign    | Number                  | Number                  | Units/km               |          |

| UVAR Technology (Communication) | Status |
|---------------------------------|--------|
| Strong website presence         |        |
| Variable-message sign (VMS)     |        |
| Road surface marking            |        |
| Road signaling                  |        |
| Mass media                      |        |
| Social networks                 |        |
| Other                           |        |

## Annex 1d: System Design and Technology - UVAR phase questions

| Importance in decision-making                                 |                          |                            | Not important  | Somewhat important | Important | Dominant | Ideation | Design  | Implementation | Operation |
|---|--------------------------|----------------------------|----------------|--------------------|-----------|----------|----------|---------|----------------|-----------|
| Traffic applications  | (1) Traffic analysis     |                            |                |                    |           |          |          |         |                |           |
|   | (2) Traffic monitoring   |                            |                |                    |           |          |          |         |                |           |
|   | (3) Traffic information  |                            |                |                    |           |          |          |         |                |           |
|   | (4) Traffic management   |                            |                |                    |           |          |          |         |                |           |
| Infrastructure  | Electric vehicle network |                            |                |                    |           |          |          |         |                |           |
|   | Variable message sign    |                            |                |                    |           |          |          |         |                |           |
| Curbside management (Parking)                                 | Payment                  | In situ (parking meter)    |                |                    |           |          |          |         |                |           |
|   |                          | Mobile payment             |                |                    |           |          |          |         |                |           |
|   |                          | In-vehicle (parking meter) |                |                    |           |          |          |         |                |           |
|   |                          | Prepaid payment            |                |                    |           |          |          |         |                |           |
|   | Pricing                  | Time of the day/week       |                |                    |           |          |          |         |                |           |
|   |                          | Demand (dynamic)           |                |                    |           |          |          |         |                |           |
|   |                          | Zone/area                  |                |                    |           |          |          |         |                |           |
|   |                          |                            |                |                    |           |          |          |         |                |           |
| Decision support tool(s) in the decision-making               |                          | Decision support tool      |                |                    |           |          | Ideation | Design  | Implementation | Operation |
| Traffic modelling   |                          |                            |                |                    |           |          |          |         |                |           |
| Traffic simulation  |                          |                            |                |                    |           |          |          |         |                |           |
| Environmental modeling  |                          |                            |                |                    |           |          |          |         |                |           |
| Environmental simulation                                      |                          |                            |                |                    |           |          |          |         |                |           |
| Other   |                          |                            | text           |                    |           |          |          |         |                |           |
| UVAR Technology Selection (Enforcement)                       |                          |                            | Not considered | Considered         | Selected  |          | Ideation | Design  | Implementation | Operation |
| Manual inspection and windscreen stickers                     |                          |                            |                |                    |           |          |          |         |                |           |
| Manual toll collection  |                          |                            |                |                    |           |          |          |         |                |           |
| Automated Number Plate Recognition (ANPR)                     |                          |                            |                |                    |           |          |          |         |                |           |
| Radio-frequency identification (RFID)                         |                          |                            |                |                    |           |          |          |         |                |           |
| Dedicated short range communication (DSRC) - RFID             |                          |                            |                |                    |           |          |          |         |                |           |
| Global Navigation Satellite System / Cellular Networks (GNSS) |                          |                            |                |                    |           |          |          |         |                |           |
| Automatic bollards  |                          |                            |                |                    |           |          |          |         |                |           |
| Other   |                          |                            |                |                    |           |          |          |         |                |           |
| UVAR Technology (Communication)                               |                          |                            |                |                    |           |          | Not used | One-way | Two-way        |           |

## Annex 1d: System Design and Technology - UVAR phase questions

|  |               |                  |
|--|---------------|------------------|
| Strong website presence<br>Variable-message sign (VMS)<br>Road surface marking<br>Road signaling<br>Flyers/leafleting<br>Mass media<br>Social networks<br>Stakeholder workshops - Public meetings<br>Dedicated short range communication (DSRC)<br>Governmental websites<br>Posters<br>Posting, emails, or text messaging<br>Other |               |                  |
| <b>UVAR Technology currently installed and in use for UVAR enforcement</b>   | Used for UVAR | Already in place |
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID<br>Global Navigation Satellite System / Cellular Networks (GNSS)<br>Automatic bollards<br>Other                     |               |                  |
| <b>Third-party data sharing (1)</b>  |               |                  |
| Is the city currently in communications with third-party data providers to share the information on  |               |                  |

|          |        |                |           |
|----------|--------|----------------|-----------|
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |

Annex 1d: System Design and Technology - UVAR phase questions

| Third-party data sharing (2)   |  |
|--|--|
| Is the information on UVAR currently being shared with third-party data providers? |  |

| Open access data update  |  |
|--|--|
| Does it exist any open access data mechanisms, agreements, or regulations to provide/update (real-time) information on the city's access |  |

| Ideation | Design | Implementation | Operation |
|----------|--------|----------------|-----------|
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
| Ideation | Design | Implementation | Operation |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |
|          |        |                |           |

## Annex 1d: System Design and Technology - UVAR phase questions

## Annex 1d: System Design and Technology - UVAR phase questions

## Annex 1d: System Design and Technology - UVAR phase questions

|                         |  |
|-------------------------|--|
| (1) Traffic analysis    | These applications aim at understanding the urban traffic and mobility, for instance, by recognizing patterns, explaining typical situations, and by understanding atypical effects.       |
| (2) Traffic monitoring  | This kind of applications focus on a derived analysis in which the focus is on the evolution of traffic in time, e.g., behavioral changes during peak hours, weekends, etc.                |
| (3) Traffic information | These applications focus on the collection and sharing of traffic information with mobility partners and/or with road users and citizens.  |
| (4) Traffic management  | Applications capable of applying different measures to adjust the demand and capacity of the traffic network in time and space to better 'match' the traffic demand and supply (capacity). |

| Selection drivers   | Operational costs | Investment cost | End-user cost | Reliability | Interoperability | End-user friendliness | Privacy | Previous experience |
|---|-------------------|-----------------|---------------|-------------|------------------|-----------------------|---------|---------------------|
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID<br>Global Navigation Satellite System / Cellular Networks (GNSS/CN)<br>Automatic bollards<br>Other |                   |                 |               |             |                  |                       |         |                     |

# Annex 1d: System Design and Technology - UVAR phase questions

| In case of changes on installed technology during phases, which were the decision drivers   |                                 | Operational costs | Investment cost | End-user cost | Reliability | Interoperability | End-user friendliness | Privacy | Previous experience |
|---|---------------------------------|-------------------|-----------------|---------------|-------------|------------------|-----------------------|---------|---------------------|
| Manual inspection and windscreen stickers<br>Manual toll collection<br>Automated Number Plate Recognition (ANPR)<br>Radio-frequency identification (RFID)<br>Dedicated short range communication (DSRC) - RFID<br>Global Navigation Satellite System / Cellular Networks (GNSS/CN)<br>Automatic bollards<br>Other |                                 |                   |                 |               |             |                  |                       |         |                     |
| Partners involved   | How is the approach/engage with |                   |                 |               |             |                  |                       |         |                     |
| Google<br>Waze<br>TomTom<br>Verizon connect<br>HERE Technologies  |                                 |                   |                 |               |             |                  |                       |         |                     |

Annex 1d: System Design and Technology - UVAR phase questions

|   |             |   |   |
|---|-------------|---|---|
| Other   | <i>text</i> |   |   |
| <b>Partners involved</b>  |             | Are their platforms currently operational? (Is the information in | How is the approach/engage with this company? |
| Google<br>Waze<br>TomTom<br>Verizon connect<br>HERE Technologies<br>Other | <i>text</i> |   |   |
| <b>Mechanisms</b>   |             |   |   |
| Social media<br>Dedicated websites<br>SMS<br>Open digital maps<br>Other   | <i>text</i> |   |   |

## IMPACT ASSESSMENT

| No.                      | Impacts                | Category              | Indicator   | Description  | Data and/or unit                               | Scope     |      |
|--------------------------|------------------------|-----------------------|---|--|--|-----------|------|
|                          |                        |                       |   |  |  | City-wide | Area |
| PILOT-RELATED INDICATORS |                        |                       |   |  |  |           |      |
| ECONOMY                  |                        |                       |   |  |  |           |      |
| IA1                      | Benefits               | Operating revenues    | Operating revenues                                | Revenues per pkm or vkm  | Euros/pkm or Euros/vkm, quantitative           |           | X    |
| IA2                      |                        | Rent                  | Land rent   | Mean real estate values  | Euros, quantitative                            |           | X    |
| IA3                      |                        | Savings               | Travel time savings                               | Monetised savings in travel time   | Euros/pkm or Euros/vkm, quantitative           |           | X    |
| IA4                      | Costs                  | Costs                 | Capital costs                                     | Capital cost per system or unit  | Euros, quantitative                            |           | X    |
| IA5                      |                        |                       | Operating costs                                   | Costs per time period  | Euros/time period, quantitative                |           | X    |
| IA6                      |                        |                       | Managing and maintenance costs                    | Costs per time period  | Euros/time period, quantitative                |           | X    |
| IA7                      |                        |                       | Congestion costs                                  | Costs per vkm  | Euros/vkm, quantitative                        |           | X    |
| IA8                      |                        |                       | Social costs                                      | Costs per fatalities and injured persons   | Euros/fatality and Euros/injured, quantitative |           | X    |
| ENERGY                   |                        |                       |   |  |  |           |      |
| IA9                      | Energy Consumption     | Fuel consumption      | Vehicle fuel efficiency                           | Fuel used per vkm, per vehicle type  | MJ/vkm, quantitative                           |           | X    |
| IA10                     |                        |                       | Fuel mix  | Percentage of fuel used by type  | %, quantitative                                |           | X    |
| ENVIRONMENT              |                        |                       |   |  |  |           |      |
| IA11                     | Pollution and nuisance | Emissions             | CO2 emissions                                     | CO2 per vkm by type  | G/vkm, quantitative                            |           | X    |
| IA12                     |                        |                       | CO emissions                                      | CO per vkm by type   | G/vkm, quantitative                            |           | X    |
| IA13                     |                        |                       | NO2 emissions                                     | NO2 per vkm by type  | G/vkm, quantitative                            |           | X    |
| IA14                     |                        |                       | Particulate emissions                             | PM10 and/or PM2.5 per vkm by type  | G/vkm, quantitative                            |           | X    |
| IA15                     |                        | Noise                 | Noise   | Level of noise (relevant locations)  | Index (%), qualitative                         |           | X    |
| SOCIETY                  |                        |                       |   |  |  |           |      |
| IA16                     | Acceptance             | Awareness             | Awareness level                                   | Awareness of the policies/measures   | Index (%), qualitative                         |           | X    |
| IA17                     |                        | Acceptance            | Acceptance level                                  | Attitude of current acceptance of the measure  | Index (%), qualitative                         |           | X    |
| IA18                     | Accessibility          | Spatial accessibility | Accessibility level by social groups              | Physical accessibility of pilot area (by gender, age, physical condition, nationality/ethnicity) | Index (%), qualitative                         |           | X    |
| IA19                     | Safety                 | Transport safety      | Injuries and deaths caused by transport accidents | Numbers of accidents, fatalities and casualties caused by transport accidents, per mode          | No, quantitative                               |           | X    |
| IA20                     | Equity                 | Equity                | Equity level by social groups                     | Equity of the UVAR measure (by gender, age, physical condition, nationality/ethnicity)           | Index (%), qualitative                         |           | X    |
| TRANSPORT                |                        |                       |   |  |  |           |      |
| IA21                     | Quality of PT service  | Service reliability   | Accuracy of timekeeping - peak                    | Percentage of services arriving / departing on time  | %, quantitative                                |           | X    |
| IA22                     |                        | Travel times          | Average service speed - peak                      | Average speed of PT (selected bus and tram lines)  | Km/h, quantitative                             |           | X    |
| IA23                     | Transport system       | Traffic levels        | Traffic flow by vehicle type - peak               | Average vehicles per hour by vehicle type - peak (relevant locations)                            | Veh per hour, quantitative                     |           | X    |
| IA24                     |                        |                       | Traffic flow by vehicle type - off peak           | Average vehicles per hour by vehicle type - off peak (relevant locations)                        | Veh per hour, quantitative                     |           | X    |
| IA25                     |                        | Congestion levels     | Car travel time - peak                            | Average travel time - peak (selected corridors)  | Minutes, quantitative                          |           | X    |
| IA26                     |                        |                       | Car travel time- off peak                         | Average travel time - off peak (selected corridors)  | Minutes, quantitative                          |           | X    |
| IA27                     |                        | Freight movements     | Goods vehicles                                    | Daily number of goods vehicles   | No, quantitative                               |           | X    |
| IA28                     |                        | Soft mobility levels  | Pedestrian flows                                  | No. of pedestrians (relevant locations)  | No. per hour, quantitative                     |           | X    |

## Annex 2: Impact Assessment

|                           |                  |                    |   |   |                            |   |   |
|---------------------------|------------------|--------------------|---|---|----------------------------|---|---|
| IA29                      |                  |                    | Cycle flows                                 | No. of cyclists (relevant locations)  | No. per hour, quantitative |   |   |
| IA30                      |                  | Sharing mobility   | Access to shared modes                      | No. of bike sharing, car sharing and micro-mobility stations  | No, quantitative           |   | X |
| IA31                      |                  | E-mobility         | Charging points                             | No. of charging points for electric vehicles  | No, quantitative           |   | X |
| IA32                      | Public space     | Public space usage | Area dedicated to transport and other needs | Extent of walkable areas, cycle paths, PT lanes, surface reserved to vehicles (general speed limit and reduced speed limit - 30km/h), parking spaces, green areas | m2, quantitative           |   | X |
| <b>CONTEXT INDICATORS</b> |                  |                    |   |   |                            |   |   |
| <b>ENVIRONMENT</b>        |                  |                    |   |   |                            |   |   |
| IA33                      | Pollution        | Air quality        | CO levels                                   | CO concentration  | Ppm or g/m3, quantitative  | X |   |
| IA34                      |                  |                    | NO2 levels                                  | NO2 concentration   | Ppm or g/m3, quantitative  | X |   |
| IA35                      |                  |                    | Particulate levels                          | Particulate PM10 and/or PM2.5 concentration   | Ppm or g/m3, quantitative  | X |   |
| IA36                      |                  |                    | Black carbon levels                         | Black carbon concentration  | Ppm or g/m3, quantitative  | X |   |
| <b>TRANSPORT</b>          |                  |                    |   |   |                            |   |   |
| IA37                      | Transport system | Modal split        | Average modal split-passengers              | Percentage of passenger-km for each mode  | %, quantitative            | X |   |
| IA38                      |                  |                    | Average modal split-vehicles                | Percentage of vehicle-km for each mode  | %, quantitative            | X |   |
| IA39                      |                  |                    | Average modal split- trips                  | Percentage of trips for each mode   | %, quantitative            | X |   |
| IA40                      |                  | PT usage levels    | PT ridership                                | PT trips per inhabitant   | No, quantitative           | X |   |
| IA41                      |                  | Regulated zones    | Area included in regulated zones            | Extent of Limited Traffic Zones, Low Emission Zones, Zero Emission Zones  | km2 or m2, quantitative    | X |   |