ReVeAL

Regulating Vehicle Access for improved Livability

# UVAR Guidance: Ensuring Compliance


## Authors: Daniel Guzman Vargas (UGent), Lucy Sadler (Sadler Consultants)

Contributors: Bonnie Fenton, Yoel Siegel, Matthieu Graindorge, Julie Schack

Correspondence: daniel.guzmanvargas@ugent.be


07/06/2021 (working document)


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

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# 1. Introduction

## 1.1 About the ReVeAL project

Urban vehicle access regulations (UVARs) are one of the tools that can help make cities more liveable, healthier and more attractive for all. The goal of the EU Horizon 2020 project ReVeAL is to support cities producing good practice in UVAR and to add UVARs to the standard range of urban mobility approaches across Europe and beyond.

The ReVeAL project supports UVAR implementation in six pilot cities and is developing a tool to help other cities decide what UVAR measures may be appropriate for them and what to be aware of when implementing. The project is also producing several guidance documents on specific UVAR-related topics.

To find out more about ReVeAL, please see the ReVeAL website.

## 1.2 Purpose and context of this document[1]

There is no one-size-fits-all solution in implementing an UVAR, however ReVeAL has identified four aspects – called *Transition Areas* in ReVeAL – that are relevant to the change process associated with the implementation of any UVAR. These are governance and financing, user needs and public acceptance, mobility concepts and ensuring compliance (see **Error! Reference source not found.**).


[1] This document is for information and guidance. ReVeAL and its partners take no responsibility for any action taken based upon its content.

*Figure 1: ReVeAL Transition Areas*

As these key aspects are relevant to all schemes, we have developed a guidance document for each one. This one addresses the **tools and methods used to ensure that users can easily comply with the UVAR**. The guidance is not intended to tell cities which options to use, but rather to help identify the questions to be asked and the factors to be considered in making decisions. As there are many linkages among the four transition areas, it may be worth reading the guidance documents together.

## 1.3 Definition and scope of guidance document

This document deals with the key aspects to consider in order to ensure compliance of an UVAR. The first aspect is the UVAR enforcement options, their main characteristics, and the factors to consider when selecting among the available alternatives. For many UVAR types, more than one enforcement method is available as an option for operation. For example, a low emission zone can be enforced using cameras and automatic number-plate recognition (ANPR), or using stickers checked by the police and enforcement officers with stickers.

The second aspect covered in this document is is the informing of those who will be affected and raising awareness of the selected UVAR. Drivers and vehicle operators cannot comply with a scheme they do not know about, so communication is essential to compliance. In addition, communication channels are also needed to provide road users with UVAR-related real-time information, which is of special importance in dynamic/reactive UVAR schemes (e.g., those that are only in force when pollution level exceed a given level).

### Understanding the implications of the choices made

One challenge in the development of an UVAR is that the enforcement options selected may have different implications for the design of the UVAR, for the way it operates and is complied with, and for the way it is used, perceived and understood by users.[2] For example, the choice of enforcement system will affect the permit management systems possible, and the choice there will define the burden on personnel, which will, in turn, either expedite or slow down the overall permit application process[3].

Given the complexity and impact of some of the topics associated with this guidance document, more detailed guidance documents have been created on geofencing in UVARs and on permits and exemptions (including permit management systems). Guidance on privacy and camera enforcement and on foreign vehicle enforcement will appear in autumn 2021 and be available at www.civitas-reveal.eu/resources-overview/publications/guidances.

This document provides a brief overview of different enforcement and awareness rising options, but case-dependent analysis of the city contexts, costs and other planning and operational

[2] How the UVAR is perceived can be influenced by effective communications. See *UVAR Guidance: User Needs and Public Acceptance*.
[3] For more details on permit systems, see *UVAR Guidance: Permits and Exemptions*.

components should be carefully analysed. For this, we recommend the ReVeAL Guidance on UVAR development process *(autumn 2021)* as a complementary tool to support a more tailored assessment and decision process for the different options.

# 1. Key aspects

There are a wide range of factors to consider when it comes to choosing the enforcement mechanism. The type of UVAR, the scale, the cultural and political context and the availability of legal frameworks are all factors to take into account.

Next to enforcement, users need to be made aware of the UVAR they should comply; drivers and vehicle operators cannot comply to a measure they do not know of with. There are many different communication and information dissemination channels that could be used to raise awareness of the coming UVAR and/or any change that may relate to it, and as a general rule, as many of these should be used as possible. Information dissemination may play an even more crucial role in the case of dynamic/reactive UVARs schemes (e.g., those that are only in force when pollution level exceed a given level), here it is of high importance that users know the *current* UVAR considerations.

The coming sections present these and other aspects with the aim of providing support in the decision of the different tools/mechanisms to use to help ensure compliance of any UVAR.

## Enforcement options

The task of the different enforcement options is to distinguish between compliant and non-compliant vehicles, and then process the appropriate information to enable penalties to be issued – in case of non-compliance. The choice of enforcement options to be used in an UVAR has a significant impact on the overall UVAR design, and the design also affects the preferred enforcement options. For example, in the case of spatial interventions, physical barriers or street layouts will be preferred, whilst ANPR cameras or manual enforcement would be the most common options for the enforcement of LEZs, ANPR and transponders for charging schemes. This relationship should be carefully considered as early as in the ideation phase to avoid continuing with the design of an UVAR for which no suitable enforcement options exist (e.g., for lack of legal frameworks or resources).

The choice also directly impacts the resources needed at a city level, the administrative burden and the level of compliance. The main enforcement options are given below, with some brief key points. Many of these can – or should – be combined to achieve effective enforcement:

1. **Cameras with automatic number-plate recognition**: This technology uses optical character recognition on images of vehicle registration plates to identify a vehicle and compare it against a vehicle database so penalties or warning letters can be sent for non-complying vehicles, or bills for tolls, as in the Norwegian congestion charges.
2. **Visual inspection:** Manual enforcement through visual inspection of vehicles by police (for moving traffic) or enforcement officers (e.g., parking wardens for parked traffic). Windscreen stickers or other documentation in the windscreen can help distinguish between complying and non-complying vehicles. Again, penalties can then be sent.



 

3. **Physical barriers** (automatic or manually operated): Such barriers work in combination with another system to ensure that only compliant vehicles have access. These other systems can be RFID or DSRC transponder (see points 4 and 5), a pay booth, ANPR cameras (see point 1), an intercom, visual inspection (see point 2), etc. A non-complying vehicle does not gain entry.
4. **Radio-frequency identification (RFID)**[4]: This requires the vehicle to have a transponder[5] (cost ~€1) or "tag" (possibly in the form of a windshield sticker) containing an antenna and is used either for payment or to open physical barriers. The antenna receives and responds to radio frequencies emitted by dedicated roadside equipment (RFID transmitter-receiver devices). RFID is commonly used for toll collection outside of the EU; in the EU, DSRC technology is more common.
5. **Dedicated short range communication (DSRC)**: This is commonly used for electronic toll payment.[6] The system consists of radio communication between roadside equipment and a dedicated on-board unit[7] (OBU) or transponder[8] (cost ~€8-10) in the vehicle. The communication can be one or two-way. The system is commonly used for electronic toll collection in the EU, but also presents potential applications within other ITS and cooperative ITS applications (e.g., parking management, real-time traffic information transmission)[9].
6. **Global Navigation Satellite System (GNSS)-based tolling**[4]: Vehicles are equipped with a GNSS on-board unit[10] (cost ~€200-300) that allows for the vehicle's position, speed and local time to be determined. The trip data[11] is used within a tolling scheme to calculate a bill. Processing can be done by the on-board unit or in a back office (where data is sent by Global System for mobile communications).
7. **Intelligent Speed Adaptation** (ISA): The vehicle's speed is compared automatically and remotely with the speed limit. The system either does not allow the vehicle to go faster than the set speed or it informs the driver that they are driving too fast. ISA consists of an in-vehicle system that uses information collected by means of image recognition (road signage), interaction with urban infrastructure (C-ITS) and/or geo-location.
8. **Geofencing**: Regulations (e.g., speed, energy source permitted) for an UVAR are defined digitally for the geofenced area and are communicated digitally either to the driver through an in-vehicle notification or directly to the vehicle, e.g., by automatically switching the

[4] Where transponders, geofencing systems or other on-board units are used, cameras are still needed to identify vehicles without such equipment; otherwise, a vehicle could avoid enforcement by simply not having the equipment. For example, the Italian TELEPASS operates through a combination of ANPR and DSRC technologies.

[5] RFID transponders usually operate in the ultra-high frequency range (860-960 MHz)

[6] See Directive 2004/52/EC, EC Decision 2009/750/EC and Directive (EU) 2019/520

[7] An on-board unit (OBU) is a device installed on-board the vehicle, communicating with roadside infrastructure or with a back office to communicate exchange relevant data. Note that an OBU is a generic term and may refer to completely different devices, e.g., an OBU in the case of DSRC technology will be very different from an OBU used for ISA or geofencing

[8] DSRC on-board units use microwave technology (5.8 GHz) following CEN standards: CEN/TC 278

[9] Recommendation ITU-R M.1890 (04/2011). Intelligent transport systems – guidelines and objectives. International Telecommunication Union. https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.1890-0-201104-S!!PDF-E.pdf

[10] In the future, on-board units could be replaced by smartphone tolling solutions.

[11] See Regulation (EU) 2016/679 (General Data Protection Regulation)

vehicle from petrol to electric power or lowering its speed once the vehicle is within the UVAR area. See ReVeAL geofencing guidance.

See Table 1 for pros and cons of each type of enforcement system.

### Deciding factors in the selection of enforcement options

There are several factors to consider in deciding which enforcement option to use. These include:

- Legal options available
    - The selection of enforcement options may be constrained by the availability of legal frameworks (see UVAR Guidance: Governance and Financing).
- Political or cultural acceptance
    - When a specific option is widely used in a country or region, its acceptance, interoperability and harmonisation increase. Familiarity usually also helps to achieve higher acceptance for a system. Conversely, some options may face resistance or aversion by the general population.
    - Skills and awareness of practitioners about the options may limit (or expand) the set of technology options that will be considered.
- The level of compliance that can be expected
    - A physical barrier leads to almost 100% compliance. ANPR also leads to high compliance levels – the camera-enforced London LEZ achieves around 95% compliance. The compliance for manual enforcement depends very much on the resources invested, as well as other issues including the tightness of the scheme as well as cultural factors, but even well-resourced schemes usually achieve less compliance than ANPR.
- Resources (both for set up and operation)
    - Manual schemes tend to be cheap to set up, but expensive to operate at levels to achieve reasonable compliance levels.
    - Automatic enforcement (e.g., ANPR) means a higher financial investment at the start, but the automatic system reduces personnel costs during operation, particularly for large schemes.
    - Hardware, software, maintenance, service and personnel costs should be considered for each option throughout the lifetime of the scheme.
    - A small scheme affecting few vehicles might be more relevant for manual enforcement than a larger scheme where there are large traffic flows, that might be more relevant for ANPR.
    - Some technologies require users to pay part of the costs (e.g., to acquire on-board units). If high, such costs may impact the level of acceptance and compliance as well as user acceptance.
    - Technology providers are increasingly offering the option to hire equipment, which can reduce the up-front costs of the equipment. It can also increase flexibility (if the equipment or method is subsequently changed), enable the renewal of equipment/software and provide additional on-going services or maintenance; the

total cost may be higher than purchasing but may be compensated for by the other benefits.

- Matching enforcement option with the type of UVAR
    - UVARs created through **spatial interventions** generally consist of physical barriers or changes to the road layout that prevent vehicles from entering a given area. However, for some specific interventions (e.g., school streets, cycle streets), other enforcement options may be an option for proper enforcement, e.g., ANPR cameras or manual enforcement, as well as temporary barriers.
    - **Limited Traffic Zones** can use ANPR, physical barriers with transponders or manual enforcement. Note that most LTZs will require a permit management system. The linkage between the permit options (e.g., 'white list' database, windscreen stickers) and the selected enforcement option(s) should be carefully considered (see Permit systems section below).
    - **LEZs** generally use ANPR or manual enforcement, potentially also combined with geofencing in the future. The selection of the enforcement option and its impact on the correct management of proof of compliance and the scheme exemptions should also be considered (see UVAR Guidance: Permits and Exemptions for LEZs and LTZs and the Permit Systems section below).
    - **Tolling schemes** can use ANPR with or without the option for transponders or GNSS. A physical toll booth is also possible for point or single-street/bridge schemes.
- Reliability
    - It is important for the enforcement option used to be robust and reliable as an unreliable system may not be well accepted and/or prevent the city from reaching its goals and ambitions. The same applies to manual enforcement: if the police cannot be reliably (or affordably) available to enforce a scheme, it may not be the most appropriate enforcement option. Non-police enforcement officers are only able to enforce parked vehicles, so can only enforce schemes in operation 24/7 (as in e.g., daytime schemes, the vehicle could have travelled there legally during a time that was permitted).
    - The use of physical barriers in roads with public transport traffic should be carefully studied. Reliability is key in this case, as a malfunctioning bollard could lead to a complete halt of public transport operations in the affected area. Emergency vehicle access may also needs to be considered.
- Interoperability
    - Synchronisation and harmonisation between complementary enforcement systems should be considered. For example, where an ITS enforcement solution (e.g., RFID, DSRC, geofencing) is used, you will still *also* need ANPR to detect vehicles that do not have such a device, as these would otherwise evade detection.
    - Complementary enforcement technologies (e.g., geofencing) could also be integrated with ISA technology to regulate and control speed within the boundary area.
    - Depending on the type of UVAR, the enforcement system would be linked to a database of vehicles for verification purposes (e.g., permit management system for

an LTZ) and penalty issue. In such cases, enforcement, verification and any system used for the issuing of exemptions and/or permits should be fully harmonised.
    - For LEZs, the national vehicle database is likely to be able to provide most of the information on whether national vehicles comply, although this needs to be checked. For vehicles where the information is not available (e.g. foreign[12] or retrofitted vehicles), these vehicles may need to register, and this registered vehicle database be added to the exemption database.
- Data privacy
    - Some technologies may generate more privacy and data management concerns than others[13] (e.g., ANPR cameras, global navigation satellite systems). A data strategy should be established that defines the conditions and parameters for collection, storage and exploitation of UVAR-related data. ReVeAL UVAR guidance on privacy and camera enforcement and foreign vehicle enforcement will be available in autumn 2021.

*Table 1: Pros and cons of various UVAR enforcement options*

| **Enforcement option** | **Pros** | **Cons** |
|---|---|---|
| *Cameras with automatic number plate recognition (ANPR)* | • Suitable for both high and low speed traffic<br>• Suitable for high traffic volumes and large areas<br>• No OBU is required<br>• Non-compliant vehicle identification: 90%+<br>• May be required anyway with some other enforcement options (e.g., DSRC, geofencing) | • May raise privacy and data protection issues<br>• Higher upfront costs than manual enforcement (equipment rental may assist with this issue)<br>• Potential aesthetic issues |
| *Manual visual inspection* | • Low upfront costs<br>• Less prone to privacy and data protection issues | • Higher operational costs (personnel)<br>• Requires ongoing control effort by personnel.<br>• Generally results in lower compliance than other options<br>• Often requires a windscreen sticker/permit to facilitate optical check |
| *Physical barriers* | • Permeable to bike and pedestrian traffic<br>• High compliance rate | • High maintenance costs (if automatic rising bollards used) |

[12] Until, or unless, the EU facilitates EU-wide foreign vehicle enforcement.
[13] Note that these privacy concerns strongly depend on the legal, cultural and political context of the city.

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| | • No privacy issues | • Malfunctioning can lead to a complete halt in traffic<br>• To allow compliant/exempted vehicles entry, another enforcement option is needed for the identification of permitted vehicles (e.g., transponder, ANPR camera, manual/officer) and to give these vehicles access.<br>• Potential aesthetic and emergency vehicle access issues |
| *Radio-frequency identification (RFID) transponders* | • Low cost on-board units (<1€)<br>• No privacy issues<br>• High potential for interoperability<br>• OBU needs no batteries | • Requires outlay for vehicle operators for transponder<br>• Less reliable than DSRC at higher speeds<br>• Requires vehicles to be fitted with an on-board unit (tag or transponder)<br>• Costly roadside equipment (gantries) required (+ create some aesthetic issues)<br>• ANPR cameras, or other mechanism, is needed to identify vehicles without on-board equipment |
| *Dedicated short range communication (DSRC)* | • More reliable than RFID for high-speed traffic<br>• Relatively low-cost on-board units (8-10€)<br>• No privacy issues<br>• High potential for interoperability (e.g., with commercial parking) | • Requires vehicles to be fitted with an OBU that is more costly than RFID<br>• ANPR cameras, or other mechanism is needed to identify vehicles without on-board equipment<br>• Costly roadside equipment (gantries) required (+ create some aesthetic issues)<br>• OBU batteries need replacing regularly |
| *Global navigation satellite system-based tolling (GNSS)* | • Less roadside equipment required than DSRC or RFID<br>• Higher on-board unit costs than DSRC or RFID<br>• High potential for interoperability | • OBU is more costly than for DSRC or RFID<br>• ANPR cameras, or other mechanism is needed to identify vehicles without on-board equipment<br>• Potentially requires costly roadside equipment (+ creates some aesthetic issues)<br>• Precision can be problematic in urban areas (e.g., sufficient signal), which requires roadside equipment to compensate<br>• May raise privacy and data protection issues |
| Smartphone as on-board unit | • May be possible in the future | • Not yet an available alternative |
| *Intelligent speed adaptation* | • Does not require roadside infrastructure | • Requires an on-board unit in vehicles<br>• Needs an appropriate legal framework<br>• Usually requires of sufficient appropriate quality road signs<br>• ANPR cameras, or other mechanism is needed to identify vehicles without on-board equipment |



 

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| *Geofencing* | • Does not require roadside infrastructure | • Requires an on-board unit in vehicles<br>• Needs of an appropriate legal framework<br>• ANPR cameras, or other mechanism is needed to identify vehicles without on-board equipment |

## Permit systems

Limited traffic zones require most vehicles or trip types to have a permit to enter. In the past, one had to apply for a permit in person, but this is increasingly a digital process, saving time and resources for both the authority and vehicle operators. This document gives an overview, but the ReVeAL UVAR Guidance on Exemptions and Permits provides further details on different options for issuing permits. Some of this is also relevant for proof of compliance and exemptions to low emission zones, although there is an argument to be made that making it easier for drivers to apply for exemptions might increase the number of exemptions, making the scheme less effective. Of course, in the end – for both limited traffic zones and low emission zones – the number of permits or exemptions is controlled by the requirements set within the scheme for access and/or decision to grant (or not).

Permits options include:

- Windscreen sticker (with or without hologram)
- Inclusion in a database "white list" of vehicles allowed entry
- A transponder (e.g., RFID, DSRC) in or on the vehicle that opens a barrier
- A letter in the windscreen granting permission

As with other enforcement issues. the decision about which method to use is linked to the enforcement method as well as to aspects such as the size of the scheme, type of area it covers, planning permission, resources available, number of permit categories and political and cultural factors.

*Table 2: Pros and cons of various permit management systems*

| **Permit management system** | **Pros** | **Cons** |
|---|---|---|
| **Fully manual** | • Very low upfront costs<br>• More appropriate for small-scale low traffic schemes | • Requires all applicants to submit application in person<br>• Especially cumbersome for sporadic applicants (e.g., tourists, unless limited permits are available on street on a paid-for basis)<br>• Administration and personnel costs are significantly higher and validation times are larger |

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| **Digital**<br><br>(note, digital systems should also allow for applications to be submitted manually) | • Can manage a larger number of applications across several permit categories<br>• Some types of permit application can be fully automatised<br>• Lower personnel costs and validation times<br>• Reduces burden on applicants, as they do not need to apply in person, and the application can be done on-line at any time of the day<br>• Available commercial products may make implementation easier and with lower upfront costs<br>• Online application is increasingly expected by users<br>• Costs are likely to be lower in the medium to long term | • Larger upfront costs (which may be able to be lowered by using a service provider with monthly costs rather than having a dedicated software solution provided)<br>• Training of personnel may be required<br>• Service/maintenance costs are incurred |

## Awareness Raising of the UVAR

Drivers and vehicle operators cannot comply with a scheme they do not know about, so communication is essential to compliance. A European Commission UVAR study indicates that "effective information and communication can mitigate criticism and lead to successful and smooth implementation of an UVAR scheme, ensuring its long-term effectiveness." In an increasingly mobile world, communication needs to extend well beyond the borders of an authority. This is discussed in more detail in a separate ReVeAL guidance document on communication and awareness raising (autumn 2021).

Different communication channels can be used for different purposes (see Table 3). For example, one-way communication is used for information dissemination and awareness rising, and two-way for stakeholder engagement or queries/complaints.[14] Communication channels are also needed to provide road users with UVAR-related real-time information, which is of special importance in dynamic/reactive UVAR schemes (e.g., those that are only in force when pollution level exceed a given level).

This document covers information dissemination / communication to inform potential drivers and vehicle operators. Further information on stakeholder involvement can be found in the other Guidance documents on UVAR Guidance: User Needs and Public Acceptance and Governance and Financing.

[14] See also ReVeAL UVAR Guidance: User Needs and Public Acceptance and Governance and Financing.



 

*Table 3: Commonly used channels to raise awareness about the confirmed UVAR to enable compliance*

| Channel | 1-way | 2-way | Real-time | Comments |
|---|---|---|---|---|
| Letters | √ | | | Sending letters to all residents, local businesses or stakeholder groups can ensure those most affected are informed; these can also be used to distribute appropriate permits. |
| E-mails | √ | | | E-mails can be sent to specific users and user groups to provide them with UVAR-related information. |
| Call line | √ | √ | √ | A dedicated telephone line to provide information on the UVAR. This can be used to receive feedback on the measure, or an automated phone message can provide current information on dynamic UVAR schemes. |
| SMS | √ | | √ | Can be used to provide users with updated information. Especially important for dynamic and reactive UVAR schemes |
| Smartphone Apps | √ | | √ | Can be used to provide users with updated information. Especially important for dynamic and reactive UVAR schemes |
| Traditional media (TV, radio, flyer, newspaper, billboard) | √ | | √ | These are (still) important communication channels.[15] They can be used to provide users with updated information on dynamic UVAR schemes. This can happen through paid adds or through press coverage. |
| Dedicated authority websites | √ | √ | | A space should be created on municipal websites to inform about the measure and provide answers to common questions about the UVAR. Such sites can serve as the main information hub for the measure and can also be used to collect feedback/complaints from users or stakeholders both during development and operation. |
| Website Widgets | √ | | √ | These can be created for use by third party websites so that they also have automatic updates). Especially important for dynamic and reactive UVAR schemes |
| Social media | √ | √ | √ | This can be used to provide users with current information on dynamic UVAR schemes, and to request citizen feedback on the scheme. This generally works better for younger audiences than for older populations. |
| Web ads | √ | | | Web ads can be used to extend the reach of the communication efforts in the development of an UVAR |

[15] The ReVeAL city, Jerusalem, found billboards particularly effective, other media surprisingly ineffective (see UVAR Guidance: Governance and Financing ). This will vary from city to city.

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| | | | | measure. The use of such ads on websites of tourist attractions can increase the awareness of incoming tourists about the measure. |
| Road signage | √ | | √ | These are a key means of communicating an UVAR – and often a required legal mechanism. These may be traditional signs, or variable-message signs (VMS). VMS can be used to provide users with current information on dynamic UVAR schemes. |
| Digitising data on UVARs[16] | √ | | √ | Not a channel as such, but it is important that the UVAR area and rules are in a digital format. This enables digital communication with navigation tools, mobility apps, ITS, etc. This is increasingly important and can increase compliance as more people become aware of the scheme. |
| Navigation systems / tools | √ | | √ | Up-to-date navigation systems can alert users when they enter an UVAR zone. They could also provide users with current information on dynamic UVAR schemes. Digitising data on an UVAR can facilitate the scheme being included in navigation schemes. |

Most of the methods described can be combined, and good practice is to use as many of the channels as possible, particularly for large or controversial schemes. **Monitoring** the communication campaign helps to identify communication gaps with specific user groups. Many cities, including Vitoria-Gasteiz and London, used (and widely communicated) an introductory phase, sending warning letters to inform drivers rather than fines in the early months of the scheme. The compliance was, unsurprisingly, greater after the introductory phase.

More information on the legal aspects of communication can be found in UVAR Guidance: Governance and Financing, and on communication for user acceptance in UVAR Guidance: User Needs and Public Acceptance.

## 2. Summary

Ensuring compliance depends on many factors. The guiding principles should be an enforcement option that works for your city, with input from different stakeholders and technical actors. The Sustainable Urban Mobility Planning process provides a good guide for some of this. The complete set of ReVeAL UVAR guidance documents will also help with specific aspects of UVAR planning and implementation.

In terms of **enforcement** options, special attention should be paid to the type of UVAR considered, the legal framework and the options it allows, the desired level of compliance and politically or culturally familiar or accepted enforcement technology, the availability of resources for

[16] For more details and support on how to do this, please see UVARBox.



 

implementation and operation, the reliability of the system, interoperability, and data privacy concerns.

It is recommended to use as many **communication** methods as possible, particularly for large or controversial schemes. Special attention should be paid to the way in which dynamic/reactive schemes are communicated to users.

## 3. References


ReVeAL UVAR guidance (all available at: https://civitas-reveal.eu/resources-overview/publications/guidances/)

- General – What to think about when planning an UVAR?*
- UVAR Process Development*
- Mobility concepts
- Ensuring Compliance
- User needs and public acceptance of UVARs
- Equity*
- Data and monitoring*
- Stakeholder involvement*
- Communication, awareness raising (incl. digitising UVARs)*
- Geofencing
- Permits and exemptions
- Privacy and camera enforcement*
- Foreign vehicle enforcement*

*available autumn 2021

European Commission study on Urban Vehicle Access Regulations (2017): https://ec.europa.eu/transport/sites/transport/files/uvar_final_report_august_28.pdf

The SUMP Process: https://www.eltis.org/mobility-plans/sump-process

SUMP Topic Guide on The Role of Intelligent Transport Systems (ITS) in Sustainable Urban Mobility Planning: Make smarter integrated mobility plans and policies: https://www.eltis.org/sites/default/files/the_role_of_intelligent_transport_systems_its_in_sumps.pdf

SUMP Practitioner Guide on Road Vehicle Automation in sustainable urban mobility planning: https://www.eltis.org/sites/default/files/road_vehicle_automation_in_sustainable_urban_mobility_planning_0.pdf

Milan Area C https://areac.atm-mi.it/Areac/iweb/English.aspx