

Directive 2010/40/EU

Progress Report 2023

Croatia

1 Introduction

1.1 General overview of the national activities and projects

This progress report has been drawn up within the framework of the European ITS Directive (2010/40/EU), under which Member States are required to submit reports at specific moments. This report is a follow-up on the progress report previously submitted to the European Commission (EC) in 2020 (National Progress Report 2017-2020 of the Republic of Croatia).

General progress since 2020

The report aims to offer an in-depth overview of the various activities undertaken by the Croatian administration to bolster road transport Intelligent Transport Systems (ITS) and implement the ITS directive. Following the adoption of the ITS directive in 2013, the Croatian government amended the Road Act to incorporate it into the country's legal framework. Since then, Croatia has been focused on ensuring the necessary conditions are in place to implement the directive, including the establishment of a National Access Point (NPT) to facilitate communication and information exchange. Croatia has also taken measures to ensure compliance with the directive's delegated acts and decisions across various areas, including but not limited to:

- Optimal use of road, traffic, and travel data,
- Continuity of traffic and freight management ITS services,
- ITS road safety and security applications,
- Linking the vehicle with the transport infrastructure.

The primary focus of the current activities is centred on the formulation of a comprehensive strategic framework for intelligent transportation systems (ITS). The development of a new ITS strategy commenced in December 2023, and the objective is to create a roadmap that encompasses various aspects related to the deployment, operation, and management of ITS. The new strategy is expected to consider the latest advancements in technology, the changing needs of the transportation industry, and the evolving expectations of the users. The strategic framework will serve as a blueprint for the implementation of ITS solutions in the country and will provide a clear direction for all stakeholders involved in the process.

1.2 Contact information

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2 Projects, activities and initiatives

2.1 Priority area I. Optimal use of road, traffic and travel data

2.1.1 Description of the national activities and projects

CEF Project – CROCODILE II CROATIA– Introduction of intelligent transport systems (ITS) on TEN-T roads

Establishment of Main Traffic Control Centres on highways and state roads

In June 2022, the Crocodile II Croatia project was completed by the Republic of Croatia. Main Traffic Control Centres for motorways and state roads has been established and fully functioning in 2022.

Regional Traffic Control Centers (RTCC) have been modernized on both motorways and state roads, by installation and commissioning of IT and network equipment, installation of video walls, implementation of DATEX II standards.

AZM achieved objective of the Crocodile II Croatia Project by implementation of DATEX II standard in centre for traffic management Krapina at A2 motorway Zagreb-Macelj. Implementation was completed in June 2021.

HAC motorway (HAC motorway (A1, A3, A4, A5, A6, A7, A10, A11))

The completion of the Crocodile 3 Croatia project is scheduled for June 2024, during which time new equipment will be installed on sections of highways under highway management in order to improve the provision of information to users about the state and conditions of public roads. Also, national and international TMP will be created and implemented, which will determine alternative routes in the event of longer-term traffic obstruction or longer delays on the TEM network. The creation of a mobile application for end users about the state and conditions on public roads is also underway, all in order to provide information to end users in real time.

Until the establishment of the National Access Point, the Road Managers have designated one Center for traffic control and management, which will take over the role of exchanging road data with foreign partners. For this purpose, the preparation of Traffic Management Plans (TMP) which will determine alternative routes in case of long-term obstruction of traffic or longer delays on the TEM network, as well as the preparation of an agreement on automatic data exchange between neighboring countries, is in the process.

Učka Regional Traffic Management Centre (A8 and A9) operated by Bina-Istra

Within Crocodile 2 Croatia project the Učka Regional Traffic Management Centre was provided with:

- IT equipment for Datex II Implementation was supplied, then functionally tested and in operation since February 2020.
- a video-wall required for Datex II implementation in 2020, supplied, mounted, tested and commissioned in the second half of August 2020.
- Datex II Platform, completed in June 2021, tested with the Main Traffic Management Centre for Motorways and NAP. Since the beginning of the operation of the Datex II platform, several fine tunings have been carried out up to the end of 2023.

The objective of the above activities was to provide relevant traffic data from A8 and A9 to the Main Centre for traffic control on motorways operated by HAC in order to ensure the operating of the National Access Point through DATEX II standard in line with Regulations 885/2013 and 886/2013.

In parallel, within the Crocodile 3 Croatia project implementation in the Učka Regional Traffic Management Centre, two weather stations and variable message signs were implemented in 2023 in order to provide reliability of data from A8 and A9 motorways to the Main Centre for traffic control on motorways and to the NAP. A public procurement procedure for update of Datex II platform was launched in December 2023. The objective of this activity is to ensure more reliable data through Datex II platform by transferring data from the aforementioned two weather stations to the Main Centre for traffic Management on motorways and NAP, as well as to implement traffic management plans in case of major accidents.

For **Croatian Roads Ltd**, the project involved modernization of Regional Traffic Management Centres (RCNUP) in Dugopolje, Sv. Ilija, and Dubrovnik, and establishment of the Main Traffic Control Centre (SCNUP-DC) and National Access Point in Karlovac. These centres were established to meet the legislative requirements of the Intelligent Transport Systems (ITS) Directive 2010/40/EU, which sets the standards for the introduction and use of ITS throughout the European Union. The NPT in Karlovac has fulfilled the mandate of the directive.

The data from subsystems managed by each regional centre is collected and processed, and part of this information is then transmitted to the Main Traffic Centre of the country's state roads.

To ensure a standardized exchange of traffic information, the DATEX II format was introduced. By implementing this communication protocol model, Croatia can provide reliable and up-to-date traffic information to its citizens and visitors, which is essential for ensuring safe and efficient transportation across the country's road network.

The Main Traffic Control Centre for the state roads was established to integrate all telematics systems owned by Croatian Roads Ltd. This integration facilitates the monitoring and management of traffic on the national road network more efficiently. All telematics systems are seamlessly integrated, providing a comprehensive and accurate real-time view of the national road network. This allows for swift and informed decision-making in response to traffic incidents and helps to improve traffic flow, reduce congestion, and ensure road safety.

CEF Project – NAPCORE

Objective: Coordination and harmonization of National access points.

The activities of the NAPCORE project are divided into several working groups. The first group deals with the analysis of the current situation in ITS and its future development, which includes the analysis

of EU policy and initiatives related to mobility. The second group deals with the analysis of interoperability and service level of access points, especially the analysis of data standards, reference profiles, metadata and support tools. The goal of the third group is to single out new requirements related to data content and monitoring of content collected at access points. The fourth group is a technical group and deals with the improvement and further development of standards for data exchange and common access to metadata. The fifth working group is dedicated to definition of the work processes that need the development of harmonized processes for random inspections and conformity assessment regarding data quality.

Ministry of the Sea, Transport and Infrastructure and Croatian Roads Ltd. are involved in activities of all workgroups and together with other EU member states work on progress, coordination and harmonization of European National Access Points.

2.1.2 Progress since 2020

Croatia established National Access Point that is collecting and sharing data through Datex II format from all highways and state roads in Croatia (more than 8.000 km of roads).

2.1.3 Delegated Regulation (EU) 2017/1926 on the provision of EU-wide multimodal travel information services (priority action a)

CEF Project - SUPPORT IN THE DEVELOPMENT AND DISTRIBUTION OF EUROPEAN STANDARDS FOR THE PROVISION OF MULTIMODAL PASSENGER INFORMATION AT THE LEVEL OF THE EUROPEAN UNION

During 2019, the Providing Multimodal Traffic Information study was carried out as a part of the Programme Support Action. This project was initiated under the "Connecting Europe Facility (CEF) - Transport Sector" grant agreement to implement multimodal passenger information throughout the Union-wide TEN-T network (MOVE/B4-2017-350). The PSA project was completed by a national state road operator the Croatian Roads Ltd., which was nominated by the Ministry of the Sea, Transport and Infrastructure to be the operator of the National access point in line with the delegated act. The result of the Project was Study for Providing Multimodal Traffic Information (MMTI). The main objective of this study was to provide a reliable basis for collecting and using interoperable travel information and services, which are based on existing standards and technologies.

To achieve its objective, during the study we analysed more than 50 stakeholders and conducted 15 workshops. The study has also analysed over 80 documents and reviewed similar systems that have been implemented in other countries. By doing so, it has gained a comprehensive understanding of the various factors that impact the implementation of such systems. In addition, the study has created a modern and innovative solution that has the potential to revolutionize the way travel information and services are provided to passengers across Europe.

Once the analysis was complete, the proposed solution involved the identification of features that the future NAP of Croatia for multimodal traffic information should support. This was followed by the development of a system architecture that encompassed various aspects such as functional, logical, and communication architecture. The proposed solution also included an organizational system architecture that outlined the processes related to establishing the NAP, updating the collected data, and monitoring the quality of the data collected.

In 2022, a study led to a project that integrated multimodal traffic information into Croatia's National Access Point. The project established several goals, including:

- a) creating a comprehensive route planner that provides the latest information on all public transportation routes across the country;
- b) developing an Open API interface that allows third-party developers to access and integrate public transport data from Croatia into their applications;
- c) creating the Linking Danube client and connecting it to the central node to ensure seamless communication and data exchange between all stakeholders involved in the project;
- d) establishing an aggregation system to receive data from stakeholders, ensuring that all data is collected and processed efficiently.

As part of the project, national profiles for protocols were created to simplify the sharing of information related to public transportation. These protocols are Netex and SIRI. Additionally, stakeholders who had readily available data sets in compliance with DU 1926/2017 were incorporated.

The project has added several benefits, which include the implementation of EPIP (NeTEx European Passenger Information Profile), the establishment of a framework for the National Stop Point Registry (additional activities are required), and test integration with the OJP4Danube route planner. We have continuously cooperated and educated various stakeholders of public transport, resulting in adjusting the data format according to the standard, and improvements to data sources, format, and availability. The implementation of this type of digital infrastructure has been a significant step forward for National Access Point of Croatia.

2.1.4 Reporting obligation under Delegated Regulation (EU) 2015/962 on the provision of EU-wide real-time traffic information services (priority action b)

To comply with the requirements of the Crocodile II Croatia project, the Republic of Croatia had the responsibility to establish a National Access Point. To fulfil this obligation, Croatian Roads Ltd constructed a facility in Karlovac. The decision to build the facility in Karlovac was based on its excellent connectivity with state roads and highways. Moreover, the facility is situated near the intersection of state roads DC1 and DC3, as well as the Karlovac toll booth (A1).

To select the appropriate National Access Point, we examined the existing National Access Points in the European Union and identified three options or levels. After careful consideration, we decided to opt for National Access Point Level 3, which entails a web interface that provides links to data providers, metadata, and databases.

To simplify and unify the exchange within the European Union, the national DATEX II profile was created and the data regarding real-time traffic information is published on a national NAP. The RTTI-related information is covered in these publications: AZM Incidents DatexII, AZM Roadworks DatexII, AZM Traffic counters DatexII, AZM Weather DatexII, HC Incidents DatexII, HC Roadworks DatexII, HC Traffic counters (locations) DatexII v3, HC Traffic counters (status) DatexII v3, HC Traffic counters DatexII, HC Weather DatexII, HC Weather DatexII v3, HC Wind DatexII, HC Wind DatexII v3. The NAP is available in Croatian and English. Besides the DATEX II format, the traffic real-time data on our NAP is available in other formats (XML, JSON, GeoJSON, RSS, Geo RSS...).

Users, drivers, and companies involved in the production of navigation devices and systems must have access to real-time information before and during a trip. The ITS directive mandates that most of the information published on the NPT should be available free of charge and accessible to as many end users as possible. Any fees associated with accessing, exchanging, or reusing public or private data should be reasonable and kept within acceptable limits.

The National Access Point provides a user-friendly web interface that grants users access to its data. However, before accessing the data, users must first register on the platform by providing their personal details and creating a secure login. Once registered, users can request permission to access specific datasets that they require for their research or other purposes. The platform's administrators verify the requests and approve them based on the users' credentials and the intended use of the data.

After approval, users can easily access and use the data via the web protocol, which ensures secure and hassle-free data transfer. The platform also offers various tools and applications to help users analyse the data and extract meaningful insights.

A2 Zagreb-Macelj motorway

CEF Project: The Crocodile III Croatia Project represents the upgrading of the technical scope that will be adopted through the project Crocodile II Croatia.

Objective: The Crocodile III Croatia Project has been related to improving quality and reliability of the traffic data that are sent with DATEX II protocol

AZM: After the implementation of the Crocodile III Croatia project on the A2 Zagreb-Macelj motorway, the quality and reliability of traffic data, which are delivered in real time to NAP, improved; by upgrading the central equipment in TCC Krapina and the peripheral equipment on the motorway alignment.

HAC motorway (A1, A3, A4, A5, A6, A7, A10, A11)

Crocodile III Croatia

Given that the regulation aims to improve the availability, exchange, reuse and updating of road and traffic data necessary for the provision of high-quality and continuous traffic information services in real time throughout the Union, Crocodile III Croatia project will expand and upgrade the National Access Point and exchange traffic information at the EU level, primarily with neighboring member countries (Slovenia, Hungary, Italy, Austria). Upgrade of travel information will be made by implement of a new VMS, CCTW cameras, weather stations and to implement TMPs. Project will be finished until June 2024.

2.1.5 Reporting obligation under Delegated Regulation (EU) No 886/2013 on data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users (priority action c)

Progress made in implementing the information service, including the criteria used to define its level of quality and the means used to monitor its quality:

Through CEF co-financed projects Crocodile 2 Croatia (2015-HR-TM-OI 14-W) and project Crocodile 3 Croatia 2016-HR-TMC-OI 62-W, the NAP of Croatia was established with the set of road-safety related minimum universal traffic information available on the web page (NPT - Croatian National Access Point (promet-info.hr))

SRTI data include: temporary slippery road; animal, people, obstacles, debris on the road; unprotected accident area; short-term road works; reduced visibility; wrong-way driver; unmanaged blockage of a road; exceptional weather conditions as stated in Article 3 of the delegated regulation (EU) No 886/2013. All data are accessible through DATEX II in these publications: AZM Incidents Datex II, AZM Roadworks Datex II, HC Incidents Datex II, HC Roadworks Datex II. The NAP is available in Croatian and English. Besides the DATEX II format, the SRTI data on our NAP is available in other formats (XML, JSON, GeoJSON, RSS, Geo RSS...).

A2 Zagreb-Macelj motorway

After the implementation of the Crocodile II Croatia project, as part of which the DATEX II protocol was introduced, basic general information in accordance with delegated regulation EU No 886/2013 is successfully exchanged by AZM with the National Access Point (NAP), and there are no changes in relation to 2021.

2.2 Priority area II. Continuity of traffic and freight management ITS services

2.2.1 Description of the national activities and projects

A2 Zagreb-Macelj motorway

CEF Project: The Crocodile III Croatia Project represents the upgrading of the technical scope that will be adopted through the project Crocodile II Croatia.

In scope of the Crocodile III Croatia Project, AZM improvement of existing Traffic management Plans (TMP) to improve quality and reliability traffic information.

HAC motorway (A1, A3, A4, A5, A6, A7, A10, A11)

Crocodile III Croatia

Within this project, there will be implement/upgrade:

- Consolidated Traffic Management Plans (TMPs) during emergency events on highways
- mobile application for informing all users about the state of traffic on highways and traffic management plans, which will implement cross-border traffic information services based on merging data and cooperation with other road managers AZM d.o.o., Bina-Istra d.d. and HC d.o.o.
- Improvement and expansion of existing TMP traffic management plans (contracted through the contract for the mobile application).

2.2.2 Progress since 2020

Description of the progress in the area since 2020:

AZM: implementation of the Crocodile III Croatia Project completed in June 2021.

2.3 Priority area III. ITS road safety and security applications

2.3.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

No new projects ongoing.

2.3.2 Progress since 2020

Description of the progress in the area since 2020:

N/A

2.3.3 112 eCall (priority action d)

Information on any changes regarding the national eCall PSAPs Infrastructure and the authorities that are competent for assessing the conformity of the operations of the eCall PSAPs:

2.3.4 Reporting obligation under Delegated Regulation (EU) No 885/2013 on the provision of information services for safe and secure parking places for trucks and commercial vehicles (priority action e)

Number of different parking places and parking spaces on their territory:

A2 Zagreb-Macelj motorway

There are currently no plans to implement safe and protected parking spaces for trucks and commercial vehicles on the A2 Zagreb-Macelj motorway in accordance with delegated regulation EU No 885/2013.

HAC motorway (A1, A3, A4, A5, A6, A7, A10, A11)

Croatian Motorways Ltd. on the basis of conducted public tenders, they conclude contracts on the use of road land and the performance of accompanying activities for equipping guarded parking lots for freight vehicles.

The contracts in question include the following provision:

The user is obliged to provide the service of information and delivery of information about the guarded parking lot for cargo vehicles in accordance with the DELEGATED REGULATION OF THE COMMISSION (EU) no. 885/2013 of 15/05/2013 on the amendment of Directive 2010/40/EU of the European Parliament and the Council regarding the provision of information services on safe and protected parking spaces for trucks and commercial vehicles and DELEGATED REGULATION OF THE COMMISSION (EU) no. 886/2013 of 15/05/2013 amending Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for providing users, where possible, with free basic general traffic information related to road safety.

Built rest area and contracted use of road land/equipment and service provision:

- Črnc resort, on the A3 section between the Ivanić Grad junction and the Dugo Selo junction (commissioning plan at the end of 2025)

Reconstructed rest area and contracted use of road land/equipment and service provision:

- Ježevo South resort, on the A3 section between the Dugo Selo junction and the Ivanić Grad junction (planned for commissioning in early 2024)

Rest area reconstruction works and implementation of road land use contracting/equipment and service provision are in progress:

- Rest area Gradna north and south, on the A3 section between the Samobor junction and the Sveta Nedelja junction

Creation of project documentation for rest area reconstruction, which includes furnishing and service provision:

- Odmorište Zagreb (Plitvice), on the A3 section between the junction Zagreb west and junction Lučko

- Rest area Brodski Stupnik south, on the A3 section between the junction Lužani and the junction Sl. Brod west

- Rest area Marsonia, on the section A3 between the junction Sl. Brod west and the junction Sl. Brod istok

- Spačvanska Šuma resort, on the A3 section between the Spačva junction and the Lipovac junction

Creation of project documentation for a new rest area, which includes furnishing and service provision:

- Rest area Mlaka, on the A3 section between the Kosnica junction and the Buzin junction.

2.4 Priority area IV. Linking the vehicle with the transport infrastructure

2.4.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status: in particular, provide information on the C-ITS deployment initiatives and their technical specifications.

Croatian Roads Ltd

A pilot project of a V2X cooperative system

Vehicle-to-Everything (V2X) communication is a key technology that enables vehicles to communicate with various entities, including other vehicles (V2V), infrastructure (V2I), pedestrians (V2P), and the cloud (V2C). This project aims to develop, implement, and evaluate V2X technologies to further improve traffic safety and the harmonization and flow of traffic flow.

Objective:

- a) Development and implementation of V2X communication systems for low-latency data exchange between vehicles, infrastructure, and cloud.
- b) Evaluation of the impact of V2X on road safety, traffic flow and environmental sustainability.
- c) Creation of a framework for standards, protocols and security measures of V2X technology.
- d) Identification of potential applications and applications for V2X technology.
- e) Cooperation with relevant stakeholders.

2.4.2 Progress since 2020

Description of the progress in the area since 2020:

Procurement is in progress since October 2023.

2.5 Other initiatives / highlights

2.5.1 Description of other national initiatives / highlights and projects not covered in priority areas 1-4:

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

N/A

2.5.2 Progress since 2020

Description of the progress in the area since 2020:

N/A

3 Key Performance Indicators (KPIs)

Note: The EC document on "ITS KPIs for the EU" is to be used for comprehensive definitions of the KPIs and further guidance. The EU EIP Activity 5 report on "ITS Deployment and Benefit KPIs definitions" is a complementary document providing in particular estimation methods.

KPI will be reported separately by type of road network / priority zone / transport network and nodes (when appropriate).

3.1 Deployment KPIs

3.1.1 Information gathering infrastructures / equipment (road KPI)

Figures to be provided by type of network / zone.

Figures to distinguish fixed and mobile equipment.

KPI to be calculated by type of network / zone (when relevant).

- Length of road network type / road sections (in km) equipped with information gathering infrastructures & Total length of this same road network type (in km):
- KPI = (kilometres of road network type equipped with information gathering infrastructures / total kilometres of same road network type) x 100

3.1.2 Incident detection (road KPI)

Figures to be provided by type of network / zone.

KPI to be calculated by type of network / zone (when relevant).

- Length of road network type / road sections (in km) equipped with ITS to detect incident & Total length of this same road network type (in km):
- $\text{KPI} = (\text{kilometres of road network type equipped with ITS to detect incident} / \text{total kilometres of same road network type}) \times 100$

3.1.3 Traffic management and traffic control measures (road KPI)

Figures to be provided by type of network / zone.

KPI to be calculated by type of network / zone (when relevant).

- Length of road network type / road sections (in km) covered by traffic management and traffic control measures & Total length of this same road network type (in km):
- $\text{KPI} = (\text{kilometres of road network type covered by traffic management and traffic control measures} / \text{total kilometres of same road network type}) \times 100$

3.1.4 Cooperative-ITS services and applications (road KPI)

Figures to be provided by type of network / zone.

KPI to be calculated by type of network / zone (when relevant).

- Length of road network type / road sections (in km) covered by C-ITS services or applications & Total length of this same road network type (in km):
- $\text{KPI} = (\text{kilometres of road network type covered by C-ITS services or applications} / \text{total kilometres of same road network type}) \times 100$

3.1.5 Real-time traffic information (road KPI)

Figures to be provided by type of network / zone / node.

KPI to be calculated by type of network / zone / node (when relevant), and if relevant indicate the proportion of services accessible to passengers with reduced mobility, orientation and/or communication.

- Length of road network type / road sections (in km) with provision of real-time traffic information services & Total length of this same road network type (in km)

- $\text{KPI} = (\text{kilometres of road network type with provision of real-time traffic information services} / \text{total kilometres of same road network type}) \times 100$

3.1.6 Dynamic travel information (multimodal KPI)

Figures to be provided by type of network / zone / node.

KPI to be calculated by type of network / zone / node (when relevant), and if relevant indicate the proportion of services accessible to passengers with reduced mobility, orientation and/or communication.

- Length of transport network type (in km) with provision of dynamic travel information services & Total length of this same transport network type (in km):
- Number of transport nodes (e.g. rail or bus stations) covered by dynamic travel information services & Total number of the same transport nodes:
- $\text{KPI} = (\text{kilometres of transport network type with provision of dynamic travel information services} / \text{total kilometres of same transport network type}) \times 100$
- $\text{KPI} = (\text{number of transport nodes with provision of dynamic travel information services} / \text{total number of same transport nodes}) \times 100$

3.1.7 Freight information (multimodal if possible or road KPI)

Figures to be provided by type of network / zone / node.

KPI to be calculated by type of network / zone / node (when relevant), and if relevant indicate the proportion of services accessible to passengers with reduced mobility, orientation and/or communication.

- Length of road network type / road sections (in km) with provision of freight information services & Total length of this same road network type (in km):
- Number of freight nodes (e.g. ports, logistics platforms) covered by freight information services & Total number of the same freight nodes:
- $\text{KPI} = (\text{kilometres of road network type with provision of freight information services} / \text{total kilometres of same road network type}) \times 100$
- $\text{KPI} = (\text{number of freight nodes with provision of freight information services} / \text{total number of same freight nodes}) \times 100$

3.1.8 112 eCalls (road KPI)

3.2 Benefits KPIs

3.2.1 Change in travel time (road KPI)

Figures to be provided also include vehicle.km for the route / area considered

$KPI = ((\text{travel time before ITS implementation or improvement} - \text{travel time after ITS implementation or improvement}) / \text{travel time before ITS implementation or improvement}) \times 100$

3.2.2 Change in road accident resulting in death or injuries numbers (road KPI)

Results shall be provided / aggregated at national level to be representative enough. If possible, distinction can be made between accidents resulting in deaths, serious injuries or slight injuries.

Figures to be provided also include vehicle.km for the route / area considered.

- Number of road accident resulting in death or injuries before ITS implementation or improvement:
- Number of road accident resulting in death or injuries after ITS implementation or improvement:

3.2.3 Change in traffic-CO2 emissions (road KPI)

Routes / areas where ITS has been implemented or improved should be specified. Length along / area within which the change in CO2 emissions is calculated should be long / wide enough to be representative.

$KPI = ((\text{traffic CO2 emissions before ITS implementation or improvement} - \text{traffic CO2 emissions after implementation or improvement}) / \text{traffic CO2 emissions before ITS implementation or improvement}) \times 100$

3.3 Financial KPIs

ITS includes any types of systems and services altogether.

Annual investment in road ITS (as a % of total transport infrastructure investments):

Annual operating & maintenance costs of road ITS (in euros per kilometre of network covered):